International Committee for Radionuclide Metrology (ICRM)
Gamma-Ray Spectrometry Working Group (GSWG)

GE.SPE.COR
used in ICRM-GSWG actions

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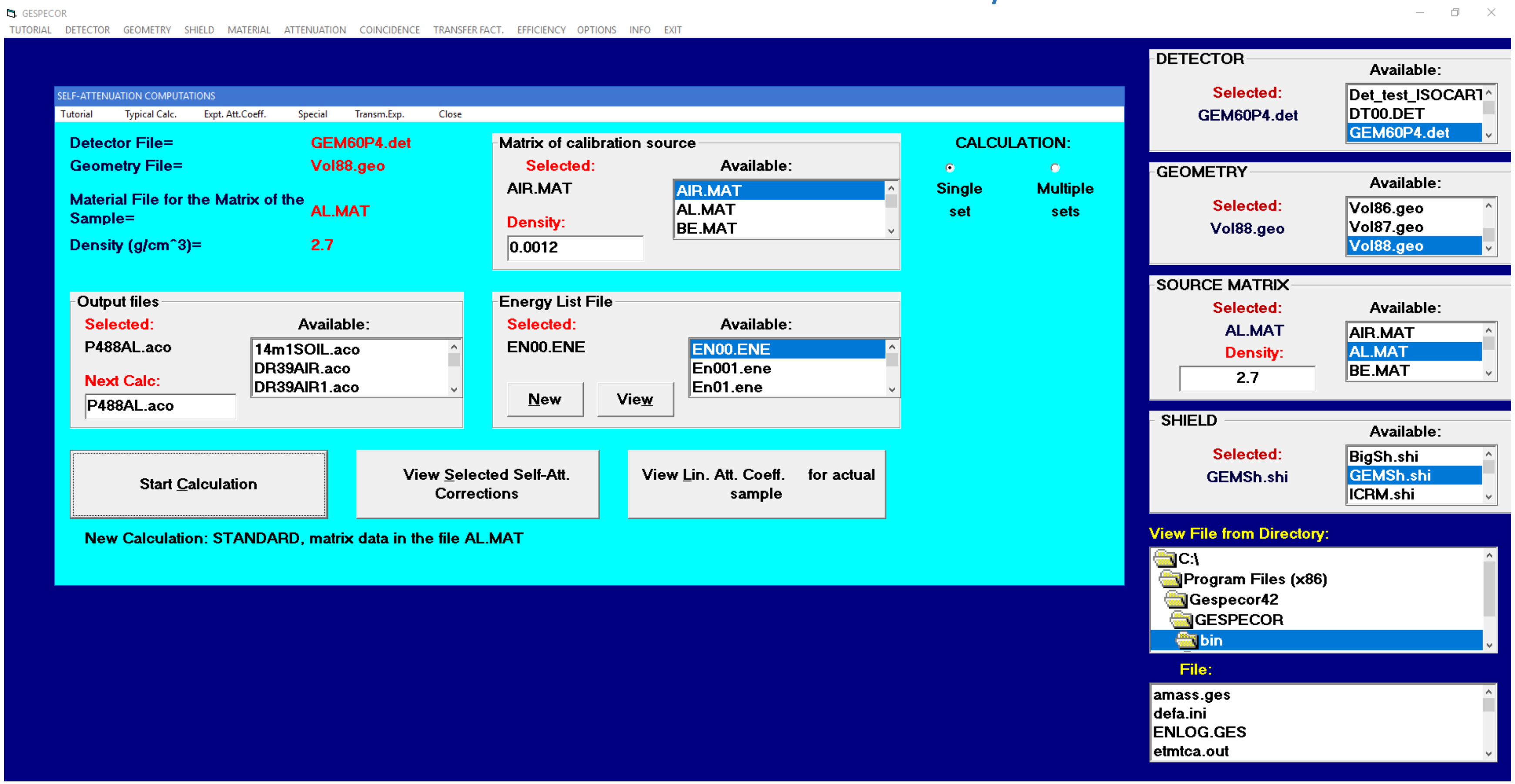
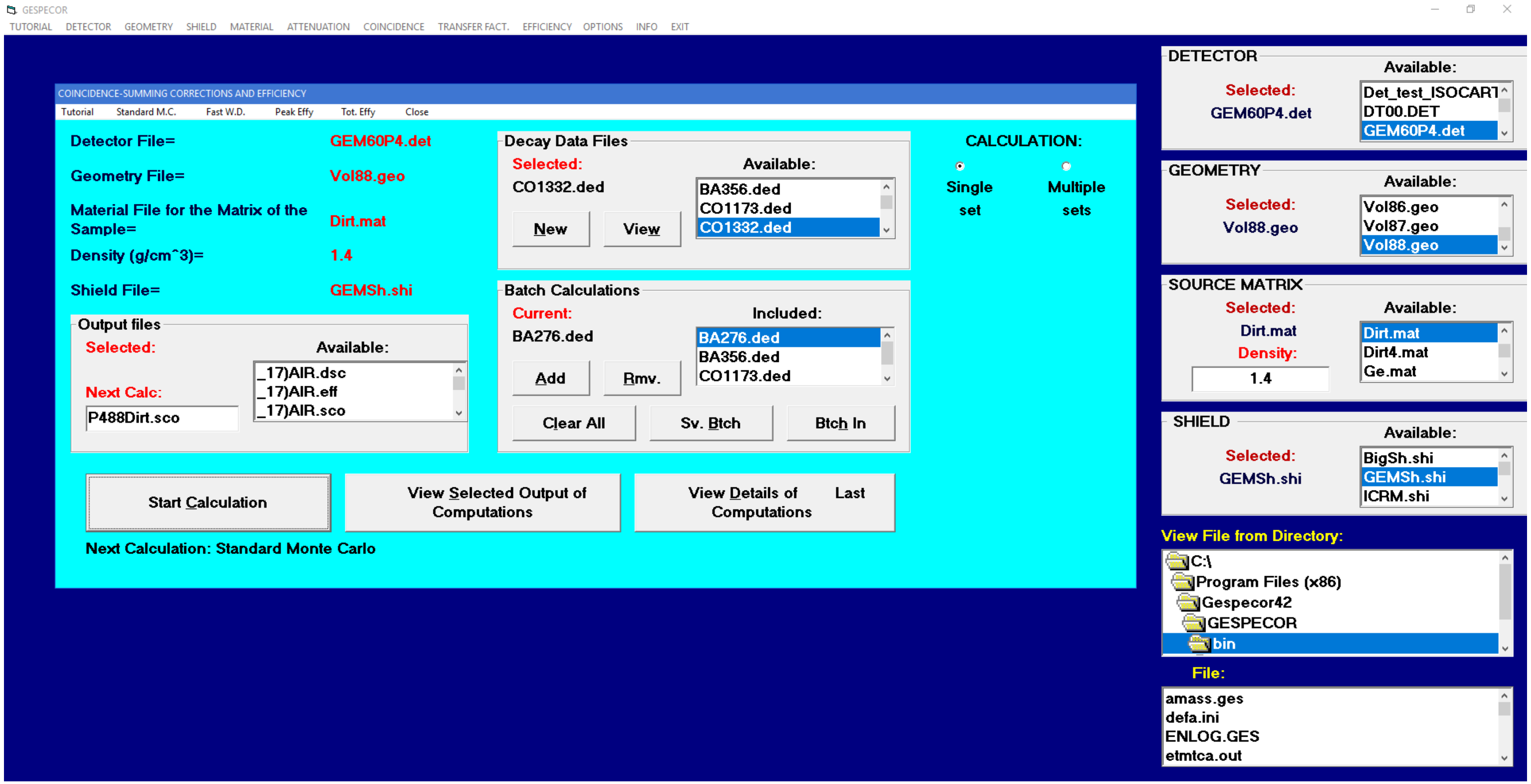
GESPECOR

