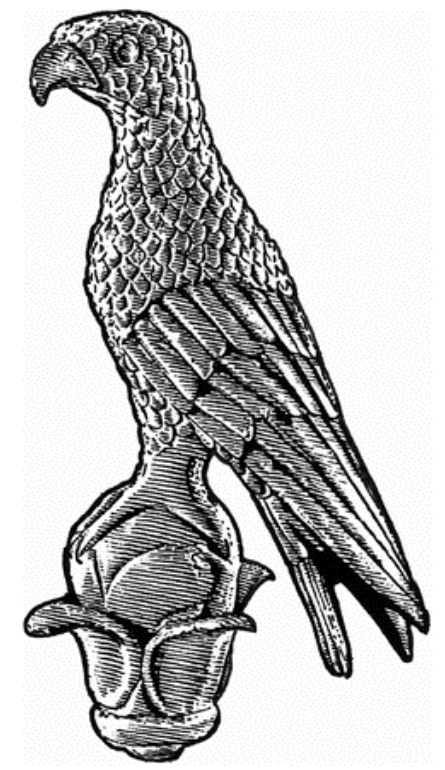


Geant4 Monte Carlo simulations of a 100% relative efficiency HPGe detector



National Technical University of Athens



Anastasios Anastasiadis¹, Nikolas Patronis¹, Michael Axiotis², Natalia Bligoura¹, Zinovia Eleme¹, Varvara Foteinou², Efstathia Georgali¹, Sotirios Harissopoulos², Antigoni Kalamara³, Michael Kokkoris³, Anastasios Lagoyannis², George Provatas², Roza Vlastou³ and Stergiani-Marina Vogiatzi¹

¹Department of Physics, University of Ioannina, 45110 Ioannina, Greece

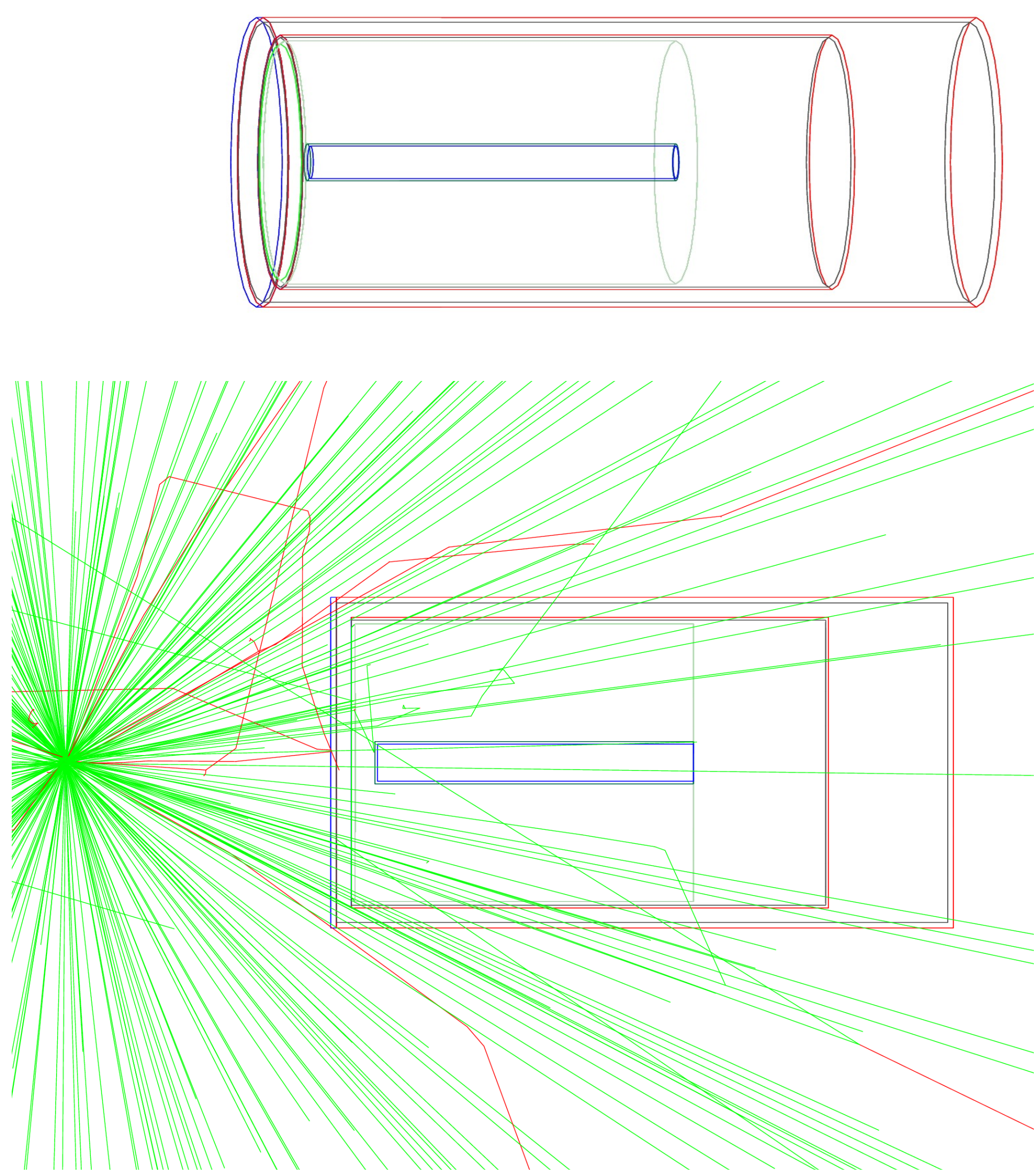
²Tandem Accelerator Laboratory, Institute of Nuclear Physics, N.C.S.R. Demokritos, Aghia Paraskevi, 15310 Athens, Greece

