Revisiting the axial form factor of the nucleon from low Q^2 pion electroproduction

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At Mainz, a high precision, coincidence experiment of p(e,e$'\pi^+$)n was performed [1] at an invariant energy of W=1125 MeV (46 MeV above threshold), at four-momentum transfers of Q^2=0.117, 0.195 and 0.273 (GeV/c)^2. The axial form factor, determined from the extracted transverse cross sections on the basis of the Mainz isobar model for pion electroproduction off the proton [2], gave an axial mass parameter M_{A} lying, somewhat accidentally, close to the average value of all previous values obtained by pion electroproduction which, however, are suffering for rather scattered values with large errors.

The Mainz data of the two lowest Q^2 values were the results of the pioneering measurement at Mainz and were thus subject to correspondingly lower statistics as well as less elaborate analysis corrections. On the other hand the recent questioning [3], whether the axial form factor can really be measured in pion electroproduction at threshold, was definitely refuted [4,5,6]. In addition, the importance of the axial form factor extracted from pion electroproduction as one of the effective tests of the Chiral Perturbation Theory was emphasised [6]. Because of both the experimental and the theoretical results, it was decided within the Mainz A1 Collaboration to scrutinize the results of this method of axial form factor determination further.

So in Mainz recently new measurements of the pion electroproduction were made, essentially at the same Q^2 values as in the previous experiment. Since the extraction of M_{A} from the transverse cross section is most sensitive to its low-Q^2 end, the measurement was also extended as close as possible toward the photon point, Q^2=0.058 (GeV/c)^2. It was possible to improve the statistics of the lower Q^2 points and also to cross check the necessary analysis corrections.

We shall discuss how the new results compare to the older ones for each particular Q^2 and in general. We shall also comment what the new results mean for the isobar model and for Chiral Perturbation Theory.

References:

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