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Microscopic calculations of neutron-rich isotopes near 40Mg

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Nuclides near the neutron drip line are the frontier in nuclear structure experiment and theory. But full configuration-interaction (FCI) calculations of such nuclides, which provide detailed spectra, can be computationally prohibitive. Instead, we approximate FCI calculations by embedding so-called “beyond mean-field” methods in a shell-model framework. Previous work showed that angular-momentum projected Hartree-Fock calculations, especially when exploiting multiple shape minima, provide surprisingly good excitation spectra (as well as systematics of binding energies such as odd-even staggering), in a variety of nuclides, including odd-A and odd-odd nuclides. Here we generalize by adding additional reference states, specifically occupation-representation of deformed Slater determinants, which can reproduce features of complex spectra such as multiple J^pi = 0+ states, and apply these methods to nuclides around 40Mg. This hybrid approach provides a flexible and computationally tenable framework for modeling nuclides as experiment continues to probe towards the driplines.

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