



โปรแกรมวิเคราะห์สเปกตรัมรังสีแกมมา GDA

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บทคัดย่อ

งานพัฒนาโปรแกรมวิเคราะห์สเปกตรัมรังสีแกมมาได้ดำเนินการแล้วเสร็จ เป็นชุดโปรแกรมสำเร็จรูปรุ่น 1.02 ชื่อโปรแกรม GDA ซึ่งย่อมาจากชื่อเต็มว่า Gamma-spectrum Deconvolution and Analysis ชุดโปรแกรมประกอบด้วยแผ่นดิสก์ ขนาด 3.5 นิ้ว สำหรับทำการติดตั้งจำนวน 3 แผ่น และคู่มือการใช้งาน 1 เล่ม โปรแกรม GDA สามารถติดตั้งให้ทำงานได้ในระบบปฏิบัติการ วินโดวส์ 95 และ วินโดวส์ เอนที 4.0 บนเครื่องคอมพิวเตอร์ที่ใช้หน่วยประมวลผลกลางรุ่น 80486 และมีหน่วยความจำขนาด 8 เมกกะไบต์

Gamma-Ray Spectrum Analysis Software GDA

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ABSTRACT

The developmental work on computer software for gamma-ray spectrum analysis has been completed as a software package version 1.02 named GDA, which is an acronym for Gamma-spectrum Deconvolution and Analysis. The software package consists of three 3.5-inch diskettes for setup and a user's manual. GDA software can be installed for using on a personal computer with Windows 95 or Windows NT 4.0 operating system. A computer maybe the type of 80486 CPU with 8 megabytes of memory.

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INTRODUCTION

The Applied Research for Radiation Measurement Section, Radiation Measurement Division, Office of Atomic Energy for Peace, has one responsibility of developmental work on gamma-ray spectrometry system for the measurement of radionuclides' activities. The work of writing new and useful gamma-ray spectroscopy application software GDA, which is an acronym for Gamma-spectrum Deconvolution and Analysis, has been completed. The program is useful for performing qualitative and quantitative gamma spectroscopic analysis, particularly with high resolution, hyper-pure Germanium (HPGe) detectors, for environmental, safety, and research purposes. GDA is a 32-bit Windows 95 and NT 4.0 application. It was developed under the integrated Microsoft Developer Studio, in which consisted of the Microsoft Visual C++ version 4.2 and Microsoft FORTRAN PowerStation version 4.0. The program requires a personal computer with Windows 95 or NT 4.0 operating system. Even though it can be executed on a personal computer with 80486 CPU and 8 megabytes of memory, but the optimized performance could be achieved on a PC with Intel Pentium processor.

MATERIALS AND METHODS

The personal computer system used for this work is Micron model Millennia Xru, in which the central processing unit is Pentium II operated at 200 MHz. It is equipped with one CD-ROM, one 3.5-inch floppy disk, and one 4GB hard disk. The computer was installed with ORTEC's ACE 1K Multichannel Analyzer board. This board has a maximum of 1024 channels for recording of gamma-ray emission events from the germanium detector. Raw data of gamma-ray spectrum obtained from the measurement are available immediately for any further data processing. The computer has been initially configured with the Microsoft Windows NT Workstation 4.0 operating system. Later on it was additionally installed with Microsoft Windows 95 Thai Edition operating system, so that there are now two operating systems in one computer. User can select any of the two operating systems when the computer is turned on.

Microsoft Visual C++ version 4.0 has been initially purchased in term of subscriber, so that later on it was updated to version 4.2. This software-development platform resides on the

computer as Microsoft Developer Studio. This platform was then additionally installed with Microsoft FORTRAN PowerStation version 4.0, so that the two computer programming languages are now being in a single development platform. Therefore, the development of GDA software is divided into two parts. One part is the programming of FORTRAN language for all gamma-ray spectrum analysis routines. Another part is the programming of Visual C++ language for all Windows-operation routines. The analysis portion of GDA program is the complementary combination of many high-performance gamma-ray spectrum analysis routines^(1, 2, 3). These routines are all in FORTRAN language. They were processed into the form of dynamic link library (.DLL) sub-programs.

