DENOTING THE NUCLEAR ISOTOPES IN EXPERIMENTAL GAMMA SPECTRUM

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Abstract. Nuclear isotopes making experimental gamma energy spectrum are denoted via their energies. One energy level of an isotope is supposed presence in the spectrum, if there is an energy level that is different from it with a value less than its error. With suitable database, the program can be used to identify isotopes even stable isotopes by using α, β, X spectra.

Introduction

In some nuclear researching processes, for example, in radioactivity measurement of environment sample, in activation analysis, a gamma energy spectrum of nuclear isotopes in studied objects are received. After analysing this spectrum, the following parameters are obtained:

- Gamma energy levels after eliminating noises, and their standard deviations.
- Intensities of these levels and their standard deviations.

The nomenclature 'intensity' means counts or velocity of counts for energy levels correspondent of studied object.

Spectra without any noises are used in different purposes. The spectra can be used to identify isotopes contained in studied object. In our case, gamma energy spectrum is used for denoting the isotopes making spectrum; its means that these isotopes contained in the studied object.

The activities of isotopes can be known by using the above informations. In order to identify the isotopes in studied object; at first, the database containing informations of isotopes must be built; the second, in order to analyse a spectrum exactly and quickly, we establish this energy spectrum in a suitable form.

By comparing informations of the isotopes in the database with the ones in the spectrum, we can identify the isotopes and estimate intensities of their energy levels in the spectrum.

1. Constructing the database for denoting nuclear isotopes

The problem is denotement nuclear isotopes making a gamma energy spectrum, so that the database has to contain the informations of energy levels of isotopes. Of course, the database cannot possibly contain all energy levels emitted by isotope. There is a

contradiction between the number of energy levels needed for identification of a nuclear isotope and the ability denoting them of experiment. The more energy levels of a nuclear isotope, the easier to identify exactly the isotope. However it is difficult to measure all energy levels of an isotope. In this program, some specific energy levels are selected.

In C language, the database of each isotope is as follow:

```
Struct Dv
{
Char Tendv[30];
Double Nlgdv[3];
};
```

In order to analyse effectively, each isotope has contain 3 energy levels. If the number of energy levels that the isotope contains is less than 3, the absent levels are pead by zero.

The database of isotopes is computed by function Taodulieu(), and is written in a file.

2. Reconstructing the gamma energy spectrum

A gamma energy spectrum is performed usually in an intensity-energy way; the error of intensity and of energy is pointed too. However this representation is not a good way for analysis of spectrum. So that spectrum is reconstructed in a good way for analysis. In this way, informations of each energy level are performed by the structure as follows:

```
Struct Phnlg
{
Double Nluong;
Double Sigmnlg;
Double Cuondo;
Double Sigmcdo;
Struct Phnlg*Trotiep;
};
```

The informations of whole spectrum are expressed in a dynamical linked namelist, whose each component is a structure containing the infomations of an energy level.

The exhibit of the information of the spectrum is multiform. It depends on each experiment and on the taste of user. In our case, it is contained in a file and is loaded in to the memory of computer to construct the dynamical linked namelist of the spectrum before analysis by using function Docpho().

3. Denoting nuclear isotopes

The flowchart of denotement isotopes making the experimental gamma energy spectrum is pointed in figure 1. The main purpose is denotement the isotopes making a gamma energy spectrum and thougth it, identification the other parameters of spectrum such as

the content of isotopes being in a studied sample, example in an environment sample. This process is done by function Phathien(). At first, the function Phathien() call the function Docpho() in order to load gamma energy spectrum into the memory of computer and make a dynamical linked namelist performing the spectrum, then a loop is worked for checking if these nominal isotopes are in the spectrum.

