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Predictive Nuclear Many-Body Theory with Ab Initio Methods: A Brief Survey and A Look Ahead

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The reach of *ab initio* many-body techniques has increased tremendously in recent years, owing to new developments in many-body theory as well as advances in their numerical implementation. Coupled Cluster, Self-Consistent Green's Function, and In-Medium Similarity Renormalization Group (IM-SRG) calculations are routinely performed for isotopes in the $A \sim 100$ region. Moreover, these techniques have been extended to tackle open-shell nuclei, either directly or through the auxiliary step of deriving valence-space interactions for use with existing Shell Model technology. One of the most powerful aspects of *ab initio* methods is their capability to provide results for energies and other observables with systematic uncertainties. Together with new accurate nuclear forces (and operators) derived from Chiral Effective Field Theory, they provide a consistent framework — and a road map — for a predictive description of nuclei. This will have a critical impact on the search for the limits of nuclear existence, tests of fundamental symmetries (e.g., the search for neutrinoless double beta decay), our understanding of quenching and effective charges in phenomenological Shell Model calculations etc. Using the Multi-Reference IM-SRG as a representative example, I will survey the current capabilities of *ab initio* methods with an emphasis on uncertainty quantification, highlight successes in the description of ground-state properties and spectra, and preview upcoming developments like the construction of consistent transition operators.