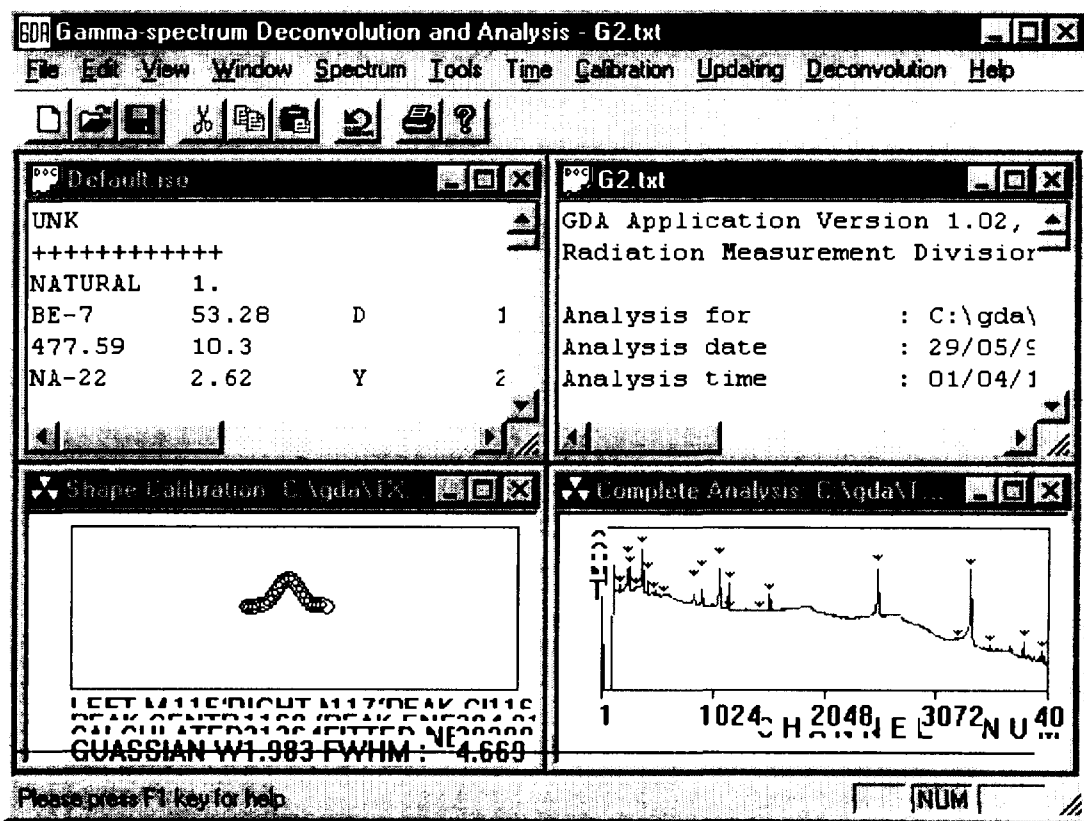


Figure 1 Multiple Document Interface of GDA program.

Designing Basis

An important basis for scientific data processing software deals with input and output data files. These data files are usually in the form of ASCII text file, which can be edited by a text editor. The original versions of gamma-ray spectrum analysis softwares^(4,5) had been designed as a kind of single document interface - Windows application, but the GDA software has been designed as a multiple document interface application. Many text files can be opened and edited at the same time with the graphical display and manipulating of spectrum data. Figure 1 shows the appearance of two text editing windows and two spectrum analysis windows. The outstanding feature of GDA program's text editor is that it uses a non-proportional character font. This kind of font enables the exact character spacing of text so that the correct input data format can be easily maintained.

RESULTS

The completed GDA program consists of menus, sub-menus, and the help system as the following:

File menu with sub-menus:

New, Open, Close, Save, Save As, Print, Print Preview, Print Setup, Exit.

Edit menu with sub-menus:

Undo, Cut, Copy, Paste, Delete, Find, Find Next, Replace, Select All,
Word Wrap.

View menu with sub-menus:

Toolbar, Set Tab Stops, Set Font, Set Printer Font, Mirror Display Font.

Window menu with sub-menus:

Cascade, Tile, Window 1, 2,...

Spectrum menu with sub-menus:

Read Spectrum Data, Display Spectrum, Complete Analysis,
Show Nuclides, Quantitative Results.

Tools menu with sub-menus:

Peak Information, Convert Spectrum, Isotopes Library, Standard Sources.

Time menu with sub-menus:

Enter Data, Open File, Update Input.

Calibration menu with sub-menus:

Shape Calibration, Energy Calibration, Efficiency Calibration.

Updating menu with sub-menus:

Shape Data, Energy Data, Efficiency Data.

Deconvolution menu with sub-menus:

Deconvolute Peak, Change FWHM.

Help menu with sub-menus:

Help Topics, About.

Help System of GDA Program

Help system of GDA program consists of two main parts. The first part is the Help Topics (on-line document) as shown in Figure 2. The second part is the help system for each window operation as shown in Figure 3.

