INTERNATIONAL ATOMIC ENERGY AGENCY

NUCLEAR DATA SERVICES

DOCUMENTATION SERIES OF THE IAEA NUCLEAR DATA SECTION

IAEA-NDS-135
September 1994

IDGAM

A PC code and database to help
nuclide identification in activation analysis

R. Paviotti Corcuera, M. de Moraes Cunha,
K.A. Jayanthi

Abstract: The document describes a PC diskette containing a code and database which helps researchers to identify the nuclides in a radioactive sample. Data can be retrieved by gamma-ray energy, nuclide or element. The PC diskette is available, costfree, from the IAEA Nuclear Data Section, upon request.

Nuclear Data Section
International Atomic Energy Agency
P.O. Box 100
A-1400 Vienna
Austria

e-mail: RNDS@IAEA1, BITNET
fax: (43-1) 234564
cable: INATOM VIENNA
telex: 1-12645 atom a
telephone: (43-1) 2360-1709
NDIS online, TELNET: IAEAND.IAEA.OR.AT username: IAEANDS

Note:

The IAEA-NDS-documents should not be considered as publications or reports. When a nuclear data library is sent out by the IAEA Nuclear Data Section, it will be accompanied by an IAEA-NDS-document which should give the data user all necessary information on contents, format and origin of the data library.

IAEA-NDS-documents are updated whenever there is additional information of relevance to the users of the data library.

For citations care should be taken that credit is given to the author of the data library and/or to the data center which issued the data library. The editor of the IAEA-NDS-document is usually not the author of the data library.

Neither the originator of the data libraries nor the IAEA assume any liability for their correctness or for any damages resulting from their use.

94/11

IDGAM

A PC code and database to help
nuclide identification in activation analysis

R. Paviotti Corcuera, M. de Moraes Cunha
K.A. Jayanthi

The package is contained on a 1.4 Mb diskette. It contains the files

IDGAM.DOC	29	kbyte
IDGAM.EXE	166	kbyte
IDGAM.IDB	1.1	Mbyte

The code is called by typing IDGAM.

The gamma-ray database of the present version is based on ENSDF as retrieved by T. Narita, T. Ichimiya, and K. Kitao in 1993 (compare under References in the attached report; compare also the data file "Strong gammas" as described in IAEA-NDS-111 Rev. 1).

The diskette is available from the IAEA Nuclear Data Section, upon request.

A DATABASE MANAGEMENT SYSTEM TO HELP NUCLIDE IDENTIFICATION IN ACTIVATION ANALYSIS

R. Paviotti Corcuera, M. de Moraes Cunha, K.A. Jayanthi

Instituto de Estudos Avançados (IEAv)
Centro Técnico Aeroespacial (CTA)
C.P. 6044
12231-970 São José dos Campos, SP, Brazil

Abstract - This paper describes an Information Retrieval System which helps researchers to identify the isotopes in a radioactive sample. The system was implemented in Prolog and uses data structure techniques to store the information and to speed up the retrieval. The system is user-friendly, and data can be retrieved by energy, nuclide or element. The database includes gamma energies by nuclide in the energy range from 1.58 keV to 9965.6 keV. This energy-nuclide-element retrieval system is a useful tool in activation analysis and other fields where gamma-ray spectra are analyzed and nuclides must be identified.

1. INTRODUCTION

Radioactive decay gamma-rays are used by researchers in the fields of activation analysis, cross-section measurements and gamma and x-ray spectroscopies.

Once the spectrum of a radioactive sample has been determined, it is necessary to identify the nuclides to which the gamma or x-rays belong. There are several compilations of data in the form of tables on hard copy. There one can search by energy or by isotope and make as many iteractions as needed to identify the nuclides (Reus and Westmeier, 1983; Tuli, 1988; Lone et al., 1983; Adams and Dams, 1969).

This database management system is intended to help researchers search for possible nuclide assigments of any gamma-ray with a reasonably well determined energy.

The data files required for the base were obtained through the Nuclear Data Section (NDS) of the International Atomic Energy Agency (IAEA) and correspond to the compilation of Ichimiya, Narita and Kitao (1992,1993), which was extracted from the radioactive decay data of Evaluated Nuclear Structure Data File (ENSDF, file as of September 1993). The ENSDF is maintained by the National Nuclear Data Center at Brookhaven National Laboratory, USA.

According to the authors mentioned above, the criteria for the retrieval are as follows:

a. The three gamma-rays with the highest intensities and energies greater than 1 KeV, emitted in the decay of each radioactive nuclide.

b. Among these gamma-rays, those with relative intensity less than 0.01 of the strongest gamma-ray are omitted.

c. If gamma-rays following the decay of a radionuclide have the same intensities, the gamma-ray with greater energy is given priority.

d. If the number of gamma-rays from a nuclide is three or less, even if their intensities are not given in ENSDF, all these gamma-rays are listed.

The program for the database has been entirely written in Prolog (Arity Version 5.1) and linked with the Microsoft linker.

