Status of the MINIBALL Array

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Major steps towards completion of the MINIBALL [1,2] spectrometer were done this year. In contrast to high spin spectrometers like EUROBALL the total full energy peak efficiency and not the resolving power is optimized for MINIBALL to gain highest efficiency up to 10 MeV for low to medium γ-ray multiplicity ($M_\gamma \leq 10$) events. In order to gain the efficiency the detectors are operated at close distance (11 - 19 cm) from the target. MINIBALL will be the first array consisting of position sensitive Ge-detectors which are needed due to their large opening angles for a proper Doppler correction of the γ-rays emitted by fast recoiling nuclei.

All spectrometer components for phase I are ready to be mounted: the 18 six-fold segmented encapsulated Ge-detectors were delivered by EURISYS Mesure, the cryostats for six triple CLUSTER detectors are provided by Cryostat- and Detector Technique Thomas, the digital CAMAC electronic modules DGF4C (customized by XIA, Mountain View (USA)) are available, the mechanical frame and the liquid nitrogen system are completed.

The support frame for the MINIBALL-Cluster detectors provides the high mechanical flexibility needed for the different types of experiments. The Cluster detectors are mounted on six semicircular arcs which are pivoted around the target. Up to three Cluster detectors can be mounted on one arc and nearly all detection angles can be reached. The individual Cluster-detector is rotatable around its axis and the distance to the target is flexible. The frame enables a fast rearrangement of the array without dismantling the detectors. In order to get access to the target chamber the two halves of MINIBALL can be moved perpendicular to the beam axis by one metre on each side. Prior to its employment at the REX-ISOLDE experiment MINIBALL is installed at Institut für Kernphysik at University of Köln. Fig. 1 shows a photograph of the new mechanical support frame with a setup of five Triple-Cluster detectors.

The MINIBALL Triple-Cluster cryostats are manufactured and most of the Ge-detectors are implemented. One cryostat houses three six-fold segmented encapsulated Ge-detectors. The cold parts of the seven preamps are mounted inside the cryostat vacuum. All 21 preamps are plugged into a motherboard mounted in the cryostat. The energy resolution of the individual Ge-detectors is $\approx$ 2.22 keV for the core signal and 2.45 keV for a segment signal [3].

The complete electronic pulse processing for MINIBALL, starting from the preamplified Ge-pulses, is realized in digital electronics. The DGF4C module comprises four complete Ge channels. The analog part contains an amplifier for gain adjustment and a low-pass Nyquist filter. The pre-amplifier signal is digitized by 12 bit, 40 MHz sampling-ADC. A field programmable gate array (FPGA) is filtering the digitized signal stream. Charge pulses are detected; the energy information is extracted and pulse shape information is stored in a FIFO. A continous baseline measurement and a pile-up inspection is implemented, the input count rate and live time is recorded.

To operate the DGF4C module together with the Munich data acquisition system MARABOU (MBS And ROOT Based Online-Offline Utility) two software packages were developed. One package serves is necessary to setup and to control the functionality of the modules and the individual channels. The second package is needed to implement the new DGF4C modules into the front-end system for data readout, event building, and data transport based on GSI's Multi Branch System (MBS) [4] and a back-end system for online data analysis. A more detailed description of this work is given in this report. In future the limited transfer rates imposed by the CAMAC standard will be overcome by an additional Firewire readout (IEEE 1394) with a maximum rate of 16 Mwrds/s. For this application further software developments are in progress.

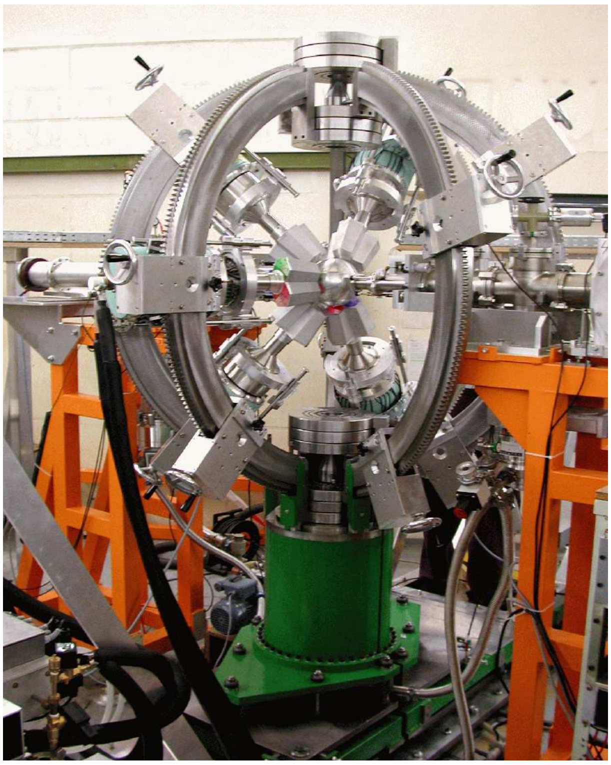

Fig. 1: The MINIBALL support frame with five Triple-Cluster detectors at IKP Köln.

References

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[2] D. Habs *et al.*, Prog. Part. Nucl. Phys **38** (1997) 111
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[4] H. Essel, N. Kurz *et al.* The GSI Multi Branch System. See also http://www.gsi.de