based on the methods developed by: O. Sima, D. Arnold, C. Dovlete

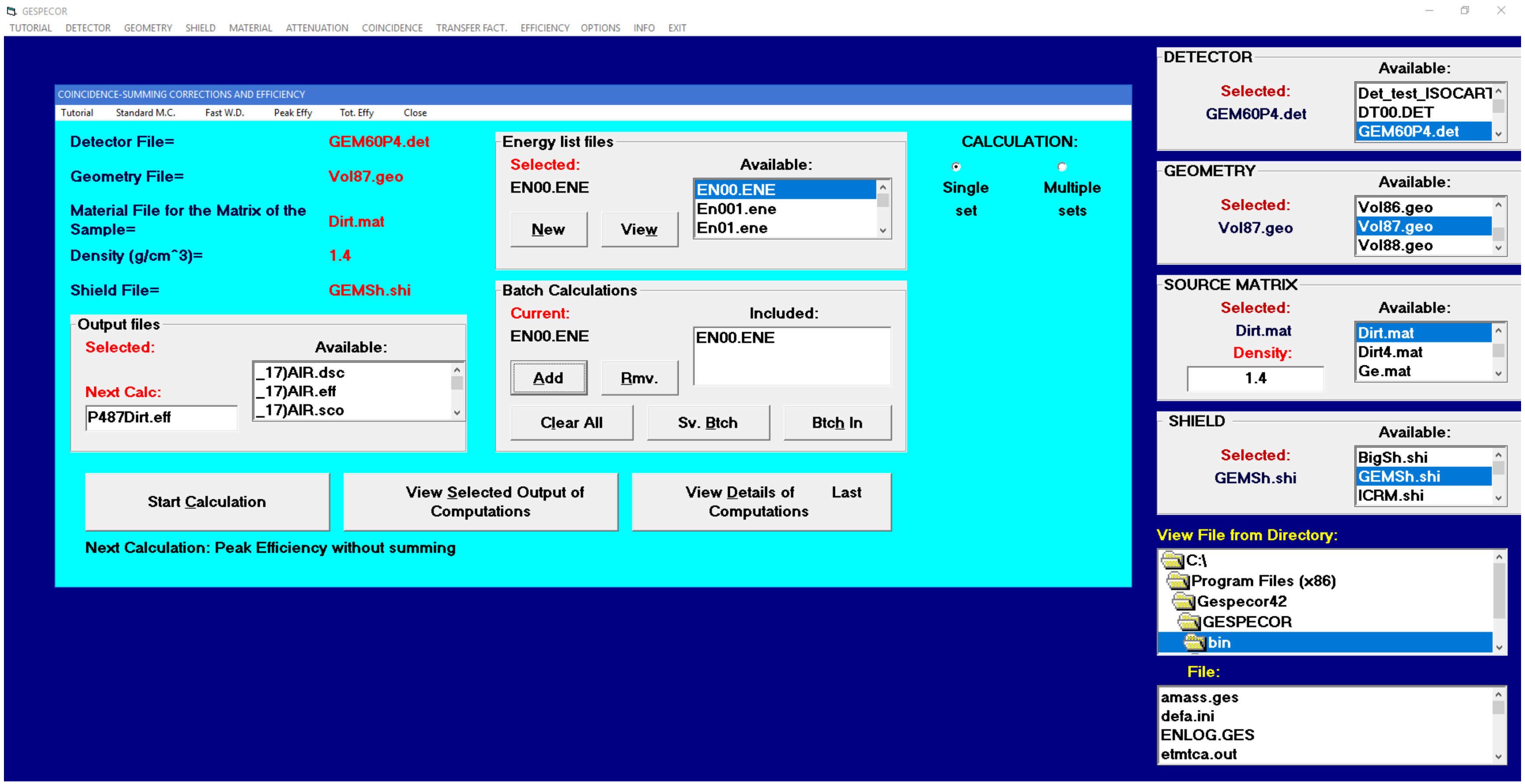
- Self-Attenuation Corrections
  - factors useful for computing the detection efficiency for a sample with a given matrix and density on the basis of the efficiency measured with a calibration source of a different matrix and density



