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Absolute spectroscopic factors from nucleon knockout with radioactive projectiles[1]

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Many experiments now demonstrate that experiments with rare-isotope beams reveal effects that were not observable in the classical nuclear-physics experiments, limited as they were to experiments with stable targets. Exploration of the drip lines is therefore an essential element in reaching a full understanding of nuclear structure. This presentation will discuss the use of one- and two-nucleon knockout reactions in inverse kinematics to measure partial cross sections and to deduce spectroscopic factors for approximately 50 nuclear states. By far the most interesting result to emerge is that, owing to the firm theoretical basis and essentially parameter-free description offered by eikonal reaction theory, it is possible to obtain absolute spectroscopic factors, accurate to 5-15%, and hence to obtain information on the physical occupancy of shell model states. While knockout reactions with electrons on stable targets had suggested a constant reduction factor R_s relative to the shell model of 0.6-0.7, we find a strong dependence on isospin. Weakly-bound halo states have R_s close to unity. In contrast, some deeply-bound states near the $N = Z$ line have R_s as low as 0.25, but in spite of this the nuclear level assignments and energies are still well described by the effective-interaction model. In other words, the quasiparticles of the model are, for these cases, only to 25% physical particles. Other recent results concern single-particle structure for neutron-rich nuclei near $N = 20$, where the shell gap vanishes, and near N=28, where a new doubly magic nucleus ^{42}Si with a large shell gap above (14,28) appears. We have demonstrated that two-proton knockout on a neutron-rich projectile proceeds as a direct reaction. In this case, the cross sections to individual final states carry detailed information about particle-particle correlations in the many-body wave function.

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