Dipole strength measurements in the ^{132}Sn region

P. Adrich[a,d], T. Aumann[a], K. Boretzky[b], D. Cortina-Gil[f], U. Datta Pramanik[a], Th.W. Elze[c], H. Emling[a], M. Fallot[a], H. Geissel[a], M. Hellström[a], K.L. Jones[a], A. Klimkiewicz[a,d], J.V. Kratz[b], R. Kulessa[d], Y. Leifels[a], C. Nociforo[b], R. Palit[c], H. Simon[e], G. Surowka[d], K. Sümmerer[a], and W. Walus[d]

[a]GSI Darmstadt; [b]Univ. Mainz; [c]Univ. Frankfurt; [d]Univ. Kraków, Poland; [e]TU Darmstadt; [f]Univ. Santiago de Compostela, Spain

Properties of the Giant Dipole Resonance in nuclei far off stability provide information on the isospin dependence of the effective nuclear interaction [1]. Moreover, recent RPA calculations of the dipole strenght in n-rich nuclei predict the existence of a new mode of collective excitation, exhausting a considerable fraction of the sum rule strenght [2, 3]. This so called Pygmy resonance, expected at energies close to the neutron separation threshold, is most commonly explained as a collective oscillation of a neutron skin against the core of a nucleus. There are, however, numerous controversies on the nature of this excitation as well as on the degree of its collectivity. Nevertheless, the existence of such a low lying state would have pronounced consequences for the astrophysical r-process scenarios [4].

Measurements of the dipole strength functions in neutron-rich nuclei around the doubly magic nucleus ^{132}Sn have been performed with the LAND-FRS facility at GSI.

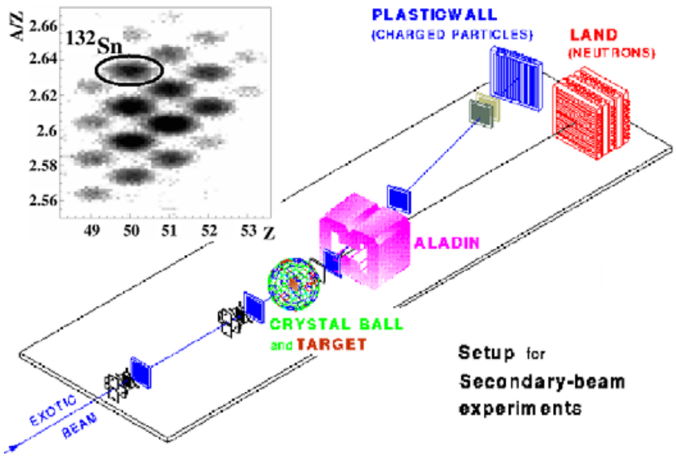

Figure 1: LAND experimental setup. Insert: identification of ^{238}U fission fragments forming the secondary beam transported from the FRS to Cave B.

The beam of ^{132}Sn and about 20 other isotopes of similar A/Z ratio was produced by in-flight fission of a ^{238}U primary beam with an intensity of 6×10^8 ions/spill incident on a Be target. Isotopes were selected according to their magnetic rigidity by the fragment separator FRS. The secondary beams with energies around 500 MeV/u were delivered to the experimental setup in Cave B with an intensity of about 50 identified ^{132}Sn ions/spill. The incoming beam was unambigously identified on event by event basis by determining the magnetic rigidity by a position measurement in the mid-focus of the FRS, time of flight and charge measurements. Projectiles were excited by means of Coulomb excitation in a secondary lead target. Additional measurements on carbon and without target were taken in order to account for nuclear and background contributions. The setup and a beam identification plot are shown in figure 1.

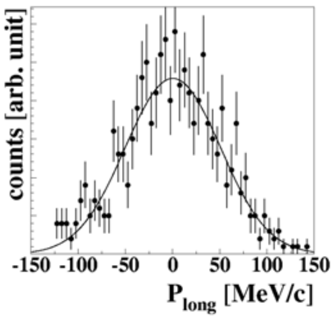

Figure 2: Distribution of neutrons longitudinal momenta in the projectile rest frame.

The momenta of the neutron(s) emerging after the projectile dissociation were measured with the LAND detector. Gamma rays were detected with the Crystal Ball spectrometer. The heavy fragment was identified and momentum analysed by means of energy loss and time of flight measurement and by tracking in the magnetic field of the dipole magnet ALADIN.

At present, the offline calibrations are finished. The consitency and correctness of the calibration is tested by, e.g., plotting the longitudinal momentum distribution of the neutrons in the projectile rest frame. Figure 2 shows that indeed the neutron p_{long} distribution is centered at zero as expected for the Coulomb excitation process.

Further data analysis is in progress. The excitation energy will be obtained from the reconstruction of the invariant mass by utilizing the measured four-momenta of all decay products. By taking into account the spectrum of the virtual photons and corrections for efficiency, acceptance and background, the dipole strength functions can be derived.

References

[1] P.-G. Reinhard, Nucl. Phys. **A649** (1999) 305c-314c

[2] D. Vretenar et al., Nucl. Phys. **A692** (2001) 496-517

[3] G. Colo et al., Nucl. Phys. **A722** (2003) 111c-116c

[4] S. Goriely, Phys. Lett. **B436** (1998) 10-18