High Energy Physics - Lattice

Review of Baryon Spectroscopy in Lattice QCD

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The complex patterns of the hadronic spectrum have puzzled physicists since the early discovery of the "particle zoo" in the 1960s. Today, the properties of these myriad particles are understood to be the result of quantum chromodynamics (QCD) with some modification by the electroweak interactions. Despite the discovery of this fundamental theory, the description of the hadronic spectrum has long been dominated by phenomenological models, due to the difficulties of addressing QCD in the strong-coupling regime, where nonperturbative effects are essential. By making numerical calculations in discretized spacetime, lattice gauge theory enables the ab initio study of many low-energy properties of QCD. Significant efforts are underway internationally to use lattice QCD to directly compute properties of ground and excited-state baryons. Detailed knowledge of the hadronic spectrum will provide insight into the character of these states beyond what can be extracted from models.

In this review, I will focus on the latest progress in lattice calculations of the $P_{11}(1440)$, the poorly known hyperon spectrum and the energies of highly-excited states of the nucleon, Delta and other light-flavor baryons. In the heavy-flavor sector, I will concentrate on recent lattice-QCD calculations of baryon masses, particularly those that make predictions concerning yet-to-be-discovered baryons, such as Ω_{cc}, $\Xi^\prime_b$ or triply-heavy baryons.

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