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Connecting Lattice QCD Nucleon-Pion Scattering to Nuclear Ab Initio Calculations

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Quantum chromodynamics (QCD) is the driving mechanism behind the binding of quarks and gluons into nucleons and nuclei. Though rich in physics, the nonperturbative nature of QCD stymies the direct formulation of nuclear physics using quark and gluon degrees of freedom. Instead, perturbative approaches such as chiral effective theory that use pions and nucleons as degrees of freedom have become a mainstay of nuclear physics. State of the art ab initio calculations provide a systematic approach for obtaining properties of nuclei with uncertainty quantification. These calculations are based on chiral effective theories with low energy constants (LECs) that are calibrated against experimental data. We present work towards further grounding ab initio calculations in QCD by providing additional constraints on nucleon-pion LECs entering chiral EFT nucleon-nucleon and three-nucleon forces using Lattice QCD simulations of nucleon-pion scattering. We will show that a combined fit employing a recent LQCD computation of nucleon-pion scattering at unphysical pion mass is consistent with the baseline fit to LECs using experimental data only. Even a modest set of LQCD spectra is sufficiently uncorrelated with experimental data to significantly improve nucleon-pion LEC constraints.

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