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DNP Mentoring Award Talk: A Collective Solution to an Individual Particle Problem

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As the exciting opportunities FRIB offers to better understand nuclear structure farther from stability approach, it becomes more important to strengthen the foundations of our current understanding at higher spin and neutron excess. One of these foundations has been the configuration-interaction models of sd-shell nuclei based on effective interactions (USD, USDA, USDB) fitted to a wide range of nuclear states. Perhaps one of its greatest successes has been the failure to describe the binding energies of low Z - high N nuclei like ^{31}Na . This island of inversion has been investigated with precursors to FRIB and is generally understood as involving excitations into the fp-shell which are not included in the USD family of interactions. The higher spins accessible with heavy-ion reactions and the large high-resolution gamma detector arrays both call for a more comprehensive theoretical treatment of cross-shell excitations and provide the data to tackle it. An experimental-theoretical collaboration of FSU researchers from graduate students to professors has determined such a more comprehensive cross-shell effective interaction based on nuclei from ^{13}C to ^{51}Ti . Examples of comparisons with experimental energy levels, spectroscopic factors, lifetimes, shell migration, isobaric analog states, and island of inversion effects will be presented.