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Hadron spectroscopy and exotics (experiment and theory)
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Contact Person: V.Mokeev
Institute: Nuclear Physics Institute of Moscow State University
Christopher Newport University
Email: mokeev@depni.npi.msu.su mokeev@jlab.org

Measurement of high lying nucleon resonances and search for missing state in double charged pion electroproduction off protons.

V.Burkert, V.Mokeev, M.Ripani

Abstract

We describe the physics analysis of data taken by the CLAS Collaboration /1/ in double charged pion production off protons using electron beams. The analysis was carried out within an isobar model specifically developed for the analysis of the $N-\pi-\pi$ channel /2/. This approach relates baryon resonance parameters and experimental cross-sections, allowing to extract electromagnetic and partly strong couplings from the fit. Goals of the analysis are: a) the extraction of poorly known photocouplings for states with masses above 1.6 GeV; b) the search for possible signals from missing baryon states. Invariant masses for the (π^+,π^-), (π^+,P) systems, as well as π^- angular

distributions were fitted for all measured bins in the hadronic mass for photon virtualities $Q^2 = 0.65, 0.95$ and 1.3 GeV^2. All well established N*:s and Δ^* states with masses below 2.0 GeV and with sizeable branching ratio to the $\pi - \Delta$ and $\rho - P$ final states were included in the fit. For the first time the Q^2-dependence of photocouplings for many of the states assigned to the [SU(6)xO(3)] supermultiplets [70,1-] and [56,2+] were extracted. The photocouplings for all states in the [70,1-] multiplet apart from small values for the D13(1700), D15(1675) states follow within 30% the predictions/3/ from a model describing resonance excitation through a Single Quark Transition between coherent 3-quark states, suggesting that this may be the dominant mechanism of [70,1-] N* excitation by virtual photons at $Q^2 \leq 1.5 GeV^2$. A remarkable feature of our analysis of CLAS data is a resonant structure around W=1.7 GeV which has not been seen in $p - \pi^+ - \pi^-$ production with real photons. The structure appears at all Q^2 values of the data. It can not be reproduced by means of conventional N*:s, assuming their strong decay couplings to be those published from recent analysis/4,5/. We found instead that the structure at 1.7 GeV could be described assuming either a strong decay pattern of the conventional P13(1720) state significantly different from published works /4,5/, or by implementing a new P13 (or P33) baryon state at 1.72 GeV. We will discuss both of these hypotheses and related issues in fitting CLAS data as well as other data with the goal of extracting properties of the baryon spectrum.

References

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