

Simulations of possible Ge arrays for the DESPEC setup at FAIR

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At the Low Energy Branch of the future FAIR facility, the fragmented beams from the Super-FRS are slowed down in energy or completely stopped. One of the experiments proposed at this branch is DESPEC (decay spectroscopy) where studies of the decay of short-lived nuclei, either in their ground state or in an isomeric state are planned.

The ions at some tens of MeV/u will be deeply implanted in an active stopper; a highly pixellated Si detector which allows correlating in time and space the signal from the implanted ion with the subsequent signal produced by the β in case of β -decay. This detector together with gamma-ray and neutron detectors arranged in a compact geometry around the stopper are the heart of the experimental setup.

The present report deals with the simulations for the Ge array. For the moment the collaboration is considering two possibilities. The first one is to use an array of planar Ge detectors specifically designed to fulfill the DESPEC requirements. The other alternative is to use more standard segmented Ge detectors of EXOGAM [1] or TIGRESS [2] type. The R&D phase requires the realization of Monte Carlo simulations in order to determine the optimal and most cost-effective setup for the future facility.

The "planar setup" consists of an array of 24 composite planar detectors (see Fig. 1 for a schematic view). The detector unit is a stack of three planar Ge detectors with dimensions $72 \times 72 \times 22 \text{ mm}^3$. Each planar has a guard ring of 2 mm, which leaves an active Ge volume of $68 \times 68 \times 22 \text{ mm}^3$. The distance between the planars is 3 mm and the stack is encapsulated in an Al capsule of 1.5 mm thickness. They are situated around a focal plane of $24 \times 8 \text{ cm}^2$ surface.

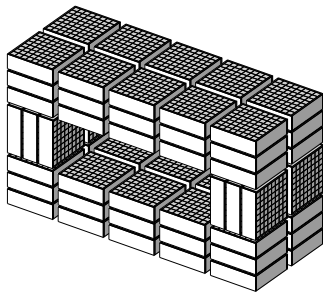


Figure 1: Schematic view of the planar setup. Each detector unit is an stack of three segmented planar detectors.

The "CLOVER" setup is an array of 6 CLOVER detectors of the EXOGAM type. Each detector consists of

four co-axial n-type Ge crystals arranged in the configuration of a four-leaf clover and housed in the same cryostat. The individual crystals considered are 60 mm diameter and 90 mm long before shaping. In this setup the detectors were positioned in an annular arrangement around the focal plane. Four CLOVER detectors are facing the longer side of the focal plane (two detectors on the top, two detectors on the bottom), while the other two detectors face the shorter sides of the focal plane.

The two described geometries have been implemented using the Monte Carlo code GEANT4 [3]. In this framework, we have studied the detection efficiency of the two setups either for point-like or extended monoenergetic sources. In Table 1 the results for the two "standard" setups are presented for centered point-like sources. The quoted peak efficiencies correspond to the sum of the individual detector efficiencies of each setup.

As part of our study, efficiencies have been also calculated for other possible geometrical arrangements with more detectors (8 CLOVER detectors), and for a focal plane of $8 \times 8 \text{ cm}^2$. The possibility of an arrangement that can be optimal to couple with neutron detectors has been also considered. The next step of our work will be the study of the performance of tracking algorithms for the different setups as well as their γ -imaging efficiency.

Table 1: Calculated efficiency (%) of the studied setups.

Energy (MeV)	Eff. planar setup		Eff. clover setup	
	(Peak)	(Total)	(Peak)	(Total)
0.10	48.4	53.7	36.4	46.3
0.25	34.5	57.4	30.7	46.2
0.50	21.0	55.6	23.5	43.6
1.00	13.3	50.3	18.0	40.7
2.00	8.9	44.5	12.9	36.6
5.00	4.1	39.6	7.1	32.8
10.00	1.8	36.7	4.0	28.7

References

- [1] <http://www.ganil.fr/exogam/>
- [2] H. C. Scraggs *et al.*, Nucl. Inst. and Meth. A543 (2005) 431
- [3] S. Agostinelli *et al.*, Nucl. Inst. and Meth. A506 (2003) 250; <http://wwwasd.web.cern.ch/wwwasd/geant4/geant4.html>

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