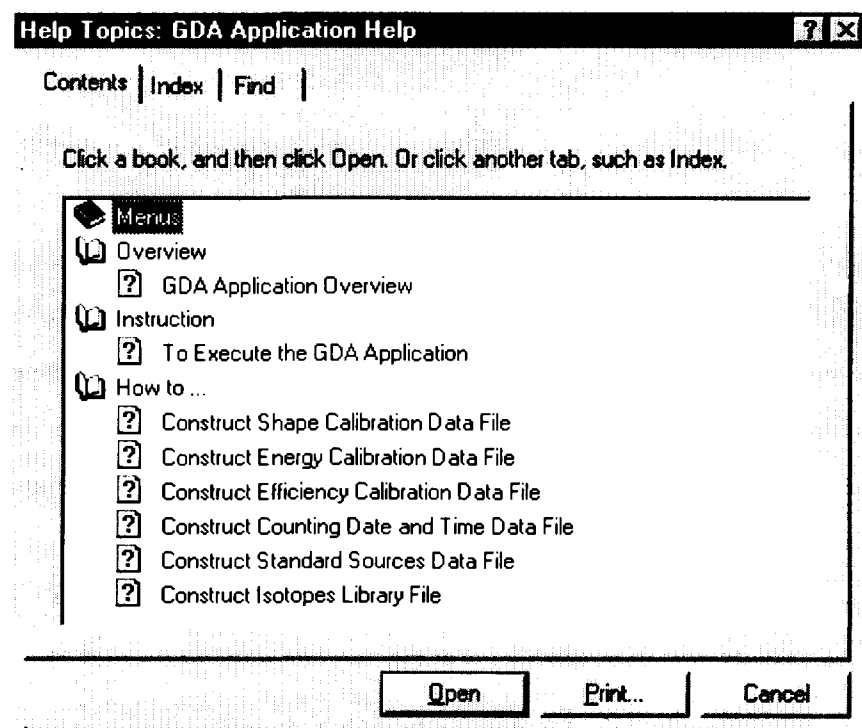


Figure 2. Help Topics of GDA Application Help

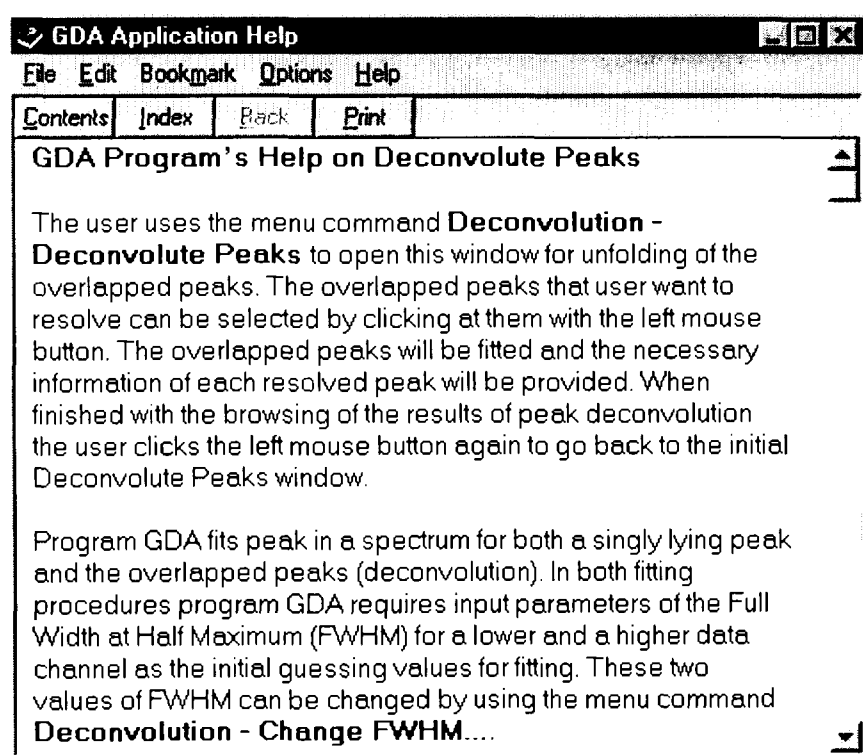


Figure 3. Help System for a Specific Window

Results of Analysis

GDA program can be used for automated and complete analysis of gamma-ray spectrum obtained with semiconductor detector. GDA program can also be used for the unfolding or deconvolution of group of peaks (multiplet) to resolve for the overlapped peak areas. When the program reads a spectrum data file, other six input calibration data files will also be read. After reading all these data files the user can then use the menu command Spectrum-Complete Analysis to analyze the spectrum. Figure 4 shows the result of this command. The quantitative results from the analysis can be opened as a text file for examination, like a portion shown in Figure 5. At this time, the graphical results of isotope identification can also be viewed via the sub-menu Spectrum-Show Nuclides. By this command user can examine each identified nuclide, one at a time, which will be displayed together with all its gamma-ray peaks.

