Photoproduction of the ηas near Threshold

Krusche *et al.* have reported, in a recent Letter [1], precise measurements of differential and total cross sections on the reaction $\gamma p \to p\eta$, from threshold to 790 MeV of the lab photon energy. We draw here some differing conclusions from those in the Letter, in interpreting this data set.

The analysis in [1] is based on its Eqs.(2) and (3). It assumes that the E_{0+} amplitude can be written *entirely* in terms of the $N^*(1535)$, which, in turn, can be expressed in a simple Breit-Wigner (BW) form, Eq.(3). This contrasts with our earlier study [2] on the effective Lagrangian approach (ELA) that included background contributions and a more complicated dependence of the resonance profile on the cm energy W than a simple BW form [1]. We compare these two approaches here.

Our main point here is the following: although the extraction [1] of the helicity amplitude $A_{1/2}$ for the N^* (1535) radiative decay to proton is model-dependent, we can extract from the new data a parameter, ξ [2], characteristic of the electrostrong property of the baryon resonance $N^*(1535)$ in a *model-independent* manner.

To demonstrate this, we display, in Table I, the results of *eight different fits*. First three rows are fits to new differential cross section data, last row to the reduced total one. The rows a (d) and b represent two extreme cases in Table I of [1], involving the contribution of N^* (1535) only, the row a (d) corresponding to $W_R = 1549$ MeV, $\Gamma_R = 202$ MeV, $b_\eta = 0.55$, the row b having these parameters as 1539 MeV, 208 MeV and 0.35 respectively; the row c includes background contributions [2] from the nucleon Born terms, vector meson and the N^* (1520) [D13] exchanges, with W_R and Γ_R in the PDG recommended range [3]. In each row, we give results for the ELA [2] and BW [1] fits.

The main conclusion from our Table I is the following: *while the extraction of $A_{1/2}$ is model-dependent, the quantity ξ, characteristic [2] of the product of the strong and electromagnetic amplitude for $N^*(1535)$, remains quite stable.* The new data set [1], yields ξ [2], to be 2.20 ± 0.15, in unit of $10^{-4} MeV^{-1}$.

Regarding the contributions of the other resonances, one should go beyond the truncation of Krusche *et al.* in their Eq.(7) [note a sign error on their cosθ term]. We agree with their *qualitative* conclusion that the presence of N*(1520)[D13] is indicated, but its *quantitative* role depends on various background contributions [2], ignored in [1]. The inclusion of the N*(1520)[D13] state, along with the nucleon and vector meson exchange terms *does improve* our fit (the row c in Table I) to the *differential* cross section. Futher exploration of this would require polarization data, not yet available.

We thank Prof. B. Krusche for communicating the MAMI data to us. This work is supported by the U. S. Department of Energy at RPI, and by the Natural Sciences and Engineering Research Council of Canada at SAL.

Nimai C. Mukhopadhyay[a], J.-F. Zhang[a] and M. Benmerrouche[b]

[a] Physics Department, Rensselaer Polytechnic Institute, Troy, NY 12180-3590.

[b] Saskatchewan Accelerator Laboratory, University of Saskatchewan, Saskatoon, SK S7N 0W0.

---

[1] B. Krusche *et al.*, *Phys. Rev. Lett.*, **74**, 3736 (1995).

[2] M. Benmerrouche and N. C. Mukhopadhyay, *Phys. Rev. Lett.* **67**, 1070 (1991). M. Benmerrouche, N. C. Mukhopadhyay and J.-F. Zhang, *Phys. Rev.* **D51**, 3237 (1995).

[3] Particle Data Group, *Phys. Rev.* **D50**, 1 (1994).

TABLE I. Fitted $A_{1/2}$ and inferred ξ for $N^*(1535)$ obtained from the new MAMI data [1], along with χ^2 per degree of freedom, for various analyses explained in the text. First three result columns are for ELA, while the last three are for BW. First three rows are fits to the differential cross sections, last row to the reduced total ones.

	$A_{1/2}$	χ^2	ξ	$A_{1/2}$	χ^2	ξ
a	113	2.8	2.2	111	2.2	2.2
b	144	3.0	2.3	142	2.2	2.3
c	98	1.4	2.2	100	1.5	2.3
d	117	3.8	2.3	110	0.9	2.2