THEORY OF AND COMPUTER AIDED NEUTRON ACTIVATION ANALYSIS

by

SEMİHA SAĞLAM

Submitted to the Institute for Graduate Studies in Science and Engineering
in Partial Fulfillment of
the Requirements for the Degree of
Master of Science
in
Nuclear Engineering

BOĞAZİÇİ UNIVERSITY

1983

KEYWORDS

NEUTRON ACTIVATION ANALYSIS
GAMMA SPECTRA
GAMMA SPECTROMETERS
LI DRIFTED GE DETECTORS
PROGRAMMING
QUANTITATIVE ANALYSIS

ABSTRACT

Neutron activation analysis, NAA, has become a widely used and important analytical technique, not only in trace analysis but also in determining alloy elements and minor constituents. The micro qualitative and quantitative analysis can usually be performed by NAA in various fields, such as biology, criminology, geochemistry, cosmochemistry, industry etc. Thus, the field of application of the method is very wide.

In this study, first the basic concepts and principles of NAA is introduced. The detection methods and various types of detectors are discussed. The use of computers in NAA problems are also given. Then, a predeveloped computer code, Gretel, which is set up for routine batchwise processing of spectrometric data obtained by GE(Li) detectors is introduced. This code, programmed originally for the IBM 370/165 computer, is adopted to the UNIVAC 1106 computer in BU for further studies. The UNIVAC version of the program, the input and the output data are finally recorded onto a magnetic tape.

Also, another computer code prepared for NAA, Corgam, which was studied previously is introduced briefly. The comparison of these two codes are given at the end of this study.

ÖZET

Günümüzde Nötron Aktivasyon Analizi, NAA, yöntemi ile çeşitli malzemelerde, bu malzemeleri teşkil eden elementlerin cins ve miktarlarının tayini büyük önem kazanmıştır. Diğer analitik yöntemlere kıyasla daha hassas sonuçlar veren bu yöntem, bugün bioloji, kriminoloji, jeokimya ve kosmokimya gibi birçok alanlarda kullanılmaktadır.

Bu çalışmada, NAA'nın temel kavram ve prensipleri, analizde kullanılan spektrometre sistemleri incelenmiş ve değişik detektör tipleri tanıtılmıştır. Nötron aktivasyon analizi sonuçlarının değerlendirilmesinde karşılaşılan güçlüklerden biri, uzun zaman alan hesaplamalardır. Bilgisayarların hızlı hesaplama yetenekleriyle bunların giderilmesinden ayrıca söz edilmiştir. Bu amaçla, daha önce hazırlanmış ve Ge(Li) tipi spektrumları inceleyen bir bilgisayar programı, Gretel, tanıtılmış ve programda gerekli bir takım düzeltmeler, çizim altprogramlarının program mantığını bozmadan çıkartılması gibi, yapılarak yalnız tasarlandığı üzere IBM 370/165 tipi bilgisayarlarla değil, UNIVAC-1106 tipi bilgisayarlarla da kullanılabilmesi sağlanmıştır. Program bu yeni şekliyle bir manyetik teybe kaydedilmiş ve gelecek kullanımlar için saklanmıştır.

Ayrıca, NAA problemleri için hazırlanmış bir diğer bilgisayar programı olan Corgam kısaca tanıtılmış ve bu iki programın kıyaslaması da çalışmanın sonunda sunulmuştur.

ACKNOWLEDGEMENT

The author would like to express her gratitude to Doç. Dr.Fahir I.Borak, her thesis advisor, who offered invaluable and encouraging guidance and assistance throughout this work. Special thanks are extended to Prof.Dr.Turan Enginol, Head of NE Department, and to Dr.Vural Altın for their constructive criticisms and suggestions. A special extension of thanks is also given to all staff of the BU computer center for their help. A very special expression of love and gratitude is extended to her parents for their encouragement and unconditional help during not only this work but also previous studies.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. INTRODUCTION

1.1. GENERAL

The nuclei of atoms are stable only when they contain a certain number of neutrons and protons. In other words, the number of excess neutrons in the nucleus of an atom determines whether that atom is radioactive or not. However, all elements found in nature with atomic number greater than 83 (bismuth) are radioactive. They belong to chains of successive decays, and all the species in one such chain constitute a radioactive family or series. Besides the naturally occuring radioactivity which was first discovered by H.Becquerel, [Fr-62, Ha-69], there are also some radioactive nuclei artificially produced.

The name of radioactivity implies that radiation is emitted. As will be seen in the next chapter, radiation may be in the form of α, β and γ rays. Since these radiations penetrate and cause ionisation and damage in the body, they may be used for various types of testing, such as tracer techniques. Activation analysis is the most sensitive tool for analysis of trace elements in many materials.

The activation analysis may be defined as a method of measuring concentrations of constitutents in a given sample by measuring the characteristic radiations emitted by the radioactive nuclei resulting from nuclear transmutations. First, originally Hevesy and Levi used thermal neutron activation to determine the concentration of dysprosium in impure

yttrium, in 1936 [He-36]. Then, increasing application of radionuclides to analytical problems led to a rapid growth of activation analysis. The activation product provides a specific method for its identification and measurement. For example, for a given problem, a specific method can be selected based on the properties of the sensitivity required in the analysis, the presence of interfering reactions, the location of a suitable irradiation facility and cost.

The activation method is now used frequently in combination with gamma-ray spectrometry in order to simplify or even to eliminate chemical separations. The digital computers are also used for the analysis of gamma-ray spectra and many computer programs are prepared not only to resolve the gamma-ray spectra, but also to calculate the weight of the activated elements from their induced radioactivities. These programs are prepared especially for three types of systems [Le-65, Be-73]. These systems may be:

1. A large centralised computer facility which can analyse batchwise punched tape on which gamma spectrometric data have been collected.

2. A time-shared teleprocessing system linking various spectrometric installations to a centralised computer.

3. A minicomputer used at the laboratory site for both data acquisition and analysis.

The programs prepared for these systems, deal with especially NaI(Tl) type or Ge(Li) type spectra.

Through its nuclear character, the neutron activation technique is a powerful analytical tool not only in trace

analysis but also in determining alloy elements and minor constituents. Therefore, the field of application of the method is very wide. It can be used to determine traces in ultrapure elements, in biological materials and minerals, in industrial product identification by trace characterization, in geochemistry and cosmochemistry, etc [Ko-69, Ch-60, Fa-73].

In this thesis, all these subjects mentioned above will be discussed briefly in the separate subchapters. In addition, a computer code for Ge(Li) type spectra, Gretel, will be examined in a detailed form and compared with another one prepared for NaI(Tl) type spectra.

1.2. OUTLINE OF THE THESIS

The main purpose of the thesis is to investigate the theory and application of the neutron activation analysis, NAA, and make a detailed study of Gretel which is a computer code used to analyze the gamma spectra obtained by Ge(Li) detectors.

The thesis is composed of five chapters and a number of appendices. These can be summarized as follows:

The first chapter is the general introduction of the thesis, covering its purpose and results, and the method of neutron activation analysis.

The second chapter is mainly based on the theory of NAA; the basic principles of activation analysis and gamma-ray spectrometry are examined in detail. First, in the subchapter 2.1 natural radioactivity, radioactive decay and radioactive equilibrium are discussed briefly. In the subchapter 2.2 interaction of neutrons is studied. In the 2.3 interaction of gamma rays with matter and the main effects of this interaction, such as photoelectric effect, Compton scattering and pair-production, are introduced briefly. Then, the detection of gamma rays by means of different types of counters, especially scintillation and semiconductor counters are explained in detail.

The subchapters 2.5 and 2.6 introduce the gamma-ray spectrometry and the basic principles of NAA. Since the use of computers in NAA is an important tool, the last subchapter examines this subject in a summary form.

In chapter 3, Gretel is introduced and investigated in detail; theory of the code, analysis of gamma spectra obtained by Ge(Li) detectors with computer, the smoothing procedure to minimize the influence of the statistical counting fluctuations and the principles for searching of the peaks and the computation of the peak areas found by two different methods are discussed in the following subchapters. In the last subchapter 3.3, the modification of the code which was recorded originally by the use of IBM 370/165 to UNIVAC-1106 is given in detail.

In the following chapter 4, introduction of another code, CORGAM, that has been studied in a previous thesis is given and comparison of these two codes in a tabular form is made. Then, in the chapter 5, discussion and conclusion of the thesis and some suggestions for the use of Gretel are given in a short form.

Finally, some mathematical methods used in Gretel and the listing of Univac version of the code, the listing of input and output data are given as appendices A to K.

1.3. NEUTRON ACTIVATION ANALYSIS

Activation analysis is based on the principle that when a material is irradiated by the nuclear particles produced in a nuclear reactor, particle accelerator or other suitable source, some of the atoms present in the material will interact with the bombarding particles and be converted into different isotopes of the same element or isotopes of different elements, depending on the nature of the bombarding particles. In many cases, the isotopes produced are radioactive. The subsequent emission of beta or gamma radiations from these nuclei is characteristic of the particular isotope. If each different induced radioactivity can be distinquished or separated from all other radioactivities produced, then the amount of each radioactivity is a measure of the quantity of the parent isotope present in the material [Wa-63].

The sensitivity of the neutron activation analysis method can be considered to be about parts per billion, ppb, for reactor irradiations and parts per million, ppm, level for irradiations with neutron generators. In fact, the sensitivity and the accuracy of the analysis are frequently based on the ability to distinquish the radiation of the radioisotopes of interest from the other activated constituents of a sample. Besides NAA, analysis with photons and charged particles can be considered [Ho-71].

Besides the high sensitivity of thermal activation analysis, this technique offers a number of other advantages such as the simplicity of the nuclear reaction, transparency of most materials to thermal neutrons and non-destruction of the sample. In principle, in most cases only neutron capture reactions have to be considered and there is no change in the chemical nature of the irradiated samples.

Unfortunately, thermal neutron activation can not solve a number of important trace analysis problems, for instance those of the light elements, such as carbon, nitrogen and oxygen. These problems can sometimes be solved by applying photons or charged particles such as protons, deuterons, etc. If neutrons and protons essentially analyze the whole mass of the sample, this is not true for charged particle analysis, as these have a very short range. While all analytical techniques require some chemical treatment before the analysis; the NAA may require the chemical treatment only after irradiation and often after removal of surface contamination. One further advantage of neutron activation analysis, NAA, is in many cases, the selectivity or even specificity of its nature. First, the activation is a reaction of the nucleus and thus independent of the chemical state of the considered element. Further, the relatively simple nature of the nuclear reaction allows one to establish with great certainty the isotope or isotopes which gave rise to the measured species. Besides chemical criteria, nuclear ones can increase the certainty of identification of elements, as, for instance, half-life measurements, type of Disintegration and energy measurements of the emitted radiation.

Gamma-ray spectrometry appears to be a powerful tool in this respect. By applying gamma scintillation spectrometry to activation analysis, it becomes possible to analyze simultaneously a number of different elements. With the use of germanium lithium drifted detectors, gamma spectrometry has developed in a spectacular way. These detectors have a very high resolving power [So-72, Ho-71].

The procedure is often summarized as follows: Irradiate a sample and a standard under the same conditions; count

both under the same conditions; the ratio of these rates will be equal to the ratio of the masses of the elements of interest. If one takes activation in a thermal reactor as an example, it should be remembered that among many other parameters the neutron energy varies from a thermal energy of 0.025 eV up to about 20 MeV. Consequently activation not only occurs with thermal neutrons, but also with epithermal and fast neutrons. Besides, the activation can vary from place to place in the reactor. The flux gradient may not be the same in standard or sample or even over the entire sample itself. Many other complexities may be met during activation, such as unsuspected reactions, production of the isotope of interest by second order reactions or radioactive growth of a daughter isotope, absorption of radiations, instability of the instrumentation, non-linearity in detector response, etc.

From this short list of possible sources of error it is concluded that activation analysis is a complex analytical technique and that experience is required to obtain satisfactory results. But all these complexities have not prevented it from developing rapidly. At the beginning, it was mainly used in the field of trace determination in high purity materials; applications are now increasingly used in different fields such as biological sciences, geochemistry, criminology, environmental sciences, etc. Since 1969, cosmochemistry is also added to these fields. For instance, the analysis of Apollo Lunar material is widely performed by activation analysis [Ho-71]. More and widespread applications are to be expected in the future.

2. THEORY

2.1. RADIOACTIVITY

Some nuclei undergo spontaneous decay or disintegration. This process is known as radioactivity. The discovery of radioactivity goes back two historical events: 1) The discovery of x rays by W.C.Roentgen in 1895, 2) In 1896, H.Becquerel reported his experimental results; after exposure to bright sunlight crystals of the uranyl double sulfate emitted a radiation which blackened a photographic plate after penetrating black paper, glass and other substances. Then, Pierre and Marie Curie concluded that the uranium rays were an atomic phenomenon characteristic of the element and not related to its chemical or physical state. They, then introduced the name "radioactivity" for the phenomenon [Fr-62, Ha-65].

There are three kinds of radiations emitted by the radioactive substances. These rays can be distinguished from each other in two ways: First, by the difference in the ease with which the rays can pass through matter. Second, by the direction in which their path is bent by the application of a magnetic field. The most easily absorbed rays are α particles which are deflected by both electric and magnetic fields. This deflection shows that its charge is positive. It is also concluded that it is composed of a doubly ionized He atom, He^{++}. The second type of radiation requires roughly 1000 times as much matter to bring it to rest. These particles, named β^-, are reflected much more readily by magnetic fields than α

particles but in the opposite direction. They, therefore, carry a negative electrical charge. The properties of these particles are similar to those of fast moving electrons. The third type of radiation, called γ ray is even more penetrating than β^- particles. The gamma-rays can only be stopped by several centimeters of lead. These rays are not deflected by magnetic or electric fields. They are electromagnetic radiations of the same kind as X rays, light and radio waves, but of very short wavelength.

The emission of α and β particles cause a change in atomic number or mass number of the nucleus. If a nucleus emits an α particle, whose charge is 2 and whose mass is 4 on the atomic weight scale, then obviously the nucleus that remains after the event will carry two units less of positive charge and four units less of mass. Since a β^- particle is negatively charged, its emission will cause an increase of one unit in the nuclear positive charge. On the other hand, the emission of a γ-ray produces no change in atomic number of the nucleus; but only a decrease in its energy content. In most cases, the emission of gamma-rays is a secondary consequence of either an α or a β decay. Following the initial decay, the residual nucleus is frequently left with excess energy which may emit one or more γ-rays.

Besides the naturally occuring radioactivity, some radioactive nuclei are artificially produced. First in 1934 I.Curie and F.Joliot discovered that boron, aluminum and magnesium could be made radioactive by bombardment with the α rays [Fr-62]. At that time, many laboratories put into operation devices for the acceleration of hydrogen ions and helium ions to energies at which nuclear transmutations were produced. Then, many artificially produced radioelements have found important applications in some fields, such as che-

mistry, physics, biology, medicine and engineering.

2.1.1. Radioactive Decay

Radioactive decay is a statistical process. The probability of one nucleus in a group of nuclei decaying in a finite time interval is independent of the time. In other words, the probability of decay at two different times t_1 and t_2 will be the same.

The probability P of decay of one nucleus in a time interval Δt can be written as,

$$P = \lambda \Delta t \tag{2.1}$$

where λ is decay constant of the isotope. The number of nuclei decaying from a group of N nuclei will be,

$$-\Delta N = NP = N\lambda\Delta t \tag{2.2}$$

If the time interval is very small, eg. (2.2) can be written as,

$$-dN/dt = \lambda N \tag{2.3}$$

integrating this equation and taking No as the number of nuclei present at time t=0, one obtains,

$$N = No\ e^{-\lambda t} \tag{2.4}$$

This equation shows that the number of radioactive nuclei decreases exponentially with time.

According to eg. (2.3), the number of nuclei decaying per unit time is equal to (λN). This is called the activity of the sample [Ou-75, Ha-65]. Multiplying both sides of eg. (2.4) by λ;

$$\lambda N = \lambda No\ e^{-\lambda t}$$

or,

$$A = Ao\ e^{-\lambda t} \qquad (2.5)$$

where A is the activity at time t and A_o is the initial activity at time t = 0. Equation (2.5) shows that the activity also changes with time exponentially.

2.1.2. Radioactive Equilibrium

Among the radioactive nuclei there are many examples of chains of decays in which a radioactive parent decays to a daughter which is also radioactive, and so on. In such a case, it is especially important to know how much of that is produced.

In the case of a radioactive parent decaying to form a radioactive daughter, the daughter product is produced at the rate of the parent's decay. However, the daughter itself decays, and this decay is proportional to the amount of daughter that is present.

Considering N_1, the number of parent atoms and N_2, the number of daughter atoms as functions of decay constants and time, it is possible to write the decay rate of the parent, according to eg. (2.3), as,

$$dN_1/dt = -\lambda_1 N_1$$

or taking $N_1 = N_{1,0}\, e^{-\lambda_1 t}$

$$dN_1/dt = -\lambda_1 N_{1,0}\, e^{-\lambda_1 t} \qquad (2.6)$$

The analogous equation for the daughter is,

$$dN_2/dt = R_F - \lambda_2 N_2 = \lambda_1 N_{1,0} e^{-\lambda_1 t} - \lambda_2 N_2 \qquad (2.7)$$

where R_F represents the rate of formation of the daughter and it is equal to $(\lambda_1\ N_{1,0} e^{-\lambda_1 t})$; the second term $(-\lambda_2 N_2)$ represents the decay term.

Rearranging the equation (2.7) which is a 1^{st} order linear differential equation, for the solution of which(*), one obtains,

$$N_2 = \frac{\lambda_1}{\lambda_2 - \lambda_1} N_{1,0}\ (e^{-\lambda_1 t} - e^{-\lambda_2 t}) \qquad (2.8)$$

Just what happens depends largely on the ratio of the half lives:

a) In the case of the parent having a much longer half-life than the daughter, $(\lambda_2 >> \lambda_1)$, λ_1 is very small and can be allowed to approach zero in eq. (2.8). The resulting equation which gives the amount of the product nuclide as a function of time, takes the form,

$$N_2 = \frac{\lambda_1}{\lambda_2 - \lambda_1} N_{1,0}\ (1 - e^{-\lambda_2 t}) \qquad (2.9)$$

(*) Solution of this equation is given in the appendix B in more detail.

or,

$$N_2 = K(1-e^{-\lambda_2 t}) \qquad (2.10)$$

The significance of K becomes apparent if t approaches to infinity. Then $N_2 = K$ and K is the equilibrium value that N_2 approaches as time goes on.

The form of the build-up or saturation factor $(1-e^{\lambda t})$ is shown in the figure (2.1)

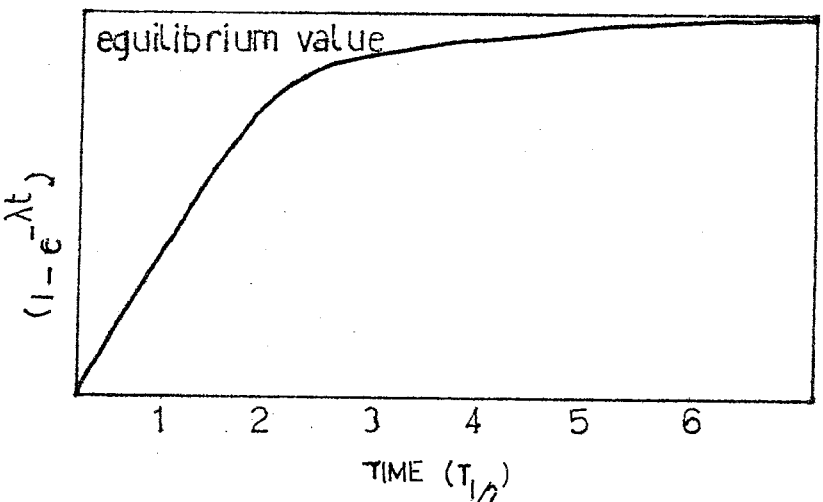


Fig. 2.1. Build up of a radioactive nuclide created at a constant rate [EL-59].

b) If $\lambda_2 > \lambda_1$, but not great enough for one to ignore the decay of the parent during the growth of the daughter, then the situation is called transient equilibrium. Fig.(2.2) shows the growth and decay of a parent and its daughter.

As shown in fig.(2.2), the amount of daughter at first increases, then reaches a maximum, and finally decreases at the same rate as the parent with which it is in transient equilibrium(*).

(*) Detailed explanations for that subject can be supplied from many text books, such as [EL-59, Ha-69, Wi-66, Se-67, Ou-75].

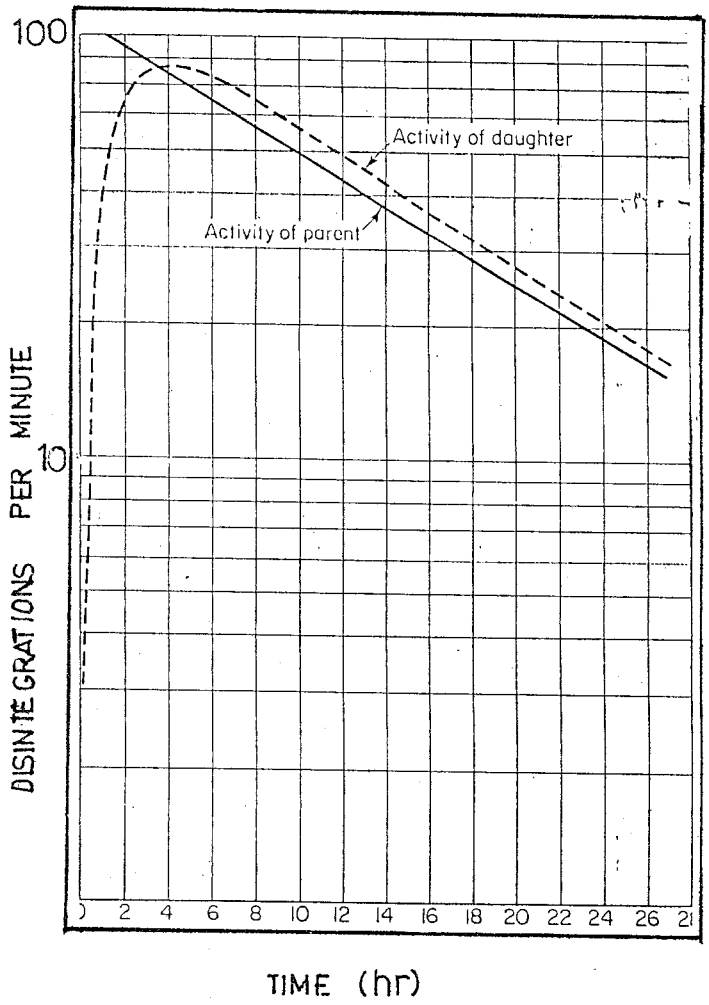


Fig. 2.2. Growth and decay of daughter in transient equilibrium with parent.

2.2. INTÉRACTION OF NEUTRONS WITH MATTER

Since neutrons are not charged and are much heavier than electrons, they do not interact significantly with electrons. They are also not repelled by electric fields; even very low energy (thermal) neutrons readily penetrate and react with nuclei. Therefore, neutrons are not easily detected by most counting instruments because they do not ionize. They must be detected by their secondary effects. In other words, for the detection of neutrons, a nuclear reaction must have reasonably high probability and must result in the production

of some other form of easily detectable radiation, such as charged particles or gamma-ray. Suitable reactions(*) fall into four general categories as follows:

Activation reactions: These reactions result in the production of excited nuclei with reasonable long life times. Samples of suitable materials, usually thin foils, are exposed to neutron irradiation . They are then removed from the neutron flux and their radioactivity is measured usually by β or γ counting. The most important of those reactions is the (n,γ) reaction. This process is also known as radiative - capture, since one of the products of the reaction is instantaneous gamma-rays.

Activation reactions are very useful for the detection of neutrons. That subject will be studied in detail in the later subsections.

Transmutation reactions: Neutrons may be captured by nuclei and cause the prompt emission of charged particles such as protons, deuterons or alpha particles. In that case, the incident neutron must supply sufficient energy to overcome the force binding the charged particle to the compound nucleus for the reaction to take place. Besides those, sometimes two or more neutrons are emitted when a nucleus is struck by a high energy neutron. These processes here are of the $(n,2n)$ or $(n,3n)$ types. A closely related process is the (n,pn) reaction which also occurs with highly energetic incident neutrons.

Fission: When a neutron collides with a heavy nucleus, the nucleus splits into two large fragments with the release of considerable energy. This process is known as fission. The fission process provides a technique for detecting neutrons

(*) These explanations and more detailed form of them can be obtained from many text books, such as [Ch-61, La-72, Wa-62, Wi-66].

in the presence of very intense gamma radiation.

Scattering: When a moving particle collides with another particle, the kinetic energy is exchanged between them according to the laws of conservation of energy and momentum. There are two types of collisions: First, if the potential energy of the system remains unchanged, kinetic energy being conserved during the collision, the phenomenon is called elastic scattering. Second is the inelastic scattering in which one of the particles is left in an excited state after collision. Here momentum and total energy of the particles before and after collision are conserved. However, kinetic energy is not.

In each scattering event, part of the kinetic energy of the neutron is transferred to initially stationary and heavier nucleus; as a result of that they are slowed down. Then the slowed down neutrons become more effective in causing nuclear reactions.

The emission of gamma radiation, as a result of the reactions described above is due to the release of excess energy of the excited nucleus. The energy of that gamma-ray is equal to the difference between the energy levels of the excited and stable states of the nucleus. In some cases two or more gamma-rays of discrete energies are emitted in cascade. Those gammas are usually emitted within 10^{-13} sec. Then β particle, α particle and electron capture decays occur. Sometimes that excited state has a characteristic half-life of its own. Whenever that half-life is of the order of 10^{-7} to 10^{-6} sec, or longer; the excited state is called an isomer of the product. The subsequent decay of that isomer by the emission of a gamma ray is called an isomeric transition. A typical example is given for Co^{60} in the figure (2.3).

The ^{60}Ni nucleus formed by the β^- decay of ^{60}Co is rapidly converted by the emission of 2.50 MeV gamma-ray. This conversion takes place by the emission of a photon of 1.17 MeV and immediately there-after a photon with 1.33 MeV.

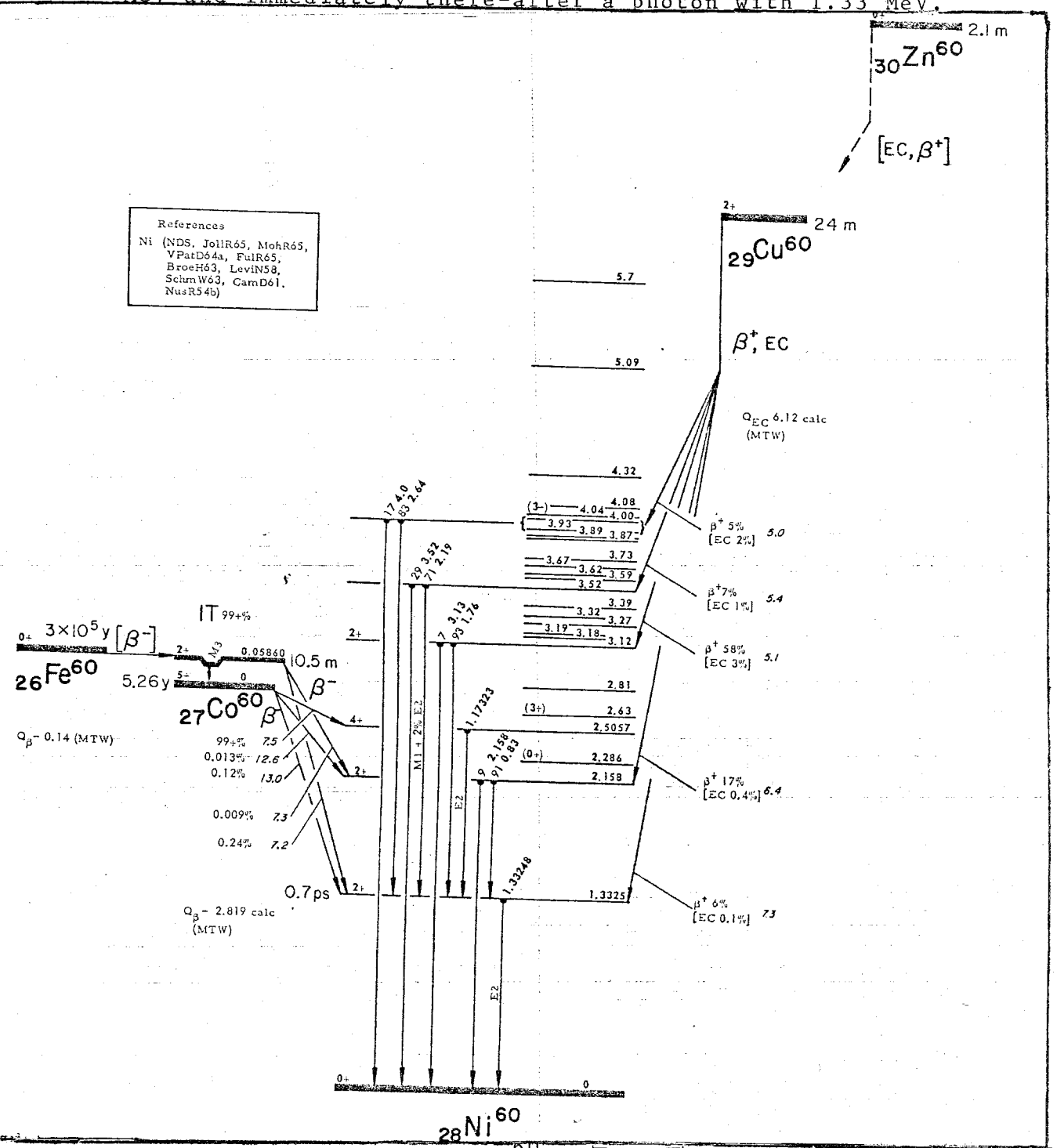


Fig. 2.3. Decay scheme of ^{60}Co [Le-68].

A more complicated one is ^{152}Eu. It has an average level spacing of about 5 keV above 100 keV. It decays to the spherical nucleus ^{152}Gd and to the deformed nucleus ^{152}Sm. Deformed and spherical states are expected close to the ground state. It is very difficult to determine the configurations of these levels in ^{152}Eu [Eg-74]. The decay scheme of ^{152}Eu can be seen in figure(2.4).

The detection of those gamma rays by suitable detectors and the analysis of that spectrum may be used to identify the radiating nuclide, its amount, etc. In the following subchapters, detection of gamma-rays, analysis of spectra obtained from unknown nuclei and, qualitative and quantitative analysis techniques will be examined in detail.

2.3. INTERACTION OF GAMMA RAYS WITH MATTER

Electromagnetic radiation of high photon energy usually originates from excited atomic nuclei and is called γ ray or X ray. These rays are usually classified according to their mode of origin, not their energy.

There are a number of processes which can cause gamma-rays to be scattered or absorbed. A cataloque of the possible processes by which the electromagnetic field of the γ-ray may interact with matter has been put in the following systematic form by Fano [Fa-53];

Kinds of interaction:

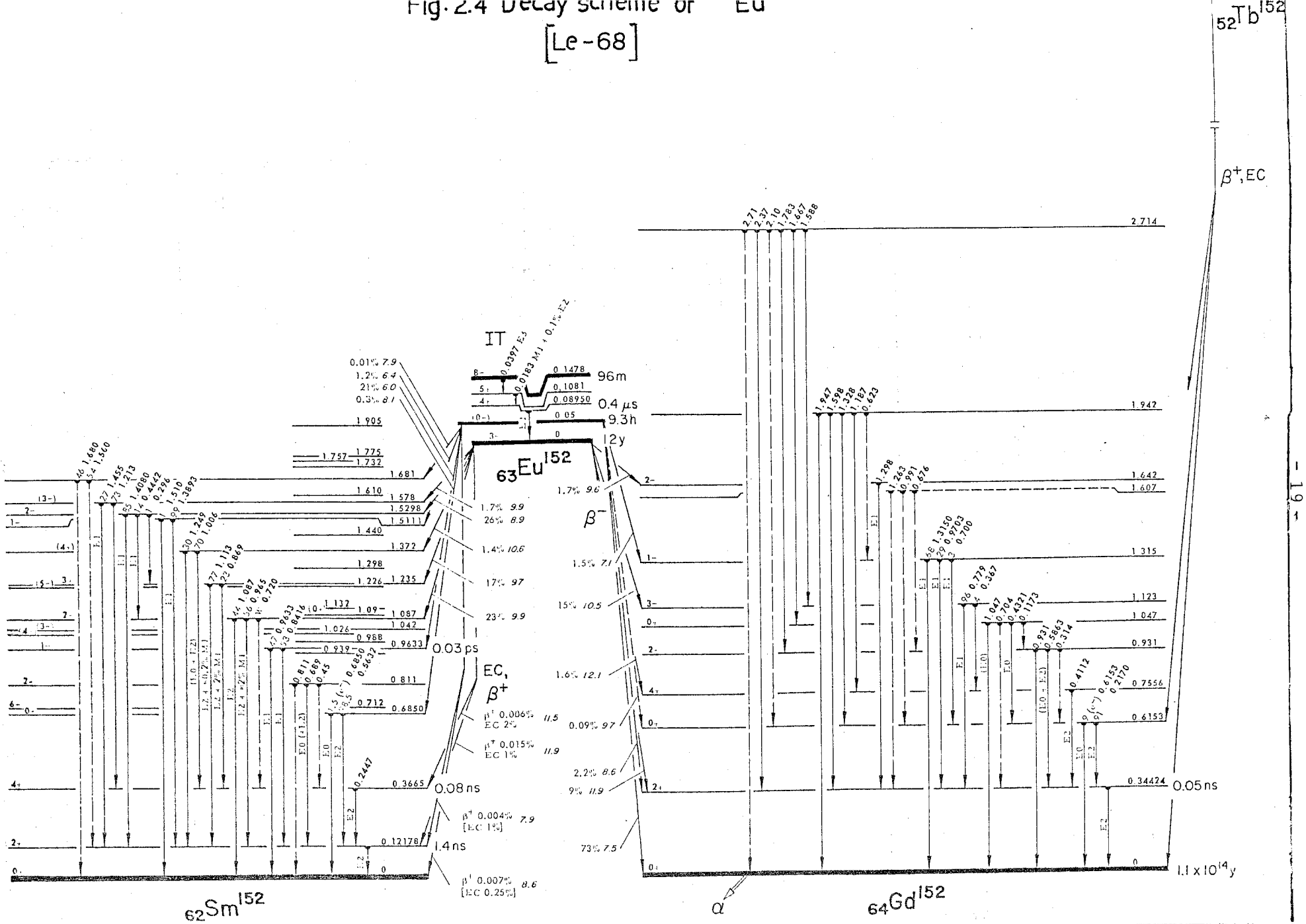
1- Interaction with atomic electrons

2- Interaction with nucleons

3- Interaction with the electric field surrounding nuclei or electrons

Fig. 2.4 Decay scheme of ^{152}Eu

[Le-68]



4- Interaction with the meson field surrounding the nucleons.

Effects of interaction:

a) Complete absorption
b) Elastic scattering (coherent)
c) Inelastic scattering (incoherent)

There are 12 ways of combining these interactions and effects, thus in theory there are 12 different processes by which gamma-rays can be absorbed or scattered. Many of these processes are infrequent. Three of them, photoelectric effect, compton scattering and pair production, are the most important effects. Figure(2.5) illustrates the relative importance of the three main interactions.

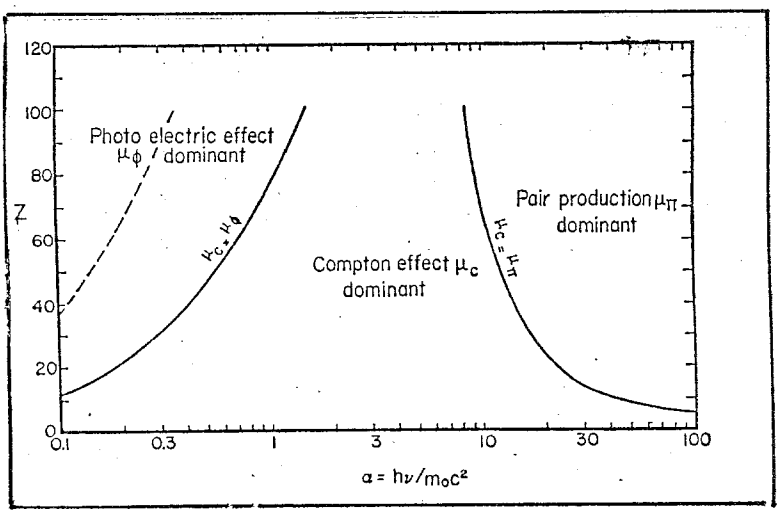


Fig. 2.5. Relative importance of the three main γ-ray interactions as a function of the absorber atomic number Z and the photon energy in the units of M_oC^2 are given (the dotted curve indicates the Rayleigh scattering) [Aj-60].

These effects will be examined in the following sub-chapters.

The minor effects which are of interest in special cases are as follows [Ev-55];

Rayleigh Scattering (1b): Gamma rays scattered by small angles resulting in only a small recoil, especially when their energy is low. The recoil is then often absorbed by a whole atom or molecule. This scattering is more likely for high Z than for low Z materials.

Thomson Scattering (2b): Thomson scattering can combine coherently with Rayleigh scattering. Because of the large mass of the nucleus, the effects are small but appear to have been detected.

Delbruck Scattering (3b): Delbruck scattering is due to virtual electron pair formation in the field of the nucleus. The effect is exteremly small.

Nuclear Resonance Scattering (2c): This type of scattering involves the excitation of a nuclear level by an incident photon, with subsequent reemission of the excitation energy.

Photodisintegration of nuclei (2a): It is possible whenever the photon energy exceeds the separation energy of a neutron or proton. Except for ^{9}Be (γ,n) and $^{2}H(\gamma,n)$, these effects are generally confined to the high energy region above approximately 8 MeV.

Meson Production (4a): Meson production requires photon energies above 150 MeV.

2.3.1. Photoelectric Effect

Below energies of about 0.1 MeV the predominant mode of γ-ray interaction in all medium and high Z absorbers is the photoelectric process. In this process the photon energy is used to remove one of the electrons from an inner shell of an atom of the absorber element. Clearly this process can occur only if the incoming gamma-ray has an energy higher than the binding energy of the electron to be removed. Thus, the energy of incident photon can be determined from the kinetic energy T of the ejected electron and the binding energy E of the atomic level from which it was ejected by the use of the expression,

$$h\nu = T + E \tag{2.11}$$

where, $h\nu$ represents the energy of incident photon, ν being frequency and h being Planck's constant.

When the experimental mass attenuation coefficient μ/ρ for the photoelectric effect is plotted as a function of λ of the incident photon, a series of jumps corresponding to the binding energy of the different orbits can be observed (e.g. Fig. 2.6).

These energies are given by Mosely's law, [Se-64],

$$E = Rhc \frac{(Z-\sigma)^2}{n^2} \tag{2.12}$$

where,

$Rhc = 13.605$ eV

Z is the atomic number

n is the quantum number of different electronic orbits (in the K series n = 1, in the L series n = 2, etc).

σ is the screening constant which has the approximate value 3 for the K shell, 5 for the L shell etc. Figure (2.6) shows these jumps for platinum.

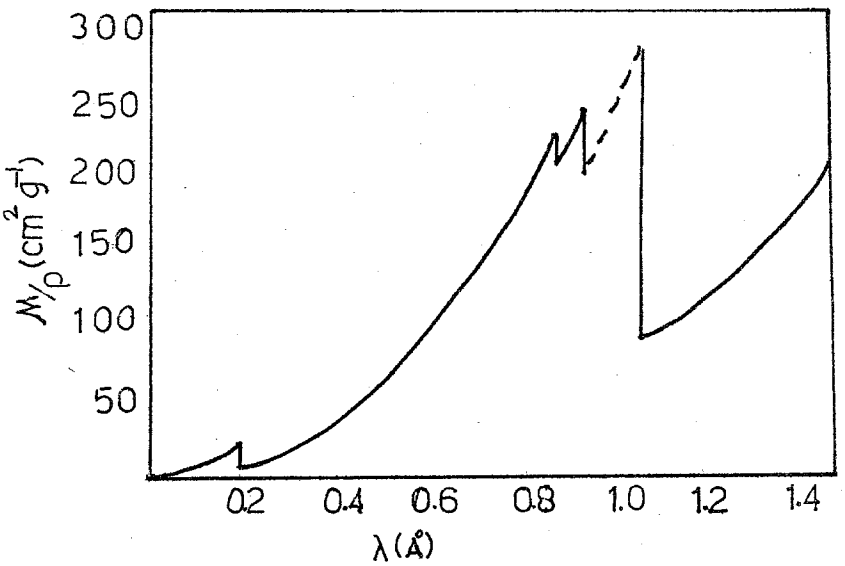


Fig. 2.6. Mass absorption coefficient of platinum as a function of the wavelength of the incident ray [Se-64].

The vacancy created by the ejection of an electron from the inner shell is filled by an outer electron falling into it, and this process may be accompanied by the emission of fluorescent radiation. Alternatively it is possible that no fluorescent radiation is emitted but that an electron from an outer shell is ejected. For instance, a vacancy in a K shell may be filled by an L electron and another L electron emitted with energy $Ek-2E_L$. Similarly, if the K vacancy is filled by an L elektron and an M elektron is emitted, the ejected electron will have the kinetic energy $E_k-E_L-E_m$. These and similar processes are called AUGER processes.

2.3.2. Compton Scattering

Compton scattering is inelastic (incoherent) scattering of photons with the atomic electrons. In this type of effect, the photon energy is considered to be large enough compared to the atomic binding energy E, so that the atomic electrons may be considered as free electrons. The incident photon momentum $h\nu_o/C$ is conserved between the scattered photon and the struck electron. Except for the trivial case of zero scattering angle, the direction of the scattered photon is not parallel to the direction of the incident photon. The scattered photon must therefore have a smaller momentum and a smaller quantum energy than the incident photon. The remaining momentum and energy are imparted to the struck electron.

Assuming that the struck electron is at rest and unbound, the schematic representation of the Compton scattering is given in figure (2.7). Where, $h\nu$ represents the energy of the incident photon, $h\nu'$ is the energy of the scattered photon, θ is the angle through which the photon scatters, ψ is the angle at which the electron recoils.

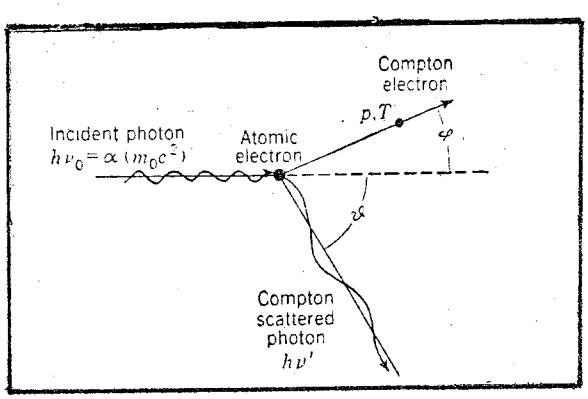


Fig. 2.7. The schematic representation of Compton scattering.

From the conservation of energy,

$$h\nu = h\nu' + T \qquad (2.13)$$

where T represents the kinetic energy of scattered electron.

The energy of the scattered photon, $h\nu'$, in terms of $h\nu$, θ and α which is a dimensionless parameter and equal to $h\nu/M_oC^2$, by using the energy and momentum conservation of the system can be written as, [A$_j$-60].

$$h\nu' = \frac{h\nu}{1+\alpha\ (1-\cos\theta)} \qquad (2.14)$$

It will be seen that $h\nu' = h\nu$ for $\theta = 0^o$ for any α and that

$$h\nu' = \frac{1}{2} M_oC^2 \quad \text{at} \quad \theta = 180^o \quad \text{with} \quad \alpha >> 1 \qquad (2.15)$$

$$h\nu' = M_oC^2 \quad \text{at} \quad \theta = 90^o \quad \text{with} \quad \alpha >> 1 \qquad (2.16)$$

Then the kinetic energy of the recoil electron in terms of ϕ and θ is

$$T = h\nu - h\nu' = h\nu\ \frac{\alpha(1-\cos\theta)}{1+\alpha\ (1-\cos\theta)} \qquad (2.17)$$

2.3.3. Pair Production

At photon energies above $2\ M_oC^2 = 1.02$ MeV pair production is a possible effect. It is the transformation of a gamma ray into an electron-positron pair, also called materialization. When a recoil is absorbed by an electron, the threshold energy required by the conservation of energy and

momentum is 4 MC^2, and there are two electrons and a positron acquiring appreciable momentum. In a cloud or bubble chamber they form a triplet; [Se-64] . Pairs can also be produced by heavy particle collision, by electron-electron collisions, in mesonic decay and by internal conversion in some gamma transitions.

The angular distribution of the electron-positron pairs is difficult to predict theoretically. If T_- and T_+ are used to denote the kinetic energies of these pairs, they can be given as

$$T_+ + T_- = h\nu - 2\ M_o C^2 \qquad (2.18)$$

where $2\ M_o C^2$ is the thresold energy required to create these pairs. [Detailed information about these processes can be obtained in many books, such as A_j-60, Ev-55, Se-64]

2.4. DETECTION OF GAMMA RAYS

Gamma rays are quantized electromagnetic waves emitted as a result of spontaneous changes between energy states of excited nuclei. Gamma rays are usually observed by detecting secondary charged particles, such as photoelectrons ejected from atoms, Compton electrons resulting from interactions with unbound electrons, positron-electron pairs created in the vicinity of a nucleus which lies in the path of the gamma-ray, or photons emitted when the gamma ray interacts with a nucleus.

In many cases one may say that a gamma-ray transition has been observed even though a gamma ray does not leave the nucleus. The most predominant process alternative to gamma -

ray emission is the internal conversion emission of a bound electron. For a gamma-ray transition involving an energy greater than 1.02 MeV a positron-electron pair may be emitted from the nucleus instead of a gamma ray or a conversion electron. This process, called internal pair creation, has the same relationship to external pair production as internal conversion has to photoelectron emission. In special cases when the emission of gamma rays is completely forbidden the transition may take place either by internal conversion, or if this energy is greater than 1.02 MeV, by pair production.

Finally, it may be said that the gamma-ray transitions may be detected by the observation of charged particles external to the atom following interaction with the γ rays. It may also be detected by measuring the internal conversion electron lines emitted from the atom itself. Most of the devices and techniques used for the measurement of gamma rays, actually analyze the secondary electrons. The only exception is the diffraction crystal spectrometer which analyzes the gamma rays directly by Bragg reflection. The ideal device for the detection and measurement of gamma rays would have high efficiency, good resolution and corresponding to each γ ray present, would yield a single peak or line. Since there are many interactions of gamma rays with matter, continuous distributions as well as discrete lines are frequently produced. There are only a few special types of spectrometers which will eliminate continuous distribution and yield only one line for each gamma ray present [A$_j$-60]. They do so generally with a considerably smaller efficiency than for the ordinary electrons. The most common devices for γ-ray detection are the ionization chamber, proportional counter and Geiger-Müller counter. [Pr-64, En-66, Ou-75]. But the NaI (TL) scintillation counter is the most widely used device which will be examined in the following subchapter. In recent years, with

the development of semiconductor counters which have considerably good resolution, these counters have found wide use. So the second subchapter of this chapter deals with the semiconductor detectors in detail and Li drifted type is especially examined as the computer code studied in this thesis, Gretel, makes use of this type of semiconductor detector.

2.4.1. Scintillation Detectors

One of the oldest methods of nuclear radiation detection is to make use of light scintillations. Although the basic principles remain the same, the techniques used have changed greatly. These techniques are particularly useful in the measurement of the energies of β and gamma rays. Besides these, the solid or liquid phosphors which are used with the scintillation detectors can absorb the β particles or the secondary electrons produced by gammas. Consequently, measurements of the energies of these particles are possible.

Figure(2.8) is a schematic diagram of a scintillator and the electronic arrangement(*) used in a counting system.

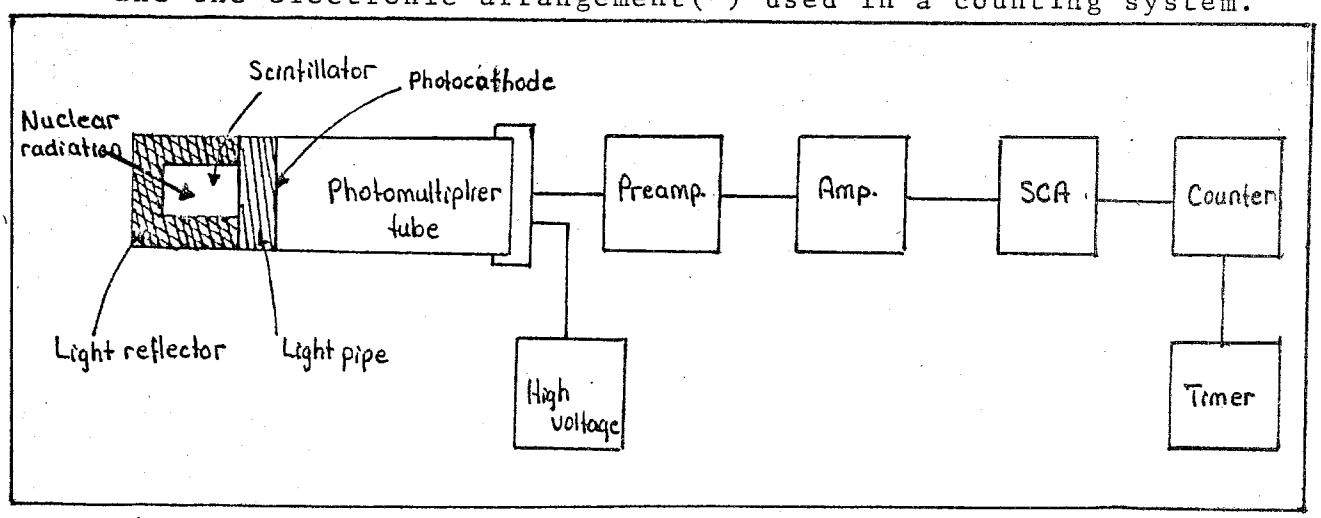


Fig. 2.8. Schematic diagram of a basic scintillation detection system [Bo-82].

(*) This electronic arrangement is taken from NE laboratory notes prepared by F.Borak.

A wide variety of scintillators is in use today. Table 2.1 gives them and some of their characteristics.

TABLE 2.1. Properties of several scintillators [Pr-64]

Materials	Density, g/cm³	Wavelength of maximum emission, A	Relative beta-ray pulse height	Alpha-beta ratio, %	Decay time, sec
1. Anthracene crystal	1.25	4,400	100	9	3×10^{-8}
2. Trans-stilbene crystal	1.15	4,100	60	9	$4\text{-}8 \times 10^{-9}$ (β)
3. Liquid phosphors	0.86	3,500-4,500	40-60	9	$2\text{-}8 \times 10^{-9}$
4. Plastic phosphors	1.06	3,500-4,500	28-48		$3\text{-}5 \times 10^{-9}$
5. NaI·Tl	3.67	4,200	210	44	3×10^{-7}
6. LiI(Eu)	4.06	4,700	70	95	1.2×10^{-6}
7. CsI(Tl)	4.51	4,200-5,700	55-95		1.1×10^{-6} (β) 0.43×10^{-6} (α)
8. ZnS·Ag) (powder)	4.10	4,500	200	100	$4\text{-}10 \times 10^{-8}$ (fast component) $4\text{-}10 \times 10^{-6}$ (slow component)

As can be seen in table 2.2, one of the most widely used scintillators is the NaI(TL). When approximately 0.5 % of thallium is added to sodium iodide, a crystal grown from the mixture has the property of emitting light in the visible range of wavelength upon the passage of an ionizing particle. The crystals are generally made cyclindrical in shape and the container is provided with a glass window adjacent to one of the flat ends. In order to get the maximum yield of light out of the window, a layer of reflecting material is packed between the surfaces of the crystal and the container walls. To convert the light scintillation to an electronic pulse the packed crystal mounted on a photomultiplier tube by using heavy grease for optical contact with the face of the tube. Typical photomultiplier tubes have a photosensitive layer on the inside of the flat end of the tube. When photons from the scintillation event eject photoelectrons from this layer, the

electrons are attracted to a dynode assembly where multiplication takes place. A voltage divider is arranged so that each successive dynode is at a voltage of 70 to 200 volts. For each photoelectron emitted from the photosensitive surface a burst containing 10^6 or more electrons depending on the voltage, is collected at the anode. The amplitude of the final pulse depends on the initial number of photoelectrons which in turn depends on the number of photons produced by an ionizing event in the crystal [Aj-60].

2.4.2. Semiconductor Counters

The operation of a semiconductor detector is analogous to the operation of an ionization chamber. In an ionization chamber the incident radiation produces positive ions and electrons, and an electrical signal is obtained by collecting these ions. In a semiconductor counter the incident radiation produces electrons and holes; then information about the radiation is obtained by collecting them. One major difference is that only 3.5 eV has to be expended to produce an electron - hole pair in a semiconductor, while the value is approximately 30 eV in an ionization chamber [Ou-75].

To understand the operation of the semiconductor counter, it can be considered as a bar of a uniform crystal with electrodes attached at the both ends as seen in figure (2.9),

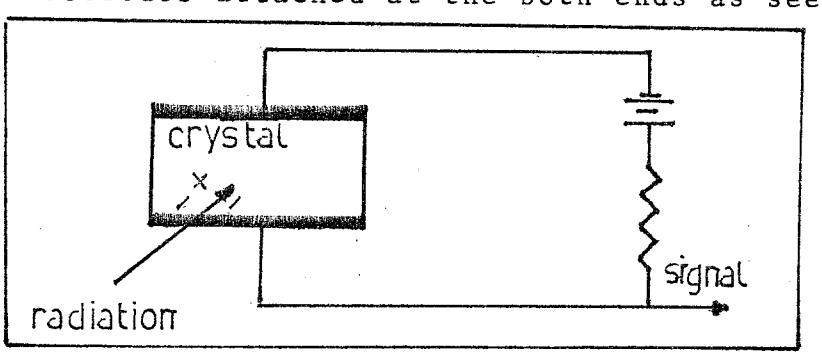


Fig. 2.9. Single crystal semiconductor counter [Ou-75]

When radiation falls on the crystal, electron-hole pairs are produced and when they are collected by the electrodes, a signal is obtained across the resistance, the height of which is proportional to the energy expended by the radiation in the material.

Energy resolution is usually an important factor in selecting a detector material. Energy resolution depends on the number of electron-hole pairs produced by the radiation. The energy required to produce an electron-hole pair is lower in a semiconductor than in an insulator. Hence the resolution of semiconductor detectors will be much better than that of detectors made of insulators.

The electron-hole pairs produced should be free to move in the detector and should be able to reach the electrodes. If the detector contains traps produced by impurities and defects, the electrons may be captured before reaching the electrode. Therefore only single crystals with the least number of traps are used for detectors. Trapping centers enhance recombination of holes and electrons, which will also reduce the pulse height.

2.4.2.1. LITHIUM DRIFTED DETECTORS(*)

Lithium is a donor atom. The diffusion coefficient is about 10^7 higher than that for phosphorus and therefore, deep diffused junctions can be prepared. First, lithium is coated onto single crystals into which it is diffused by heating. In the second step, the sample is heated and a strong reverse

(*) Detailed explanations about these detectors can be obtained from the given references, such as [De-63, Pr-64, Ou-75, So-72].

bias(*) is applied. This helps the lithium atoms to diffuse deeper into the crystal. There are three region; the p region, the n region and an intrinsic region. Figure(2.10) shows these regions.

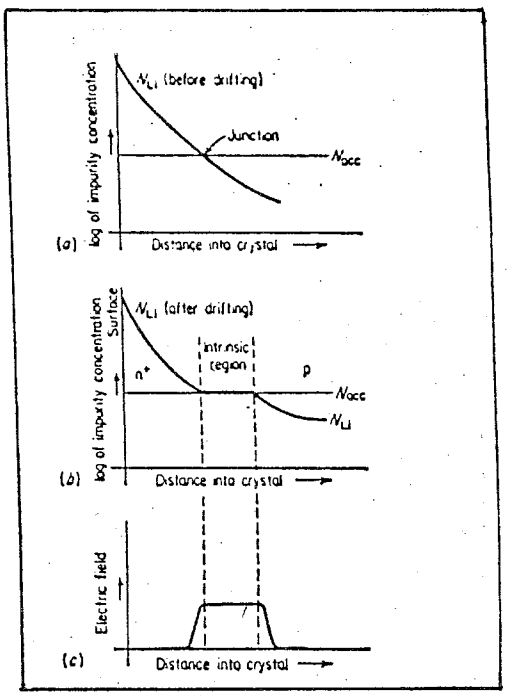
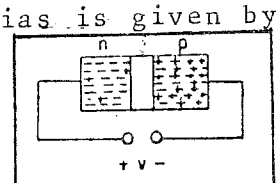


Fig. 2.10. Concentration profile for acceptor impurities (N_{acc}) and for lithium donor impurities (N_{Li}) in a diffused junction diode. (a) Before the drifting process; (b) after the drifting process; (c) electric field distribution with applied reverse bias [Pr-64].

When lithium atoms diffuse onto a surface, the donor - acceptor profile of the junction diode will be as shown in the figure 2.10 (a). If the resulting junction is reverse - biased and the temperature is raised for a short time, the donor-acceptor profile changes to that shown in fig. 2.10 (b). The donor and acceptor impurities in equal numbers compensate each other and effectively produce an intrinsic region bet-

(*) Reverse bias is given by the following figure.



ween the p and the n regions. When the material is returned to room temperature and operated as a detector with a reverse bias, the residual carriers are swept from the intrinsic region and a space charge is developed at either edge, as indicated by the electric field plot in fig. 2.10 (c).

Intrinsic regions over 1 cm thick have been produced by this technique and further developments will lead to thicker sensitive regions. But when one goes to larger and larger sensitive regions, the pulse rise time lengthens.

2.5. GAMMA RAY SPECTROMETRY

The detection of gamma rays is mostly performed by means of a NaI(TL) scintillator or with a Ge(Li) junction. As the output of these detectors is proportional to the amount of energy absorbed, integral counting as well as spectrometry is possible, The NaI(TL) and the Ge(Li) detectors are made in different shapes, according to the purposes for which they will be used such as planar, coaxial etc.

Although gamma rays are monoenergetic, their energy spectra are complex, as illustrated in Fig.(2.11),

According to the size and the absorbing properties of the detector used and depending on the energy of the gamma ray, total or partial absorption can occur.

With NaI(TL) detectors, the escape of the detector X ray by photoelectric effect can be observed at 28 keV. At higher energies the escape peak disappears under the photo-

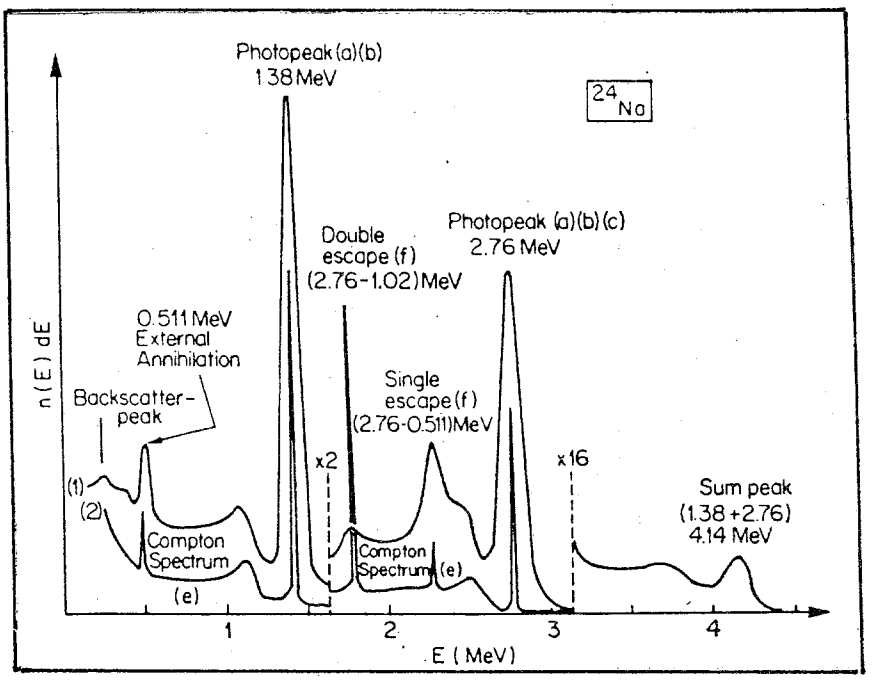


Fig. 2.11. Gamma spectrum of ^{24}Na [SO-72].

peak due to the poor detector resolution. In Ge(Li) detectors the escape peak should appear at about 10 keV below the photopeak, and should be observed up to energies of approximately 1 MeV.

When dealing with gamma rays with energies higher than 1.02 MeV single and double escape of the positron annihilation quanta produce peaks at energies respectively 0.511 and 1.02 MeV below the gamma ray energy. In this case an annihilation peak also occurs at 0.511 MeV due to positron escape and subsequent annihilation in the surrounding materials. When positron emitters are measured, the typical annihilation gamma ray of 0.511 MeV appears in the spectrum and in good geometry also the 1.02 MeV sumpeak.

In order to achieve gamma spectrometric measurements, pulse height discrimination becomes necessary, which can be

done either with a single channel or a multichannel pulse height analyzer.

The resolution of a gamma spectrometer varies with the gamma ray energy and is normally given for the 0.662 MeV peak of ^{137}Cs. With a NaI(TL) detector, the resolution R is expressed in percent using the expression, [SO-72],

$$R_{\%} = \frac{(FWHM) \times 100}{E} \qquad (2.19)$$

where, FWHM is full width at half maximum of the photopeak and E is the peak energy.

When dealing with Ge(Li) detectors, the resolution is normally expressed as the FWHM in keV of the 0.662 MeV ^{137}Cs. Typical resolution of these detectors are between 5 and 2 keV.

The detector resolution R_D is energy dependent, and can be expressed as follows:

$$R_D^2 = 2.355\ FE\varepsilon \qquad (2.20)$$

where, R_D and the gamma energy E are given in keV, ε is the energy needed to create an electron-hole pair and is approximately equal to 3.10^{-3} keV for Ge, for Ge(Li) detectors, F is the Fano factor which is variance to yield factor (The true value of fano factor for Si and Ge is still unknown. However it is assumed as 0.1 for both Si and Ge [Or-80]).

Then the resolution of the spectrometer R is composed of the electronic line broadening, for which the main factor is noise produced by the detector and the amplifying instruments, and of the detector resolution as,

$$R^2 = R_E^2 + R_D^2 \qquad (2.21)$$

The energy of the unknown gamma ray can be determined by the pulse height of the photopeak maximum. The calibration of the spectrometer is performed by means of isotopes emitting gamma rays of known energies. Sets of calibration sources are commercially available or can be prepared by irradiation of the stable isotopes. As a Ge(Li) detector shows a very good resolution, gamma ray energies can be determined within a few tenths of a keV. Table 2.2 shows some calibration sources for gamma-ray spectrometry.