Each energy is associated with the decay scheme of a nuclide. This nuclide is shown when data is retrieved. Other quantities shown are intensity, decay mode, half-life, total number of gamma-rays emitted from the nuclide, energy and intensity of the two gamma-rays with the second and third highest intensities for the parent nuclide.

More information about the compilation can be obtained by using the "Help" option of the menu when running the system.

2. DESCRIPTION OF THE SYSTEM

The different parts that compose the system (Fig. 1) are:

- A file where data is stored in the form of strings.
- A module to optimize and manage the storage of data. Because the database is not going to be updated by the user, it is considered to be a "static database". This means that the operations of insertion, deletion and updating do not need to be implemented.
- An extremely user friendly interface which allows energy, nuclide and element retrievals and selection of data sets in user-created files.

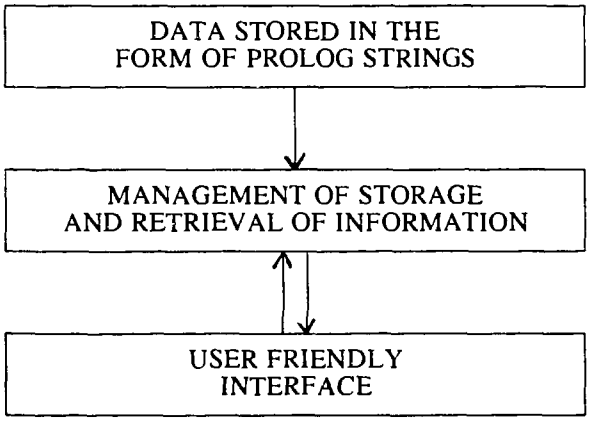

Fig. 1. System Architecture

The system requires an IBM-XT, AT, or compatible, 640 Kb of RAM and about 1.4 Mb of hard disk space.

3. INTERACTING WITH THE USER

The interaction with the user is through the menu at the top of the screen (Fig. 2), where several options are available. These are: *Energy, Nuclide, Element, OpenFile, View, Quit and Help.*

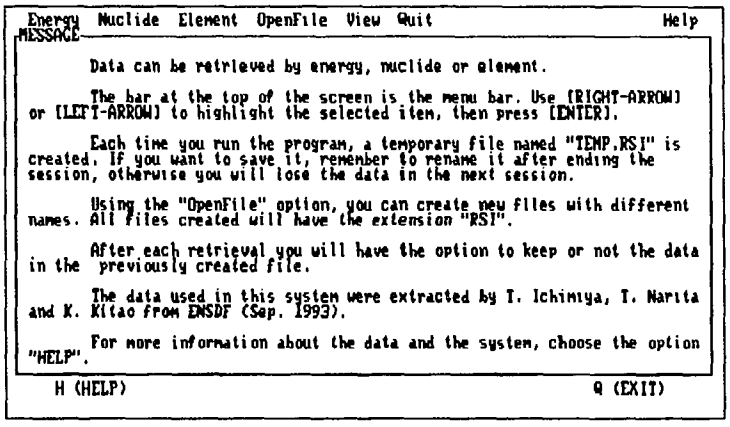

Fig. 2. Menu bar and general instructions about the program

The *Energy* option allows the search and retrieval of data in the energy range from 1.58 keV to 9965.6 keV. Energy should be introduced in keV and a tolerance error may be introduced before the search.

The *Nuclide* option searches by nuclide name (eg: Th-232). The data available for the selected nuclide will be displayed through a scrollable window.

The *Element* option will allow the display of a scrollable window with a list of all nuclides for the chosen element and the user may select a nuclide by pressing [ENTER]. Data will be displayed as in the *Nuclide* option (Fig.3).

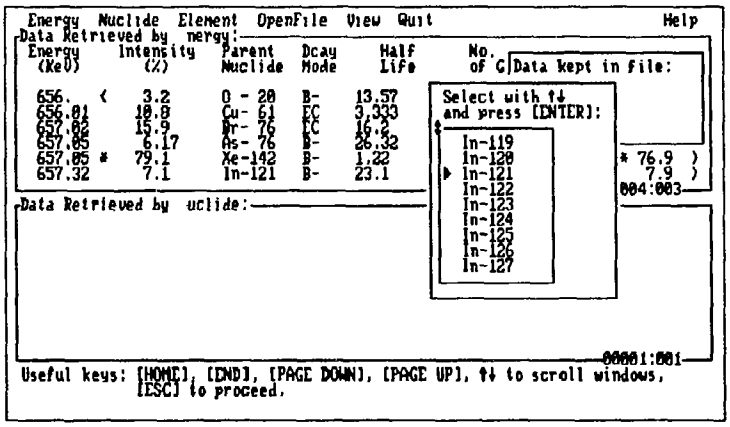

Fig. 3. Element option chosen. The scrollable window is shown

Through the *OpenFile* option it is possible to create several working files other than the temporary file "TEMP.RSI" created by the program. All files created will have the extension "RSI". To keep or not a selected retrieved data set on a working file is a decision the user can take later on.

The *Quit* option leaves the system.

The *Help* option displays a scrollable window with detailed information about this software and the gamma-ray data compilation used.

