Report of the meeting of the Gamma Spectrometry Working Group

The meeting of the ICRM took place at the ENEA Casaccia (Italy), on October 18-19, 2010.

Twenty participants attended this workshop (List of participants) and the meeting was held according to the proposed agenda:

Monday October 18th

09:00 09:30 Get together
09:30 09:40 Welcome – practical information P. De Felice
09:40 09:50 Presentation of the workshop schedule M.-C. Lépy
09:50 10:00 **Coincidence summing action – volume sources**
Introduction M.-C. Lépy/ L. Ferreux
10:00 10:40 Presentation of the methods used by the participants to compute the coincidence summing corrections
A. Ceccatelli
P. De Felice
M. Djurasevic
P. Dryak

10:40 11:00 Coffee break

11:00 11:40 Presentation of the methods (continuation)

G. Carvalhal
M.-C. Lépy
O. Sima
T. Vidmar
Other participants

11:40 12:30 Presentation of the results and first discussion L. Ferreux / S. Pierre

12:30 14:00 Lunch

Presentation by the participants

14:00 14:30 A. Ceccatelli Necessity of recommendations and guidelines in gamma spectrometry: role of the IAEA and outcomes of the activities in this field
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14:30 14:50 T. Vidmar EFFTRAN and CCCC software presentation

14:50 15:10 M. Jurado Vargas DETEFF last improvements

15:10 15:30 A. Vargas INTE-UPC activities

15:30 15:50 Coffee break

15:50 16:10 T. Vidmar IAEA CRP – Efficiency transfer codes comparison
16:10 16:30 O. Sima GESPECOR: presentation and demonstration

16:30 16:50 M.C. Lépy Information from Ipen-Cnen/SP (”Cascade summing corrections for HPGe spectrometers by the Monte Carlo method” by Mauro S. Dias, Mauro N. Takeda, Marina F. Koskinas: Applied Radiation and Isotopes 56 (2002) 105–109)
Information on ANGLE software (http://www.dlabac.com/angle/home.html)

16:50 17:30 General discussion

18:00-21:30 Visit of Anguillara and Social Dinner

Tuesday October 19th

09:00 10:30 Continuation of the discussion about coincidence summing exercise

Contribution to ICRM 2011

Report of the whole action

10:30 10:45 Coffee break

10:45 12:30 Proposal for new actions of the WG, improvement of the web site, etc..;

12:30 Conclusion

Afternoon : Visit of the ENEA laboratory.

The relevant presentations are included as pdf files.

Main outputs of the presentations and discussions

1. Coincidence summing action

1.1 Experimental conditions

This second part of the action concerned the calculation of the corrective factors for ^{152}Eu and ^{134}Cs, for several energies and 3 volume sources, as shown hereafter. The containers are assumed to be made of polyethylene with a density of 1.05 g.cm^{-3}. They were filled with ^{152}Eu (HCl 1N – specific mass : 1.0159 g.cm^{-3}) and ^{134}Cs (HCl 0.1 N – specific mass : 1.001 g.cm^{-3}); two series of mass activities were used, respectively with 40 Bq.g-1 (B solution) and 4 Bq.g-1 (C solution).

Different geometry measurements were studied :

Volume 1

Volume 2

Volume 3

- Volume 1 at 10 cm from the detector window, at contact with a copper screen and at contact with a Plexiglas screen;
- Volume 2 at contact with a Mylar foil or with a copper screen, or with a Plexiglas screen;
- Volume 3 at contact with a copper screen, or with a Plexiglas screen.

The participants received the experimental spectra corresponding to these acquisition conditions and were asked to compute the coincidence summing for each case for both radionuclides.

