Electromagnetic Production of Eta Mesons in η-MAID Analysis

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Electromagnetic production of eta mesons off the nucleons, $\gamma N \to \eta N$, provide an alternative tool to study nucleon resonances besides πN scattering and pion photoproduction. Fewer resonances are involved in this reaction since the ηN final state couples to isospin $I = 1/2$ nucleon resonances only. Therefore, this process is cleaner and more selective to distinguish certain resonances than pion production. This provides opportunities to access less studied resonances and possibly the "missing resonances".
Recently, we use an isobar model (η-MAID [1]) to study η photoproduction and electroproduction on the nucleon. The model contains nucleon Born terms and contributions from t-channel vector meson exchange as nonresonant background. In addition to the dominant $S_{11}(1535)$ nucleon resonance, we also consider resonance contribution from $D_{13}(1520)$, $S_{11}(1650)$, $D_{15}(1675)$, $F_{15}(1680)$, $D_{13}(1700)$, $P_{11}(1710)$, and $P_{13}(1720)$.
Within this model we analyze recent η photoproduction data for differential and total cross sections, beam asymmetry, and target asymmetry, as well as electroproduction data, and good agreement have been achieved. We show that besides the dominant $S_{11}(1535)$ resonance, the second S_{11} resonance, $S_{11}(1650)$, is also required in order to extract $S_{11}(1535)$ resonance parameters properly. Our extracted helicity amplitude for $S_{11}(1535)$ is $A^p_{1/2} = 118 \times 10^{-3}$ GeV$^{-1/2}$ and total decay width is 191 MeV, assuming $S_{11}(1535) \to \eta N$ branching ratio of 50%. In addition, the beam asymmetry data allow us to extract very small ($< 0.1\%$) $N^* \to \eta N$ decay branching ratios of $D_{13}(1520)$ and $F_{15}(1680)$ resonances because of the overwhelming s-wave dominance. Finally, the Q^2 dependence of $S_{11}(1535)$ are extracted from two recent JLab electroproduction data.
Currently, data from several η production experiments are being analyzed and will become available soon. These include beam asymmetry from GRAAL [2], and photoproduction and electroproduction cross sections from CLAS [3,4]. These data cover more W and Q^2 regions. We will discuss these new data in our updated analysis.

References

[1] W.-T. Chiang, S. N. Yang, L. Tiator, and D. Drechsel, Nucl. Phys. A **700** (2002) 429; η-MAID program can be accessed in *http://www.kph.uni-mainz.de/MAID/maid.html*.
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