- Coincidence-Summing Corrections
  - procedures applied to obtain the efficiency specific to a given peak of a nuclide with coincidence-summing problems on the basis of the common calibration curve



- Efficiency computation
  - procedures applied for direct computation of the full energy peak efficiency and of the total efficiency
  - Efficiency evaluation based on the method of efficiency transfer from a reference measurement (detector, geometry, sample matrix, shield) to another measurement



GESPECOR software used in two ICRM on-going actions

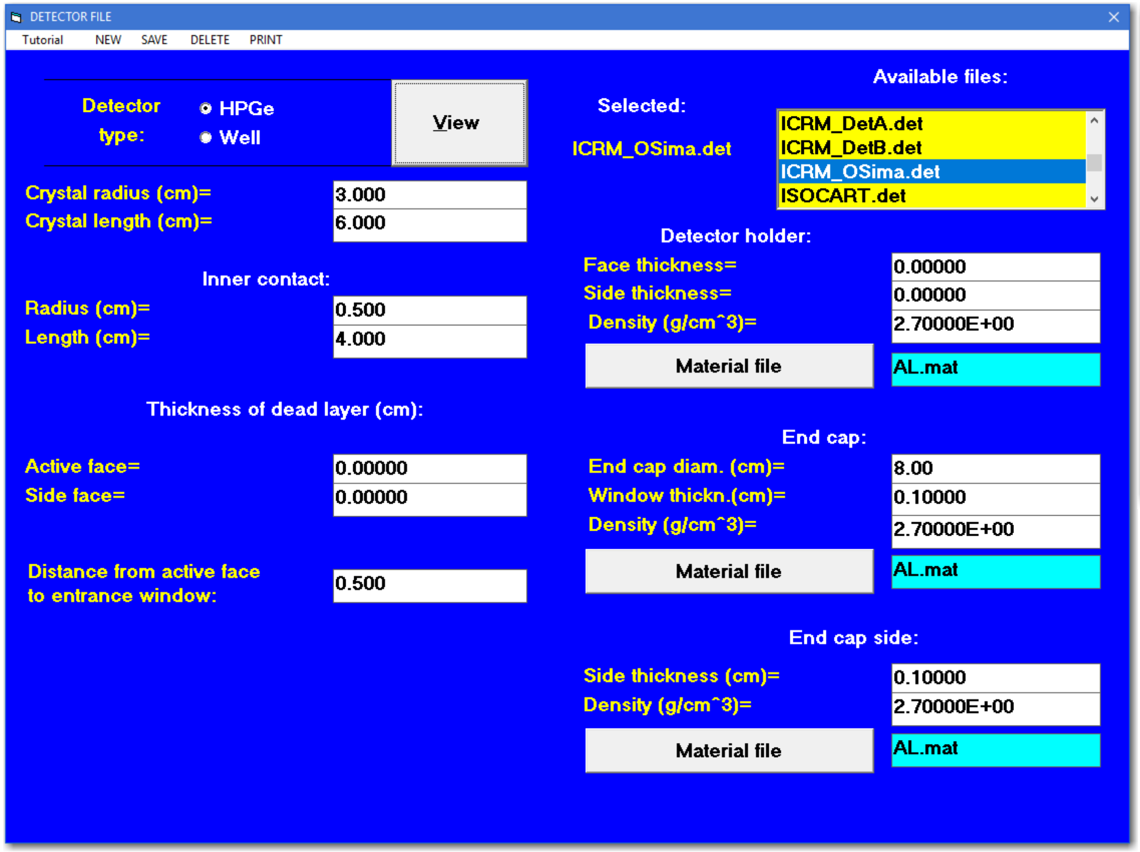
- Action 1: Simple exercise on self-consistency of the methods applied for the evaluation of coincidence summing corrections in the case of volume sources
  Coordination: Mr. Octavian Sima

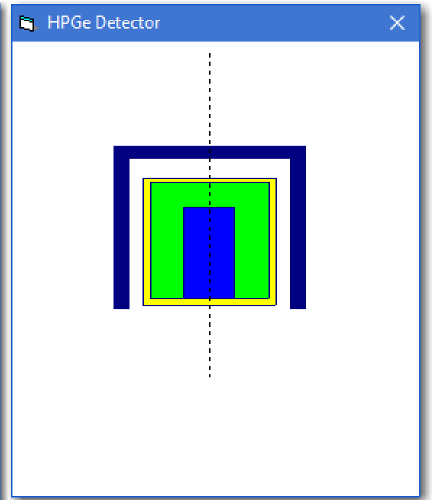
- Action 2: Action to facilitate the use of Monte Carlo simulation software
  Coordination: Ms. Marie-Christine Lépy