1.2 Participating laboratories

Fourteen laboratories participated in this part of the action and each provided about 8 series of results (geometries) for 27 energies (16 energies for ^{152}Eu and 11 energies for ^{134}Cs). In this presentation, about 4800 data were gathered obtained using 18 different methods.:

- GESPECOR (3 times)
- TrueCoinc
- CSCOR
- Fast procedure
- LABSOCS (default parameters + correction)
- LABSOCS (default parameters)
- ETNA + MCNP
- CCCC
- ETNA + PENELOPE

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1.3 Presentation of the results

The raw results were presented by Sylvie Pierre. The participants received the tables with all results before the meeting to have the opportunity to verify that their values were correctly reported. Thus, most of these inputs had already been checked however, some other have not yet been included. As example, the next figure shows the corrective factors computed for 122-keV peak of ^{152}Eu for the smallest volume (1B) at 10 cm from the detector. Most of the data include associated uncertainties; however, some are still missing in the current presentation and should be added in the next step.

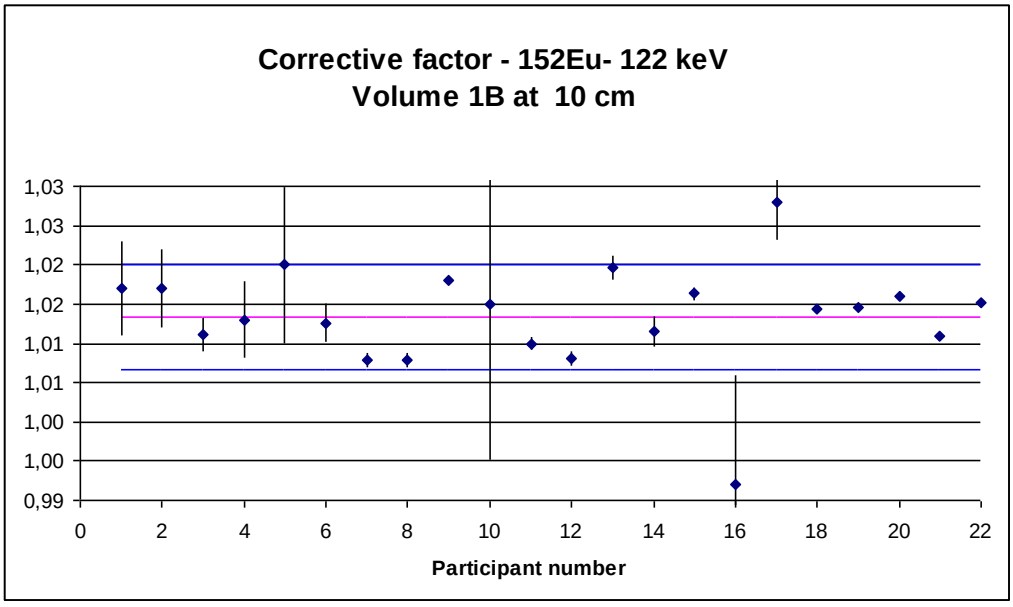

Figure 1: Corrective factors computed for 122-keV peak of ^{152}Eu for volume 1B at 10 cm from the detector.

The experimental mean (pink line) is show for each energy and each volume geometry. In this first step, this has been computed as a simple arithmetical mean.

The next two figures display as blue diamonds the mean value of the corrective factor computed by the participants per energy for the smallest volume (1B) at contact with the Plexiglas screen for ^{152}Eu and ^{134}Cs, respectively.