Table 2.2. Calibration sources for gamma-ray spectrometry [SO-72]

Isotope	Energy (keV)	Isotope	Energy (keV)
^{241}Am	59.568 ± 0.017	^{95}Nb	765.83 ± 0.07
^{131}I	80.166 ± 0.009	^{54}Mn	834.84 ± 0.07
^{153}Gd	97.43 ± 0.02	^{88}Y	898.01 ± 0.07
^{153}Gd	103.18 ± 0.02	^{207}Bi	1063.82 ± 0.28
^{177}Lu	112.97	^{60}Co	1173.13 ± 0.04
^{141}Ce	145.44 ± 0.05	^{60}Co	1332.39 ± 0.05
^{139}Ce	165.84 ± 0.03	^{24}Na	1368.40 ± 0.04
		^{56}Co(D.E.)	1576.9 ± 0.32
^{177}Lu	208.36	^{208}Tl(ThC″)(D.E.)	1592.3 ± 0.13
^{203}Hg	279.12 ± 0.05	^{24}Na (D.E.)	1731.6 ± 0.16
^{131}I	364.47 ± 0.005	^{88}Y	1836.1 ± 0.07
		^{56}Co	2035.2 ± 0.50
		^{56}Co(D.E.)	2232.2 ± 0.67
^{198}Au	411.776 ± 0.01	^{24}Na (S.E.)	2242.6 ± 0.14
		^{56}Co	2598.9 ± 0.30
Annihilation	511.006 ± 0.02	^{208}Tl (ThC″)	2614.3 ± 0.09
^{207}Bi	569.65 ± 0.10	^{24}Na	2753.6 ± 0.12
^{137}Cs	661.59 ± 0.07	^{56}Co	3202.4 ± 0.65
		^{56}Co	3254.2 ± 0.65
		^{56}Co	3273.6 ± 0.4
		^{56}Co	3452.5 ± 0.75

S.E. = single escape D.E. = double escape.

Quantitative data of the gamma ray intensity can be obtained from the area or the height of the photopeak. The photopeak can be described as a Gaussian error curve, with an area S, given by

$$S = 1.06\ (FWHM)h \qquad (2.22)$$

where, h is the peak height.

When peaks are superimposed on Compton continuum of higher energy or when poor counting statistics are obtained, it is difficult to determine the peak height. There are some other methods to calculate the peak areas, such as the method of Covel (which will be examined in chapter 3 in detail), spectrum stripping, etc.

Linearity of a detector is another important subject. This property of semiconductor detector is excellent, and deviations from linearity in existing spectrometers can be traced back to amplification and analysis equipment except for very low energies, [HO-71].

2.6. QUANTITATIVE ANALYSIS

2.6.1. Basic Principles and Concepts

The technique of activation analysis is based on the formation of radioactive nuclides as a result of reactions between nuclear particles and the isotopes of the trace elements of interest. These isotopes are transformed into different isotopes of either the same or a different element. There are many nuclear reactions for this purpose. In the great majority of cases two-particle reactions are utilized; one particle being a reactant and the other being a product. The particles for general use as reactants are neutrons, protons, deuterons, alpha particles and photons.

As an example, when a target material is exposed to

neutrons, photons or charged particles, the resulting nuclear reaction and the product decay may be represented by,

$$A \xrightarrow{n} B^* \longrightarrow C$$

The stable isotope A being bombarded is transmutted to radionuclide B* which decays with its characteristic decay constant λ_B to the stable isotope C. (or unstable isotope C* which will also decay with λ_c, etc.). These subjects are examined in 2.1.1 and 2.1.2 in detail.

The rate of formation, R_F, of a particular activation product B in a given sample is proportional to the intensity of the flux or beam of incident particles, to the concentration of the target nuclide in the sample, and to the cross - section for the nuclear reaction. Thus, for the case of neutron irradiation R_F is given as,

$$R_F = \phi N_A \sigma V \qquad (2.23)$$

where $N_A = A_V f \rho / M_A$ or for unit volume, $N_A = A_V m f / M_A$ and R_F is assumed as constant (the case of $R_F \neq$ constant, was examined in subchapter 2.1.2). Then,

$$R_F = \frac{\phi m A_V f \sigma}{M_A} \qquad (2.24)$$

where,

N_A = the number of target atoms

ϕ = the neutron flux (n/cm^2-sec)

m = the mass of the trace element in the specimen (gm)

M_A = the atomic weight of the trace element.

f = the fractional isotope abundance of the target nuclide

A_V = Avagadro's number (atom/gm. atom)

σ = the reaction cross-section (cm^2/atom)

The decay rate expressed in atomic disintegrations per second of the product radionuclide in the specimen was given by the equation 2.3, as

$$dN/dt = -\lambda N$$

Therefore, the rate of change of the quantity of the activation product in the sample during the irradiation is given as,

$$\frac{dN_B}{dt} = R_F - N_B\lambda_B \qquad \text{or,}$$

$$\frac{dN_B}{dt} = \frac{\phi m A_V f \sigma}{M_A} - N_B\lambda_B \tag{2.25}$$

The solution of this differential equation will be given in the appendix B. The result is,

$$N_B = \frac{\phi m A_V f \sigma}{\lambda_B M_A} (1-e^{-\lambda_B t}) \tag{2.26}$$

The number of disintegrations per second of the product represented as the activity after an irradiation time t sec is,

$$A = N_B\lambda_B = \frac{\phi m A_V f \sigma}{M_A} (1-e^{-\lambda_B t}) \tag{2.27}$$

The equation (2.27) can be used to estimate the activation levels for the various elements in the sample under varying conditions of flux, irradiation time and sample size. This equation is rearranged for M and is given as, [KO-60],

$$M(gm) = \frac{M_A\ A}{\phi A_v f\sigma(1-e^{-\lambda_B t})} \qquad (2.28)$$

$$M(gm) = \frac{M_A\ A}{6.02 \times 10^{23}\ \phi f\sigma(1-e^{-\lambda_B t})} \qquad (2.29)$$

The maximum or saturation activity is attained when the irradiation time is long compared to the half-life of the product and the rate of formation is equal to the rate of disintegration $[1-e^{-\lambda_B t}]$ approaches unity and,

$$A_s = N_B\lambda_B = \frac{\phi M A_v f\sigma}{M_A} \qquad (2.30)$$

Assuming the sample has been irradiated to saturation and no significant decay has occured in the interval between the end of bombardment and counting time t, a formula can be obtained to calculate the weight of the element by reducing the eg. (2.30) to,

$$M(gm) = \frac{M_A\ A}{6.02 \times 10^{23}\ \phi f\sigma} \qquad (2.31)$$

Besides, the sensitivity expressed in terms of the minimum weight of a target element that will produce the minimum detectable activity after a certain bombarding time t will be given by,

$$\text{Sensitivity in micrograms} = \frac{M_A \; A \times 10^6}{6.02 \times 10^{23} \; \phi f \sigma (1 - e^{-\lambda_B t})} \qquad (2.32)$$

2.6.2. Methods of Analysis

When determining a large number of elements in one sample, the comparison of samples is very troublesome and time consuming. Besides, it is often impossible to irradiate a large number of comparison samples together with the unknown samples because of the restricted volumes of irradiation containers. Moreover, when performing multielement determinations, the presence of one or several elements in the sample is often only realized during the evaluation of the gamma spectra. When no comparison standards for these elements were irradiated a semiquantitative quess is all that can be derived concerning the concentrations.

Several techniques have been put forward to eliminate the above mentioned shortcomings, such as absolute, single or multicomparator methods [HO-71].

Absolute Method: This direct method performed by Girardi, [Gi-64], based on the determination of weights by means of the activation relationship is generally considered as a semiquantitative technique. It deals with absolute gamma - ray counting and direct calculation of weights from an estimation of the activation formula. The reliability of that method depends on the accuracy with which the absolute of the thermal cross-section, the resonance integral and the decay schemes are known. But most of these are not sufficiently well known to allow their use for accurate absolute calculations.

Comparator Method: Many sources of error can be eliminated by irradiating the sample with a standard of similar composition. When the composition of a substance is unknown, a preliminary irradiation can be used as a qualitative determination, and a suitable standard can be fabricated for simultaneous irradiation with the sample. The sample and standard should be approximately the same weight, shape and thickness. Thus, effects due to variations in flux and self attenuation during the irradiation will not influence the analysis.

If the activities are measured in an identical manner, comparing the counting rates in the sample and the standard will give the weight of the element in the sample by the following simple relation, [Ad-70],

$$\text{Weight of the element in sample} = \frac{(\text{Activity in sample})\ (\text{Weight of element in standard})}{(\text{Activity in standard})}$$

Single Comparator(*): The use of Ge(Li) detectors allows the simultaneous determination of an important number of elements after a single irradiation. The classical comparator method requires one standard for every element to be determined; but this method uses only one comparator consisting of known amounts of elements to be determined.

2.7. USE OF COMPUTERS IN NAA

With the development of modern methods of radionuclide measurement, the ability to record vast amounts of data reliably and automatically has led to the use of computers. Many computer programs have been developed up to now, to interpret and evaluate that data. Some of these programs have been pre-

(*) This method will be discussed in appendix C in detail.

pared for big computers; some others are for small ones, which are particularly for the routine processing of spectrometric data.

The large computers allow, of course, the most sophisticated and complete analysis of that data. The computing programs can easily be written and the hardware problems for data collection and transfer to the large computer system have been solved for several years. This data analysis system keeps its full validity, particularly when large batches of samples must be analysed in a similar way [Be-73].

On the other hand, the small computers are used at the laboratory site for both data acquisition and analysis, requiring the small amounts of memory locations. However, the programs prepared for these computers could not define the location of photopeaks and the computation of the peak areas as reliably as those prepared for the big ones [Çi-81].

As a result of this short discussion, it can be concluded that; the choice of a data-handling system is a rather cumbersome task since the money involved is important and the information available on the real performances of the various systems are often incomplete.

Modern gamma-spectrometers collect their data simultaneously in a large number of energy channels. When NaI(TL) scintillators are used, a few hundred energy channels were sufficient for adequate representation of the spectrum. But, the introduction of the Ge(Li) type detector with its excellent energy resolution, pushed the number of energy channels required for an adequate spectral response, up into the thousands. For the relevant information from the enormous amount of digital data comprised in a Ge(Li) type spectrum,

"data-reduction system" has been used. The purpose of such a system is to recognize valuable data and to reject useless information.

The following five steps can be distinquished in the course of a data-reduction procedure, as in Gretel which will be discussed in chapter 3, [HO-71];

a) the preliminary treatment of all data
b) the location of possible photopeaks
c) the determination of the peak limits
d) the application of statistical and peak shape tests,
e) the evaluation of exact peak centroid location, determination of net peak area with corresponding standard deviation and detection limit.

a) In general, the preliminary treatment of data involves the application of smoothing techniques and the computation of the first or higher derivatives of the spectral data. Smoothing, as will be discussed in 3.3.2, is used to minimize the influence of the statistical counting fluctuations First or second derivatives which can be calculated according to the least squares method, detect the location of the photopeaks [So-72, Sa-64].

b) For the detection of exact photopeak location, the calculation of the maxima that belong to true photopeaks is the second problem. When a preliminary data treatment has produced a first derivative, then the maxima correspond to points where this function goes from a positive value to a negative one.

c) The most critical point in the data-reduction system is the determination of the left and right boundaries of the

photopeaks. This will determine the separation that is to be made between the peak area and underlying continuum. This will also determine both accuracy and precision of any quantitative interpretation of the spectra.

d) Once a maximum has been detected and its boundaries have been established, some further tests are required to make sure that a real photopeak has been found. There are different tests used for that purpose. Some of them used in Gretel will be studied in 3.3.3.

e) Once a peak has been detected and accepted, the spectral data contributing to the photopeak should be interpreted in terms of energy and intensity of the corresponding gamma radiation. This is the classical problem of NAA and it is usually the last step of many computer programs.

Besides these, another important subject of some programs is the analysis of detection limits for the peaks actually found or for those not detected but expected at specified location.

Up to now some analysts have used minimum data-reduction without any qualitative interpretation. Others used a very extensive data reduction but only a limited amount of qualitative analysis, mainly to interpret the standard spectra in order to define the elements to be determined [Ho-71].

The program examined in this thesis is one of these programs which involves data-reduction, interpretation of the activation process and standard spectra quantitatively, which will be examined in the following chapter in detail.

3. GRETEL
A COMPUTER PROGRAM FOR GAMMA RAY SPECTROMETRY WITH Ge(Li) DETECTORS

3.1. INTRODUCTION OF THE COMPUTER CODE

Gretel performs the quantitative analysis of gamma-ray spetcra obtained by Ge(L_i) detectors, using special "oriented libraries" which are prepared for each particular problem (Table 3.1 shows such an oriented library).

The scheme of the Gretel program is the following: An energy calibration source is counted as the first spectrum of the series; then the unknown neutron activated samples are successively counted. The counting equipment consists of a 4096 channel analyzer for high resolution spectrometry with Ge(L_i) detectors, equipped with sample changers to allow the automated acquisition of gamma-ray data from successive specimen. The data coming from the analyzer, are first punched on paper tapes, then transferred on to magnetic tapes. These tapes are then read by one of the subroutines (TAPE, TAPEAS or TAPEGA), according to the punching code adopted; such as IBM, ASCII or ASCII with no parity. These routines transform the data in a suitable format, either by the functions CONV or CONVB.

The analysis is carried out by the single comparator method as will be seen in the appendix C.

TABLE 3.1- EXAMPLE OF "ORIENTED LIBRARY" FOR LONG LIVED RADIOISOTOPES

[Gu-74]

Radioisotope	Energy (keV)	Resolution (keV) FWHM	Decay Constant (minutes)	Specific Activity(1) (cpm)	Molecular Weight
Ag 110 M	657.8	3.0	1.85×10^{-6}	6.911×10^{8}	107.87
Ca 47	489.5	2.9	1.01×10^{-4}	5.761×10^{13}	40.08
Ca 47	807.4	3.1	1.01×10^{-4}	9.274×10^{13}	40.08
Ca 47	1296.4	4.2	1.01×10^{-4}	1.13×10^{14}	40.08
Co 60	1173.2	4.1	2.497×10^{-7}	2.612×10^{7}	58.9
Co 60	1332.4	4.2	2.497×10^{-7}	2.893×10^{7}	58.9
Cs 134	604.7	3.0	5.98×10^{-7}	4.1×10^{7}	132.91
Cs 134	795.0	3.1	5.98×10^{-7}	5.683×10^{7}	132.91
Hg 203	279.1	2.5	1.035×10^{-5}	1.018×10^{9}	200.61

(1) Calculated from irradiation of one μg of element in a thermal flux of 10^{13} n/cm^2. sec at saturation and at decay time equal zero.

The program is essentially composed of a MAIN part which controls the various subroutines, also involving those mentioned above, thirteen subroutines and three functions.

These routines which detect and evaluate peak areas perform the following operations:

a) Local smoothing of the spectrum for minimizing the influence of the statistical counting fluctuations.

b) First derivative of the smoothed spectrum.

c) Detection of peak location according to the change of sign of the first derivative.

d) Computation of the net area of each peak found.

e) Possibility of detection and computation of double peak.

f) Computation of the minimum counting rates that could have had a photopeak to be detected over the existing background in case no peaks are found in the interval indicated by the oriented library [Gu-74, Gu-67].

All those subjects will be discussed in the following subchapters in more detailed form. Description of the routines will also be given in appendix G.

Results in ppm or sensitivity limits for the elements not detected, are obtained in the form of digital lists.

At first, the original raw spectrometric data are collected on punched tapes which are then processed at the Scientific Information Processing Center, Ispra-Italy, by an IBM 370/165 computer with fortran IV level G and assembly languages. It also has possibility of obtaining analog outputs as results given in digital lists, using a CALCOMP unit. One request, a graphical representation of the spectrum could be produced, showing the way in which the spectrum has been processed. The code has been updated by the author for UNIVAC-1106, by deleting all the plotting subroutines from the main program because a Univac plotting unit was not available in BU. The updated form of the code is recorded on a new magnetic tape for further studies by BU-NE Department. This tape(*) contains four files:

1. file: UNIVAC-1106 version of GRETEL source program containing main and subprograms.
2. file: sample problem input data
3. file: spectra for sample problem
4. file: sample problem output data

(*) This tape covering the UNIVAC version of Gretel and input and output data is labelled as "SAGLAM" for further studies by the NE Department.

3.2. THEORY OF NAA USED IN GRETEL

In this chapter, the theory of neutron activation analysis, NAA, used in Gretel is given in a summary form as follows:

The neutron activation analysis in subchapter 1.3 and the basic principles of this method in 2.6 were examined in detail. The equation (2.27) derived in the same subchapter 2.6 was given

$$A = N_B\lambda_B = \frac{\Phi m A_v f\sigma}{M_A}(1-e^{-\lambda_B t})$$

where, A represents the amount of radioactivity of the daughter nuclei N_B which is present at the end of the activation time t. Since the activity also decays exponentially with time, according to the equation (2.5), the activity A_d that will be detected, will depend on the decay time τ after irradiation,

$$A_d = A\, e^{-\lambda_B \tau} = \frac{\Phi m\, A_v f\sigma}{M_A}(1-e^{-\lambda_B t})e^{-\lambda_B \tau} \qquad (3.1)$$

This equation can be rearranged for the weight of the element as,

$$g(\mu gm) = \frac{M_A\, A_d \times 10^6}{6.02\times10^{23}\, \Phi f\sigma(1-e^{-\lambda_B t})e^{-\lambda_B \tau}} \qquad (3.2)$$

Besides the basic activation formulas given above the analysis of the spectra with computers will be discussed in the following chapters in the detailed form.

3.3. ANALYSIS OF GAMMA-RAY SPECTRA WITH DIGITAL COMPUTERS

3.3.1. Introduction

With the development of modern methods of radionuclide measurement, as discussed in subchapter 2.7, the ability to record vast amounts of data automatically has led to the use of computers. Many computer programs have been derived up to now, to interpret that data.

Gretel is one of these programs prepared for gamma-ray spectra obtained with high resolution Ge(L_i) detectors. The program is used for the quantitative analysis of trace elements from gamma-spectra of neutron activated materials. As mentioned before, it is composed of three main parts as follows:

First part introduces the smoothing procedure by taking 5,7 or 9 point segments of the spectrum. This procedure is used to minimize the influence of the statistical counting fluctuations. The smoothed spectrum is then examined to define the location of a peak where the sign of the derivative changes from a positive value to a negative one. This subject will be discussed in the subchapter 3.3.2 in more detail.

In the second part, the peaks are searched and located exactly. To avoid the statistical fluctuations from being kept as analytical peaks, the absolute values of the maximum and minimum of the derivative must be larger than a confidence band chosen suitably. The criteria for the choice of confidence band will be explained in the subchapter 3.3.3. Besides this procedure, some other tests for recognizing the peaks as single or double will also be introduced in the same subchapter.

Third part examines the computation methods of peak

areas. There are two different methods used in the program.

1) Computation of the areas of the peaks observed over the background: If the peaks found are above the Compton continuum, their left and right limits are examined according to Covel, [Co-59], in the subsection 3.3.4.1.

2) Searching of detection limits: As mentioned in the 3.1 briefly, in case the peak is not detected in the interval given by the library, the minimum counting rates due to the hidden peaks are calculated by a particular subroutine, subroutine SENSIT. That procedure will be given in the 3.3.4.2 in more detail.

Finally, the results in ppm or sensitivity limits for the elements not detected are obtained in the form of a digital list. The errors due to statistical counting fluctuations, as percentages, are also estimated in the program. That data is also given in the appendix K.

3.3.2. Smoothing and Differentiating Procedures

The majority of published literature on the uses of computers in activation analysis relates to the unscrambling of gamma-ray spectra. This may be achieved in a variety of ways, such as spectrum stripping, the method of least squares fitting, vector analysis and iterative methods, etc [Gi-65]. One of these ways is the spectrum smoothing procedure.

The primary output of any experiment is information which measures the phenomenon under observation. The random errors which are indistinquishable from this information are

characteristically described as noise. It is important for an analyst, to remove as much of this noise as possible without unduly degrading the underlying information. There are some mathematical methods for handling such problems in the processing of analytical data.

One of the simplest ways to smooth the fluctuating data is by a moving average based on the concept of a convolute and of a convolution function(*) [Sa-64].

In summarized form, it can be said that the method of data convolution is to fit a polynomial to such data by use of the method of least squares. Assuming that f's represent any set of convoluting integers, and S_n is the smoothed value in the n_{th} channel, the mathematical description of this process is given by [Sa-64, Gu-74],

$$S_n = \frac{1}{N} \sum_{i=m}^{+m} (f_i S_{n+i}) \qquad (3.3)$$

where the index n indicates that (2n+1) points are used for that procedure. For the calculation of these convolution coefficients, a set of experimental points is to be fitted to a curve, as given in the eq. (3.3), and then the square of the differences between the computed values and the observed values are to be minimum for the total of the observations.

There is also an associated normalizing or scaling factor. These coefficients and factors are given in the tabular form [Sa-64]. The table 3.2 gives the convoluting integers and normalizing factors.

(*) Convolution method will be discussed in the appendix D.

TABLE 3.2 [Sa-64]

CONVOLUTES	SMOOTHING			QUADRATIC	CUBIC		A20	A30			
POINTS	25	23	21	19	17	15	13	11	9	7	5
-12	-253										
-11	-138	-42									
-10	-33	-21	-171								
-09	62	-2	-76	-136							
-08	147	15	9	-51	-21						
-07	222	30	84	24	-6	-78					
-06	287	43	149	89	7	-13	-11				
-05	322	54	204	144	18	42	0	-36			
-04	387	63	249	189	27	87	9	9	-21		
-03	422	70	284	224	34	122	16	44	14	-2	
-02	447	75	309	249	39	147	21	69	39	3	-3
-01	462	78	324	264	42	162	24	84	54	6	12
00	467	79	329	269	43	167	25	89	59	7	17
01	462	78	324	264	42	162	24	84	54	6	12
02	447	75	309	249	39	147	21	69	39	3	-3
03	422	70	284	224	34	122	16	44	14	-2	
04	387	63	249	189	27	87	9	9	-21		
05	322	54	204	144	18	42	0	-36			
06	287	43	149	89	7	-13	-11				
07	222	30	84	24	-6	-78					
08	147	15	9	-51	-21						
09	62	-2	-76	-136							
10	-33	-21	-171								
11	-138	-42									
12	-253										
NORM	5175	8059	3059	2261	323	1105	143	429	231	21	35

Increase in the number of data points used causes better smoothing but decreases the peak amplitudes at the same time. The minimum distortion occurs when the polynomial accurately describes the analytical data. The best results are obtained when the data are digitized at high densities, i.e., points very close together and the number of points used in the convolution is chosen to be small enough so that no more than one inflection in the observed data is included in any convolution interval. As an example, equation (3.4) can be illustrated for 5 points as, [Gi-65, Gu-74].

$$S_n = \frac{1}{35}\left[-3S_{n-2} + 12S_{n-1} + 17S_n + 12S_{n+1} - 3S_{n+2}\right] \qquad (3.4)$$

Another important subject in the use of this method is the degree of polynomial. High degree polynomials represent less smoothing than the others. This is especially important when there are double peaks found. Therefore, it is shown that, quadratic and cubic functions are the best for that convolution process. [Çi-81].

This type of data processing, as far as computers are concerned requires a relatively small amount of programming and relatively little use of the computer memory.

As mentioned in the previous subchapters, the first selection of possible peaks is done by considering the change of sign of the first derivative from a positive value to a negative value. The zero point can be considered as the location of a peak.

Therefore after smoothing procedure, this smoothed spectrum is differentiated by the following formula [Gu-74],

$$d_n = \frac{S_{n-1} + S_{n+1}}{2} \qquad (3.5)$$

where d_n is the differentiated value of the content of the nth channel. S_n's represent the smoothed values in the channels (n-1) and (n+1).

These smoothing and derivation processes are carried out by the subroutines SMOOS and DERIV which are given in the appendices G, I.

3.3.3. Search of the Peaks

After the smoothing procedure, the second problem con-

sidered by Gretel is the search of peak locations. As mentioned in the previous subchapter, a first selection of possible peaks is made by considering the change of sign of the first derivative from a positive value to a negative value. Therefore, one needs the values of maxima and minima of the spectrum. Many authors use different methods, [Ho-71], to obtain these values with or without preliminary data treatment as explained in the subchapter 2.7. The most simplified system of all is used by Anders [An-69], by just taking any set of consecutive data points that are higher than their neighboring points as a possible peak.

A similar method is used in Gretel which can be explained briefly as follows:

A possible maximum in channel n, is given by the condition below [Gu-67],

$$C_{n-2} < C_n - P\sqrt{C_n} > C_{n+2} \qquad (3.6)$$

when its content C_n satisfies that condition. Where P is chosen empirically (presently P = 1).

The minima on both sides of the maxima are chosen as the channels (n-k) and (n+k') for which:

$$C_{n-k-1} \geq C_{n-k} - P\sqrt{C_{n-k}} \qquad (3.7)$$

and,

$$C_{n+k'+1} \geq C_{n+k'} - P\sqrt{C_{n+k'}} \qquad (3.8)$$

The point n is considered as the location of a peak.

For the determination of the exact photopeak locations, besides the conditions stated, two conditions must be satisfied simultaneously:

1. The absolute values of the maximum and the minimum of the derivative must be larger than a confidence band suitably chosen. That band is calculated by multiplying standard deviations of data in each channel with a factor chosen, [Gu-74]. Data is taken from the smoothed spectrum instead of the original one. As a result of that process, the counting fluctuations are reduced and statistical fluctuations are kept as analytical peaks are avoided.

2. The ratio between maximum and minimum values of the spectrum must be less than or equal to 1.5. This also avoids unsymmetrical peaks being considered.

After having made these tests, the center of a peak where the sign of the first derivative changes from a positive value to a negative value, is determined by linear interpolation by taking the negative and positive differentiated data in the nearest channels to the center.

In the cases in which these two conditions are not fulfilled, a further examination of the shape of the derivative is performed to ascertain if a double peak is present in the considered interval. For two successive peaks to be considered as a doublet, the distance between the summit of each peak should be less than (2.0 x FWHM) [Gu-67, Gu-74].

According to the tests performed on the ratios between the maxima (AMAX) and the minima (AMIN) of the derivatives, three different cases are possible according to Guzzi, [Gu-74]. These are shown in the figure (3.1).

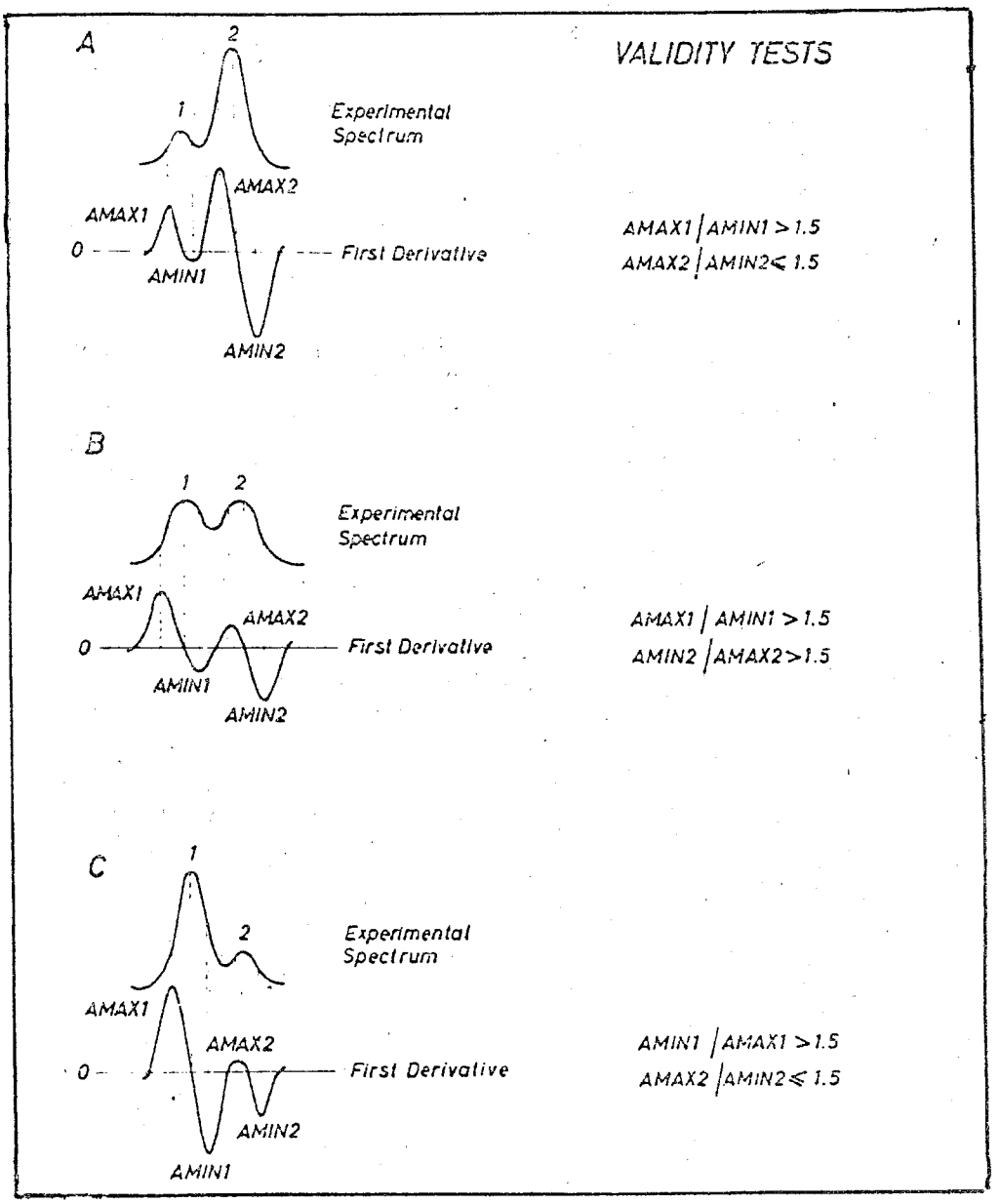


Figure 3.1

where,

A. AMAX1/AMIN1 > 1.5 AMAX2/AMIN2 $\leq$ 1.5

Peak 1 is considered as belonging to a doublet, peak 2 is treated as a single peak.

B. AMAX1/AMIN1 > 1.5 AMIN2/AMAX2 > 1.5

Both 1 and 2 are treated as a doublet

C. AMIN1/AMAX1 > 1.5 AMAX2/AMIN2 $\leq$ 1.5

Peak 1 is considered as single peak, peak 2 is treated as being a doublet.

On the other hand, the other most critical point in searching of peak locations is the determination of the left and right boundaries of the photopeaks. This will indeed determine the separation that is to be made between the peak area and underlying continuum. Many authors follow different ways for the determination of the peak boundaries [Ho-71]. That used in Gretel can be given in a brief form as follows:

The below figure, fig.(3.2), shows a small photopeak which is assumed as Gaussian, superimposed on a high constant

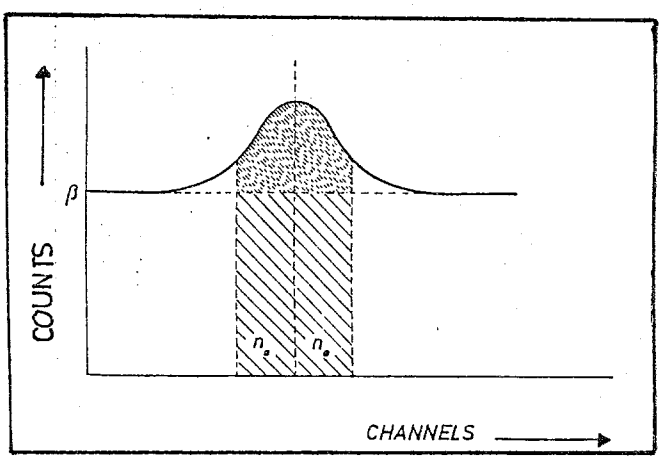


Fig.3.2. Schematic representation of a photopeak [Pa-66].

background such as it would be obtained after a very long measurement. The area of the background under the photopeak as seen in the above figure is given by J.Pauly et al. [Pa-66], by the relation, ($2n_o$ = 1.2xFWHM). Where FWHM is the full width at half maximum. If the background counting rate is small, as often happens when a lithium drifted germanium detector is used, the optimum value of n_o increases slightly.

But approximate value is taken as $2n_o$ = 1.2 x FWHM for all values of the background [Pa-66, Gu-74].

Under this consideration the left and right limits of the peaks are determined in the program by the relations given below;

$$H_1 = n-1.2 \times FWHM \quad (3.9)$$

$$H_2 = n+1.2 \times FWHM \quad (3.10)$$

where, H_1 and H_2 represent left and right boundaries of a peak. FWHM is the energy resolution.

All these procedures described above are carried out by the subroutines ANALYS and PKF.

3.3.4. Computation of Peak Areas

One of the classical problems of qualitative and quantitative interpretation of gamma spectra for NAA is the calculation of peak areas found by some tests described before.

The procedure employed by Gretel can be explained in two subsections as follows:

1. Computation of the areas of the peaks observed over the existing background. These may be single or double peaks.

2. Computation of the minimum counting rates in case no peaks are found in the given interval.

3.3.4.1. Computation of the Areas of Observed Peaks

a) Computation of the area S of a single photopeak:

There are several methods, in the literature, used for the separation of a peak from its underlying continuum. Seven different methods, [Co-59, Yu-68, Qu-69], were especially studied up to now. Five of them use a straight line to separate the peak from the underlying continuum. Two use a nonlinear procedure, [Ho-71]. One of them which is known as Covel's method, [Co-59], is more common than the others. The method used in Gretel is derived from that method and it can be summarized as follows:

This method describes a procedure which utilizes the digital nature of pulse height distribution data to apply statistical methods of data reduction, [Co-59]. As the response of a pulse height analyzer is stated in counts per unit increment of amplitude, individual channel responses may be represented graphically as rectangles whose areas bear direct proportionality to the number of counts observed in the channel. A graphical representation is given in the figure (3.3).

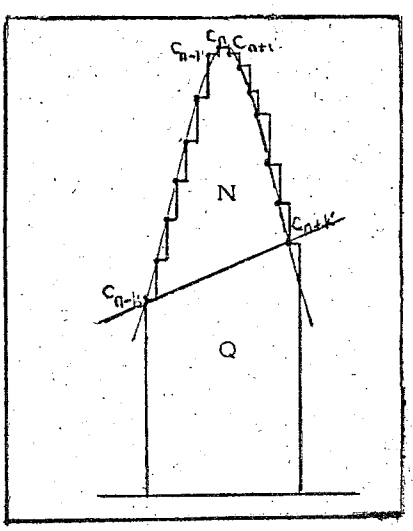


Fig.3.3. Fraction, N, of total counts contained in peak channel, a2 and n channels on either side.

Here, the response of the channel containing the greatest number of counts is defined as C_n and succeeding channel responses, progressing down the low amplitude side of the peak as $C_{n-1} \cdots C_{n-k}$, similarly channel responses on the high amplitude side of the peak are defined as $C_{n+1} \cdots C_{n+k'}$ (where C_{n-k} and $C_{n+k'}$ are defined by the intercept points of the rising and falling traces of the curve).

If the contributions from the C_n channel and the channels on either side are added, the sum is a value representing the total counts contained in these channels. This value is graphically represented as the area P in the above figure. If this area P, were divided by a line connecting the ordinate values of C_{n-k}, $C_{n+k'}$ as seen in the figure (3.3), the area above this line can be defined as follows:

$$N = P - Q \qquad (3.11)$$

where, N may be used under a wide variety of observational conditions to estimate the total peak area.

Although this method due to Covel, [Co-59], is the most common one, it is especially used for NaI(TL) detector peak area computations. For the Ge(Li) detector peak area computations, many authors use different methods, [Ho-71].

The method used in Gretel is the one which is based on smoothing and differentiating procedures of the spectra. Yule, [Yu-68], gives the principles of that method which is derived from the Covel's method. This method can be explained briefly as follows:

The method known as the smoothed first derivative method employs the simplified least squares data convolution

technique(*) to generate, from the observed spectrum, a new spectrum which has essentially all the statistical scatter removed. The new spectrum defines a smooth curve through the observed data. The data convolution techniques can also generate a spectrum which is the smoothed first derivative of the observed data. The total peak area is then computed from the equation given by P.H. Yule as, [Yu-68]

$$\text{Total peak area} = \sum_{n=n-k}^{n+k'} C_n \qquad (3.12)$$

where, C_n is the number of counts in channel n, and the boundary channels are (n-k), (n+k'). The base area is the area of the trapezoid below the peak, similar to the figure 3.3.

$$\text{Base Area} = \frac{C_{n-k} + C_{n+k'}}{2} (k-k'-1) \qquad (3.13)$$

and the net peak area is given by the difference between them, [Yu-68, Gu-74]

$$\text{Net peak area} = \text{Total Peak Area} - \text{Base Area}$$

or,

$$S = \sum_{n=n-k}^{n+k'} C_n - \frac{C_{n-k} + C_{n+k'}}{2} (k-k'-1) \qquad (3.14)$$

where, the quantity (k-k'-1) is the number of channels included in the peak or, in other words, it represents the width of the peak.

(*) This subject will be discussed in the appendix D as mentioned in subchapter 3.2.

The associated errors in the evaluation of the peak areas are also calculated and given as digital lists.

b) Computation of the area of a double peak:

For the computation of the area of a double peak several assumptions are made by the authors. One that is used in Gretel is given as: The area of a doublet is approximated by considering the left half of the first peak and the right half of the second peak as being symmetrical with respect to the remaining portions of each peak. Then these halves are doubled to obtain the total area. The underlying continuum is subtracted as explained in the previous subchapter. Standard

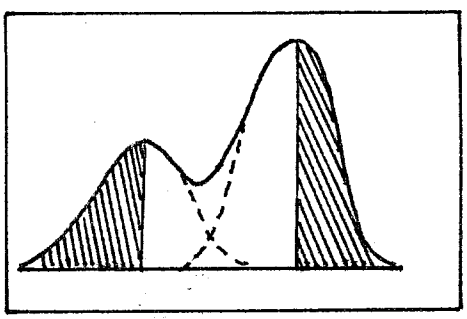


Fig.3.4. Computation of the area of a doublet.

devitaion is approximated by doubling the standard deviation calculated for each half of each peak of the doublet.

All these operations are performed by the routines SURF and SURF2.

3.3.4.2. Search of Detection Limits

In the case where no peaks are found by the tests described in the subsection 3.3.4.1, in the indicated interval, the minimum counting rates that could have had a photo-

peak over the existing background, are also calculated in Gretel. This procedure is performed by the subroutine SENSIT. Theory of that calculation can be explained briefly as follows:

As known, many properties of materials depend on their impurity content. There always exists a lower limit of concentration beyond which the effect of an impurity becomes negligible. Therefore, in an analytical study it is usually sufficient to demonstrate that the concentration is smaller than a detection limit chosen to be low enough, so that the effects on the properties of the substance can be neglected.

As a result of this idea, in many problems it is important to know the concentration, or an upper limit for it for as large a number of elements as possible [Pa-66].

In NAA, the gamma spectra obtained from the experiments contain a small number of visible photopeaks which can be used to determine the exact concentration of the corresponding impurities. The other elements produce peaks too small to appear above the background due to their activities and it is then possible only to evaluate an upper limit of the concentration, which is the sensitivity or detection limit for that particular gamma-spectrum. The operation for the evaluation of detection limits can be summarized as follows: If the element to be determined does not give a visible photopeak in the gamma-ray spectrum, whether a chemical separation has been applied or not, a detection limit is deduced by considering in the zone in which the photopeak should occur.

For this procedure, a gamma sensitivity spectrum is derived from the experimental gamma-ray spectrum by means of a mathematical treatment which is based on the statistical

laws. This is done as; taking a detection limit for each spectrometer channel, the whole set of detection limits constitute the sensitivity spectrum. This spectrum is one in which the channel contents represent the minimum detectable activity of an isotope having a peak centered on the channel. The principles on which the derivation of the gamma sensitivity spectrum is based differ according to the configuration of the part of the spectrum which is considered. A typical gamma spectrum obtained with a NaI(Tl) scintillation detector is given in the figure (3.5).

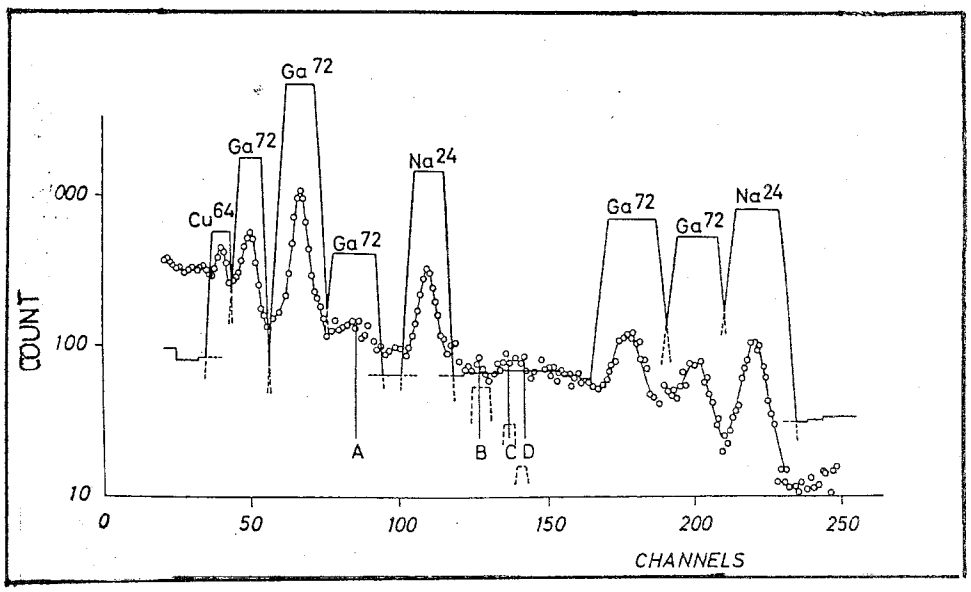


Fig.3.5. Derivation of the sensitivity spectrum from an original one. [Pa-66].

(The detection limits corresponding to the spectrum are seen in the above figure. The part of the curve corresponding to the photopeaks have a form which retains the aspect of the original peak, but the top is flattened. Between these peaks the region corresponding to the background shows a detection limit which varies rather smoothly as a function of the channel number).

As seen, it consists of rather smoothly varying continuous distribution on which several gamma peaks of different radioisotopes are superimposed. For the regions of the spectrum which are far from the visible photopeaks, and where the difference in the counting rates of different isotopes, for adjacent channels is small, the detection limit is calculated from the counting statistics.

In the zone where the counting rates vary smoothly between successive channels, the minimum detectable activity is obtained by considering the activity in the spectrum to be a background and calculating an upper limit of the statistical fluctuations as given below:

If ν_1 is the counting rate of the background, it is given by [Se-64, Di-57, Se-59],

$$\nu_1 = \frac{n_1}{t_1} \pm \frac{n_1^{1/2}}{t_1} \qquad (3.15)$$

Similarly, for the observed effect, , it is given as,

$$\nu = \frac{n}{t} \pm \frac{n^{1/2}}{t} \qquad (3.16)$$

where, n and n_1 represent counts; t and t_1 represent counting times. The expressions following the ± sign are always standard deviations.

For the net activity the below equation is given,

$$\text{Net activity} = \nu - \nu_1 \qquad (3.17)$$

Since the minimum detectable activity is obtained by taking the activity to be background due to this method described above, it can be $\nu_1 = \nu - \nu_1 \Rightarrow \nu = 2\nu_1$ Then using

the formula of propagation of errors,

$\sigma(\nu) = \left[\sigma^2(\nu_1) + \sigma^2(\nu)\right]^{1/2}$, one obtains the standard deviation of the measurement as,

$$\sigma(\nu) = \left[\frac{n}{t^2} + 2\,\frac{n_1}{t_1^2}\right]^{1/2} = \left[\frac{\nu}{t} + 2\,\frac{\nu_1}{t_1}\right]^{1/2} \qquad (3.18)$$

Assuming the counting times t and t_1 are the same, and considering a confidence level required for the problem, $\sigma(\nu)$ is given by, [Pa-66]

$$\sigma(\nu) = k\left[\frac{2\nu_1 + \nu}{t}\right]^{1/2} \qquad (3.19)$$

where the constant k can be taken as 2 corresponding to a confidence level of 95% [Pa-66, Gu-74]

The minimum detectable effect is then derived from this equation by assuming equal to its standard deviations, which finally gives,

$$\nu = \left(\frac{1}{2}\,k^2/t\right)\left[1 + \left(1 + 8t\nu_1/k^2\right)^{1/2}\right] \qquad (3.20)$$

From the curve representing the gamma detection limits, in fig.3.5, and from the value given by equation (3.20), the minimum detectable weights of the elements are calculated. First, from fig.3.5, it is easy to derive the minimum detectable absolute activity by dividing by the efficiency of the counter. By means of these limits, the minimum detectable weights for each element are then derived by comparing the results to the specific activity which is calculated from the given experimental conditions. Since an element can give several radioisotopes upon irradiation, e.g. ^{72}Ga, a certain

number of different values are obtained for the minimum detectable weight of the element. Among these values, the smallest one is selected for that element.

3.4. MODIFICATION OF THE CODE

As mentioned in the previous subchapter 3.1, the computer code examined in this thesis was prepared originally by using an IBM 370/165 computer with fortran IV level G and assembly languages of the computer used, at the Scientific Information Processing Center, Ispra-Italy. It was then adopted for use with the UNIVAC-1106 at BU. However, since a Calcomp plotting unit was not available in BU and the assembly language depends on the computer used, it was impossible to modify it in the original form to UNIVAC-1106. Therefore, all the plotting subroutines (assembler) which were given as two files, were deleted from the source program. The remaining part of the code which still consists of a main part and thirteen subroutines, was run by using the UNIVAC-1106. This listing is given in the appendix I.

The modified form of the code then was recorded on a new tape for further studies by BU-NE Department.

Some examples of the updating programs(*) used during the procedure mentioned above, are given as follows:

The first program is used to read the original tape and the second is used to record the content of that tape to the main storage of a UNIVAC-1106 computer used in BU. First,

---

(*) These updating programs are prepared according to EXEC level 36R2 (1978) manual, [EXEC-78], SPERRY UNIVAC, Series 1100, Excutive System, Vol.2.

main program and input data were recorded on the same file, and they were then loaded separately into three different files; one being the program file, second being the input data for sample problem, and the third one as spectra for sample problem. To rerun the main program by adding these data files, many corrections were necessary. Programs 3,4,5 and 6 given in the following pages, represent some examples for updating procedure. Program 6 is also used for the rerun of the main program. Finally, program 7 is used for recording all these processes and output data on a new tape and program 8 is for getting a listing of that tape.

Program 1 Reads the tape

```
@RUN,
@ASG, TJ   T., 6C9, D80218
@COB,  ISE

          IDENTIFICATION  DIVISION.
          PROGRAM-ID. TEYP-OKUMA.
          ENVIRONMENT  DIVISION.
          CONFIGURATION  SECTION.
          SOURCE-COMPUTER.  U-1106.
          OBJECT-COMPUTER.  U-1106.
          INPUT-OUTPUT  SECTION.
          FILE-CONTROL.
                SELECT  T  ASSIGN TO UNISERVO T.
          DATA DIVISION.
          FILE  SECTION.
          F D T
                LABEL RECORDS OMITTED
                RECORDING MODE IS F.
          0 1 T-REC  PIC  × (80).
          PROCEDURE DIVISION.
          AC. OPEN INPUT T WITH NO REWIND.
          OPEN OUTPUT F.
          OKU. READ T AT END GO TO SON.
                DISPLAY T-REC UPON PRINTER.
                GO TO OKU.
          SON. CLOSE T WITH NO REWIND.
                STOP RUN.

@MAP, IN
@×QT
@FIN
```

Program 2 Records the tape on the mass-storage

```
@RUN,
@ASG, TJ  T.,6C9, D80218
@DELETE, C   GAMMA.
@ASG, UP   GAMMA.
@USE   F., GAMMA.
@COB, ISE
        IDENTIFICATION DIVISION.
        PROGRAM-ID.   TEYP-OKUMA.
        ENVIRONMENT DIVISION.
        CONFIGURATION SECTION.
        SOURCE-COMPUTER.   U-1106.
        OBJECT-COMPUTER.   U-1106.
        INPUT-OUTPUT SECTION.
        FILE-CONTROL.
             SELECT T ASSIGN TO UNISERVO T.
             SELECT F ASSIGN TO MASS-STORAGE F.
        DATA DIVISION.
        FILE SECTION.
        FD T
             LABEL RECORDS OMITTED
             RECORDING MODE IS F.
        01  T-REC  PIC  X(80).
        FD F
              RECORDING MODE IS SDF.
        01   F-REC PIC  X(80).
        PROCEDURE DIVISION.
        AC. OPEN INPUT T WITH NO REWIND.
        OPEN OUTPUT F.
        OKU. READ T AT END GO TO SON.
             MOVE T-REC TO F-REC.
             WRITE F-REC
             GO TO OKU.
             SON. CLOSE T WITH NO REWIND.
        CLOSE F.
              STOP RUN.
```

```
@MAP, IN
@XQT
@DATA, L     SAGLAM.
@FIN
```

Program 3 Updating of main program

```
@RUN,
@ASG, UP    DATA1.
@ASG, A     SAGLAM.
@COPY       SAGLAM., DATA1.
@ASG, A     GAMMA.
@FTN, US    GAMMA. MAIN
 -183,183
 -184
        IF (NPK.LE.1) GO TO 333
@PREP       GAMMA.
@MAP, I   GAMMA.MAIN
  IN        GAMMA. MAIN
  LIB       GAMMA.
@XQT        GAMMA. MAIN
@ADD        DATA 1.
@FIN
```

Program 4 Updating of the data file

```
@RUN,
@ASG,A     DATA 1.
@ASG,UP    DATA 1 (+1).
@DATA,L    DATA 1., DATA (+1).
-10,10
     21
@END
@FIN
```

Program 5 Evaluation of a new program and updating of it

```
@RUN,
@ASG,A  GAMMA.
@ASG,A  DATA 1.
@ASG,A  DATA 2.
@USE  II, DATA 2.
@ASG,UP  SPECTRA., F ///1000 , UD105
@COPY    GAMMA., SPECTRA.
@DELETE, SR    .SPET
@DELETE, SR    .FIGURE
@FTN,S         .KAL
@FTN,S         .SMOOS
   .              .
   .              .
   .              .
```

```
@MAP,I    SPECTRA.MAIN
  IN      SPECTRA.MAIN
  LIB     SPECTRA.
@XQT      SPECTRA.MAIN
@ADD      DATA 1.
@ADD      DATA 2.
@FIN
```

Program 6 Rerun of the main program with data

```
@RUN,
@ASG,A    SPECTRA.
@ASG,A    TKR.
@USE      11, TKR.
@ASG,A    INPUTX.
@ASG,UP   INPUTX(+1).
@DATA,L   INPUTX., INPUTX(+1).
 -10,10
     22
 SCX  1119.0   3.12  5.675E-06  3.900E+00
@END
@XQT  SPECTRA. MAIN
@ADD  TKR.
@ADD  INPUTX.
@FIN
```

Program 7 Records to a new tape from the mass-storage

```
@RUN,
@ASG,A   SPECTRA.
@ASG,T   T.,16N,SAGLAM
@MOVE    T.,1
@COPY,GM   SPECTRA.,T.
@FIN
```

Program 8 Taking the listing of the tape

```
@RUN,
@ASG,T   T.,16N,SAGLAM
@UNIVAC*TTOC.TTOC T.
@FIN
```

4. COMPARISON OF GRETEL WITH ANOTHER CODE, CORGAM

The importance and use of digital computers in NAA was mentioned in the previous subchapters. It was also mentioned that there are many computer codes dealing with this problem. Each of these codes have their own techniques in analysing, in unfolding complex gamma-ray spectra. Some of them sutdy the estimating of intensity coefficients, as Corgam. There are many methods for estimating these coefficients. These methods are stripping, least squares, iterative methods, vector analysis and stepwise regression [Ec-68, Le-65].

One of these codes mentioned above, prepared by NEA-CPL in the experimental data processing field is Corgam. Corgam was studied before as a subject of another thesis introduced at NE Department. Since these two codes, Corgam and Gretel, deal with NAA, but their logics for the approaching to the problems are quite different from each other, a short comparison of these two computer codes will be given in this chapter. Therefore first, Corgam will be introduced in a summary form in the following subchapter.

4.1. INTRODUCTION OF CORGAM

Corgam, a correlation algorithm for gamma-ray spectra, allows the reference gamma-ray spectra to be correlated with a complex gamma-ray spectrum [Ec-69]. This correlation algorithm is based on a least squares procedure which is a logical method for determining the intensity coefficients for NAA.

The analysis used by Corgam is described as the least squares procedure for fitting a dependent variable, e.g., a complex spectrum, to a set of independent variables, e.g., a set of reference spectra.

Corgam sets up a mathematical model in order to make an analysis by using least squares procedure. The formulation of Corgam can be summarized as follows:

The gamma-ray spectrum of a complex sample containing several isotopes (m in number) may be represented by [Ec-69],

$$Y_i = \sum_{j=1}^{m} B_{ij} \qquad i = 1,2,\ldots,n \tag{4.1}$$

where,

Y_i = the counts registered in channel i of a multi-channel analyzer.

B_{ij} = the counts registered in channel i from the j^{th} constituent isotope.

The reference gamma-ray spectra of each of the m constituent isotopes are related to the complex gamma-ray spectrum by,

$$Y_i = \sum_{j=1}^{m} X_{ij} B_j + e_j \qquad i = 1,2,\ldots,m \tag{4.2}$$

where,

B_j = the intensity coefficient for isotope, j, i.e., a coefficient proportional to the quantity of isotope j in the complex sample.

X_{ij} = the counts registered in channel i from the j^{th} isotope of known quantity.

e_i = the deviation at point i of the estimated value of Y_i, $\Sigma X_{ij} B_j$, from the observed value Y_i.

There are some difficulties in applying least squares technique to the unfolding of gamma-ray spectra. One of them is that some calculated intensity coefficients may have negative sign. For physical reasons, they must be non-negative. Besides, the least squares method may yield positive intensity coefficients for all reference spectra, but some of these may not be significant according to the tests applied. The problem is to determine which reference spectra are not significant.

In order to overcome these difficulties, some statistical tests are applied such as t value for the null hypothesis which is calculated for each intensity coefficient. These values are used in the correlation algorithm to eliminate those reference spectra for which the calculated intensity coefficients are negative or non-significant.

As a summary, it can be stated that Corgam,

a) compansates for electronic instabilities in the multichannel analyzer,

b) corrects for the background, subtracts it from the complex spectrum,

c) normalizes the data to a fixed neutron flux level,

d) represents a mathematical model in matrix form for reference spectra and allows a choice of weighting factors,

e) allows a choice of methods for the calculation of standard deviations.

f) it corrects for decay time,

g) may also consider time dependent spectra for those isotopes which have isomers.

Finally, Corgam is a novel method of unfolding complex gamma-ray spectra because the variance calculations include contributions from both the complex and reference spectra. Also, only reference spectra that have intensity coefficients which are significant at a preselected level are retained in the output.

4.2. COMPARISON OF THE TWO CODES

As mentioned in the previous chapters, Gretel and Corgam are two computer programs prepared for NAA problems. However, their mathematical approach to these problems are quite different. One of the reasons for these differences is that they are prepared to analyze data from different kinds of detectors; Gretel uses data from a Ge(Li) detector, Corgam from a NaI(Tl) scintillator. Therefore, their data handling procedures are different from each other. Besides that, many authors apply their own techniques to unfold gamma-ray spectra. For the comparison of these two codes, this sub-chapter gives the main specifications in the following form:

CORGAM is a computer code of unfolding complex gamma-ray spectra by using reference spectra. In the analysis, intensity coefficients of the isotope spectra which are significant at a preselected level are retained in the output and the variance calculations include contributions both from the reference and the complex spectra [Bö-82, Ec-69]. Its specifications can be given in a brief form as follows:

1. Corgam is based on estimating the intensity coefficient. It uses the least squares procedure for fitting a dependent variable, i.e., a complex spectrum, to a set of independent variables, i.e., a set of reference spectra [Ec-68].

2. Corgam sets up a mathematical model and by using the least squares procedure, correlates the reference gamma-ray spectra with a complex one.

Example: The program multiplies any spectrum of a reference isotope with a coefficient and similarly other spectra with other coefficients. These coefficients are defined as intensity coefficients. Then, adding the contents of these spectra channel by channel, a third spectrum is obtained. Subtracting the complex spectrum due to an unknown sample from this third one, their difference is obtained. By using the least squares procedure the program tries to calculate these coefficients for the minimization of that difference. Those intenstiy coefficients are proportional to the quantity of isotope in the complex spectrum. Finally, the quantity of the isotope in the complex can be given in terms of ppm.

3. The reference spectra and the complex one required for Corgam are collected for the fixed counting time, using the scintillation detectors.

4. Before the analysis of the spectra, Corgam compensates for electronic instabilities in the spectrometer system used, because these instabilities can cause shifts in these spectra. To compensate for these inconsistencies, the gamma ray photopeaks of the spectra are fit to a Gaussian function using the least squares method.

5- Corgam corrects for the background and decay times. It normalizes the data to a fixed neutron flux level.

6- Corgam in the standard form is restricted to a problem of 400 channels and 15 reference spectra.

7- Corgam requires less than I minute of execution time with the restrictions mentioned above, on the computer IBM 360/50.

8- Corgam also considers time dependent spectra for those isotopes which have isomers.

9- The program was recorded originally for IBM 360/50 using fortran IV level G. It was then updated by Böğrün, [Bö-82], for UNIVAC-1106. The updated form of the code was recorded on to a magnetic tape for further use in BU-NE department.

10- An intermediate disk storage is required for Corgam. The source deck contains 1303 cards.

GRETEL is a computer program which is set up for routine batchwise processing of spectrometric data [Gu-74]. The characteristics of Gretel can be given as follows:

1- Gretel performs the quantitative analysis of gamma-ray spectra using special oriented libraries which are prepared for each particular problem.

2- The gamma-ray spectra needed for Gretel, are obtained by Ge(Li) detectors.

3- For the analysis of the spectra, a preliminary data handling procedure required was discussed in detail in the

clapter 3. As a summary, this procedure can be given as: First, smoothing of the spectra is done. Then, the peak locations are searched by using some tests to avoid the statistical fluctuations being kept as analytical peaks. Computation of the peak areas is the third step of the program. Two different methods are used for that purpose. Since Gretel examines any spectrum peak by peak, for the visible peaks a method derived by Yule, [Yu-69], and for hidden peaks new detection limits are determined.

4- In Gretel, compton continuum at the fixed level is substracted from the computed areas of the photopeaks. Also, decay time corrections are made.

5- The restrictions for Gretel in the standard form, are given as; 50 elements as the maximum number for the oriented library which corresponds the reference isotopes in Corgam, and 4096 channels as the maximum number of the spectrometer used.

6- For a typical analysis, on the average, of 30 spectra of 2048 channels (a calibration spectrum plus 29 unknowns) with a library of 30 elements the running time is about 30 seconds.

7- The memory requirements are not much for Gretel.

8- Gretel was recorded originally for IBM 370/165 using fortran IV level G. The code was then updated by the author for UNIVAC-1106, by deleting all the plotting subroutines since there was not available a Univac plotting unit. The modified form of the code is recorded on a new magnetic tape for further studies by BU-NE department.

As a result of these specifications and others given in 4.1, one can conclude that Corgam is a more comprehensive program prepared for the activation analysis by using a NaI(Tl) scintillation detector and a small channel region in the spectrometer used. On the other hand, Gretel is one of first ones prepared for NAA problems by using a Ge(Li) detector which has a better energy resolution than a scintillator. The program also gives analog outputs with a Calcomp unit and it performs the quantitative analysis.

5. DISCUSSION AND CONCLUSIONS

The basic principles, the use and importance of neutron activation analysis, NAA, was discussed in the previous subchapters. It was also mentioned that the determination of the microconstituents of an unknown sample was possible down to the ppm (parts per million) level or even to the ppb (parts per billion) level. As also discussed in the previous chapter, determination of a large number of elements in one sample and the treatment of the comparison samples are very troublesome and time consuming. Therefore, instrumental activation analysis has been improved as one of the major techniques for the control and measurement of the trace element distribution in a large number of samples. The speed of this technique is based to a large extent on the availability of nuclear reactors with a high and reliable neutron flux. It also depends on the development of the high resolution gamma-ray spectrometers with the computer hardware and software. The computer programs for NAA problems are usually prepared for the spectra obtained especially by two types of detectors, such as NaI(Tl) scintillators and Li drifted Ge or Si semiconductors. Recently, semiconductor detectors with excellent energy resolution pushed the number of energy channels required for an adequate spectral response up into the thousands.

As an example, a computer code for NAA based on a GE(Li) spectra was studied in this thesis as a part of it. The program which is set up for routine batchwise processing of spectrometric data, was first prepared in 1966 as one of

the earliest codes developed for Ge(Li) spectra. This program has then been revised and rewritten to follow the continous development of the analytical instrumentation, such as multichannel analyzer, calcomp unit of the computer used, etc. The new program, called Gretel, performs the quantitative analysis of gamma-ray spectra obtained by a Ge(Li) detector which has a better energy resolution than a scintillator. The data-reduction system required for Ge(Li) spectra is used in Gretel. This system involves the smoothing of the spectra, differentiation of these data, the determination of peak locations and peak boundaries, the computation of peak areas and the associated errors. The program gives the results in terms of ppm in the form of digital lists. In addition, with some modifications in the main program, analog outputs can also be obtained by means of a Calcomp unit if it is available. Also, Gretel performs the search of the small peaks not detected over the background and gives the minimum detectable activity.

However, one can not conclude that Gretel is an integral program. Because the program fails in the identification of isotopes when there are interferences coming from different isotopes, e.g., Sc and Zn. To avoid this problem, the preparation of the libraries for each kind of problem, which is a responsability of the analyst, is very important. Some suggestions can be made to correct this shortcoming. First, for the preparation of any library, "analytical peaks" should be chosen. These peaks are those given the best sensitivity and the highest chance of being free from interference within a range of energy which depends on the resolution of the detector. Second, when there are interfering isotopes, some modifications can be applied to the main program such as control peaks. Introducing other peaks due to interfering isotopes, one can check whether these isotopes are present or not. Third, the energy range in which the interfering peaks are

searched could be restricted considerably by using a pre-amplifier with a high resolution power. Fourth, since the single Ge(Li) measurements are not adequate so the coincidence measurements may be offered for analysis of gamma-ray spectra free of interference. However, coincidence technique is not much succesful for Ge(Li) detectors because the reduced detector efficiency seems to be a serious obstacle.

