Probing the single particle structure around ^{54}Ca with one-neutron knockout

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The structure of neutron-rich nuclei is one of the current topics of theoretical and experimental studies of atomic nuclei. Due to the influence of residual interactions between valence orbitals the shell structure is expected to change locally. For calcium isotopes, a new shell closure for neutron number N=34 is predicted [1]. Knockout reactions at high beam energies in combination with γ-ray spectroscopy allow to determine the l-values, locations and spectroscopic factors of single-particle states and therefore to test theoretical predictions. This method is well established for lighter masses, but it is unclear how reliable spectroscopic factors can be extracted for knock-out reactions at medium energies. However, at the high beam energies available at GSI the approximations to the reaction dynamics are much better fulfilled. Therefore, part of our study aims at testing the reliability of spectroscopic factors from knockout reactions in well-bound medium mass nuclei.

In April 2006 we performed a one-nucleon knockout experiment at the fragment separator (FRS) at GSI. A 500 MeV/nucleon ^{86}Kr primary beam was fragmented on a ^{9}Be production target. The first two dipole stages of the FRS equipped with additional devices for TOF and energy loss measurements were used to identify the incident fragments at the central focus of the spectrometer where a secondary target (^{9}Be, 1760 mg/cm^2) was placed. The MINIBALL gamma-ray spectrometer was used to tag excited states in the residual nucleus. The second half of the FRS provided the identification of the fragments after one-nucleon removal and the measurement of their longitudinal momentum distribution from which the angular momentum of the knocked-out nucleon is determined. From the measured cross sections to specific final states spectroscopic factors can be extracted.

Using this set-up we were able to study the knockout from neutron-rich nuclei, especially ^{50}Ca, and ^{74}Zn and the N=34 nucleus ^{56}Ti. First results will be presented for these nuclei along with results from one-neutron knockout from ^{48}Ca which was used for benchmarking purposes.

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