GDA program is equipped with the complete and user-friendly calibration routines. They are peak-shape calibration, energy calibration, efficiency calibration, and counting date and time calibration.

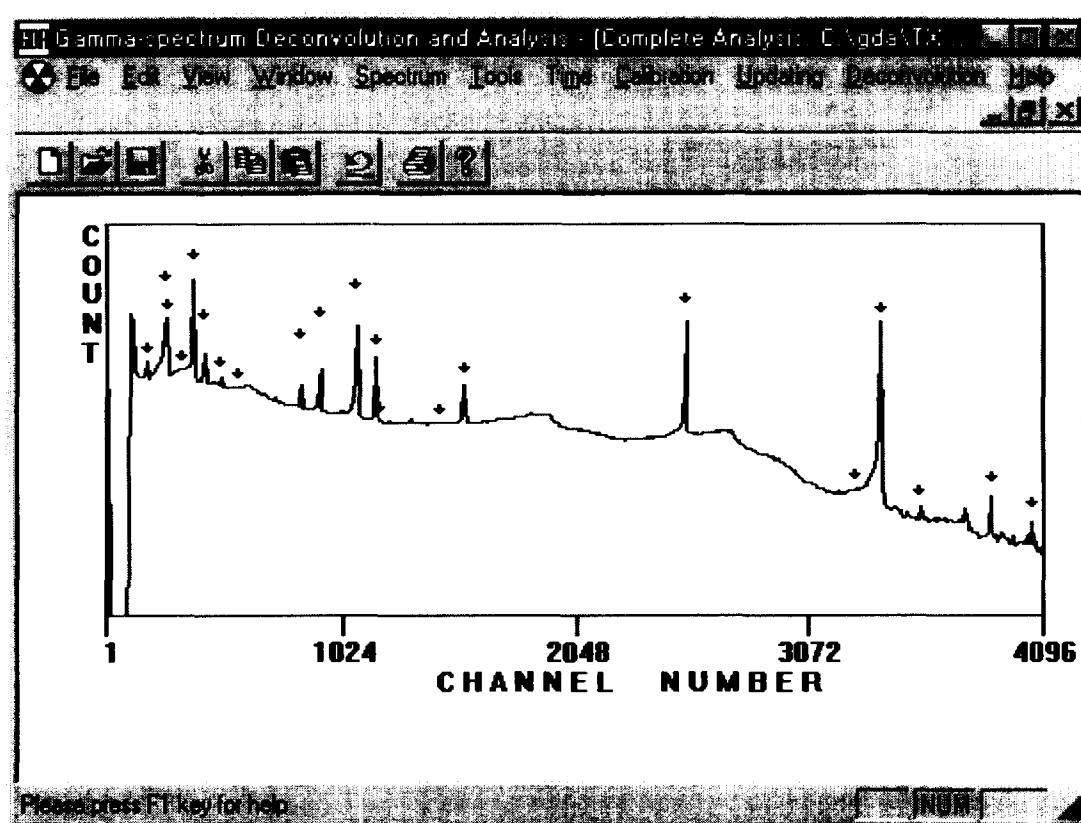


Figure 4. Result of a complete analysis

DISCUSSION

The GDA program has been installed in the computer network of the Office of Atomic Energy for Peace (OAEP) since February 23, 1998 as a pre-release version BETA-1 for testing. It was planned to freely distribute the GDA software via the Internet network, but this thinking has, later on, been canceled off. Instead, the completed software package version 1.02, which is consisted of three 3.5-inch diskettes for setup and one user's manual has been distributed to a few universities. It is hoped that with the utilization of GDA software by the faculty's members and students many useful comments will be reflected back. A person who wishes to obtain a copy of the evaluation version of GDA software package should make a request directly to the author.

TABLE OF IDENTIFIED ISOTOPES

NUMBER	NUCLIDE	CONF. VALUE	SAMPLE ACT. (picoCi)	% ERROR
1	BE-7	.9247	2.0787E+03	4.01
2	NA-22	.9674	5.3879E+03	4.25
3	MN-54	.9754	1.7748E+06	10.54
4	CO-57	.9995	1.3218E+06	4.16
5	CO-60	.9604	1.5169E+03	3.01
6	ZN-65	.9933	2.6326E+06	5.28
7	RB-86	.9623	9.6745E+03	4.03
8	SN-113 *	.8945	2.4118E-01	4.00
9	TE-123M	.7917	1.7063E+04	4.22
10	BA-133	.8304	2.0035E+06	2.51
11	EU-155	.1287	2.1549E+03	3.29
12	RA-226U	.9999	1.4266E+04	4.01

Please press F1 key for help

Figure 5. Output file contains result of quantitative analysis.

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