The other program, Corgam, described briefly in the Chapter 4 to make a comparison, examines the spectra obtained by a NaI(Tl) scintillation detector. As mentioned in the above subchapters, Corgam has a more comprehensive mathematical model; so it can be stated that it is one of the better programs for the resolution of gamma-ray spectra with the correlation algorithm. Besides, the program can be applied to other kinds of analysis problems, such as the analysis of a spectrum in the ultraviolet light region, etc. On the other hand, Corgam is restricted to a problem of 400 channels and 15 reference spectra due to the level of accuracy desired. Also, the computer memory requirements are large for the correlation algorithm.

REFERENCES

|Ad-70| Adams F., Dams R., "Applied Gamma-Ray Spectrometry", Pergamon Press, 2nd ed. (1970)

|Aj-60| Ajzenberg-Selove F., "Nuclear Spectroscopy" Part A, Academic Press, (1960)

|An-69| Anders O.U., "Instrumental NAA using TRIGA reactor High-Resolution Gamma Spectrometer and Computer", Anal.Chem., 41(1969)428.

|Be-73| Bertozzi G., Girardi F., Guzzi G., Cola Di G., "Comparative Analysis of Different Comp. Handling Sys. for Gamma-Spectrometric Data", J.Radioanal. Chem. 15 (1973)637.

|Bo-82| Borak F., "Nuclear Engineering Laboratory Notes" (1982)

|Bö-82| Böğrün H., A master thesis, BU.NE Department (1982)

|Ch-61| Chase L.R., "Nuclear Pulse Spectrometry", McGraw-Hill Book Comp. (1961)

|Co-59| Covell D.F., "Determination of Gamma-Ray Abundance Directly From the Total Absorption Peak", Anal. Chem. 31(1959)1785.

|Çi-81| Çiftçioğlu Ö., "Ge(Li) Nükleer Radyasyon Detektörlerinden Elde Edilen Fotopikler için Analitik Bir Yaklaşım ve Yüksek Doğrulukta Otomatik Gamma Spektrum Analizi", İ.T.Ü.Elek. Fak. (1981)

|De-63| Dearnaley G., Northrop D.C., "Semiconductor Counters for Nuclear Radiations", E and F.N Spon Limited (1963)

|Di-57| Dixon J.W., Massey J.F., "Introduction to Statistical Analysis", McGraw-Hill Book Comp. (1957)

|Ec-68| Eckhoff N.D., "Corgam", Ph. D. Thesis, Kansas State University, (1968)

|Ec-69| Eckhoff N.D., "A correlation Algorithm for Gamma-Ray Spectra", Nuclear Inst. and Meth. 74(1969)77.

|Eg-74| Egidy T., Kaiser W., Mampe W., Lanier R.G., Muhlbauer K., Schult O.W.B., Koch H.R., Baader H.A., Mlekodaj R.L., "The Transitional Nucleus ^{152}Eu", 2^{nd} Int. Sym. on Neutron Capture Gamma-Ray Spectr.", Netherland (1974).

|El-59| Ellis R.H., "Nuclear Technology for Engineers", Mc Graw-Hill Book Comp. (1959)

|En-66| Enge A.H., "Intr. to Nuclear Physics", Add.Wesley Pub. Comp. (1966)

|Ev-55| Evans R.D., "The Atomic Nucleus", McGraw-Hill Book Comp. (1955)

|Exec-78| Exec level 36R2 (1978) Manual, "SPERRY UNIVAC Series 1100 Excutive System" Vol.2.

|Fa-53| Fano U. "Nucleonics", 8(1959)8 and 9(1953)55.

|Fa-73| Faires R.A., Parks B.H., "Radioisotope Laboratory Techniques", Butterworths Group, (1973)

|Fr-62| Friedlander G., Kennedy J.W., "Nuclear and Radiochemistry" John Wiley and Sons Inc. (1962)

|Gi-64| Girardi F., Guzzi G., Pauly J., "Activation Analysis by Absolute Gamma-Ray Counting and Direct Calculations of Weights from Nuclear Constants", Anal. Chem. 36 (1964) 1588.

|Gi-65| Gibbons D., "Computer Methods in Activation Analysis", Wantge Research Lab. England. (1965).

|Gu-65| Guzzi G., Girardi F., Pauly J., "Reactor NAA by the Single Comparator Method", Anal. Chem. 37(1965)1085.

|Gu-67| Guzzi G., Girardi F., Pauly J., Dorpema B., "Computer Program for AA with Ge(Li) Detectors", Report, EUR 3469 e (1967).

|Gu-74| Guzzi G., Cuypers J., "Gretel, A Computer Program for Gamma Ray Spectrometry with Ge(Li) Detectors", M inual, NEA-CPL Ispra-Italy, (1974).

|Ha-65| Harvey B.G., "Nuclear Chemistry", Prentice-Hall Inc. (1965).

|Ha-69| Harvey B.G., "Intr. to Nuclear Physics and Chemistry", Prentice-Hall Inc. (1969)

|He-36| Hevesy G., Levi H., "Mathematics, Physics and Medicine", 14(1936)5.

|Ho-71| Hoste,J., Op De Beeck J., Gijbels R., Adams F., Van den Winkel P., De Soete D., "Intrumental and Radiochemical Activation Analysis", CRC Press (1971)

|Ko-60| Koch R.C., "Activation Analysis Handbook", Academic Press, (1960)

|La-72| Lamarsh J.R., "Intr. to Nuclear Reactor Theory", Add. Wesley Pub. Comp. 2nd ed. (1972)

|Le-65| Lenihan J.M.A., Thomson S.J., "Activation Analysis", Academic Press (1965)

|Le-68| Lederer C.M., Hollander J.M., Perlman I, "Table of Isotopes" John Wiley and Sons Inc. 6th ed. (1968)

|Mu-61| Murray R.S., "Statistics", Schaum's Outline Series, Mc Graw-Hill Book Comp. (1961)

|Ou-75| Ouseph P.J., "Intr. to Nuclear Radiation Detectors", Plenum Press (1975)

|Or-80| EG & G ORTEC "Instruments for Research and Applied Sciences", Manual (1980)

|Pa-66| Pauly J., Guzzi G., Girardi F., Borella A., "Application of Gamma-Ray Spectrometry and Computer Techniques to the Determination of Minimum Detectable Content of Trace Elements in NAA", Nuclear Inst. and Meth. 42(1966)15.

|Pr-64| Price J.W., "Nuclear Radiation Detection", Mc Graw-Hill Book Comp. 2nd ed. (1964)

|Qu-69| Quittner P., "Determination of Peak Areas", Anal. Chem. 41(1969)1505

|Sa-64| Savitzky A., Golay M.J.E., "Smoothing and Differentiation of Data by Simplified Least Squares Procedures", Anal. Chem. 36(1964)1627.

|Se-59| Segre E., "Experimental Nuclear Physics", John Wiley and Sons Inc. Vol.III. (1959)

|Se-64| Segre E., "Nuclei and Particles", W.A.Benjamin Inc. (1964)

|Se-67| Sesonske A., Glasstone S., "Nuclear Reactor Engineering" Van Nostrand Reinhold Comp. (1967)

|So-41| Sokolnikoff S.I., Sokolnikoff S.E., "Higher Mathematics for Engineers and Physicists", Mc Graw-Hill Book Comp. (1941)

|So-72| Suete D.De, Gijbels R., Hoste J., "Neutron Activation Analysis", Wiley-Interscience Comp. (1972)

|Wa-62| Wakil M.M.El, "Nuclear Power Engineering", Mc Graw-Hill Book Comp. (1962)

|Wa-63| Wainerdi R.E., Beau N.P.Du, "Science", 139(1963)1027.

|Wi-66| Wilfrid B.M., Garfinkel S.B., "Radioactivity and Its Measurement", Van Nostrand Comp. (1966).

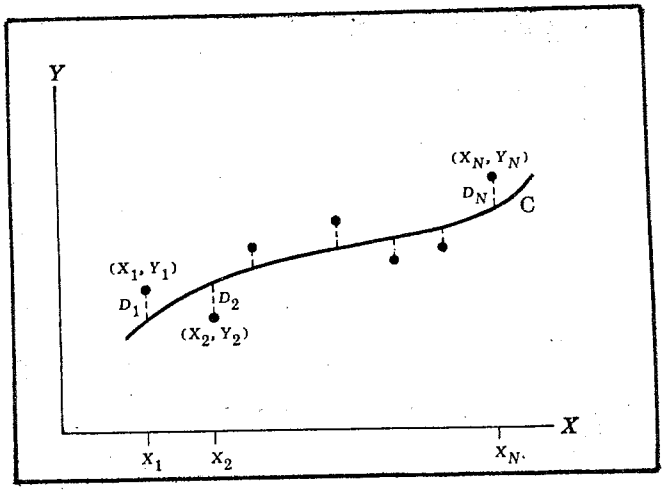
|Wy-66| Wylie C.R., "Advanced Engineering Mathematics", Mc Graw-Hill Book Comp. (1966)

|Yu-68| Yule P.H., "Computation of Ge(Li) Detector Peak Areas for AA and Gamma-Ray Spectrometry", Anal. Chem. 40(1968)148.

APPENDIX A

THE METHOD OF LEAST SQUARES

A measure of the fit for the curve C given in the figure, to the given data is provided by the quantities $D_1^2 + D_2^2 + \ldots + D_N^2$. Those D's are denoted as deviations or errors.



If D's are small, it is said that the fit is good, if they're large, the fit is bad.

Of all the curves approximating a given set of data points, the curve having the property that $D_1^2 + D_2^2 + \ldots + D_N^2$ is a minimum is called a best fitting curve in the sense of least squares. It is also called a least square curve. Thus a line having this property is called a least square line; a parabola with this property is called a least square parabola, etc. [Mu-61].

The least sqare line: The least square line approximating the set of points (x_1,y_1), $(x_2,y_2)\ldots(x_n,y_n)$ has the equation, [Ec-68],

$$y_i = A + Bx_i + e_i \qquad i = 1,2,\ldots,n \tag{1}$$

where e_i is the deviation at point i of the estimated value, from its observed value y_i, A and B are the true values of the intercept and slope respectively. The estimators a and b for A and B, can be obtained by minimizing the sum of squared errors. If each data point has a different, statistical accuracy, then each residual is multiplied by a proper weight, w_i. Therefore the sum of squared errors is given by, [Ec-68, So-41],

$$S = \sum_{i=1}^{n} e_i^2 = \sum_{i=1}^{n} [y_i - (A+Bx_i)]^2 w_i \qquad (2)$$

For this problem w_i are equal to 1. Then,

$$S = \sum_{i=1}^{n} [y_i - (A+Bx_i)]^2 \qquad (3)$$

S is minimized by differentiating with respect to A and B, and equating the results to zero. Then a and b the estimators are substituted for A and B. The resulting equations are,

$$\sum_{i=1}^{n} [y_i-(a+bx_i)] = 0 \qquad (4)$$

$$\sum_{i=1}^{n} \{x_i [y_i - (a+bx_i)]\} = 0 \qquad (5)$$

Equations (4) and (5) are rearranged into a form called the normal equations [Mu-61],

$$an + b \sum_{i=1}^{n} x_i = \sum_{i=1}^{n} y_i \qquad (6)$$

$$a \sum_{i=1}^{n} x_i + b \sum_{i=1}^{n} x_i^2 = \sum_{i=1}^{n} x_i y_i \qquad (7)$$

Solution of these equations for a and b, results in,

$$b = \frac{\sum_{i=1}^{n} x_i y_i - ((\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i))/n}{\sum_{i=1}^{n} x_i^2 - (\sum_{i=1}^{n} x_i)^2/n} = \frac{\sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n} (x_i - \bar{x})^2} \quad (8)$$

$$a = \bar{y} - b\bar{x} \quad (9)$$

where

$$\bar{y} = (\sum_{i=1}^{n} y_i)/n \quad \text{and,} \quad (10)$$

$$\bar{x} = (\sum_{i=1}^{n} x_i)/n \quad (11)$$

Then, equation (1) can also be rewritten in terms of the estimators b and mean value $\bar{x}$, $\bar{y}$ through the use of equation (9) as,

$$y_i = \bar{y} + b(x_i + \bar{x}) \quad (12)$$

APPENDIX B

ISOTOPE BUILD-UP AND DECAY

Considering N_1, the number of parent and N_2, the number of daughter nucleus as functions of decay constants and time, it is possible to write the decay rate of the parent nuclei as,

$$\frac{dN_1}{dt} = -\lambda_1 N_1 \tag{1}$$

or

$$\frac{dN_1}{dt} = \lambda_1 N_{1,0} e^{-\lambda_1 t} \tag{2}$$

where,

$N_{1,0}$: number of parent nuclei initially present
λ_1 : decay constant of parent

The analogous equation for the daughter nuclei is given by,

$$\frac{dN_2}{dt} = R_T - \lambda_2 N_2 \tag{3}$$

Since R_T represents the rate of formation of the daughter, it is also given as,

$$\frac{dN_2}{dt} = \lambda_1 N_{1,0} e^{-\lambda_1 t} - \lambda_2 N_2 \tag{47}$$

which is a 1^{st} order linear differential equation.

FOr the solution of that equation, choosing $y = N_2$, $x = t$, $P(x) = \lambda_2$ and the integrating factor as,

$$e^{\int P(x)dx} \Longrightarrow e^{\int \lambda_2 dt} = e^{\lambda_2 t}$$

then, multiplying both sides of the original differential equation, eg.(4), with this factor, it is obtained as, [Wy-66]

$$e^{\lambda_2 t}\frac{dN_2}{dt} + e^{\lambda_2 t}\lambda_2 N_2 = \lambda_1 N_{1,0}\, e^{\lambda_2 t}\, e^{-\lambda_1 t}$$

where the sum of two terms on the left side are equal to the term $\frac{d}{dt}(e^{\lambda_2 t} N_2)$.

Then,

$$\frac{d}{dt}(N_2 e^{\lambda_2 t}) = \lambda_1 N_{1,0} e^{(\lambda_2-\lambda_1)t}$$

Integrating both sides from t=0 to t=t and rearranging it for N_2,

$$N_2 = \frac{\lambda_1}{\lambda_2-\lambda_1} N_{1,0}(e^{-\lambda_1 t} - e^{-\lambda_2 t}) + C\, e^{-\lambda_2 t} \qquad (5)$$

If the amount of daughter is initially zero, i.e., at $t = 0$, $N_2 = N_{2,0} = 0$, then the second term of the equation (5) at the right side which represents the decay of daughter vanishes.

Finally, one obtains

$$N_2 = \frac{\lambda_1}{\lambda_2-\lambda_1} N_{1,0}(e^{-\lambda_1 t} - e^{-\lambda_2 t}) \qquad (6)$$

APPENDIX C

SINGLE COMPARATOR METHOD

Neutron activation analysis usually consists of 5 steps, such as 1. irradiation, 2. purification, 3. measurement, 4. comparison, 5. verification [Ad-70].

For the first step, suitable amounts of the sample and standard are weighted and irradiated simultaneously for a predetermined time. The sample and standard sizes should be chosen so that the intensity of radiation emitted from the desired radioelement will be approximately the same in both sources. There are three methods for the analysis such as a) absolute method, b) comparator or relative method, c) single comparator method. Single comparator method is used in Gretel so it will be described briefly in the following:

The use of germanium-lithium drifted detectors allows the simultaneous determination of an important number of elements after a single irradiation. The classical comparator method requiring one comparator for each element to be determined hence becomes less appropriate for routine work. These operations are time-consuming and can also introduce sources of error. On the other hand, the absolute method which performs direct calculation of weights of the isotopes from an estimation of the activation formula, suffers from the inaccurate knowledge of several constants.

In the single comparator method, the known weights of the elements are irradiated together with a suitable flux monitor under specified conditions (A known weight of a reference element is taken as flux monitor). The unknown sample is then irradiated with a similar flux monitor which is used

as a single comparator for different elements [Gu-65]. This method is suitable especially for routine or automated determinations; mainly when dealing with isotopes with a very short half-life, when a large number of elements is determined or when standards and samples could not be irradiated together.

There is also a very similar method which utilizes elements present in known quantities in the matrix itself as internal standard (as in Gretel), with the advantage of correcting flux perturbations within the matrix.

Principle of the method can be summarized as follows:

The weight, w, of an irradiated element is related to the photopeak counting rate, Ap, of the radioisotope measured by the relation, [Gu-65],

$$w = \frac{Ap}{\phi S D} \frac{M}{\sigma N E a \delta} \qquad (1)$$

where,

M: atomic weight of the irradiated element

δ: isotopic abundance of the target nuclide.

σ: effective activation cross section for the neutron energy spectrum used

N: Avagadro's number

E: efficiency of the detector for the gamma ray measured

a: gamma-ray abundance in decay scheme

ϕ: neutron flux

S: saturation factor $(1-e^{-\lambda T})$ depending on irradiation time T and decay constant λ

D: decay factor $(e^{-\lambda t})$, where t is decay time

When the neutron flux is measured by irradiating a known weight of a reference element (neutron flux monitor) and measuring the induced radioactivity by gamma-ray spectrometry and using the other known quantities due to this element, the same relation holds:

$$\phi = \frac{Ap^*}{S^*D^*W^*} \frac{M^*}{\sigma^*\delta^*NE^*a^*} \qquad (2)$$

where the asteriks refer to the neutron flux monitor which is also used as single comparator for the elements to be determined in a sample. By substituting ϕ taken from eg.2 in eg.1 one obtains,

$$W = k \frac{Ap}{Ap^*} \frac{S^*D^*}{S\ D} W^* \qquad (3)$$

where

$$k = \left(\frac{\sigma^*\delta^*NE^*a^*}{M^*}\right) / \left(\frac{\sigma\delta NEa}{M}\right) \qquad (4)$$

APPENDIX D

CONVOLUTION METHOD

In much experimental work, the information may be obtained in the form of a two-column table of numbers, e.g. A vs. B. There are some methods for handling of this type of data [Sa-64].

One of the simplest ways to smooth fluctuating data is by a moving average. In this procedure, one takes a fixed number of points, adds their ordinates together, and divides by the number of points to obtain the average ordinate at the center abscissa of the group. Next, the point at one end of the group is dropped, the next point at the other end added, and the process is repeated.

Table (1) illustrates how the moving average might be obtained. According to this table, the set of numbers on the right are the data or ordinate values, those on the left, the abscissa information. The outlined block in the center may be considered to be a separate piece of paper on which a new set of abscissa numbers are written ranging from -2 through 0 to +2. The C's at the right represent the convoluting integers. For the moving average, each C is numerically equal to one. To perform a convolution of the ordinate numbers in the table of data with a set of convoluting interges C_i, each number in the block is multiplied by the corresponding number in the table of data, the resulting products are added and this sum is divided by five. The set of ones is the convoluting function and the number by which we divide, in this case 5, is the normalizing factor. To get the next point in the moving average, the center block is slid down one line and process repeated.

1800.0			705
1799.8			712
1799.6			717
1799.4			718
1799.2	x_o-2	C_{-2}	721
1799.0	x_o-1	C_{-1}	722
1798.8	x_o	C_o	725
1798.6	x_o+1	C_1	730
1798.4	x_o+2	C_2	735
1798.2			736
1798.0			741
1797.8			746
1797.6			750

Table 1. Convolution operation.

Abscissa point on the left, tabular data on the right. Operation is the multiplication of the data points by the corresponding C_i, summation of the products and division by a normalizer, resulting an a single convolute at point x_o.

The concept of convolution can be generalized beyond a simple moving average. In the general case the C's represent any set of convoluting integers. There is an associated normalizing factor. The mathematical description of the process described above, is given as;

$$Y_j = \frac{\sum_{i=-m}^{+m} C_i Y_{j+i}}{N} \qquad (1)$$

The index j represents the running index of the ordinate data in the original data table. For the moving average, each C_i is equal to one and N is the number of convoluting integers. However, for many types of data, the set of all 1's which yields the average, is not particularly useful. For example, on going through a sharp peak, the average would tend to degrade the end of the peak. There are different types of smoothing functions. Figure (1) illustrates these functions.

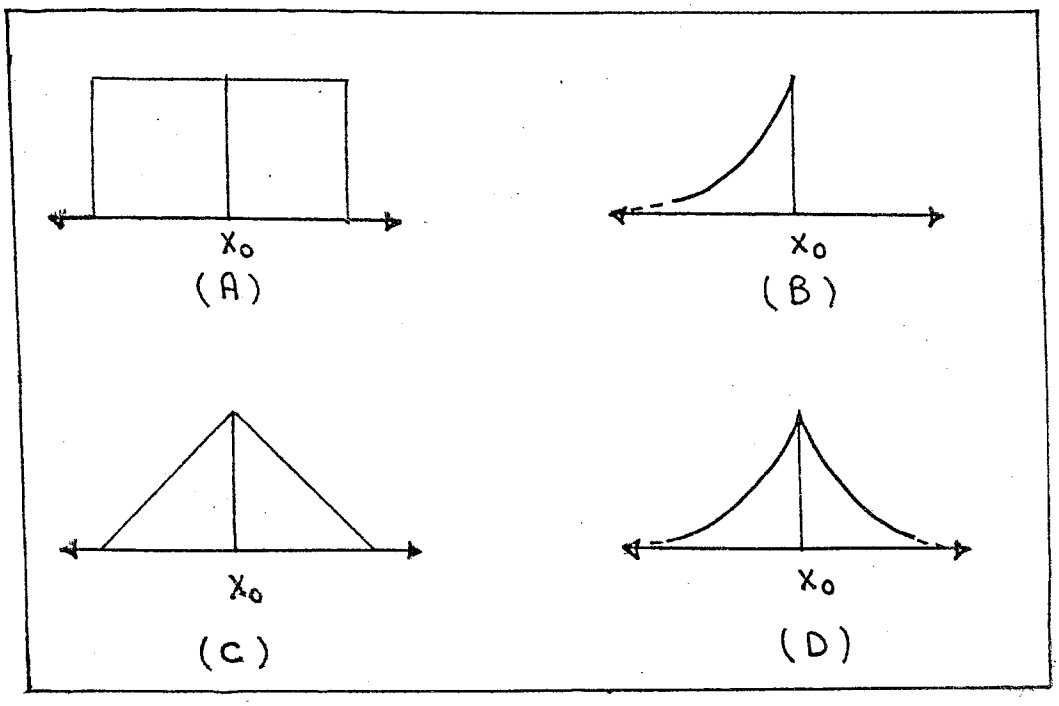


Fig.1- Various convolute functions

A. Moving average. B. Exponential function. C. Symmetrical triangular function. D. Symmetrical exponential function.

The function in the figure 1.B is an exponential set which simulates the exponential law. The usual spectrum from a spectrophotometer is the resultant of two convolutions of the actual spectrum of the material; first with a function representing the slit function of the instrument which is given in the figure 1.C, and then this first convolute spectrum is further convoluted with a function representing the time constant of the instrument.

APPENDIX E

LISTING OF COMMON VARIABLES USED IN GRETEL

The common variables used in Gretel can be given in the following form:

ELI	: Symbol of the radioelement in calibration library
ENI	: Energy of this isotope in keV
ICAN	: Channel in which the calibration peak falls
INT	: Interval for the search of the calibration peak (in channels)
ELEM	: Symbol of the radioelement in oriented library
EN	: Energy of this isotope in keV
FWT	: Full width at half maximum in keV (oriented lib.)
XLAM	: Decay constant of the radiositope in minutes (oriented lib.)
AA	: Specific activity (oriented lib.)
COUNT	: Counts in each channel
SPSM	: The smoothed values in each channel
DER	: Differentiated values of the contents in each channel
ISTAR	: First channel of the spectrum
IEND	: Last channel of the spectrum
INDEX	: Index indicating the kind of the peak found
JMAX	: Number of peaks found by PKF
FMEDIO	: Average value of the geometrical correction factor
AREA	: Area of the photopeak calculated by SURF
ERR	: Error calculated during the evaluation of peak areas
FWHM	: Full width at half maximum
LS	: Left limit of the peak found
CENTR	: Center of the peak found by PKF

LD : Right limit of the peak found

PMOL : Molecular weight of the element given in the oriented library

DECAY : Decay constant of the radioisotope (calibration lib.)

VALA : Specific activity for a μgram sample irradiated in a thermal flux of 10^{13} neutrons/cm^2sec (calib.lib.)

PESO : Weight of the element in grams (calib. lib.)

TDEC1 : Decay times of radioisotopes calculated by TDEC

TIRR : Irradiation duration in minutes

TCON : Counting duration in minutes

ALFA : Slope of the calibration line

BETA : Intercept of the calibration line

FLUX : Neutron flux during irradiation

WEIGHT : Weight of the sample in grams

STAND(6,K):Area zero/microgram of the element

NELST : Number of standards in standard library

IREL : A switch indicating the way which is followed by the program

NIRR : Irradiation number

MO : The beginning of the measurement being year, month, day, hour and minute

ANOME : The name of the problem involved

ASAMPL : Identification of the sample

EL4 : Symbol of the radioisotope found by FIRST for the calibration line

CKK : Center of the peak found by FIRST

VKK : Energy of the peak found by FIRST

VMAX : Counts due to the peak found by FIRST

NPK : Number of the peaks in the calibration lib.

EL3 : Symbol of the radioisotope found by SENSIT

VS : Counts due to that peak

P2 : Energy of that peak in keV

CS : Center of that peak

VS2 : Right limit of that peak

VD2 : Left limit of that peak

CLS2 : Channel contents at the right limit of the peak

CLD2 : Channel contents at the left limit of the peak

ISENS : Number of peaks found by SENSIT

EL2 : Symbol of the radioisotope found by PKF

VC : Counts due to the single peak found by PKF

PI : Energy of that peak in keV

VS1 : Right limit of that peak

VD1 : Left limit of that peak

CC : Center of that peak

CLSI : Channel contents at the right limit of that peak

CLDI : Channel contents at the left limit of that peak

IPICK : Number of single peaks found by PKF

FDEC : Decay factor calculated as $e^{\lambda tdec}$ by ANALYS

FSAT : Saturation factor calculated as $(1-e^{\lambda tirr})$ by ANALYS

DENS : Density of the sample

EL2D : Symbol of the radioisotope found by PKF

VCD : Counts due to double peaks found by PKF

PID : Energy of the doublet in keV

CCD : Center of one of the doublet

VID : Left limit of that peak (or right limit according to peak)

CLID : Channel contents at the limit of that peak

IPCD : Number of doublet

EL2REL : Symbol of the radioisotope found by PKF when there is a standard library

EL3REL : Symbol of the radioisotope found by SENSIT when there is a standard library

EL2RDRE: Symbol of the radioisotope which gives a doublet when there is a standard library

APPENDIX F

LISTING OF THE INPUT DATA AND INPUT OPTIONS

Input for Gretel consists of:

i) IME: One card for the computation of decay times (in minutes) of the radioisotopes after irradiation in the reactor. (It indicates the days in each month of the year)

FORMAT (12I6)

ii) LIBST: One card indicating the number of peaks of the calibration library.

FORMAT (I6)

iii) One card for each gamma peak of the calibration library. This card contains:

ELI	: Symbol of the radioelement
ENI	: Energy in keV
ICAN	: Channel in which the calibration peak falls
INT	: Interval for the search of the calibration peak (in channels)
DECAY	: Decay constant of the isotope to which the peak belongs ($\lambda = 0.693/T_{1/2}$ in minutes)
VALA	: Specific activity for a g sample irradiated in a thermal flux of 10^{13} neutrons/cm^2 sec
PESO	: Weight of the element in grams

where the formats are given as,

FORMAT (A6, F7.2, 2I4, 2E10.4, F12.8)

iv) NLIB: One card indicating the number of peaks of the "oriented analytical library".

FORMAT (I6)

v) One card for each gamma peak of the above mentioned library.

This card contains:

ELEM : Symbol of the radioelement of the oriented library

EN : Energy in keV

FWT : Full width at half maximum in keV

XLAM : Decay constant of the radioisotope in minutes

AA : Specific activity

PMOL : Molecular weight of the element

Where the format is given as,

FORMAT (A8, 2F10.3, 2E10.4, F10.5)

vi) One card giving irradiation and problem characteristics:

FLUX : Neutron flux during irradiation in neutrons/cm^2 sec

TIRR : Irradiation duration in minutes

IO : End of the irradiation stating its year, month day, hour and minute

NIRR : Irradiation number

ANOME : The name of the problem involved

DENS : Density of the sample, to compute atoms/cm^3 for each element

Put 1 if not requested.

FORMAT (E10.4, F10.3, 5I4, I5, 5A4, F7.3)

vii) One card with a set of figures and switches allowing the program to flow in different ways:

NSPT : Number of spectra to elaborate

NCH : Number of channels for each spectrum. In the case in which a partial data-out has been performed,

NCH = 2048

NSMO : Number of points to be used for the smoothing of the spectra

NSMO = 5 five point smoothing

NSMO = 7 seven point smoothing

NSMO = 9 nine point smoothing

IPDO : Indicates if a partial data-out has been used:

IPDO = 0 the whole spectrum has been punched

IPDO = 1 partial data-out

IASCI : Indicates the perforation code used:

IASCI = 1 IBM code

IASCI = 2 ASCII code

IASCI = 3 ASCII code, no parity

where the format is given as,

FORMAT (6I6)

viii) In the case of partial data-out (IPDO = 1) one card for each measurement, containing:

MO : year, month, day, hour and minute of the beginning of the measurement

ASAMPL : identification of the sample

WEIGHT : weight of the sample in grams

TCON : counting duration in minutes

ISTAR : first channel of the partial spectrum

IEND : last channel

ITR : switch indicating whether to elaborate the spectrum or not

ITR = 1 elaboration

ITR = 0 no elaboration

IS : switch indicating whether the area of the peaks must be computed with the original spectrum or with the smoothed one

IS = 0 original spectrum

IS = 1 smoothed spectrum

Where the format is given as,

FORMAT (5I4, 3A4, F10.6, F10.3, 2I5, 3I2)

ix) According to the values of IASCI, one of the following cards is read for each measurement:

a) IASCI = 1 or 2; the card contains:
MO, ASAMPL, WEIGHT, ITR, IS

FORMAT (5I4, 3A4, F10.6, f0X, 2I2)

b) IASCI = 3; the card contains:
MO, ASAMPL, WEIGHT, TCON, ITR, IS

FORMAT (5I4, 3A4, F10.6, F10.3, 10X, 2I2)

APPENDIX G

DESCRIPTION OF GRETEL

Gretel, as mentioned in the chapter 3.1, performs the quantitative analysis of gamma-ray spectra obtained by Ge(Li) detectors. The program is composed of a MAIN part which controls the various subroutines and allows the reading of the input data and library from punched cards, a number of subroutines and three functions.

As also mentioned in the same subchapter and in the 3.4, some modifications due to elimination of some subroutines belong to plotting procedure were required on original Gretel in order to adopt it to UNIVAC 1106. After having eliminated these routines, the program reran. These thirteen subprograms called by the main program are given in the following pages in detail.

The gamma-ray spectra of up to 4096 channels obtained by the multichannel analyzer, are first punched on paper tapes and read by one of the routines, TAPE, TAPEAS or TAPEGA, according to the punching code adopted, such as IBM, ASCII or ASCII with no parity. The routines transform the data in a suitable format, either by the function CONV or CONVB.

The routines used in Gretel, except the five mentioned above, are listed in the order called:

1- Function TDEC
2- Subroutine SMOOS
3- Subroutine DERIV
4- Subroutine FIRST
5- Subroutine KAL

6- Subroutine ANALYS
7- Subroutine PKF
8- Subroutine SURF
9- Subroutine SURF2
10- Subroutine SENSIT
11- Subroutine PRINT

The following is the description listing of the main and subprograms called by the main part. These descriptions are given with their options.

MAIN PROGRAM

The main part of the program reads the data of the calibration source, the oriented or standard libraries and some other input parameters, such as weight of samples and neutron flux. It also controls the various subroutines and functions.

It contains a number of common statements at the beginning of the program. These are described in the appendix E.

1. Function TDEC

```
FUNCTION TDEC (MO, IO, IME)
DIMENSION MO(5), IO(5), IME(12)
```

Where MO, IO and IME are defined in the appendix F. MO and IO are in terms of year, month, day, hour and minute so they are given as MO(5), IO(5).

This function calculates the decay times of isotopes in minutes.

2. Subroutine SMOOS

```
SUBROUTINE SMOOS (NSMO)
```

NSMO : number of points to be used for the smoothing of the spectra

NSMO = 5 five point smoothing

NSMO = 7 seven point smoothing

NSMO = 9 nine point smoothing

This routine performs the smoothing of the spectra on five, seven or nine points in order to reduce the influence of the statistical fluctuations.

3. Subroutine DERIV

```
SUBROUTINE DERIV (NSMO)
```

NSMO : it is explained in the above routine

It gives the first derivative of the smoothed spectrum. The shape of this spectrum is then analyzed in each given interval.

4. Subroutine FIRST

```
SUBROUTINE FIRST (LIBST, NCH, III, JS)
DIMENSION CK(10), VK(10), FCOR(10)
```

LIBST : number of peaks of the calibration library

NCH : number of channel of the spectrum

III : number of spectra to elaborate

JS : switch indicating whether the area of the peaks must be computed with the original spectrum or with the smoothed one

JS = 0 original spectrum

JS = 1 smoothed spectrum

CK : centers of the peaks found

VK : energies of these peaks

FCOR : correction factor for counting geometry to the specific activities of the elements belonging to the oriented library and finally the calibration line equation.

It is given as, $\frac{\text{exp. specific activity}}{\text{theoretical specific activity}}$

Subroutine FIRST treats the first spectrum of the series that is calibration spectrum. There is a certain number of known peaks in that spectrum. The calibration spectrum is always the first one in the set.

5. Subroutine KAL

```
SUBROUTINE KAL (N,C,E,A,B)
DIMENSION C(10), E(10)
```

N : number of measurement

C : number of channel used as abscissa for the calibration line

E : gamma-ray energies used as ordinate for the calibration line

A : slope of the calibration line

B : intercept of that line

Subroutine KAL calculates the calibration by least squares fitting, according to the data given in the calibration library.

The maximum number of the calibration peaks is 10, so C and E are given as C(10) and E(10).

6. Subroutine ANALYS

SUBROUTINE ANALYS(NLIB,NCH,III,JS)

NLIB : number of peaks of the oriented library which is prepared for each particular problem.
NCH : as defined in FIRST
III : as defined in FIRST
JS : as defined in FIRST

Subroutine ANALYS analyses all the spectra except that which belongs to calibration library, according to the information given in the oriented library in each interval calculated from the FWHM value given in that library. The program also performs the calculation of the concentration of the elements present in the sample in terms of ppm.

7. Subroutine PKF

```
SUBROUTINE PKF (JJJ,III,IRIG)
DIMENSION SIGMA(50)
DIMENSION IND(50)
```

JJJ : number of channels of the spectrum
III : number of spectrum to be analyzed
IRIG : number of write statements used
SIGMA : standard deviation for each element
IND(JMAX): indexes indicating the kinds of the peaks found by the routine.

The search of the peaks based on the change of the sign of the first derivative of the spectrum is carried out by this routine, PKF. It also searches the possible double peaks in the spectrum. The mathematical tests used for that purpose are given in the subchapter 3.3.3 in detail.

The maximum number of elements of the oriented library is given as 50 so it is used as dimensions for SIGMA and IND in the routine.

8. Subroutine SURF

```
SUBROUTINE SURF (NCH,JS)
DIMENSION  POUNT (4096)
```

NCH : defined in FIRST
JS : defined in FIRST
POUNT : number of counts detected in each channel

This routine computes the area of the peaks found by the routine PKF. The method for the computation of areas is discussed in the subchapter 3.3.4.

9. Subroutine SURF2

```
SUBROUTINE SURF2 (IRIG)
DIMENSION  SIGMA (50)
```

IRIG : defined in PKF
SIGMA : defined in the same routine.

Subroutine SURF2 computes the areas of doublet when they are recognized by the routine PKF.

10. Subroutine SENSIT

```
SUBROUTINE SENSIT (RAD)
```

RAD : minimum detectable effect observed.

If no peaks are observed in the interval indicated by the oriented library, the minimum counting rates that could have had a photopeak over the existing background are calculated by this routine, SENSIT.

11. Subroutine PRINT

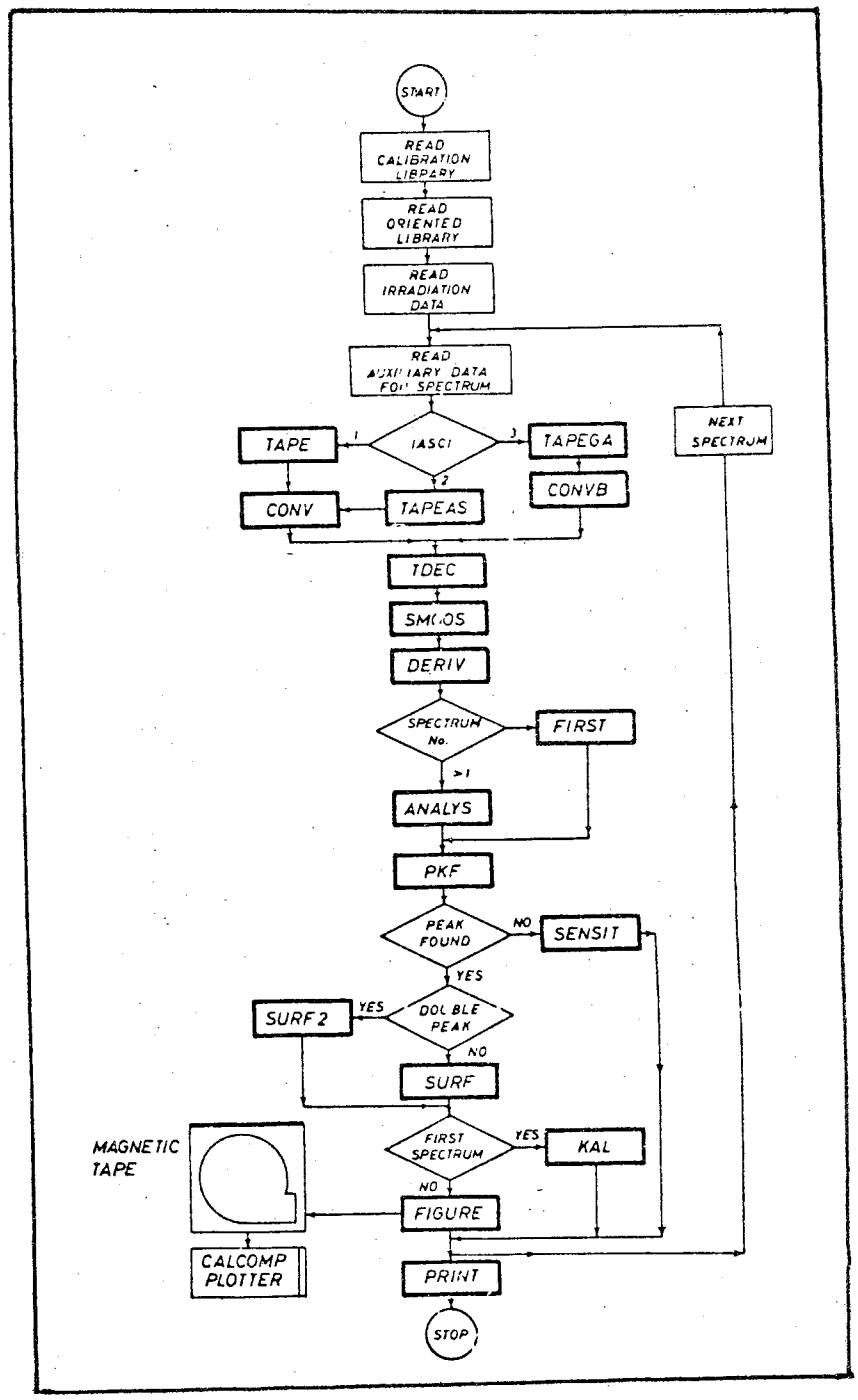
SUBROUTINE PRINT (IWR, IRIG)

IWR : an integer indicating what are printed according to the routines

IRIG : it is defined in PKF

This routine is used for the printing of the results obtained.

