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Ab initio nuclear theory with uncertainty quantification

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Predictive power requires the ability to quantify theoretical uncertainties. While it is true that theoretical error estimates are difficult to obtain, the pursuit thereof plays a pivotal role in science. Reliable theoretical errors can help to determine to what extent a disagreement between experiment and theory hints at new physics, and they can provide input to identify the most relevant new experiments. In this talk I will show that nuclear theory is at a stage where such questions can be addressed.

In particular, chiral effective field theory can be used to systematically bridge the gap from low-energy quantum chromodynamics to nucleons and pions as effective nuclear-physics degrees of freedom. Following this avenue we are making the quantification of theoretical uncertainties possible through the incorporation of state-of-the-art statistical and computational tools. I will outline this procedure and present results from ab initio calculations that provide important steps towards quantifying our understanding of atomic nuclei from first principles.

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