Fig. 4 shows the energy and nuclide retrieval windows. Scrolling is possible in both windows. The same figure shows a window in which the user may choose to save or not the data. It is possible to save the data sets in different files, provided that the OpenFile option has been accessed before.

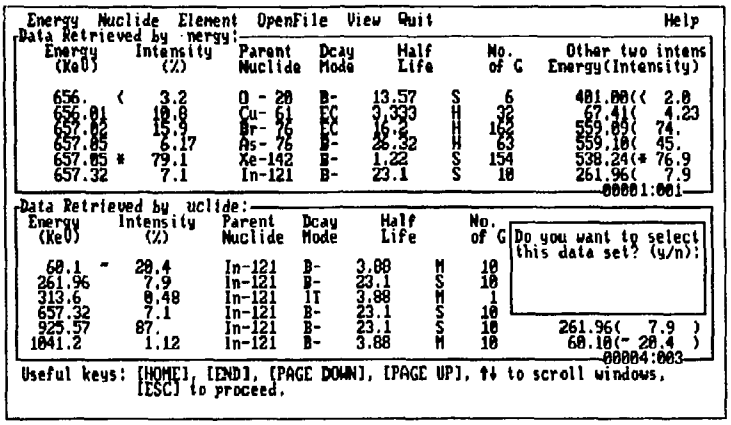

Fig. 4. Example of energy (659. keV) and nuclide (In-121) retrievals

When the *View* option is selected, a list of working files already created, even in previous sessions, is displayed. The user may select one of these and see its contents through a window (Fig.5).

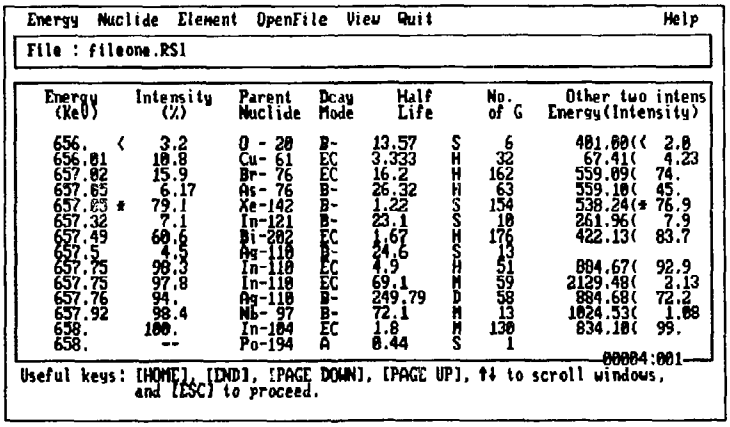

Fig. 5. A view of "fileone.rsi" where the energy retrieval was kept

4. GENERAL COMMENTS

A decay gamma energy-nuclide retrieval system has been created. This should serve as a very useful tool for researchers in activation analysis and other fields, where gamma-ray spectra are analyzed and nuclides need to be identified.

The database contains more than 5775 strings of data which could, in principle, be examined manually in a hard copy catalogue to localize the energy and the corresponding isotope. In this work, a database accessed through a user-friendly menu makes the consultation easy and very fast. (Approximately three seconds are needed for a search by energy and six seconds are needed for a search by nuclide, on an IBM-PC AT with 16 MHz clock).

For this application, Prolog clearly constitutes a well suited tool for modelling the relational database, the data storage-retrieval structure and the friendly menu query facility.

Logic programming languages such as Prolog should be better exploited in the use of similar scientific databases because of their many advantages. Conventional database systems need to interface with a conventional programming language in order to host the database, express the constraints on the data and generate user applications.

Logical languages, in contrast, can be used straightforwardly to express data definitions, queries and integrity constraints as well as to build special user-oriented applications.

The system is available from the IAEA, Nuclear Data Section, P.O.Box 100, Vienna, Austria, upon request.

ACKNOWLEDGEMENT

The authors would like to acknowledge Otto Schwerer from the Nuclear Data Section, IAEA, for his cooperation and helpful suggestions about improvements of the system.

REFERENCES

F. Adams and R. Dams, "A Compilation of Precisely Determined Gamma - Transition Energies of Radionuclides Produced by Reactor Irradiation", Journal of Radional. Chem., Vol.3, p.p. 99-125, (1969).

M.A. Lone, R.A. Leavitt and D.A. Harrison, "Prompt Gamma-Rays from Thermal-Neutron Capture", Atomic Data and Nuclear Data Tables, Vol. 26. N° 6, (1981).

R. Reus and W. Westmeier, " Atomic Data and Nuclear Data Tables", Vol. 29, N° 1 and N° 2, (1983).

J.K. Tuli, "Thermal Neutron Capture Gamma-Rays", BNL-NCS-51647, (1983).

T. Narita and K. Kitao, "List of Strong gamma-rays emitted from radionuclides", JAERI-M 92-51, 1992.

T. Narita, T. Ichimiya, and K. Kitao, "List of Strong gamma-rays emitted from radionuclides (Version2), JAERI-M 94-059, March 1994.