APPENDIX H



Flow chart for the GRETEL code

APPENDIX I

LISTING OF THE UNIVAC VERSION OF GRETEL

```
C
C     CON QUESTO PROGRAMMA SI TROVANO I PICCHI DOPPI
C
C
C
C
      REAL*8 EL1,ELEM
      REAL*8 EL2,EL3,EL4,EL2D
C
      COMMON EL1(10),EN1(10),ICAN(10),INT(10)
      COMMON ELEM(50),EN(50),FWT(50),XLAM(50),AA(50)
      COMMON COUNT(4096),SPSM(4096),DER(4096)
      COMMON ISTAR,IEND,INDEX,JMAX,EMEDIO
      COMMON AREA(50),ERR(50),FWHM(50)
      COMMON LS(50),CENTR(50),LD(50),PMOL(50)
      COMMON DECAY(10),VALA(10),PESO(10)
      COMMON TDEC1,TIRR,TCON,ALFA,BETA,FLUX,WEIGHT
      COMMON STAND(6,50),NELST,IREL
C
      COMMON/ET1/NIRR,IO(5),MO(5),AHOME(5),ASAMPL(3)
      COMMON /ET4/ EL4(10),CKK(10),VKK(10),VMAX(10),NPK
      COMMON /ET5/ EL3(50),VS(50),P2(50),CS(50),VS2(50),VD2(50),CLS2(50)
     1,CLD2(50),ISENS
      COMMON /ET6/ EL2(50),VC(50),P1(50),CC(50),VS1(50),VD1(50),CLS1(50)
     1,CLD1(50),IPICK
      COMMON/ET8/TDEC,FSAT,DENS
      COMMON/ET9/EL2D(50),VCD(50),P1D(50),CCD(50),V1D(50),CL1D(50),IPICD
      COMMON/ET10/EL2REL(50),EL3REL(50),EL2DPE(50)
C
      DIMENSION IME(12)
      DATA STAN/'STAN'/
C
      FLUX=0.
      DENS=0.
      DO 777 J=1,50
      AA(J)=0.
      PMOL(J)=0.
  777 CONTINUE
      READ(5,999) (IME(I),I=1,12)
      READ(5,1000) LIBST
      DO 9 K=1,LIBST
    9 READ(5,998) EL1(K),EN1(K),ICAN(K),INT(K),DECAY(K),VALA(K),PESO(K)
      READ (5,1000) NSPT,NCH,NSMO,IPDO,IASCI,IREL
      IF(IREL) 200,200,201
  201 READ (5,1000) NELST
C                                                                    *****
C     *****
C
C     STAND(1,K)=SIMBOLO ELEMENTO (4 LETTERE)
C     STAND(2,K)=ENERGIA PICCO IN KEV
C     STAND(3,K)=RISOLUZIONE RIVELATORE IN KEV
C     STAND(4,K)=COSTANTE DECADIMENTO 0.693/TDEC IN MINUTI
```

```
C      STAND(5,K)=PPM DI ELEMENTO DELLO STANDARD                                GRE0055
C      STAND(6,K)=AREA PICCO AL TEMPO ZERO/MICROGRAMMI ELEMENTO (CALCOLA-       GRE0056
C      TO DAL PROGRAMMA E MESSO IN LIBRERIA DELLO STANDARD)                     GRE0057
C                                                                               GRE0058
C      *****                                                    *****           GRE0059
C                                                                               GRE0060
      DO 202 K=1,NELST                                                          GRE0061
  202 READ (5,1030) STAND(1,K),STAND(2,K),STAND(3,K),STAND(4,K),STAND(5,        GRE0062
     1K)                                                                        GRE0063
      READ(5,1031) (IO(K),K=1,5),NIRR,TIRR,(ANOME(K),K=1,5)                    GRE0064
      GO TO 500                                                                 GRE0065
  200 READ (5,1000) NLIB                                                        GRE0066
      DO 10 J=1,NLIB                                                            GRE0067
   10 READ (5,1001) ELEM(J),EN(J),EWT(J),XLAM(J),AA(J),PMOL(J)                  GRE0068
      READ (5,1003) FLUX,TIRR,(IO(K),K=1,5),NIRR,(ANOME(K),K=1,5),DENS          GRE0069
C                                                                               GRE0070
C                                                                               GRE0071
      WRITE(6,1014) NSPT                                                        GRE0072
      IF(IASCI-2) 70,80,60                                                      GRE0073
   60 WRITE (6,1012) IASCI                                                      GRE0074
      GO TO 90                                                                  GRE0075
   70 WRITE(6,1015) IASCI                                                       GRE0076
      GO TO 90                                                                  GRE0077
   80 WRITE(6,1016) IASCI                                                       GRE0078
   90 WRITE (6,1018)                                                            GRE0079
      DO 50  K=1,NLIB,2                                                         GRE0080
      K1=K+1                                                                    GRE0081
   50 WRITE (6,1019) ELEM(K),EN(K),EWT(K),XLAM(K),AA(K),PMOL(K),ELEM(K1)        GRE0082
     1,EN(K1),EWT(K1),XLAM(K1),AA(K1),PMOL(K1)                                  GRE0083
C                                                                               GRE0084
  500 TCON=1.                                                                   GRE0085
      DO 1 II=1,NSPT                                                            GRE0086
      III=II                                                                    GRE0087
      IF(IPDO.EQ.1) GO TO 444                                                   GRE0088
      ISTAR=1                                                                   GRE0089
      IEND=NCH                                                                  GRE0090
      IF(IASCI-2) 20,30,33                                                      GRE0091
C                                                                               GRE0092
C     *** LETTURA CON CODICE ASCII NO PARITY ***                                GRE0093
C                                                                               GRE0094
   33 READ(5,1008)(MO(K),K=1,5),(ASAMPL(K),K=1,3),WEIGHT,TMIS,ITR,ICALC,       GRE0095
     1JS                                                                        GRE0096
      IF(ASAMPL(1).NE.STAN) GO TO 7770                                          GRE0097
      DO 7771 IJK=1,NELST                                                       GRE0098
 7771 STAND(5,IJK)=WEIGHT*STAND(5,IJK)                                          GRE0099
 7770 CALL TAPEGA(NCH,COUNT)                                                    GRE0100
      TCON=TMIS                                                                 GRE0101
      GO TO 40                                                                  GRE0102
C                                                                               GRE0103
C     *** LETTURA CON CODICE IBM ***                                            GRE0104
C                                                                               GRE0105
   20 READ(5,1004)(MO(K),K=1,5),(ASAMPL(K),K=1,3),WEIGHT,ITR,ICALC,JS           GRE0106
      IF(ASAMPL(1).NE.STAN) GO TO 7772                                          GRE0107
      DO 7773 IJK=1,NELST                                                       GRE0108
 7773 STAND(5,IJK)=WEIGHT*STAND(5,IJK)                                          GRE0109
 7772 CALL TAPE(NCH,COUNT)                                                      GRE0110
      IF(COUNT(1).LE.1.) GO TO 40                                               GRE0111
      TCON=COUNT(1)/240.                                                        GRE0112
      GO TO 40                                                                  GRE0113
C                                                                               GRE0114
C     *** LETTURA CON CODICE ASCII ***                                          GRE0115
C                                                                               GRE0116
   30 READ(5,1004)(MO(K),K=1,5),(ASAMPL(K),K=1,3),WEIGHT,ITR,ICALC,JS           GRE0117
      IF(ASAMPL(1).NE.STAN) GO TO 7774                                          GRE0118
      DO 7775 IJK=1,NELST                                                       GRE0119
 7775 STAND(5,IJK)=WEIGHT*STAND(5,IJK)                                          GRE0120
 7774 CALL TAPEAS(NCH,COUNT)                                                    GRE0121
      IF(COUNT(1).LE.1.) GO TO 40                                               GRE0122
      TCON=COUNT(1)/60.                                                         GRE0123
C                                                                               GRE0124
      GO TO 40                                                                  GRE0125
  444 READ(5,1011)(MO(K),K=1,5),(ASAMPL(K),K=1,3),WEIGHT,TCON,ISTAR,IEND       GRE0126
     1,ITR,ICALC,JS                                                             GRE0127
      IF(ASAMPL(1).NE.STAN) GO TO 7776                                          GRE0128
      DO 7777 IJK=1,NELST                                                       GRE0129
 7777 STAND(5,IJK)=WEIGHT*STAND(5,IJK)                                          GRE0130
 7776 NCH=IEND-ISTAR+1                                                          GRE0131
      IF(IASCI-2) 445,446,447                                                   GRE0132
C                                                                               GRE0133
C     *** LETTURA CON CODICE ASCII NO PARITY ***                                GRE0134
C                                                                               GRE0135
  447 CALL TAPEGA(NCH,COUNT)                                                    GRE0136
```

```
      GO TO 40                                                          GRE0137
C                                                                       GRE0138
C     *** LETTURA CON CODICE ASCII ***                                  GRE0139
C                                                                       GRE0140
  446 CALL TAPEAS(NCH,COUNT)                                            GRE0141
      GO TO 40                                                          GRE0142
C                                                                       GRE0143
C     *** LETTURA CON CODICE IBM ***                                    GRE0144
C                                                                       GRE0145
  445 CALL TAPE(NCH,COUNT)                                              GRE0146
   40 CONTINUE                                                          GRE0147
      IF(ITR.EQ.0) GO TO 1                                              GRE0148
C                                                                       GRE0149
      TDEC1=TDEC(MO,IO,IME)                                             GRE0150
      IF(ICALC.EQ.1) GO TO 9999                                         GRE0151
      WRITE (6,1005) II,NCH,TCON,(MO(K),K=1,5),TDEC1                    GRE0152
      GO TO 9998                                                        GRE0153
 9999 WRITE (6,1020) II,NCH,TCON,(MO(K),K=1,5),TDEC1                    GRE0154
 9998 CONTINUE                                                          GRE0155
C                                                                       GRE0156
C                                                                       GRE0157
      IF(IPDO.EQ.1) GO TO 448                                           GRE0158
      WRITE (6,1006) (I,I=1,10)                                         GRE0159
      IMX=NCH/10+1                                                      GRE0160
      DO 2 I=1,IMX                                                      GRE0161
      IP=I-1                                                            GRE0162
      IL=IP*10+1                                                        GRE0163
      IH=MIN0(I*10,NCH)                                                 GRE0164
    2 WRITE (6,1007) IP,(COUNT(J),J=IL,IH)                              GRE0165
      GO TO 449                                                         GRE0166
C                                                                       GRE0167
  448 WRITE (6,1009) (I,I=1,8)                                          GRE0168
      DO 336 J=1,NCH                                                    GRE0169
      I=J+ISTAR-1                                                       GRE0170
  336 COUNT(I)=COUNT(J)                                                 GRE0171
      DO 337 I=ISTAR,IEND,8                                             GRE0172
      IP=I-1                                                            GRE0173
      IL=IP+1                                                           GRE0174
      IH=IL+7                                                           GRE0175
  337 WRITE (6,1010) IP,(COUNT(J),J=IL,IH)                              GRE0176
C                                                                       GRE0177
  449 WRITE (6,199)                                                     GRE0178
C                                                                       GRE0179
      CALL SMOOS(NSMO)                                                  GRE0180
      CALL DERIV(NSMO)                                                  GRE0181
      IF(II.GT.1) GO TO 11                                              GRE0182
C                                                                       GRE0183
      CALL PRINT(1,0)                                                   GRE0184
C                                                                       GRE0185
      CALL FIRST(LIBST,NCH,ITI,JS)                                      GRE0186
      IF(JMAX.LE.1) GO TO 333                                           GRE0187
      IF(NPK.LE.1) GO TO 333                                            GRE0188
      WRITE(6,1013) ALFA,BETA                                           GRE0189
      GO TO 1                                                           GRE0190
C                                                                       GRE0191
   11 CALL PRINT(2,0)                                                   GRE0192
C                                                                       GRE0193
      INELST=NELST                                                      GRE0194
      IF(IREL.EQ.1) NLIB=INELST                                         GRE0195
      CALL ANALYS(NLIB,NCH,ITI,JS)                                      GRE0196
      IF(ICALC.EQ.0) GO TO 1                                            GRE0197
    1 CONTINUE                                                          GRE0198
  199 FORMAT(1H1)                                                       GRE0199
  998 FORMAT(A6,F7.2,2I4,2E10.4,F12.8)                                  GRE0200
  999 FORMAT(12I6)                                                      GRE0201
 1000 FORMAT(6I6)                                                       GRE0202
 1001 FORMAT (A8,2F10.3,2E10.4,F10.5)                                   GRE0203
 1002 FORMAT(10F8.3)                                                    GRE0204
 1003 FORMAT (E10.4,F10.3,5I4,I5,5A4,F7.3)                              GRE0205
 1004 FORMAT(5I4,3A4,E10.6,20X,3I2)                                     GRE0206
 1005 FORMAT (1H1,,SPETTRO N.,,I5,,  CANALI,,I5,,  TCON,,F10.3,, MINUTI GRE0207
     1   DATA  ,,5I4,,   DECAD,,F12.3,,  MIN,/)                         GRE0208
 1006 FORMAT (1H0,10(8X,I2)/)                                           GRE0209
 1007 FORMAT (1H ,I3,10F10.0)                                           GRE0210
 1008 FORMAT(5I4,3A4,E10.6,F10.3,10X,3I2)                               GRE0211
 1009 FORMAT (1H0,8(8X,I2)/)                                            GRE0212
 1010 FORMAT (1H ,I4,8F10.0)                                            GRE0213
 1011 FORMAT(5I4,3A4,F10.6,F10.3,2I5,3I2)                               GRE0214
 1012 FORMAT (1H+,45X,, PERFORATI CON CODICE ASCII NO PARITY,)          GRE0215
 1013 FORMAT (1H0,,CALIBRAZIONE    Y=,,F7.3,,*X+,,F8.3)                 GRE0216
 1014 FORMAT(1H0,,IN QUESTO PROGRAMMA CI SONO ,,I4,,  SPETTRI,)         GRE0217
 1015 FORMAT(1H+,45X,, PERFORATI CON CODICE IBM,)                       GRE0218
```

```
 217.      1016 FORMAT(1H+,45X,,'PERFORATI CON CODICE ASCII',)                                  GRE0224
 218.      1017 FORMAT (1H0,,NON CI SONO PICCHI DI CALIBRAZIONE',)                              GRE0225
 219.      1018 FORMAT (1H0,5X,,LIBRERIA,///, ELEM,,5X,,EN(KEV) RES(KEV)  DEC(MIN)             GRE0226
 220.          1,,3X,,VALORE A,,3X,,P. MOL.,,5X,,ELEM,,5X,,EN(KEV) RES(KEV)  DEC(M          GRE0227
 221.          2IN),,3X,,VALORE A,,3X,,P.MOL.,//)                                            GRE0228
 222.      1019 FORMAT (1H0,A3,2X,F7.2,F7.3,3X,1PE9.3,2X,E9.3,2X,0PF7.3,5X,A8,2X,F          GRE0229
 223.          17.2,F7.3,3X,1PE9.3,2X,E9.3,2X,0PF7.3)                                        GRE0230
 224.      1020 FORMAT (1H1,,SPETTRO N.,,I5,,  CANALI,,I5,,  TCON,,F10.3,, MINUTI           GRE0231
 225.          1  DATA  ,,5I4,,  DECAD,,F12.3,,  MIN,,14X,,CALCOMP,/)                       GRE0232
 226.      1030 FORMAT(A4,2E7.2,2E9.3)                                                       GRE0233
 227.      1031 FORMAT(5I4,I5,F10.3,5A4)                                                     GRE0234
 228.           GO TO 334                                                                    GRE0235
 229.       333 WRITE (6,1017)                                                              GRE0236
 230.       334 STOP                                                                        GRE0237
 231.           END                                                                         GRE0238

FTN 405 IBANK 330 DBANK 14808 COMMON
$S  SPECTRA.TDEC
R1  *06/16/82-22:12(2,)
       1.          FUNCTION TDEC(M0,I0,IME)                                                GRE05
       2.          DIMENSION M0(5),I0(5),IME(12)                                           GRE0525
       3.          I1=M0(2)                                                                GRE0526
       4.          I2=I0(2)                                                                GRE0527
       5.          TDEC=(((M0(1)-I0(1))*365+IME(I1)-IME(I2)+M0(3)-I0(3))*24+M0(4)-I0(      GRE0528
       6.         14))*60+M0(5)-I0(5)                                                      GRE0529
       7.          RETURN                                                                  GRE0530
       8.          END

FTN 52 IBANK 18 DBANK
$S  SPECTRA.KAL
R1  *06/16/82-22:12(2,)
       1.          SUBROUTINE KAL(N,C,E,A,B)                                               GRE0533
       2.          DIMENSION C(10),E(10)                                                   GRE0534
       3.    C                                                                             GRE0535
       4.          FN=N                                                                    GRE0536
       5.          C1=0.                                                                   GRE0537
       6.          E1=0.                                                                   GRE0538
       7.          C2=0.                                                                   GRE0539
       8.          CE=0.                                                                   GRE0540
       9.          DO 1 J=1,N                                                              GRE0541
      10.          C1=C1+C(J)                                                              GRE0542
      11.          E1=E1+E(J)                                                              GRE0543
      12.          C2=C2+C(J)**2                                                           GRE0544
      13.          CE=CE+C(J)*E(J)                                                         GRE0545
      14.        1 CONTINUE                                                                GRE0546
      15.          DEN=FN*C2-C1**2                                                         GRE0547
      16.          A=(FN*CE-C1*E1)/DEN                                                     GRE0548
      17.          B=(C2*E1-C1*CE)/DEN                                                     GRE0549
      18.          RETURN                                                                  GRE0550
      19.          END

FTN 85 IBANK 26 DBANK
$S  SPECTRA.TAPE
R1  *06/16/82-22:12(7,)
       1.          SUBROUTINE TAPE(NPT,Y)
       2.          DIMENSION Y(4096)
       3.          INTEGER A(64)                                                           GRE055
       4.          J=0                                                                     GRE055
       5.        2 CONTINUE                                                                GRE055
       6.          IF (J.EQ.NPT) GO TO 3                                                   GRE055
       7.          READ(11,1,END=4) (A(I),I=1,60)                                          GRE055
       8.        1 FORMAT (6X,60A1)                                                        GRE056
       9.          J=J+1                                                                   GRE056
      10.          Y(J)=CONV(A,1,5)                                                        GRE056
      11.          IF(Y(J).NE.0.) GO TO 2                                                  GRE056
      12.          Y(J)=1.                                                                 GRE056
      13.          GO TO 2                                                                 GRE056
      14.        3 NPT=J                                                                   GRE056
      15.          RETURN                                                                  GRE056
      16.        4 WRITE(6,5)                                                              GRE056
      17.        5 FORMAT (1H1,,** END OF FILE ON PAPER TAPE **,)                          GRE056
      18.          STOP                                                                    GRE057
      19.          END

FTN 48 IBANK 103 DBANK
$S  SPECTRA.TAPEAS
R1  *06/16/82-22:12(7,)
       1.          SUBROUTINE TAPEA'(NPT,Y)
       2.          DIMENSION Y(4096)
       3.          INTEGER A(64)
       4.          INTEGER   UNO/,1 ,/-                                                    GRE05
       5.          J=0
```

```
      22 CONTINUE                                                        GRE0577
         IF(J.EQ.NPT) GO TO 3                                            GRE0578
         READ (11,1,END=4) K,(A(I),I=1,60)                               GRE0579
       1 FORMAT (3X,I3,60A1)                                             GRE0580
         IF (K-57) 2,101,102                                             GRE0581
       2 IF(K-1)22,22,103                                                GRE0582
     103 DO 100 I=1,60                                                   GRE0583
         A(I)=UNO                                                        GRE0584
     100 CONTINUE                                                        GRE0585
     101 DO 5 K=1,8                                                      GRE0586
         J=J+1                                                           GRE0587
         L1=K*7-6                                                        GRE0588
         L2=L1+5                                                         GRE0589
         Y(J)=CONV(A,L1,L2)                                              GRE0590
         IF(Y(J).NE.0.) GO TO 5                                          GRE0591
         Y(J)=1.                                                         GRE0592
       5 CONTINUE                                                        GRE0593
         GOTO 22                                                         GRE0594
     102 DO 6 K=1,8                                                      GRE0595
         J=J+1                                                           GRE0596
         L1=K*7-5                                                        GRE0597
         L2=L1+5                                                         GRE0598
         Y(J)=CONV(A,L1,L2)                                              GRE0599
         IF (Y(J).NE.0.) GO TO 6                                         GRE0600
         Y(J)=1.                                                         GRE0601
       6 CONTINUE                                                        GRE0602
         GOTO 22                                                         GRE0603
       3 NPT=J                                                           GRE0604
         RETURN                                                          GRE0605
       4 WRITE (6,15)                                                    GRE0606
      15 FORMAT (1H1,,**END OF FILE ON PAPER TAPE**,)                    GRE0607
         STOP                                                            GRE0608
         END                                                             GRE0609
```

```
TN 117 IBANK 116 DBANK
S  SPECTRA.TAPEGA
R1  *06/16/82-22:12(3,)
         SUBROUTINE TAPEGA(NPT,Y)                                        GRE0611
         DIMENSION Y(4096)                                               GRE0612
         INTEGER   A(64)                                                 GRE0613
         INTEGER   UNO/,1 ,/                                             GRE0614
         J=0                                                             GRE0615
      22 CONTINUE                                                        GRE0616
         IF(J.EQ.NPT) GO TO 3                                            GRE0617
         READ (11,1,END=4) K,(A(I),I=1,64)                               GRE0618
       1 FORMAT (3X,I3,10X,64A1)                                         GRE0619
         IF(K-71) 2,101,101                                              GRE0620
       2 IF(K-12) 22,22,103                                              GRE0621
     103 DO 100 I=1,64                                                   GRE0622
         A(I)=UNO                                                        GRE0623
     100 CONTINUE                                                        GRE0624
     101 DO 5 K=1,8                                                      GRE0625
         J=J+1                                                           GRE0626
         L1=K*8-7                                                        GRE0627
         L2=L1+7                                                         GRE0628
         Y(J)=CONVB(A,L1,L2)                                             GRE0629
         IF(Y(J).NE.0.) GO TO 5                                          GRE0630
         Y(J)=1.                                                         GRE0631
       5 CONTINUE                                                        GRE0632
         GO TO 22                                                        GRE0633
       3 NPT=J                                                           GRE0634
         RETURN                                                          GRE0635
       4 WRITE (6,15)                                                    GRE0636
      15 FORMAT (1H1,,**END OF FILE ON PAPER TAPE**,)                    GRE0637
         STOP                                                            GRE0638
         END                                                             GRE0639
```

```
         FUNCTION CONV(A,L1,L2)                                          GRE0
C
         INTEGER     A(1),TAB(11)                                        GRE0
         DATA TAB /,0 ,,,1 ,,,2 ,,,3 ,,,4 ,,,5 ,,,6 ,,,7 ,,,8 ,,        GRE0
                  ,9 ,,,  ,/                                             GRE0
        *                                                                GRE0
         CONV=0.                                                         GRE0
         DO 2   I=L1,L2                                                  GRE0
         IF(A(I).EQ.TAB(11)) A(I)=TAB(1)                                 GRE0
```

```
      DO 1 J=1,10                                                       GRE0648
      IF(A(I).EQ.TAB(J)) GO TO 3                                        GRE0649
    1 CONTINUE                                                          GRE0650
      CONV=0.                                                           GRE0651
      RETURN                                                            GRE0652
    3 FJ=J                                                              GRE0653
      CONV=CONV*10.+FJ-1.                                               GRE0654
    2 CONTINUE                                                          GRE0655
      RETURN                                                            GRE0656
      END                                                               GRE0657
```

```
      FUNCTION CONVB(A,L1,L2)                                           GRE0658
C                                                                       GRE0659
      INTEGER     A(1),TAB(11)
      DATA TAB /,0 ,,,1 ,,,2 ,,,3 ,,,4 ,,,5 ,,,6 ,,,7 ,,,8 ,,
     *         ,9 ,,,  ,/
      CONVB=0.                                                          GRE0663
      DO 2   I=L1,L2                                                    GRE0664
      IF(A(I).EQ.TAB(11)) RETURN                                        GRE0665
      DO 1 J=1,10                                                       GRE0666
      IF(A(I).EQ.TAB(J)) GO TO 3                                        GRE0667
    1 CONTINUE                                                          GRE0668
      CONVB=0                                                           GRE0669
      RETURN                                                            GRE0670
    3 FJ=J                                                              GRE0671
      CONVB=CONVB*10.+FJ-1.                                             GRE0672
    2 CONTINUE                                                          GRE0673
      RETURN                                                            GRE0674
      END                                                               GRE0675
```

```
N 216 IBANK 164 DBANK
 SPECTRA.SMOOS
1  *06/16/82-22:12(2,)
      SUBROUTINE SMOOS(NSMO)                                            GRE0678
C                                                                       GRE0679
      REAL*8 EL1,ELEM                                                   GRE0680
      COMMON EL1(10),EN1(10),ICAN(10),INT(10)                           GRE0681
      COMMON ELEM(50),EN(50),FWT(50),XLAM(50),AA(50)                    GRE0682
      COMMON COUNT(4096),SPSM(4096),DER(4096)                           GRE0683
      COMMON ISTAR,IEND,INDEX,JMAX,FMEDIO                               GRE0684
      COMMON AREA(50),ERR(50),FWHM(50)                                  GRE0685
      COMMON LS(50),CENTR(50),LD(50),PMOL(50)                           GRE0686
      COMMON DECAY(10),VALA(10),PES0(10)                                GRE0687
      COMMON TDEC1,TIRR,TCON,ALFA,BETA,FLUX,WEIGHT                      GRE0688
C                                                                       GRE0689
C                                                                       GRE0690
      IF(NSMO-7) 30,40,50                                               GRE0691
C                                                                       GRE0692
C     *** SMOOTHING A 9 PUNTT ***                                       GRE0693
C                                                                       GRE0694
   50 N1=ISTAR+4                                                        GRE0695
      N2=IEND-4                                                         GRE0696
      C0=59.                                                            GRE0697
      C1=54.                                                            GRE0698
      C2=39.                                                            GRE0699
      C3=14.                                                            GRE0700
      C4=-21.                                                           GRE0701
      CNORM=231.                                                        GRE0702
      GO TO 60                                                          GRE0703
C                                                                       GRE0704
C     *** SMOOTHING A 7 PUNTT ***                                       GRE0705
C                                                                       GRE0706
   40 N1=ISTAR+3                                                        GRE0707
      N2=IEND-3                                                         GRE0708
      C0=7.                                                             GRE0709
      C1=6.                                                             GRE0710
      C2=3.                                                             GRE0711
      C3=-2.                                                            GRE0712
      C4=0.                                                             GRE0713
      CNORM=21.                                                         GRE0714
      GO TO 60                                                          GRE0715
C                                                                       GRE0716
C     *** SMOOTHING A 5 PUNTT ***                                       GRE0717
C                                                                       GRE0718
   30 N1=ISTAR+2
```

```
      N2=IEND-2                                                                 GRE07190
      C0=17.                                                                    GRE07200
      C1=12.                                                                    GRE07210
      C2=-3.                                                                    GRE07220
      C3=0.                                                                     GRE07230
      C4=0.                                                                     GRE07240
      CNORM=35.                                                                 GRE07250
C                                                                               GRE07260
   60 DO 1 K=N1,N2                                                              GRE07270
      SPSM(K)=C0*COUNT(K)+C1*(COUNT(K+1)+COUNT(K-1))+C2*(COUNT(K+2)+COUN        GRE07280
     1T(K-2))+C3*(COUNT(K+3)+COUNT(K-3))+C4*(COUNT(K+4)+COUNT(K-4))             GRE07290
    1 SPSM(K)=SPSM(K)/CNORM                                                     GRE07300
      RETURN                                                                    GRE07310
      END                                                                       GRE07320

N 105 IBANK 39 DBANK 13030 COMMON
  SPECTRA.DERIV
1   *06/16/82-22:12(2,)
      SUBROUTINE DERIV(NSMO)                                                    GRE07340
      REAL*8 EL1,ELEM                                                           GRE07350
      COMMON EL1(10),EN1(10),ICAN(10),INT(10)                                   GRE07360
      COMMON ELEM(50),EN(50),FWT(50),XLAM(50),AA(50)                            GRE07370
      COMMON COUNT(4096),SPSM(4096),DER(4096)                                   GRE07380
      COMMON ISTAR,IEND,INDEX,JMAX,EMEDIO                                       GRE07390
      COMMON AREA(50),FRR(50),FWHM(50)                                          GRE07400
      COMMON LS(50),CENTR(50),LD(50),PMOL(50)                                   GRE07410
      COMMON DECAY(10),VALA(10),PESO(10)                                        GRE07420
      COMMON TDEC1,TIRR,TCON,ALFA,BETA,FLUX,WEIGHT                              GRE07430
C                                                                               GRE07440
      IF(NSMO-7) 10,20,30                                                       GRE07450
   30 IS=ISTAR+5                                                                GRE07460
      IE=IEND-5                                                                 GRE07470
      GO TO 40                                                                  GRE07480
   20 IS=ISTAR+4                                                                GRE07490
      IE=IEND-4                                                                 GRE07500
      GO TO 40                                                                  GRE07510
   10 IS=ISTAR+3                                                                GRE07520
      IE=IEND-3                                                                 GRE07530
C                                                                               GRE07540
   40 DO 1 I=IS,IE                                                              GRE07550
      IP=I+1                                                                    GRE07560
      IN=I-1                                                                    GRE07570
      DER(I)=(SPSM(IP)-SPSM(IN))/2.                                             GRE07580
    1 CONTINUE                                                                  GRE07590
      RETURN                                                                    GRE07600
      END                                                                       GRE07610

N 56 IBANK 15 DBANK 13030 COMMON
  SPECTRA.FIRST
1   *06/16/82-22:12(2,)
      SUBROUTINE FIRST(LIBST,NCH,III,JS)                                        GRE07640
      REAL*8 EL1,ELEM                                                           GRE07650
      REAL*8 EL4                                                                GRE07660
      COMMON EL1(10),EN1(10),ICAN(10),INT(10)                                   GRE07670
      COMMON ELEM(50),EN(50),FWT(50),XLAM(50),AA(50)                            GRE07680
      COMMON COUNT(4096),SPSM(4096),DER(4096)                                   GRE07690
      COMMON ISTAR,IEND,INDEX,JMAX,EMEDIO                                       GRE07700
      COMMON AREA(50),FRR(50),FWHM(50)                                          GRE07710
      COMMON LS(50),CENTR(50),LD(50),PMOL(50)                                   GRE07720
      COMMON DECAY(10),VALA(10),PESO(10)                                        GRE07730
      COMMON TDEC1,TIRR,TCON,ALFA,BETA,FLUX,WEIGHT                              GRE07740
      COMMON STAND(6,50),NELST,IREL                                             GRE07750
      COMMON /ET4/ EL4(10),CKK(10),VKK(10),VMAX(10),NPK                         GRE07760
C                                                                               GRE07770
      DIMENSION CK(10),VK(10),FCOR(10)                                          GRE07780
C                                                                               GRE07790
      NPK=0                                                                     GRE07800
      JJJ=0                                                                     GRE07810
      CALL PKF(JJJ,III,IRIG)                                                    GRE07820
      IF(JMAX.LE.1) RETURN                                                      GRE07830
      CALL SURF(NCH,JS)                                                         GRE07840
C                                                                               GRE07850
      WRITE (6,1998)                                                            GRE07860
      WRITE (6,1999)                                                            GRE07870
      DO 3 J=1,JMAX                                                             GRE07880
      DO 4 I=1,LIBST                                                            GRE07890
      IDELTA=ICAN(I)-INT(I)                                                     GRE07900
      KDELTA=ICAN(I)+INT(I)                                                     GRE07910
      IF(CENTR(J)-IDELTA) 4,6,6                                                 GRE07920
    6 IF(CENTR(J)-KDELTA) 7,7,4                                                 GRE07930
    7 NPK=NPK+1                                                                 GRE07940
      CK(NPK)=CENTR(J)                                                          GRE07950
```

```
            VK(NPK)=EN1(I)                                                      GRE0795
            EL1(NPK)=EL1(I)                                                     GRE0796
            FDEC=EXP(DECAY(I)*TDEC1)                                            GRE0797
            FSAT=1.-EXP(-DECAY(I)*TIRR)                                         GRE0798
            CPM=AREA(J)/TCON                                                    GRE0799
            AZERO=CPM*FDEC                                                      GRE0800
            ASPER=0.                                                            GRE0801
            FCOR(NPK)=0.                                                        GRE0802
            IF(IREL.EQ.1) GO TO 100                                             GRE0803
            ASPER=FLUX*FSAT*PESO(I)*1.E+06/AZERO                                GRE0804
            FCOR(NPK)=ASPER/VALA(I)                                             GRE0805
C                                                                               GRE0806
C     ***** I SEGUENTI VALORI VANNO NEL COMMON /ET4/ E SERVONO PER ,FIGUR       GRE0807
C                                                                               GRE0808
  100 IK=CK(NPK)+0.5                                                            GRE0809
            VMAX(NPK)=COUNT(IK)                                                 GRE0810
            EL4(NPK)=EL1(NPK)                                                   GRE0811
            CKK(NPK)=CK(NPK)                                                    GRE0812
            VKK(NPK)=VK(NPK)                                                    GRE0813
C                                                                               GRE0814
            WRITE (6,2000) NPK,EL1(NPK),VK(NPK),PESO(I),CK(NPK),CPM,AZERO,ASPE  GRE0815
           1R,VALA(I),FCOR(NPK)                                                 GRE0816
          4 CONTINUE                                                            GRE0817
          3 CONTINUE                                                            GRE0818
            IF(NPK.LE.1) RETURN                                                 GRE0819
C                                                                               GRE0820
            CALL KAL(NPK,CK,VK,ALFA,BETA)                                       GRE0821
            FMEDIO=0.                                                           GRE0822
            DO 5 K=1,NPK                                                        GRE0823
          5 FMEDIO=FMEDIO+FCOR(K)                                               GRE0824
            FMEDIO=FMEDIO/NPK                                                   GRE0825
            WRITE (6,2002)                                                      GRE0826
            WRITE (6,2001) NPK,FMEDIO                                           GRE0827
C                                                                               GRE0828
 1998 FORMAT (1H0)                                                              GRE0829
 1999 FORMAT (1H0,3X,,N.,,4X,,EL,M,,7X,,EN,,6X,,PESO (G),,5X,,CENTR,,5X,       GRE0830
           1,C P M,,4X,,AREA ZERO,,3X,,A SPER,,5X,,A TEOR,,4X,,FATT CORR,////) GRE0831
 2000 FORMAT (1H ,I5,2X,A8,2X,F7.2,2X,F11.8,3X,F7.2,5(2X,1PE9.3))               GRE0832
 2001 FORMAT (1H ,5X,,VALORE MEDIO DEL FATTORE CORRETTIVO SU ,,I4,, PICC       GRE0833
           1HI,,39X,1PE9.3/////)                                                GRE0834
 2002 FORMAT (1H0,93X,,---------,///)                                           GRE0835
            RETURN                                                              GRE0836
            END                                                                 GRE0837
```

```
N 198 IBANK 213 DBANK 13383 COMMON
  SPECTRA.ANALYS
1  *06/16/82-22:12(2,)
      1.          SUBROUTINE ANALYS(NLIB,NCH,III,JS)
      2.          INTEGER   H1,H2                                               GRE0841
      3.          REAL*8 EL1,ELEM                                               GRE0842
      4.          REAL*8 EL2,EL3,EL2D                                           GRE0843
      5.  C                                                                     GRE0844
      6.          COMMON EL1(10),EN1(10),ICAN(10),INT(10)                       GRE0845
      7.          COMMON ELEM(50),EN(50),FWT(50),XLAM(50),AA(50)                GRE0846
      8.          COMMON COUNT(4096),SPSM(4096),DER(4096)                       GRE0847
      9.          COMMON ISTAR,IEND,INDEX,JMAX,FMEDIO                           GRE0848
     10.          COMMON AREA(50),ERR(50),FWHM(50)                              GRE0849
     11.          COMMON LS(50),CENTR(50),LD(50),PMOL(50)                       GRE0850
     12.          COMMON DECAY(10),VALA(10),PESO(10)                            GRE0851
     13.          COMMON TDEC1,TIRR,TCON,ALFA,BETA,FLUX,WEIGHT                  GRE0852
     14.          COMMON STAND(6,50),NELST,IREL                                 GRE0853
     15.          COMMON FWHT                                                   GRE0854
     16.  C                                                                     GRE0855
     17.          COMMON /ET1/ NIRR,IO(5),MO(5),ANOME(5),ASAMPL(3)              GRE0856
     18.          COMMON/ET2/PPM,ATOMI,PERC,AKEV,CPM,AREAO,UGM,LARG,H1,H2,J1    GRE0857
     19.          COMMON /ET5/ EL3(50),VS(50),P2(50),CS(50),VS2(50),VD2(50),CLS2(50)  GRE0858
     20.         1,CLD2(50),ISENS                                               GRE0859
     21.          COMMON /ET6/ EL2(50),VC(50),P1(50),CC(50),VS1(50),VD1(50),CLS1(50)  GRE0860
     22.         1,CLD1(50),IPICK                                               GRE0861
     23.          COMMON/ET7/C1,C2,JDOUB,KKK,IND2                               GRE0862
     24.          COMMON/ET8/FDEC,FSAT,DENS                                     GRE0863
     25.          COMMON/ET9/EL2D(50),VCD(50),P1D(50),CCD(50),V1D(50),CL1D(50),IPICD  GRE0864
     26.          COMMON/ET10/EL2REL(50),EL3REL(50),EL2DRE(50)                  GRE0865
     27.          DATA STAR /,STAR,/                                            GRE0866
     28.          DATA BLANK/,    ,/                                            GRE0867
     29.  C                                                                     GRE0868
     30.          IPICD=0                                                       GRE0869
     31.          IPICK=0                                                       GRE0870
     32.          ISENS=0                                                       GRE0871
     33.          IRIG=0                                                        GRE0872
     34.          FA=2.                                                         GRE0873
     35.          FB=1.2
```

```
      CALL PRINT(3,IRIG)
C
  200 IF(IREL.EQ.1) NLIB=NELST
      IF(ASAMPL(1).NE.STAN) GO TO 204
      DO 201 K=1,NELST
      XLAM(K)=STAND(4,K)
      EN(K)=STAND(2,K)
  201 FWT(K)=STAND(3,K)
  204 DO 3 J=1,NLIB
      JJJ=J
      J1=J
      FDEC=EXP(XLAM(J)*TDEC1)
      FSAT=1.-EXP(-XLAM(J)*TTRR)
      ENCH=(EN(J)-BETA)/ALFA
      FWHT=FWT(J)/ALFA
      ISTAR=(ENCH-FWHT*FA)
      IEND=(ENCH+FWHT*FA)
      H1=(ENCH-FWHT*FB)-0.5
      H2=(ENCH+FWHT*FB)+0.5
      L=1
      IF(ISTAR.GT.L.AND.IEND.LT.NCH) GO TO 7
C
      CALL PRINT(4,IRIG)
C
      GO TO 3
    7 CALL PKF(JJJ,III,IRIG)
      IF(JMAX.GT.0) GO TO 9
      IF(JDOUR.GT.0) GOTO 3
      IF(ASAMPL(1).NE.STAN) GO TO 10
      STAND(6,J)=BLANK
      PPM=BLANK
      GO TO 301
   10 CALL SENSIT(RAD)
      SENS=RAD/TCON
      AREA0=SENS*FDEC
      IF(ASAMPL(1).EQ.STAN) STAND(6,J)=AREA0/STAND(5,J)
      IF(IREL.EQ.1) GO TO 300
      UGM=AA(J)*AREA0/(FLUX*FSAT)
      PPM=UGM/WEIGHT
      ATOMI=6.02E17*UGM*DENS/(PMOL(J)*WEIGHT)
      GO TO 301
C
  300 IF(STAND(6,J).NE.BLANK) GO TO 299
      PPM=BLANK
      GO TO 301
  299 PPM=(1./STAND(6,J))*(AREA0/WEIGHT)
  301 CONTINUE
C     ***** I SEGUENTI VALORI VANNO NEL COMMON /ET5/ E SERVONO PER FIGUR
C
      IIN=H1+(H2-H1)/2
      ISENS=ISENS+1
      VS(ISENS)=COUNT(IIN)
      P2(ISENS)=EN(J)
      CS(ISENS)=IIN+0.5
      IF(IREL.EQ.1) GO TO 400
      EL3(ISENS)=ELEM(J)
      GO TO 401
  400 EL3REL(ISENS)=STAND(1,J)
  401 VS2(ISENS)=H1+0.5
      VD2(ISENS)=H2+0.5
      CLS2(ISENS)=COUNT(H1)
      CLD2(ISENS)=COUNT(H2)
C
      CALL PRINT(5,IRIG)
C
      GO TO 3
    9 CALL SURF(NCH,JS)
      DO 1 K=1,JMAX
      IF(AREA(K).GT.0) GO TO 8
      GO TO 10
    8 CPM=AREA(K)/TCON
      ERR1=ERR(K)/TCON
      PERC=ERR1*100./CPM
      AREA0=CPM*FDEC
      IF(ASAMPL(1).EQ.STAN) STAND(6,J)=AREA0/STAND(5,J)
      IF(IREL.EQ.1) GO TO 302
      UGM=AA(J)*AREA0/(FLUX*FSAT)
      PPM=UGM/WEIGHT
      ATOMI=6.02E17*UGM*DENS/(PMOL(J)*WEIGHT)
      GO TO 303
  302 IF(STAND(6,J).NE.BLANK) GO TO 298
      PPM=BLANK
```

```
                GO TO 303                                                                GRE0956
                                                                                         GRE0957
  298           PPM=(1./STAND(6,J))*(AREA0/WEIGHT)                                       GRE0958
  303           CONTINUE                                                                 GRE0959
                AKEV=CENTR(K)*ALFA+BETA                                                  GRE0960
                ENDIFF=EN(J)-AKEV                                                        GRE0961
                H1=LS(K)                                                                 GRE0962
                H2=LD(K)                                                                 GRE0963
                LARG=LD(K)-LS(K)+1                                                       GRE0964
                IK=CENTR(K)+0.5                                                          GRE0965
C                                                                                        GRE0966
C     ***** I SEGUENTI VALORI VANNO NEL COMMON /ET6/ E SERVONO PER ,FIGUR                GRE0967
C                                                                                        GRE0968
                IPICK=IPICK+1                                                            GRE0969
                IF(IREL.EQ.1) GO TO  402                                                 GRE0970
                EL2(IPICK)=ELEM(J)                                                       GRE0971
                GO TO 403                                                                GRE0972
  402           EL2REL(IPICK)=STAND(1,J)                                                 GRE0973
  403           CONTINUE                                                                 GRE0974
                VC(IPICK)=COUNT(IK)                                                      GRE0975
                P1(IPICK)=AKEV                                                           GRE0976
                CC(IPICK)=CENTR(K)                                                       GRE0977
                VS1(IPICK)=LS(K)                                                         GRE0978
                VD1(IPICK)=LD(K)                                                         GRE0979
                CLS1(IPICK)=COUNT(H1)                                                    GRE0980
                CLD1(IPICK)=COUNT(H2)                                                    GRE0981
C                                                                                        GRE0982
                IF(PERC.GT.50.) GO TO 40                                                 GRE0983
C                                                                                        GRE0984
                CALL PRINT(9,IRIG)                                                       GRE0985
C                                                                                        GRE0986
                GO TO 1                                                                  GRE0987
C                                                                                        GRE0988
   40           CALL PRINT(10,IRIG)                                                      GRE0989
    1           CONTINUE                                                                 GRE0990
    3           CONTINUE                                                                 GRE0991
C                                                                                        GRE0992
                IF(ASAMPL(1).NE.STAN) GO TO 202                                          GRE0993
                WRITE (6,2001)                                                           GRE0994
                DO 3000 K=1,NELST                                                        GRE0995
                IF(STAND(6,K).NE.BLANK) GO TO 297                                        GRE0996
                WRITE (6,2002) STAND(1,K),STAND(2,K),STAND(3,K),STAND(4,K),STAND(5       GRE0997
               1,K),STAND(6,K)                                                           GRE0998
                GO TO 3000                                                               GRE0999
  297           WRITE (6,2000) STAND(1,K),STAND(2,K),STAND(3,K),STAND(4,K),STAND(5       GRE1000
               1,K),STAND(6,K)                                                           GRE1001
 3000           CONTINUE                                                                 GRE1002
C                                                                                        GRE1003
 2000           FORMAT (1H0,A4,6X,F7.2,F7.3,3X,1PE9.3,2(2X,E9.3))                        GRE1004
 2001           FORMAT (1H1,,LIBRERIA  METODO  RELATIVO,///, ELEM,,5X,,EN(KEV) RES       GRE1005
               1(KEV)  DEC(MIN),,5X,,UGM,,6X,,CPM0/UGM,//)                               GRE1006
 2002           FORMAT(1H0,A4,6X,F7.2,F7.3,3X,1PE9.3,2X,E9.3,7X,A4)                      GRE1007
  202           RETURN                                                                   GRE1008
                END
```

```
IN 485 IBANK 211 DBANK 14774 COMMON
S  SPECTRA.PKE
R1   *06/16/82-22:12(2,)
     1.         SUBROUTINE PKE(JJJ,III,IRIG)                                          GRE1010
     2.         REAL*8 EL1,ELEM,EL2D                                                  GRE1011
     3.         INTEGER   H1,H2                                                       GRE1012
     4.         COMMON EL1(10),EN1(10),ICAN(10),INT(10)                               GRE1013
     5.         COMMON ELEM(50),EN(50),FWT(50),XLAM(50),AA(50)                        GRE1014
     6.         COMMON COUNT(4096),SPSM(4096),DER(4096)                               GRE1015
     7.         COMMON ISTAR,IEND,INDEX,JMAX,EMEDIO                                   GRE1016
     8.         COMMON AREA(50),ERR(50),FWHM(50)                                      GRE1017
     9.         COMMON LS(50),CENTR(50),LD(50),PMOL(50)                               GRE1018
    10.         COMMON DECAY(10),VALA(10),PESO(10)                                    GRE1019
    11.         COMMON TDEC1,TIRR,TCON,ALFA,BETA,FLUX,WEIGHT                          GRE1020
    12.         COMMON STAND(6,50),NELST,IREL                                         GRE1021
    13.         COMMON FWHT                                                           GRE1022
    14.         COMMON/ET2/PPM,ATOMI,PERC,AKEV,CPM,AREA0,UGM,LARG,H1,H2,J1            GRE1023
    15.         COMMON/ET3/ENERG(50)                                                  GRE1024
    16.         COMMON/ET7/C1,C2,JDOUB,KKK,IND2                                       GRE1025
    17.         COMMON/ET8/FDEC,FSAT,DENS                                             GRE1026
    18.         COMMON/ET9/EL2D(50),VCD(50),P1D(50),CCD(50),V1D(50),CL1D(50),IPICD    GRE1027
    19.         DIMENSION SIGMA(50)                                                   GRE1028
    20.         DIMENSION IND(50)                                                     GRE1029
    21.  C                                                                            GRE1030
    22.  C                                                                            GRE1031
    23.           J1=JJJ                                                            GRE1032
    24.           JDOUB=0                                                           GRE1033
    25.           ITOUB=0                                                           GRE1034
```

```
      ITOUPE=0                                                          GRE1035
   12 CONE=1.5                                                          GRE1036
      I=ISTAR                                                           GRE1037
      JMAX=0                                                            GRE1038
   10 IL=I                                                              GRE1039
      ISW=-1                                                            GRE1040
    1 I=I+1                                                             GRE1041
      IF(I.GE.IEND) GOTO 6                                              GRE1042
      IF(DER(I)) 3,3,2                                                  GRE1043
    2 IF(ISW.GT.0) GO TO 1                                              GRE1044
      ISW=1                                                             GRE1045
      GO TO 1                                                           GRE1046
    3 IF(ISW.LT.0) GO TO 1                                              GRE1047
      ISW=-1                                                            GRE1048
      AMAX=-10.E+30
      AMIN=+10.E+30                                                     GRE1051
      J=I-1                                                             GRE1052
    7 IF(DER(J).LE.AMAX) GO TO 4                                        GRE1053
      AMAX=DER(J)                                                       GRE1054
      JL=J                                                              GRE1055
      J=J-1                                                             GRE1056
      GO TO 7                                                           GRE1057
    4 CONTINUE                                                          GRE1058
      J=I                                                               GRE1059
    8 IF(DER(J).GE.AMIN) GO TO 5                                        GRE1060
      AMIN=DER(J)                                                       GRE1061
      JR=J                                                              GRE1062
      J=J+1                                                             GRE1063
      GO TO 8                                                           GRE1064
    5 CONTINUE                                                          GRE1065
      A1=SPSM(JL+1)+SPSM(JL-1)                                          GRE1066
      A2=SPSM(JR+1)+SPSM(JR-1)                                          GRE1067
      IF(A1.LE.0.OR.A2.LE.0) GO TO 10                                   GRE1068
      SDEV1=CONE*SQRT(A1)/2.0                                           GRE1069
      SDEV2=CONE*SQRT(A2)/2.0                                           GRE1070
      AMIN=ABS(AMIN)                                                    GRE1071
      IF(AMIN.EQ.0.OR.AMAX.EQ.0)GOTO10                                  GRE1072
      VALMAX=AMAX1(AMAX,AMIN)                                           GRE1073
      VALMIN=AMIN1(AMAX,AMIN)                                           GRE1074
      RATIO=VALMAX/VALMIN                                               GRE1075
      IF(AMAX.LE.SDEV1.AND.AMIN.LE.SDEV2) GO TO 10                      GRE1076
      JMAX=JMAX+1                                                       GRE1077
C                                                                       GRE1078
C     POUR CHAQUE PIC RECHERCHE DE L,INDICE IND(JMAX)                   GRE1079
C                                                                       GRE1080
C     IF((AMAX.GT.SDEV1.AND.AMIN.GT.SDEV2).AND.(RATIO.LE.1.5)) GOTO 97  GRE1081
C                                                                       GRE1082
C     IF(AMAX.GT.SDEV1.AND.AMAX.GE.AMIN) GOTO 98                        GRE1083
C                                                                       GRE1084
C     IF(AMIN.GT.SDEV2.AND.AMIN.GE.AMAX) GOTO 99                        GRE1085
C                                                                       GRE1086
   97 IND(JMAX)=0                                                       GRE1087
      GOTO 100                                                          GRE1088
C                                                                       GRE1089
   98 IND(JMAX)=1                                                       GRE1090
      GOTO 100                                                          GRE1091
C                                                                       GRE1092
   99 IND(JMAX)=2                                                       GRE1093
C                                                                       GRE1094
C     CALCUL DES PARAMETRES                                             GRE1095
C                                                                       GRE1096
  100 FL=JL+(DER(JL-1)-DER(JL+1))*0.5/(DER(JL+1)-2.*DER(JL)+DER(JL-1))  GRE1097
      FR=JR+(DER(JR-1)-DER(JR+1))*0.5/(DER(JR+1)-2.*DER(JR)+DER(JR-1))  GRE1098
      IM=I-1                                                            GRE1099
      CENTR(JMAX)=IM-DER(IM)/(DER(I)-DER(IM))                           GRE1100
      CENTR1=CENTR(JMAX)                                                GRE1101
      SIGMA(JMAX)=(FR-FL)/2.0                                           GRE1102
      SIGMA1=SIGMA(JMAX)                                                GRE1103
      FWHM(JMAX)=SIGMA(JMAX)*2.355                                      GRE1104
      FWHM1=FWHM(JMAX)                                                  GRE1105
      INDICE=IND(JMAX)                                                  GRE1106
      I=JR                                                              GRE1107
C                                                                       GRE1108
C     VALABLE POUR LE PREMIER SPECTRE DE CALIBRATION                    GRE1109
C     EXCLUSION DES PICS DOUBLETS                                       GRE1110
C                                                                       GRE1111
      IF(III-1)102,103,102                                              GRE1112
  103 IF(IND(JMAX).EQ.1.OR.IND(JMAX).EQ.2)JMAX=JMAX-1                   GRE1113
      IF(JMAX.LT.0) JMAX=0                                              GRE1114
      GOTO 10                                                           GRE1115
  102 ENERG(JMAX)=CENTR(JMAX)*ALFA+BETA                                 GRE1116
      ENERG1=ENERG(JMAX)                                                GRE1117
```

```
      IF(IND(JMAX).EQ.2) GOTO400
      IF(IND(JMAX).EQ.1) GO TO 900
      IF(JMAX.EQ.1) GO TO 11
C
C     RECHERCHE SI LE PIC AVEC IND(JMAX)=0 FAIT PARTIE D'UN DOUBLET
C
      IF(IND(JMAX-1).EQ.1) GO TO 200
   11 IF(JMAX-50)10,6,6
  200 IF((CENTR(JMAX)-CENTR(JMAX-1)).GE.(2.0 * FWHT)) GOTO 300
      C1=CENTR(JMAX-1)
      C2=ISTAR
      JDOUB=1
      CALL SURF2(IRIG)
      GOTO 301
  300 IF(ITOURE.EQ.1) GOTO 800
  301 JMAX=JMAX-1
      CENTR(JMAX)=CENTR1
      FWHM(JMAX)=FWHM1
      SIGMA(JMAX)=SIGMA1
      IND(JMAX)=INDICE
      ENERG(JMAX)=ENERG1
      IF(ITOURE.EQ.1) GOTO 60
      GOTO10
C
C     ETUDE DU PIC AVEC IND(JMAX)=2
C     RETOUR EN ARRIERE DU CANAL DE DEPART DE L'INTERVALLE
C
  400 IF(JMAX.GT.1) GOTO 500
      IF(ITOUR.GT.0) GOTO 303
      ISTAR= CENTR1-5*FWHT
      ITOUR=ITOUR+1
      GOTO 12
C
C     RECHERCHE DU PIC DOUBLET
C     1) FORME UN PIC DOUBLET AVEC PIC NORMAL IND(JMAX)=0
C
  500 IF(IND(JMAX-1).EQ.1) GO TO 700
      IF((CENTR(JMAX)-CENTR(JMAX-1)).GE.(2.0 * FWHT)) GOTO 310
      C2=CENTR(JMAX)
      C1=IEND
      JDOUB=2
      CALL SURF2(IRIG)
  302 IF(ITOUR.NE.1) GOTO 303
      JMAX=JMAX-1
      ITOUR=ITOUR+1
      GOTO 10
  310 IF(ITOUR.NE.1) GOTO 303
      JMAX=JMAX-2
      ITOUR=ITOUR+1
      GOTO 10
  303 JMAX=JMAX-1
      GO TO 10
C     2) FORME UN PIC DOUBLET AVEC PIC  IND(JMAX)=1
C
  700 IF((CENTR(JMAX)-CENTR(JMAX-1)).GE.(2.0 * FWHT)) GOTO 801
      C1=CENTR(JMAX-1)
      C2=CENTR(JMAX)
      JDOUB=3
      CALL SURF2(IRIG)
  801 IF(ITOUR.NE.1) GOTO 800
      JMAX=0
      ITOUR=ITOUR+1
      GOTO 10
  800 JMAX=JMAX-2
      IF(ITOURE.EQ.1) GOTO 60
      GO TO 10
C
C     ETUDE DU PIC AVEC IND(JMAX)=1
C
  900 IF(JMAX.EQ.1) GO TO 10
      IF(IND(JMAX-1).EQ.1) GO TO 1000
      GO TO 11
 1000 JMAX=JMAX-1
      CENTR(JMAX)=CENTR1
      FWHM(JMAX)=FWHM1
      SIGMA(JMAX)=SIGMA1
      IND(JMAX)=INDICE
      ENERG(JMAX)=ENERG1
      GOTO10
    6 IF(JMAX.EQ.0) GOTO 60
      IF(IND(JMAX)-1) 60,62,60
```

```
GRE1117
GRE1118
GRE1119
GRE1120
GRE1121
GRE1122
GRE1123
GRE1124
GRE1125
GRE1126
GRE1127
GRE1128
GRE1129
GRE1130
GRE1131
GRE1132
GRE1133
GRE1134
GRE1135
GRE1136
GRE1137
GRE1138
GRE1139
GRE1140
GRE1141
GRE1142
GRE1143
GRE1144
GRE1145
GRE1146
GRE1147
GRE1148
GRE1149
GRE1150
GRE1151
GRE1152
GRE1153
GRE1154
GRE1155
GRE1156
GRE1157
GRE1158
GRE1159
GRE1160
GRE1161
GRE1162
GRE1163
GRE1164
GRE1165
GRE1166
GRE1167
GRE1168
GRE1169
GRE1170
GRE1171
GRE1172
GRE1173
GRE1174
GRE1175
GRE1176
GRE1177
GRE1178
GRE1179
GRE1180
GRE1181
GRE1182
GRE1183
GRE1184
GRE1185
GRE1186
GRE1187
GRE1188
GRE1189
GRE1190
GRE1191
GRE1192
GRE1193
GRE1194
GRE1195
GRE1196
GRE1197
GRE1198
GRE1199
```

```
C
C      BOND EN AVANT DU CANAL FINAL DE L'INTERVALLE
C
   62  IF(ITOURE.GT.0) GOTO 61
       IEND=CENTR1+5*FWHT
       ITOURE=ITOURE+1
       I=JR
       GOTO 10
   61  JMAX=JMAX-1
   60  CONTINUE
       RETURN
       END
```

485 IBANK 157 DBANK 13753 COMMON

SPECTRA.SURF

*06/16/82-22:13(2,)

```
      SUBROUTINE SURF(NCH,JS)
      REAL*8 EL1,ELEM
      COMMON EL1(10),EN1(10),ICAN(10),INT(10)
      COMMON ELEM(50),EN(50),FWT(50),XLAM(50),AA(50)
      COMMON COUNT(4096),SPSM(4096),DER(4096)
      COMMON ISTAR,IEND,INDEX,JMAX,FMEDIO
      COMMON AREA(50),ERR(50),FWHM(50)
      COMMON LS(50),CENTR(50),LD(50),PMOL(50)
      COMMON DECAY(10),VALA(10),PESO(10)
      COMMON TDEC1,TIRR,TCON,ALFA,BETA,FLUX,WEIGHT
      DIMENSION POUNT(4096)
C
      IF(JS.EQ.1) GO TO 20
      DO 30 J=1,NCH
   30 POUNT(J)=COUNT(J)
      GO TO 40
C
   20 DO 10 I=1,NCH
   10 POUNT(I)=SPSM(I)
C
   40 DO 1 J=1,JMAX
      IC=CENTR(J)+0.5
      IL=IC-1
      IR=IC+1
      W=SQRT(POUNT(IC))
      W=POUNT(IC)-W
      IND=0
      AR=POUNT(IC)
      IF(POUNT(IC-1).LT.W) GO TO 2
      IND=1
    2 IF(POUNT(IC+1).LT.W) GO TO 3
      IF(IND.EQ.1) GO TO 4
      AR=AR+POUNT(IC+1)
      IR=IR+1
    3 IF(IND.EQ.0) GO TO 4
      AR=AR+POUNT(IC-1)
      IL=IL-1
    4 CONTINUE
      A=POUNT(IL)+POUNT(IR)
      INTV=CENTR(J)+FWHM(J)*2.1231+0.5
      DO 5 I=IC,INTV
      AR=AR+A
      IR=IR+1
      IL=IL-1
      A1=POUNT(IR)+POUNT(IL)
      IF(A1.GT.A) GO TO 6
      A=A1
    5 CONTINUE
    6 HM=IR-IL-1
      A2=(POUNT(IR-1)+POUNT(IL+1))/2.
      FONDO=A2*HM
      LD(J)=IR-1
      LS(J)=IL+1
      AREA(J)=AR-FONDO
      ERR(J)=SQRT(AR+HM*FONDO/2.0)
    1 CONTINUE
      RETURN
      END
```

IN 186 IBANK 4137 DBANK 13030 COMMON

S SPECTRA.SURF2

R1 *06/16/82-22:13(4,)

```
      SUBROUTINE SURF2(IR,IG)
      REAL*8 EL1,ELEM,EL2D
      INTEGER H1,H2
      COMMON EL1(10),EN1(10),ICAN(10),INT(10)
```

```
      COMMON ELEM(50),EN(50),EWT(50),XLAM(50),AA(50)                    GRE1275
      COMMON COUNT(4096),SPSM(4096),DER(4096)                           GRE1276
      COMMON ISTAR,IEND,INDEX,JMAX,EMEDIO                              GRE1277
      COMMON AREA(50),ERR(50),FWHM(50)                                  GRE1278
      COMMON LS(50),CENTR(50),LD(50),PMOL(50)                           GRE1279
      COMMON DECAY(10),VALA(10),PESO(10)                                GRE1280
      COMMON IDEC1,TIRR,TCON,ALFA,BETA,FLUX,WEIGHT                      GRE1281
      COMMON STAND(6,50),NELST,IREL                                     GRE1282
      COMMON EWHT                                                       GRE1283
      COMMON/ET1/NIRR,IQ(5),MQ(5),ANOME(5),ASAMPL(3)                    GRE1284
      COMMON/ET2/PPM,ATOMI,PERC,AKEV,CPM,AREAQ,UGM,LARG,H1,H2,J1        GRE1285
      COMMON/ET3/ENERG(50)                                              GRE1286
      COMMON/ET7/C1,C2,JDOUB,KKK,IND2                                   GRE1287
      COMMON/ET8/EDEC,ESAT,DENS                                         GRE1288
      COMMON/ET9/EL2D(50),VCD(50),P1D(50),CCD(50),V1D(50),CL1D(50),IPICD GRE1289
      COMMON/ET10/EL2REL(50),EL3REL(50),EL2DRE(50)                      GRE1290
      DIMENSION SIGMA(50)                                               GRE1291
      DATA STAN /'STAN'/                                                GRE1292
      DATA BLANK/'    '/                                                GRE1293
C                                                                       GRE1294
      JJJ=J1                                                            GRE1295
      IC1=C1                                                            GRE1296
      IC2=C2                                                            GRE1297
      JC1=IC1+1                                                         GRE1298
      JC2=IC2+1                                                         GRE1299
      ASPM1=AMAX1(SPSM(IC1),SPSM(JC1))                                  GRE1300
      ASPM2=AMAX1(SPSM(IC2),SPSM(JC2))                                  GRE1301
      IF(ASPM1.NE.SPSM(IC1)) IC1=JC1                                    GRE1302
      IF(ASPM2.NE.SPSM(IC2))IC2=JC2                                     GRE1303
      IND=1                                                             GRE1304
      GOTO(10,20,30),JDOUB                                              GRE1305
   30 JDOUB=2                                                           GRE1306
      DO1 K1=1,JDOUB                                                    GRE1307
      KKK=K1                                                            GRE1308
      GOTO (11,21),KKK                                                  GRE1309
   10 DO1 K2=1,JDOUB                                                    GRE1310
      KKK=K2                                                            GRE1311
   11 AR=SPSM(IC1)                                                      GRE1312
      W=AR                                                              GRE1313
      IL=IC1-1                                                          GRE1314
      IPICD=IPICD+1                                                     GRE1315
      GOTO 4                                                            GRE1316
   20 DO1 K3=2,JDOUB                                                    GRE1317
      KKK=K3                                                            GRE1318
   21 AR=SPSM(IC2)                                                      GRE1319
      W=AR                                                              GRE1320
      IL=IC2+1                                                          GRE1321
      IND=1                                                             GRE1322
      IPICD=IPICD+1                                                     GRE1323
    4 IF(W-SPSM(IL))2,3,3                                               GRE1324
    3 IND=IND+1                                                         GRE1325
      AR=AR+SPSM(IL)                                                    GRE1326
      W=SPSM(IL)                                                        GRE1327
      GOTO (40,50),KKK                                                  GRE1328
   40 IL=IL-1                                                           GRE1329
      GOTO 4                                                            GRE1330
   50 IL=IL+1                                                           GRE1331
      GOTO 4                                                            GRE1332
    2 AR=AR*2                                                           GRE1333
      IF(KKK.NE.1) GOTO 60                                              GRE1334
      IL=IL+1                                                           GRE1335
      AR=AR-SPSM(IC1)                                                   GRE1336
C                                                                       GRE1337
      IF(IREL.EQ.1) GO TO 202                                           GRE1338
      EL2D(IPICD)=ELEM(JJJ)                                             GRE1339
      GO TO 203                                                         GRE1340
  202 EL2DRE(IPICD)=STAND(1,JJJ)                                        GRE1341
  203 VCD(IPICD)=COUNT(IC1)                                             GRE1342
      P1D(IPICD)=ENERG(JMAX-1)                                          GRE1343
      CCD(IPICD)=C1                                                     GRE1344
      V1D(IPICD)=IL                                                     GRE1345
      CL1D(IPICD)=COUNT(IL)                                             GRE1346
C                                                                       GRE1347
      GOTO 70                                                           GRE1348
   60 AR=AR-SPSM(IC2)                                                   GRE1349
      IL=IL-1                                                           GRE1350
C                                                                       GRE1351
      IF(IREL.EQ.1) GO TO 200                                           GRE1352
      EL2D(IPICD)=ELEM(JJJ)                                             GRE1353
      GO TO 201                                                         GRE1354
  200 EL2DRE(IPICD)=STAND(1,JJJ)                                        GRE1355
  201 VCD(IPICD)=COUNT(IC2)                                             GRE1356
```

```
                P1D(IPICD)=ENERG(JMAX)                                          GRE1357
                CCD(IPICD)=C2                                                   GRE1358
                V1D(IPICD)=IL                                                   GRE1359
                CL1D(IPICD)=COUNT(IL)                                           GRE1360
      C                                                                         GRE1361
           70   FIND=IND*2                                                      GRE1362
                FIND=FIND-1                                                     GRE1363
                FOND=W*FIND                                                     GRE1364
                ARES=AR-FOND                                                    GRE1365
                CPM=ARES/TCON                                                   GRE1366
                ERS=SQRT(AR+FIND*FOND/2.0)                                      GRE1367
                ERR1=ERS/TCON                                                   GRE1368
                PERC=ERR1*100./CPM                                              GRE1369
                AREAO=CPM+FDEC                                                  GRE1370
                IF(ASAMPL(1).EQ.STAN) STAND(6,JJJ)=AREAO/STAND(5,JJJ)           GRE1371
                IF(IREL.EQ.1) GO TO 100                                         GRE1372
                UGM=AA(JJJ)*AREAO/(FLUX*FSAT)                                   GRE1373
                PPM=UGM/WEIGHT                                                  GRE1374
                ATOMI=6.02E17*UGM*DENS/(PMOL(JJJ)*WEIGHT)                       GRE1375
                GO TO 101                                                       GRE1376
           100  IF(STAND(6,JJJ).NE.BLANK) GO TO 99                             GRE1377
                PPM=BLANK                                                       GRE1378
                GO TO 101                                                       GRE1379
            99  PPM=(1./STAND(6,JJJ))*(AREAO/WEIGHT)                           GRE1380
      C                                                                         GRE1381
           101  H1=IL                                                           GRE1382
                IF(KKK.EQ.1) LARG=IC1-IL                                        GRE1383
                IF(KKK.EQ.2) LARG=IL-IC2                                        GRE1384
                IF(KKK.EQ.1) IWR=6                                              GRE1385
                IF(KKK.EQ.2) IWR=7                                              GRE1386
                CALL PRINT(IWR,IPIG)                                            GRE1387
              1 CONTINUE                                                        GRE1388
                RETURN                                                          GRE1389
                END                                                             GRE1390

TN 363 IBANK 99 DBANK 13922 COMMON
S  SPECTRA.SENSIT
R1   *06/16/82-22:13(2,)
        1.      SUBROUTINE SENSIT(RAD)
        2.      INTEGER   H1,H2
        3.      REAL*8 EL1,ELEM                                                 GRE1394
        4.      COMMON EL1(10),EN1(10),ICAN(10),INT(10)                         GRE1395
        5.      COMMON ELEM(50),EN(50),FWT(50),XLAM(50),AA(50)                  GRE1396
        6.      COMMON COUNT(4096),SPSM(4096),DER(4096)                         GRE1397
        7.      COMMON ISTAR,IEND,INDEX,JMAX,EMEDIO                             GRE1398
        8.      COMMON AREA(50),ERR(50),FWHM(50)                                GRE1399
        9.      COMMON LS(50),CENTR(50),LD(50),PMOL(50)                         GRE1400
       10.      COMMON DECAY(10),VALA(10),PESO(10)                              GRE1401
       11.      COMMON IDEC1,TIRR,TCON,ALFA,BETA,FLUX,WEIGHT                    GRE1402
       12.      COMMON/ET2/PPM,ATOMI,PERC,AKEV,CPM,AREAO,UGM,LARG,H1,H2,J1      GRE1403
       13.  C                                                                   GRE1404
       14.      SP=0.                                                           GRE1405
       15.      CAPPA=4./1.06                                                   GRE1406
       16.      DO 1 J=H1,H2                                                    GRE1407
       17.    1 SP=SP+COUNT(J)                                                  GRE1408
       18.      RAD=CAPPA*(1.+SQRT(1.+2.*SP))                                   GRE1409
       19.      RETURN                                                          GRE1410
       20.      END                                                             GRE1411

TN 34 IBANK 16 DBANK 13041 COMMON
S  SPECTRA.PRINT
R1   *06/16/82-22:13(2,)
        1.      SUBROUTINE PRINT(IWR,IPIG)
        2.  C   **********  IN QUESTA ROUTINE SI FANNO TUTTE LE STAMPE  **********  GRE1414
        3.  C                                                                   GRE1415
        4.      REAL*8 EL1,ELEM,EL2D                                            GRE1416
        5.      INTEGER   H1,H2                                                 GRE1417
        6.  C                                                                   GRE1418
        7.      COMMON EL1(10),EN1(10),ICAN(10),INT(10)                         GRE1419
        8.      COMMON ELEM(50),EN(50),FWT(50),XLAM(50),AA(50)                  GRE1420
        9.      COMMON COUNT(4096),SPSM(4096),DER(4096)                         GRE1421
       10.      COMMON ISTAR,IEND,INDEX,JMAX,EMEDIO                             GRE1422
       11.      COMMON AREA(50),ERR(50),FWHM(50)                                GRE1423
       12.      COMMON LS(50),CENTR(50),LD(50),PMOL(50)                         GRE1424
       13.      COMMON DECAY(10),VALA(10),PESO(10)                              GRE1425
       14.      COMMON IDEC1,TIRR,TCON,ALFA,BETA,FLUX,WEIGHT                    GRE1426
       15.      COMMON STAND(6,50),NELST,IREL                                   GRE1427
       16.      COMMON/ET1/NIRR,IO(5),MO(5),ANOME(5),ASAMPL(3)                  GRE1428
       17.      COMMON/ET2/PPM,ATOMI,PERC,AKEV,CPM,AREAO,UGM,LARG,H1,H2,J1      GRE1429
       18.      COMMON/ET3/ENERG(50)                                            GRE1430
       19.      COMMON/ET7/C1,C2,JDOUB,KKK,IND2                                 GRE1431
       20.      COMMON/ET9/EL2D(50),VCD(50),P1D(50),CCD(50),V1D(50),CL1D(50),IPICD  GRE1432
```

```
      DATA BLANK/'    '/                                                    GRE1433
C                                                                           GRE1434
      JJJ=J1                                                                GRE1435
      J=J1                                                                  GRE1436
      IF(IRIG-53) 20,21,21                                                  GRE1437
   21 WRITE (6,906)                                                         GRE1438
      IRIG=0                                                                GRE1439
      WRITE (6,902)                                                         GRE1440
      WRITE (6,900)                                                         GRE1441
      WRITE(6,901)                                                          GRE1442
      WRITE (6,900)                                                         GRE1443
      WRITE (6,902)                                                         GRE1444
      IRIG=IRIG+5                                                           GRE1445
C                                                                           GRE1446
   20 GO TO(1,2,3,4,5,6,7,8,9,10),IWP                                       GRE1447
C                                                                           GRE1448
    1 CONTINUE                                                              GRE1449
      WRITE (6,1008) NIRR,TIRR,(TO(K),K=1,5),FLUX                           GRE1450
      WRITE (6,1009) TCON,(MO(K),K=1,5),TDEC1                               GRE1451
      WRITE (6,1012) (ASAMPL(K),K=1,3),(ANOME(K),K=1,5)                     GRE1452
      WRITE (6,1011)                                                        GRE1453
      GO TO 100                                                             GRE1454
C                                                                           GRE1455
    2 CONTINUE                                                              GRE1456
      WRITE (6,1008) NIRR,TIRR,(TO(K),K=1,5),FLUX                           GRE1457
      WRITE (6,1009) TCON,(MO(K),K=1,5),TDEC1                               GRE1458
      WRITE (6,1010) (ASAMPL(K),K=1,3),WEIGHT,ALFA,BETA,(ANOME(K),K=1,5)    GRE1459
      WRITE (6,1011)                                                        GRE1460
      GO TO 100                                                             GRE1461
C                                                                           GRE1462
    3 IRIG=0                                                                GRE1463
      WRITE (6,902)                                                         GRE1464
      WRITE (6,900)                                                         GRE1465
      WRITE (6,901)                                                         GRE1466
      WRITE (6,900)                                                         GRE1467
      WRITE (6,902)                                                         GRE1468
      IRIG=IRIG+5                                                           GRE1469
      GO TO 100                                                             GRE1470
C                                                                           GRE1471
    4 CONTINUE                                                              GRE1472
      WRITE (6,900)                                                         GRE1473
      IF(IREL.EQ.1) GO TO 200                                               GRE1474
      WRITE (6,904) ELEM(J),EN(J)                                           GRE1475
      GO TO 201                                                             GRE1476
  200 WRITE(6,1904) STAND(1,J),EN(J)                                        GRE1477
  201 IRIG=IRIG+2                                                           GRE1478
      GO TO 100                                                             GRE1479
C                                                                           GRE1480
    5 CONTINUE                                                              GRE1481
      WRITE (6,900)                                                         GRE1482
      IF(IREL.EQ.1) GO TO 202                                               GRE1483
      WRITE (6,905) ELEM(J),PPM,AA(J),EN(J),ATOMI                           GRE1484
      GO TO 203                                                             GRE1485
  202 IF(PPM.NE.BLANK) GO TO 300                                            GRE1486
      WRITE(6,900)                                                          GRE1487
      WRITE(6,3000) STAND(1,J),EN(J)                                        GRE1488
      GO TO 203                                                             GRE1489
  300 WRITE(6,1905) STAND(1,J),PPM,EN(J)                                    GRE1490
  203 IRIG=IRIG+2                                                           GRE1491
      GO TO 100                                                             GRE1492
C                                                                           GRE1493
    6 CONTINUE                                                              GRE1494
      WRITE(6,900)                                                          GRE1495
      IF(IREL.EQ.1) GO TO 204                                               GRE1496
      WRITE(6,909) ELEM(JJJ),PPM,PERC,AA(JJJ),EN(JJJ),ENERG(JMAX-1),H1,L    GRE1497
     1ARG,CPM,ENERG(JMAX-1),ENERG(JMAX),ATOMI                               GRE1498
      GO TO 205                                                             GRE1499
  204 IF(PPM.NE.BLANK) GO TO 301                                            GRE1500
      WRITE(6,900)                                                          GRE1501
      WRITE(6,3000) STAND(1,JJJ),EN(JJJ)                                    GRE1502
      GO TO 205                                                             GRE1503
  301 WRITE(6,1909) STAND(1,JJJ),PPM,PERC,EN(JJJ),ENERG(JMAX-1),H1,LARG,    GRE1504
     1CPM,ENERG(JMAX-1),ENERG(JMAX)                                         GRE1505
  205 IRIG=IRIG+2                                                           GRE1506
      GO TO 100                                                             GRE1507
C                                                                           GRE1508
    7 CONTINUE                                                              GRE1509
      WRITE(6,900)                                                          GRE1510
      IF(IREL.EQ.1) GO TO 206                                               GRE1511
      WRITE(6,910) ELEM(JJJ),PPM,PERC,AA(JJJ),EN(JJJ),ENERG(JMAX),H1,LAR    GRE1512
     1G,CPM,ENERG(JMAX-1),ENERG(JMAX),ATOMI                                 GRE1513
      GO TO 207                                                             GRE1514
```

```
  206 IF(PPM.NE.BLANK) GO TO 302                                        GRE1515
      WRITE(6,900)                                                      GRE1516
      WRITE(6,3000) STAND(1,JJJ),EN(JJJ)                                GRE1517
      GO TO 207                                                         GRE1518
  302 WRITE(6,1910) STAND(1,JJJ),PPM,PERC,EN(JJJ),ENERG(JMAX),H1,LARG,CP GRE1519
     1M,ENERG(JMAX-1),ENERG(JMAX)                                       GRE1520
  207 IRIG=IRIG+2                                                       GRE1521
      GO TO 100                                                         GRE1522
C                                                                       GRE1523
    8 CONTINUE                                                          GRE1524
      WRITE(6,900)                                                      GRE1525
      IRIG=IRIG+2                                                       GRE1526
      GO TO 100                                                         GRE1527
C                                                                       GRE1528
    9 CONTINUE                                                          GRE1529
      WRITE (6,900)                                                     GRE1530
      IF(IREL.EQ.1) GO TO 208                                           GRE1531
      WRITE (6,903) ELEM(J),PPM,PERC,AA(J),EN(J),AKEV,H1,LARG,CPM,AREA0,GRE1532
     1UGM,ATOMI                                                         GRE1533
      GO TO 209                                                         GRE1534
  208 IF(PPM.NE.BLANK) GO TO 303                                        GRE1535
      WRITE(6,900)                                                      GRE1536
      WRITE(6,3000) STAND(1,J),EN(J)                                    GRE1537
      GO TO 209                                                         GRE1538
  303 WRITE(6,1903) STAND(1,J),PPM,PERC,EN(J),AKEV,H1,LARG,CPM,AREA0    GRE1539
  209 IRIG=IRIG+2                                                       GRE1540
      GO TO 100                                                         GRE1541
C                                                                       GRE1542
   10 CONTINUE                                                          GRE1543
      WRITE (6,900)                                                     GRE1544
      IF(IREL.EQ.1) GO TO 210                                           GRE1545
      WRITE (6,907) ELEM(J),PPM,PERC,AA(J),EN(J),AKEV,H1,LARG,CPM,AREA0,GRE1546
     1UGM,ATOMI                                                         GRE1547
      GO TO 211                                                         GRE1548
  210 IF(PPM.NE.BLANK) GO TO 304                                        GRE1549
      WRITE(6,900)                                                      GRE1550
      WRITE(6,3000) STAND(1,J),EN(J)                                    GRE1551
      GO TO 211                                                         GRE1552
  304 WRITE(6,1907) STAND(1,J),PPM,PERC,EN(J),AKEV,H1,LARG,CPM,AREA0    GRE1553
  211 IRIG=IRIG+2                                                       GRE1554
C                                                                       GRE1555
C                                                                       GRE1556
  900 FORMAT (1H ,,I,,10X,,I,,11X,,I,,9X,,I I,,11X,,I,,9X,,I,,9X,,I,,10X GRE1557
     1,,I,,11X,,I,,11X,,I,,11X,,I,)                                    GRE1558
  901 FORMAT (1H ,,I   ELEM   I   P.P.M.  I ERR.0/0 I I VALORE A  I KEV  GRE1559
     1(I) I KEV (S) I  LS   WT I   C P M   I AREA ZERO I    UGM    I  A GRE1560
     2T/CC    I,)                                                      GRE1561
  902 FORMAT(1H ,,I----------I----------I----------I I----------I------ GRE1562
     1---I---------I---------I---------I---------I----------I----------I----- GRE1563
     2------I,)                                                         GRE1564
  903 FORMAT (1H ,,I ,,A8,, I ,,1PE9.3,, I ,,0PF6.2,,  I I ,,1PF9.3,, I GRE1565
     1,,0PF7.2,, I ,,F7.2,, I ,,2I4,, I ,,1PF9.3,, I ,,E9.3,, I ,,F9.3,, GRE1566
     2 I ,,E9.3,, I,)                                                   GRE1567
  904 FORMAT (1H ,,I ,,A8,, I OUT SCALE I,,9X,,I I,,11X,,I ,,F7.2,, I ,, GRE1568
     18X,,I,,10X,,I,,11X,,I,,11X,,I,,11X,,I,,11X,,I,)                  GRE1569
  905 FORMAT (1H ,,I ,,A8,, I(,,1PE9.3,,)I,,9X,,I I ,,E9.3,, I ,,0PF7.2, GRE1570
     1, I,,9X,,I,,10X,,I,,11X,,I,,11X,,I,,11X,,I ,,1PE9.3,, I,)        GRE1571
  906 FORMAT(1H1)                                                       GRE1572
  907 FORMAT (1H ,,I ,,A8,, I ,,1PE9.3,, I ,,0PF6.2,,  I*I ,,1PE9.3,, I GRE1573
     1,,0PF7.2,, I ,,F7.2,, I ,,2I4,, I ,,1PE9.3,, I ,,E9.3,, I ,,F9.3,, GRE1574
     2 I ,,E9.3,, I,)                                                   GRE1575
  909 FORMAT (1H ,,I ,,A8,, I ,,1PE9.3,, I ,,0PF6.2,,  I I ,,1PE9.3,, I GRE1576
     1,,0PF7.2,, I ,,F7.2,, I ,,2I4,, I ,,1PE9.3,, I,,,PRIMO (,,0PF7.2,1 GRE1577
     2X,F7.2,),,,I ,,1PE9.3,, I,)                                       GRE1578
  910 FORMAT (1H ,,I ,,A8,, I ,,1PE9.3,, I ,,0PF6.2,,  I I ,,1PE9.3,, I GRE1579
     1,,0PF7.2,, I ,,F7.2,, I ,,2I4,, I ,,1PE9.3,, I,,,SECOND(,,0PF7.2,1 GRE1580
     2X,F7.2,),,,I ,,1PE9.3,, I,)                                       GRE1581
 1008 FORMAT (1H ,,- IRRAGGIAMENTO -,,I7,2X,F12.3,,  MINUTI    DATA ,,5I GRE1582
     15,5X,,FLUSSO,,3X,1PE10.4/)                                        GRE1583
 1009 FORMAT (1H ,,- MISURA -  TEMPO CONTEGGIO  ,,F8.3,,  MINUTI    DAT GRE1584
     1A ,,5I5,5X,,DECADIMENTO ,,F12.3,,  MINUTI,/)                      GRE1585
 1010 FORMAT (1H ,,- CAMPIONE -,,2X,3A4,5X,,PESO  ,,F12.8,, G     CALIB. GRE1586
     1    Y=,,F7.3,,*X+,,F8.3,8X,,PROBLEMA   ,,5A4)                    GRE1587
 1011 FORMAT (1H ,93X,,------------------------------,/)                GRE1588
 1012 FORMAT (1H ,,- CAMPIONE -,,2X,3A4,67X,,PROBLEMA   ,,5A4)          GRE1589
C                                                                       GRE1590
 1903 FORMAT(1H ,,I ,,A4,4X,, I ,,1PE9.3,, I ,,0PF6.2,,  I I ,,9X,, I ,, GRE1591
     1F7.2,, I ,,F7.2,, I ,,2I4,, I ,,1PE9.3,, I ,,E9.3,, I ,,9X,, I ,,9 GRE1592
     2X,, I,)                                                           GRE1593
 1904 FORMAT(1H ,,I ,,A4,4X,, I OUT SCALE I,,9X,,I I,,11X,,I ,,F7.2,, I GRE1594
     1,,8X,,I,,10X,,I,,11X,,I,,11X,,I,,11X,,I,,11X,,I,)                GRE1595
 1905 FORMAT (1H ,,I ,,A4,4X,, I(,,1PE9.3,,)I,,9X,,I I ,,9X,, I ,,0PF7.2 GRE1596
```

```
 185:      1907 FORMAT(1H ,I ,9X,,I ,,10X,,A4,,4X,,I ,,11X,,I ,,11X,,I ,,11X,,I ,)                    : GRE1597
 186:      1908 FORMAT(1H ,I ,,A4,,4X,,I ,,1PE9.3,,I ,,0PF6.2,,,I*I ,,9X,,,I ,,                      : GRE1598
 187:          1F7.2,,,I ,,F7.2,,,I ,,2I4,,,I ,,1PE9.3,,I ,,E9.3,,,I ,,9X,,,I ,,9                    : GRE1599
 188:          2X,,,I,)                                                                               : GRE1600
 189:      1909 FORMAT(1H ,,I ,,A4,,4X,,I ,,1PE9.3,,I ,,0PF6.2,,,I I ,,9X,,,I ,,                     : GRE1601
 190:          1F7.2,,,I ,,F7.2,,,I ,,2I4,,,I ,,1PE9.3,,I,,PRIMO (,,0PF7.2,1X,F7                     : GRE1602
 191:          2.2,,),,,I ,,9X,,,I,)                                                                  : GRE1603
 192:      1910 FORMAT(1H ,,I ,,A4,,4X,,I ,,1PE9.3,,I ,,0PF6.2,,,I I ,,9X,,,I ,,                     : GRE1604
 193:          1F7.2,,,I ,,F7.2,,,I ,,2I4,,,I ,,1PE9.3,,I,,SECOND(,,0PF7.2,1X,F7                     : GRE1605
 194:          2.2,,),,,I ,,9X,,,I,)                                                                  : GRE1606
 195:      3000 FORMAT(1H+,2X,A4,43X,F7.2)                                                            : GRE1607
 196:     C                                                                                           : GRE1608
 197:        100 RETURN                                                                               : GRE1609
 198:            END                                                                                  : GRE1610
 199:
```

```
N 255 IBANK 1217 DBANK 13768 COMMON
 SPECTRA.
 28R1 E35 S74T11 06/16/82 22:13:21
EP. GRETHEL*SPECTRA(1) 16 REL 18 ENTRY PT(S) 1 DUP(S)
N ,SPECTRA.MAIN
R1 S74T11 06/16/82 22:13:22

P.  ERRORS: 0  TIME: 34.292  STORAGE: 19328/6/037777/077777
SPECTRA.MAIN
```

