Status of the MINIBALL-Array

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The MINIBALL detector will be a new Ge detector array which is optimized to gain highest full-energy peak efficiency for low to medium γ-ray multiplicity ($M_\gamma \lesssim 10$) events. The array will consist of 42 segmented position sensitive Ge detectors [1]. γ-spectroscopic investigations will be performed utilizing radioactive beams provided by the REX-ISOLDE accelerator facility in near future and the MAFF facility on the long term.

After first measurements and experiences with a first generation of six fold segmented MINIBALL prototype detectors in Munich, Heidelberg and Cologne the manufacturer, Eurisys Measure, adressed several problems. The delivery of four new improved Ge detectors was delayed into the second half of 1998. Ongoing source measurements with the new detectors confirm the very good high energy resolution at the core contact of $\Delta E \approx$2.1 keV and the segments with typically $\Delta E \approx$3.0 keV at E_γ =1.33 MeV. While the FET of the central contact is kept near liquid nitrogen temperature, the energy resolution of the six individual segments is measured with a 'warm' FET. The final mounting of the detectors in a common cryostat will also allow to cool the FET of the segments improving their energy resolution below 2.5 keV. Hence, 42 x 7 individual electronic signals have to be instrumented with high resolution Geelectronic for the MINIBALL array in its final stage.

A major decision was made by the MINIBALL collaboration in 1998 by a modification of the cryostat configuration to increase the versatility of the final instrument in order to suit specific requirements of individual experiments. The previous 'standard' design of the detector array was foreseen to be built up by 6 Cluster detectors of the Euroball design [2]. Each Cluster consists of 7 individual encapsulated six-fold segmented Ge detectors. The new design will combine subgroups of three and four Ge detectors respectively to units with a common vacuum chamber, cryostat and dewar. The same high photo peak efficiency of the final array will be achieved. However, smaller subsets of detector groups may be arranged in a very efficient way. F.e. a set of 18 Gecrystals can be arranged in six groups of three detectors in a cubic geometry. The photopeak efficiency of this setup ($\epsilon \approx$10%) will be comparable with spectrometers like Euroball or Gammasphere. The reduced number of Ge detectors will be available for the first experiments scheduled in the second half of 1999 at REX-ISOLDE. The mechanical and electronical assembly of the triple detector system has been started and will be finished by the group of J. Eberth (Cologne). The Munich group contributed the vacuum vessel, which houses the three crystals.

A fully digitized signal processing electronic is actually commercially customized by XIA, Mountain View (USA) for the 294 MINIBALL electronic channels. The concept will be to digitize the preamplifier signals after an analog amplifier and a low-pass filter with an ADC at 40 MHz. A real time processing unit (a field programmable gate array) is filtering the digitized signal stream. Pulse events are detected, the pulse height (energy) information is extracted and pulse shape information is stored in a FIFO. In addition the baseline is measured continuously, a pile-up inspection is implemented, the input count rate and live time is recorded. A Digital Signal Processor (DSP) is used for improved pulse height and pulse shape analysis. The DSP also controls the other system sections and communicates with a host processor. Prototype modules are available and first test measurements with MINIBALL Ge detectors are being performed. The achieved energy resolution with the digital electronic module is of equal quality compared to results achieved with standard analog Ge electronics. Timing properties and position determination are currently investigated exploiting the digitized pulse shape information.

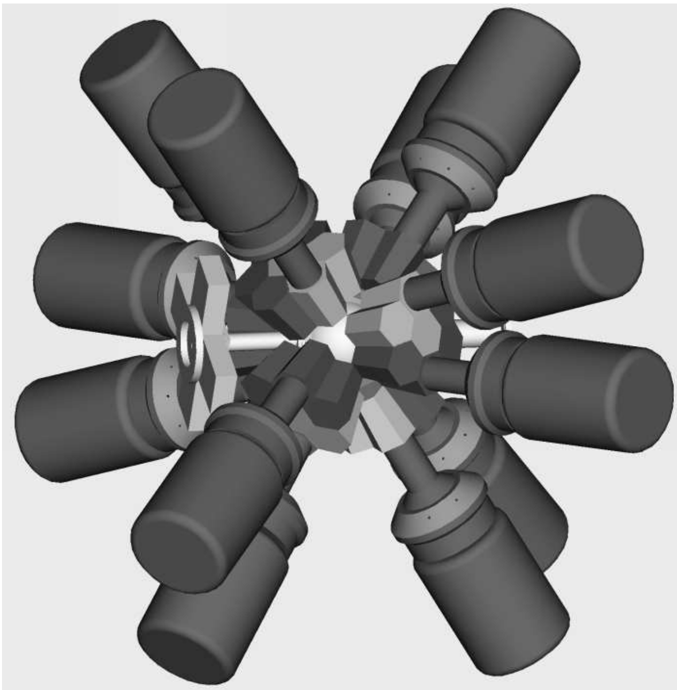

Fig. 1: The modified MINIBALL consisting of composite Ge detectors with three and four Ge crystals in a common vacuum chamber, cryostat and dewar.

References

[1] D. Habs *et al.*, Prog. Part. Nucl. Phys **38** (1997) 111
[2] J. Eberth *et al.*, Prog. Part. Nucl. Phys **38** (1997) 29