

Origin of the most visible mass in the universe

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The most visible matter in the universe is due to the strong interaction; it is trapped in the protons and neutrons that make up atomic nuclei. There is by now overwhelming evidence that quantum chromodynamics (QCD), the theory of the quarks and gluons, is indeed the correct theory of the strong interaction and yet we do not understand how it actually works. Brute-force, large-scale lattice QCD calculations have reproduced the experimental values of the masses of ground-state hadrons with a single quark-antiquark pair or three valence quarks. But those calculations do not tell us the mechanisms QCD uses to produce those masses. Our ignorance in this matter is profound. Experimentally, information on the origin of mass can be accessed with near-threshold quarkonium-proton scattering, as I will explain in the talk. I will also discuss in the talk our recent progress in using effective field theory techniques to explore this issue and relate those theoretical developments to upcoming experiments in different laboratories worldwide.