APPENDIX J

LISTING OF THE INPUT DATA FOR SAMPLE PROBLEM

```
        0    31    59    90   120   151   181   212   243   273   304   334
        6
 EU1     245.0  245     51.0550E-071.2860E+06
 EU2     344.0  344     51.0550E-071.2860E+06
 EU3     778.4  778     51.0550E-071.2860E+06
 EU4     963.5  964     51.0550E-071.2860E+06
 CO2    1332.4 1333     52.4960E-073.7600E+06
 EU5    1408.0 1409     51.0550E-071.2860E+06
       12  2048       5       9       2       1
       20
 CF     145.40      3.001.592E-051.660E+02
 CO    1332.48      3.202.496E-074.900E+00
 CR     320.08      3.071.730E-059.000E+00
 CS     795.80      3.125.980E-071.500E+00
 EU    1408.11      3.221.955E-071.500E+00
 HF     482.60      3.101.969E-057.500E+00
 HG     279.20      3.001.935E-054.400E-02
 IN    1300.00      3.209.320E-063.900E-02
 NI     810.81      3.106.750E-066.400E+00
 RB    1076.60      3.153.320E-052.340E+02
 SB    1691.00      3.258.030E-065.300E-02
 SC     889.25      3.125.675E-053.900E+00
 TA    1221.60      3.234.185E-069.100E-01
 TB     879.33      3.106.592E-065.200E-01
 TH     311.90      3.051.780E-052.520E+01
 YB     197.80      3.001.500E-051.000E+00
 ZN    1115.51      3.171.964E-067.490E+01
 ZR     765.80      3.107.404E-063.160E+02
 BA     216.00      3.004.150E-051.950E+03
 FE    1099.27      3.171.960E-051.888E+04
  1974   12  15  24  00     91    2400.0  ALFALFA                   1 2 0
  1975    1   7  19  30 CALIB             1.0                       1 2 0
  1975    1   9  10  00STANG2*            0.001889                  1 2 0
  1975    1  22  15  00 ALFA 374          0.0527                    1 2 0
  1975    1  23   8  00 ALFA 656          0.0563                    1 2 0
  1975    1  23  14  30 ALFA 154          0.0615                    1 2 0
  1975    1  24   7  30 ALFA 10           0.0479                    1 2 0
  1975    1  25   0  30 ALFA 756          0.057                     1 2 0
  1975    1  25  17  30 ALFA 515          0.0623                    1 2 0
  1975    1  26  11  30 ALFA 888          0.0572                    1 2 0
  1975    1  27   4  30 ALFA 274          0.055                     1 2 0
  1975    1  28  21  30 ALFA 467          0.0622                    1 2 0
  1975    1  29  18  45 ALFA 910          0.0632
```

APPENDIX K

LISTING OF THE OUTPUT OF SAMPLE PROBLEM

SPETTRO N. 1 CANALI 2048 TCON 13.333 MINUTI DATA 1975 1 7 10 30 DECAD 32310.000 MIN

	1	2	3	4	5	6	7	8	9	10
0	800.	12.	13.	48.	172.	194.	146.	136.	72.	60.
1	35.	12.	5.	4.	7.	1.	4.	4.	4.	1.
2	5.	5.	1.	1.	2.	3.	4.	8.	13.	24.
3	30.	47.	70.	107.	153.	238.	360.	608.	1540.	5366.
4	9281.	8653.	6401.	4840.	4008[illegible].	3777.	3494.	2953.	2563.	3276.
5	2082.	1964.	1944.	1994.	2069.	2050.	2043.	2016.	2102.	2177.
6	2138.	2102.	2170.	2145.	2254.	2208.	2243.	2353.	2336.	2252.
7	2230.	2361.	2324.	2336.	2347.	2472.	2477.	2459.	2458.	2405.
8	2412.	2469.	2423.	2471.	2429.	2556.	2565.	2571.	2678.	2622.
9	2601.	2702.	2661.	2607.	2609.	2676.	2678.	2602.	2580.	2711.
10	2718.	2723.	2685.	2736.	2660.	2780.	2791.	2743.	2600.	2737.
11	2773.	2727.	2848.	2802.	2762.	2710.	2631.	2633.	2565.	2504.
12	2664.	3389.	6078.	9154.	7935.	4140.	2147.	1690.	1527.	1515.
13	1521.	1519.	1482.	1576.	1588.	1540.	1515.	1541.	1530.	1558.
14	1569.	1478.	1547.	1599.	1461.	1513.	1524.	1593.	1501.	1521.
15	1486.	1557.	1508.	1525.	1485.	1446.	1520.	1518.	1434.	1474.
16	1559.	1454.	1414.	1409.	1363.	1298.	1348.	1293.	1358.	1307.
17	1352.	1307.	1355.	1301.	1312.	1313.	1306.	1357.	1348.	1345.
18	1267.	1322.	1310.	1345.	1271.	1300.	1345.	1328.	1309.	1368.
19	1334.	1348.	1284.	1331.	1310.	1292.	1299.	1314.	1285.	1246.
20	1330.	1296.	1260.	1216.	1311.	1228.	1221.	1255.	1223.	1201.
21	1291.	1276.	1296.	1270.	1316.	1306.	1249.	1338.	1201.	1271.
22	1217.	1208.	1331.	1329.	1214.	1223.	1256.	1237.	1255.	1310.
23	1249.	1212.	1300.	1229.	1232.	1242.	1284.	1251.	1216.	1323.
24	1246.	1257.	1249.	1370.	1719.	2453.	2464.	1751.	1310.	1225.
25	1145.	1110.	1153.	1159.	1090.	1062.	1108.	1092.	1059.	1137.
26	1088.	1050.	1093.	1113.	1100.	1074.	1042.	1114.	1097.	1041.
27	1106.	1072.	1083.	1130.	1101.	1107.	1047.	1097.	1110.	1085.
28	1092.	1096.	1048.	1121.	1124.	992.	1099.	1043.	1014.	1074.
29	975.	1028.	1061.	1022.	1022.	1078.	1129.	1103.	1080.	1053.
30	1085.	1056.	1052.	1036.	1038.	1013.	1058.	989.	1099.	1106.
31	1030.	1102.	1063.	1010.	1039.	1050.	1049.	1077.	1034.	1030.
32	994.	1042.	1047.	1068.	1060.	1064.	1071.	1063.	1059.	1103.
33	1084.	1090.	1096.	1060.	1039.	1041.	1137.	1116.	1131.	1135.
34	1102.	1127.	1334.	2074.	4099.	5093.	3369.	1519.	942.	883.
35	869.	939.	888.	867.	888.	814.	865.	843.	885.	819.
36	889.	835.	855.	859.	883.	887.	880.	944.	988.	870.
37	851.	845.	847.	844.	832.	866.	867.	849.	937.	877.
38	904.	882.	834.	810.	907.	786.	905.	831.	831.	837.
39	810.	846.	857.	814.	821.	869.	862.	866.	822.	837.
40	878.	818.	852.	835.	852.	888.	833.	878.	853.	866.
41	993.	1086.	1020.	970.	866.	826.	801.	836.	802.	833.
42	827.	764.	804.	798.	816.	806.	816.	842.	813.	835.
43	808.	828.	833.	800.	776.	807.	780.	817.	811.	712.
44	789.	815.	841.	954.	1087.	1108.	925.	772.	771.	822.
45	790.	860.	798.	818.	792.	767.	781.	781.	841.	860.
46	809.	788.	762.	827.	777.	817.	794.	838.	814.	809.
47	850.	827.	830.	793.	789.	794.	775.	756.	779.	783.
48	756.	747.	773.	740.	681.	775.	704.	725.	736.	764.
49	747.	692.	782.	778.	703.	688.	713.	730.	718.	732.
50	753.	680.	714.	669.	746.	718.	729.	718.	705.	665.
51	760.	718.	724.	663.	714.	659.	670.	656.	727.	606.
52	678.	654.	696.	710.	655.	739.	656.	684.	675.	688.
53	704.	660.	691.	655.	638.	670.	706.	702.	704.	652.
54	689.	620.	680.	715.	740.	685.	669.	667.	653.	667.
55	662.	675.	704.	653.	696.	677.	654.	647.	650.	686.
56	710.	694.	663.	694.	726.	728.	707.	720.	686.	687.
57	620.	680.	669.	675.	702.	675.	636.	695.	653.	603.
58	668.	652.	689.	674.	678.	697.	699.	721.	682.	688.
59	663.	697.	733.	691.	713.	665.	723.	640.	690.	765.
60	675.	674.	692.	713.	711.	667.	656.	688.	746.	691.
61	708.	698.	718.	645.	694.	667.	638.	697.	712.	724.
62	716.	707.	651.	705.	686.	732.	723.	715.	703.	686.
63	697.	712.	759.	662.	703.	696.	712.	726.	726.	709.
64	805.	784.	796.	718.	754.	741.	728.	720.	713.	718.
65	769.	754.	714.	740.	759.	765.	715.	828.	834.	1005.
66	2404.	4923.	6029.	3865.	1467.	735.	612.	564.	620.	535.
67	577.	587.	575.	602.	637.	634.	597.	611.	585.	561.
68	618.	617.	593.	596.	556.	618.	603.	597.	632.	648.
69	636.	602.	610.	566.	592.	568.	572.	613.	581.	535.
70	585.	588.	593.	610.	618.	588.	598.	574.	604.	563.
71	618.	606.	615.	601.	600.	579.	584.	605.	635.	587.
72	593.	572.	597.	705.	658.	621.	609.	616.	587.	629.
73	596.	580.	581.	595.	567.	584.	591.	575.	588.	589.
74	622.	588.	578.	600.	621.	606.	620.	638.	603.	603.
75	596.	606.	612.	619.	567.	652.	589.	600.	658.	636.
76	625.	610.	574.	583.	574.	606.	629.	577.		616.

77	566.	596.	564.	604.	607.	592.	598.	806.	1141.	1392.
78	1142.	816.	596.	619.	563.	576.	606.	580.	607.	536.
79	583.	581.	583.	583.	609.	564.	532.	584.	579.	593.
80	585.	608.	589.	598.	579.	597.	620.	605.	589.	591.
81	581.	597.	618.	626.	595.	553.	632.	598.	611.	671.
82	609.	630.	597.	592.	581.	611.	578.	590.	590.	574.
83	603.	582.	598.	576.	619.	592.	555.	589.	552.	604.
84	549.	614.	595.	590.	623.	593.	630.	598.	583.	606.
85	616.	621.	609.	596.	586.	633.	581.	591.	599.	601.
86	628.	547.	582.	597.	560.	670.	661.	749.	812.	708.
87	606.	628.	624.	640.	618.	632.	651.	587.	623.	650.
88	608.	597.	569.	619.	569.	596.	609.	597.	599.	602.
89	592.	576.	615.	557.	597.	595.	611.	621.	639.	615.
90	601.	616.	632.	613.	589.	584.	567.	558.	604.	611.
91	591.	615.	567.	628.	588.	574.	575.	552.	636.	597.
92	586.	601.	606.	581.	589.	597.	618.	571.	645.	613.
93	600.	582.	619.	588.	613.	623.	601.	608.	637.	630.
94	575.	643.	640.	613.	583.	604.	640.	615.	615.	622.
95	625.	643.	603.	620.	636.	602.	624.	601.	639.	628.
96	590.	635.	739.	1007.	1167.	988.	715.	586.	539.	470.
97	509.	501.	503.	525.	478.	485.	489.	526.	473.	516.
98	492.	505.	480.	477.	493.	508.	543.	484.	500.	461.
99	484.	492.	491.	467.	508.	503.	533.	536.	502.	539.
100	475.	462.	457.	515.	497.	567.	539.	513.	496.	442.
101	462.	451.	440.	470.	461.	445.	422.	451.	447.	497.
102	486.	482.	445.	440.	476.	441.	454.	420.	476.	490.
103	428.	460.	401.	476.	428.	439.	421.	375.	409.	448.
104	430.	443.	412.	414.	431.	406.	434.	423.	426.	427.
105	406.	419.	407.	436.	412.	422.	415.	427.	384.	436.
106	434.	365.	410.	427.	411.	448.	403.	395.	436.	431.
107	429.	414.	417.	404.	421.	425.	416.	454.	413.	400.
108	402.	416.	393.	424.	569.	694.	897.	744.	546.	491.
109	490.	467.	418.	436.	403.	407.	437.	410.	423.	421.
110	404.	414.	431.	424.	400.	398.	425.	455.	461.	469.
111	537.	694.	887.	825.	610.	448.	406.	384.	414.	408.
112	376.	362.	384.	368.	376.	370.	336.	344.	345.	359.
113	337.	344.	377.	341.	369.	353.	364.	330.	334.	345.
114	337.	339.	353.	344.	386.	376.	362.	356.	368.	346.
115	356.	366.	355.	339.	358.	345.	357.	378.	369.	335.
116	341.	350.	349.	385.	349.	352.	379.	370.	314.	306.
117	554.	1388.	3609.	6090.	6079.	3212.	1147.	320.	218.	185.
118	193.	180.	195.	169.	196.	194.	154.	189.	172.	171.
119	149.	149.	185.	182.	156.	153.	135.	147.	164.	167.
120	148.	166.	142.	153.	164.	135.	141.	148.	154.	157.
121	155.	148.	157.	161.	176.	119.	144.	131.	103.	114.
122	130.	138.	125.	139.	126.	98.	120.	115.	102.	133.
123	121.	113.	124.	120.	137.	140.	108.	128.	130.	134.
124	116.	109.	100.	132.	107.	105.	127.	119.	119.	134.
125	102.	114.	120.	124.	122.	114.	101.	112.	122.	106.
126	109.	129.	109.	124.	124.	119.	119.	120.	135.	122.
127	133.	119.	130.	164.	207.	234.	182.	142.	129.	141.
128	114.	128.	113.	133.	141.	121.	132.	132.	108.	125.
129	135.	147.	136.	218.	212.	186.	156.	139.	179.	177.
130	187.	173.	152.	143.	137.	154.	140.	151.	151.	151.
131	143.	157.	137.	165.	150.	163.	146.	148.	166.	165.
132	167.	150.	154.	173.	188.	183.	177.	163.	175.	241.
133	669.	2148.	4463.	5507.	3809.	1480.	354.	67.	39.	33.
134	38.	39.	37.	33.	29.	47.	31.	35.	40.	39.
135	30.	32.	25.	33.	34.	24.	37.	33.	30.	31.
136	22.	33.	27.	35.	38.	32.	29.	19.	32.	35.
137	32.	38.	38.	36.	34.	26.	45.	33.	31.	37.
138	32.	36.	36.	49.	43.	24.	37.	46.	23.	38.
139	44.	44.	35.	31.	36.	33.	34.	47.	40.	39.
140	31.	40.	40.	44.	38.	67.	160.	352.	584.	575.
141	322.	107.	53.	26.	21.	31.	30.	23.	20.	24.
142	23.	23.	17.	31.	28.	22.	32.	27.	33.	33.
143	37.	30.	29.	40.	39.	43.	40.	34.	37.	34.
144	29.	32.	34.	42.	36.	49.	36.	29.	41.	31.
145	23.	25.	25.	20.	25.	23.	25.	32.	35.	26.
146	27.	15.	19.	20.	28.	15.	27.	26.	11.	17.
147	15.	17.	18.	12.	16.	15.	14.	17.	15.	12.
148	13.	21.	24.	14.	21.	18.	19.	22.	16.	21.
149	16.	19.	34.	25.	26.	14.	15.	25.	14.	16.
150	22.	20.	13.	23.	18.	18.	20.	20.	20.	18.
151	19.	19.	15.	20.	18.	26.	12.	22.	14.	24.
152	14.	12.	18.	22.	16.	23.	23.	25.	37.	20.
153	33.	24.	23.	16.	20.	10.	22.	12.	18.	13.
154	16.	16.	16.	22.	12.	19.	18.	12.	12.	19.
155	17.	17.	14.	12.	14.	15.	22.	19.	14.	21.
156	11.	17.	12.	11.	19.	18.	22.	15.	20.	16.
157	12.	15.	16.	19.	21.	10.	17.	19.	16.	19.
158	11.	7.	16.	13.	14.	16.	25.	13.	13.	14.

15 10 13 13 12 13 13 11 12 11 8 10 10 13 8 8 8 14 17 17 11 20 14 7 14 8 8 6 13 7 11 13 6 0 12 7 5 4 8 7 15
7 10 5 5 8 14 7 11 11 8 11 7 11 9 12 5 12 12 7 8 8 13 7 7 5 8 7 11 11 11 12 8 7 6 8 10 6 8 8 13 0
23 13 13 20 13 15 15 22 22 5 7 7 16 5 12 7 16 8 4 16 6 12 13 10 0 11 2 11 6 10 12 9 13 8 12 7 8 6 0 12 13 12 10 0
15 14 11 8 15 14 14 13 15 16 11 9 10 0 11 8 12 0 10 4 9 9 12 13 13 11 0 20 5 2 7 11 11 6 5 4 6 6 9 5 14 6 7 8 10 3 7
21 10 5 12 3 15 11 4 0 7 10 8 16 6 9 10 2 12 9 13 5 15 6 11 8 8 17 4 14 9 7 12 6 13 9 11 9 7 6 15 10 5 5 1 12 6 8 7 13 7 8 6
11 14 7 17 15 11 9 15 14 9 12 10 6 12 5 13 15 10 13 8 5 9 23 0 14 9 12 13 8 8 9 9 12 10 11 6 5 7 9 7 8 8 7 9 3 9 9
19 14 7 2 3 11 7 13 6 15 23 0 0 11 12 5 11 8 8 20 5 11 2 13 13 4 11 7 12 11 4 8 8 6 6 6 6 0 11 5 4 8 13 0 2 13 7 11
12 13 13 10 5 15 2 2 6 9 3 5 14 4 9 3 13 11 4 6 10 7 7 17 8 14 13 0 5 10 11 8 11 8 11 10 8 6 7 7 5 10 11 7 5 6 9
14 14 19 12 9 13 11 7 18 12 2 3 13 2 12 5 14 6 11 6 2 16 2 10 9 6 10 11 15 6 7 8 10 0 0 10 0 2 12 4 12 8 12 0 9 10 4 6 5 10
9 20 6 16 2 0 3 7 13 7 16 5 11 6 5 16 11 6 16 0 12 3 5 7 9 7 7 11 11 0 4 7 11 4 6 11 6 6 10 0 3 11 5 1 7 4 6 6 9 11 6
15 9 9 16 6 1 6 2 3 16 6 4 16 6 5 16 6 7 16 6 8 16 6 8 9 17 0 17 7 1 17 7 2 17 7 3 17 7 4 17 7 5 17 7 6 17 7 7 17 7 8 17 7 9 18 8 1 18 8 2 18 8 3 18 8 4 18 8 5 18 8 6 18 8 7 18 8 8 18 8 9 19 9 0 19 9 1 19 9 2 19 9 3 19 9 4 19 9 5 19 9 6 19 9 7 19 9 8 19 9 9 20 0 0 20 0 1 20 0 2 20 0 3 20 0 4

- IRRAGGIAMENTO - 91 2400.000 MINUTI DATA 1974 12 15 24 0 FLUSSO .0000
- MISURA - TEMPO CONTEGGIO 13.333 MINUTI DATA 1975 1 7 10 30 DECADIMENTO 32310.000 MINUTI
- CAMPIONE - CALIB PROBLEMA ALEALEA

N.	ELEM	EN	PESO (G)	CENTR	C P M	AREA ZERO	A SPER	A TEOR	FATT CORR
1	EU1	245.00	.00000000	246.51	3.122+002	3.133+002	.000	1.286+006	.000
2	EU2	344.00	.00000000	345.81	8.678+002	8.708+002	.000	1.286+006	.000
3	EU3	778.40	.00000000	780.01	1.726+002	1.732+002	.000	1.286+006	.000
4	EU4	963.50	.00000000	964.96	1.519+002	1.524+002	.000	1.286+006	.000
5	C02	1332.40	.00000000	1333.83	1.341+003	1.351+003	.000	8.761+006	.000
6	EU5	1408.00	.00000000	1409.44	1.473+002	1.479+002	.000	1.286+006	.000

VALORE MEDIO DEL FATTORE CORRETTIVO SU 6 PICCHI .000

CALIBRAZIONE Y= 1.000*X+ -1.712

SPETTRO N. 2 CANALI 2048 TCON 166.667 MINUTI DATA 1975 1 9 10 0 DECAD 35160.000 MIN

	1	2	3	4	5	6	7	8	9	10
0	10000.	1.	1.	1.	5.	4.	7.	4.	28.	76.
1	91.	94.	87.	66.	58.	63.	89.	123.	126.	134.
2	78.	67.	59.	26.	14.	12.	10.	9.	5.	3.
3	8.	6.	4.	6.	4.	2.	1.	1.	2.	5.
4	1.	1.	1.	3.	1.	1.	1.	1.	1.	1.
5	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
6	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
7	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
8	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
9	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
10	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
11	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
12	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
13	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
14	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
15	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
16	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
17	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
18	1.	3.	3.	5.	4.	12.	89.	586.	1471.	1813.
19	1925.	1869.	1966.	2239.	2446.	2218.	1904.	1786.	1824.	1937.
20	1913.	1846.	1772.	1663.	1753.	1759.	1641.	1746.	1744.	1704.
21	1711.	1728.	1723.	1662.	1672.	1721.	1854.	1954.	1968.	1886.
22	1696.	1651.	1643.	1718.	1687.	1621.	1629.	1576.	1574.	1537.
23	1577.	1558.	1611.	1567.	1501.	1525.	1523.	1491.	1440.	1489.
24	1463.	1547.	1532.	1452.	1509.	1602.	1853.	1772.	1539.	1470.
25	1477.	1419.	1422.	1425.	1352.	1365.	1347.	1350.	1327.	1352.
26	1376.	1353.	1373.	1342.	1314.	1412.	1405.	1402.	1347.	1278.
27	1288.	1356.	1336.	1414.	1375.	1331.	1278.	1289.	1373.	1318.
28	1326.	1301.	1272.	1346.	1318.	1320.	1291.	1292.	1371.	1374.
29	1327.	1254.	1308.	1328.	1355.	1288.	1373.	1352.	1386.	1519.
30	1828.	2251.	2171.	1742.	1525.	1351.	1251.	1336.	1337.	1337.
31	1389.	1804.	3350.	5478.	5082.	2871.	1640.	1147.	1072.	1021.
32	1139.	1110.	1122.	1075.	1045.	993.	1000.	1032.	1005.	956.
33	993.	1043.	1039.	997.	1040.	1031.	1042.	1028.	1064.	1067.
34	1067.	1326.	1469.	1540.	1810.	2425.	2625.	1996.	1376.	1016.
35	902.	897.	880.	883.	867.	863.	899.	839.	856.	892.
36	901.	845.	866.	836.	840.	867.	899.	896.	887.	905.
37	835.	912.	838.	921.	849.	931.	963.	887.	877.	850.
38	840.	843.	798.	844.	816.	835.	811.	790.	838.	832.
39	828.	796.	842.	864.	821.	829.	824.	839.	885.	895.
40	901.	846.	816.	818.	843.	805.	802.	783.	782.	801.
41	751.	846.	889.	892.	860.	833.	917.	916.	910.	834.
42	836.	783.	775.	785.	796.	821.	771.	784.	768.	795.
43	816.	787.	797.	801.	830.	762.	807.	737.	783.	802.
44	862.	744.	758.	775.	846.	926.	858.	824.	737.	768.
45	755.	772.	814.	784.	751.	754.	838.	823.	804.	817.
46	757.	800.	764.	833.	803.	838.	756.	788.	783.	792.
47	801.	813.	835.	772.	838.	800.	825.	839.	796.	853.
48	790.	949.	1504.	2053.	1846.	1302.	878.	770.	736.	773.
49	751.	756.	776.	754.	711.	789.	837.	909.	946.	813.
50	749.	772.	760.	731.	734.	732.	772.	806.	745.	769.
51	748.	760.	819.	845.	931.	945.	897.	818.	744.	715.
52	728.	689.	729.	718.	758.	797.	767.	752.	775.	727.
53	703.	729.	797.	751.	775.	750.	774.	693.	728.	728.
54	774.	727.	736.	692.	716.	755.	728.	760.	747.	771.
55	737.	760.	722.	772.	739.	790.	764.	715.	738.	730.
56	785.	708.	791.	742.	711.	900.	776.	770.	811.	731.
57	770.	772.	726.	731.	713.	780.	761.	726.	757.	750.
58	722.	775.	733.	798.	786.	793.	793.	739.	728.	694.
59	721.	719.	735.	735.	785.	753.	745.	713.	722.	707.
60	746.	778.	724.	760.	832.	987.	1012.	912.	780.	830.
61	759.	735.	752.	723.	726.	764.	724.	771.	745.	775.
62	754.	716.	740.	734.	690.	705.	718.	706.	732.	727.
63	728.	704.	718.	760.	695.	684.	746.	711.	739.	735.
64	707.	700.	708.	748.	717.	668.	740.	739.	723.	675.
65	711.	717.	737.	698.	715.	717.	768.	746.	776.	679.
66	745.	685.	726.	692.	711.	792.	744.	698.	713.	718.
67	707.	685.	747.	701.	749.	681.	739.	720.	725.	737.
68	740.	732.	737.	709.	701.	690.	724.	727.	714.	722.
69	719.	705.	698.	656.	698.	639.	689.	653.	665.	642.
70	642.	669.	648.	644.	613.	648.	626.	646.	653.	649.
71	639.	659.	612.	653.	599.	619.	613.	643.	608.	610.
72	628.	648.	636.	664.	712.	737.	664.	666.	605.	646.
73	666.	590.	630.	650.	621.	619.	620.	607.	594.	636.
74	593.	623.	626.	568.	587.	591.	623.	594.	575.	589.
75	630.	600.	598.	580.	623.	614.	628.	688.	663.	633.
76	615.	622.	628.	567.	613.	601.	698.	724.	671.	637.

77	610.	553.	580.	601.	590.	582.	546.	578.	673.	754.
78	831.	781.	608.	587.	568.	571.	557.	571.	568.	568.
79	545.	615.	587.	503.	566.	662.	727.	699.	678.	622.
80	619.	591.	508.	614.	562.	578.	578.	579.	549.	581.
81	606.	597.	560.	602.	604.	576.	573.	597.	597.	606.
82	562.	585.	599.	613.	591.	566.	590.	574.	565.	570.
83	573.	603.	611.	665.	759.	1073.	1160.	898.	715.	616.
84	650.	603.	618.	573.	604.	595.	634.	610.	631.	617.
85	600.	673.	643.	587.	617.	604.	624.	630.	584.	598.
86	610.	603.	624.	603.	627.	626.	651.	642.	647.	678.
87	676.	636.	591.	664.	632.	700.	593.	659.	671.	673.
88	733.	767.	687.	584.	657.	631.	655.	841.	1704.	4270.
89	6169.	5014.	2665.	1151.	658.	516.	492.	432.	488.	451.
90	485.	490.	459.	390.	449.	489.	456.	475.	454.	448.
91	434.	439.	456.	416.	430.	424.	393.	353.	394.	399.
92	413.	390.	367.	380.	359.	357.	396.	390.	381.	374.
93	352.	372.	377.	387.	347.	331.	371.	397.	383.	328.
94	353.	357.	308.	362.	333.	341.	349.	381.	342.	322.
95	346.	317.	333.	314.	337.	322.	327.	323.	328.	305.
96	305.	324.	358.	426.	511.	526.	525.	439.	373.	322.
97	275.	283.	293.	283.	299.	302.	290.	318.	255.	280.
98	297.	275.	286.	307.	258.	274.	270.	293.	292.	280.
99	292.	271.	290.	271.	261.	278.	262.	279.	300.	285.
100	261.	288.	267.	261.	286.	266.	295.	252.	250.	233.
101	245.	241.	265.	230.	264.	228.	233.	251.	256.	241.
102	256.	253.	221.	263.	231.	251.	249.	270.	234.	248.
103	225.	195.	224.	229.	245.	246.	257.	245.	232.	216.
104	256.	247.	265.	237.	270.	241.	251.	262.	304.	242.
105	252.	247.	261.	256.	262.	273.	224.	263.	255.	257.
106	272.	304.	295.	268.	285.	272.	262.	283.	278.	262.
107	243.	269.	257.	282.	279.	297.	370.	451.	502.	399.
108	286.	291.	278.	260.	300.	285.	422.	417.	366.	329.
109	307.	298.	304.	262.	270.	309.	276.	354.	812.	1637.
110	2349.	1940.	1135.	482.	296.	239.	220.	224.	225.	220.
111	241.	296.	360.	446.	430.	443.	529.	492.	501.	996.
112	2649.	4258.	4246.	2464.	1039.	343.	134.	120.	108.	95.
113	100.	82.	84.	80.	88.	93.	102.	94.	109.	95.
114	85.	97.	93.	102.	82.	95.	102.	98.	112.	108.
115	96.	82.	96.	89.	123.	86.	91.	108.	97.	104.
116	98.	92.	82.	90.	93.	78.	87.	96.	91.	93.
117	95.	103.	179.	356.	520.	453.	279.	145.	105.	103.
118	104.	65.	75.	68.	57.	60.	57.	58.	74.	104.
119	123.	103.	77.	66.	62.	49.	74.	65.	51.	55.
120	62.	61.	80.	56.	70.	62.	61.	66.	57.	55.
121	69.	66.	54.	84.	75.	64.	60.	69.	50.	56.
122	80.	104.	131.	107.	96.	90.	76.	60.	57.	64.
123	71.	79.	72.	90.	62.	64.	48.	64.	59.	79.
124	59.	53.	62.	62.	60.	62.	67.	62.	58.	69.
125	65.	77.	55.	47.	60.	59.	75.	57.	49.	62.
126	50.	54.	52.	62.	67.	68.	56.	68.	54.	54.
127	60.	70.	75.	99.	114.	123.	96.	76.	69.	75.
128	68.	74.	59.	75.	73.	72.	65.	57.	95.	128.
129	241.	667.	1215.	1270.	830.	394.	129.	43.	43.	49.
130	39.	40.	34.	39.	24.	26.	31.	29.	40.	29.
131	23.	33.	25.	33.	26.	38.	25.	38.	27.	31.
132	26.	24.	28.	33.	39.	26.	40.	37.	25.	29.
133	28.	106.	192.	345.	359.	237.	111.	50.	20.	36.
134	18.	23.	16.	10.	16.	20.	23.	33.	25.	26.
135	21.	26.	31.	26.	16.	20.	20.	14.	19.	23.
136	18.	14.	12.	26.	25.	25.	28.	21.	31.	26.
137	21.	20.	21.	17.	28.	19.	16.	22.	18.	27.
138	19.	23.	14.	23.	21.	19.	22.	20.	19.	30.
139	21.	16.	18.	16.	13.	20.	22.	21.	32.	22.
140	16.	28.	28.	24.	33.	30.	39.	83.	173.	211.
141	171.	103.	58.	37.	22.	21.	19.	18.	11.	12.
142	17.	12.	14.	24.	20.	18.	14.	17.	12.	14.
143	17.	15.	12.	17.	12.	17.	20.	19.	19.	10.
144	25.	20.	14.	13.	16.	21.	16.	19.	15.	18.
145	27.	13.	14.	28.	18.	23.	14.	16.	22.	23.
146	19.	22.	24.	22.	18.	17.	9.	7.	11.	17.
147	17.	8.	11.	17.	14.	15.	20.	11.	13.	12.
148	11.	11.	15.	15.	16.	13.	15.	11.	7.	9.
149	14.	11.	13.	16.	15.	16.	18.	16.	10.	8.
150	12.	17.	13.	6.	17.	10.	16.	15.	10.	16.
151	20.	8.	15.	14.	17.	8.	9.	13.	9.	14.
152	10.	11.	12.	13.	11.	14.	12.	12.	13.	17.
153	16.	13.	17.	13.	9.	14.	15.	14.	10.	8.
154	15.	17.	15.	14.	8.	12.	13.	14.	8.	11.
155	15.	18.	12.	11.	6.	10.	11.	5.	13.	10.
156	9.	16.	13.	11.	20.	11.	14.	7.	12.	10.
157	16.	16.	12.	8.	12.	10.	13.	8.	5.	10.
158	12.	8.	8.	7.	12.	5.	6.	12.	9.	10.

159	11.	7.	8.	12.	8.	6.	12.	14.	16.	11.
160	9.	8.	12.	14.	8.	11.	5.	12.	7.	4.
161	6.	8.	10.	12.	10.	9.	7.	11.	4.	12.
162	9.	5.	7.	13.	10.	16.	9.	9.	16.	8.
163	9.	7.	5.	7.	8.	11.	6.	1.	11.	9.
164	13.	7.	9.	11.	3.	9.	8.	13.	10.	9.
165	10.	7.	9.	9.	6.	4.	7.	12.	5.	6.
166	11.	13.	13.	9.	7.	4.	9.	10.	6.	11.
167	9.	7.	4.	8.	7.	12.	7.	6.	6.	9.
168	14.	7.	11.	13.	8.	5.	8.	6.	8.	7.
169	9.	12.	6.	12.	14.	9.	9.	7.	14.	12.
170	9.	5.	6.	4.	4.	6.	13.	10.	6.	8.
171	5.	4.	6.	4.	11.	4.	9.	7.	4.	7.
172	13.	7.	5.	10.	10.	6.	10.	11.	7.	10.
173	13.	10.	6.	11.	8.	10.	10.	9.	6.	6.
174	2.	5.	6.	7.	8.	8.	5.	5.	6.	3.
175	7.	7.	5.	8.	8.	11.	5.	7.	5.	7.
176	8.	8.	5.	8.	6.	11.	6.	15.	14.	12.
177	2.	3.	5.	7.	3.	4.	7.	6.	7.	4.
178	11.	8.	6.	2.	2.	7.	7.	5.	3.	4.
179	6.	7.	4.	8.	3.	7.	3.	7.	4.	7.
180	7.	9.	6.	5.	8.	6.	7.	5.	5.	4.
181	6.	8.	4.	5.	4.	4.	3.	8.	3.	5.
182	7.	3.	5.	5.	6.	6.	3.	1.	5.	2.
183	6.	5.	7.	7.	5.	4.	7.	4.	4.	6.
184	1.	4.	3.	3.	2.	4.	4.	6.	4.	8.
185	4.	5.	6.	3.	4.	6.	4.	6.	4.	2.
186	5.	2.	2.	1.	9.	5.	3.	6.	3.	6.
187	4.	2.	7.	5.	5.	6.	6.	2.	5.	6.
188	5.	6.	3.	4.	3.	6.	5.	3.	2.	1.
189	1.	2.	2.	5.	2.	3.	1.	2.	5.	2.
190	3.	1.	4.	7.	2.	2.	1.	4.	5.	2.
191	3.	1.	2.	4.	4.	3.	3.	3.	3.	1.
192	3.	5.	2.	6.	1.	4.	1.	2.	1.	5.
193	3.	1.	2.	5.	1.	1.	5.	3.	5.	3.
194	1.	5.	2.	1.	5.	5.	8.	3.	2.	5.
195	1.	3.	4.	6.	4.	4.	1.	4.	3.	1.
196	4.	3.	4.	6.	5.	4.	1.	3.	7.	4.
197	1.	4.	2.	2.	2.	6.	2.	3.	2.	4.
198	6.	1.	5.	1.	2.	5.	6.	5.	3.	1.
199	7.	4.	2.	3.	6.	4.	1.	2.	3.	6.
200	4.	5.	3.	5.	2.	3.	2.	4.	7.	19.
201	34.	26.	26.	13.	7.	2.	1.	1.	1.	1.
202	3.	2.	1.	1.	1.	1.	1.	1.	1.	2.
203	1.	2.	1.	1.	1.	2.	2.	1.	1.	1.
204	1.	3.	2.	2.	1.	1.	1.	1.		

- IRRAGGIAMENTO - 91 2400.000 MINUTI DATA 1974 12 15 24 0 FLUSSO .0000
- MISURA - TEMPO CONTEGGIO 166.667 MINUTI DATA 1975 1 9 10 0 DECADIMENTO 35160.000 MINUTI
- CAMPIONE - STANG2 PESO .00188900 G CALIB. Y= 1.000*X+ -1.712 PROBLEMA ALFALFA

ELEM	P.P.M.	ERR.0/0		VALORE A	KEV (T)	KEV (S)	LS	WT	C.P.M.	AREA ZERO	UGM	AT/CC
CE					145.40							
CO	4.900+000	4.22			1332.48	1333.16	1330	10	7.392+000	7.457+000		
CR	9.000+000	60.03	*		320.08	320.53	320	5	1.362+000	2.502+000		
CS					795.80							
EU	1.500+000	7.57			1408.11	1408.61	1404	13	4.275+000	4.291+000		
HF	7.500+000	5.99			482.60	482.71	479	11	2.431+001	3.540+001		
HG					279.20							
IN					1300.00							
NI					810.81							
RB	2.340+002	19.85			1076.60	1077.16	1074	11	4.284+000	1.377+001		
SB					1691.00							
SC	3.900+000	1.35			889.25	889.65	886	11	1.083+002	1.323+002		
TA					1221.60							
TB					879.33							
TH	2.520+001	2.65			311.90	312.75	309	13	8.126+001	1.519+002		
YB	1.000+000	14.88			197.80	193.26	192	7	9.813+000	1.663+001		
YB	1.000+000	51.39	*		197.80	198.91	198	6	2.424+000	4.108+000		
ZN	7.490+001	9.37			1115.51	1115.75	1109	8	1.247+001	PRIMO (1115.75 1120.98)		
ZN	7.490+001	1.29			1115.51	1120.98	1118	10	8.395+001	8.995+001		
ZR	3.160+002	37.47			765.80	766.41	764	8	2.478+000	3.215+000		
BA	1.950+003	26.80			216.00	216.91	214	10	7.092+000	3.051+001		
FE	1.888+004	2.73			1099.27	1099.71	1094	15	4.296+001	6.236+001		

LIBRERIA METODO RELATIVO

ELEM	EN(KEV)	RES(KEV)	DEC(MIN)	UGM	CPMO/UGM
CE	145.40	3.000	1.502-005	3.136-001	
CO	1332.48	3.200	2.496-007	9.256-003	8.056+002
CR	320.08	3.070	1.730-005	1.700-002	1.472+002
CS	795.80	3.120	5.980-007	2.834-003	
EU	1408.11	3.220	1.055-007	2.834-003	1.514+003
HF	482.60	3.100	1.069-005	1.417-002	2.498+003
HG	279.20	3.000	1.035-005	8.312-005	
IN	1300.00	3.200	9.820-006	7.367-005	
NI	810.81	3.100	6.750-006	1.209-002	
RB	1076.60	3.150	3.320-005	4.420-001	3.114+001
SB	1691.00	3.250	8.030-006	1.001-004	
SC	889.25	3.120	5.675-006	7.367-003	1.795+004
TA	1221.60	3.200	4.185-006	1.719-003	
TB	879.33	3.100	6.592-006	9.823-004	
TH	311.90	3.050	1.780-005	4.760-002	3.192+003
YB	197.80	3.000	1.500-005	1.889-003	2.174+003
ZN	1115.51	3.170	1.964-006	1.415-001	6.358+002
ZR	765.80	3.100	7.404-006	5.969-001	5.386+000
BA	216.00	3.000	4.150-005	3.684+000	8.283+000
FE	1099.27	3.170	1.060-005	3.566+001	1.749+000

SPETTRO N. 3 CANALI 2048 TCON 1851.850 MINUTI DATA 1975 1 22 15 0 DECAD 54180.000 MIN

	1	2	3	4	5	6	7	8	9	10
0	111111.	111111.	111111.	111111.	111111.	111111.	111111.	111111.	6313.	5942.
1	3866.	2935.	1557.	992.	670.	460.	315.	307.	238.	195.
2	126.	115.	107.	90.	99.	64.	69.	81.	75.	88.
3	94.	135.	146.	235.	314.	534.	963.	1547.	3684.	14221.
4	530940.	214600.	556890.	526690.	453840.	400132.	920129.	650126.	110197.	107596.
5	105212.	102939.	101242.	98809.	97132.	95173.	94170.	92464.	91567.	90058.
6	89347.	87219.	86081.	85143.	83458.	82557.	83700.	83435.	84912.	84067.
7	84755.	81089.	76927.	75442.	74415.	73753.	73545.	73230.	73745.	74717.
8	75089.	73202.	72015.	70396.	68967.	67414.	67260.	66524.	66473.	67186.
9	66621.	65177.	66191.	66820.	65734.	63404.	111111.	111111.	111111.	111111.
10	111111.	111111.	111111.	111111.	58744.	59208.	58802.	57192.	56651.	56094.
11	55808.	54778.	54095.	54419.	55714.	59778.	66319.	66687.	59794.	53408.
12	50327.	49055.	48894.	48719.	49942.	49226.	51108.	54832.	55430.	51536.
13	48412.	47407.	46130.	44700.	44339.	44195.	45181.	46816.	49870.	53093.
14	55691.	51371.	44441.	40839.	40209.	40395.	40439.	40250.	40035.	39472.
15	38666.	38592.	38306.	37740.	37380.	36868.	37164.	36218.	35896.	36115.
16	35780.	35729.	35089.	34975.	34982.	34752.	34837.	34195.	34411.	34101.
17	34241.	34318.	34258.	33757.	33516.	32701.	32423.	32241.	32363.	32361.
18	31799.	31737.	31751.	31771.	32147.	33535.	36345.	37252.	33850.	31367.
19	31024.	31610.	31672.	31394.	30323.	29696.	29210.	29214.	29992.	29021.
20	29262.	29087.	29052.	29269.	28751.	28908.	28726.	28729.	28880.	29165.
21	29629.	28859.	27825.	27730.	28002.	27956.	29122.	28021.	27620.	26517.
22	26920.	26648.	26724.	26464.	26702.	25641.	25706.	25020.	25497.	25102.
23	25275.	25090.	24838.	24753.	24894.	24711.	24497.	24872.	26294.	26770.
24	25635.	24308.	24272.	23688.	23392.	22894.	23155.	22659.	22671.	22671.
25	22756.	22430.	22509.	22474.	22419.	22583.	22438.	22587.	22914.	22709.
26	22600.	21928.	21757.	21828.	22052.	21699.	21627.	21383.	21485.	21506.
27	21280.	21374.	21592.	21855.	22005.	21311.	21328.	21082.	21162.	21121.
28	20932.	21040.	20881.	20934.	21103.	20746.	20885.	20653.	21024.	21240.
29	21727.	22174.	23451.	24432.	23481.	22201.	21135.	20717.	20334.	20565.
30	20383.	21109.	21161.	21536.	23748.	27703.	29513.	26068.	22157.	20712.
31	21093.	23196.	31716.	40352.	61734.	49109.	28681.	19038.	17244.	16986.
32	17162.	16945.	17051.	17044.	16937.	16764.	16933.	16626.	17140.	17196.
33	17135.	15766.	16961.	17326.	17852.	18265.	20172.	23793.	26529.	24602.
34	20147.	17342.	15986.	15719.	15571.	15886.	15918.	15505.	15529.	15246.
35	15401.	15708.	15400.	15475.	15371.	15156.	15334.	15157.	15452.	15389.
36	15242.	15406.	15531.	15178.	15238.	15021.	15099.	15148.	15265.	15232.
37	15270.	15016.	14801.	15134.	14841.	15098.	15038.	14698.	15083.	14953.
38	14820.	14741.	14580.	14707.	14838.	14561.	14894.	14772.	14552.	14642.
39	14629.	14690.	14955.	14743.	14882.	14680.	14520.	14327.	14567.	14569.
40	14573.	14289.	14374.	14618.	14681.	15050.	14727.	14516.	14640.	14536.
41	14701.	14295.	14354.	14341.	14365.	14497.	14356.	14232.	14114.	14178.
42	14130.	14092.	14062.	14117.	14040.	13960.	13949.	13902.	13851.	13932.
43	13816.	13902.	13938.	13855.	13809.	13800.	14246.	14136.	14462.	14349.
44	13936.	13795.	13836.	13951.	13932.	13872.	13804.	13917.	13753.	13759.
45	13965.	13736.	13748.	13685.	13859.	13785.	13863.	13674.	13638.	13788.
46	13928.	13932.	13894.	13767.	13728.	13894.	13796.	13784.	14148.	14025.
47	14143.	13976.	13773.	14516.	16159.	18449.	19857.	17356.	14638.	13504.
48	13246.	13464.	13480.	13433.	13404.	13480.	13367.	13323.	13498.	13730.
49	13656.	13727.	13491.	13339.	13436.	13436.	13355.	13532.	13485.	13565.
50	13420.	13715.	14280.	15280.	16063.	16661.	16337.	15821.	15508.	14400.
51	13562.	13552.	13201.	13083.	13369.	13208.	13147.	13459.	13374.	13365.
52	13192.	13208.	13183.	13362.	13424.	13507.	13305.	13413.	13356.	13476.
53	13319.	13247.	13647.	13543.	13438.	13385.	13466.	13264.	13463.	13407.
54	13446.	13701.	13747.	13405.	13703.	13554.	13685.	13667.	13443.	13747.
55	13551.	13485.	13640.	13672.	13649.	14069.	15096.	15258.	14020.	14101.
56	14135.	14717.	15982.	16630.	15734.	14315.	13669.	13564.	13690.	13513.
57	13537.	13757.	13466.	13641.	13755.	13523.	13740.	13676.	13645.	14071.
58	13852.	13945.	13811.	13916.	13749.	13815.	13859.	13946.	13886.	13886.
59	13842.	13762.	13883.	13868.	14657.	16933.	21782.	28034.	33464.	28805.
60	19656.	14649.	13278.	13322.	12917.	12795.	13041.	12737.	12997.	12997.
61	12935.	12747.	12816.	12673.	12766.	12772.	12586.	12745.	12849.	12821.
62	12536.	12712.	12731.	12665.	12980.	12748.	12950.	12805.	12611.	12833.
63	12614.	12666.	12778.	12931.	12607.	12750.	12703.	12768.	12698.	12777.
64	12743.	12746.	12869.	12589.	12974.	12507.	12637.	12550.	12631.	12878.
65	12741.	12912.	12920.	12828.	12721.	12627.	12729.	12625.	12816.	12623.
66	12767.	12871.	12765.	12739.	12727.	12789.	12715.	12905.	12812.	12977.
67	12718.	12815.	12871.	12880.	12710.	12839.	12796.	12786.	12908.	12698.
68	12631.	12599.	12787.	12821.	12653.	11919.	11972.	11559.	11634.	11506.
69	11384.	11392.	11379.	11497.	11356.	11011.	11020.	11153.	11327.	11320.
70	11125.	11118.	11236.	11072.	11008.	10988.	11065.	11029.	11030.	10856.
71	10799.	10941.	10898.	11017.	10968.	11262.	11530.	11676.	11310.	11108.
72	10860.	10899.	10584.	10538.	10683.	10522.	10707.	10736.	10465.	10588.
73	10741.	10579.	10410.	10511.	10442.	10468.	10538.	10596.	10538.	10314.
74	10365.	10301.	10458.	10494.	10467.	10441.	10502.	10468.	10591.	10914.
75	10822.	10767.	10568.	10300.	10376.	10284.	10470.	10530.	10378.	11060.
76	11067.	10568.	10221.	10240.	10152.	9859.	10090.	10107.	10131.	10313.

77	10303.	10978.	11697.	11533.	10836.	10145.	10070.	9878.	10080.	9902.
78	9850.	10044.	10089.	10068.	9891.	10137.	10673.	13088.	17808.	22373.
79	20803.	14921.	11149.	10207.	10510.	10814.	10767.	10076.	9717.	9723.
80	9764.	9823.	9889.	10623.	10797.	10668.	10009.	9774.	9617.	9890.
81	9864.	9873.	9842.	9869.	10047.	9845.	10096.	9960.	10083.	10071.
82	10048.	9901.	10262.	9941.	10162.	10435.	12029.	14456.	16732.	16002.
83	12923.	10896.	10238.	10193.	10081.	10198.	10156.	10067.	10158.	10278.
84	10135.	10411.	10473.	10136.	10187.	10316.	10508.	10635.	10643.	10358.
85	10563.	10776.	10530.	10564.	10742.	10762.	10766.	10762.	10622.	11019.
86	11356.	11212.	11083.	10993.	10745.	11069.	11003.	11237.	11057.	11241.
87	11127.	11406.	12006.	12068.	11660.	11302.	11223.	11169.	11952.	14712.
88	26729.	50382.	100773.	110915.	72136.	30562.	12574.	8575.	8060.	8026.
89	7913.	8082.	8256.	8088.	8066.	7890.	8049.	8035.	7890.	7894.
90	7724.	7694.	7578.	7571.	7537.	7243.	7084.	6927.	6872.	6660.
91	6527.	6531.	6649.	6424.	6299.	6347.	6378.	6191.	6255.	6141.
92	6116.	6281.	6056.	5994.	6101.	5949.	6027.	6059.	5950.	5996.
93	5972.	5767.	5843.	5884.	5873.	5867.	5833.	5724.	5833.	5725.
94	5746.	5672.	5821.	5675.	5616.	5730.	5540.	5703.	5512.	5499.
95	5502.	5424.	5251.	5447.	5496.	5872.	6203.	6628.	6850.	6307.
96	5805.	5484.	5213.	5144.	4801.	4840.	4926.	4820.	4751.	4906.
97	4786.	4671.	4777.	4710.	4703.	4529.	4715.	4621.	4564.	4540.
98	4452.	4477.	4523.	4336.	4307.	4356.	4315.	4322.	4395.	4265.
99	4294.	4236.	4254.	4144.	4172.	4240.	4171.	4253.	4212.	4173.
100	4082.	3984.	3985.	3936.	3954.	3849.	3852.	3895.	3861.	3905.
101	3960.	3912.	3879.	3791.	3827.	3851.	3777.	3815.	3823.	3832.
102	3799.	3750.	3828.	3845.	3819.	3895.	3865.	3833.	3902.	3929.
103	3807.	3925.	3958.	3954.	3936.	3901.	3955.	3978.	4004.	4000.
104	3940.	3923.	4031.	4018.	3917.	4046.	4061.	4115.	4015.	4025.
105	4190.	4130.	4074.	4115.	4241.	4121.	4208.	4308.	4281.	4369.
106	4230.	4381.	4328.	4444.	4423.	4467.	4456.	4665.	5276.	6338.
107	7336.	6977.	5634.	4865.	4488.	4271.	4447.	4462.	5173.	5261.
108	5285.	5123.	4641.	4686.	4657.	4689.	4702.	4673.	4916.	5509.
109	7823.	14751.	23027.	26077.	18709.	10026.	5462.	4497.	4330.	4265.
110	4268.	4431.	4391.	4697.	4991.	5803.	7706.	12132.	20115.	25206.
111	22378.	19880.	33273.	63980.	83778.	66865.	31712.	9510.	2697.	1629.
112	1541.	1486.	1544.	1483.	1429.	1490.	1550.	1477.	1463.	1474.
113	1466.	1496.	1461.	1415.	1490.	1409.	1460.	1461.	1471.	1395.
114	1458.	1393.	1373.	1387.	1444.	1382.	1324.	1419.	1320.	1430.
115	1359.	1348.	1475.	1372.	1323.	1349.	1416.	1379.	1378.	1352.
116	1499.	1526.	1504.	1675.	2747.	5343.	9296.	10415.	7482.	3736.
117	1785.	1433.	1328.	1263.	1081.	1028.	969.	980.	953.	1009.
118	1023.	1179.	1215.	1278.	1133.	997.	954.	956.	986.	876.
119	883.	922.	903.	974.	1023.	991.	869.	932.	936.	780.
120	865.	880.	873.	882.	947.	898.	938.	920.	933.	882.
121	824.	850.	882.	988.	1209.	1291.	1190.	1009.	874.	794.
122	839.	843.	865.	905.	1005.	1004.	935.	883.	824.	824.
123	806.	866.	838.	846.	858.	806.	827.	788.	809.	816.
124	809.	829.	857.	901.	833.	801.	855.	814.	845.	874.
125	888.	935.	827.	834.	881.	853.	873.	855.	872.	886.
126	944.	888.	926.	887.	1037.	1064.	1219.	1228.	1241.	1163.
127	1066.	969.	920.	921.	953.	952.	926.	969.	1025.	910.
128	1032.	1246.	2177.	5017.	10311.	14420.	12840.	7087.	2710.	994.
129	615.	616.	695.	709.	610.	583.	621.	560.	557.	575.
130	607.	621.	567.	620.	604.	622.	628.	648.	602.	508.
131	582.	624.	607.	647.	613.	609.	587.	611.	613.	647.
132	596.	627.	750.	1359.	3166.	6186.	9295.	7331.	3875.	1494.
133	572.	379.	358.	402.	422.	380.	382.	376.	375.	387.
134	347.	400.	365.	374.	372.	355.	366.	376.	410.	407.
135	386.	362.	394.	363.	415.	362.	436.	523.	608.	606.
136	614.	474.	392.	394.	384.	357.	379.	366.	348.	362.
137	369.	386.	403.	351.	369.	367.	374.	370.	397.	364.
138	375.	397.	339.	365.	349.	360.	336.	306.	389.	335.
139	342.	355.	417.	469.	465.	431.	430.	347.	432.	604.
140	957.	1417.	1604.	1216.	669.	428.	340.	293.	306.	327.
141	304.	290.	323.	305.	315.	350.	326.	293.	322.	294.
142	293.	312.	310.	293.	324.	311.	328.	338.	337.	331.
143	338.	347.	343.	329.	352.	333.	343.	314.	331.	289.
144	302.	298.	342.	294.	294.	270.	280.	313.	293.	286.
145	336.	362.	371.	323.	317.	345.	301.	317.	258.	284.
146	294.	275.	292.	283.	268.	288.	247.	232.	280.	261.
147	257.	288.	259.	264.	279.	316.	279.	255.	252.	269.
148	257.	241.	257.	272.	268.	245.	254.	275.	280.	268.
149	279.	253.	269.	269.	256.	241.	252.	272.	274.	255.
150	248.	277.	234.	260.	243.	257.	213.	246.	261.	249.
151	221.	253.	245.	231.	244.	250.	251.	276.	251.	243.
152	242.	263.	283.	259.	276.	252.	238.	238.	239.	219.
153	232.	226.	229.	237.	220.	217.	235.	213.	214.	223.
154	222.	194.	213.	214.	225.	214.	215.	240.	207.	191.
155	193.	211.	223.	219.	223.	206.	206.	248.	202.	194.
156	209.	213.	200.	224.	207.	194.	218.	198.	205.	218.
157	213.	209.	234.	185.	215.	226.	214.	215.	195.	192.
158	209.	221.	191.	179.	203.	208.	219.	192.	178.	254.

159	245.	295.	226.	200.	317.	197.	186.	201.	194.	218.
160	191.	179.	182.	166.	169.	196.	188.	176.	180.	201.
161	204.	188.	178.	201.	200.	185.	161.	166.	173.	163.
162	191.	179.	175.	173.	182.	194.	186.	156.	166.	186.
163	182.	180.	173.	180.	166.	162.	191.	173.	182.	156.
164	174.	177.	178.	192.	176.	188.	183.	165.	193.	172.
165	201.	159.	169.	199.	178.	198.	167.	190.	203.	189.
166	154.	171.	192.	197.	164.	172.	162.	170.	164.	164.
167	179.	181.	201.	197.	176.	615.	145.	182.	164.	149.
168	163.	162.	244.	364.	529.	146.	598.	367.	210.	166.
169	153.	144.	177.	149.	149.	145.	131.	131.	150.	150.
170	154.	151.	145.	163.	144.	141.	143.	146.	143.	123.
171	140.	154.	145.	139.	164.	158.	136.	148.	151.	142.
172	158.	153.	143.	173.	123.	153.	166.	136.	142.	150.
173	143.	150.	132.	141.	130.	155.	155.	145.	137.	152.
174	158.	128.	154.	142.	138.	148.	148.	174.	142.	200.
175	132.	127.	154.	116.	120.	128.	156.	177.	193.	132.
176	129.	167.	134.	134.	134.	137.	128.	149.	129.	122.
177	126.	136.	133.	122.	132.	129.	115.	115.	154.	108.
178	107.	114.	121.	154.	133.	148.	122.	114.	191.	115.
179	103.	122.	118.	126.	109.	126.	98.	101.	98.	100.
180	110.	120.	109.	182.	116.	98.	105.	100.	88.	125.
181	199.	86.	113.	97.	92.	92.	104.	99.	101.	102.
182	100.	89.	195.	91.	84.	84.	115.	90.	82.	80.
183	75.	85.	88.	87.	90.	67.	86.	88.	82.	69.
184	73.	101.	82.	65.	78.	81.	75.	64.	104.	84.
185	93.	81.	86.	60.	67.	69.	77.	93.	75.	67.
186	75.	66.	70.	68.	64.	73.	62.	62.	84.	61.
187	71.	82.	69.	59.	75.	64.	53.	64.	52.	50.
188	73.	58.	57.	59.	61.	57.	70.	65.	58.	59.
189	68.	68.	58.	65.	52.	58.	49.	55.	58.	57.
190	62.	66.	63.	52.	64.	58.	56.	58.	61.	49.
191	59.	57.	49.	54.	53.	46.	48.	58.	58.	75.
192	61.	42.	51.	48.	50.	58.	52.	57.	57.	57.
193	45.	54.	60.	47.	70.	62.	51.	60.	60.	63.
194	69.	59.	52.	54.	57.	60.	59.	56.	54.	49.
195	52.	57.	54.	54.	76.	64.	72.	54.	72.	51.
196	61.	55.	58.	56.	55.	65.	65.	57.	62.	72.
197	71.	61.	73.	59.	76.	64.	73.	65.	64.	63.
198	48.	59.	59.	73.	55.	58.	72.	45.	58.	77.
199	62.	71.	68.	72.	57.	52.	45.	48.	50.	70.
200	98.	173.	309.	593.	692.	566.	349.	120.	19.	19.
201	18.	20.	23.	20.	20.	19.	18.	23.	17.	20.
202	26.	14.	28.	16.	20.	24.	28.	24.	22.	15.
203	29.	28.	28.	22.	24.	22.	22.	24.	22.	
204	21934.	287.	361.	704.	1758.	3090.	3550.	3500.		