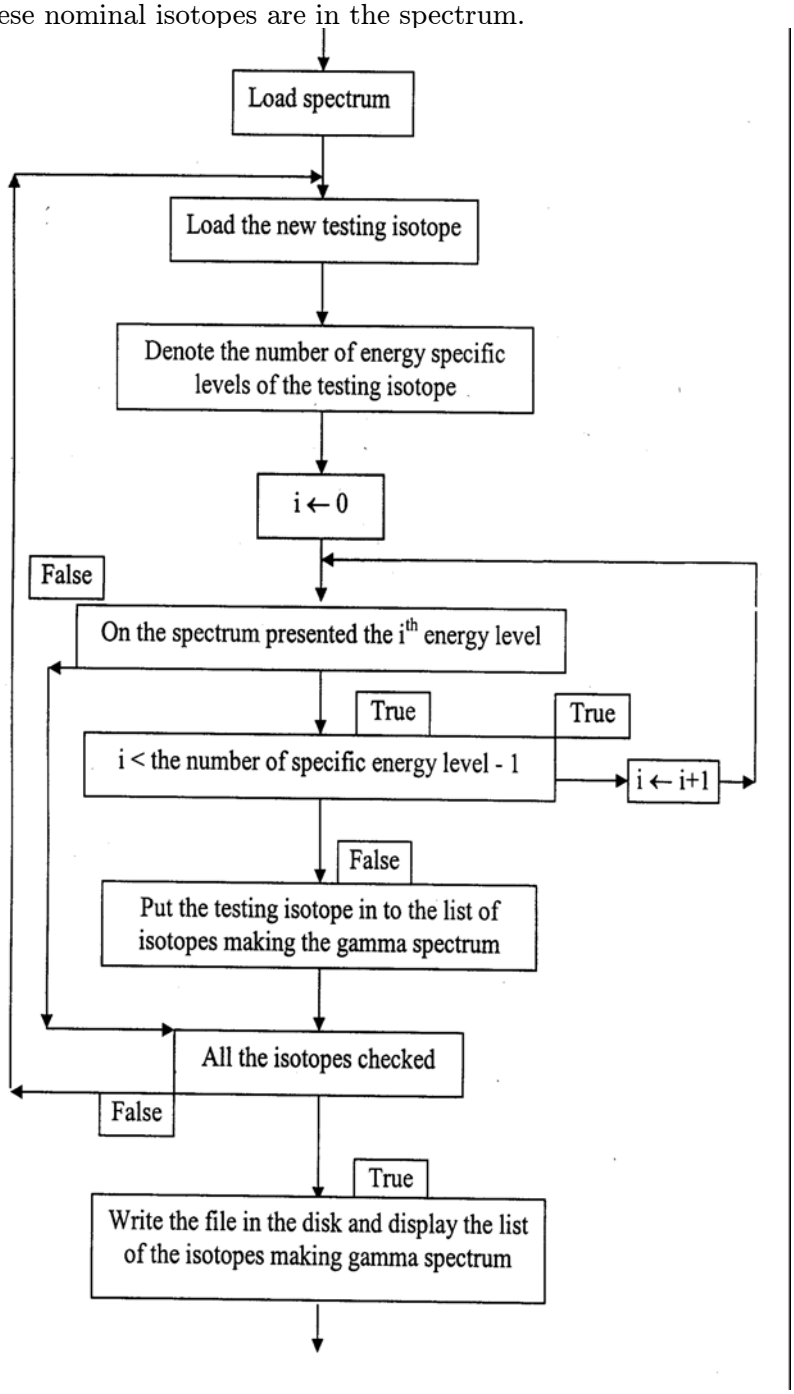

Fig. 1. The flowchart of the isotope making the experimental gamma spectrum

Each isotope is loaded in the memory and its informations are contained in a structure. The computer calculated to indentify number of specific energy levels that the isotope contained in the database. For each testing isotope, the program checks whether its specific energy levels is presented in the spectrum. If one energy level is absent, the isotope is not accepted, and next isotope in the database becomes the testing isotope. The isotope is considered finding if all specific energy levels of it presented in the spectrum and this testing isotope is given to the dynamical linked namelist containing the isotopes making the spectrum.

