Recent measurements with the out-of-plane spectrometer system at MIT/Bates

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Coincidence electron scattering with out-of-plane detection of hadrons ejected from nuclear targets is known to be a powerful method to measure the hadronic response functions of the $(\vec{e}, e'p)$ reactions.

The Out-of-Plane Spectrometer System (OOPS) at MIT/Bates is a unique facility optimised for measurements of small effects in $(\vec{e}, e'p)$ and $(\vec{e}, e'\pi^+)$ reactions. The possibility of a simultaneous placement of the spectrometers around the momentum transfer enables measurements of asymmetries and absolute cross-sections with minimal systematic uncertainties. We have commissioned four spectrometer modules for use with the high-duty factor electron beam extracted from the South Hall Ring of the MIT/Bates Linear Accelerator Center.

Recent experimental program with the OOPS system encompassed an extensive set of $d(\vec{e}, e'p)$ measurements, investigations of the $N \to \Delta$ transition using $p(\vec{e}, e'p)\pi^0$ and $p(\vec{e}, e'\pi^+)n$ reaction channels, and studies of virtual Compton scattering (VCS) $p(e, e'p)\gamma$ below the pion threshold. The LT interference response in deuteron electro-disintegration is sensitive to relativistic effects, while the TT interference is mostly sensitive to two-body currents. Data from the $N \to \Delta$ measurements will yield information on the C2/M1 and E2/M1 ratios. The measurements of the LT, LT$'$, and TT responses will provide stringent tests on models of electro-production. The goal of the VCS measurements is the determination of the generalised electric and magnetic polarisabilities of the proton at a momentum transfer of $Q^2 = 0.05\ (\mathrm{GeV}/c)^2$ where predictions of Chiral Perturbation Theory can be tested. In particular the electric polarisability can only be measured using the out-of-plane technique. Preliminary results will be discussed.

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