PROPOSAL FOR AN AB INITIO-DRIVEN NUCLEAR EDF METHOD

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The nuclear energy density functional (EDF) method provides a powerful quantum mechanical tool that can be applied to all bound atomic nuclei, irrespective of their mass and isospin, thanks to a low computational cost. The EDF method however relies, in its traditional implementation, on an empirical formulation of the EDF kernels at play that makes predictions away from known data unreliable if not plagued with spuriosities leading to critical pathologies [1]. Those pathologies are the consequences of a violation of the Pauli exclusion principle that eventually contaminates state-of-the-art multi-reference EDF calculations with nonphysical contributions to the energy [2,3,4].

One possibility to reconcile the necessity to resum many-body correlations into the EDF kernels with the fact that safe multi-reference EDF calculations cannot be achieved whenever the Pauli principle is not enforced is to root the construction of the EDF kernels into a well-suited and well-defined many-body formalism [5]. To be amenable to this guidance, the many-body formalism in question must rely on the concepts of symmetry breaking and restoration [6,7] that have made the fortune of the nuclear EDF method. After elaborating on its motivations, we will briefly describe the first steps we have undertaken towards the realization of this long-term research project.

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