³Department of Physics, National Technical University of Athens, Zografou Campus, 15780 Athens, Greece

Introduction

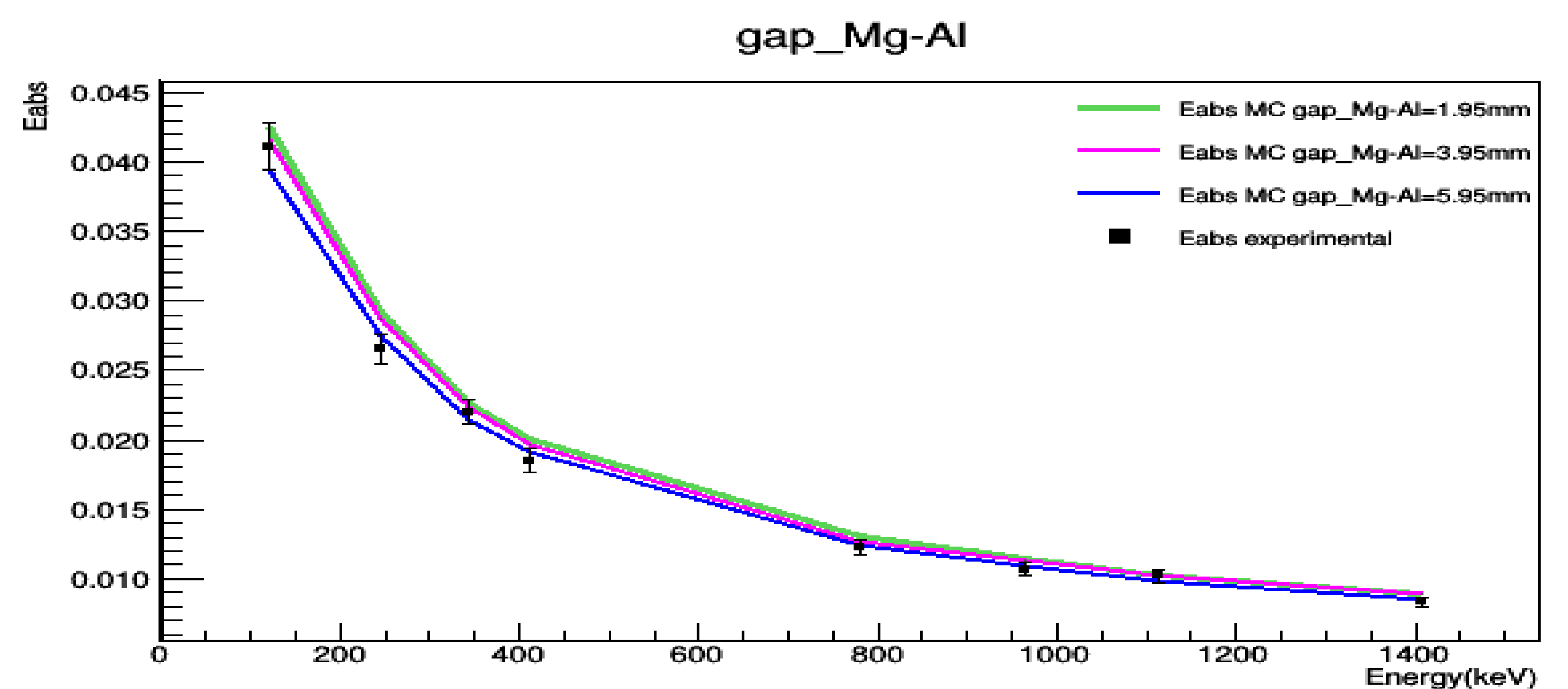
HPGe detectors are widely used for γ -ray spectroscopy, mostly due to their high resolution. Within the present study, HPGe detector with relative efficiency 100% was characterized. The efficiency of the detector was experimentally determined at two source to detector distances by using a Eu-152 calibrated point source. Following the experimental peak efficiency, a Monte Carlo simulation for the same geometry was implemented using the Geant4 simulation package, reproducing the experimental results for two distances and for the characteristic γ -rays of the Eu-152. Through the successful modelling of the detector with respect the point sources, the absolute peak efficiency for extended sources can be accurately estimated and self attenuation effects can be taken into account for the actual sample measurements. As to characterize the simulated detector, many trials were performed by using slightly different detector geometrical characteristics. After numerous trials and by comparing the experimental efficiency with the simulated one, the full characterization of the detector was achieved.