Action 1

Evaluation of the coincidence summing corrections in the case of volume sources

The detector file

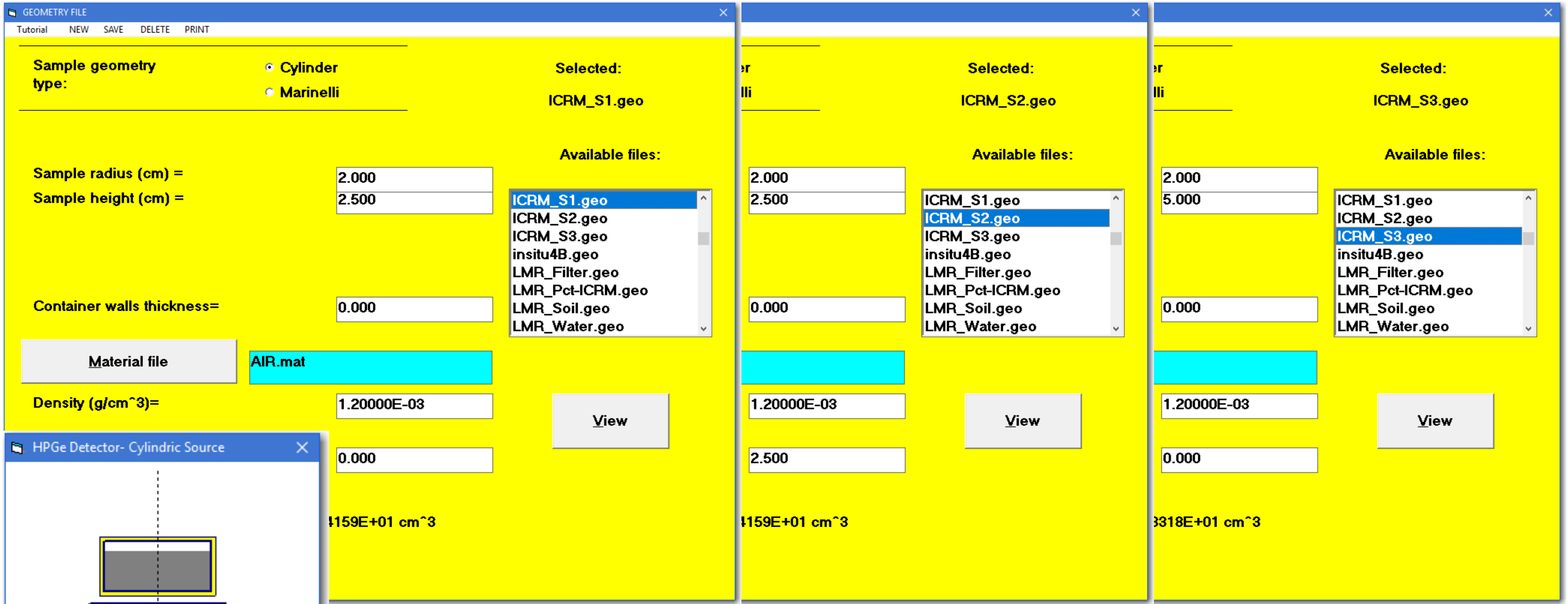


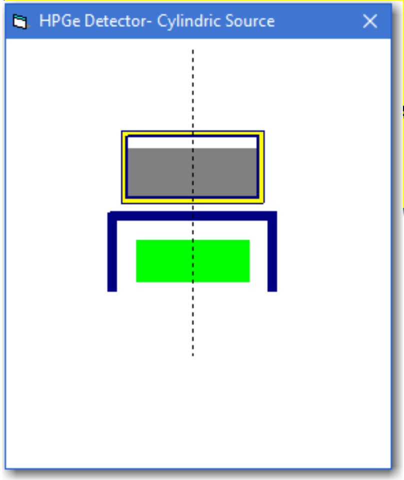


Action 1

Evaluation of the coincidence summing corrections in the case of volume sources

The geometry file

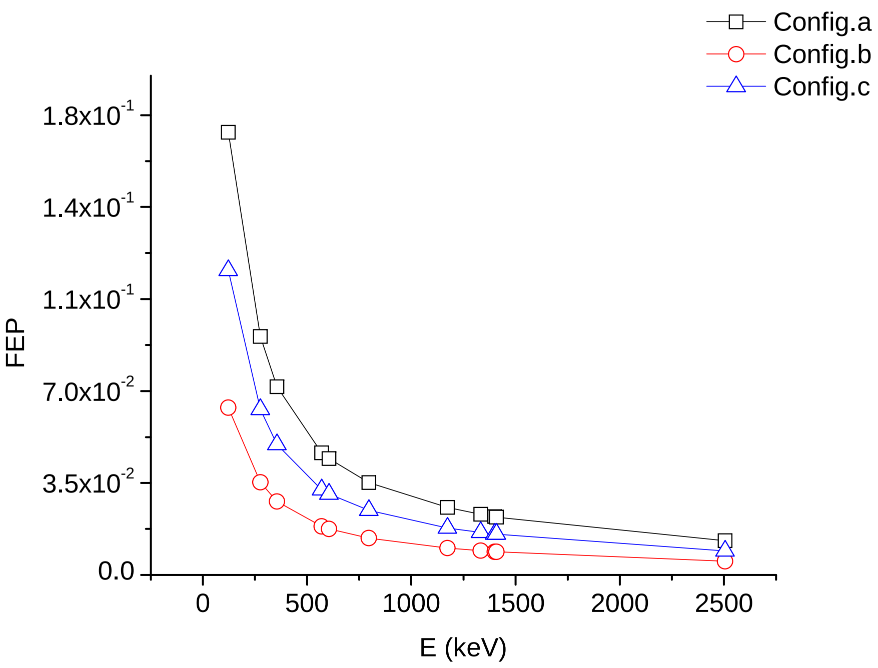


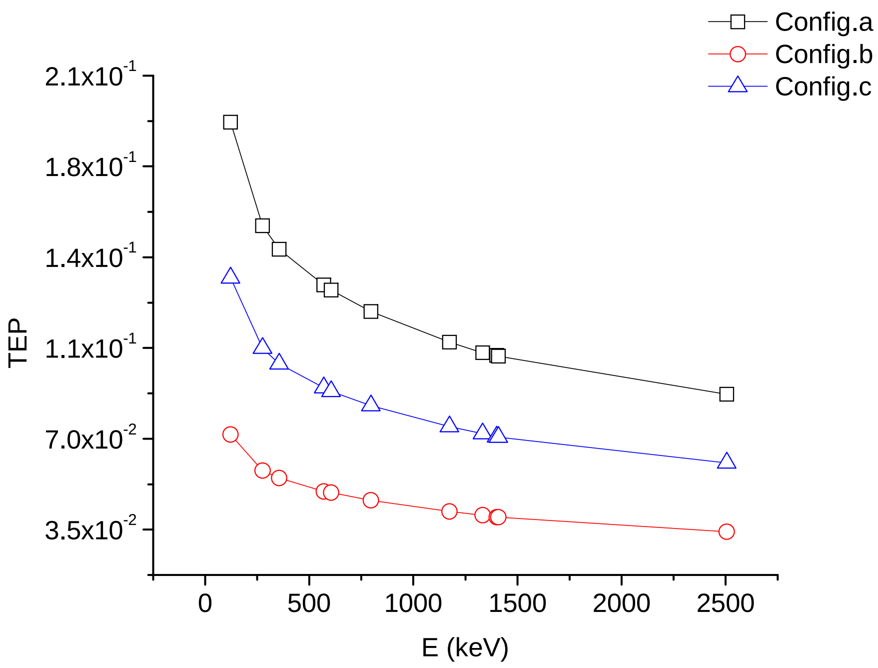


Each configuration is placed in air and there are no other materials in the vicinity of the detector and sources.

Action 1

Full and total energy peak efficiency





Uncertainties <0.6%, k=1

Coincidence-summing correction factor

FC is a measure of the coincidence-summing effects

		Config.a		Config.b		Config.c	
Nuclide	E (keV)	FC	UNC(FC)	FC	UNC(FC)	FC	UNC(FC)
Co-60	1173.23	8.87E-01	2.30E-01	9.58E-01	2.00E-01	9.06E-01	2.20E-01
Co-60	1332.49	8.81E-01	2.30E-01	9.56E-01	3.30E-01	9.02E-01	3.30E-01
Co-60	2505.75	5.20E-02	2.80E-01	1.92E-02	6.50E-01	4.19E-02	4.10E-01
Cs-134	569.33	7.48E-01	1.80E-01	9.02E-01	2.20E-01	7.91E-01	3.10E-01
