The MINIBALL-Project

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With the construction of the first generation of radioactive beam facilities in Europe [1,2] it became apparent that a new generation of highly efficient γ-detector arrays is needed to make optimum use of these low intensity and expensive beams. In contrast to the EUROBALL or GAMMASPHERE arrays the total full-energy peak efficiency and not the resolving power has to be optimized. Presently a mobile Ge-detector array, called MINIBALL [3], is being developed. It consists of a cube of 6 CLUSTER detectors of EUROBALL design. Here, however, each CLUSTER consists of 7 individually encapsulated six-fold segmented Ge-detectors. Fig. 1 shows the arrangement of the six segmented CLUSTER detectors in the MINIBALL geometry, displaying the sixfold angular segmentation and the radial subdivision expected from a pulse shape analysis of the central energy signal.

The compact MINIBALL is mainly suited for the detection of events with low γ-ray multiplicity. Hence, it complements the high-spin physics addressed with, e.g. EUROBALL. While the primary goal is the use of the MINIBALL array in radioactive beam experiments, in particular at REX-ISOLDE [1] at CERN, the mobility of MINIBALL allows for its efficient use in many other experimental setups.

At the Munich Fission Fragment Accelerator new possibilities will open up for the high resolution spectroscopy of neutron rich nuclei. The MINIBALL can be used to study the vicinity of the doubly magic nuclei ^{78}Ni or ^{132}Sn via Coulomb excitation and transfer reactions. Nuclei close to the valley of stability can be produced in fusion reactions opening up a new area of high-spin γ-spectroscopy where by now only low-spin states could be investigated.

At the Munich Tandem spectroscopic studies in the actinide mass region will be performed, adressing the back decay of fission isomers in ^{236,238}U [4] as well as the decay in the second minimum [5].

In order to exploit the flexibility provided by the individually encapsulated MINIBALL detector crystals, not only cryostats of the EUROBALL type housing 7 crystals in the CLUSTER geometry will be available, but also smaller units with three detectors in a common cryostat will be developed in order to allow for different geometrical detector arrangements.

Besides the novel technologies needed for the production of sixfold segmented, encapsulated Germanium detectors leading to the first prototype of a sixfold segmented CLUSTER detector presently being tested at the manufacturer EURISYS [6], the drastically increased number of signals (7x7 instead of 7 energy signals) at the back of the CLUSTER array requires new solutions for the arrangement of the signal cables in order to assure a proper shielding of the signals.

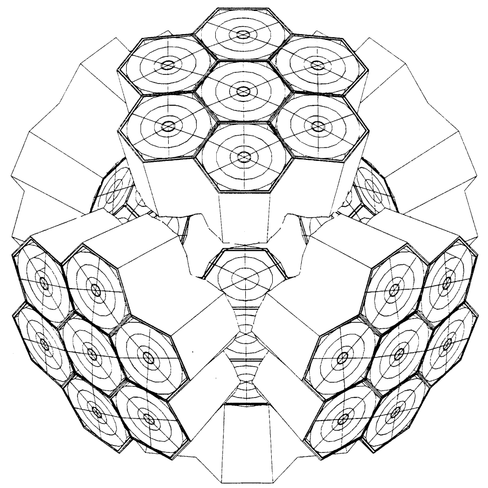

Fig. 1: Arrangement of the six segmented CLUSTER detectors in the MINIBALL array. For each crystal the sixfold angular segmentation and the radial subdivision expected from pulse-shape analysis is indicated.

Two options for the signal processing of the segmented detectors are presently being evaluated: the first solution would be a VXI based electronics, derived from the CLUSTER card development for EUROBALL but upgraded for improved resolution at lower γ-ray energies and including the possibility of a pulse shape analysis to determine the radial position of the γ-ray interaction. Alternatively, a CAMAC electronics with FERA-readout into a VME-system based on the electronics from GAMMASPHERE and the segmented CLOVER array presently built up at Oak Ridge is under investigation. In addition, any final solution for the MINIBALL electronics has to be able to incorporate electronics from ancillary detectors such as the highly segmented double sided silicon strip detector ('CD') presently being developed at Edinburgh for MINIBALL.

References

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