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Wavefunction-spectroscopy with rare-isotope beams[1]

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The nuclear shell model pictures deeply-bound states as fully occupied by nucleons. At and above the Fermi sea, configuration mixing leads to occupancies that gradually decrease to zero. Correlation effects (short-range, soft-core, long-range, and coupling to vibrational excitations) are beyond the effective interactions employed in shell model and mean-field approaches. The picture given above is modified depending on the strength of the correlations. In stable nuclei a reduction of $R_s = 0.6-0.7$ with respect to the shell model has been established from $(e, e'p)$ data. The question on the universality of this reduction beyond the valley of β-stability arises. At rare-isotope accelerators, very deeply and weakly bound exotic nuclei become accessible. One experimental approach to assess the occupation number of single-particle orbits in exotic nuclei are one-nucleon removal reactions at intermediate beam energies. The measured spectroscopic factor C^2S relates to the occupation number of the orbit involved. Our recent work has demonstrated that the spectroscopic factors deduced from knockout reactions are in agreement with the electron-scattering results. Experiments close to stability and far out towards the drip lines have been performed at the Coupled Cyclotron Facility of the National Superconducting Cyclotron Laboratory at Michigan State University. Results covering a wide range of nucleon separation energies across the nuclear chart will be presented and compared.

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