Cs-134	604.72	8.38E-01	2.70E-01	9.40E-01	1.70E-01	8.66E-01	2.20E-01
Cs-134	795.86	8.36E-01	1.20E-01	9.39E-01	3.30E-01	8.66E-01	3.10E-01
Cs-134	1400.59	6.62E-02	2.10E-01	2.55E-02	2.80E-01	5.40E-02	3.40E-01
Ba-133	276.4	6.31E-01	1.30E-01	8.48E-01	1.80E-01	6.93E-01	1.80E-01
Ba-133	356.01	7.54E-01	2.20E-01	9.04E-01	2.70E-01	7.97E-01	2.20E-01
Eu-152	121.78	7.21E-01	6.00E-02	8.90E-01	9.20E-02	7.67E-01	1.30E-01
Eu-152	1408.01	7.15E-01	2.50E-01	8.92E-01	3.80E-01	7.66E-01	2.00E-01

For normal peaks FC it is

- equal to 1 if the effects are absent,
- <1 if the coincidence losses from the peak are prevailing,
- >1 if coincidence summing up in the peak is the dominating factor.

Action 1

The coincidence-summing effects

- depend on the probability with which other radiations are emitted simultaneously with the gamma radiation for which the effects are computed.

    - Example! The sum peak of ^{134}Cs at 1400 keV is due to the simultaneous detection in the peak of the 604 keV and 796 keV photons, that are emitted together with the probability of 0.8547 per photon

