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Microscopically-based energy density functionals for nuclei

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A fundamental challenge of nuclear theory is to predict the properties of nuclei starting from the underlying vacuum two- and three-nucleon interactions. While impressive progress has been made in extending the limits of *ab initio* methods beyond the lightest nuclei, the nuclear energy density functional (EDF) approach is the only computationally feasible many-body method capable of describing nuclei across the mass table. Driven by interest in the coming generation of radioactive isotope beam facilities, along with studies of astrophysical systems such as neutron stars and supernovae that require controlled extrapolations of nuclear properties in isospin, density, and temperature, there is a large effort currently underway to develop nuclear energy functionals with substantially reduced global errors and improved predictive power away from stability. One possible path forward is to develop non-empirical EDFs that are more closely linked to the underlying nuclear Hamiltonian. In this talk, I describe how the interplay and coalescence of different threads: rapidly increasing computational power, effective field theory, renormalization group transformations, and density matrix expansion techniques are enabling the development of next-generation EDFs starting from realistic two- and three-nucleon interactions.