- IRRAGGIAMENTO - 91 2400.000 MINUTI DATA 1974 12 15 24 0 FLUSSO .0000
- MISURA - TEMPO CONTEGGIO 1851.850 MINUTI DATA 1975 1 22 15 0 DECADIMENTO 54180.000 MINUTI
- CAMPIONE - ALFA 374 PESO .05270000 G CALIB. Y= 1.000*X+ -1.712 PROBLEMA ALFALFA

ELEM	P.P.M.	ERR.0/0	VALORE A	KEV (T)	KEV (S)	LS	WT	C P M	AREA ZERO	UGM	AT/CC
CE				145.40							
CO	(4.115-003)			1332.48							
CR	(2.480-001)			320.08							
CS				795.80							
EU	(1.345-003)			1408.11							
HF	(9.197-003)			482.60							
HG				279.20							
IN				1300.00							
NI				810.81							
RB	5.240+000	12.69		1076.60	1079.00	1078	6	1.423+000	8.601+000		
SB				1691.00							
SC	(8.720-004)			889.25							
TA				1221.60							
TB				879.33							
TH	1.108+000	.92		311.90	313.32	310	11	7.102+001	1.863+002		
YB	(1.862-002)			197.80							
ZN	3.966+000	.41		1115.51	1113.55	1111	9	1.195+002	1.329+002		
ZR	(2.935+000)			765.80							
BA	(1.995+001)			216.00							
FE	(8.062+000)			1099.27							

SPETTRO N. 4 CANALI 2048 TCON 39.183 MINUTI DATA 1975 1 23 8 0 DECAD 55200.000 MIN

	1	2	3	4	5	6	7	8	9	10
0	2351.	2277.	1344.	993.	627.	343.	229.	201.	132.	111.
1	80.	58.	56.	42.	36.	40.	27.	28.	26.	20.
2	21.	41.	44.	53.	73.	142.	159.	292.	455.	738.
3	1733.	8378.	28981.	50911.	62631.	62925.	60220.	58695.	56958.	56617.
4	54579.	53262.	51945.	50588.	49301.	48253.	47227.	45178.	44635.	44003.
5	43561.	42006.	41238.	40398.	39246.	38951.	38256.	37655.	37415.	36626.
6	35843.	35764.	35316.	34660.	34082.	33822.	33672.	33800.	34527.	34534.
7	34109.	32812.	31515.	30830.	30668.	30060.	30203.	30159.	30310.	31030.
8	30516.	30083.	29858.	28960.	28258.	27656.	27558.	27744.	27369.	27610.
9	27450.	26975.	27250.	27100.	27253.	25911.	25493.	24975.	24907.	24532.
10	24276.	24286.	23791.	23950.	24013.	24140.	24122.	23737.	23380.	22702.
11	22881.	22323.	22164.	22231.	23119.	25948.	27584.	26690.	24202.	21020.
12	20512.	19995.	19775.	19988.	20061.	20602.	22160.	23697.	23032.	21688.
13	20262.	19460.	18683.	17993.	18340.	18167.	18572.	19208.	20484.	22503.
14	22995.	20517.	18111.	16530.	16495.	16413.	16450.	16257.	16111.	15935.
15	15871.	15640.	15592.	15442.	15277.	15080.	15185.	14742.	14940.	14562.
16	14704.	14597.	14561.	14364.	14153.	14316.	14066.	13933.	13915.	14012.
17	14172.	14031.	14119.	13774.	13637.	13655.	13358.	13204.	13284.	13077.
18	13034.	13153.	12922.	13140.	13308.	14203.	14851.	14686.	13810.	13073.
19	12970.	13227.	13270.	13072.	12953.	12141.	12178.	12463.	12067.	11890.
20	12065.	11949.	12118.	12118.	12262.	12000.	11919.	11963.	12063.	12121.
21	12091.	12038.	11328.	11535.	11664.	11745.	11757.	11490.	11450.	11186.
22	11084.	11148.	11387.	11051.	11177.	10990.	10783.	10677.	10725.	10608.
23	10512.	10394.	10466.	10439.	10316.	10484.	10537.	10680.	11212.	11078.
24	10795.	10183.	10225.	9881.	9694.	8779.	9695.	9592.	9484.	9610.
25	9703.	9421.	9452.	9409.	9493.	9532.	9478.	9514.	9732.	9576.
26	9443.	9247.	9309.	9118.	9071.	9100.	9093.	9130.	8899.	9030.
27	9082.	9099.	9286.	9360.	9254.	9090.	9035.	8819.	8871.	8670.
28	8689.	8763.	8832.	8804.	9648.	8739.	8789.	8845.	9088.	8910.
29	9162.	9694.	10269.	10387.	9805.	9456.	8897.	8425.	8579.	8595.
30	8879.	8859.	9835.	9317.	10806.	12180.	12503.	11011.	9383.	8523.
31	8600.	9719.	13716.	13815.	13852.	15684.	10990.	8231.	7325.	7299.
32	7232.	7266.	7215.	7344.	7244.	7289.	7421.	7142.	7440.	7337.
33	7213.	7343.	7532.	7617.	7644.	8155.	9338.	10826.	11569.	10437.
34	8736.	7501.	7000.	6706.	6831.	6706.	6639.	6730.	6725.	6502.
35	6617.	6636.	6601.	6517.	6730.	6641.	6462.	6526.	6566.	6508.
36	6731.	6537.	6556.	6643.	6548.	6300.	6563.	6435.	6500.	6434.
37	6404.	6348.	6424.	6452.	6279.	6426.	6400.	6351.	6481.	6404.
38	6350.	6271.	6374.	6157.	6563.	6739.	6527.	6412.	6242.	6362.
39	6422.	6319.	6308.	6471.	6402.	6261.	6108.	6233.	6340.	6436.
40	6070.	6098.	6256.	6319.	6434.	6320.	6304.	6202.	6130.	6487.
41	6425.	6324.	6307.	6297.	6236.	6202.	6091.	6228.	6171.	6094.
42	6116.	6085.	6015.	6150.	6022.	6202.	6056.	6102.	6071.	6084.
43	6071.	5950.	5933.	6025.	6106.	6060.	6226.	6315.	6367.	6217.
44	6195.	5913.	6043.	6104.	6010.	6035.	5999.	6104.	6053.	6065.
45	5982.	5987.	6123.	6049.	6001.	6133.	5854.	5870.	6004.	5956.
46	6000.	5988.	6057.	6111.	6119.	6096.	6042.	6049.	6115.	6200.
47	6201.	6016.	6230.	6540.	7889.	9037.	8819.	7038.	6702.	6025.
48	5818.	5960.	5786.	5848.	5906.	5907.	5816.	5946.	5911.	6104.
49	6055.	5849.	6030.	5889.	5958.	5950.	5864.	5978.	5815.	5941.
50	5864.	6259.	6370.	7240.	7865.	7927.	7462.	7041.	6701.	6149.
51	5930.	5851.	5963.	5772.	5854.	5935.	5776.	5734.	5951.	5709.
52	5782.	5858.	5783.	5804.	5979.	5842.	5886.	5762.	5932.	5872.
53	5932.	5737.	5948.	5832.	5805.	5916.	5889.	5955.	5966.	5882.
54	5653.	5872.	5867.	5738.	5778.	5928.	5884.	6105.	5936.	5863.
55	5874.	5877.	5974.	5879.	6051.	6081.	6413.	6318.	6081.	5951.
56	6053.	6226.	6777.	6609.	6460.	6089.	6018.	5877.	5872.	5907.
57	5730.	5927.	5908.	6059.	5936.	5974.	6014.	5904.	5904.	5989.
58	6019.	6066.	5949.	6049.	6162.	6093.	6120.	5950.	6004.	5969.
59	5964.	6 22.	6114.	6019.	6551.	7659.	9500.	11400.	11795.	9981.
60	7799.	6265.	5819.	5720.	5671.	5732.	5869.	5657.	5765.	5603.
61	5620.	5635.	5664.	5647.	5773.	5570.	5631.	5703.	5677.	5708.
62	5657.	5699.	5493.	5671.	5598.	5681.	5453.	5608.	5716.	5649.
63	5547.	5673.	5574.	5728.	5603.	5627.	5539.	5552.	5660.	5699.
64	5735.	5664.	5572.	5608.	5672.	5544.	5508.	5680.	5702.	5777.
65	5705.	5644.	5693.	5655.	5719.	5679.	5659.	5704.	5603.	5563.
66	5763.	5789.	5818.	5603.	5603.	5770.	5550.	5666.	5620.	5743.
67	5668.	5791.	5616.	5809.	5606.	5668.	5800.	5662.	5670.	5642.
68	5676.	5689.	5571.	5575.	5316.	5432.	5324.	5236.	5136.	5213.
69	5156.	5186.	5222.	5143.	4985.	5113.	4998.	5019.	5002.	5038.
70	5101.	5134.	4883.	5005.	4955.	4903.	5106.	5006.	4968.	4954.
71	4961.	4857.	4869.	4948.	4945.	5105.	5227.	5102.	5062.	5010.
72	4952.	4751.	4784.	4844.	4748.	4855.	4752.	4745.	4755.	4735.
73	4941.	4768.	4769.	4805.	4787.	4753.	4841.	4712.	4880.	4803.
74	4659.	4788.	4843.	4779.	4697.	4731.	4849.	4771.	4904.	5020.
75	4946.	4920.	4779.	4604.	4544.	4995.	4642.	4901.	5020.	4926.
76	4935.	4807.	4726.	4677.	4570.	4548.	4595.	4644.	4709.	4714.

SPETTRO N. 4 CANALI 2048 TCON 39.183 MINUTI DATA 1975 1 23 8 0 DECAD 55200.000 MIN

	1	2	3	4	5	6	7	8	9	10
0	2351.	2277.	1344.	993.	627.	343.	229.	201.	132.	111.
1	80.	58.	56.	42.	36.	40.	28.	27.	26.	29.
2	21.	41.	44.	53.	73.	142.	159.	282.	455.	738.
3	1733.	8378.	28981.	50911.	62631.	62025.	60220.	58805.	56958.	56617.
4	54579.	53262.	51945.	50580.	49901.	48253.	47227.	45178.	44635.	44003.
5	43561.	42006.	41238.	40398.	39246.	38951.	38256.	37655.	37415.	36626.
6	35842.	35764.	35316.	34669.	34082.	33822.	33672.	33380.	33537.	34534.
7	34109.	32812.	31515.	30830.	30668.	30060.	30203.	30159.	30310.	31030.
8	30516.	30083.	29858.	28960.	28258.	27656.	27558.	27744.	27560.	27610.
9	27450.	26975.	27250.	27190.	27253.	25911.	25493.	24975.	24947.	24532.
10	24276.	24286.	23791.	23959.	24013.	24140.	24122.	23737.	23390.	22702.
11	22881.	22323.	22164.	22231.	23119.	25948.	27584.	26690.	24209.	21929.
12	20512.	19995.	19775.	19988.	20061.	20602.	22160.	23697.	23032.	21688.
13	20262.	19460.	18683.	17993.	18340.	18167.	18572.	19208.	20484.	22503.
14	22995.	20517.	18111.	16530.	16495.	16413.	16450.	16257.	16111.	15935.
15	15871.	15640.	15592.	15442.	15277.	15080.	15185.	14742.	14849.	14562.
16	14704.	14597.	14561.	14364.	14153.	14316.	14066.	13933.	13915.	14012.
17	14172.	14031.	14119.	13774.	13637.	13655.	13358.	13204.	13284.	13077.
18	13034.	13153.	12922.	13140.	13308.	14203.	14851.	14686.	13810.	12973.
19	12970.	13227.	13270.	13072.	12453.	12141.	12178.	12463.	12067.	11890.
20	12065.	11949.	12118.	12118.	12262.	12000.	11919.	11963.	12063.	12121.
21	12091.	12038.	11828.	11525.	11664.	11745.	11757.	11490.	11459.	11186.
22	11084.	11148.	11387.	11051.	11177.	10980.	10783.	10677.	10725.	10608.
23	10512.	10394.	10466.	10439.	10316.	10537.	10680.	11212.	11078.	11078.
24	10795.	10183.	10225.	9881.	9694.	9779.	9695.	9592.	9484.	9610.
25	9703.	9421.	9452.	9409.	9493.	9532.	9478.	9514.	9732.	9576.
26	9443.	9247.	9309.	9118.	9071.	9190.	9093.	9130.	8829.	9030.
27	9082.	9099.	9286.	9360.	9254.	9090.	9035.	8819.	8871.	8670.
28	8689.	8763.	8832.	8804.	8648.	8739.	8799.	8845.	9088.	8910.
29	9162.	9694.	10269.	10387.	9805.	9456.	8887.	8425.	8579.	8595.
30	8879.	8859.	8835.	9317.	10806.	12180.	12503.	11011.	9383.	8523.
31	8600.	9719.	13716.	19815.	19852.	15684.	10990.	8231.	7325.	7290.
32	7232.	7266.	7215.	7344.	7244.	7289.	7421.	7142.	7449.	7337.
33	7213.	7343.	7532.	7617.	7644.	8155.	9338.	10828.	11569.	10437.
34	8736.	7501.	7000.	6706.	6831.	6706.	6639.	6730.	6725.	6502.
35	6617.	6636.	6601.	6517.	6730.	6641.	6462.	6526.	6566.	6508.
36	6731.	6537.	6556.	6643.	6548.	6300.	6563.	6435.	6590.	6434.
37	6404.	6348.	6424.	6452.	6278.	6426.	6400.	6351.	6481.	6404.
38	6350.	6271.	6374.	6157.	6563.	6739.	6527.	6412.	6242.	6362.
39	6422.	6319.	6308.	6471.	6402.	6261.	6108.	6233.	6349.	6436.
40	6070.	6098.	6256.	6319.	6434.	6320.	6304.	6202.	6139.	6487.
41	6425.	6324.	6307.	6297.	6236.	6202.	6091.	6228.	6171.	6094.
42	6116.	6085.	6015.	6159.	6022.	6202.	6056.	6102.	6071.	6084.
43	6071.	5950.	5933.	6025.	6196.	6060.	6226.	6313.	6367.	6217.
44	6195.	5913.	6043.	6104.	6010.	6035.	5989.	6104.	6053.	6065.
45	5982.	5997.	6123.	6049.	6001.	6133.	5854.	5879.	6004.	5956.
46	6000.	5988.	6057.	6111.	6119.	6096.	6042.	6049.	6115.	6200.
47	6201.	6016.	6230.	6540.	7889.	9037.	8819.	7938.	6702.	6025.
48	5818.	5990.	5786.	5848.	5906.	5997.	5816.	5946.	5911.	6104.
49	6055.	5849.	6030.	5889.	5958.	5950.	5864.	5978.	5915.	5941.
50	5864.	6259.	6870.	7240.	7865.	7927.	7462.	7041.	6701.	6149.
51	5930.	5651.	5963.	5772.	5854.	5935.	5776.	5734.	5951.	5709.
52	5782.	5858.	5783.	5804.	5979.	5902.	5886.	5762.	5632.	5872.
53	5932.	5737.	5948.	5832.	5805.	5916.	5889.	5955.	5966.	5883.
54	5653.	5872.	5867.	5738.	5778.	5928.	5884.	6105.	5936.	5863.
55	5874.	5877.	5974.	5879.	6051.	6081.	6413.	6318.	6081.	5951.
56	6053.	6226.	6777.	6603.	6460.	6089.	6018.	5877.	5879.	5907.
57	5730.	5927.	5908.	6050.	5936.	5974.	6014.	5904.	5904.	5989.
58	6019.	6006.	5949.	6040.	6162.	6003.	6120.	5950.	6004.	5960.
59	5964.	6 22.	6014.	6019.	5561.	7658.	9590.	11400.	11785.	9981.
60	7799.	6265.	5819.	5720.	5671.	5732.	5868.	5657.	5765.	5603.
61	5620.	5635.	5664.	5647.	5773.	5579.	5631.	5703.	5677.	5708.
62	5557.	5609.	5493.	5671.	5598.	5681.	5453.	5608.	5716.	5649.
63	5547.	5673.	5574.	5728.	5603.	5627.	5539.	5552.	5660.	5699.
64	5735.	5664.	5572.	5608.	5672.	5544.	5588.	5680.	5702.	5777.
65	5705.	5644.	5693.	5655.	5719.	5679.	5659.	5704.	5603.	5563.
66	5763.	5789.	5818.	5603.	5603.	5770.	5550.	5666.	5620.	5743.
67	5668.	5701.	5616.	5803.	5696.	5668.	5800.	5662.	5670.	5642.
68	5676.	5689.	5571.	5575.	5316.	5432.	5324.	5236.	5136.	5213.
69	5156.	5186.	5222.	5143.	4985.	5113.	4998.	5019.	5002.	5030.
70	5101.	5034.	4983.	5005.	4955.	4993.	5106.	5006.	4968.	4954.
71	4961.	4857.	4869.	4948.	4945.	5105.	5227.	5102.	5062.	5010.
72	4952.	4751.	4784.	4844.	4748.	4855.	4752.	4745.	4755.	4735.
73	4941.	4768.	4769.	4805.	4787.	4753.	4841.	4712.	4880.	4903.
74	4659.	4788.	4843.	4779.	4697.	4731.	4849.	4771.	4904.	5020.
75	4946.	4920.	4779.	4694.	4544.	4825.	4642.	4901.	5020.	4926.
76	4935.	4807.	4726.	4677.	4570.	4548.	4585.	4644.	4709.	4714.

77	4819.	5016.	5344.	5194.	5038.	4624.	4485.	4525.	4549.	4568.
78	4475.	4583.	4565.	4592.	4508.	4608.	4958.	6099.	7459.	8016.
79	7304.	5929.	4953.	4660.	4746.	4805.	4712.	4682.	4463.	4580.
80	4450.	4593.	4632.	4842.	4879.	4759.	4669.	4702.	4491.	4586.
81	4490.	4553.	4544.	4431.	4556.	4596.	4549.	4578.	4597.	4569.
82	4651.	4596.	4588.	4702.	4793.	4941.	5676.	6706.	6993.	6509.
83	5682.	4996.	4741.	4663.	4672.	4688.	4769.	4748.	4802.	4726.
84	4582.	4737.	4924.	4810.	4772.	4794.	4743.	4709.	4867.	4842.
85	4765.	4818.	4320.	4930.	4737.	4944.	4953.	4967.	5046.	5003.
86	5121.	5107.	5031.	4935.	5054.	5072.	5126.	5058.	5135.	5081.
87	5105.	5571.	5495.	5408.	5392.	5178.	5146.	5320.	5496.	7494.
88	15291.	30006.	42461.	39920.	26460.	12743.	6092.	4214.	3994.	4000.
89	3922.	3895.	3901.	3797.	3825.	3901.	3835.	3837.	3761.	3786.
90	3731.	3796.	3515.	3512.	3453.	3373.	3377.	3293.	3184.	3189.
91	3160.	3068.	3080.	3128.	3009.	2936.	3007.	2879.	3005.	2872.
92	2910.	2849.	2889.	2886.	2918.	2770.	2998.	2824.	2826.	2631.
93	2844.	2738.	2728.	2713.	2826.	2788.	2719.	2767.	2753.	2695.
94	2615.	2653.	2708.	2677.	2718.	2582.	2522.	2491.	2704.	2596.
95	2524.	2583.	2564.	2514.	2659.	2738.	2970.	3074.	3110.	2922.
96	2830.	2605.	2453.	2324.	2267.	2323.	2256.	2308.	2307.	2302.
97	2187.	2204.	2256.	2131.	2183.	2135.	2194.	2138.	2165.	2110.
98	2147.	1985.	1964.	2072.	2071.	2056.	1953.	2039.	1986.	2064.
99	2035.	1997.	2008.	1941.	1987.	2019.	1981.	1949.	1927.	1932.
100	1923.	1830.	1786.	1804.	1895.	1858.	1817.	1863.	1823.	1809.
101	1755.	1820.	1803.	1752.	1755.	1774.	1821.	1740.	1762.	1861.
102	1806.	1694.	1756.	1767.	1759.	1767.	1731.	1704.	1874.	1888.
103	1768.	1857.	1804.	1791.	1767.	1809.	1797.	1838.	1898.	1784.
104	1871.	1862.	1885.	1866.	1816.	1899.	1883.	1866.	1887.	1888.
105	1865.	1891.	1851.	1945.	1988.	1904.	1969.	2023.	1973.	1937.
106	2019.	2033.	2103.	2081.	2102.	1992.	2064.	2200.	2536.	2954.
107	3153.	2940.	2538.	2249.	2054.	2042.	2120.	2204.	2376.	2459.
108	2353.	2397.	2217.	2196.	2215.	2179.	2235.	2172.	2265.	2653.
109	4247.	7254.	9653.	9525.	6868.	4205.	2503.	2162.	2167.	2169.
110	2217.	2169.	2212.	2329.	2469.	3156.	5524.	10932.	16912.	18516.
111	14771.	12989.	19052.	28802.	31212.	23140.	11733.	4240.	1302.	782.
112	686.	672.	660.	651.	719.	672.	668.	676.	664.	620.
113	645.	677.	615.	612.	683.	645.	690.	629.	685.	653.
114	627.	694.	657.	617.	613.	621.	650.	604.	639.	651.
115	664.	635.	609.	602.	637.	596.	598.	633.	592.	646.
116	673.	710.	690.	890.	1767.	3434.	4953.	4743.	3270.	1782.
117	937.	619.	605.	498.	506.	499.	413.	430.	440.	433.
118	495.	502.	515.	525.	442.	401.	420.	401.	392.	377.
119	365.	415.	379.	421.	436.	373.	384.	394.	374.	376.
120	377.	363.	397.	344.	388.	412.	392.	379.	375.	396.
121	380.	372.	417.	478.	558.	549.	505.	427.	396.	337.
122	373.	336.	375.	449.	453.	440.	433.	410.	380.	380.
123	379.	356.	376.	344.	354.	344.	354.	359.	332.	318.
124	350.	376.	373.	357.	356.	371.	403.	375.	383.	376.
125	385.	383.	366.	368.	404.	348.	365.	387.	378.	377.
126	420.	370.	381.	379.	485.	464.	542.	541.	503.	498.
127	445.	407.	424.	389.	395.	385.	409.	400.	385.	380.
128	456.	556.	1259.	2612.	4655.	5252.	4345.	2466.	1067.	442.
129	312.	299.	297.	296.	292.	267.	242.	225.	249.	298.
130	266.	266.	236.	261.	284.	311.	281.	278.	277.	281.
131	271.	251.	308.	278.	248.	266.	256.	287.	299.	303.
132	279.	286.	431.	960.	2218.	3671.	4187.	3340.	1781.	770.
133	283.	179.	163.	155.	167.	170.	179.	162.	152.	156.
134	164.	158.	170.	174.	163.	144.	174.	154.	167.	156.
135	149.	174.	183.	173.	156.	168.	186.	191.	212.	251.
136	212.	197.	160.	167.	187.	149.	162.	167.	148.	137.
137	166.	155.	167.	147.	160.	139.	154.	169.	165.	180.
138	153.	132.	149.	149.	148.	149.	169.	166.	165.	119.
139	156.	165.	148.	179.	179.	197.	158.	150.	191.	295.
140	481.	653.	623.	473.	320.	191.	140.	132.	137.	123.
141	135.	131.	133.	139.	133.	120.	137.	139.	150.	146.
142	143.	136.	140.	140.	132.	130.	161.	135.	150.	155.
143	137.	141.	144.	129.	144.	161.	143.	122.	120.	124.
144	122.	129.	124.	111.	135.	141.	127.	144.	99.	139.
145	120.	131.	137.	145.	126.	155.	136.	134.	113.	102.
146	83.	132.	111.	119.	112.	120.	115.	105.	125.	114.
147	116.	118.	99.	111.	130.	114.	120.	118.	127.	124.
148	127.	129.	95.	132.	119.	108.	118.	121.	125.	107.
149	100.	110.	110.	107.	89.	107.	118.	101.	137.	116.
150	128.	102.	123.	116.	115.	119.	119.	100.	104.	109.
151	114.	87.	109.	99.	89.	115.	114.	86.	105.	102.
152	97.	113.	127.	112.	106.	103.	84.	98.	88.	93.
153	76.	94.	104.	93.	90.	97.	102.	108.	89.	101.
154	112.	103.	89.	88.	99.	103.	97.	86.	108.	95.
155	72.	90.	94.	88.	101.	101.	77.	83.	104.	84.
156	91.	86.	96.	95.	88.	97.	92.	86.	100.	86.
157	84.	92.	91.	80.	96.	87.	88.	81.	107.	104.
158	89.	67.	67.	99.	76.	96.	87.	88.	84.	89.

159	98.	89.	92.	95.	91.	79.	93.	77.	87.
160	98.	86.	86.	76.	81.	76.	75.	82.	86.
161	78.	105.	82.	77.	66.	83.	65.	71.	81.
162	81.	83.	92.	77.	71.	58.	77.	79.	74.
163	84.	63.	72.	68.	76.	71.	80.	70.	80.
164	62.	70.	63.	72.	69.	69.	93.	76.	85.
165	86.	88.	83.	61.	75.	79.	68.	73.	78.
166	87.	71.	77.	69.	67.	80.	75.	70.	80.
167	86.	66.	59.	67.	79.	73.	75.	73.	89.
168	76.	91.	113.	181.	276.	246.	230.	131.	67.
169	70.	68.	139.	560.	62.	64.	65.	68.	46.
170	58.	55.	57.	63.	50.	71.	64.	62.	60.
171	95.	55.	70.	52.	75.	71.	64.	64.	61.
172	67.	70.	70.	47.	65.	72.	58.	58.	66.
173	49.	66.	52.	57.	58.	70.	75.	56.	58.
174	52.	69.	57.	60.	54.	50.	60.	53.	63.
175	53.	63.	64.	57.	58.	51.	72.	59.	66.
176	66.	70.	67.	55.	56.	58.	55.	60.	62.
177	44.	60.	56.	59.	66.	60.	40.	58.	66.
178	59.	60.	56.	51.	58.	67.	51.	46.	64.
179	49.	48.	51.	60.	47.	54.	43.	49.	56.
180	40.	43.	46.	42.	44.	39.	56.	44.	50.
181	46.	43.	34.	46.	41.	51.	39.	38.	48.
182	37.	32.	42.	44.	35.	26.	47.	35.	31.
183	48.	50.	25.	41.	35.	42.	42.	46.	41.
184	34.	35.	31.	36.	37.	41.	34.	34.	41.
185	36.	36.	34.	25.	25.	29.	31.	25.	30.
186	26.	32.	39.	32.	35.	29.	29.	36.	27.
187	31.	21.	31.	44.	23.	23.	30.	25.	20.
188	20.	31.	30.	23.	22.	26.	29.	26.	17.
189	20.	31.	24.	27.	21.	36.	26.	19.	20.
190	21.	15.	25.	20.	26.	34.	31.	26.	33.
191	16.	33.	30.	26.	24.	32.	25.	17.	22.
192	22.	20.	28.	29.	25.	26.	24.	24.	28.
193	28.	25.	19.	21.	22.	28.	24.	26.	27.
194	25.	20.	38.	28.	24.	21.	18.	21.	30.
195	32.	18.	16.	27.	23.	24.	26.	30.	29.
196	26.	24.	31.	20.	24.	24.	38.	36.	27.
197	22.	29.	26.	25.	25.	24.	33.	21.	33.
198	27.	30.	27.	29.	33.	34.	33.	29.	32.
199	32.	29.	24.	30.	15.	160.	31.	34.	16.
200	48.	89.	158.	214.	241.	100.	105.	48.	11.
201	8.	11.	9.	13.	10.	12.	8.	16.	19.
202	11.	5.	13.	9.	11.	12.	11.	8.	5.
203	5.	14.	13.	14.	15.	13.	9.	14.	
204	60000.	424.	568.	941.	1735.	3756.	8206.	11741.	

- IRRAGGIAMENTO - 91 2400.000 MINUTI DATA 1974 12 15 24 0 FLUSSO .0000
- MISURA - TEMPO CONTEGGIO 39.183 MINUTI DATA 1975 1 23 8 0 DECADIMENTO 55200.000 MINUTI
- CAMPIONE - ALFA 656 PESO .05630000 G CALIB. Y= 1.000*X+ -1.712 PROBLEMA ALFALFA

ELEM	P.P.M.	ERR.0/0	VALORE A	KEV (T)	KEV (S)	LS	WT	C P M	AREA ZERO	UGM	AT/CC
CE				145.40							
CE				145.40							
CO	(1.245-001)			1332.48							
CR	(7.242+000)			320.08							
CS				795.80							
CS				795.80							
EU	(3.969-002)			1408.11							
HF	(2.737-001)			482.60							
HG				279.20							
IN				1300.00							
NI				810.81							
RB	(4.703+001)			1076.60							
SB				1691.00							
SC	(2.650-002)			889.25							
TA				1221.60							
TB				879.33							
TH	1.583+001	1.87		311.90	313.02	310	11	1.065+003	2.844+003		
YB	1.684+000	17.61		197.80	190.95	196	3	9.006+001	SECOND(185.64	190.95)	
YB	3.029+000	12.67		197.80	185.64	183	9	1.620+002	3.709+002		
ZN	5.953+001	.92		1115.51	1113.19	1111	9	1.912+003	2.131+003		
ZR	(8.876+001)			765.80							
BA	(5.950+002)			216.00							
FE	(2.499+002)			1099.27							

SPETTRO N. 5 CANALI 2048 TCON 151.017 MINUTI DATA 1975 1 23 14 30 DECAD 55590.000 MTN

	1	2	3	4	5	6	7	8	9	10
0	9061.	6976.	4917.	4371.	3584.	1681.	936.	628.	422.	378.
1	257.	216.	159.	152.	119.	114.	108.	76.	77.	77.
2	61.	84.	97.	111.	138.	175.	262.	446.	682.	1120.
3	2350.	6474.	18367.	63021.	147542.	182001.	174984.	167251.	162448.	158603.
4	155607.	152054.	148364.	144279.	140742.	136344.	134142.	129997.	126934.	123751.
5	120624.	118660.	116493.	113585.	111072.	108680.	107234.	105271.	103832.	101398.
6	100458.	98315.	97061.	96266.	94880.	93170.	91624.	91123.	90038.	89031.
7	93782.	93473.	89545.	84984.	82930.	81704.	81171.	80914.	81215.	81135.
8	83046.	82144.	80984.	79333.	77379.	75161.	74398.	73455.	73500.	73544.
9	74123.	72727.	72349.	71764.	73084.	71999.	69580.	67654.	66517.	66296.
10	65770.	65240.	64058.	63971.	64038.	64941.	64834.	64028.	62935.	61791.
11	61847.	60710.	60056.	59080.	60286.	60855.	65990.	73460.	73226.	64000.
12	57912.	54953.	53846.	53540.	53696.	53759.	54836.	56597.	61029.	61705.
13	56754.	52845.	51428.	51370.	49354.	48913.	49192.	49972.	51542.	52682.
14	56654.	59511.	54990.	47904.	45850.	44505.	44594.	45053.	44970.	44376.
15	43551.	43381.	43067.	42375.	42328.	42000.	41147.	40996.	40764.	40139.
16	40119.	40032.	40053.	39147.	39663.	38907.	38873.	38468.	39318.	38074.
17	38402.	38048.	38705.	38778.	39325.	37107.	36534.	36497.	36349.	35719.
18	35886.	35829.	35215.	35468.	35287.	36044.	37735.	40698.	41972.	37084.
19	34893.	34408.	35605.	36251.	35432.	33971.	32914.	32866.	32624.	32582.
20	32608.	32393.	32414.	32377.	32666.	32245.	32184.	32339.	32235.	32348.
21	32680.	32722.	32400.	30892.	31137.	31059.	31424.	31423.	31077.	30759.
22	29875.	29771.	29605.	29738.	29970.	29289.	28974.	28658.	29307.	28382.
23	28501.	28112.	28010.	28071.	28205.	27811.	27873.	27735.	28122.	29566.
24	30324.	28864.	27218.	26602.	26583.	26162.	26319.	25830.	25715.	25475.
25	25399.	25563.	25461.	25632.	25695.	25430.	25376.	25252.	25674.	25800.
26	25661.	25234.	24944.	24807.	24837.	24841.	24843.	24660.	24506.	24677.
27	24209.	24272.	24288.	24553.	25041.	25157.	24408.	24343.	24171.	23755.
28	24305.	23708.	23867.	23880.	23762.	23934.	23719.	23749.	23567.	23987.
29	24224.	24816.	25586.	27139.	27806.	26357.	24716.	23966.	23490.	23584.
30	23897.	23835.	24156.	24555.	25023.	26983.	31119.	32855.	29150.	24995.
31	24072.	24805.	28337.	38770.	63562.	80399.	60552.	31870.	20923.	19453.
32	19416.	19186.	19268.	19236.	19217.	19317.	19269.	18860.	19287.	19429.
33	19796.	18895.	19106.	19223.	19373.	20011.	20904.	22555.	26861.	30403.
34	27397.	22042.	19500.	18056.	17875.	17753.	18174.	17843.	17778.	17823.
35	17473.	17476.	17432.	17150.	17161.	17237.	17502.	17210.	17145.	17032.
36	17247.	17298.	17466.	17160.	17280.	16858.	16911.	17038.	17237.	17019.
37	17088.	17091.	17088.	17009.	17043.	16921.	17001.	16876.	16805.	16555.
38	16711.	16667.	16852.	16489.	16587.	16572.	16715.	16619.	16610.	16698.
39	16685.	16603.	16494.	16702.	16535.	16855.	16359.	16325.	16542.	16310.
40	16430.	16343.	16333.	16310.	16575.	16632.	16672.	16516.	16447.	16134.
41	16451.	16272.	16390.	16229.	15732.	16020.	16097.	16044.	15689.	15951.
42	15866.	15753.	15636.	15780.	15433.	15501.	15534.	15602.	15524.	15547.
43	15617.	15576.	15397.	15494.	15655.	15381.	15451.	15530.	16077.	15779.
44	15684.	15651.	15141.	15261.	15169.	15540.	15431.	15513.	15478.	15185.
45	15348.	15090.	15072.	15362.	15263.	15238.	15019.	15092.	15141.	15270.
46	15420.	15265.	15366.	15232.	15279.	15379.	15268.	15360.	15421.	15601.
47	15664.	15471.	15248.	15756.	16012.	17840.	21333.	22708.	18933.	16110.
48	14812.	14709.	14969.	14825.	14952.	14709.	14999.	14664.	14988.	14964.
49	15354.	15348.	15036.	14815.	14938.	14694.	14846.	14998.	14833.	14868.
50	14865.	15035.	15042.	15960.	15950.	18002.	18496.	17809.	17807.	17287.
51	15809.	14873.	14541.	14513.	14742.	14599.	14481.	14610.	14658.	14612.
52	14745.	14747.	14763.	14635.	14845.	14847.	14846.	14707.	14776.	14831.
53	14592.	14670.	14704.	14673.	14888.	14670.	14948.	15002.	14936.	14771.
54	14840.	14869.	14961.	14913.	14883.	15015.	14925.	14726.	14914.	14816.
55	14930.	14949.	14994.	15086.	14942.	15312.	16072.	17377.	18037.	16628.
56	15441.	15627.	16953.	18732.	19712.	17891.	15929.	15193.	15036.	15175.
57	15188.	15150.	15095.	14820.	15096.	15276.	15136.	15091.	15206.	15188.
58	15319.	15495.	15357.	15241.	15317.	15095.	15436.	15188.	15241.	15366.
59	15304.	15080.	15327.	15381.	15701.	17073.	20323.	27407.	37918.	45223.
60	37354.	23067.	15091.	14430.	14341.	14298.	13833.	13523.	13862.	13927.
61	13801.	13776.	13732.	13842.	13743.	13981.	13716.	13697.	13708.	13929.
62	13856.	13739.	13695.	13930.	13810.	13677.	13977.	13817.	13625.	13743.
63	13720.	13835.	13960.	13676.	13863.	13970.	13373.	13664.	14014.	13540.
64	13984.	13911.	13777.	13737.	13590.	13687.	13580.	13571.	13518.	13466.
65	13659.	13779.	13857.	13600.	13676.	13794.	13516.	13778.	13636.	13718.
66	13714.	13889.	13513.	13911.	13737.	13575.	13866.	13760.	13818.	13877.
67	13609.	13736.	14077.	13764.	13702.	13796.	13755.	13873.	13601.	13700.
68	13381.	13420.	13297.	13287.	13233.	12866.	12879.	12730.	12442.	12414.
69	12236.	12112.	12416.	12269.	12145.	11974.	11902.	11844.	11704.	11827.
70	12014.	11796.	12002.	11965.	11900.	11556.	11824.	11914.	11852.	11480.
71	11814.	11730.	11883.	11643.	11758.	11725.	12206.	12360.	12495.	12187.
72	11823.	11480.	11612.	11598.	11359.	11292.	11491.	11406.	11482.	11329.
73	11526.	11344.	11336.	11393.	11302.	11291.	11312.	11336.	11411.	11344.
74	11299.	11314.	11256.	11156.	11176.	11178.	11365.	11199.	11067.	11334.
75	11822.	11951.	11599.	11391.	11411.	11128.	11145.	11355.	11659.	11673.
76	12231.	11766.	11608.	10995.	11140.	11056.	11048.	10963.	10964.	11049.

77	11138.	11372.	12240.	12629.	12543.	11502.	10947.	11030.	10999.	10853.
78	11066.	10880.	10998.	10826.	11111.	11081.	11458.	12557.	16022.	23290.
79	29704.	26224.	17189.	11911.	10955.	11452.	12164.	12161.	11447.	10414.
80	10253.	10458.	10618.	10981.	11497.	11837.	11730.	10724.	10673.	10452.
81	10659.	10678.	10656.	10572.	10736.	10483.	10743.	10778.	10880.	10658.
82	10731.	10701.	10874.	10745.	10917.	11026.	11664.	12955.	16184.	19118.
83	17502.	13577.	11631.	10812.	10824.	10804.	10957.	10893.	11057.	10788.
84	11076.	10929.	11148.	11245.	11037.	11176.	11008.	11226.	11217.	11074.
85	11356.	11289.	11450.	11368.	11565.	11395.	11408.	11517.	11463.	11621.
86	11815.	11984.	12144.	11888.	11921.	11977.	11772.	12069.	11955.	11932.
87	11774.	12158.	12541.	13025.	13127.	12736.	12338.	12064.	12237.	13001.
88	17543.	30529.	63906.	100476.	114627.	67859.	25987.	11424.	9107.	8600.
89	8886.	8805.	8740.	8773.	8685.	8635.	8772.	8488.	8504.	8649.
90	8578.	8390.	8319.	8224.	7991.	8040.	7693.	7653.	7550.	7348.
91	7152.	7143.	7025.	7045.	6928.	6890.	6909.	6780.	6814.	6657.
92	6742.	6636.	6625.	6461.	6632.	6413.	6482.	6645.	6587.	6462.
93	6469.	6430.	6346.	6423.	6189.	6258.	6214.	6286.	6191.	6147.
94	6125.	6161.	6050.	6034.	6127.	6005.	6062.	6030.	6092.	5908.
95	5909.	5726.	5937.	5883.	5807.	6016.	6280.	6839.	7623.	7444.
96	6980.	6425.	5864.	5699.	5474.	5284.	5338.	5309.	5169.	5232.
97	5206.	5099.	5099.	4912.	5050.	4893.	4917.	4952.	5003.	5020.
98	4811.	4751.	4790.	4804.	4730.	4788.	4738.	4761.	4573.	4614.
99	4682.	4747.	4601.	4680.	4502.	4551.	4491.	4488.	4538.	4659.
100	4563.	4270.	4334.	4140.	4228.	4269.	4209.	4175.	4277.	4206.
101	4061.	4203.	4075.	4176.	4269.	4177.	4209.	4071.	4120.	4096.
102	4112.	4094.	4221.	4089.	4075.	4089.	4295.	4144.	4248.	4240.
103	4125.	4224.	4242.	4414.	4262.	4327.	4161.	4304.	4295.	4231.
104	4293.	4391.	4336.	4260.	4303.	4390.	4325.	4521.	4445.	4434.
105	4560.	4480.	4394.	4499.	4537.	4614.	4501.	4518.	4578.	4635.
106	4520.	4695.	4799.	4749.	4671.	4814.	4752.	4927.	5082.	5867.
107	7248.	8207.	7535.	6069.	5133.	4818.	4808.	4821.	5165.	5422.
108	5752.	5844.	5097.	5111.	5048.	5001.	5028.	5010.	5020.	5532.
109	6371.	9572.	17105.	27298.	29248.	19454.	9453.	5361.	4739.	4519.
110	4527.	4744.	4776.	4732.	4978.	5503.	6722.	8923.	14372.	24118.
111	29676.	25113.	21860.	37055.	70214.	88282.	64409.	26577.	7110.	2361.
112	1675.	1671.	1595.	1627.	1618.	1598.	1613.	1523.	1579.	1581.
113	1585.	1532.	1571.	1596.	1595.	1622.	1534.	1677.	1493.	1489.
114	1560.	1549.	1546.	1510.	1571.	1505.	1509.	1552.	1510.	1515.
115	1468.	1547.	1542.	1529.	1454.	1451.	1482.	1462.	1366.	1467.
116	1563.	1635.	1738.	1757.	2047.	3322.	6262.	10513.	11333.	7572.
117	3367.	1744.	1568.	1481.	1310.	1057.	1068.	1079.	1064.	1053.
118	1100.	1068.	1221.	1312.	1328.	1149.	1013.	1018.	1042.	910.
119	1009.	881.	969.	934.	1015.	1022.	905.	961.	875.	896.
120	886.	920.	939.	980.	938.	974.	1001.	1035.	1029.	964.
121	953.	893.	861.	972.	1087.	1322.	1543.	1273.	1043.	947.
122	850.	889.	918.	967.	1051.	1095.	1142.	955.	924.	895.
123	931.	886.	913.	871.	914.	907.	924.	937.	908.	887.
124	934.	868.	899.	916.	982.	942.	915.	916.	937.	896.
125	907.	966.	920.	956.	988.	910.	936.	959.	918.	977.
126	920.	975.	999.	960.	1010.	1111.	1184.	1342.	1305.	1305.
127	1242.	1084.	999.	987.	1028.	1032.	1004.	1045.	1010.	987.
128	1116.	1151.	1534.	2772.	6192.	12455.	16958.	14026.	6738.	2134.
129	802.	610.	711.	782.	709.	691.	619.	632.	637.	556.
130	626.	567.	613.	569.	615.	602.	681.	709.	623.	658.
131	634.	645.	634.	587.	641.	695.	608.	642.	633.	683.
132	702.	607.	710.	897.	1716.	3733.	7103.	9277.	7580.	3636.
133	1176.	531.	414.	420.	361.	373.	385.	379.	413.	390.
134	429.	389.	403.	370.	377.	411.	430.	374.	425.	391.
135	415.	421.	371.	417.	414.	393.	389.	442.	508.	762.
136	779.	666.	511.	431.	379.	388.	362.	374.	397.	425.
137	381.	406.	411.	413.	392.	408.	360.	371.	398.	385.
138	389.	385.	341.	385.	371.	375.	381.	404.	358.	383.
139	374.	382.	381.	438.	547.	542.	469.	450.	399.	487.
140	684.	1070.	1551.	1724.	1204.	634.	390.	309.	330.	330.
141	311.	333.	308.	325.	304.	364.	348.	342.	335.	322.
142	330.	316.	309.	290.	360.	313.	349.	297.	360.	355.
143	381.	377.	362.	329.	360.	329.	356.	335.	357.	350.
144	336.	312.	331.	298.	288.	320.	320.	306.	287.	310.
145	290.	303.	298.	344.	362.	343.	348.	317.	291.	264.
146	281.	326.	297.	282.	280.	280.	277.	277.	295.	266.
147	289.	284.	271.	295.	275.	289.	272.	302.	276.	267.
148	277.	291.	255.	256.	268.	299.	263.	264.	268.	258.
149	259.	237.	271.	250.	247.	290.	232.	259.	255.	268.
150	279.	265.	240.	283.	240.	274.	232.	262.	240.	233.
151	241.	252.	261.	228.	298.	261.	215.	253.	253.	252.
152	239.	238.	294.	292.	267.	265.	236.	256.	263.	250.
153	257.	215.	219.	213.	204.	226.	228.	219.	255.	227.
154	227.	247.	217.	221.	231.	210.	211.	225.	225.	195.
155	215.	214.	240.	210.	208.	232.	226.	239.	200.	234.
156	205.	208.	211.	220.	212.	212.	204.	209.	213.	209.
157	226.	208.	194.	215.	219.	227.	181.	204.	236.	179.
158	198.	223.	193.	192.	213.	208.	194.	203.	212.	248.

159	220.	240.	239.	208.	206.	175.	198.	205.	186.	185.
160	184.	188.	190.	180.	204.	171.	185.	205.	185.	186.
161	196.	203.	214.	204.	214.	181.	194.	190.	191.	195.
162	167.	161.	200.	159.	190.	203.	188.	182.	180.	187.
163	196.	198.	171.	166.	187.	198.	198.	190.	185.	192.
164	186.	191.	186.	179.	180.	209.	203.	208.	191.	191.
165	180.	168.	190.	165.	169.	176.	179.	207.	183.	144.
166	209.	177.	189.	161.	170.	171.	184.	193.	185.	191.
167	153.	179.	209.	190.	186.	192.	193.	189.	152.	195.
168	187.	173.	186.	298.	472.	748.	888.	702.	401.	236.
169	208.	147.	155.	147.	164.	161.	153.	148.	162.	150.
170	153.	175.	152.	152.	133.	143.	160.	134.	153.	125.
171	160.	164.	177.	157.	133.	125.	167.	166.	154.	148.
172	131.	157.	147.	145.	186.	161.	156.	141.	141.	140.
173	129.	138.	150.	134.	150.	143.	121.	127.	143.	150.
174	158.	143.	146.	161.	131.	142.	168.	141.	141.	120.
175	121.	135.	154.	150.	127.	139.	143.	156.	175.	108.
176	236.	214.	167.	141.	111.	134.	132.	129.	136.	133.
177	130.	138.	119.	139.	132.	136.	126.	112.	122.	133.
178	119.	122.	121.	120.	138.	128.	124.	116.	149.	125.
179	113.	116.	118.	108.	110.	107.	117.	115.	115.	113.
180	98.	106.	99.	106.	108.	102.	93.	93.	99.	88.
181	92.	108.	98.	116.	105.	97.	108.	97.	103.	95.
182	83.	94.	91.	102.	106.	93.	84.	88.	84.	95.
183	79.	87.	76.	88.	85.	90.	90.	86.	87.	71.
184	88.	96.	83.	81.	73.	68.	83.	81.	76.	76.
185	80.	77.	81.	80.	84.	80.	71.	82.	71.	90.
186	75.	87.	70.	76.	75.	69.	79.	66.	70.	62.
187	77.	77.	66.	68.	70.	73.	76.	70.	56.	69.
188	65.	62.	69.	63.	58.	60.	44.	71.	59.	61.
189	58.	58.	74.	58.	50.	68.	59.	65.	53.	78.
190	54.	58.	65.	48.	65.	64.	56.	56.	56.	68.
191	57.	60.	52.	59.	59.	55.	66.	65.	62.	64.
192	55.	59.	46.	67.	48.	51.	59.	60.	43.	52.
193	52.	55.	65.	66.	58.	59.	62.	70.	50.	50.
194	44.	50.	55.	63.	61.	61.	68.	59.	64.	75.
195	62.	58.	55.	69.	55.	51.	49.	58.	58.	61.
196	77.	58.	66.	63.	64.	78.	68.	79.	60.	55.
197	61.	62.	54.	62.	61.	67.	61.	71.	57.	65.
198	58.	59.	54.	66.	57.	52.	58.	65.	71.	58.
199	68.	61.	67.	80.	72.	66.	66.	74.	77.	82.
200	66.	108.	203.	388.	584.	617.	470.	235.	83.	39.
201	26.	27.	33.	19.	18.	18.	23.	18.	17.	17.
202	23.	19.	28.	24.	24.	21.	29.	20.	16.	22.
203	16.	20.	23.	22.	24.	17.	21.	29.	26.	25.
204	60000.	410.	575.	995.	2030.	4187.	6757.	9010.		

- IRRAGGIAMENTO - 91 2400.000 MINUTI DATA 1974 12 15 24 0 FLUSSO .0000
- MISURA - TEMPO CONTEGGIO 151.017 MINUTI DATA 1975 1 23 14 30 DECADIMENTO 55590.000 MINUTI
- CAMPIONE - ALFA 154 PESO .06150000 G CALIB. Y= 1.000*X+ -1.712 PROBLEMA ALFALFA

ELEM	P.P.M.	ERR.0/0	VALORE A	KEV (T)	KEV. (S)	LS	WT	C P M	AREA ZERO	UGM	AT/CC
CE				145.40							
CO	4.250+000	1.16		1332.48	1326.61	1319	19	2.077+002	2.106+002		
CR	(3.126+000)			320.08							
CS				795.80							
EU	(1.587-002)			1408.11							
HF	(1.045-001)			482.60							
HG				279.20							
IN				1300.00							
NI				810.81							
RB	2.598+002	5.01		1076.60	1070.61	1067	11	7.857+001	4.975+002		
RU	6.095+001	16.07		1076.60	1079.79	1078	8	1.944+001	1.167+002		
SA				1691.00							
SC	(1.147-002)			889.25							
TA				1221.60							
TB				879.33							
TH	1.570+001	.76		311.90	314.26	311	11	1.146+003	3.082+003		
YB	(2.123-001)			197.80							
ZN	1.921+001	1.25		1115.51	1109.64	1099	12	6.735+002	PRIMO (1109.64 1114.40)		
ZN	4.143+001	.43		1115.51	1114.40	1112	9	1.453+003	1.620+003		
ZR	(3.258+001)			765.80							
BA	(2.358+002)			216.00							
FE	(9.838+001)			1099.27							

SPETTRO N. 6 CANALI 2048 TCON 133.833 MINUTI DATA 1975 1 24 7 30 DECAD 56610.000 MIN

	1	2	3	4	5	6	7	8	9	10
0	8030.	7533.	5627.	4467.	2921.	2035.	1179.	780.	429.	459.
1	275.	241.	190.	153.	123.	112.	118.	88.	80.	90.
2	49.	80.	65.	77.	73.	111.	160.	231.	381.	664.
3	1366.	5420.	19716.	51053.	89114.	112823.	119051.	115619.	113514.	110312.
4	108220.	105663.	102926.	100223.	98198.	95607.	93657.	90848.	89468.	87508.
5	85326.	83306.	82309.	80420.	78566.	77039.	75542.	74840.	73140.	72306.
6	71068.	70603.	70256.	68505.	67800.	66586.	66120.	66040.	67046.	67793.
7	68479.	67094.	64821.	61919.	60297.	59145.	58508.	58162.	58365.	59511.
8	59262.	59272.	58488.	57435.	56081.	54724.	53447.	53226.	52830.	53402.
9	52613.	52089.	51023.	52062.	52368.	51321.	50804.	49326.	48900.	47704.
10	47914.	46917.	47424.	46417.	46647.	46900.	46782.	46394.	45787.	45285.
11	44932.	44350.	44237.	43330.	43805.	45670.	48544.	50749.	50494.	46861.
12	43276.	40789.	39540.	38995.	39065.	39518.	40176.	42486.	44446.	43939.
13	42056.	39318.	39185.	36885.	35847.	35396.	35573.	36131.	37061.	38917.
14	40541.	40719.	38299.	35592.	33275.	32577.	32145.	32173.	32204.	32107.
15	31424.	31019.	30793.	30467.	30148.	29898.	29758.	29255.	29595.	29896.
16	28846.	28404.	28332.	27861.	27997.	27806.	27570.	27457.	27218.	27284.
17	27351.	27144.	27103.	27193.	26702.	26613.	26150.	25857.	25473.	25488.
18	25619.	25539.	25143.	25195.	25283.	25706.	26581.	27347.	27706.	26354.
19	25279.	24821.	24864.	24769.	24583.	24002.	23477.	23127.	22837.	22724.
20	22701.	22555.	22744.	22560.	22911.	22517.	22524.	22449.	22671.	22218.
21	22535.	22557.	22290.	22055.	21949.	21736.	21853.	21855.	21590.	21299.
22	21234.	20776.	20659.	20541.	20443.	20211.	20515.	19808.	19905.	20040.
23	19241.	19487.	19348.	19325.	19101.	19153.	19251.	19184.	19733.	20203.
24	20014.	19543.	19007.	18863.	18155.	18191.	17853.	17836.	17723.	18010.
25	17490.	17581.	17503.	17503.	17425.	17198.	17442.	17413.	17568.	17642.
26	17573.	17166.	16980.	16923.	16976.	16794.	16656.	16899.	16574.	16549.
27	16455.	16466.	16694.	16736.	16726.	16754.	16761.	16280.	16040.	16176.
28	16117.	16043.	16180.	15919.	16098.	16219.	16071.	15898.	16211.	16179.
29	16372.	16741.	16951.	17563.	18076.	17281.	16753.	16301.	16067.	15703.
30	16048.	15945.	16260.	16586.	17026.	18391.	20176.	20133.	19614.	17533.
31	16533.	17509.	21685.	29952.	41056.	44654.	37209.	25957.	17374.	13986.
32	12884.	13022.	12869.	13050.	12766.	12665.	12843.	12557.	12837.	12824.
33	12809.	12851.	12733.	12551.	12902.	13217.	14240.	15862.	17954.	18884.
34	17577.	15576.	13412.	12107.	12183.	11741.	11857.	11880.	11790.	11590.
35	11803.	11319.	11355.	11531.	11503.	11408.	11295.	11312.	11260.	11502.
36	11407.	11483.	11356.	11354.	11348.	11406.	11310.	11085.	11251.	11108.
37	11143.	11033.	11102.	10882.	10945.	11103.	10957.	11006.	10993.	11100.
38	11201.	10974.	11074.	10484.	10816.	10854.	10800.	10723.	10658.	10892.
39	10708.	10570.	11015.	10746.	10922.	10660.	10694.	10671.	10743.	10676.
40	10630.	10491.	10620.	10689.	10772.	11079.	10803.	10650.	10732.	10683.
41	10630.	10661.	10559.	10397.	10503.	10550.	10417.	10402.	10488.	10288.
42	10381.	10342.	10443.	10444.	10304.	10329.	10395.	10077.	10245.	10128.
43	10165.	10200.	10199.	10133.	10324.	10314.	10133.	10313.	10511.	10312.
44	10310.	10116.	10223.	10067.	10076.	9937.	10285.	10241.	10000.	9884.
45	10194.	10217.	10114.	10205.	10029.	10030.	10100.	9948.	10121.	10106.
46	10031.	10092.	10286.	10190.	10122.	10078.	10113.	10165.	10181.	10368.
47	10307.	10363.	10341.	10507.	11604.	12783.	14313.	14585.	13210.	11610.
48	10404.	10108.	9870.	9830.	9800.	9802.	9869.	9759.	9634.	9917.
49	9906.	9829.	9975.	9707.	9856.	9913.	9757.	9824.	9787.	9904.
50	9886.	10108.	10191.	10638.	11444.	11886.	12456.	11997.	11777.	11185.
51	10334.	10180.	9787.	9635.	9619.	9598.	9522.	9738.	9638.	9549.
52	9405.	9600.	9603.	9488.	9632.	9720.	9596.	9617.	9614.	9795.
53	9538.	9589.	9734.	9760.	9704.	9684.	9547.	9659.	9681.	9642.
54	9630.	9660.	9827.	9664.	9841.	9888.	9730.	9628.	9645.	9657.
55	9765.	9662.	9857.	9714.	9885.	10088.	10256.	10416.	10486.	10291.
56	10352.	10291.	10742.	11110.	11252.	10958.	10324.	9999.	9967.	9734.
57	9845.	9717.	9754.	9774.	9743.	9790.	9701.	9841.	9601.	9735.
58	9860.	9657.	9990.	9937.	9750.	9686.	10010.	9956.	9945.	9874.
59	10013.	9862.	9916.	9895.	10237.	10767.	12647.	15257.	18380.	19567.
60	17138.	14043.	11402.	10072.	9729.	9615.	9420.	9240.	9314.	9276.
61	9255.	9376.	9333.	9276.	9318.	9465.	9105.	9249.	9383.	9205.
62	9356.	9261.	9342.	9365.	9356.	9209.	9322.	9115.	9224.	9310.
63	9205.	9287.	9470.	9317.	9217.	9209.	9128.	9174.	9311.	9359.
64	9195.	9320.	9372.	9275.	9175.	9359.	9195.	9205.	9178.	9172.
65	9408.	9236.	9335.	9255.	9324.	9260.	9436.	9449.	9318.	9433.
66	9233.	9356.	9386.	9300.	9376.	9277.	9178.	9282.	9333.	9321.
67	9523.	9255.	9408.	9436.	9259.	9226.	9408.	8741.	8750.	8595.
68	9179.	9232.	9078.	9084.	9865.	8861.	8715.	8173.	8186.	7929.
69	8310.	8188.	8280.	8255.	8102.	7954.	8112.	8171.	7958.	7964.
70	7977.	7965.	8159.	8037.	8123.	8008.	8067.	8179.	8261.	8108.
71	7983.	7883.	8035.	7895.	7899.	8117.	8324.	7802.	7725.	7766.
72	8078.	7908.	7958.	7740.	7898.	7738.	7751.	7555.	7630.	7551.
73	7830.	7877.	7731.	7648.	7679.	7563.	7743.	7641.	7666.	7702.
74	7556.	7637.	7645.	7618.	7473.	7535.	7629.	7672.	7668.	8114.
75	7809.	8067.	7872.	7687.	7645.	7555.	7578.	7398.	7297.	7464.
76	8147.	7908.	7657.	7527.	7464.	7257.	7325.			

77	7430.	7831.	8153.	9350.	9101.	7702.	7552.	7432.	7237.	7207.
78	7455.	7449.	7401.	9328.	7451.	7248.	7539.	8528.	10092.	12200.
79	13124.	12273.	10475.	8462.	7781.	7673.	7607.	7540.	7367.	7276.
80	7125.	7247.	7249.	7574.	7880.	7860.	7781.	7583.	7400.	7365.
81	7222.	7078.	7169.	7266.	7169.	7251.	7295.	7310.	7397.	7284.
82	7395.	7358.	7483.	7358.	7404.	7614.	8110.	9312.	10758.	11448.
83	10776.	9321.	8203.	7586.	7309.	7424.	7435.	7449.	7643.	7309.
84	7463.	7505.	7528.	7679.	7673.	7440.	7689.	7665.	7690.	7622.
85	7699.	7807.	7840.	7876.	7855.	7795.	7902.	7920.	7961.	8059.
86	8143.	8253.	8021.	8200.	8010.	8252.	8303.	8173.	8242.	8226.
87	8330.	8612.	8442.	8686.	8639.	8786.	8548.	8147.	8740.	10091.
88	15848.	29307.	48589.	64895.	63038.	45943.	26118.	12767.	7636.	6103.
89	5967.	6031.	6018.	5985.	5921.	5864.	6021.	5910.	5901.	5975.
90	5793.	5817.	5653.	5512.	5510.	5436.	5343.	5247.	5152.	5008.
91	4932.	5117.	4767.	4800.	4809.	4648.	4640.	4612.	4649.	4702.
92	4553.	4547.	4524.	4445.	4496.	4360.	4524.	4282.	4354.	4408.
93	4375.	4306.	4302.	4333.	4297.	4208.	4222.	4180.	4370.	4151.
94	4192.	4059.	4071.	4141.	4102.	4110.	3988.	4108.	4069.	4050.
95	4014.	4007.	3945.	4035.	3952.	4156.	4394.	4597.	4394.	4820.
96	4562.	4376.	3976.	3774.	3653.	3637.	3645.	3547.	3484.	3532.
97	3490.	3434.	3425.	3493.	3400.	3409.	3329.	3381.	3378.	3345.
98	3255.	3273.	3355.	3255.	3202.	3176.	3180.	3047.	3024.	3223.
99	3163.	3194.	3085.	3176.	3110.	3002.	3030.	2809.	2817.	3033.
100	3031.	2954.	2927.	2862.	2908.	2802.	2834.	2756.	2790.	2730.
101	2838.	2891.	2851.	2880.	2787.	2754.	2825.	2807.	2787.	2780.
102	2853.	2748.	2789.	2709.	2771.	2843.	2763.	2919.	2905.	2794.
103	2861.	2838.	2869.	2896.	2885.	2843.	2808.	2982.	2852.	2885.
104	2916.	2872.	2963.	2867.	2895.	2851.	2880.	3086.	3155.	2965.
105	3018.	3058.	3028.	3180.	3038.	2900.	2903.	3421.	3736.	3160.
106	3185.	3250.	3200.	3233.	3201.	3288.	3259.	3373.	3447.	4167.
107	4730.	4967.	4762.	4145.	3670.	3433.	3228.	3367.	3502.	3753.
108	3806.	3799.	3684.	3474.	3402.	3392.	3403.	4865.	3586.	3804.
109	4938.	7879.	11698.	15189.	15044.	11513.	7667.	7719.	11998.	3270.
110	3105.	3227.	3238.	3456.	3615.	3988.	5112.	22879.	10204.	16429.
111	18114.	18544.	21848.	32358.	44866.	48861.	38434.	1089.	1050.	3572.
112	1533.	1150.	1160.	994.	1013.	1010.	1014.	1022.	1036.	1047.
113	1053.	1072.	1056.	1051.	1066.	1014.	999.	1014.	967.	965.
114	1097.	981.	1020.	988.	1037.	1029.	993.	936.	982.	991.
115	971.	967.	1013.	1001.	964.	979.	957.	4567.	6220.	1000.
116	959.	1040.	1051.	1240.	1803.	2829.	4567.	699.	6348.	4733.
117	2895.	1585.	1127.	926.	846.	799.	747.	743.	728.	751.
118	679.	767.	802.	886.	878.	810.	703.	645.	674.	637.
119	631.	629.	633.	708.	663.	616.	685.	665.	624.	627.
120	606.	619.	638.	604.	676.	503.	627.	826.	606.	622.
121	589.	636.	631.	661.	803.	880.	925.	643.	725.	636.
122	646.	619.	571.	631.	669.	703.	746.	506.	623.	666.
123	587.	632.	610.	591.	586.	509.	611.	583.	637.	571.
124	617.	603.	559.	607.	626.	655.	577.	640.	603.	636.
125	680.	641.	599.	644.	632.	595.	604.	839.	611.	623.
126	633.	673.	641.	681.	682.	708.	768.	681.	845.	831.
127	836.	719.	711.	614.	704.	630.	698.	7316.	680.	656.
128	626.	817.	1321.	2741.	4988.	7366.	9696.	4590.	2336.	
129	1004.	561.	449.	451.	463.	431.	401.	398.	405.	
130	440.	417.	434.	441.	475.	439.	455.	467.	426.	
131	429.	420.	443.	407.	464.	432.	461.	449.	414.	
132	447.	440.	534.	853.	1621.	3114.	4521.	5183.	4417.	2813.
133	1419.	627.	396.	250.	244.	263.	275.	259.	254.	273.
134	261.	284.	269.	253.	284.	268.	257.	249.	284.	253.
135	297.	278.	245.	250.	304.	252.	280.	338.	350.	383.
136	424.	327.	331.	309.	267.	238.	258.	278.	264.	262.
137	279.	280.	301.	264.	216.	271.	254.	245.	252.	258.
138	248.	278.	270.	249.	267.	274.	298.	236.	242.	273.
139	255.	260.	373.	276.	296.	295.	289.	272.	260.	357.
140	570.	759.	996.	982.	768.	523.	327.	226.	211.	213.
141	217.	209.	217.	204.	219.	213.	194.	230.	217.	205.
142	255.	208.	209.	210.	201.	251.	207.	232.	253.	238.
143	253.	247.	227.	235.	251.	220.	225.	100.	240.	234.
144	225.	222.	239.	204.	208.	221.	101.	211.	236.	183.
145	214.	250.	226.	213.	244.	238.	228.	228.	215.	181.
146	237.	181.	167.	177.	179.	174.	216.	167.	169.	176.
147	188.	193.	201.	204.	176.	200.	103.	200.	190.	201.
148	180.	166.	194.	188.	191.	182.	176.	194.	191.	176.
149	189.	187.	203.	161.	194.	173.	178.	157.	192.	198.
150	171.	194.	165.	210.	186.	169.	182.	170.	163.	183.
151	186.	182.	174.	190.	192.	197.	168.	172.	190.	168.
152	174.	176.	189.	187.	177.	212.	187.	163.	162.	145.
153	154.	169.	172.	200.	153.	159.	151.	145.	171.	188.
154	181.	170.	155.	156.	153.	162.	154.	168.	162.	147.
155	178.	157.	173.	147.	142.	150.	149.	133.	143.	145.
156	160.	183.	152.	145.	143.	143.	149.	152.	158.	160.
157	155.	159.	145.	159.	154.	122.	155.	143.	167.	154.
158	177.	129.	129.	146.	152.	151.	133.	146.	150.	165.

159	170.	122.	143.	135.	161.	152.	134.	124.	131.	137.
160	141.	129.	137.	134.	167.	134.	119.	112.	121.	141.
161	133.	133.	133.	117.	128.	124.	138.	125.	110.	128.
162	112.	123.	139.	155.	127.	114.	125.	127.	147.	130.
163	137.	138.	133.	120.	132.	119.	106.	132.	136.	132.
164	121.	136.	137.	135.	125.	128.	137.	126.	118.	138.
165	117.	122.	112.	129.	127.	123.	118.	129.	128.	112.
166	144.	129.	113.	124.	119.	111.	123.	131.	134.	117.
167	120.	149.	136.	121.	120.	118.	79.	113.	121.	131.
168	133.	130.	151.	185.	266.	315.	351.	281.	205.	159.
169	121.	116.	108.	100.	110.	130.	132.	94.	107.	96.
170	118.	133.	122.	99.	86.	97.	110.	117.	112.	109.
171	80.	112.	112.	113.	108.	106.	108.	79.	106.	112.
172	105.	108.	115.	119.	103.	130.	122.	115.	123.	101.
173	80.	98.	105.	80.	128.	108.	104.	97.	88.	77.
174	111.	93.	96.	115.	103.	115.	109.	92.	101.	121.
175	103.	96.	110.	104.	99.	107.	114.	116.	136.	143.
176	133.	147.	113.	100.	104.	112.	90.	81.	101.	86.
177	86.	102.	107.	102.	96.	86.	101.	92.	89.	96.
178	86.	83.	89.	91.	96.	83.	99.	95.	89.	93.
179	89.	96.	86.	88.	74.	73.	86.	99.	105.	98.
180	87.	74.	83.	83.	60.	92.	82.	66.	77.	78.
181	76.	73.	68.	59.	63.	63.	61.	58.	62.	70.
182	89.	71.	75.	63.	62.	73.	61.	73.	68.	63.
183	57.	68.	67.	46.	69.	61.	57.	59.	62.	67.
184	45.	72.	55.	70.	70.	59.	50.	48.	67.	57.
185	65.	66.	57.	44.	56.	54.	48.	54.	49.	51.
186	63.	56.	46.	55.	42.	53.	49.	54.	38.	55.
187	47.	50.	52.	47.	52.	38.	46.	51.	36.	46.
188	41.	53.	48.	39.	49.	44.	44.	52.	36.	45.
189	32.	42.	42.	39.	45.	48.	41.	35.	39.	54.
190	37.	33.	49.	40.	37.	42.	48.	46.	43.	46.
191	36.	34.	38.	40.	50.	35.	37.	33.	40.	48.
192	52.	44.	37.	47.	45.	44.	33.	33.	40.	38.
193	49.	51.	37.	43.	23.	38.	49.	53.	42.	43.
194	49.	43.	34.	37.	40.	47.	50.	48.	34.	54.
195	47.	47.	42.	39.	48.	60.	41.	39.	45.	39.
196	53.	39.	51.	44.	42.	53.	54.	45.	41.	62.
197	43.	56.	43.	42.	48.	44.	29.	41.	51.	39.
198	37.	48.	34.	39.	35.	53.	49.	60.	40.	51.
199	49.	44.	50.	56.	49.	41.	38.	35.	57.	46.
200	66.	107.	176.	309.	376.	392.	293.	181.	25.	45.
201	28.	17.	20.	11.	22.	19.	12.	10.	21.	8.
202	23.	13.	13.	10.	16.	22.	11.	20.	10.	19.
203	11.	12.	20.	24.	24.	18.	24.	11.	23.	19.
204	60000.	135.	170.	279.	316.	502.	855.	2657.		