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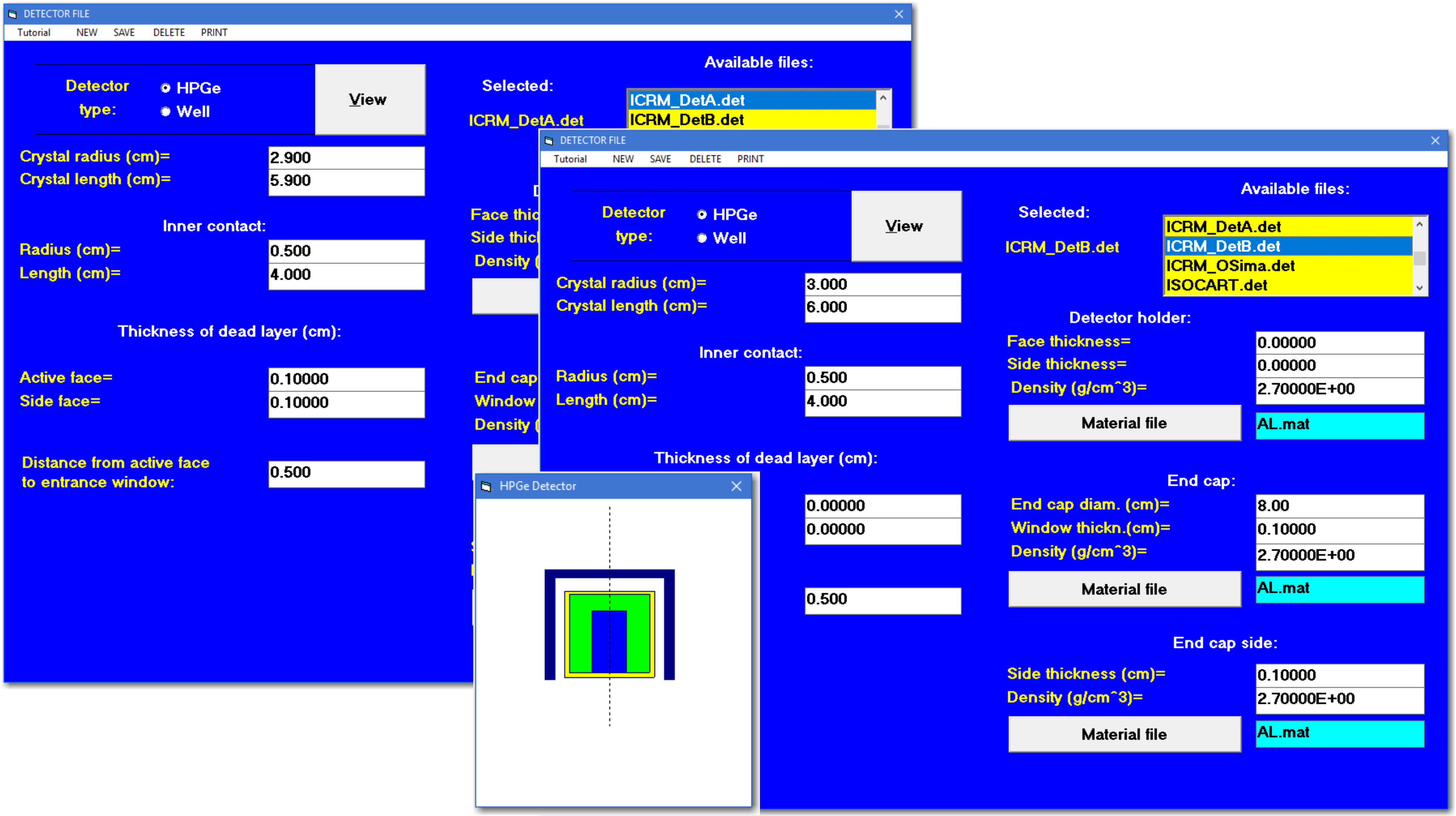
- library included in GESPECOR and contain 225 nuclides encountered most frequently in gamma-ray spectrometry

