PreSPEC-AGATA Experiments at the Frontier of Nuclear Structure

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In 2012, Coulomb excitation and secondary fragmentation experiments using radioactive ion beams at relativistic energies have been performed for the first time with the new PreSPEC-AGATA setup.

PreSPEC-AGATA is a unique combination of the FRagment Separator(FRS) [1], used for providing and selecting specific radioactive ion beams, the Lund-York-Cologne CAlorimeter (LYCCA) [2], which discriminates heavy ions produced in nuclear reactions taking place at the secondary target, the HECTOR [3] array and 10 $LaBr_3$ detectors used for detection of high-energy γ-rays and the Advanced Gamma Tracking Array (AGATA) [4] , for the precise measurement of γ-ray energies. PreSPEC-AGATA is based on the very successful RISING campaign [5]. The major improvements are the ability of LYCCA to determine the mass of the reaction products and the accurate determination of the first γ-ray interaction point in the AGATA array. The latter leads to a higher γ-efficiency ($\sim$ 10%) keeping the γ-ray energy resolution at about 1%, after Doppler correction, as AGATA can be positioned closer to the PreSPEC-AGATA target. These improvements together with the higher beam intensity provided by the SIS-UNILAC accelerators, yield a factor of 10 higher sensitivity compared to RISING. A picture of the setup is shown in Figure 1.

In 2012, four experiments were performed with the new setup. They investigated how the collectivity is build-up from single particle excitations and how it evolves away from magic nuclei.

Excitation probabilities of the first excited states in nuclei south-west of ^{208}Pb were measured, including heavy Pb, Hg and Pt isotopes. The level scheme of the ^{52}Fe nucleus which is only two valence proton and neutron holes away from the doubly magic ^{56}Ni, shows rotational behavior for the low spin states. In the primary FRS production target ^{52}Fe nuclei were not only populated in their ground state but also in the 12^+ isomeric state, which was Coulomb excited using a gold target at the PreSPEC-AGATA setup. For ^{64}Fe the Pygmy dipole resonance was studied, which probes the properties of neutron skin. Finally, neutron rich Zr isotopes were excited to determine their shape evolution.

A γ-spectrum taken during the commissioning is shown in Figure 2. The fragments identification with LYCCA is discussed in Reference [6], while the trigger configuration used for the experiments is described in Reference [7].

In 2013, the PreSPEC-AGATA experiments will be extended to life-time measurements as well as scattering on a liquid hydrogen target.

* This work was supported by NAVI, Helmholtz Association Nuclear Astrophysics Virtual Institute.

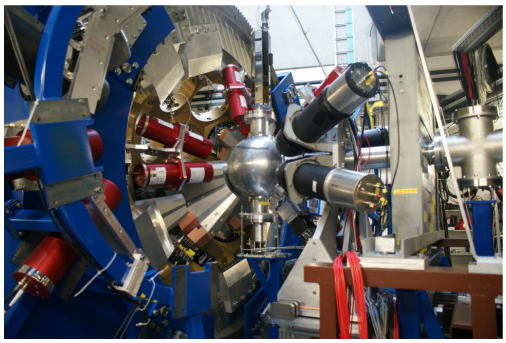

Figure 1: A photograph of the PreSPEC-AGATA setup. The beam from the FRS comes from the right. HECTOR detectors in black, chamber with target manipulators, $LaBr_3$ detectors in red, the AGATA detectors are mounted on the large metal ring, a beam tube connects the target chamber to the LYCCA array.

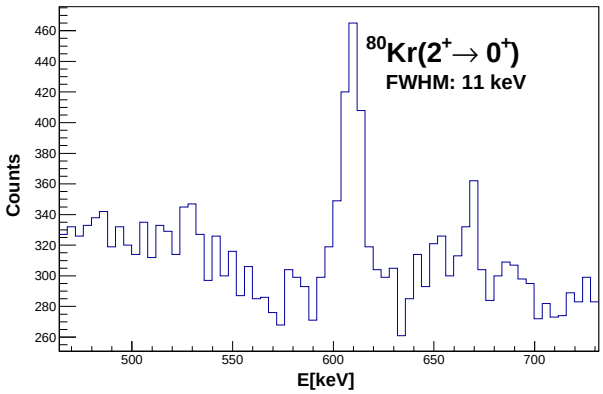

Figure 2: γ-ray spectrum from Coulomb excitation of ^{80}Kr on a gold target at the PreSPEC-AGATA setup. The γ-transition from the first 2^+ excited state to the ground state of ^{80}Kr is marked.

References

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