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Quasi-free Proton Knockout Reactions on the Oxygen Isotopic Chain

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According to the Independent Particle Model (IPM) single-particle states are fully occupied up to the Fermi energy with spectroscopic factors of one. However, it is well known from electron-induced proton knock-out that the single-particle strength is reduced to about 60-70% for stable nuclei, which has been attributed to the presence of short-range and long-range correlations[1]. This finding has been confirmed by nuclear knockout reactions using stable and exotic beams, however, with a strong dependency on the proton-neutron asymmetry [2]. The observed strong reduction of single-particle cross sections for the deeply bound valence nucleons in asymmetric nuclei is theoretically not understood. To understand this dependency quantitatively a complementary approach, quasi-free knockout reactions, is introduced. Quasi-free knockout reactions in inverse kinematics at relativistic energies provide a direct way to investigate the single-particle structure of stable and exotic nuclei [3].

We have performed a systematic study of spectroscopic strength of oxygen isotopes using quasi-free (p,2p) knockout reactions in complete kinematics at the R3B/LAND setup at GSI with secondary beams containing $^{13-24}$O. The oxygen isotopic chain covers a large variation of separation energies, which allow a systematic study of spectroscopic factors with respect to neutron-proton asymmetry.

We will present results on the (p,2p) cross sections for the entire oxygen isotopic chain obtained from a single experiment. By comparison with the Eikonal reaction theory [4] the spectroscopic factors and reduction factors as a function of separation energy have been extracted and will be compared to existing data in literature. The results include total and partial cross sections extracted by means of gamma-coincidence measurements as well as momentum distributions. The latter are sensitive to the angular momentum of the knocked-out nucleon in the projectile.

Finally, a brief report will be given on a pioneer experiment performed at RIKEN where the quasi-free (p,2p)-fission reaction was employed for the first time on ^{238}U as a benchmark test for future applications to determine fission barriers of neutron-rich exotic nuclei near ^{208}Pb and ^{214}Bi.

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