Action 2

Action to facilitate the use of Monte Carlo simulation software

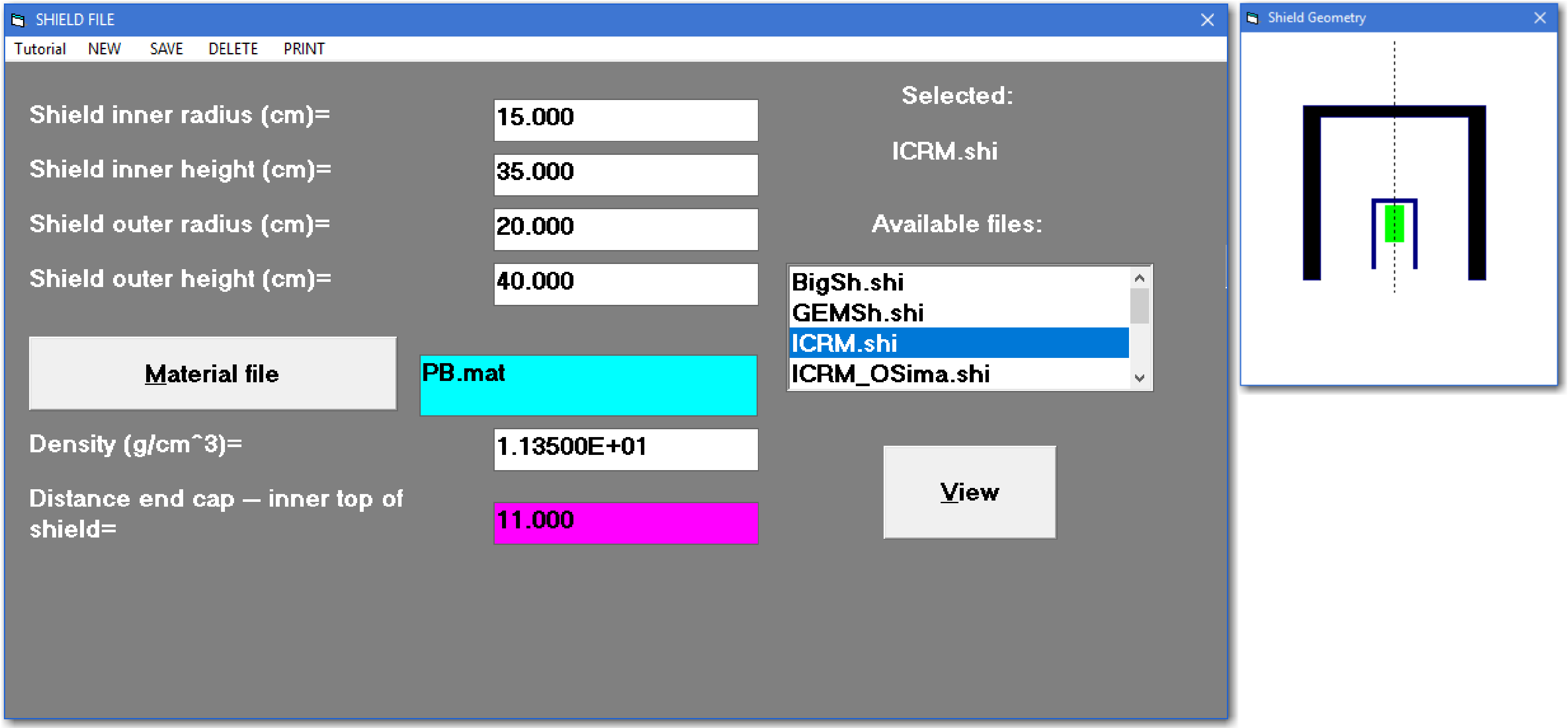
The detector file



Action 2

Action to facilitate the use of Monte Carlo simulation software

The shield file



Action 2

Action to facilitate the use of Monte Carlo simulation software

The geometry file

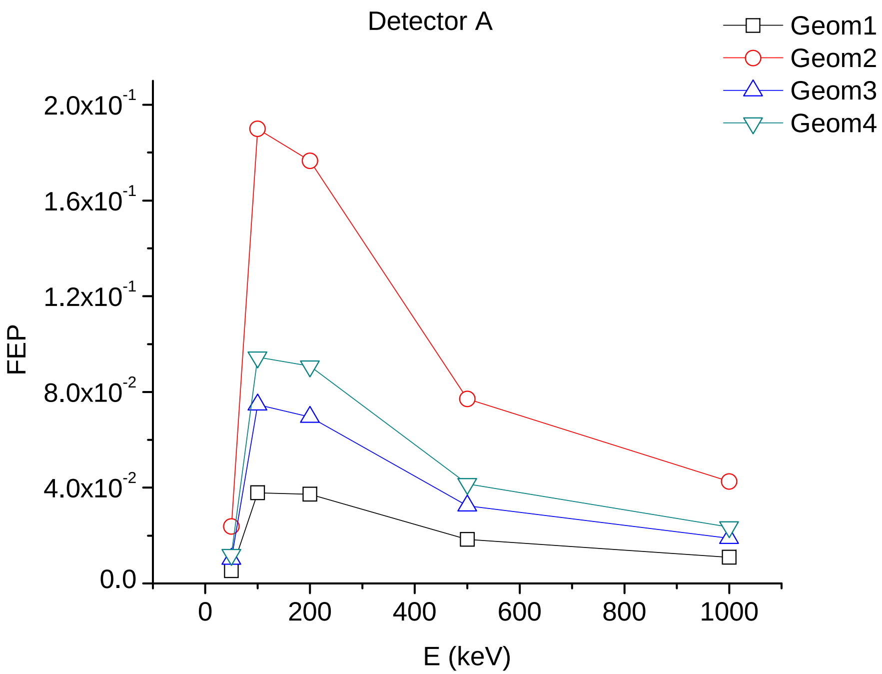
Parameter	Geom1	Geom2	Geom3	Geom4
	Water	Point	Soil	Filter
Sample diameter (mm)	90	-	60	80
Sample thickness (mm)	40	-	20	3
Sample material	Water	-	Dirt	Cellulose
Sample-to-window distance (mm)	1.0	1.0	1.0	1.0

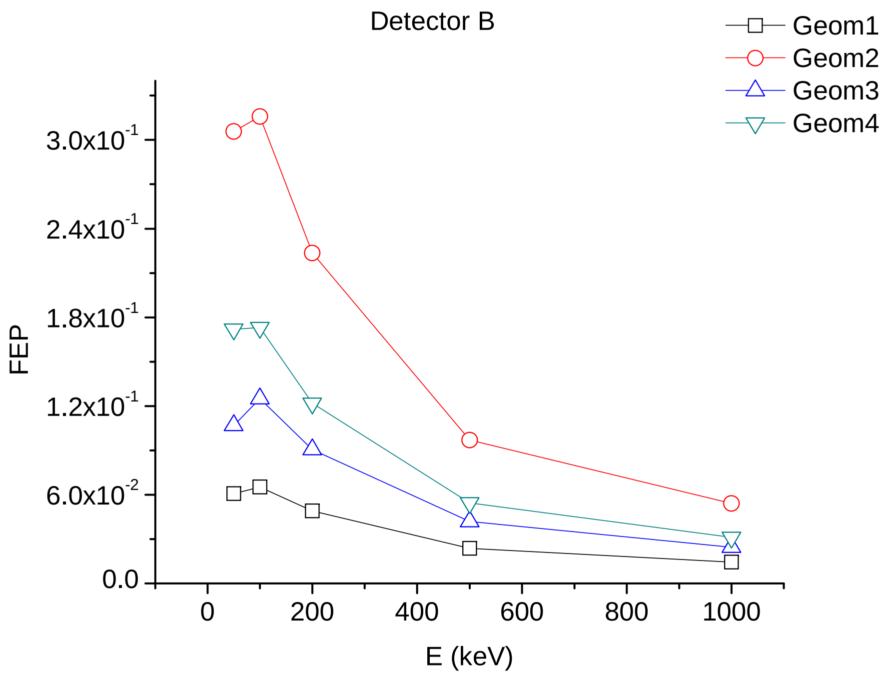
Sample materials

Material	Density (g/cm^3)	Chemical formula
Ge	5.323	Ge
Al	2.70	Al
Water	1.0	H_2O
Dirt	1.4	SiO_2
Cellulose	0.3	$C_6H_{11}O_5$

