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Recent Progress in Understanding the Baryon Resonance Spectrum[1]

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Baryons are complex systems of confined quarks and gluons and exhibit the characteristic spectra of excited states. These states are sensitive to the details of quark confinement, which is only poorly understood with quantum chromodynamics (QCD), the fundamental theory of the strong interaction. To gain insight into this complex dynamics, the baryonic excitation spectrum has been studied for many years. The key question remains what are the relevant degrees of freedom for the resonance physics of QCD. Are the so-called constituent quarks the most efficient way to describe reaction amplitudes and the excitation spectrum of QCD with light quarks? To what extent are diquark correlations, gluonic modes or hadronic degrees of freedom important in this physics? In recent years, lattice-QCD has made significant progress toward understanding the spectra of hadrons, reducing statistical uncertainties and employing robust techniques for spin identication. However, a calculation of the physical excited baryon spectrum is still a tough challenge with present computing power. On the experimental side, high-energy electrons and photons are a remarkably clean probe of hadronic matter, providing a microscope for examining atomic nuclei and the strong nuclear force. Significant progress has been achieved with the recent availability of new polarization data, utilizing polarized beams and/or polarized targets at various laboratories worldwide, e.g. Jefferson Lab in the United States. These are important steps toward so-called complete experiments that will allow us to unambiguously determine the scattering amplitudes in the underlying reactions and to identify resonance contributions. In this presentation, I will give an overview of the excited baryon program and I will discuss the current (experimental) status of the nucleon excitation spectrum.

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