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Studying Laws of Nature with Polarisation Observable

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Hadrons are strongly interacting systems whose dynamics is driven by complex intercommunication between quarks and gluons. The theory of strong interaction, Quantum ChromoDynamics (QCD) , is supposed to describe all particles, however, due to numerical complexity we are still far away from reaching this goal. In such a situation, experimental knowledge about existing resonances becomes crucial. Over the last decade photoproduction proved to be a very valuable tool in extraction of resonance properties - all 6 new three/four-star N*resonances accepted by the Particle Data Group in 2004-2020 years originated from a clean and controlled photoproduction environment. One of the main features which allows photoproduction to be such a superior technique is the ability to access very sensitive polarisation observables. Single and double polarisation observables are a lot more sensitive in resonance searches compared to trivial bump-hunting technique. Due to technical limitations most groups are concentrated on polarisation observables which involve beam and/or target polarisation. In this research we present new data on the so-called spin-transfer variable Cx, which describes polarisation dependence of the recoil nucleon from photon helicity. The talk will present the world first results of neutron Cx for deuteron photodisintegration reaction and for single-pion photoproduction on the proton, obtained with the Crystal Ball at MAMI with linearly and circularly polarised photon beams. The first reaction is very interesting for the study of the first hexaquark state, the . The second reaction constraints systematical errors from more conventional double-polarisation observables and complement baryonic "missing resonance" searches. The new analysis indicated that the is likely to be excited predominantly through an M3 transition rather than an E2 transition, which is consistent with its proposed compact nature, thus constraining the d*(2380) shape.

On behalf the the A2@MAMI Collaboration

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