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The quest for missing baryon states in electromagnetic interactions

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The excitation spectrum of nucleons reveals properties of the quark and gluon interactions in a confined system. Knowledge of the nucleon excitations is central to our understanding of the basic interactions underlying the spectrum, and is a fundamental goal of experimental nuclear and hadronic physics. Accounting for the complete baryon spectrum has recently been shown as critical for modeling the transition from the quark-gluon plasma phase to the confinement phase of stable nucleons in the early universe. Microscopic approaches such as constituent quark models and more recently Lattice QCD make predictions regarding masses and quantum numbers of the excited states and their internal structure according to radial, spin, and orbital transitions of the quark-gluon system. Pion induced transitions have revealed many nucleon states consistent with these predictions, but most of the predicted states have not been observed, especially those in the higher mass range. The quest for a more complete understanding of the systematic and the internal structure of baryons has led to a worldwide experimental effort to measure electromagnetically induced meson production including many polarization observables. The CLAS detector at Jefferson Lab is playing a key role in measuring many of the key observables with unprecedented precision, and some of these data have been employed in coupled-channel resonance analyses that led to strong evidence for a number of excited states that were previously unobserved or lacked sufficient evidence. In this talk I will discuss the current status of and future directions in the search for new baryon states using electromagnetic probes.