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Understanding the nature of baryon resonances

Tuesday, 6 June 2023 10:00 (30 minutes)

This presentation will open with a brief review of lattice QCD calculations showing the 2s radial excitation of the nucleon sits at ~1.9 GeV, well above the Roper resonance position. We'll then proceed to reconcile this observation with experimental scattering data, gaining insight into the interplay between quark-model states, meson-baryon interactions and the nature of baryon resonances.

While the idea of dressing quark-model states in a coupled-channel analysis to describe scattering data has been around for decades, it's now possible to bring these descriptions to the finite-volume of lattice QCD for confrontation with lattice-QCD calculations. This combination of lattice QCD and experiment demands that we reconsider our preconceived notions about the quark-model and its excitation spectrum.

Herein, the infinite volume world of experiment and the finite-volume world of lattice-QCD are bridged by Hamiltonian effective field theory (HEFT), a nonperturbative extension of effective field theory incorporating the Luscher formalism. After presenting the formalism in the context of the Delta resonance, we'll explore the low-lying odd-parity nucleon resonances where two nearby quark-model like states introduce new challenges. The results lead to a consideration of the even-parity Roper resonance and its isospin-3/2 Delta-resonance partner.

The presentation will close with the results of a new calculation hinting the 2s radial excitation of the nucleon is associated with the N1/2+(1880) resonance observed in photoproduction. The impact of this on the missing baryon resonances problem will be discussed.

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