Spectroscopy of Baryon Resonances at ELSA

Volker Crede [a] for the CBELSA/TAPS Collaboration

[a] Florida State University

Nucleons are complex systems of confined quarks and exhibit characteristic spectra of excited states. Highly excited nucleon states are sensitive to details of quark confinement which is poorly understood within Quantum Chromodynamics (QCD), the fundamental theory of strong interactions. Thus, measurements of excited nucleon states and the corresponding determination of their properties are needed to come to a better understanding of how confinement works in nucleons. However, the excited states of the nucleon cannot simply be inferred from cleanly separated spectral lines. Quite the contrary, a spectral analysis in nucleon resonance physics is challenging because of the fact that these resonances are broadly overlapping states which decay into a multitude of final states involving mesons and baryons.

A long-standing question in hadron physics is whether the large number of so-called missing baryon resonances really exists, i.e. experimentally not established baryon states which are predicted by all quark models based on three effective constituent quark degrees of freedom. It is important to note that nearly all existing data on non-strange production of baryon resonances result from πN scattering experiments. However, quark models predict quite reasonable couplings of these (yet) unobserved states to photon-nucleon rendering the study of these resonances in photo-induced reactions (for example at ELSA) a very promising approach. Several new states have in fact been proposed in recent experiments.

Current and upcoming experiments at the electron accelerator ELSA and at other laboratories will determine polarization (or spin) observables for photoproduction processes involving baryon resonances. Differences between the predictions for these observables can be large, and so conversely they provide strong constraints in the analyses. The current effort with the Crystal Barrel/Taps detector at ELSA, University of Bonn, is to utilize highly-polarized frozen-spin (butanol) and deuterium targets in combination with polarized photon beams. I will review recent spectroscopy results from ELSA.

E-mail: crede@fsu.edu