Study of Nucleon Excited States with Hamiltonian Effective Field Theory

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Drawing on experimental data for baryon resonances, Hamiltonian effective field theory (HEFT) is used to predict the positions of the finite-volume energy levels to be observed in lattice QCD simulations of the lowest-lying nucleon excitation $N^*(1440)$, $N^*(1535)$, $\Lambda(1404)$. In the initial analysis, the phenomenological parameters of the Hamiltonian model are constrained by experiment and the finite-volume eigenstate energies are a prediction of the model. The agreement between HEFT predictions and lattice QCD results obtained on volumes with spatial lengths of 2 and 3 fm is excellent. These lattice results also admit a more conventional analysis where the low-energy coefficients are constrained by lattice QCD results, enabling a determination of resonance properties from lattice QCD itself. Finally, the role and importance of various components of the Hamiltonian model are examined.