The visualization of the HPGe detector

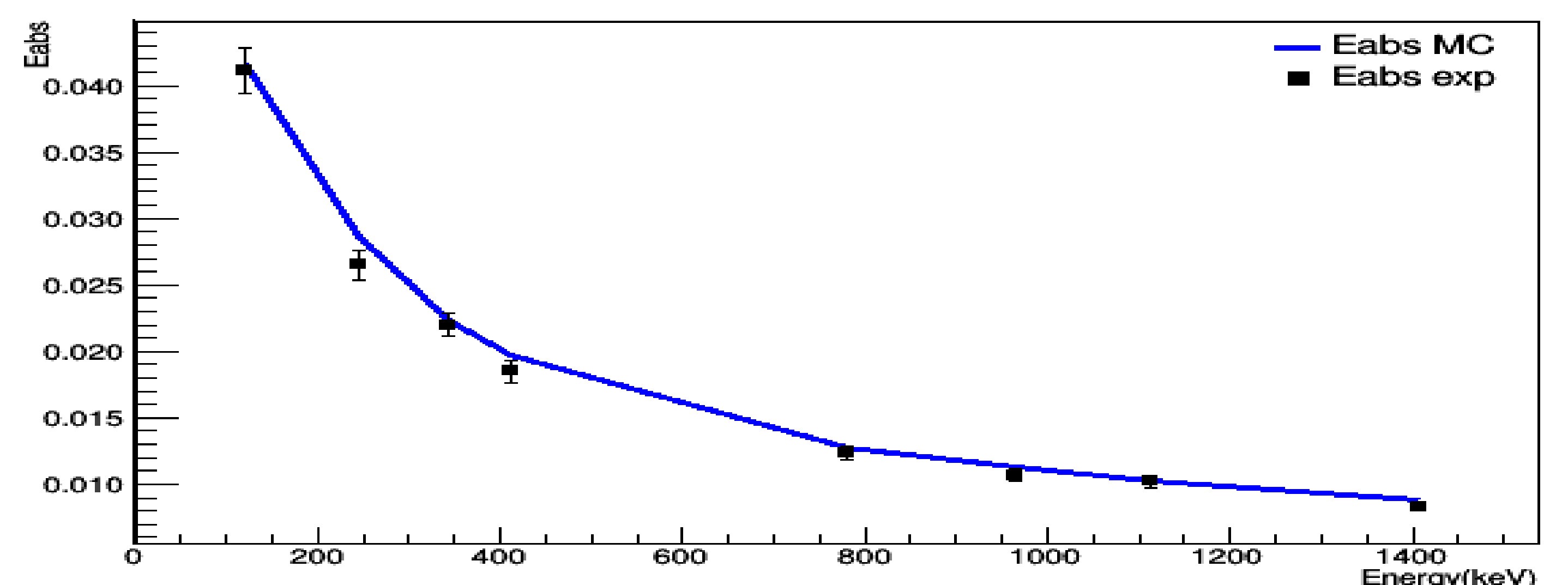


Some trials

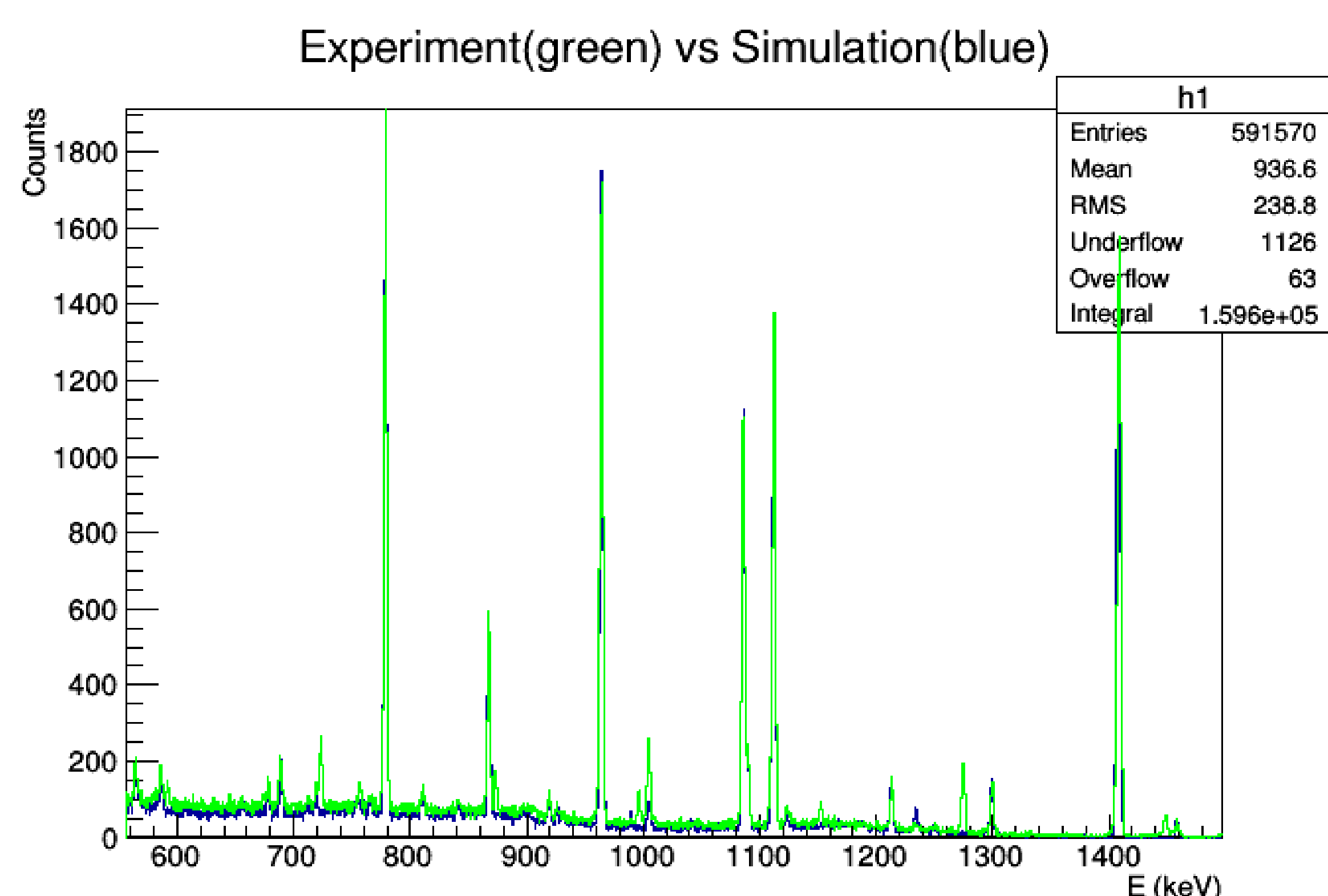
Using as a starting point the specifications given by the manufacturer, with respect the nominal values extensive trials and tests were performed towards to the optimum characterisation of the detector, by changing, in a consistent way, the front dead layer, the crystal radius and the distance of the crystal from the entrance window of the detector.



FDL thickness 0.3microns



The experimental and the simulated spectrum



Conclusions

Using the Geant4, in every trial, the recommended dimensions provided by the manufacturer reproduced fully the experimental results, with respect the efficiency of the detector in the energy range 100 keV-1500 keV for the two different detection geometries. Accordingly, the detector was successfully modeled, which means that the present Geant4 application can be used for the specific needs of data analysis, as well as for optimization of future experimental champings.