Installation of the MINIBALL Spectrometer at REX-ISOLDE

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After the successful commissioning of the REX-ISOLDE accelerator in November 2001, the next milestone of the project was achieved by installing the MINIBALL γ-ray spectrometer [1] at the REX-ISOLDE beamline at CERN. MINIBALL in its present configuration comprises eight triple cryostats each housing three hexagonal sixfold segmented Germanium detectors. Preceding the movement of the spectrometer to CERN the system was tested in a first commissioning phase at the tandem accelerator at Cologne. Reliable operation was proven in a three months test phase. In a combined effort of the MINIBALL collaboration the complete system, including the detectors, the automatic liquid nitrogen filling system, the support structures, target chamber, vacuum system, electronics and the data acquisition system was shipped to CERN and installed at the 65^o beam line of the REX-ISOLDE accelerator. Despite requiring extremely sensitive handling immediate tests showed that none of the detectors lost in performance during the ground transport from Cologne to Geneva. Fig. 1 shows a photograph of the completed installation. The highly flexible support structure, consisting of two hemispheres, each formed of three moveable arcs, allows to arrange (and quickly re-arrange) different detector configurations using all three spatial degrees of freedom.

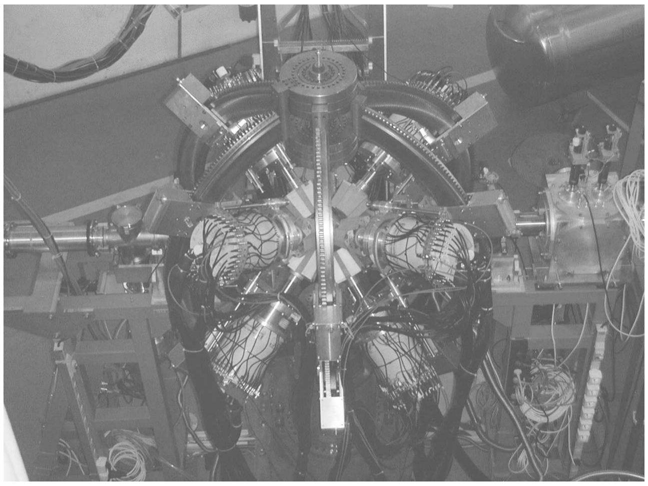

Fig. 1: MINIBALL setup at the REX-ISOLDE beamline at CERN. 8 triple cryostats with a total of 24 sixfold-segmented Germanium crystals are mounted in a close geometry around the target chamber that houses a double-sided silicon strip detector for particle identification and a position sensitive PPAC for beam monitoring.

In its present configuration, optimized for high solid angle coverage, the eight triple units are placed at an average distance of 85 mm from the target, thus resulting in a γ-ray photopeak efficiency of about 15% (at 1.3 MeV). Fig. 2 gives an impression of the close package of Germanium detectors around the target chamber.

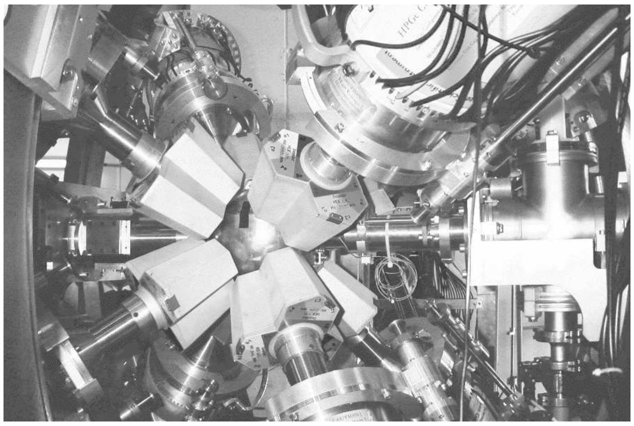

Fig. 2: Close geometrical arrangement of 8 triple cryostat around the REX-ISOLDE target chamber.

Signal processing is performed using a fully digitized electronics, thus allowing for a pulse-shape analysis of the energy signals in order to improve the position resolution provided by the segmented crystals. This capability is needed during in-beam experiments to restore the high Germanium energy resolution by a precise Doppler correction. Immediately before and after installation the energy resolution of all 24 detectors has been tested and proven to be around 2.5 keV (at 1.3 MeV) using the digital electronics. Additionally required in order to achieve the optimum energy resolution is a position sensitive identification of the reaction products, provided by an annular double-sided Silicon strip detector ('CD-detector') specifically developed for the Miniball project. Located behind the target wheel inside the target chamber, the CD detector with its 160 channels (wafer thickness optional from 36 μm to 1000μm) allows for an anguar coverage of 10^o - 40^o, A position sensitive parallel plate avalance detector allows to monitor the radioactive ion beam near the target area even at high counting rates up to 10^9 particles/s. The target chamber including the vacuum system has been installed and leak tightness has been sucessfully tested.
Regularly scheduled beamtime operation of the completed REX-ISOLDE and MINIBALL facility will start after the installation of the data acquisition system, which was developed in Garching, at the end of April, 2002.

References

[1] J. Eberth *et al.*, Progr. Part. Nucl. Phys. **46** (2001) 389