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Towards an ab initio covariant density functional for nuclear structure

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Nuclear structure models built from phenomenological mean fields, the effective nucleonnucleon interactions (or Lagrangians), and the realistic bare nucleon-nucleon interactions are reviewed. The success of covariant density functional theory, which starts from effective Lagrangians, to describe nuclear ground-state and excited-state properties and its influence on Brueckner theory within the relativistic framework are focused upon. The challenges and ambiguities of predictions for unstable nuclei without data or for high-density nuclear matter, arising from covariant density functionals, are discussed. The basic ideas in building an ab initio covariant density functional for nuclear structure from ab initio calculations with realistic nucleon-nucleon interactions for both nuclear matter and finite nuclei are presented. The current status of fully self-consistent relativistic Brueckner-Hartree-Fock (RBHF) calculations for finite nuclei or neutron drops (ideal systems composed of a finite number of neutrons and confined within an external field) is reviewed. The guidance and perspectives towards an ab initio covariant density functional for nuclear structure derived from the RBHF results are provided.

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