Status of the MINIBALL Array

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The upcoming next generation of radioactive-beam facilities like REX-ISOLDE and MAFF makes it inevitable that a new highly efficient γ-detector-array will be available to make optimum use of these elaborate and expensive beams. With the MINIBALL array a factor of two larger full energy peak efficiency compared to the high spin spectrometers like EUROBALL can be achieved for an individual γ-ray. The MINIBALL detector will be a Ge-detector array which is optimized to gain highest efficiency up to 10 MeV for low to medium γ-ray multiplicity ($M_\gamma \leq 10$) events. The basic element of MINIBALL is a six-fold segmented encapsulated Ge-detector of Euroball shape [1]. The array will consist of 42 segmented position sensitive Ge detectors [2]. The capsules will be packed to clusters of either three, four or seven to provide a high level of flexibility and to accomodate the various demands of individual experiments.

Meanwhile, three Ge-crystals of the first triple CLUSTER detector were equipped with a new cold preamplifier bord (liquid nitrogen temperature) for seven cooled FET's and mounted in the final cryostat. As a consequence, the energy resolution of the segments improved to typical values of 2.5 keV at 1.3 MeV and 1.6 keV at 122 keV. Furthermore, the microphonic sensitivity of the output channels could be minimized reducing thereby electronical problems.

Energy resolution of MINIBALL CLUSTER detector						
Detector	HEX 606		HEX 603		HEX 612	
E_γ [keV]	122	1332	122	1332	122	1332
core	1.36	2.33	1.25	2.19	1.30	2.22
seg.1	1.70	2.72	1.41	2.47	1.65	2.41
seg.2	1.91	2.89	1.49	2.53	1.52	2.44
seg.3	1.58	2.63	1.52	2.49	1.63	2.44
seg.4	1.47	2.55	1.58	2.55	1.96	2.60
seg.5	1.86	2.72	1.66	2.70	1.71	2.45
seg.6	1.87	3.25	1.64	2.57	1.76	2.53

Table 1:

For the MINIBALL array, 42 x 7 individual electronic signals have to be instrumented with high resolution Ge-electronics. A fully digitized signal processing electronic CAMAC module DGF4C (customized by XIA, Mountain View (USA)) replaces the conventional analog pulse processing electronics. The pre-amplifier signal is digitized with a sampling-ADC running at 40 MHz, from the digitized values the energy- and time information as well as pulse shape parameters for position determination are deduced by exploiting real time digital filter algorithms.

The DGF4C module houses four complete channels on one circuit board. Two prototype modules were available for first test measurements with MINIBALL Ge detectors at Munich in 1999. As a first step a software package was developed within the new ROOT framework [3] responsible for setup and control of the DGF4C modules. The software objects, programmed with C++, are necessary to operate the following functionality of each channel: An analog amplifier and a low-pass filter with an ADC at 40 MHz. A real time processing unit (a field programmable gate array), which 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. A continous baseline measurement and a pile-up inspection is implemented, the input count rate and live time is recorded. A Digital Signal Processor (DSP) is used for pulse height and pulse shape analysis.

In a second step the DGF4C modules were successfully implemented into the MAR$_a$BOOU system (MBS And ROOT Based Online-Offline Utility), which consists of two main parts: a 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.

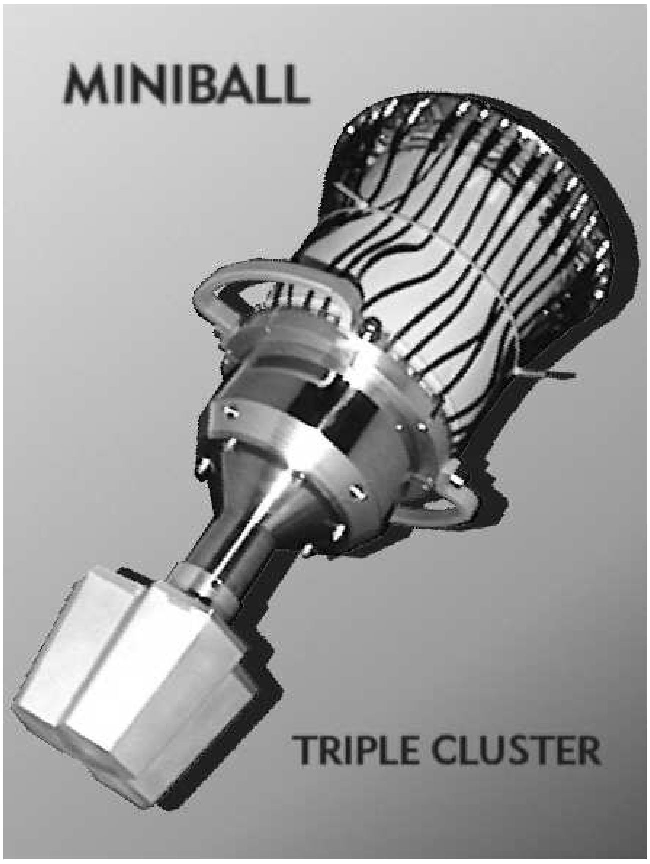

Fig. 1: The first MINIBALL CLUSTER detector with three Ge crystals in a common vacuum chamber, cryostat and dewar.

References

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