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Ab Initio Computations of Ground States and Optical Potentials in Nuclei

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Modern ab initio theory in low energy nuclear physics is based on two addressing main challenges: defusing the nuclear force consistently from QCD (the residual string force between confined nucleons being the relevant degrees of freedom) and providing reliable first principle solutions of the associated many-body problem. Crucial advances on both problems over the last 20 years have allowed predictions up to masses A~140 with unprecedented precision. These are allowing to shed light on the structure exotic isotopes, in particular those o high relevance to astrophysics, electro weak processes and many other observables of interest.
In recent years, we have advanced high-performance computations using many-body propagator theory that can be used to compute the spectral function but that also allow meaningful predictions of radii and binding energies up to masses of A~140.
This talk will review such progress and aim at giving a broader perspective of ab initio theory, in which large scale computations are used to benchmark the theories of nuclear forces besides helping to constrain our insight about nuclear phenomena. I will further discuss some cases in which the knowledge fo the spectral function is important to predict, e.g., the interplay between structure and reactions and the response to neutrinos under the wide range of energies relevant to oscillation experiments.

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