Working group #6: Baryon Spectroscopy

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Goal: Proposal for the measurement of polarization observables in η photoproduction off the nucleon with the Crystal Barrel/TAPS experiment at ELSA.

Photons are able to excite atoms as well as nuclear constituents proton and neutron, even if the needed energies are more than 10 Mio. times larger for the later case. Obviously the proton and neutron are not elementary.
Assuming that they are made out of three quarks with similar mass using an appropriate potential, quark models describe the measured spectrum of such states (the baryon spectrum) quite well. At least there are no unmeasured but predicted states below center of mass energies $W = 1800\,\mathrm{MeV}$. For higher energies the number of predicted states exceeds the number of measured states by far and one can doubt if these states really exist. Unfortunately the theory of the strong force between the quarks, quantum chromo dynamics (QCD), is not solvable in the energy regime of light baryons. Lattice QCD, unfortunately still using approximations, confirms the rich spectrum predicted by quark models. Therefore one of the main tasks of hadron spectroscopy is to find out what the effective degrees of freedom and the effective forces between them are in the regime of non–perturbative (strong) QCD.
Due to their short lifetime, baryon resonances are broad and overlap strongly with other baryon resonances in the data. Polarization experiments are needed to disentangle unambiguously the contributing resonances to a final state. The upgraded Crystal Barrel/TAPS experiment will again start data taking in 2017 with linear or circular polarized beam and longitudinal or transversal polarized proton/deuteron target allowing the measurement of all single polarization observables and all double polarization observables accessible with beam and target polarization.
In this working group you will learn about hadrons and especially baryons, scattering theory, quark models, partial wave analysis, polarization observables and complete experiments, detection of photons and charge particle identification.