- IRRAGGIAMENTO - 91 2400.000 MINUTI DATA 1974 12 15 24 0 FLUSSO .0000
- MISURA - TEMPO CONTEGGIO 133.833 MINUTI DATA 1975 1 24 7 30 DECADIMENTO 56610.000 MINUTI
- CAMPIONE - ALFA 10 PESO .04700000 G CALIB. Y= 1.000*X+ -1.712 PROBLEMA ALFALFA

ELEM	P.P.M.	ERR.0/0	VALORE A	KEV (T)	KEV (S)	LS	WT	C.P.M.	AREA ZERO	UGM	AT/CC
CE				145.40							
CO	(7.026-002)			1332.48							
CR	(3.844+000)			320.08							
CS				795.80							
EU	(1.930-002)			1408.11							
HF	(1.262-001)			482.60							
HG				279.20							
IN				1300.00							
NI				810.81							
RB	2.572+002	6.25		1076.60	1070.52	1067	11	5.858+001	3.837+002		
RB	6.991+001	19.13		1076.60	1079.88	1077	9	1.592+001	1.043+002		
SB				1691.00							
SB				1691.00							
SC	(1.466-002)			889.25							
TA				1221.60							
TB				879.33							
TH	1.560+001	.93		311.90	314.15	311	11	8.709+002	2.386+003		
YB	(2.615-001)			197.80							
ZN	7.102+001	.36		1115.51	1114.22	1106	21	1.935+003	2.163+003		
ZR	(3.890+001)			765.80							
BA	(2.981+002)			216.00							
FE	(1.212+002)			1099.27							

SPETTRO N. 7 CANALI 2048 TCON 96.100 MINUTI DATA 1975 1 25 0 30 DECAD 57630.000 MIN

	1	2	3	4	5	6	7	8	9	10
0	5766.	9082.	9618.	8601.	7025.	5470.	3973.	2708.	1481.	1141.
1	605.	478.	353.	318.	241.	195.	149.	138.	131.	116.
2	95.	97.	87.	72.	80.	111.	114.	162.	213.	301.
3	508.	898.	1410.	2661.	12042.	50600.	108049.	148348.	157418.	151539.
4	146254.	142598.	139691.	136854.	133504.	130299.	127201.	124480.	120834.	117704.
5	114751.	112142.	109438.	108326.	105823.	102999.	100518.	98524.	96544.	94917.
6	93703.	91922.	90622.	89121.	88141.	86978.	85773.	84021.	82672.	82075.
7	82737.	83944.	84918.	84566.	82270.	78406.	76263.	74856.	73004.	73467.
8	73169.	73215.	74419.	74765.	73838.	72610.	70922.	69277.	68266.	67364.
9	66968.	66648.	66984.	66498.	66169.	65700.	66516.	65574.	64815.	62399.
10	61472.	60490.	60216.	59653.	59066.	58437.	58932.	58453.	58088.	58511.
11	58628.	57035.	56744.	55791.	55228.	54708.	54416.	55838.	59264.	65068.
12	66285.	62013.	56131.	51855.	49997.	49320.	49102.	48881.	48937.	52051.
13	56520.	57674.	54586.	51096.	49928.	46793.	45357.	44259.	44458.	45217.
14	46056.	47926.	50756.	52575.	50062.	46106.	42217.	40969.	40350.	40579.
15	40419.	40275.	39865.	39447.	39283.	38749.	37994.	38353.	37371.	37605.
16	36864.	36509.	36349.	36372.	36078.	35970.	35390.	35670.	35266.	35136.
17	34774.	34641.	34732.	34767.	35059.	35046.	34559.	34220.	33638.	33200.
18	32868.	32694.	32417.	32667.	32513.	32118.	32039.	32643.	33860.	36330.
19	36722.	35098.	33205.	31819.	32205.	32766.	32573.	31442.	30497.	29840.
20	30093.	29984.	29870.	29642.	29591.	29587.	29881.	29828.	29626.	29504.
21	29256.	29440.	29649.	29741.	29301.	29011.	28810.	28357.	28690.	28725.
22	28779.	28020.	27811.	27134.	27235.	27132.	27323.	26945.	26643.	26485.
23	26374.	26262.	25647.	26062.	25598.	25683.	25482.	25527.	25171.	25228.
24	25847.	26600.	27018.	26302.	25317.	24681.	24241.	24105.	23856.	23730.
25	23238.	23322.	23497.	23525.	23077.	23346.	23306.	22694.	23313.	23221.
26	23334.	23495.	23286.	23251.	22919.	22625.	22311.	22335.	22241.	22088.
27	22134.	21701.	21776.	22122.	22378.	22051.	22511.	22642.	21770.	21770.
28	21568.	21484.	21073.	21313.	21611.	21277.	21511.	21370.	21187.	21157.
29	21604.	21253.	21689.	21777.	22716.	23701.	24527.	24181.	23024.	21666.
30	21180.	21047.	20896.	20855.	21309.	21433.	21784.	23216.	26564.	27779.
31	26799.	23619.	21491.	21059.	22505.	29066.	41923.	50858.	46538.	33612.
32	23258.	18764.	17623.	17638.	17835.	17657.	17660.	17403.	17523.	17867.
33	17714.	17704.	17805.	17772.	17558.	17437.	17589.	18250.	18804.	20707.
34	24266.	26772.	26012.	22551.	19396.	17367.	16587.	16287.	16446.	16474.
35	16487.	16273.	15975.	15894.	16067.	16101.	15705.	15829.	15941.	15744.
36	15891.	15857.	15762.	15825.	15865.	16004.	15782.	15836.	15753.	15665.
37	15789.	15543.	15722.	15521.	15775.	15522.	15600.	15402.	15424.	15536.
38	15395.	15462.	15457.	15408.	15393.	15440.	15441.	15474.	15435.	15371.
39	15408.	15306.	15223.	15046.	15290.	15494.	15248.	15215.	15181.	15010.
40	15049.	15014.	15297.	14946.	14952.	15230.	15174.	15266.	15333.	15305.
41	15154.	15238.	15226.	14961.	15254.	14897.	14760.	15006.	14804.	14717.
42	14722.	14748.	14748.	14614.	14753.	14779.	14560.	14733.	14347.	14709.
43	14380.	14708.	14397.	14533.	14401.	14496.	14484.	14520.	14429.	14780.
44	15010.	15049.	14827.	14570.	14453.	14489.	14386.	14437.	14387.	14627.
45	14138.	14514.	14348.	14387.	14121.	14396.	14341.	14246.	14373.	14442.
46	14526.	14304.	14304.	14381.	14476.	14305.	14404.	14263.	14171.	14481.
47	14861.	14712.	14607.	14456.	14771.	14414.	15185.	17239.	20435.	22110.
48	20085.	17341.	14815.	14214.	14089.	14024.	14040.	14131.	13920.	14087.
49	14022.	14127.	14239.	14072.	14318.	14199.	14184.	13966.	14001.	14181.
50	14112.	14092.	13964.	14394.	14247.	14761.	15714.	16515.	16967.	16965.
51	16694.	15397.	15388.	14450.	14077.	14054.	14170.	13874.	14055.	13704.
52	14002.	14005.	14037.	13776.	14030.	14146.	14148.	13851.	14020.	13939.
53	13931.	13916.	13928.	14051.	13825.	13917.	14105.	13964.	13693.	14251.
54	13894.	13961.	13666.	13913.	13901.	13808.	13978.	13934.	14160.	13960.
55	13979.	13981.	14099.	13994.	14384.	14096.	13720.	14450.	14575.	15245.
56	15377.	14906.	14737.	14585.	14702.	15723.	16146.	15740.	15061.	14569.
57	14087.	14065.	14184.	14283.	14456.	14218.	13883.	14298.	14083.	14140.
58	14149.	14378.	14159.	14431.	14233.	14366.	14271.	14412.	14126.	14477.
59	14326.	14580.	14184.	14145.	14470.	14468.	14364.	15014.	16961.	20311.
60	25056.	27939.	26163.	21046.	16533.	14624.	14301.	13852.	13784.	13715.
61	13804.	13655.	13626.	13685.	13460.	13606.	13515.	13384.	13526.	13515.
62	13577.	13506.	13539.	13476.	13510.	13458.	13454.	13293.	13514.	13646.
63	13522.	13471.	13373.	13433.	13524.	13218.	13639.	13359.	13623.	13538.
64	13436.	13635.	13565.	13672.	13433.	13406.	13647.	13451.	13460.	13381.
65	13565.	13273.	13652.	13345.	13537.	13617.	13493.	13504.	13475.	13586.
66	13452.	13491.	13527.	13507.	13378.	13568.	13409.	13568.	13485.	13498.
67	13595.	13590.	13569.	13656.	13657.	13615.	13665.	13640.	13600.	13802.
68	13647.	13369.	13547.	13233.	13224.	13207.	13213.	12940.	12784.	12758.
69	12553.	12230.	12086.	12017.	12107.	11764.	11879.	11838.	11760.	11693.
70	11748.	11688.	11859.	11669.	11865.	11555.	11496.	11758.	11578.	11757.
71	11601.	11601.	11457.	11390.	11321.	11542.	11440.	11646.	11830.	11976.
72	12243.	12208.	11950.	11715.	11406.	11376.	11342.	11384.	11031.	11244.
73	11109.	11004.	11248.	11163.	11167.	11128.	10940.	11203.	11281.	11082.
74	11050.	10978.	10947.	11038.	11143.	10991.	10964.	10856.	10920.	10852.
75	11116.	11173.	11228.	11620.	11568.	11366.	11009.	10867.	10878.	10999.
76	11140.	11596.	11899.	11937.	11209.	10867.	10893.	10691.	10407.	10650.

77	10736.	10733.	10749.	10726.	11453.	12041.	11915.	11406.	10007.	10656.
78	10566.	10631.	10579.	10403.	12380.	10579.	10554.	10518.	10554.	11088.
79	12678.	15996.	18658.	18018.	15266.	12286.	11195.	10720.	10915.	11109.
80	10847.	10665.	10261.	10531.	10459.	10502.	10976.	11258.	11384.	10873.
81	10771.	10549.	10432.	10428.	10530.	10472.	10781.	10515.	10678.	10730.
82	10484.	10492.	10694.	10513.	10671.	10653.	10720.	11025.	11177.	12658.
83	15223.	17267.	17303.	14698.	12398.	11309.	10967.	10577.	11014.	10857.
84	10677.	10829.	10859.	10951.	10753.	11034.	11110.	10931.	11008.	10951.
85	11064.	11016.	11243.	11438.	11310.	11262.	11315.	11407.	11553.	11532.
86	11506.	11541.	11658.	11962.	11882.	11809.	11633.	11812.	11690.	11084.
87	11806.	11862.	11879.	11943.	12497.	12503.	12848.	12558.	12153.	12171.
88	12180.	13202.	15131.	27717.	53953.	95888.	107500.	93841.	47334.	21356.
89	11023.	8984.	8728.	8625.	8582.	8477.	8618.	8555.	8482.	8473.
90	8423.	8453.	8511.	8278.	8267.	8068.	8100.	7970.	7607.	7610.
91	7459.	7265.	7188.	7064.	7031.	6976.	6900.	6795.	6688.	6591.
92	6614.	6506.	6600.	6630.	6522.	6517.	6448.	6316.	6370.	6470.
93	6428.	6260.	6320.	6242.	6365.	6346.	6243.	6182.	6075.	6058.
94	6241.	6064.	6074.	5916.	5931.	6001.	5978.	5906.	5962.	5908.
95	5862.	5896.	5821.	5791.	5749.	5750.	5660.	5807.	6085.	6460.
96	6986.	7036.	6978.	6295.	5919.	5574.	5443.	5307.	5268.	5270.
97	5079.	5272.	4985.	5057.	4948.	5003.	5025.	4878.	4992.	4951.
98	4903.	4847.	4753.	4821.	4741.	4787.	4632.	4644.	4604.	4620.
99	4743.	4606.	4544.	4617.	4497.	4521.	4415.	4442.	4321.	4438.
100	4394.	4541.	4393.	4333.	4300.	4161.	4068.	4087.	4165.	4096.
101	4065.	4132.	4130.	4057.	4087.	4010.	4074.	4022.	4132.	4071.
102	4056.	3961.	4034.	4011.	4111.	3987.	4113.	4085.	4103.	4052.
103	4140.	4021.	4001.	4075.	4095.	4192.	4198.	4136.	4158.	4148.
104	4180.	4090.	4133.	4183.	4199.	4149.	4214.	4246.	4365.	4342.
105	4344.	4418.	4397.	4286.	4368.	4368.	4417.	4390.	4462.	4476.
106	4477.	4538.	4584.	4590.	4510.	4575.	4632.	4512.	4700.	4755.
107	4915.	5618.	6293.	7211.	7126.	6220.	5366.	4888.	4662.	4683.
108	4915.	5351.	5597.	5614.	5303.	5250.	5092.	4925.	4818.	4995.
109	4977.	5116.	5691.	8227.	14121.	21250.	24225.	19923.	12736.	7485.
110	5308.	4707.	4576.	4625.	4692.	4620.	4811.	5230.	5980.	7757.
111	12642.	19188.	23429.	22009.	23044.	36834.	62725.	79046.	71450.	43509.
112	10052.	6249.	2258.	1636.	1591.	1606.	1552.	1487.	1500.	1539.
113	1538.	1578.	1490.	1559.	1600.	1559.	1533.	1540.	1528.	1557.
114	1515.	1570.	1534.	1519.	1512.	1463.	1478.	1529.	1483.	1495.
115	1528.	1465.	1491.	1480.	1524.	1412.	1454.	1463.	1447.	1439.
116	1432.	1468.	1411.	1522.	1516.	1558.	1812.	3131.	6125.	9301.
117	10909.	8951.	5484.	2847.	1766.	1464.	1247.	1116.	1111.	1063.
118	1038.	1047.	1033.	1115.	1225.	1263.	1277.	1242.	1058.	1052.
119	981.	978.	945.	928.	938.	989.	946.	935.	939.	933.
120	941.	909.	876.	909.	926.	892.	925.	865.	913.	902.
121	993.	903.	948.	868.	845.	974.	1069.	1295.	1350.	1304.
122	1137.	989.	901.	829.	855.	936.	986.	1088.	1069.	1049.
123	923.	913.	831.	844.	849.	903.	865.	850.	812.	835.
124	855.	858.	859.	910.	852.	892.	891.	949.	890.	897.
125	870.	895.	919.	912.	930.	967.	859.	964.	913.	912.
126	864.	956.	949.	958.	998.	955.	986.	983.	1162.	1238.
127	1196.	1217.	1166.	1085.	1017.	986.	992.	1002.	987.	996.
128	1007.	1013.	992.	1011.	1200.	2335.	5106.	9535.	12842.	12203.
129	8355.	4154.	1668.	839.	695.	725.	717.	701.	665.	669.
130	650.	599.	591.	608.	660.	611.	643.	643.	670.	714.
131	715.	670.	623.	655.	618.	583.	616.	627.	682.	658.
132	628.	678.	702.	642.	675.	917.	1587.	3709.	6693.	8734.
133	3244.	5386.	2662.	1103.	550.	412.	375.	393.	399.	381.
134	414.	387.	401.	420.	404.	396.	360.	373.	381.	410.
135	384.	392.	415.	401.	380.	401.	391.	390.	414.	385.
136	446.	516.	560.	566.	472.	424.	429.	387.	401.	358.
137	356.	365.	397.	391.	402.	374.	436.	345.	396.	381.
138	390.	370.	412.	356.	369.	391.	415.	327.	365.	366.
139	359.	383.	364.	354.	333.	395.	397.	478.	454.	404.
140	382.	449.	592.	954.	1360.	1421.	1272.	844.	545.	408.
141	305.	333.	356.	332.	330.	309.	304.	301.	398.	336.
142	318.	348.	312.	336.	343.	314.	316.	340.	319.	328.
143	338.	332.	352.	367.	363.	351.	317.	312.	331.	336.
144	333.	357.	337.	332.	287.	313.	301.	296.	321.	310.
145	335.	292.	326.	292.	322.	307.	363.	342.	345.	352.
146	296.	295.	260.	313.	300.	278.	250.	307.	295.	288.
147	259.	293.	267.	260.	299.	256.	312.	257.	287.	267.
148	277.	305.	276.	269.	283.	270.	306.	306.	252.	302.
149	283.	259.	253.	280.	283.	250.	270.	232.	257.	259.
150	283.	267.	253.	298.	230.	291.	304.	263.	277.	256.
151	268.	238.	270.	255.	238.	266.	257.	253.	254.	251.
152	250.	263.	270.	277.	278.	273.	262.	287.	270.	253.
153	244.	260.	290.	223.	230.	246.	269.	257.	262.	238.
154	232.	238.	241.	251.	256.	191.	248.	251.	227.	228.
155	216.	259.	237.	205.	250.	254.	234.	233.	209.	235.
156	245.	249.	250.	223.	211.	207.	231.	220.	226.	237.
157	211.	211.	224.	237.	216.	220.	249.	225.	207.	223.
158	204.	221.	193.	179.	199.	209.	201.	226.	216.	212.

159	196.	238.	223.	224.	225.	212.	207.	206.	202.	197.
160	194.	188.	180.	200.	211.	191.	183.	181.	184.	205.
161	177.	184.	189.	202.	197.	212.	206.	203.	206.	205.
162	216.	200.	189.	206.	164.	181.	197.	191.	198.	192.
163	198.	206.	167.	189.	195.	210.	176.	170.	217.	196.
164	212.	191.	175.	183.	178.	186.	212.	211.	210.	196.
165	173.	188.	185.	170.	197.	182.	218.	201.	183.	160.
166	181.	184.	163.	187.	180.	172.	176.	185.	166.	174.
167	175.	184.	165.	183.	163.	191.	205.	199.	199.	127.
168	203.	187.	191.	181.	216.	261.	356.	521.	607.	569.
169	419.	275.	202.	182.	155.	162.	150.	169.	149.	131.
170	165.	140.	162.	140.	149.	154.	155.	138.	178.	135.
171	151.	159.	163.	140.	159.	177.	181.	172.	151.	149.
172	154.	143.	151.	157.	167.	152.	144.	177.	164.	138.
173	130.	156.	148.	146.	162.	174.	135.	163.	154.	137.
174	165.	164.	143.	150.	156.	150.	138.	155.	138.	138.
175	164.	151.	141.	164.	164.	121.	139.	155.	148.	164.
176	207.	196.	218.	185.	189.	190.	132.	142.	148.	144.
177	129.	149.	132.	159.	137.	128.	164.	143.	138.	115.
178	148.	134.	140.	138.	142.	115.	145.	127.	136.	137.
179	147.	120.	137.	149.	132.	149.	132.	122.	124.	125.
180	130.	121.	118.	117.	132.	125.	131.	108.	98.	130.
181	102.	110.	106.	107.	88.	108.	95.	102.	102.	94.
182	92.	95.	88.	110.	111.	88.	91.	95.	86.	98.
183	105.	113.	100.	97.	103.	79.	78.	105.	80.	94.
184	79.	57.	96.	91.	86.	103.	102.	97.	99.	81.
185	83.	89.	80.	76.	77.	81.	93.	83.	87.	94.
186	72.	75.	73.	96.	85.	79.	76.	57.	87.	73.
187	86.	62.	71.	69.	81.	72.	63.	69.	75.	71.
188	80.	56.	75.	66.	64.	69.	76.	61.	65.	73.
189	47.	66.	64.	67.	67.	69.	55.	62.	63.	65.
190	67.	70.	55.	67.	43.	62.	51.	64.	53.	61.
191	69.	61.	76.	64.	64.	51.	66.	56.	53.	73.
192	57.	59.	53.	50.	59.	44.	47.	58.	65.	58.
193	65.	77.	63.	56.	56.	58.	49.	59.	81.	64.
194	59.	58.	49.	52.	58.	69.	77.	59.	64.	65.
195	71.	69.	64.	58.	72.	79.	79.	63.	51.	57.
196	80.	59.	71.	59.	61.	72.	58.	68.	71.	60.
197	67.	68.	59.	47.	76.	46.	47.	70.	50.	71.
198	58.	69.	55.	77.	61.	67.	46.	69.	69.	68.
199	73.	49.	74.	70.	50.	68.	62.	69.	71.	74.
200	61.	74.	83.	118.	204.	383.	542.	614.	577.	344.
201	176.	55.	26.	24.	20.	19.	18.	22.	22.	17.
202	29.	20.	21.	25.	18.	21.	22.	25.	21.	23.
203	29.	26.	21.	23.	24.	28.	19.	34.	30.	24.
204	60000.	148.	228.	251.	316.	509.	793.	2600.		

- IRRAGGIAMENTO - 01 2400.000 MINUTI DATA 1974 12 15 24 0 FLUSSO .0000
- MISURA - TEMPO CONTEGGIO 96.100 MINUTI DATA 1975 1 25 0 30 DECADIMENTO 57630.000 MINUTI
- CAMPIONE - ALFA 756 PESO .05700000 G CALIB. Y= 1.000*X+ -1.713 PROBLEMA ALFALFA

ELEM	P.P.M.	ERR.0/0	VALORE A	KEV (T)	KEV (S)	LS	WT	C P M	AREA ZERO	UGM	AT/CC
CE				145.40							
CO	7.922+000	.85		1332.48	1328.86	1324	13	3.586+002	3.639+002		
CR	3.754+002	1.10		320.08	316.56	313	11	1.162+003	3.149+003		
CS				795.80							
EU	5.778-001	3.59		1409.11	1404.41	1401	11	4.957+001	4.987+001		
HF	3.655+000	3.18		482.60	478.35	476	9	2.811+002	5.205+002		
HG				279.20							
IN				1300.00							
NI				810.81							
RB	4.441+002	6.06		1076.60	1072.94	1068	13	1.164+002	7.884+002		
SB				1691.00							
SC	5.306+000	.38		889.25	885.28	879	17	3.915+003	5.430+003		
TA				1221.60							
TB				879.33							
TH	3.596+000	4.60		311.90	308.42	306	9	2.345+002	6.542+002		
YB	2.394+000	12.22		197.80	194.54	201	5	1.250+002	SECOND(189.06	194.54)	
YB	2.956+000	8.54		197.80	189.06	187	9	1.543+002	3.664+002		
ZN	1.214+002	.29		1115.51	1116.70	1108	21	3.930+003	4.401+003		
ZR	2.975+002	16.55		765.80	761.75	758	12	5.961+001	9.134+001		
BA	(4.201+002)			216.00							
FE	1.466+004	.97		1099.27	1095.39	1091	13	7.934+002	1.462+003		

SPETTRO N. 8 CANALI 2048 TCON 108.983 MINUTI DATA 1975 1 25 17 30 DECAD 58650.000 MIN

	1	2	3	4	5	6	7	8	9	10
0	6539.	10563.	10654.	8652.	6906.	5370.	3700.	2391.	1216.	1015.
1	553.	487.	372.	282.	207.	189.	140.	153.	126.	126.
2	107.	114.	112.	113.	121.	167.	151.	226.	280.	485.
3	753.	1259.	2156.	3891.	14972.	67554.	152052.	198507.	196396.	186427.
4	178540.	174951.	171350.	166638.	162123.	158194.	154034.	150619.	145850.	142697.
5	138659.	135817.	132787.	129688.	128048.	124830.	121681.	119018.	117129.	114470.
6	112685.	111361.	109712.	107973.	106000.	104596.	103240.	101614.	99911.	99000.
7	99150.	100380.	101367.	101045.	99205.	93778.	91618.	90086.	89510.	88874.
8	88844.	88579.	90098.	90986.	90445.	88052.	85875.	83659.	82252.	81878.
9	81266.	81012.	81644.	81070.	80635.	80281.	81317.	80584.	78515.	75673.
10	73528.	73942.	72984.	72564.	71704.	71071.	71170.	72007.	71616.	71259.
11	70407.	69158.	68851.	67387.	67312.	66659.	66150.	67202.	74965.	84537.
12	87130.	77154.	66770.	61135.	59274.	58968.	58694.	58558.	59843.	63108.
13	69527.	71113.	66154.	60147.	57726.	55956.	54240.	53386.	52730.	53898.
14	55932.	58379.	64682.	68570.	63853.	54949.	49951.	48523.	48272.	48938.
15	48737.	48542.	47462.	46744.	46580.	46503.	45734.	45173.	44723.	44357.
16	43975.	43499.	43317.	42800.	42889.	42601.	42741.	41736.	41694.	41397.
17	41915.	41134.	41014.	41187.	41389.	41790.	41265.	40243.	39525.	39289.
18	39144.	38948.	38750.	38821.	38852.	38464.	38067.	37756.	37381.	36165.
19	45318.	42226.	38874.	37715.	38626.	39497.	38756.	37381.	36165.	36029.
20	35535.	35468.	35861.	35219.	35548.	35684.	35497.	35413.	35508.	35268.
21	35151.	35345.	35922.	36228.	35786.	34733.	34604.	34172.	34812.	35091.
22	35124.	34168.	33278.	32880.	32758.	32911.	32570.	32609.	32215.	32137.
23	31609.	31387.	31669.	30900.	31410.	30972.	31354.	30759.	30785.	30568.
24	31479.	33023.	34209.	32697.	30992.	29707.	29556.	29143.	29096.	28447.
25	28746.	28202.	28440.	27895.	28246.	27779.	27840.	27818.	28031.	28269.
26	28553.	28725.	28578.	28309.	27224.	27089.	27390.	27262.	27262.	27010.
27	26700.	26881.	26515.	27197.	26635.	26969.	27414.	27112.	26825.	26510.
28	26275.	25999.	26194.	26039.	26089.	25790.	26168.	25853.	25728.	25992.
29	26333.	25991.	26473.	26825.	27930.	29717.	30457.	29860.	29226.	26407.
30	25799.	25696.	25743.	25975.	26320.	26306.	26846.	29264.	33260.	36700.
31	33420.	28512.	25870.	25847.	27289.	35771.	54320.	66976.	57885.	37058.
32	24978.	22106.	21904.	21632.	21766.	21806.	21521.	22077.	21274.	21522.
33	21724.	22032.	21919.	21651.	21701.	21906.	22040.	22499.	23476.	25960.
34	32415.	37160.	35141.	28483.	23082.	20274.	19938.	19795.	20125.	20087.
35	20201.	19703.	19552.	19810.	19622.	19406.	19582.	19521.	19305.	19341.
36	19243.	19432.	19511.	19240.	19629.	19449.	19345.	19020.	19304.	19075.
37	19365.	19061.	19354.	19402.	19308.	18929.	19089.	18838.	18788.	19040.
38	19113.	18925.	19100.	18817.	18862.	18783.	18757.	18773.	18945.	19025.
39	18912.	18558.	18717.	18636.	18815.	18861.	18870.	18205.	18824.	18809.
40	18344.	18571.	18506.	18543.	18623.	18592.	18856.	19091.	19310.	18885.
41	18513.	18571.	18573.	18731.	18536.	18655.	18203.	18210.	18280.	18134.
42	18304.	18340.	18026.	18221.	18104.	18307.	18180.	17876.	18032.	18156.
43	18017.	18072.	17884.	18200.	17928.	18069.	18081.	17815.	18324.	18531.
44	18648.	19061.	18900.	18110.	18069.	18000.	18123.	18167.	18040.	18116.
45	17950.	18113.	18028.	17953.	17896.	17976.	18144.	17932.	18033.	18367.
46	18080.	17844.	17989.	18043.	18327.	18197.	18042.	18136.	18033.	18013.
47	18163.	18485.	18235.	18134.	18496.	18424.	19068.	21642.	26460.	28545.
48	25150.	20357.	18113.	17839.	17683.	17660.	17753.	17352.	17425.	17664.
49	17764.	17627.	17838.	17816.	18014.	17912.	17708.	17456.	17814.	17521.
50	17751.	17713.	17626.	17752.	18076.	18711.	19883.	20928.	21528.	21347.
51	21306.	20200.	19214.	17884.	17690.	17383.	17354.	17534.	17585.	17682.
52	17466.	17294.	17435.	17422.	17508.	17287.	17400.	17533.	17553.	17609.
53	17369.	17291.	17348.	17612.	17477.	17587.	17325.	17633.	17516.	17545.
54	17585.	17671.	17488.	17675.	17409.	17624.	17618.	17436.	17662.	17505.
55	17995.	17909.	17739.	17651.	17459.	17550.	17610.	17707.	18248.	18328.
56	18853.	18277.	17968.	17872.	18216.	18903.	19308.	18667.	18106.	17806.
57	17771.	17595.	17791.	17570.	17952.	17362.	18069.	17790.	17940.	17949.
58	17956.	17743.	17761.	18142.	18076.	17871.	18096.	18087.	18120.	17919.
59	17586.	17770.	17893.	17813.	18016.	17739.	18187.	19117.	20915.	24084.
60	27309.	28654.	25955.	21304.	18622.	17776.	17930.	17711.	17476.	17284.
61	17446.	17665.	17597.	17460.	17401.	17572.	17375.	17548.	17448.	17471.
62	17256.	17489.	17182.	17338.	17580.	17328.	17498.	17426.	17357.	17335.
63	17281.	17 140.	17168.	17406.	17325.	17264.	17191.	17044.	17370.	17374.
64	17441.	17357.	17469.	17495.	17430.	17330.	17469.	17210.	17133.	17119.
65	17419.	17369.	17324.	17577.	17615.	17455.	17288.	17426.	17460.	17483.
66	17323.	17224.	17151.	17145.	17506.	17276.	17388.	17618.	17475.	17343.
67	17452.	17518.	17565.	17555.	17879.	17525.	17852.	17407.	17493.	17626.
68	17666.	17250.	17339.	17353.	17283.	17413.	17080.	16924.	16310.	16407.
69	16021.	15753.	15647.	15641.	15748.	15609.	15457.	15238.	15214.	15068.
70	15066.	15358.	15396.	14983.	15210.	15047.	15145.	15008.	14717.	15241.
71	14962.	14846.	14798.	14756.	14901.	14983.	14882.	14843.	15000.	15765.
72	16006.	15855.	14926.	14792.	14715.	14426.	14592.	14511.	14342.	14620.
73	14311.	14298.	14370.	14462.	14497.	14181.	14513.	14239.	14374.	13912.
74	14196.	14073.	14301.	14297.	14182.	13989.	14000.	14269.	14134.	14042.
75	14086.	14334.	14629.	14862.	14737.	14315.	13747.	13872.	13802.	14023.
76	14125.	14983.	15316.	15407.	14312.	13731.	13741.	13552.	13680.	13508.

77	13563.	13607.	13738.	14163.	14979.	15776.	15815.	14766.	13765.	13608.
78	13581.	13349.	13276.	13366.	13342.	13467.	13723.	13507.	13465.	13631.
79	14686.	17094.	19338.	18451.	16310.	14002.	13371.	13728.	13648.	13598.
80	13691.	13350.	13750.	13358.	13415.	13723.	14095.	14396.	14845.	13991.
81	13586.	13541.	13528.	13567.	13551.	13456.	13857.	13552.	13676.	13653.
82	13671.	13870.	13796.	13719.	13631.	13845.	13671.	13990.	14268.	16338.
83	19825.	23015.	22045.	18066.	15135.	14087.	13984.	14061.	14114.	14012.
84	14242.	14216.	14076.	14275.	14178.	14217.	14423.	14302.	14413.	14434.
85	14587.	14386.	14521.	14505.	14789.	14549.	14673.	14602.	14517.	14733.
86	15066.	14942.	15197.	15617.	15590.	15334.	15234.	15170.	15285.	15395.
87	15377.	15411.	15206.	15646.	15964.	16556.	16612.	16476.	15900.	15406.
88	15507.	16855.	16330.	35321.	89971.	130091.	153875.	105873.	48205.	10213.
89	12162.	11120.	11235.	11130.	11141.	11233.	10964.	10923.	11197.	11018.
90	10987.	11114.	10842.	10778.	10686.	10506.	10597.	10005.	9922.	9776.
91	9535.	9206.	9125.	9011.	8950.	8727.	8827.	8616.	8634.	8669.
92	8588.	8618.	8504.	8280.	8387.	8217.	8490.	8426.	8023.	7977.
93	8236.	8315.	8030.	8003.	8155.	7808.	8039.	8027.	7912.	7810.
94	7807.	7751.	7803.	7729.	7612.	7664.	7624.	7691.	7524.	7600.
95	7510.	7516.	7351.	7351.	7237.	7328.	7351.	7417.	7960.	8726.
96	9579.	9553.	8931.	8348.	7722.	6906.	6638.	6610.	6608.	6572.
97	6666.	6588.	6397.	6528.	6445.	6452.	6443.	6305.	6275.	6153.
98	6293.	6311.	5900.	6077.	6017.	6090.	6022.	5914.	5910.	5872.
99	5877.	5930.	5964.	5782.	5788.	5764.	5644.	5854.	5656.	5778.
100	5926.	5804.	5686.	5531.	5182.	5289.	5200.	5480.	5355.	5373.
101	5259.	5074.	5273.	5323.	5154.	5143.	5157.	5207.	5206.	5268.
102	5325.	5164.	5306.	5223.	5238.	5137.	5160.	5154.	5177.	5162.
103	5175.	5135.	5251.	5287.	5313.	5308.	5306.	5088.	5278.	5217.
104	5421.	5376.	5342.	5371.	5459.	5321.	5353.	5303.	5361.	5428.
105	5465.	5449.	5666.	5568.	5581.	5596.	5620.	5763.	5763.	5713.
106	5733.	5853.	5927.	5739.	5842.	5766.	6104.	6047.	5977.	5963.
107	6233.	6922.	8381.	9352.	8982.	7562.	6500.	6120.	5993.	5903.
108	6357.	6916.	7584.	7363.	6794.	6476.	6426.	6445.	6337.	6195.
109	6323.	6590.	7137.	10663.	18930.	29975.	32878.	24859.	13820.	7873.
110	6237.	6007.	5920.	6042.	5988.	6178.	6377.	7140.	8090.	10231.
111	162233.	26687.	326609.	28966.	26867.	47313.	90062.	115272.	94437.	48415.
112	15711.	4368.	2199.	2022.	2061.	2056.	2020.	1966.	1992.	2009.
113	1957.	1954.	1907.	1986.	1944.	1948.	1852.	1933.	2024.	1956.
114	1930.	1877.	1907.	1897.	1935.	1916.	1858.	1858.	1921.	1832.
115	1849.	1904.	1923.	1845.	1906.	1783.	1853.	1853.	1832.	1758.
116	1802.	1842.	1819.	1826.	1887.	1918.	2127.	3575.	7406.	11915.
117	13514.	9946.	5360.	2610.	1960.	1909.	1712.	1489.	1409.	1365.
118	1271.	1289.	1334.	1412.	1622.	1682.	1743.	1523.	1376.	1320.
119	1274.	1250.	1211.	1211.	1254.	1258.	1304.	1249.	1235.	1166.
120	1122.	1185.	1155.	1169.	1173.	1199.	1182.	1167.	1170.	1346.
121	1331.	1257.	1201.	1161.	1165.	1171.	1495.	1736.	1822.	1776.
122	1447.	1182.	1142.	1104.	1121.	1191.	1202.	1395.	1458.	1306.
123	1241.	1106.	1147.	1167.	1183.	1102.	1162.	1110.	1164.	1102.
124	1119.	1095.	1091.	1148.	1168.	1082.	1192.	1124.	1166.	1137.
125	1165.	1125.	1127.	1142.	1169.	1253.	1212.	1222.	1502.	1151.
126	1168.	1162.	1224.	1210.	1164.	1201.	1265.	1410.	1273.	1618.
127	1715.	1716.	1599.	1393.	1310.	1305.	1203.	1236.	1334.	1234.
128	1225.	1302.	1271.	1326.	1533.	2227.	6777.	13355.	18175.	16063.
129	9413.	3565.	1381.	876.	878.	919.	943.	939.	805.	754.
130	788.	757.	740.	755.	809.	828.	759.	824.	891.	863.
131	873.	823.	784.	819.	794.	765.	802.	859.	797.	794.
132	808.	851.	866.	822.	840.	1054.	1864.	4325.	9167.	10954.
133	9618.	5304.	2186.	913.	576.	508.	523.	509.	541.	519.
134	505.	543.	514.	531.	508.	498.	500.	503.	517.	531.
135	544.	517.	551.	542.	524.	537.	488.	503.	518.	535.
136	591.	612.	619.	651.	557.	562.	514.	511.	502.	506.
137	477.	505.	491.	563.	529.	520.	537.	510.	493.	529.
138	507.	495.	536.	541.	485.	493.	501.	486.	537.	444.
139	517.	441.	482.	457.	538.	502.	548.	552.	542.	510.
140	511.	547.	797.	1413.	2191.	2371.	1825.	1108.	634.	449.
141	450.	493.	432.	410.	447.	403.	457.	407.	401.	422.
142	440.	466.	461.	409.	426.	462.	464.	443.	450.	461.
143	430.	487.	498.	465.	457.	466.	464.	441.	430.	454.
144	493.	451.	482.	463.	434.	415.	399.	423.	404.	390.
145	411.	385.	401.	431.	440.	463.	430.	453.	467.	443.
146	414.	403.	392.	405.	374.	359.	383.	364.	361.	403.
147	369.	383.	367.	401.	384.	384.	377.	390.	373.	364.
148	383.	386.	384.	382.	327.	332.	397.	367.	358.	347.
149	336.	378.	316.	409.	350.	372.	400.	359.	366.	335.
150	363.	338.	346.	351.	363.	356.	337.	336.	312.	353.
151	313.	370.	337.	342.	345.	352.	342.	292.	314.	314.
152	336.	320.	347.	347.	375.	378.	385.	366.	345.	335.
153	347.	306.	323.	288.	348.	299.	329.	332.	301.	290.
154	325.	332.	344.	315.	320.	301.	290.	337.	297.	323.
155	343.	293.	297.	291.	296.	311.	321.	338.	326.	296.
156	270.	306.	303.	288.	292.	290.	315.	312.	290.	278.
157	316.	293.	267.	319.	316.	278.	302.	277.	313.	274.
158	292.	244.	303.	288.	281.	301.	305.	274.	285.	276.

159	290.	294.	323.	291.	279.	302.	292.	287.	252.	256.
160	291.	249.	245.	285.	263.	238.	248.	276.	283.	259.
161	236.	257.	238.	259.	277.	295.	263.	272.	242.	275.
162	269.	264.	276.	274.	235.	253.	249.	286.	241.	248.
163	264.	263.	262.	271.	262.	251.	251.	240.	217.	238.
164	231.	250.	257.	241.	233.	256.	236.	255.	243.	239.
165	233.	210.	263.	238.	248.	242.	218.	262.	240.	258.
166	254.	229.	229.	262.	237.	265.	235.	227.	276.	229.
167	238.	237.	237.	250.	222.	191.	229.	249.	228.	244.
168	225.	250.	246.	219.	279.	335.	488.	708.	823.	787.
169	560.	309.	238.	203.	196.	211.	223.	216.	220.	215.
170	219.	199.	217.	235.	211.	219.	227.	206.	205.	202.
171	207.	185.	221.	211.	197.	173.	218.	195.	199.	212.
172	197.	197.	205.	213.	207.	219.	200.	227.	206.	192.
173	169.	184.	199.	190.	198.	201.	198.	192.	200.	200.
174	194.	179.	197.	195.	174.	181.	195.	203.	216.	190.
175	191.	199.	173.	197.	182.	196.	194.	180.	165.	192.
176	205.	284.	266.	250.	201.	187.	197.	207.	177.	179.
177	180.	181.	164.	183.	172.	165.	176.	179.	172.	178.
178	189.	170.	189.	163.	207.	181.	158.	178.	159.	177.
179	197.	175.	163.	229.	168.	168.	187.	169.	155.	155.
180	153.	129.	157.	135.	144.	123.	140.	139.	132.	158.
181	147.	138.	151.	132.	153.	142.	156.	134.	150.	134.
182	103.	121.	116.	120.	111.	99.	131.	106.	123.	108.
183	122.	129.	126.	105.	115.	119.	122.	102.	125.	121.
184	106.	105.	128.	132.	113.	107.	149.	92.	117.	96.
185	117.	104.	107.	103.	106.	107.	90.	104.	102.	105.
186	109.	111.	105.	104.	107.	102.	99.	104.	93.	100.
187	86.	107.	105.	104.	93.	87.	104.	92.	95.	89.
188	72.	74.	81.	65.	96.	106.	59.	72.	115.	73.
189	80.	79.	69.	74.	74.	102.	80.	86.	93.	67.
190	73.	79.	84.	79.	70.	83.	68.	89.	87.	62.
191	91.	70.	65.	86.	78.	72.	82.	79.	75.	76.
192	81.	89.	65.	75.	69.	69.	81.	66.	80.	73.
193	88.	58.	71.	88.	75.	53.	76.	78.	77.	75.
194	93.	80.	76.	84.	86.	85.	98.	65.	77.	84.
195	69.	75.	60.	64.	91.	88.	92.	68.	74.	92.
196	83.	74.	86.	81.	80.	81.	97.	106.	72.	74.
197	74.	73.	73.	69.	85.	79.	72.	83.	84.	76.
198	89.	92.	86.	95.	84.	97.	64.	95.	108.	99.
199	81.	81.	103.	78.	91.	94.	95.	98.	71.	90.
200	82.	87.	102.	172.	258.	478.	732.	880.	708.	435.
201	193.	70.	34.	29.	28.	22.	24.	28.	29.	31.
202	25.	24.	27.	29.	28.	22.	37.	33.	24.	21.
203	27.	16.	26.	20.	32.	33.	21.	31.	26.	35.
204	60000.	159.	161.	224.	307.	466.	717.	1978.		

- IRRAGGIAMENTO - 91 2400.000 MINUTI DATA 1974 12 15 24 0 FLUSSO .0000
- MISURA - TEMPO CONTEGGIO 108.983 MINUTI DATA 1975 1 25 17 30 DECADIMENTO 58650.000 MINUTI
- CAMPIONE - ALFA 515 PESO .06230000 G CALIB. Y= 1.000*X+ -1.712 PROBLEMA ALFALFA

ELEM	P.P.M.	ERR.0/0	VALORE A	KEV (T)	KEV (S)	I.S	WT	C.P.M	AREA ZERO	UGM	AT/CC
CE				145.40							
CO	7.156+000	.83		1332.48	1328.74	1324	13	3.540+002	3.592+002		
CR	3.788+002	.99		320.08	316.44	313	11	1.259+003	3.474+003		
CS				795.80							
EU	7.119-001	3.13		1408.11	1404.31	1400	13	6.675+001	6.716+001		
HF	3.051+000	3.82		482.60	478.23	474	13	3.203+002	5.994+002		
HG				279.20							
IN				1300.00							
NT				810.81							
RB	4.027+002	5.46		1076.60	1072.75	1069	11	1.115+002	7.814+002		
SB				1691.00							
SC	1.791-002	37.39		889.25	893.30	892	3	1.436+001	PRIMO (893.30	898.12)	
SC	5.857-001	5.41		889.25	898.12	919	20	4.696+002	SECOND(893.30	898.12)	
SC	5.666+000	.30		889.25	885.15	880	15	4.543+003	6.337+003		
TA				1221.60							
TB				879.33							
TH	4.186+000	3.60		311.90	308.29	306	9	2.930+002	8.324+002		
YB	2.884+000	15.08		197.80	194.42	205	9	1.621+002	SECOND(189.02	194.42)	
YB	3.409+000	5.29		197.80	189.02	188	7	1.916+002	4.618+002		
ZN	2.758+001	1.26		1115.51	1111.92	1102	11	9.737+002	PRIMO (1111.92	1116.57)	
ZN	8.355+001	.33		1115.51	1116.57	1114	9	2.949+003	3.309+003		
ZR	2.627+002	14.61		765.80	761.69	759	10	5.709+001	8.814+001		
BA	(3.893+002)			216.00							
FE	1.532+004	.96		1099.27	1095.24	1090	15	8.962+002	1.669+003		

SPETTRO N. 9 CANALI 2048 TCON 107.450 MINUTI DATA 1975 1 26 11 30 DECAD 59730.000 MIN

	1	2	3	4	5	6	7	8	9	10
0	6447.	10747.	10497.	8219.	6340.	5075.	3370.	2257.	1159.	978.
1	519.	454.	324.	285.	228.	197.	149.	136.	123.	103.
2	98.	84.	68.	79.	83.	104.	114.	157.	174.	306.
3	495.	886.	1422.	2303.	7551.	47167.	126041.	162099.	156611.	147232.
4	142676.	138770.	136857.	133263.	129696.	125582.	123101.	119769.	116050.	113435.
5	109830.	107250.	104957.	102568.	101624.	99068.	96729.	94557.	91907.	90735.
6	89257.	87922.	87440.	85763.	84509.	83656.	82222.	80351.	79813.	78622.
7	79759.	81072.	81995.	82403.	79094.	75053.	73754.	72045.	71387.	71579.
8	70971.	71515.	72889.	73776.	72532.	71285.	69309.	67015.	66209.	65572.
9	64736.	65745.	65623.	65235.	63774.	64009.	65032.	64743.	63082.	61189.
10	59837.	59659.	59374.	58594.	57980.	57634.	58244.	58491.	59740.	58179.
11	57187.	56557.	55419.	55010.	54749.	53722.	53439.	54864.	61035.	71046.
12	72375.	63058.	53663.	49754.	49556.	47675.	44985.	42569.	43174.	43712.
13	58278.	60343.	53880.	49734.	47388.	45275.	44085.	40260.	39218.	39884.	39901.
14	44650.	46549.	50490.	53135.	40931.	43174.	40260.	37095.	36811.	36648.	36396.
15	40134.	39088.	38771.	38253.	38311.	37562.	37095.	34770.	34360.	34299.	33086.
16	35748.	35803.	35251.	35044.	35192.	34777.	34360.	34237.	32959.	32803.	32444.
17	34106.	33588.	33645.	33886.	34564.	34844.	34237.	31540.	33047.	35004.
18	31934.	31794.	31562.	31754.	31589.	31432.	31354.	30565.	29245.	29328.
19	36838.	33817.	31313.	30933.	32298.	33405.	32571.	28072.	28886.	28691.
20	29480.	29066.	29037.	29320.	29080.	28095.	29065.	27840.	28183.	28649.
21	28813.	28993.	29153.	29448.	29281.	28659.	28093.	26382.	26086.	25965.
22	28436.	27469.	27514.	26755.	26415.	26664.	26669.	24907.	24855.	24730.
23	25880.	25725.	25349.	25366.	25199.	25563.	23784.	23409.	23373.	23368.
24	25486.	27330.	28620.	26744.	24938.	24280.	22796.	22844.	22787.	22506.
25	22844.	23081.	23009.	23267.	23005.	22096.	22085.	22165.	21975.	22047.
26	22807.	23318.	23316.	22829.	22416.	21815.	22766.	22575.	21904.	21152.
27	21800.	21868.	21715.	21500.	21811.	21987.	20842.	20847.	20860.	20741.
28	20961.	21113.	20899.	21222.	20822.	21146.	25332.	24491.	22380.	21150.
29	20891.	21162.	20953.	21508.	22738.	24538.	21209.	22620.	26485.	28693.
30	20491.	20477.	21074.	20953.	20802.	21153.	42051.	53435.	44293.	27106.
31	26029.	21971.	20492.	20539.	21145.	25739.	17450.	17372.	17527.	17334.
32	19567.	17609.	17509.	17484.	17364.	17526.	18027.	18097.	19585.	20874.
33	17499.	17608.	17979.	17731.	17655.	17259.	15736.	15879.	16186.	16189.
34	26764.	32281.	29577.	22614.	18361.	16209.	15449.	15724.	15563.	15748.
35	15926.	15928.	15808.	15677.	15664.	15413.	15405.	15300.	15458.	15277.
36	15396.	15581.	15470.	15550.	15849.	15605.	15215.	15095.	15032.	15132.
37	15250.	15348.	15400.	15345.	15176.	15033.	15029.	14863.	14864.
38	15131.	15005.	14937.	14935.	15123.	15071.	14802.	15133.	14802.	14698.
39	14909.	15104.	14958.	14926.	14978.	15076.	15024.	14889.	15462.	15038.
40	14713.	14762.	14404.	14612.	14729.	14481.	14637.	14552.	14500.	14415.
41	14557.	14690.	14498.	14956.	14720.	14448.	14223.	14430.	14423.	14365.
42	14426.	14579.	14354.	14547.	14461.	14237.	14342.	14311.	14456.	14099.
43	14349.	14481.	14368.	14119.	14417.	14342.	14106.	14130.	14162.	14401.
44	14980.	15205.	14660.	14507.	14404.	14240.	14426.	14203.	14365.	14316.
45	14551.	14111.	14223.	14114.	14045.	14174.	14402.	14293.	14163.	14269.
46	14324.	14130.	14165.	14400.	14508.	14367.	14514.	17116.	22485.	24001.
47	14360.	14310.	14691.	14353.	14465.	14366.	14785.	14039.	13821.	13717.	13995.
48	20248.	16225.	14093.	13947.	13966.	13886.	14039.	13857.	13846.	13742.
49	13747.	14079.	14038.	14157.	13925.	13847.	13854.	15613.	16203.	16627.	16606.
50	13873.	13810.	13827.	13925.	14229.	14235.	15613.	13720.	13633.	13932.
51	16375.	16020.	14919.	14240.	13862.	13666.	13792.	13688.	13530.	13834.
52	13517.	13859.	13504.	13488.	13914.	13715.	13534.	13709.	13526.	13578.
53	13790.	13650.	13887.	13613.	13783.	13661.	13716.	13873.	13741.	13603.	13773.
54	13789.	13632.	13463.	13705.	13737.	13927.	13873.	13772.	13803.	14281.	14302.
55	13671.	14005.	13728.	13931.	13816.	14033.	14567.	15141.	14113.	13909.
56	14371.	14357.	14061.	14010.	14080.	14041.	13946.	13987.	13756.	13987.
57	13666.	13822.	13660.	14148.	13771.	13782.	14009.	14080.	13909.	13944.
58	14061.	13781.	14143.	14148.	14207.	13967.	14073.	14421.	15820.	18096.
59	14232.	13925.	13862.	13591.	14033.	13947.	13719.	13701.	13504.	13490.
60	20922.	22138.	20153.	16258.	14322.	13675.	13538.	13546.	13411.	13502.
61	13693.	13653.	13695.	13596.	13554.	13543.	13452.	13426.	13570.	13567.
62	13602.	13628.	13628.	13426.	13381.	13765.	13274.	13663.	13433.	13309.
63	13263.	13511.	13590.	13396.	13544.	13597.	13664.	13510.	13611.	13327.
64	13404.	13404.	13749.	13802.	13399.	13464.	13652.	13635.	13720.	13554.
65	13285.	13509.	13358.	13710.	13543.	13548.	13327.	13561.	13560.	13535.
66	13564.	13482.	13322.	13542.	13472.	13558.	13785.	13608.	13520.	13564.
67	13858.	13801.	13538.	13768.	13632.	13648.	13179.	13012.	12913.	12712.
68	13309.	13404.	13299.	13568.	13572.	13304.	12037.	11829.	11845.	11833.
69	12412.	12263.	12065.	11972.	11932.	12003.	11634.	11682.	11626.	11672.
70	11724.	11885.	11560.	11767.	11905.	11634.	11629.	11613.	11763.	12118.
71	11740.	11499.	11319.	11461.	11495.	11368.	11302.	11179.	11210.	10966.
72	12486.	12015.	11575.	11583.	11341.	11288.	11301.	11082.	11130.	10893.
73	11173.	11159.	11099.	11125.	11153.	11089.	10975.	11019.	11007.	10740.
74	11229.	11068.	11139.	11039.	11111.	10794.	10818.	10866.	10735.	10520.
75	10963.	11101.	11444.	11539.	11522.	10973.	10503.	10639.	10680.	10524.
76	11059.	11804.	12190.	11953.	11280.	10836.				

77	10423.	10502.	10362.	10849.	11763.	12675.	12225.	11340.	10663.	10290.
78	10561.	10484.	10486.	10258.	10409.	10341.	10302.	10407.	10313.	10630.
79	11347.	13332.	15251.	14608.	12208.	10775.	10588.	10462.	10678.	10727.
80	10516.	10378.	10444.	10552.	10328.	10660.	11169.	11458.	11182.	10695.
81	10609.	10321.	10344.	10392.	10573.	10344.	10538.	10445.	10686.	10634.
82	10534.	10634.	10805.	10563.	10780.	10656.	10860.	10673.	11258.	12458.
83	15736.	18500.	17441.	14007.	11502.	10824.	10636.	10891.	10864.	10802.
84	10872.	10999.	10958.	11074.	11041.	10897.	10756.	11073.	11195.	11169.
85	11007.	11104.	11240.	11341.	11320.	11407.	11530.	11414.	11589.	11407.
86	11650.	11505.	11757.	11819.	12301.	12159.	11574.	11703.	11738.	12076.
87	12019.	12009.	12219.	12229.	12513.	13130.	13390.	12799.	12319.	12121.
88	12103.	12316.	13856.	24879.	61952.	115603.	127729.	81217.	32834.	13035.
89	9093.	8722.	8481.	8635.	8463.	8422.	8694.	8458.	8539.	8492.
90	8444.	8349.	8319.	8284.	9173.	8142.	7947.	7953.	7662.	7490.
91	7318.	7220.	6949.	6877.	7000.	6903.	6599.	6666.	6622.	6462.
92	6580.	6644.	6508.	6555.	6339.	6379.	6271.	6328.	6216.	6113.
93	6265.	6133.	6004.	6134.	6133.	6132.	6153.	6116.	5982.	6075.
94	6087.	5924.	6011.	5815.	5865.	5817.	5775.	5761.	5777.	5722.
95	5681.	5730.	5742.	5682.	5582.	5659.	5757.	5708.	6187.	6831.
96	7492.	7679.	7256.	6650.	5846.	5512.	5208.	5024.	4999.	4983.
97	5025.	5033.	4912.	4946.	4790.	4903.	4802.	4765.	4861.	4699.
98	4796.	4738.	4660.	4596.	4539.	4614.	4594.	4609.	4467.	4450.
99	4534.	4362.	4456.	4481.	4514.	4345.	4251.	4266.	4235.	4397.
100	4500.	4398.	4463.	4246.	4182.	3994.	4048.	4075.	3963.	3947.
101	4070.	3960.	4011.	3914.	3877.	3921.	3870.	3836.	4046.	3954.
102	3854.	4006.	3929.	3896.	3974.	3955.	3959.	3880.	3910.	3875.
103	3951.	4003.	3901.	3869.	3943.	4065.	3923.	3944.	3983.	3982.
104	4015.	4049.	4142.	4082.	4117.	4078.	4247.	4244.	4134.	4153.
105	4103.	4147.	4200.	4262.	4216.	4306.	4135.	4261.	4338.	4259.
106	4304.	4309.	4444.	4438.	4372.	4523.	4480.	4543.	4426.	4532.
107	4740.	5264.	6416.	7328.	7032.	5643.	4802.	4655.	4686.	4650.
108	4906.	5359.	5846.	5856.	5299.	4999.	4933.	4866.	4850.	4781.
109	4810.	4962.	5328.	7399.	13980.	23212.	25731.	18164.	9625.	5663.
110	4661.	4597.	4429.	4695.	4543.	4502.	4939.	5325.	6179.	7623.
111	11890.	20395.	25630.	21285.	17832.	34654.	73315.	97345.	75469.	34010.
112	9941.	2771.	1597.	1486.	1490.	1471.	1469.	1461.	1483.	1429.
113	1445.	1435.	1469.	1414.	1453.	1448.	1467.	1388.	1414.	1449.
114	1426.	1422.	1396.	1428.	1422.	1420.	1320.	1377.	1407.	1447.
115	1414.	1338.	1477.	1364.	1322.	1397.	1325.	1295.	1298.	1336.
116	1285.	1339.	1311.	1325.	1409.	1405.	1530.	2363.	5024.	8862.
117	10005.	6938.	3341.	1956.	1658.	1567.	1272.	1121.	1026.	1029.
118	965.	972.	1016.	1031.	1131.	1319.	1285.	1144.	1020.	957.
119	952.	915.	878.	908.	920.	983.	961.	936.	957.	903.
120	898.	850.	888.	837.	874.	851.	893.	884.	976.	1013.
121	1015.	931.	860.	888.	869.	919.	1053.	1348.	1474.	1260.
122	983.	925.	883.	879.	843.	880.	956.	1078.	1102.	1011.
123	928.	923.	832.	870.	852.	854.	883.	900.	824.	817.
124	890.	833.	877.	831.	847.	899.	840.	855.	873.	863.
125	823.	780.	857.	862.	892.	959.	876.	880.	879.	884.
126	959.	893.	880.	932.	904.	949.	958.	1057.	1154.	1303.
127	1345.	1371.	1219.	1036.	941.	893.	971.	918.	923.	937.
128	971.	981.	931.	930.	1018.	1788.	4562.	9966.	14105.	12221.
129	6481.	2342.	919.	617.	602.	731.	717.	668.	658.	606.
130	564.	615.	585.	547.	573.	573.	597.	628.	635.	704.
131	635.	589.	616.	576.	570.	599.	539.	633.	597.	613.
132	568.	609.	646.	614.	634.	709.	1131.	2797.	6074.	8005.
133	6844.	3698.	1318.	567.	454.	390.	375.	404.	394.	386.
134	419.	359.	403.	390.	395.	387.	403.	401.	364.	419.
135	417.	358.	397.	398.	398.	376.	414.	386.	388.	387.
136	446.	451.	475.	454.	475.	405.	369.	402.	391.	390.
137	372.	389.	387.	406.	430.	412.	376.	391.	361.	369.
138	362.	405.	373.	418.	367.	358.	385.	365.	346.	389.
139	377.	385.	416.	404.	363.	411.	424.	447.	440.	413.
140	386.	443.	624.	1147.	1857.	2003.	1534.	828.	461.	375.
141	344.	329.	322.	314.	344.	330.	334.	343.	342.	354.
142	357.	338.	317.	353.	318.	298.	352.	326.	312.	337.
143	378.	365.	387.	378.	328.	326.	370.	353.	357.	298.
144	363.	347.	346.	337.	333.	333.	323.	324.	310.	299.
145	311.	292.	307.	310.	318.	354.	394.	359.	347.	342.
146	275.	297.	294.	297.	291.	265.	305.	302.	280.	295.
147	248.	278.	274.	300.	280.	281.	295.	268.	288.	293.
148	299.	262.	291.	287.	306.	309.	306.	278.	281.	281.
149	278.	266.	272.	264.	269.	236.	272.	262.	288.	268.
150	279.	332.	280.	282.	305.	293.	270.	297.	268.	267.
151	278.	271.	266.	256.	273.	237.	255.	237.	265.	262.
152	244.	233.	251.	271.	315.	305.	281.	281.	245.	245.
153	235.	250.	250.	230.	254.	236.	285.	215.	252.	248.
154	224.	241.	256.	267.	252.	232.	241.	256.	237.	242.
155	212.	228.	221.	254.	207.	237.	236.	247.	254.	219.
156	235.	223.	229.	213.	214.	227.	204.	230.	221.	195.
157	242.	214.	202.	207.	213.	227.	220.	203.	191.	231.
158	225.	223.	248.	218.	200.	202.	218.	240.	238.	235.

