NEAR THRESHOLD NEUTRAL PION ELECTROPRODUCTION AT HIGH MOMENTUM TRANSFERS

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ABSTRACT

Pion photo- ($\gamma p \to \pi N$) and electroproduction ($\gamma^* p \to \pi N$) close to threshold have been the subject of experimental and theoretical study since the 1950s. The predictions for near threshold cross sections have been studied for momentum transfers $Q^2 < 1\,\mathrm{GeV}^2/\mathrm{c}^2$ theoretically via the Low Energy Theorems (LETs). Additionally, these LETs give predictions for the axial form factor $G_A(Q^2)$ via the charged pion process near threshold. The LETs provide transition amplitude predictions for both neutral and charged pion reactions using chiral symmetry and current algebra arguments near threshold. Previous experimental measurements from Saclay, Mainz and others have shown consistency with the LET predictions at low momentum transfers $Q^2 < 1\,\mathrm{GeV}^2/\mathrm{c}^2$.

Recently, new extensions to these LETs at high Q^2 have been introduced by Pobylista *et al* (2001) and then by Braun *et al* (2008). In the work of Braun *et al*, the near threshold pion electroproduction transition amplitudes are written in terms of new form factors. These new generalized form factors $G_1^{\pi N}(Q^2)$ and $G_2^{\pi N}(Q^2)$ are obtained on the current quark basis and have been predicted using light cone sum rules (LCSRs) in the chiral limit ($m_\pi \to 0$) for the reactions $ep \to eN\pi$ in the Q^2 range of $1 - 10\,\mathrm{GeV}^2/\mathrm{c}^2$. Additionally, the predictions include a prescription to access the axial form factor G_A near threshold at these high momentum transfers for the charged pion reaction.

An experiment at Jefferson Lab was conducted using the CLAS detector to measure near threshold neutral pion electroproduction $ep \to ep\pi^0$ as a function of Q^2. This is the first measurement of this process in the near threshold region of W from 1.08 to 1.16 GeV and at momentum transfers $Q^2 \approx 2 - 5\,\mathrm{GeV}^2/\mathrm{c}^2$. The differential angle integrated cross sections were measured and the associated structure functions and S-wave multipoles were extracted. The cross section, extracted multipole amplitudes and generalized form factors $G_1^{\pi^0 p}(Q^2)$ and $G_2^{\pi^0 p}(Q^2)$ are presented along with the predictions from Braun *et al*.