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Effective single-particle energies in weakly bound systems

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There are now well-established solenoidal-spectrometer programs at ATLAS at Argonne, ReA at the Facility for Rare Isotope Beams, and HIE-ISOLDE at CERN. These are facilities with capabilities to deliver radioactive ion beams at energies of a few MeV per nucleon above the Coulomb barrier—ideal energies for direct nuclear reaction studies. Solenoidal spectrometers have proven to be exquisite microscopes for nuclear-structure studies. Over the last few years, these facilities and devices have been important in extending our knowledge of effective single-particle energies from well-bound nuclei to those approaching the limit of nuclear binding. This has triggered a lively discussion as to the mechanism that modifies, for example, the separation between spin-orbit partners such as the p1/2-p3/2 levels around the N = 20 region—these states approach the binding threshold at different rates, reducing the separation between them. I will highlight several new experimental results from all three devices that yield new insights into this behavior, something that appears across the chart of nuclides.