159	211	221	232	207	218	230	187	224	200
160	185	216	197	210	201	204	185	196	202
161	200	200	189	205	207	215	188	212	187
162	213	195	190	188	201	238	194	207	178
163	205	201	193	193	208	181	176	197	207
164	203	179	210	185	196	163	167	184	181
165	193	185	178	185	183	200	210	186	198
166	191	176	198	216	181	187	197	173	190
167	178	194	171	163	198	182	185	174	211
168	187	189	172	185	141	205	353	460	507
169	354	194	171	145	174	160	146	153	185
170	157	169	140	156	142	160	158	174	157
171	153	166	141	156	177	139	130	162	151
172	159	156	173	160	162	148	166	153	191
173	152	139	153	146	164	164	145	157	151
174	161	142	145	135	165	147	155	174	174
175	135	158	151	151	157	167	131	162	135
176	177	216	226	196	128	150	163	143	160
177	173	126	134	156	134	137	122	146	138
178	149	134	139	126	155	140	123	139	120
179	151	144	142	137	123	112	144	133	131
180	125	140	122	118	112	113	118	117	108
181	128	106	128	117	116	100	101	103	98
182	105	93	108	109	94	177	81	84	89
183	84	92	99	107	96	77	98	102	87
184	79	90	88	97	113	76	70	71	79
185	75	72	83	81	72	68	101	92	86
186	63	73	98	83	68	104	93	71	67
187	83	69	82	68	62	75	65	70	64
188	71	83	89	62	74	82	68	87	61
189	61	71	62	64	62	64	67	56	55
190	58	61	61	58	59	72	57	55	53
191	54	49	58	64	67	65	58	45	51
192	44	57	48	62	64	53	57	61	61
193	71	55	70	60	66	55	60	51	55
194	58	54	52	58	59	61	56	57	61
195	64	67	46	67	60	56	52	73	65
196	67	55	49	59	71	61	48	67	65
197	51	60	82	68	51	76	68	75	56
198	56	65	67	55	72	58	55	63	61
199	65	70	45	68	87	71	65	61	59
200	55	53	67	70	170	77	62	69	66
201	128	43	16	40	12	414	603	763	587
202	122	10	30	20	21	21	11	34	22
203	23	21	27	20	20	20	25	14	26
204	60000	360	480	951	371	5478	7463	17	16
								9013	

233	185	196	198	191	172	176	193	184	154
171	151	191	151	174	135	160	138	120	131
108	88	89	87	79	86	67	64	61	55
53	51	61	55	65	65	56	61	59	66
28	19	28	24						

- IRRAGGIAMENTO - 91 2400.000 MINUTI DATA 1974 12 15 24 0 FLUSSO .0000
- MISURA - TEMPO CONTEGGIO 107.450 MINUTI DATA 1975 1 26 11 30 DECADIMENTO 59730.000 MINUTI
- CAMPIONE - ALFA 888 PESO .05720000 G CALIB. Y= 1.000*X+ -1.712 PROBLEMA ALFALFA

ELEM	P.P.M.	ERR.0/0	VALORE A	KEV (T)	KEV (S)	LS	WT	C P M	AREA ZERO	UGM	AT/CC
CE				145.40							
CO	5.475+000	1.03		1332.48	1328.71	1324	13	2.486+002	2.523+002		
CR	3.154+002	1.19		320.08	316.42	313	11	9.447+002	2.655+003		
CS				795.80							
EU	6.473-001	2.99		1408.11	1404.30	1401	11	5.572+001	5.607+001		
HF	3.793+000	2.78		482.60	478.19	476	9	2.862+002	5.421+002		
HG				279.20							
IN				1300.00							
NI				810.81							
RB	3.571+002	6.15		1076.60	1072.75	1069	11	8.756+001	6.361+002		
SB				1691.00							
SC	4.936+000	.30		889.25	885.12	881	13	3.611+003	5.068+003		
TA				1221.60							
TB				879.33							
TH	3.198+000	4.74		311.90	308.27	306	9	2.016+002	5.839+002		
YB	1.535+000	11.71		197.80	194.40	193	7	7.796+001	1.910+002		
ZN	2.264+001	1.15		1115.51	1111.55	1105	8	7.323+002	PRIMO (1111.55 1116.54)		
ZN	7.435+001	.36		1115.51	1116.54	1114	9	2.405+003	2.704+003		
ZR	2.348+002	14.62		765.80	761.58	759	9	4.649+001	7.233+001		
BA	(4.058+002)			216.00							
FE	1.271+004	1.00		1099.27	1095.21	1091	13	6.748+002	1.271+003		

SPETTRO N. 10 CANALI 2048 TCON 141.783 MINUTI DATA 1975 1 27 4 30 DECAD 60750.000 MIN

	1	2	3	4	5	6	7	8	9	10
0	8507.	7997.	5307.	4015.	2507.	1801.	1098.	777.	449.	467.
1	305.	235.	187.	168.	161.	130.	106.	96.	90.	86.
2	80.	77.	79.	117.	119.	174.	268.	432.	661.	1111.
3	21988.	9238.	40402.	33041.	120317.	145367.	152248.	145822.	139431.	135464.
4	131982.	128755.	125488.	122037.	119742.	115305.	113371.	110905.	108272.	105213.
5	102607.	100483.	97656.	96450.	93599.	91182.	89866.	87751.	87079.	85432.
6	84141.	83264.	82562.	80856.	79861.	78935.	78264.	78704.	79273.	80325.
7	80452.	78480.	76905.	73898.	71817.	70569.	70379.	70609.	71260.	71565.
8	72243.	71708.	70585.	69497.	68223.	66964.	66134.	65489.	65738.	65171.
9	65198.	64663.	64857.	64486.	64800.	64052.	63005.	61919.	60904.	60090.
10	59356.	59623.	58811.	58599.	59032.	58646.	58842.	58065.	57414.	56745.
11	56631.	55331.	55200.	54738.	56888.	62982.	70173.	71987.	69841.	63075.
12	55244.	50146.	48475.	47733.	47721.	49169.	52880.	58707.	61285.	59939.
13	55774.	50383.	45966.	44590.	43380.	42299.	42421.	42817.	44801.	47203.
14	48613.	47320.	45233.	42133.	39415.	38568.	38788.	38543.	37916.	37965.
15	37164.	36720.	36661.	36319.	36162.	35184.	34992.	35183.	34718.	34625.
16	34186.	33776.	33997.	33925.	33298.	33035.	33329.	32989.	32474.	32649.
17	32604.	32530.	32914.	32164.	32109.	31470.	31272.	30722.	30837.	30535.
18	30670.	30432.	30409.	30050.	30665.	31354.	33801.	33432.	32906.	31360.
19	30327.	29979.	30201.	30165.	29336.	28438.	28112.	28150.	27819.	27590.
20	27274.	27446.	27798.	27122.	27311.	27447.	27252.	27317.	27539.	27525.
21	27413.	27367.	27175.	26707.	26516.	26575.	26909.	26822.	26364.	26140.
22	25363.	25310.	25165.	25058.	25085.	24997.	24731.	24139.	24517.	24263.
23	24068.	24065.	23762.	23882.	23529.	23540.	23885.	24362.	25808.	26391.
24	26177.	25511.	23877.	22920.	22292.	22405.	22107.	22156.	21847.	21502.
25	21743.	21488.	21365.	21463.	21553.	21254.	21387.	21040.	21433.	21568.
26	21458.	21182.	21034.	20852.	20834.	20564.	20822.	20504.	20650.	20350.
27	20327.	20417.	20688.	20609.	20486.	20460.	20311.	20267.	19705.	19728.
28	19929.	19624.	19789.	19887.	19532.	19522.	19601.	19749.	19782.	20172.
29	20246.	20630.	21544.	22037.	22236.	21576.	20452.	20043.	19870.	19510.
30	19573.	19651.	19976.	20457.	21417.	23242.	24201.	24220.	22649.	21268.
31	20039.	21330.	27213.	38067.	44919.	44008.	38045.	27761.	19880.	16682.
32	16321.	16149.	16522.	16403.	16243.	16250.	16333.	16219.	16325.	16569.
33	16484.	16507.	16188.	16489.	17100.	17748.	21079.	26337.	30062.	30291.
34	27876.	22861.	18064.	15781.	14798.	14753.	14834.	14824.	14631.	14399.
35	14369.	14144.	14224.	14287.	14095.	14211.	14189.	14039.	14015.	14156.
36	14296.	14315.	14463.	14253.	14102.	13864.	14002.	13978.	13958.	14047.
37	13884.	13833.	13616.	13689.	13670.	13774.	13649.	13914.	13600.	13733.
38	13761.	13462.	13654.	13480.	13542.	13650.	13655.	13348.	13554.	13576.
39	13667.	13503.	13573.	13511.	13648.	13439.	13260.	13263.	13359.	13450.
40	13117.	13225.	13646.	13525.	13826.	14002.	13659.	13550.	13708.	13473.
41	13623.	13510.	13122.	13216.	13307.	12941.	13150.	12969.	13159.	12913.
42	13060.	13248.	12983.	13177.	13022.	12894.	13078.	13019.	13086.	13049.
43	12841.	12920.	13049.	12931.	13129.	13140.	13399.	13543.	13725.	13554.
44	13485.	13066.	12865.	12673.	13001.	12747.	13191.	13141.	12925.	12846.
45	13014.	13060.	13126.	12985.	13088.	13144.	13044.	12987.	13076.	13205.
46	13218.	13211.	13136.	13311.	13128.	12999.	13013.	12992.	12850.	13314.
47	13125.	13323.	13386.	14163.	17504.	21571.	23613.	22681.	20065.	16107.
48	13424.	12635.	12411.	12456.	12689.	12419.	12541.	12342.	12552.	12568.
49	12666.	12446.	12517.	12501.	12467.	12445.	12496.	12541.	12341.	12475.
50	12437.	12663.	12805.	13867.	14919.	15470.	15369.	15414.	14640.	13908.
51	13257.	12726.	12543.	12114.	12219.	12057.	12128.	12302.	12523.	12153.
52	12185.	12232.	12239.	12367.	12132.	12286.	12113.	12571.	12331.	12209.
53	12179.	12419.	12312.	12165.	12356.	12187.	12188.	12350.	12402.	12258.
54	12257.	12240.	12260.	12309.	12348.	12182.	12391.	12467.	12480.	12265.
55	12436.	12315.	12522.	12418.	12486.	12585.	12547.	12880.	12980.	12596.
56	12543.	12744.	12866.	13056.	12995.	12730.	12587.	12500.	12437.	12780.
57	12731.	12393.	12606.	12332.	12629.	12315.	12460.	12534.	12457.	12505.
58	12614.	12651.	12515.	12578.	12411.	12369.	12425.	12603.	12400.	12270.
59	12246.	12312.	12417.	12686.	13205.	14210.	15840.	17811.	18786.	18272.
60	16627.	14686.	13277.	12500.	12320.	12206.	12104.	12236.	12084.	12201.
61	12216.	12659.	12162.	11933.	12007.	11907.	11837.	12123.	12045.	11912.
62	12076.	11936.	11972.	11882.	11830.	11974.	11849.	11886.	11889.	11798.
63	11776.	11676.	12001.	11972.	11852.	11886.	11843.	11763.	11876.	12139.
64	12039.	11923.	12111.	11893.	12062.	11942.	11852.	11918.	11940.	11704.
65	12063.	11966.	11950.	12039.	11860.	12075.	11895.	12049.	12159.	11947.
66	12194.	12051.	12105.	11995.	11884.	11979.	12050.	12025.	12271.	12071.
67	12015.	12071.	12334.	12024.	12048.	12012.	11991.	12117.	12123.	12162.
68	12018.	12075.	11938.	11841.	11603.	11469.	11399.	11288.	11073.	10944.
69	10888.	10838.	10755.	10819.	10827.	10633.	10445.	10639.	10807.	10545.
70	10687.	10453.	10460.	10527.	10507.	10439.	10500.	10579.	10492.	10265.
71	10350.	10168.	10360.	10359.	10518.	10747.	11413.	11266.	11551.	11128.
72	10926.	10470.	10075.	10243.	10058.	10064.	9935.	10119.	10128.	10142.
73	10088.	9842.	10017.	9879.	9889.	10037.	10099.	10045.	10114.	9800.
74	10221.	9984.	10058.	10044.	9863.	9818.	9903.	10017.	10065.	10754.
75	10727.	10836.	10602.	10056.	10012.	9736.	9839.	10322.	11022.	11274.
76	11377.	10796.	10314.	10028.	9669.	9440.	9519.	9340.	9643.	9539.

77	9964.	12759.	11480.	11544.	11284.	10530.	9882.	9415.	9843.	9882.	9783.
78	9357.	8142.	8425.	9375.	9511.	9326.	9503.	10411.	11500.	12438.	12387.
79	12560.	12034.	10315.	10037.	9687.	9688.	9580.	9598.	9413.	9366.	9366.
80	9275.	9351.	8667.	9776.	9991.	9798.	10027.	9808.	9622.	9385.	9385.
81	9505.	9355.	9549.	9434.	9415.	9423.	9566.	9526.	9616.	9611.	9611.
82	9482.	9468.	9567.	9534.	9706.	10004.	11244.	12812.	14304.	14536.	14536.
83	13741.	12110.	10451.	9848.	9493.	9684.	9615.	9796.	9577.	9912.	9912.
84	9662.	9763.	8735.	9717.	9854.	9965.	10048.	10003.	10004.	10177.	10177.
85	9973.	10198.	9995.	10106.	10218.	10263.	10351.	10332.	10296.	10545.	10545.
86	10633.	10996.	10773.	10740.	10740.	10661.	10495.	10798.	10742.	10640.	10640.
87	10837.	10840.	11155.	11258.	11065.	10925.	10850.	10785.	11110.	13193.	13193.
88	23000.	45000.	69569.	80084.	73331.	52615.	39506.	14960.	9699.	9017.	9017.
89	7797.	7801.	7787.	7902.	7976.	7644.	7870.	7827.	7659.	7715.	7715.
90	7600.	7347.	7508.	7365.	7317.	7086.	6944.	6677.	6603.	6511.	6511.
91	6421.	6279.	6498.	6212.	6234.	6201.	6001.	6093.	6060.	6012.	6012.
92	6078.	5850.	5956.	5834.	5777.	5740.	5985.	5806.	5846.	5815.	5815.
93	5790.	5750.	5670.	5609.	5622.	5653.	5519.	5596.	5390.	5514.	5514.
94	5494.	5519.	5514.	5478.	5400.	5408.	5344.	5259.	5337.	5284.	5284.
95	5365.	5459.	5294.	5262.	5473.	5740.	6500.	6795.	7145.	7018.	7018.
96	6410.	5753.	5253.	4953.	4894.	4731.	4771.	4721.	4619.	4725.	4725.
97	4571.	4569.	4592.	4555.	4437.	4511.	4435.	4468.	4473.	4327.	4327.
98	4369.	4335.	4419.	4275.	4211.	4256.	4212.	4317.	4245.	4280.	4280.
99	4189.	4252.	4060.	4119.	4108.	4064.	4123.	4202.	4268.	4251.	4251.
100	4153.	4029.	3932.	3821.	3877.	3724.	3704.	3755.	3688.	3673.	3673.
101	3695.	3685.	3606.	3657.	3689.	3674.	3645.	3671.	3726.	3527.	3527.
102	3625.	3669.	3680.	3747.	3776.	3740.	3699.	3684.	3591.	3768.	3768.
103	3715.	3704.	3848.	3760.	3740.	3738.	3661.	3732.	3773.	3872.	3872.
104	3739.	3738.	3760.	3963.	3891.	3795.	3911.	3833.	3967.	3937.	3937.
105	3836.	3971.	3880.	4062.	4115.	4054.	4062.	4176.	4022.	4075.	4075.
106	4138.	4146.	4193.	4207.	4234.	4195.	4307.	4448.	4931.	5489.	5489.
107	6095.	6265.	5825.	5243.	4560.	4253.	4397.	4611.	5139.	5402.	5402.
108	5502.	5426.	5133.	4779.	4706.	4518.	4654.	4462.	4625.	5170.	5170.
109	7176.	11560.	16501.	18706.	17414.	13646.	8628.	5529.	4405.	4294.	4294.
110	4262.	4281.	4504.	4797.	5208.	6101.	8193.	13176.	19774.	23702.	23702.
111	24311.	25416.	32974.	47749.	58000.	56217.	44006.	25100.	10056.	3281.	3281.
112	1697.	1469.	1493.	1401.	1392.	1361.	1455.	1408.	1375.	1456.	1456.
113	1395.	1420.	1354.	1402.	1416.	1444.	1337.	1373.	1361.	1378.	1378.
114	1411.	1387.	1463.	1358.	1411.	1310.	1392.	1390.	1367.	1317.	1317.
115	1390.	1313.	1414.	1329.	1321.	1313.	1207.	1301.	1306.	1398.	1398.
116	1370.	1353.	1378.	1651.	2661.	4734.	7037.	7865.	7363.	5661.	5661.
117	3461.	1946.	1384.	1224.	1130.	978.	977.	980.	962.	985.	985.
118	996.	1078.	1178.	1208.	1165.	1107.	930.	896.	863.	861.	861.
119	911.	912.	872.	890.	855.	890.	893.	864.	847.	849.	849.
120	894.	871.	843.	866.	865.	926.	993.	971.	942.	845.	845.
121	821.	832.	885.	1018.	1099.	1269.	1161.	1079.	936.	838.	838.
122	813.	829.	872.	827.	921.	933.	951.	964.	820.	820.	820.
123	835.	819.	831.	802.	826.	764.	732.	821.	837.	810.	810.
124	764.	808.	825.	825.	826.	816.	827.	790.	821.	788.	788.
125	802.	866.	808.	834.	811.	750.	816.	835.	835.	863.	863.
126	844.	821.	872.	865.	919.	1043.	1153.	1258.	1275.	1213.	1213.
127	1123.	997.	943.	919.	860.	847.	845.	869.	824.	842.	842.
128	873.	1085.	1815.	4124.	7100.	9422.	9629.	7865.	5006.	2305.	2305.
129	1062.	706.	678.	696.	729.	647.	587.	565.	555.	578.	578.
130	561.	534.	577.	539.	581.	585.	591.	532.	500.	568.	568.
131	559.	586.	575.	572.	604.	566.	583.	574.	578.	567.	567.
132	554.	635.	782.	1344.	2812.	5025.	6453.	6476.	5129.	3154.	3154.
133	1520.	635.	392.	358.	372.	356.	371.	358.	385.	342.	342.
134	349.	347.	320.	360.	342.	357.	319.	368.	331.	372.	372.
135	381.	358.	381.	364.	344.	380.	369.	389.	425.	422.	422.
136	454.	437.	397.	380.	390.	345.	356.	332.	371.	358.	358.
137	369.	387.	393.	401.	346.	344.	356.	346.	351.	372.	372.
138	367.	344.	346.	324.	345.	317.	346.	370.	477.	719.	719.
139	360.	375.	378.	412.	396.	391.	372.	329.	321.	313.	313.
140	1295.	1705.	1086.	1933.	1451.	867.	509.	323.	309.	306.	306.
141	207.	306.	280.	288.	323.	303.	291.	352.	324.	337.	337.
142	295.	301.	340.	314.	275.	305.	298.	323.	330.	333.	333.
143	360.	325.	261.	304.	325.	294.	331.	280.	278.	278.	278.
144	314.	320.	554.	275.	332.	277.	280.	251.	338.	341.	341.
145	200.	200.	305.	322.	295.	299.	308.	264.	303.	342.	342.
146	274.	243.	287.	244.	237.	240.	241.	240.	264.	260.	260.
147	240.	335.	219.	253.	284.	259.	274.	245.	240.	240.	240.
148	225.	254.	230.	251.	249.	253.	273.	273.	244.	265.	265.
149	280.	236.	265.	225.	239.	239.	227.	219.	214.	230.	230.
150	255.	239.	267.	220.	247.	221.	283.	242.	242.	236.	236.
151	250.	252.	226.	222.	193.	237.	233.	234.	210.	233.	233.
152	256.	236.	260.	236.	250.	226.	234.	221.	201.	205.	205.
153	204.	200.	193.	204.	194.	230.	236.	212.	216.	184.	184.
154	197.	233.	190.	214.	202.	194.	213.	201.	179.	202.	202.
155	195.	182.	205.	205.	153.	206.	194.	196.	183.	217.	217.
156	188.	187.	178.	201.	198.	200.	199.	197.	169.	183.	183.
157	227.	195.	187.	190.	196.	182.	193.	198.	201.	198.	198.
158	172.	180.	168.	192.	189.	173.					

159	218.	208.	218.	170.	193.	177.	172.	194.	185.	166.
160	170.	188.	158.	171.	165.	192.	153.	176.	162.	166.
161	186.	198.	171.	186.	176.	187.	146.	196.	166.	170.
162	189.	154.	161.	171.	166.	154.	169.	163.	166.	161.
163	154.	200.	185.	150.	155.	166.	149.	162.	165.	176.
164	136.	125.	172.	176.	174.	152.	189.	154.	122.	158.
165	155.	159.	171.	181.	157.	142.	152.	146.	146.	173.
166	148.	157.	149.	167.	157.	136.	161.	143.	157.	143.
167	174.	157.	157.	146.	136.	159.	492.	431.	172.	206.
168	172.	156.	206.	331.	418.	559.	139.	120.	110.	132.
169	157.	137.	136.	127.	139.	135.	138.	131.	130.	134.
170	159.	145.	139.	143.	144.	138.	135.	127.	140.	144.
171	159.	135.	137.	133.	147.	171.	135.	121.	126.	143.
172	137.	138.	136.	125.	168.	126.	130.	147.	145.	135.
173	130.	136.	136.	120.	152.	133.	133.	123.	141.	122.
174	132.	141.	114.	120.	117.	133.	121.	169.	187.	198.
175	140.	114.	144.	129.	141.	134.	138.	128.	111.	118.
176	171.	124.	139.	129.	122.	113.	121.	109.	104.	123.
177	174.	177.	131.	128.	115.	119.	106.	104.	134.	93.
178	142.	124.	121.	121.	110.	102.	103.	110.	121.	96.
179	124.	114.	121.	112.	104.	119.	100.	88.	125.	85.
180	125.	122.	116.	116.	89.	128.	94.	83.	73.	70.
181	86.	121.	100.	86.	79.	102.	105.	82.	91.	74.
182	76.	89.	94.	83.	85.	86.	83.	76.	74.	66.
183	86.	81.	85.	88.	90.	68.	80.	80.	69.	71.
184	90.	75.	85.	82.	85.	80.	84.	84.	75.	76.
185	59.	84.	97.	67.	79.	90.	73.	80.	66.	73.
186	78.	73.	56.	56.	73.	72.	65.	52.	64.	73.
187	51.	58.	75.	58.	57.	55.	57.	63.	57.	47.
188	63.	67.	66.	68.	56.	71.	63.	57.	62.	59.
189	54.	66.	68.	57.	43.	51.	52.	60.	57.	45.
190	60.	54.	59.	71.	52.	60.	58.	35.	50.	63.
191	47.	42.	54.	41.	52.	48.	43.	78.	55.	44.
192	41.	58.	45.	56.	59.	48.	53.	44.	58.	57.
193	51.	45.	54.	54.	51.	41.	45.	43.	57.	55.
194	63.	63.	45.	45.	74.	49.	47.	48.	57.	59.
195	50.	59.	63.	50.	48.	48.	57.	58.	50.	55.
196	55.	50.	59.	58.	60.	59.	55.	60.	50.	44.
197	60.	58.	50.	66.	55.	50.	60.	63.	52.	47.
198	66.	54.	44.	64.	57.	60.	67.	60.	68.	48.
199	77.	50.	65.	47.	60.	64.	64.	50.	78.	50.
200	37.	54.	49.	43.	49.	47.	471.	202.	93.	37.
201	26.	159.	277.	28.	18.	23.	23.	14.	22.	24.
202	12.	21.	16.	16.	23.	27.	27.	20.	17.	21.
203	16.	19.	20.	16.	26.	18.	18.	18.	17.	19.
204	60000.	368.	487.	784.	1983.	6732.	11489.	11705.	1765.	1900.

- TRAGGIAMENTO - 91 2400.000 MINUTI DATA 1974 12 15 24 0 FLUSSO .0000
- MISURA - TEMPO CONTEGGIO 141.783 MINUTI DATA 1975 1 27 4 30 DECADIMENTO 60750.000 MINUTI
- CAMPIONE - ALFA 274 PESO .05500000 G CALIB. Y= 1.000*X+ -1.712 PROBLEMA ALFALFA

ELEM	P.P.M.	ERR.0/0	VALORE A	KEV (T)	KEV (S)	LS	WT	C.P.M.	AREA ZERO	UGM	AT/CC
CE				145.40							
CO	(6.233-002)			1332.48							
CD	(3.649+000)			320.08							
CS				795.80							
EU	(2.006-002)			1408.11							
HF	(1.242-001)			482.60							
HG				279.20							
IN				1300.00							
NT				810.81							
RB	1.741+002	10.04		1076.60	1079.50	1076	11	3.969+001	2.982+002		
SB				1691.00							
SC	(1.339-002)			889.25							
TA				1221.60							
TB				879.33							
TH	1.309+001	1.10		311.90	313.84	310	11	7.793+002	2.298+003		
YB	(2.513-001)			197.80							
ZN	7.916+001	.33		1115.51	1113.89	1103	25	2.457+003	2.769+003		
ZR	(3.772+001)			765.80							
BA	(3.211+002)			216.00							
FE	(1.164+002)			1099.27							

SPETTRO N. 11 CANALI 2048 TCON 139.083 MINUTI DATA 1975 1 28 21 30 DECAD 63210.000 YIN

	1	2	3	4	5	6	7	8	9	10
0	8345.	7631.	4929.	3486.	1724.	1043.	633.	538.	319.	354.
1	240.	215.	165.	127.	137.	112.	87.	81.	63.	68.
2	93.	100.	111.	142.	152.	268.	361.	605.	1006.	1604.
3	2913.	10174.	51640.	133535.	171754.	166839.	157421.	152143.	148756.	145407.
4	142113.	138258.	135048.	131314.	129506.	125087.	122442.	118770.	115948.	113478.
5	111565.	108698.	107128.	104813.	103076.	99740.	98185.	95960.	94902.	93727.
6	93093.	91063.	90383.	88088.	86809.	85243.	85358.	85585.	87517.	88059.
7	88214.	84889.	80650.	78292.	78046.	77220.	77509.	76193.	77110.	79362.
8	79082.	77769.	76331.	74120.	72516.	71160.	70746.	70685.	70260.	70851.
9	70715.	68973.	69613.	70909.	70723.	67706.	65969.	64506.	64164.	63704.
10	62867.	63055.	62222.	62027.	62892.	63227.	63186.	61562.	60937.	60461.
11	60025.	59186.	58160.	58460.	59378.	64964.	74979.	76336.	66822.	57306.
12	53558.	52325.	51969.	51902.	51974.	52900.	56160.	63113.	66380.	59121.
13	52862.	50622.	49228.	47359.	47115.	46957.	47673.	49238.	50997.	56164.
14	60619.	55696.	47284.	43450.	42480.	42652.	43409.	43637.	42561.	41771.
15	41419.	41135.	40714.	39837.	39887.	39510.	39256.	38709.	38772.	38367.
16	38427.	37889.	38044.	37557.	37563.	36923.	37011.	36892.	36446.	36625.
17	36563.	37178.	37361.	36716.	36181.	35591.	34882.	34779.	34878.	34773.
18	34230.	34073.	34242.	34169.	34476.	36114.	39765.	41541.	37671.	33915.
19	33508.	35006.	35468.	34706.	33197.	32210.	31939.	32095.	31655.	31772.
20	31800.	31821.	32070.	31798.	32007.	32141.	31969.	31786.	31974.	32088.
21	31966.	31935.	30880.	30793.	30708.	30821.	31470.	31087.	30484.	29973.
22	29991.	29200.	29623.	29492.	29378.	28789.	28873.	28183.	28227.	27995.
23	28062.	27859.	27767.	27558.	27757.	27484.	27690.	28067.	29956.	30460.
24	29093.	27206.	27065.	26365.	25882.	25802.	25764.	25528.	25632.	25342.
25	25433.	25241.	25089.	24817.	25130.	25070.	25035.	25086.	25643.	25673.
26	25276.	24318.	24541.	24536.	24590.	24356.	24296.	24289.	24297.	23901.
27	23864.	24261.	24267.	24451.	24806.	24210.	23676.	23615.	23346.	23667.
28	23479.	23473.	23887.	23213.	23119.	23185.	23267.	23100.	23411.	23740.
29	23650.	24675.	26300.	27424.	26526.	24575.	23262.	22930.	22938.	22504.
30	22741.	23375.	23348.	23688.	25672.	30174.	32567.	29313.	24760.	22917.
31	22684.	23817.	29643.	45611.	58115.	48553.	29774.	21497.	20127.	19637.
32	19749.	19582.	19678.	19714.	19640.	19614.	19576.	19572.	19928.	19821.
33	19723.	19468.	19442.	19755.	20550.	20729.	23099.	28092.	34448.	31507.
34	25218.	20653.	18275.	18056.	17947.	18399.	18450.	17926.	17939.	17732.
35	17871.	17708.	17532.	17607.	17501.	17531.	17397.	17242.	17384.	17580.
36	17697.	17783.	17749.	17435.	17293.	17302.	17477.	17442.	17204.	17280.
37	17565.	17063.	17034.	17172.	17172.	17165.	16970.	17034.	17112.	16932.
38	17012.	16933.	17347.	16948.	17062.	17002.	16855.	17075.	16949.	16778.
39	17048.	16864.	17204.	17180.	17295.	16904.	16693.	16894.	17145.	16883.
40	16843.	16527.	16899.	17097.	17240.	17166.	17200.	16837.	16787.	16960.
41	16959.	16677.	16761.	16375.	16594.	16406.	16810.	16650.	16608.	16304.
42	16409.	16539.	16312.	16401.	16212.	16390.	16429.	16336.	16351.	16314.
43	16361.	16136.	16349.	16010.	16202.	16405.	16804.	17163.	17228.	16911.
44	16426.	16210.	16151.	16184.	16284.	16264.	16164.	16505.	16078.	16046.
45	16353.	16484.	16204.	16163.	16517.	16305.	16357.	16326.	16389.	16316.
46	16468.	16569.	16556.	16447.	16274.	16245.	16137.	16291.	16490.	16388.
47	16590.	16611.	16553.	17118.	19732.	24359.	27746.	23223.	18426.	16255.
48	15825.	16014.	15925.	16284.	15982.	15927.	16034.	15708.	15041.	16225.
49	16355.	16277.	15694.	15927.	15937.	15855.	15808.	15708.	15809.	15907.
50	15984.	16044.	16853.	17634.	19165.	19206.	18988.	18939.	19419.	17041.
51	16063.	15723.	15623.	16040.	15570.	15702.	15744.	15802.	15622.	15611.
52	15860.	15897.	15678.	15744.	15838.	15810.	15993.	15668.	15723.	15660.
53	15694.	15645.	16069.	16068.	15578.	15995.	15938.	15823.	15607.	15813.
54	15768.	15712.	15992.	15695.	15863.	15982.	15700.	16023.	15988.	16013.
55	16161.	15804.	15812.	16022.	16176.	16067.	16707.	16859.	16801.	16414.
56	16038.	16333.	17244.	17851.	16960.	16322.	15950.	15881.	16215.	15969.
57	16104.	15997.	16127.	15953.	16032.	16084.	15942.	16066.	16350.	16004.
58	16109.	16137.	16091.	16120.	16160.	16321.	15309.	16293.	16039.	16111.
59	16175.	15934.	16123.	16118.	17092.	19153.	22537.	25260.	26533.	23334.
60	15997.	16003.	16162.	16149.	15656.	15864.	15632.	15755.	15750.	15669.
61	15847.	15586.	15596.	15463.	15671.	15852.	15579.	15446.	15614.	15636.
62	15837.	15614.	15793.	15524.	15411.	15357.	15709.	15567.	15600.	15615.
63	15586.	15563.	15620.	15354.	15720.	15678.	15584.	15649.	15580.	15607.
64	15847.	15660.	15715.	15318.	15461.	15517.	15584.	15479.	15670.	15677.
65	15583.	15703.	15943.	15919.	15506.	15514.	15584.	15464.	15416.	15769.
66	15369.	15695.	15523.	15908.	15953.	15723.	15901.	15936.	15758.	15730.
67	15881.	15873.	16075.	15365.	16003.	15664.	15616.	15811.	15707.	15643.
68	15833.	15951.	15822.	15800.	15806.	15720.	14733.	14451.	14210.	14216.
69	14141.	15901.	15868.	14800.	13806.	13824.	13741.	13717.	13730.	13506.
70	13573.	13362.	13576.	13456.	13619.	13487.	13508.	13531.	13451.	13315.
71	13422.	13248.	13571.	13183.	13551.	13704.	14258.	14286.	14304.	13507.
72	13303.	13096.	13231.	12883.	12834.	13044.	12864.	13004.	13113.	13009.
73	12993.	13060.	12731.	12755.	12812.	12878.	12864.	12843.	12770.	12730.
74	12857.	12540.	12507.	12741.	12596.	12814.	12453.	12713.	12840.	13057.
75	13522.	13184.	12818.	12296.	12559.	12505.	12515.	12896.	13527.	14104.
76	13676.	13159.	12436.	12183.	12333.	12287.	12170.	12238.	12130.	12098.

77	12507.	13301.	14354.	14179.	12987.	12025.	12073.	11958.	11912.	11965.
78	12166.	12020.	11960.	12059.	12062.	12103.	12374.	13245.	15503.	17625.
79	17078.	14494.	12714.	12129.	12294.	12381.	12608.	12172.	12052.	11917.
80	12143.	12069.	12165.	12526.	13048.	12951.	12500.	12137.	12075.	12149.
81	12057.	12143.	12198.	12315.	12356.	12356.	12156.	12284.	12271.	12455.
82	12200.	12446.	12554.	12495.	12591.	12920.	14352.	17665.	20867.	19930.
83	15955.	13365.	12759.	12690.	12446.	12765.	12643.	12674.	12764.	12607.
84	12650.	12693.	12983.	12933.	12888.	12860.	12993.	13031.	13202.	13166.
85	12992.	13115.	13129.	13150.	13478.	13258.	13087.	13241.	13198.	13601.
86	13975.	14319.	14021.	13948.	13831.	13606.	13912.	13907.	13974.	13792.
87	13821.	14169.	14807.	15166.	14939.	14155.	14037.	14212.	14364.	16618.
88	29203.	68968.	129323.	149575.	92480.	40683.	15923.	10860.	10232.	9969.
89	10174.	9918.	10131.	9970.	10054.	9789.	9794.	9782.	9739.	9707.
90	9628.	9649.	9517.	9492.	9270.	8978.	8834.	8728.	8320.	8203.
91	8010.	8234.	7966.	7881.	7891.	7808.	7763.	7629.	7751.	7449.
92	7454.	7432.	7569.	7222.	7485.	7386.	7326.	7241.	7289.	7312.
93	7247.	7261.	7237.	7138.	7044.	6963.	6875.	6986.	6980.	6904.
94	6920.	6946.	6940.	6911.	6764.	6737.	6764.	6654.	6584.	6710.
95	6666.	6577.	6570.	6649.	6780.	6926.	7590.	8338.	8573.	7979.
96	7529.	6927.	6293.	6074.	6101.	5821.	5923.	5933.	5934.	5818.
97	5841.	5597.	5669.	5792.	5714.	5688.	5653.	5656.	5501.	5414.
98	5413.	5354.	5364.	5449.	5457.	5354.	5288.	5275.	5368.	5231.
99	5296.	5208.	5194.	4965.	5048.	5044.	5102.	5102.	5120.	5143.
100	4965.	4915.	4672.	4790.	4713.	4644.	4750.	4645.	4623.	4609.
101	4707.	4702.	4603.	4759.	4631.	4703.	4728.	4539.	4640.	4506.
102	4588.	4538.	4649.	4511.	4613.	4541.	4625.	4634.	4604.	4650.
103	4619.	4689.	4655.	4767.	4642.	4686.	4690.	4808.	4738.	4919.
104	4824.	4843.	4779.	4923.	4813.	4782.	4882.	4912.	4943.	4930.
105	5018.	5003.	4993.	5076.	5032.	5105.	5214.	4982.	5176.	5264.
106	5119.	5201.	5265.	5410.	5427.	5348.	5314.	5476.	6106.	7176.
107	8506.	7975.	6777.	5681.	5466.	5493.	5554.	5691.	6246.	6609.
108	6669.	6194.	5737.	5851.	5674.	5556.	5617.	5700.	5845.	6375.
109	8808.	16480.	27823.	31810.	23430.	12431.	6677.	5297.	5425.	5307.
110	5316.	5500.	5530.	5591.	6026.	6899.	8738.	13893.	23580.	30616.
111	26963.	22267.	38255.	79837.	111287.	90703.	43600.	12964.	3500.	1920.
112	1751.	1618.	1737.	1644.	1718.	1776.	1677.	1680.	1669.	1666.
113	1685.	1667.	1667.	1750.	1668.	1689.	1687.	1640.	1628.	1614.
114	1678.	1649.	1645.	1633.	1627.	1609.	1586.	1574.	1667.	1623.
115	1634.	1635.	1581.	1602.	1557.	1511.	1589.	1538.	1589.	1551.
116	1567.	1570.	1632.	1825.	2782.	5505.	10149.	11871.	8665.	4379.
117	2113.	1698.	1690.	1464.	1273.	1228.	1178.	1276.	1158.	1131.
118	1216.	1413.	1582.	1553.	1369.	1169.	1077.	1099.	1107.	1075.
119	1054.	999.	1088.	1135.	1168.	1020.	1054.	1065.	1120.	988.
120	1026.	1053.	1020.	1099.	1032.	1038.	1132.	1118.	1081.	1086.
121	1029.	998.	1062.	1182.	1503.	1644.	1526.	1286.	1059.	993.
122	1008.	1000.	1023.	1085.	1265.	1320.	1157.	1058.	1016.	963.
123	959.	979.	979.	991.	982.	970.	954.	933.	948.	1008.
124	945.	1005.	978.	999.	1010.	934.	1054.	956.	991.	1093.
125	990.	1076.	1016.	1051.	1052.	1018.	1005.	1047.	1065.	1021.
126	1070.	1115.	1116.	1107.	1187.	1306.	1332.	1481.	1514.	1421.
127	1254.	1164.	1111.	1166.	1150.	1148.	1154.	1204.	1162.	1137.
128	1189.	1329.	2187.	5180.	11805.	17108.	15879.	8914.	3179.	1069.
129	705.	747.	837.	844.	833.	718.	694.	701.	692.	662.
130	759.	668.	691.	725.	693.	763.	799.	776.	711.	698.
131	696.	700.	699.	705.	709.	724.	710.	706.	763.	778.
132	758.	733.	822.	1306.	3136.	6613.	9387.	8439.	4786.	1792.
133	670.	485.	453.	451.	482.	470.	435.	432.	483.	467.
134	418.	482.	498.	445.	439.	423.	411.	428.	447.	491.
135	460.	476.	454.	448.	443.	466.	455.	481.	567.	600.
136	548.	523.	501.	503.	465.	449.	417.	437.	404.	449.
137	479.	463.	483.	485.	427.	420.	449.	459.	449.	452.
138	449.	455.	446.	417.	453.	449.	437.	439.	409.	455.
139	455.	434.	508.	516.	523.	475.	462.	458.	465.	640.
140	1172.	1792.	2074.	1620.	924.	539.	370.	371.	390.	405.
141	366.	379.	397.	375.	407.	407.	387.	374.	381.	375.
142	386.	387.	397.	397.	406.	396.	406.	425.	401.	433.
143	449.	415.	393.	384.	405.	377.	415.	405.	420.	398.
144	410.	403.	452.	362.	369.	369.	354.	360.	357.	374.
145	343.	407.	416.	406.	403.	430.	381.	351.	331.	319.
146	344.	328.	327.	391.	352.	332.	321.	349.	306.	337.
147	336.	309.	337.	326.	339.	330.	327.	317.	362.	340.
148	325.	375.	329.	348.	376.	339.	309.	333.	330.	336.
149	305.	322.	320.	309.	323.	320.	322.	294.	348.	293.
150	303.	318.	314.	338.	315.	312.	311.	332.	296.	298.
151	303.	345.	288.	275.	311.	313.	304.	280.	286.	299.
152	324.	349.	319.	366.	343.	304.	291.	313.	292.	291.
153	281.	308.	292.	255.	272.	279.	251.	277.	284.	269.
154	265.	293.	272.	301.	285.	287.	291.	238.	269.	276.
155	258.	253.	290.	269.	218.	271.	247.	239.	288.	250.
156	252.	265.	274.	269.	246.	235.	252.	273.	244.	244.
157	246.	234.	253.	290.	242.	264.	232.	248.	239.	263.
158	215.	250.	261.	248.	256.	250.	240.	229.	224.	285.

159	274	261	282	258	247	220	226	222	243
160	236	261	281	231	266	221	216	235	227
161	235	212	246	242	213	232	240	203	226
162	241	214	215	228	205	217	234	225	225
163	210	242	214	211	291	200	217	253	234
164	210	180	210	196	223	212	208	245	220
165	230	199	213	196	235	236	228	231	217
166	231	236	215	213	235	217	176	218	205
167	240	210	282	213	204	209	227	205	206
168	232	218	292	216	137	210	210	515	204
169	197	177	161	206	162	207	201	205	188
170	172	176	195	180	168	204	205	204	193
171	197	170	191	179	184	210	178	201	197
172	192	161	170	195	184	178	178	177	181
173	154	177	154	185	170	166	174	194	155
174	187	169	180	148	166	146	152	165	191
175	170	173	162	158	173	191	177	202	242
176	182	193	190	166	177	161	175	161	174
177	164	196	167	156	165	155	143	142	162
178	170	153	148	156	152	172	150	163	163
179	166	164	114	152	154	156	147	143	146
180	142	139	111	106	144	130	107	110	117
181	126	137	74	121	137	114	116	110	100
182	109	97	103	113	105	96	105	109	102
183	102	100	108	108	101	98	96	79	88
184	110	102	96	117	105	75	87	93	93
185	105	102	89	107	82	69	91	90	84
186	83	73	82	100	117	67	94	87	62
187	96	64	78	95	82	66	83	86	76
188	89	76	55	67	87	61	86	78	72
189	71	72	78	64	56	70	82	64	60
190	76	66	74	67	71	79	65	64	55
191	66	62	68	68	63	63	60	70	73
192	72	73	88	70	57	65	59	59	50
193	72	65	58	72	64	62	68	75	64
194	65	72	95	57	56	54	71	69	60
195	76	73	71	54	81	79	69	63	70
196	66	69	82	72	59	82	84	76	77
197	65	66	58	87	68	75	69	73	76
198	71	72	95	80	72	71	71	81	71
199	110	190	395	86	82	604	95	90	78
200	22	31	22	694	875	25	391	167	53
201	24	19	13	27	27	22	27	20	20
202	28	22	28	17	21	19	30	15	31
203	60000	381	436	22	1183	3190	7923	11154	28
204				757					

- IRRAGGIAMENTO - 91 2400.000 MINUTI DATA 1974 12 15 24 0 FLUSSO .0000
- MISURA - TEMPO CONTEGGIO 139.083 MINUTI DATA 1975 1 28 21 30 DECADIMENTO 63210.000 MINUTI
- CAMPIONE - ALFA 467 PESO .06220000 G CALIB. Y= 1.000*X+ -1.712 PROBLEMA ALFALFA

ELEM	P.P.M.	ERR.0/0	VALORE A	KEV (T)	KEV (S)	LS	WT	C P M	AREA ZERO	UGM	AT/CC
CE				145.40							
CO	(5.114-002)			1332.48							
CR	(3.482+000)			320.08							
CS				795.80							
EU	(1.706-002)			1408.11							
HF	(1.251-001)			482.60							
HG				279.20							
IN				1300.00							
NT				810.81							
RB	1.395+002	14.84		1076.60	1078.99	1075	12	3.313+001	2.702+002		
SB				1691.00							
SC	(1.169-002)			889.25							
TA				1221.60							
TB				879.33							
TH	1.209+001	1.18		311.90	313.43	310	11	7.789+002	2.399+003		
YB	(2.515-001)			197.80							
ZN	6.017+001	.35		1115.51	1113.64	1111	9	2.102+003	2.379+003		
ZR	(3.889+001)			765.80							
BA	(3.449+002)			216.00							
FE	(1.109+002)			1099.27							

SPETTRO N. 12 CANALI 2048 TCON 160.317 MINUTI DATA 1975 1 29 18 45 DECAD 64485.000 MIN

	1	2	3	4	5	6	7	8	9	10
0	9619.	7707.	5613.	4637.	2990.	1911.	1093.	740.	484.	418.
1	284.	280.	207.	158.	154.	131.	114.	88.	95.	78.
2	72.	76.	77.	85.	96.	150.	204.	282.	473.	810.
3	1302.	2470.	9821.	49814.	117695.	146752.	145103.	137211.	131750.	129611.
4	126620.	123656.	120392.	116829.	114128.	110510.	108407.	105485.	103504.	100552.
5	98536.	96117.	94861.	92372.	90245.	88834.	86035.	84733.	83770.	82273.
6	81701.	80701.	79451.	78457.	76899.	75731.	74447.	74203.	75416.	76770.
7	77392.	77004.	73265.	69780.	67970.	67442.	67291.	66546.	66430.	66962.
8	67801.	68033.	67040.	65680.	64088.	62415.	62099.	60868.	60979.	61359.
9	61737.	60786.	60349.	60958.	61297.	60976.	58524.	56566.	56037.	55593.
10	55188.	54336.	54111.	54223.	54325.	54500.	54806.	53941.	53002.	53202.
11	52678.	51573.	51350.	50619.	50576.	51562.	50556.	50044.	49565.	49005.
12	49679.	45996.	45177.	44368.	44800.	44618.	45491.	49562.	54065.	57305.
13	49762.	45984.	43997.	42045.	41201.	39975.	40066.	41264.	42300.	44000.
14	48432.	50375.	45599.	40386.	37321.	36715.	36644.	36834.	37067.	36717.
15	35910.	35668.	35462.	34837.	34854.	34130.	33927.	33175.	33543.	33051.
16	32984.	32889.	32644.	32615.	32243.	31913.	32053.	31596.	31254.	31165.
17	31450.	31039.	31923.	31677.	30964.	30871.	30398.	29717.	29673.	29898.
18	29566.	29377.	29275.	29232.	29216.	29401.	31471.	34117.	34079.	31423.
19	29243.	29750.	29077.	29522.	29426.	28104.	27464.	27225.	27314.	27030.
20	26781.	26917.	27011.	26689.	27019.	27556.	27163.	26605.	26758.	26931.
21	27268.	26879.	26734.	26251.	26159.	26179.	26143.	26355.	26158.	25907.
22	24841.	25057.	24602.	24561.	24787.	24338.	24305.	23883.	23715.	23705.
23	23401.	23853.	23435.	23142.	23005.	23233.	23052.	23282.	23910.	25210.
24	25674.	24095.	22941.	22290.	22105.	21747.	21628.	21396.	21169.	21582.
25	21180.	21091.	21207.	20921.	20813.	20660.	20616.	20673.	20984.	21300.
26	21420.	20784.	20369.	20422.	20342.	20448.	20254.	20140.	20093.	19976.
27	19656.	19923.	20173.	20245.	20932.	20837.	20080.	19954.	19470.	19807.
28	19624.	19316.	19289.	19359.	19489.	19318.	19360.	19211.	19161.	19408.
29	19473.	19742.	20744.	22026.	22379.	21415.	20407.	19410.	19096.	19007.
30	19439.	19265.	19567.	19577.	20101.	22103.	25749.	26617.	23154.	20040.
31	19016.	18868.	20683.	27886.	42301.	48633.	39033.	23877.	17929.	16383.
32	16235.	15952.	16405.	16036.	16227.	16208.	16102.	16148.	16114.	16204.
33	16401.	16290.	16028.	16261.	16819.	16791.	17600.	20284.	26261.	20210.
34	25714.	20352.	16869.	15102.	15050.	14792.	14719.	14690.	14533.	14800.
35	14619.	14382.	14563.	14330.	14685.	14526.	14427.	14473.	14388.	14305.
36	14184.	14345.	14610.	14667.	14259.	14370.	14278.	14204.	14098.	14314.
37	14313.	14219.	14218.	14198.	14277.	13891.	14044.	14017.	13887.	14245.
38	13804.	14193.	14225.	13765.	13876.	14090.	14154.	14076.	14051.	14163.
39	13850.	13942.	13977.	14127.	14227.	13959.	13859.	13867.	13806.	13973.
40	13593.	13759.	13880.	13917.	14026.	14361.	14347.	14059.	13959.	13912.
41	13969.	14132.	13838.	13740.	13658.	13541.	13462.	13263.	13396.	13886.
42	13381.	13631.	13456.	13374.	13432.	13509.	13334.	13342.	13406.	14066.
43	13433.	13618.	13505.	13292.	13438.	13248.	13453.	13921.	14108.	14066.
44	13759.	13430.	13532.	13211.	13562.	13404.	13454.	13356.	13555.	13975.
45	13555.	13446.	13401.	13362.	13479.	13308.	13565.	13267.	13374.	13365.
46	13422.	13604.	13349.	13605.	13460.	13520.	13356.	13477.	13496.	13522.
47	13640.	13548.	13709.	13655.	14859.	17415.	21817.	22119.	19105.	14878.
48	13484.	13189.	13329.	13117.	12972.	12939.	13021.	12754.	13087.	13211.
49	13257.	13528.	13260.	13286.	13050.	13071.	13089.	13111.	13101.	13011.
50	12895.	13257.	13630.	13836.	15189.	15800.	16204.	15885.	15580.	14037.
51	13977.	13324.	12954.	12910.	13085.	12756.	13008.	13020.	13008.	12959.
52	12932.	12686.	13079.	13026.	13132.	13555.	13176.	12960.	13216.	13226.
53	12954.	13058.	13006.	12869.	13120.	12990.	13109.	13110.	13177.	13373.
54	13113.	13028.	13211.	13151.	13055.	12986.	13189.	13255.	13087.	13530.
55	13092.	13051.	13115.	13122.	13208.	13108.	13631.	13087.	13103.	13173.
56	13320.	13400.	13891.	14000.	14104.	13846.	13489.	12963.	13172.	13043.
57	13326.	13140.	13245.	13171.	12984.	13065.	13287.	13172.	13044.	13352.
58	13288.	13308.	13207.	13297.	13242.	13390.	13449.	13196.	13000.	21047.
59	13280.	13149.	13200.	13287.	13524.	14065.	15279.	18007.	20830.	13162.
60	18557.	15720.	13642.	13151.	12943.	12864.	13108.	12866.	12970.	12595.
61	13000.	12924.	13035.	12862.	12726.	12817.	12787.	13032.	12961.	12715.
62	12838.	12591.	12889.	13005.	12760.	13079.	13036.	12856.	12846.	12937.
63	12912.	13150.	12984.	12968.	12876.	12776.	12597.	12795.	12886.	12810.
64	12856.	12939.	13004.	12771.	12881.	12867.	12810.	12818.	12869.	12954.
65	13077.	13146.	12939.	12877.	12881.	13002.	13072.	13058.	13015.	12954.
66	12976.	12850.	13112.	13036.	13025.	13050.	12964.	13064.	13121.	13233.
67	13277.	13236.	12802.	12867.	13002.	13003.	12967.	12862.	13117.	12937.
68	13232.	12903.	12672.	12578.	12524.	12542.	12157.	11918.	11699.	11633.
69	11877.	11821.	11641.	11623.	12250.	11667.	11149.	11331.	11303.	11281.
70	11292.	11250.	11211.	10863.	11201.	10987.	11144.	11101.	11245.	11034.
71	10986.	11117.	11153.	10815.	10736.	10915.	11479.	11606.	12127.	11470.
72	11218.	10927.	10387.	10820.	10873.	10686.	10967.	10871.	10703.	10625.
73	10684.	10809.	10727.	10682.	10504.	10682.	10741.	10590.	10507.	10600.
74	10578.	10500.	10486.	10504.	10518.	10747.	10463.	10528.	10637.	10880.
75	11136.	10946.	11056.	10464.	10300.	10350.	10375.	10466.	10828.	11562.
76	11844.	11178.	10704.	10343.	10214.	10162.	10043.	10049.	10092.	10020.

77	10331.	10700.	11663.	12281.	11634.	10797.	10221.	10091.	10016.	10131.
78	10031.	9953.	10071.	9958.	9881.	10052.	10046.	10390.	11598.	13714.
79	14797.	13564.	11296.	10277.	10186.	10223.	10270.	10245.	10207.	10118.
80	9972.	9827.	10307.	10145.	10654.	10824.	10776.	10384.	10107.	9966.
81	10153.	10026.	10085.	10221.	10107.	10201.	10311.	10093.	10177.	10254.
82	10370.	10304.	10339.	10530.	10202.	10394.	11074.	12727.	15723.	17574.
83	15238.	12628.	10966.	10357.	10388.	10325.	10307.	10601.	10464.	10444.
84	10401.	10494.	10613.	10631.	10650.	10725.	10489.	10685.	10636.	10904.
85	11023.	10887.	10944.	11126.	11047.	10951.	10985.	11116.	11092.	11214.
86	11335.	11491.	11729.	11430.	11494.	11349.	11368.	11449.	11556.	11351.
87	11421.	11683.	11339.	12414.	12457.	11833.	11636.	11681.	11740.	12074.
88	15929.	33367.	76098.	115312.	105670.	59635.	24976.	11720.	9787.	8741.
89	8544.	8290.	8358.	8398.	8351.	8331.	8236.	8293.	8303.	8031.
90	8146.	8044.	7923.	7730.	7615.	7596.	7331.	7220.	7129.	6897.
91	6821.	6656.	6702.	6555.	6455.	6421.	6372.	6394.	6388.	6336.
92	6377.	6158.	6331.	6254.	6213.	6094.	5982.	6053.	6049.	5978.
93	6145.	6006.	5935.	6004.	5996.	5960.	5855.	5826.	5736.	5825.
94	5861.	5690.	5841.	5830.	5573.	5744.	5616.	5672.	5557.	5435.
95	5529.	5596.	5559.	5407.	5430.	5647.	6069.	6753.	7090.	6975.
96	6586.	5890.	5429.	5143.	5010.	4933.	5040.	4933.	4931.	4866.
97	4832.	4762.	4703.	4695.	4797.	4685.	4709.	4453.	4705.	4505.
98	4592.	4500.	4608.	4417.	4475.	4325.	4467.	4414.	4430.	4413.
99	4457.	4431.	4270.	4127.	4284.	4251.	4240.	4280.	4395.	4431.
100	4177.	4008.	4083.	3862.	3976.	3913.	3883.	3965.	3863.	3954.
101	3809.	3929.	3822.	3881.	3808.	3930.	3909.	3868.	3880.	3837.
102	3874.	3828.	3813.	3783.	3830.	3864.	3865.	3884.	3927.	3864.
103	3777.	4015.	3976.	4009.	3853.	3947.	3940.	3877.	3927.	3953.
104	3882.	3902.	4059.	3996.	4075.	4075.	3969.	4133.	4116.	3959.
105	4227.	4236.	4098.	4246.	4264.	4138.	4290.	4254.	4358.	4297.
106	4418.	4365.	4257.	4442.	4265.	4357.	4496.	4530.	4745.	5493.
107	6594.	6976.	6168.	5272.	4685.	4366.	4510.	4588.	4985.	5591.
108	5796.	5357.	5229.	4900.	4867.	4866.	4812.	4917.	4761.	5018.
109	5839.	9792.	18003.	25234.	23425.	14676.	7949.	5166.	4617.	4517.
110	4458.	4504.	4582.	4684.	4878.	5629.	6573.	9108.	16190.	24837.
111	26179.	20435.	22832.	47148.	79458.	84365.	54631.	22774.	6950.	2409.
112	1659.	1520.	1469.	1442.	1518.	1393.	1416.	1402.	1430.	1460.
113	1479.	1399.	1400.	1357.	1377.	1437.	1335.	1291.	1432.	1303.
114	1335.	1404.	1377.	1381.	1433.	1395.	1378.	1342.	1325.	1345.
115	1363.	1344.	1378.	1286.	1293.	1319.	1326.	1319.	1293.	1340.
116	1259.	1344.	1440.	1401.	1834.	3651.	7090.	10158.	9557.	5746.
117	2739.	1635.	1382.	1278.	1058.	981.	975.	936.	937.	1007.
118	945.	1074.	1118.	1267.	1165.	1064.	953.	884.	944.	888.
119	850.	899.	872.	923.	893.	885.	925.	854.	916.	904.
120	839.	909.	864.	859.	830.	875.	938.	951.	891.	806.
121	874.	845.	814.	928.	1118.	1354.	1300.	1073.	924.	809.
122	811.	833.	837.	903.	988.	1058.	1008.	877.	858.	848.
123	804.	752.	789.	801.	820.	812.	814.	869.	901.	832.
124	776.	813.	841.	803.	858.	830.	810.	839.	822.	825.
125	838.	888.	838.	906.	846.	885.	936.	837.	882.	887.
126	800.	834.	852.	901.	933.	1025.	1077.	1221.	1298.	1289.
127	1107.	971.	913.	867.	953.	900.	886.	921.	894.	945.
128	910.	989.	1315.	2892.	7248.	12621.	14182.	9729.	4694.	1765.
129	769.	592.	644.	643.	691.	569.	573.	541.	614.	529.
130	550.	546.	550.	554.	567.	624.	618.	603.	594.	566.
131	600.	588.	585.	570.	548.	558.	564.	563.	592.	592.
132	635.	642.	615.	885.	1909.	4432.	7753.	8215.	5723.	2739.
133	987.	467.	392.	387.	343.	363.	384.	340.	367.	372.
134	395.	351.	388.	319.	352.	361.	372.	343.	357.	396.
135	369.	336.	316.	347.	356.	359.	369.	330.	420.	474.
136	458.	407.	404.	368.	333.	326.	358.	335.	343.	369.
137	371.	389.	354.	353.	358.	320.	324.	384.	358.	350.
138	327.	333.	330.	338.	327.	331.	323.	394.	360.	328.
139	334.	352.	357.	409.	409.	367.	334.	345.	340.	494.
140	788.	1349.	1948.	1677.	1069.	524.	368.	335.	263.	314.
141	276.	282.	318.	295.	314.	304.	315.	292.	311.	298.
142	320.	289.	305.	283.	284.	308.	321.	307.	303.	347.
143	305.	328.	312.	280.	299.	295.	289.	285.	316.	299.
144	310.	284.	290.	280.	287.	291.	277.	269.	254.	293.
145	297.	301.	297.	348.	311.	316.	312.	266.	284.	260.
146	271.	272.	253.	258.	262.	260.	257.	248.	226.	291.
147	269.	254.	265.	252.	251.	275.	269.	241.	272.	260.
148	246.	237.	275.	258.	266.	252.	242.	280.	230.	252.
149	241.	238.	212.	292.	276.	251.	229.	251.	231.	245.
150	266.	263.	242.	246.	257.	249.	245.	237.	206.	220.
151	233.	234.	246.	241.	232.	223.	230.	225.	217.	232.
152	218.	273.	244.	285.	290.	246.	216.	238.	239.	234.
153	202.	248.	231.	187.	222.	222.	224.	199.	211.	235.
154	218.	210.	236.	216.	217.	197.	208.	208.	191.	199.
155	197.	236.	199.	203.	186.	197.	215.	204.	207.	206.
156	219.	221.	200.	223.	185.	205.	177.	186.	191.	197.
157	194.	177.	187.	184.	171.	205.	201.	192.	176.	196.
158	197.	186.	228.	203.	192.	185.	192.	185.	187.	200.

159	199.	205.	196.	191.	170.	207.	186.	182.	169.	167.
160	163.	179.	178.	163.	130.	163.	182.	179.	167.	170.
161	216.	169.	181.	197.	186.	188.	170.	157.	219.	181.
162	192.	171.	186.	168.	173.	172.	172.	160.	170.	183.
163	189.	167.	159.	175.	170.	152.	162.	173.	170.	174.
164	181.	189.	168.	159.	162.	192.	169.	155.	191.	179.
165	188.	186.	155.	173.	160.	154.	144.	160.	150.	162.
166	166.	172.	152.	158.	170.	152.	162.	193.	165.	178.
167	147.	152.	143.	194.	162.	160.	161.	131.	168.	148.
168	181.	176.	182.	249.	387.	475.	519.	355.	256.	174.
169	165.	162.	136.	122.	149.	149.	161.	171.	142.	148.
170	157.	144.	155.	145.	160.	149.	128.	153.	153.	132.
171	134.	141.	165.	143.	138.	169.	155.	150.	153.	123.
172	130.	134.	132.	136.	139.	164.	133.	119.	125.	146.
173	137.	153.	136.	139.	130.	134.	130.	134.	130.	130.
174	133.	157.	130.	145.	138.	137.	155.	126.	121.	150.
175	140.	139.	133.	147.	160.	151.	133.	131.	144.	145.
176	132.	152.	116.	136.	133.	138.	134.	132.	124.	122.
177	134.	147.	124.	118.	128.	130.	125.	121.	128.	121.
178	132.	130.	127.	121.	143.	113.	128.	124.	131.	135.
179	120.	120.	112.	110.	136.	102.	103.	112.	117.	109.
180	99.	106.	107.	94.	87.	102.	93.	98.	72.	94.
181	102.	92.	81.	88.	93.	92.	108.	78.	93.	82.
182	94.	101.	90.	88.	84.	96.	91.	65.	82.	77.
183	78.	87.	83.	74.	88.	88.	87.	93.	73.	83.
184	79.	90.	84.	76.	59.	68.	83.	77.	69.	77.
185	74.	86.	71.	78.	71.	88.	62.	89.	70.	83.
186	66.	65.	62.	60.	61.	63.	62.	81.	91.	61.
187	68.	59.	53.	52.	45.	66.	62.	75.	57.	71.
188	63.	57.	52.	58.	69.	68.	57.	57.	42.	62.
189	55.	56.	51.	57.	68.	48.	53.	43.	53.	49.
190	50.	53.	69.	62.	57.	52.	62.	48.	48.	59.
191	56.	56.	59.	45.	47.	58.	58.	62.	51.	50.
192	46.	63.	65.	49.	54.	56.	52.	62.	52.	64.
193	60.	48.	62.	65.	65.	54.	50.	56.	51.	67.
194	49.	58.	67.	68.	64.	46.	50.	60.	57.	52.
195	77.	66.	51.	60.	57.	69.	61.	53.	51.	66.
196	65.	57.	56.	58.	46.	61.	75.	70.	65.	52.
197	57.	58.	58.	67.	58.	42.	44.	60.	64.	62.
198	59.	57.	68.	70.	58.	52.	50.	68.	61.	64.
199	47.	69.	66.	55.	59.	60.	50.	77.	45.	59.
200	79.	142.	268.	496.	641.	599.	362.	207.	66.	23.
201	25.	16.	17.	13.	18.	18.	14.	22.	14.	17.
202	22.	31.	22.	17.	17.	20.	17.	29.	14.	16.
203	22.	17.	28.	17.	18.	22.	20.	25.	29.	23.
204	999999.	999999.	999999.	999999.	999999.	999999.	999999.	999999.		

- IRRAGGIAMENTO - 91 2400.000 MINUTI DATA 1974 12 15 24 0 FLUSSO .0000
- MISURA - TEMPO CONTEGGIO 160.317 MINUTI DATA 1975 1 29 18 45 DECADIMENTO 64035.000 MINUTI
- CAMPIONE - ALFA 910 PESO .06320000 G CALIB. Y= 1.000*X+ -1.712 PROBLEMA ALFALFA

ELEM	P.P.M.	ERR.0/0		VALORE A	KEV (T)	KEV (S)	LS	WT	C P M	AREA ZERO	UGM	AT/CC
CE					145.40							
CO	(4.702-002)				1332.48							
CR	(2.939+000)				320.08							
CS					795.80							
EU	(1.385-002)				1408.11							
HF	(9.976-002)				482.60							
HG					279.20							
IN					1300.00							
IN					1300.00							
IN					1300.00							
NI					810.81							
RB	(2.088+001)				1076.60							
SB					1691.00							
SC	(1.067-002)				889.25							
TA					1221.60							
TB					879.33							
TH	9.351+000	1.21			311.90	314.18	311	11	5.986+002	1.886+003		
YB	1.607+000	13.78			197.80	192.42	201	7	8.392+001	SECOND(196.82	192.42)	
YB	1.891+000	6.85			197.80	186.82	185	8	9.978+001	2.599+002		
ZN	4.197+001	.38			1115.51	1114.11	1112	9	1.486+003	1.687+003		
ZR	(3.060+001)				765.80							
BA	7.073+002	33.50			216.00	209.43	216	5	2.548+001	SECOND(204.47	209.43)	
BA	1.989+002	69.76		*	216.00	204.47	204	6	7.167+000	1.041+002		
FE	(9.362+001)				1099.27							

AFIN