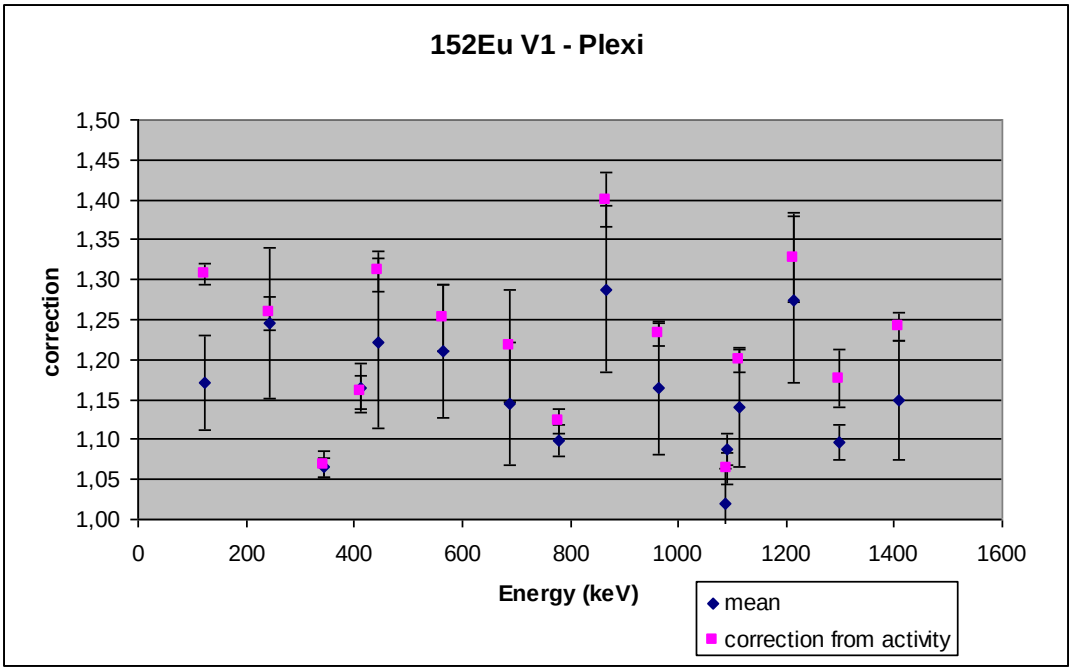

Figure 2: Mean corrective factors for the main energies of ^{152}Eu
for volume 1B at contact of the detector window with a Plexiglas screen.

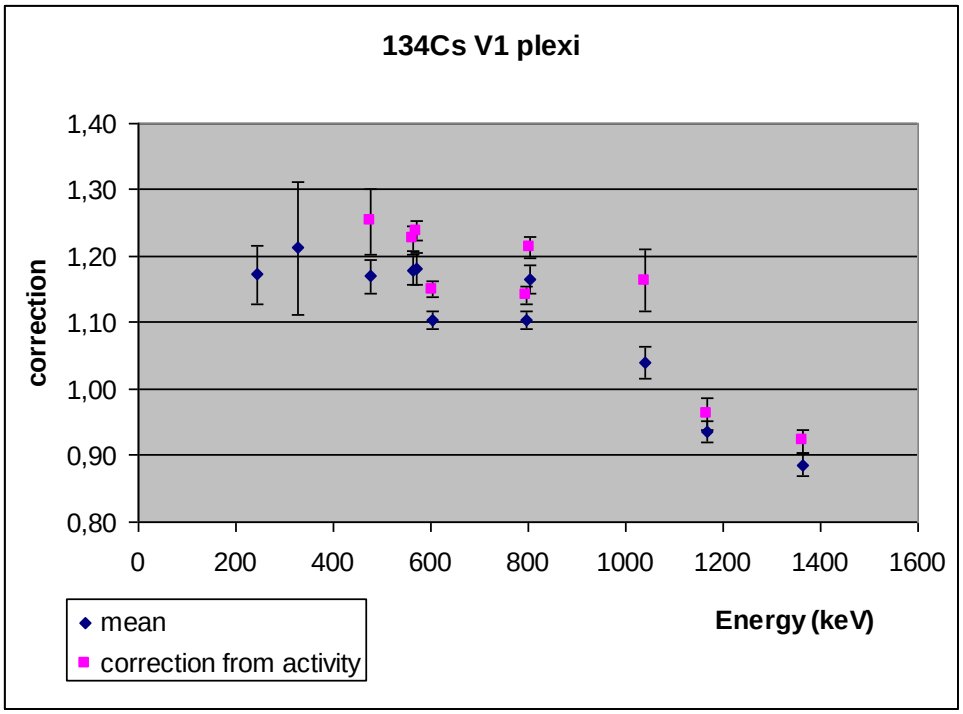

Figure 3: Mean corrective factors for the main energies of ^{134}Cs
for volume 1B at contact of the detector window with a Plexiglas screen.

