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Measuring neutron polarisation in pn production using CLAS

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The existence of hexaquark states has far-reaching consequences, such as our understanding of quark structure, and the mechanisms involved inside neutron stars[1]. Predicted in 1964[2], and recently discovered, the simplest non-trivial hexaquark, is the d*(2380), an "excited deuteron" state. The deuteron, comprised of a proton and neutron, can be excited to this state during deuteron photo-disintigration reactions with high photon energies (Eγ ~500-600 MeV). Several other bound/quasibound N-N* dibaryonic states can also be studied in this reaction. Unfortunately, the world dataset of deuteron photo-disintegration has significant gaps in terms of photon energy and angular coverage, particularly in measurements of polarisation observables. To address this problem, we have utilised experimental data from the CEBAF large acceptance spectrometer (CLAS) in a unique way. CLAS was a many-component detector housed in Hall B of Jefferson Lab, a world leading international facility. One such component, the start counter, consisting of a set of thin plastic scintillators surrounding the beamline, was used to determine the start time of an event originating in the target via photo-induced reactions. A novel approach that exploits the start counter as a nucleon polarimeter is implemented by this project. We will show analysis that has led to measurements of neutron induced polarisation by circularly polarised photons in deuteron photodisintegration for beam energies of 0.6 to 2.2 GeV, making use of CLAS's wide angular range, covering N-N* reaction dynamics in second and third resonance regions, and providing exciting new insights into hexaquark studies.

[1] I. Vidana, M. Bashkanov, D. P. Watts, and A. Pastore, Phys. Lett. B 781, 112 (2018).
[2] F. J. Dyson and N.-H. Xuong, Phys. Rev. Lett. 13, 815 (1964).

Primary author: BOOTH, William

Presenter: BOOTH, William

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