Because of the error of experiment, energy levels in a experimental spectrum are not exactly the same with the ones of the testing isotopes; therefore, an energy level of the testing isotope is considered presenting in the spectrum, if in the spectrum there is an energy level that is different it less than its error. This process continues with other testing isotopes in the database.

The namelist of isotope making gamma energy spectrum is writen in file, in this file name, energy, intensity and their errors as well as the number of specific energy levels of isotopes are saved. The energy and intensity of isotopes are the ones from the experimental spectrum. They are able to different from the ones in the database as we explicated above. The isotopes are also displayed on screen.

The function Phathien() is follow:

```
Phathien()
{
char k;
struct Phnlg*Trg;
struct Dvph*Tam;
int i;
FILE*Trotep;
char Tentep[30];
struct Dv Dongvi;
int Snlgdvthco;
int Snlgvctrph;
printf(" \ n Loading the name of database file:");
gets(Tentep);
Tentepdv=Tentep;
printf(" \ n Loading the name of file for saving the isotopes in the spectrum");
gets(Tentep);
Tentepdvph=Tentep;
if((Trotep=fopen(Tentepdv,"rb"))==NILL)
Docpho();
clrscr;
Trddvph=(struct Dvph*)NULL;
while(!feof(Trotep))
```

```
{
fread(&Dongvi, Sizeof(Dongvi),1,Trotep);
Snlgdvthco=0;
for(i=0;i<MAXNLG;i++)
if(Dongvi.Nlgdv[i]!=0.000)
Snlgdvthco=1;
Snlgdvtrph=0;
if((tam=(struct Dvph*)malloc(sizeof(struct Dvph)))==(struct Dvph*)NULL)
exit(1)
else
{
strcpy(tam->Tendv, Dongvi.Tendv);
Tam->Snlgthc=Snlgdvthco;
}
for(i=0;i<Snlgdvthco;i++)
{
Trg=Trodauph;
while(Trg!=(struct Phnlg*)NULL)
{
if(fabs(Dongvi.Nlgdv[i]-Trg->Nluong)<=Trg-> Sigmnlg)
Snlgdvctrph+=1;
Tam-4Nlgdv[i]=Trg->Nluong;
Tam->Sigmnlg[i]=Trg->Sigmnlg;
Tam->Cuongdo[i]=Trg->Cuongdo;
Tam->Sigmcdo[i]=Trg->Sigmcdo;
break;
}
Trg=Trg->Trotiep;
}
if(Snlgdvtrph!=i+1)break;
}
if(Snlgdvctrph==Snlgdvthco)
{
if(Trddvph==(struct Dvph*)NULL)
{
Trddvph=Trdvph=Tam;
Trdvph->Trotiep=(struct dvph*)NULL;
}
else
{
Trcdvph=Trotiep=Tam;
```

```
Trcdvph=Tam;
Trcdvph->Trotiep=(struct Dvph*)NULL;
}
}
}
if((Trotiep=fopen(Tepdvph,"wb",))==NULL)
exit(1);
printf("\n In the spectrum contained isotopes:");
while(Trddvph!=(struct DVph*)NULL)
{
Tam=Trddvph;
fwrite(Tam, sizeof(strucr Dvph),1,Trotiep);
printf(i=0;i<Tam->Snlgthc;i++)
printf("\n %5c(%-8.3f+&-%8.3f)MeV", ".Tam->Nlgdv[i],Tam->Sigmnlg[i ]);
printf(" \n%5c(%-8.3f+&−%8.3f)Xung","Tam->Cuongdo[i],Tam->Sigmcdo[i]);
{
printf("\NL: %2.3f MeV,",Tam->Cuongdo[i]);
}
Trddvph=Tam->Trotep;
free(Tam);
}
fclose(Trotep);
getch();
}
```

4. Conclusion

The program for denoting the nuclear isotopes by using experimental gamma energy spectrum is worked stably, this can be used even on a small computer. Up to now, the database contains almost isotopes in environment samples.

With the suitable database, we can use it to identify the isotopes emitted α, β and X rays.

Reference

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