These figures also include the "experimental correction", C(E), plotted as pink squares. This was derived from the ratio between the "true" container activity, A_t, known with 0.3 %, relative uncertainty and the activity derived from experimental spectra (using efficiency transfer) called « false » activity: $A_f(E)$ obtained with 2-3 % relative uncertainty:

$$C(E) = \frac{A_t}{A_{f(E)}}$$

1.4 Discussion

These results were commented by all the participants and the discussion raised the following points:

Pavel Dryak suggests that container 2 is not strictly cylindrical, but should have a conical shape. But, according to the measurements carried out on the empty containers, this should not be a difference larger that 1 or 2 mm in the container diameter.

Octavian Sima compared the results between double and triple coincidences and thus, the effect of the triple coincidence can be stated for this exercise.

Discussion about the importance of the integration over the volume source for computing the coincidence correction. Octavian Sima demonstrated the importance of this effect. This should be easily demonstrated using ETNA since this software has two options (with and without integration).

1.5 Next steps

Following the workshop and discussions, the participants will be invited to check their values that have been reported, and eventually to provide updated data by February 28th.

LNHB will include the last data provided by the participants and updated values, and will also update the graphs consequently.

Pierino De Felice proposed to concentrate on one specific energy for each radionuclide and to get complementary information from the participants (efficiencies used for the computation): 867 keV for 152Eu and 1635 keV for 134Cs
Thus, LNHB will send a questionnaire for these specific energies to know the efficiency values used, and more details on the calculations.

To assess the validity of the “experimental correction” , it was decided to provide the experimental efficiency using mono-energetic radionuclides for at least one volume geometry to establish the correction value with better reliability. This should be performed at LNHB at the end of 2010. It must be noted that the geometrical conditions will be slightly different for the ones used to acquire the experimental spectra with multigamma sources, since the detector is now installed in a different lead shielding, as show hereafter:

Acquisition conditions for ^{134}Cs and ^{152}Eu

Acquisition conditions for calibration with mono-energetic emitters

An abstract will been submitted to the 2011 ICRM conference. This conference will give be also the opportunity to discuss the new series of results and to prepare the detailed report that should be prepared as a CEA report.

2. Other topics

2.1 Contribution with IAEA : Following the presentation by Alessia Ceccatelli, the need of more exchanges between IAEA and ICRM is raised. This can be obtained through exchange of information through the web sites of each organization, and by common action : for example, the data of the ICRM coincidence summing action could be used by IAEA for further comparison.

2.2 Link with commercial software suppliers: there is a recurrent demand to be able to input formatted data for corrective factors (efficiency transfer, coincidence corrections, etc.). It is proposed to send to the major companies a formal letter under the auspices of ICRM.

2.3 Efficiency fitting

A presentation kindly forwarded by Virginia Peyres (CIEMAT) showed the discrepancies that can be obtained in the fitting procedure, thus pointing out the relevant uncertainties. This point is discussed and most of the participants agreed to participate in a further action to compare the efficiency fitting procedures. This should be performed, either on the old set of data (that was prepared by Dr Debertin in the eighties for a similar comparison, or from the set used by V. Peyres. Tim Vidmar also suggested to used Monte Carlo simulated efficiencies. The framework of such an action should be discussed in the next months.

2.4 GSWG Web page and forum

M.-C. Lépy reminds that this GSWG Web page is the site of the participants of the WG: each one is welcomed to include any useful information, to make any comment. It is suggested to add some training material already prepared by some participants. The report of this meeting together with the presentations will be included in the web page as soon as possible.
The GSWG forum remains too poorly used: to try to shake it, participants to the meeting are requested to access the forum and input some reply or question or comment, at least once within the next month.

3. Conclusion

All participants are thanked for their active participation in the meeting. Pierino de Felice and his co-workers of ENEA are warmly thanked for their kind welcome and perfect organization of the workshop.
The next meeting of the ICRM Gamma Spectrometry Working Group will the biennial "general meeting" that will be held during the ICRM 2011 conference in Tsukuba (Japan).