

THE RISING PROJECT AT GSI AND ITS FIRST RESULTS

T. R. Saito

*Gesellschaft für Schwerionenforschung (GSI), Planckstrasse 1, D-64291 Darmstadt,
Germany*

For the RISING collaboration

The RISING project (Rare ISotope INvestigations at GSI) employs a combination of the EUROBALL Cluster Ge-detectors, MINIBALL Ge-detectors in a second phase, HECTOR BaF₂-detectors and the fragment separator (FRS) at GSI for high-resolution γ -ray spectroscopy measurements. The SIS/FRS facility at GSI provides secondary beams of unstable rare isotopes produced via fragmentation reactions or fission of relativistic heavy ions. These unique radioactive beams have sufficient intensity to perform γ -ray spectroscopy measurements. We are currently performing γ -ray spectroscopy with the FRS-RISING fast beam setup and an in-beam technique by using Coulomb excitation and secondary fragmentation reactions at relativistic energies. We also plan to perform experiments with a stopped-beam technique for decay studies and with a slowed-down beam technique for performing experiments with multiple Coulomb excitation, a few nucleon transfer reaction, a fusion evaporation reaction and a deep inelastic reaction. We investigate various important subjects for nuclear physics with RISING, and they are, (1) shell structure of unstable doubly magic nuclei and nuclei in their vicinity, (2) isospin symmetry along the N=Z line and mixed symmetry states, (3) deformed shapes and shape coexistence, and (4) collective modes of nuclear excitation and E1 strength distribution. The RISING project started in summer, 2003, with the fast beam setup for in-beam γ -ray spectroscopy at relativistic energies. Experiments with the same setup but with the MINIBALL array in addition will be performed in December, 2004. In 2005, we plan to perform experiments with fast and stopped beams. The Feasibility study of slowed-down beam experiments will be performed in 2006. The overview of the RISING project will be presented.

Four experiments have been successfully performed with the FRS-RISING fast beam setup. In the first experiment, a primary beam of ⁸⁴Kr was impinging on a gold target mounted at the center of the RISING Ge and HECTOR BaF₂ arrays in the final focal plane of FRS, in order to investigate feasibility of Coulomb excitation measurements under excellent beam condition by measuring the $2^+ \rightarrow 0^+$ transition of ⁸⁴Kr and to study the particle- γ -ray angular correlation at relativistic energies. Two relativistic Coulomb excitation experiments with secondary beams were also performed to measure $B(E2)$ values of transitions depopulating the first 2^+ state in neutron rich ⁵⁶Cr and neutron deficient ¹⁰⁸Sn. A two-step fragmentation method was applied to observe excited states in ⁵³Ni. The goal of the measurement was to study the mirror symmetry between ⁵³Ni and ⁵³Mn. A secondary beam of ⁵⁵Ni was produced in fragmentation of ⁵⁸Ni primary beam on a beryllium target and was bombarded on a secondary beryllium target mounted in the final focal plane of FRS in order to produce secondary fragments. Experimental detail and the first results of these experiments will be presented.