not included
in GESPECOR

Full energy peak efficiency

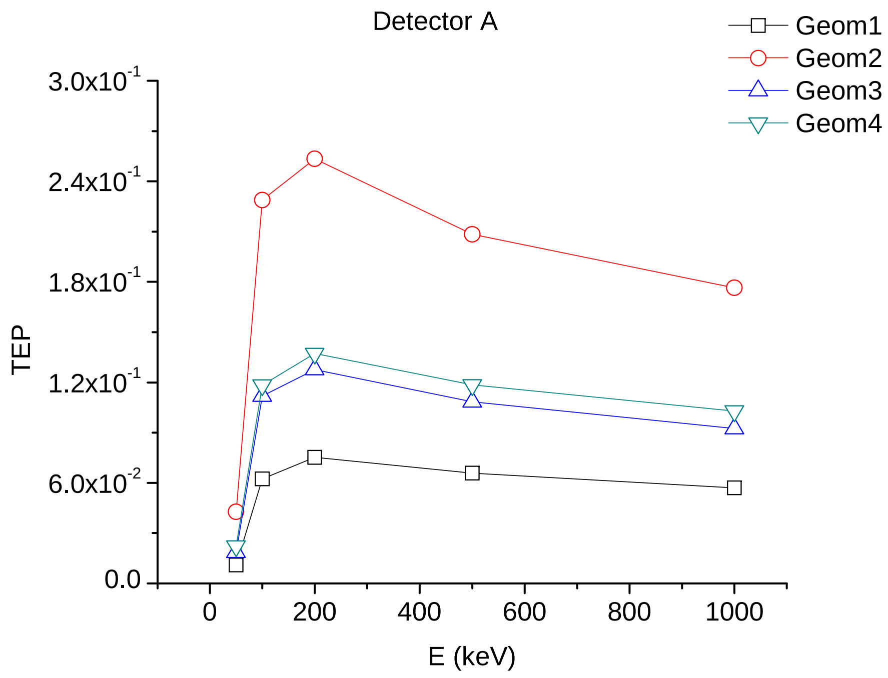


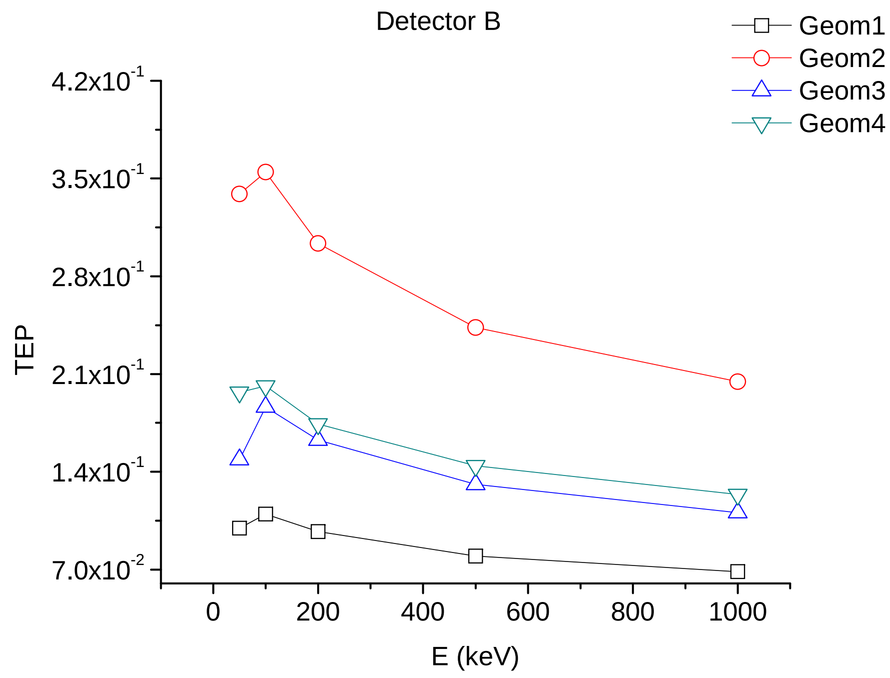


Uncertainties <0.30%, k=1, for Detector A (<0.28% for A. Luca)
<0.29%, k=1, for Detector B (<0.31% for A. Luca)

Action 2

Total energy peak efficiency





Uncertainties <0.76%, k=1, for Detector A (<0.72% for A. Luca)
<0.40%, k=1, for Detector B (<0.33% for A. Luca)

An important comment (Action 2):

- Both participants used GESPECOR, version 4.2, with software files from 2007 (A. Luca) and 2014 (D. Gurau), respectively; very high relative differences (up to 65 %) were obtained between the two sets of results for the total energy peak efficiency, at 50 keV, for all the four types of samples and especially for the detector A.
- When A. Luca installed the new files (beginning of May 2018), kindly provided by prof. Octavian Sima, and re-run the simulations, then the two sets of results were in good agreement (within *k*=3).
- **SO, BE CAREFUL WHICH FILES YOU USE WITH YOUR SOFTWARE !**

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Thank you for your attention!