Exclusive π^+ Electroproduction at High Momentum Transfer

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Introduction

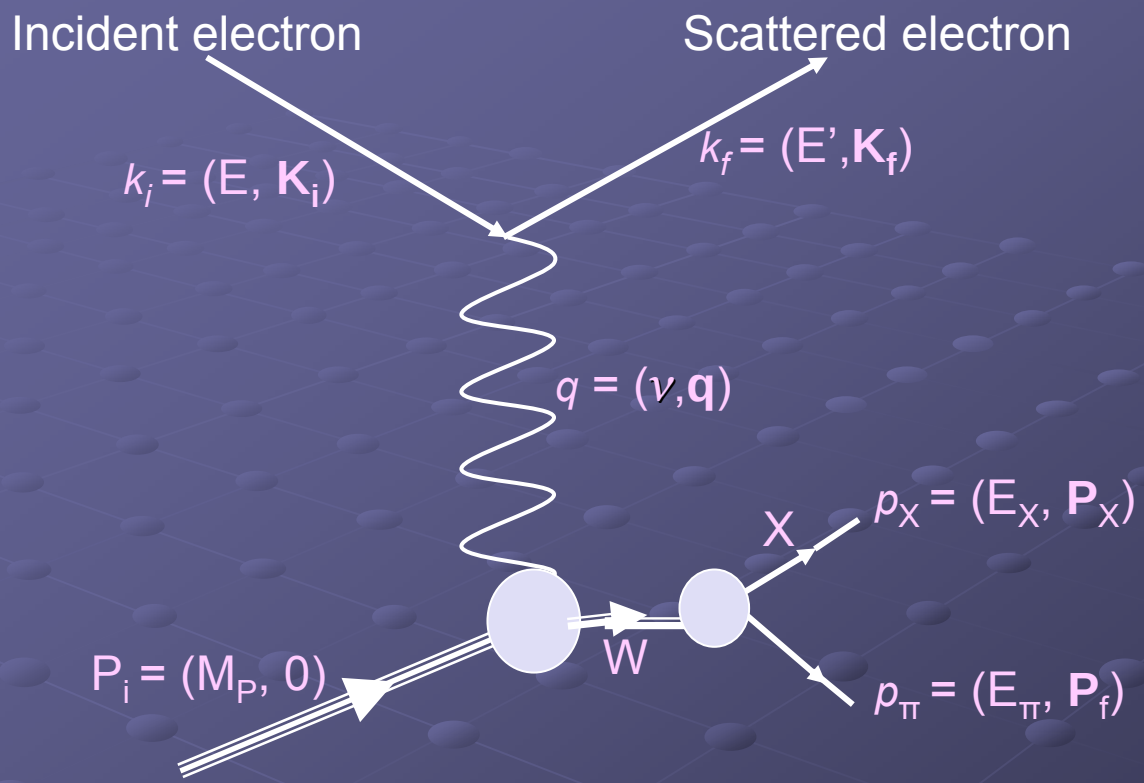
- The differential cross section of the process

$$e + p \rightarrow e' + \pi^+ + n$$

has been measured at an average $Q^2 = 5.5\ GeV^2$ in the low invariant mass range of $1.3 < W < 2\ GeV$ at forward angles

- This is one of the highest Q^2 measurements of this exclusive process

Born diagram of the process



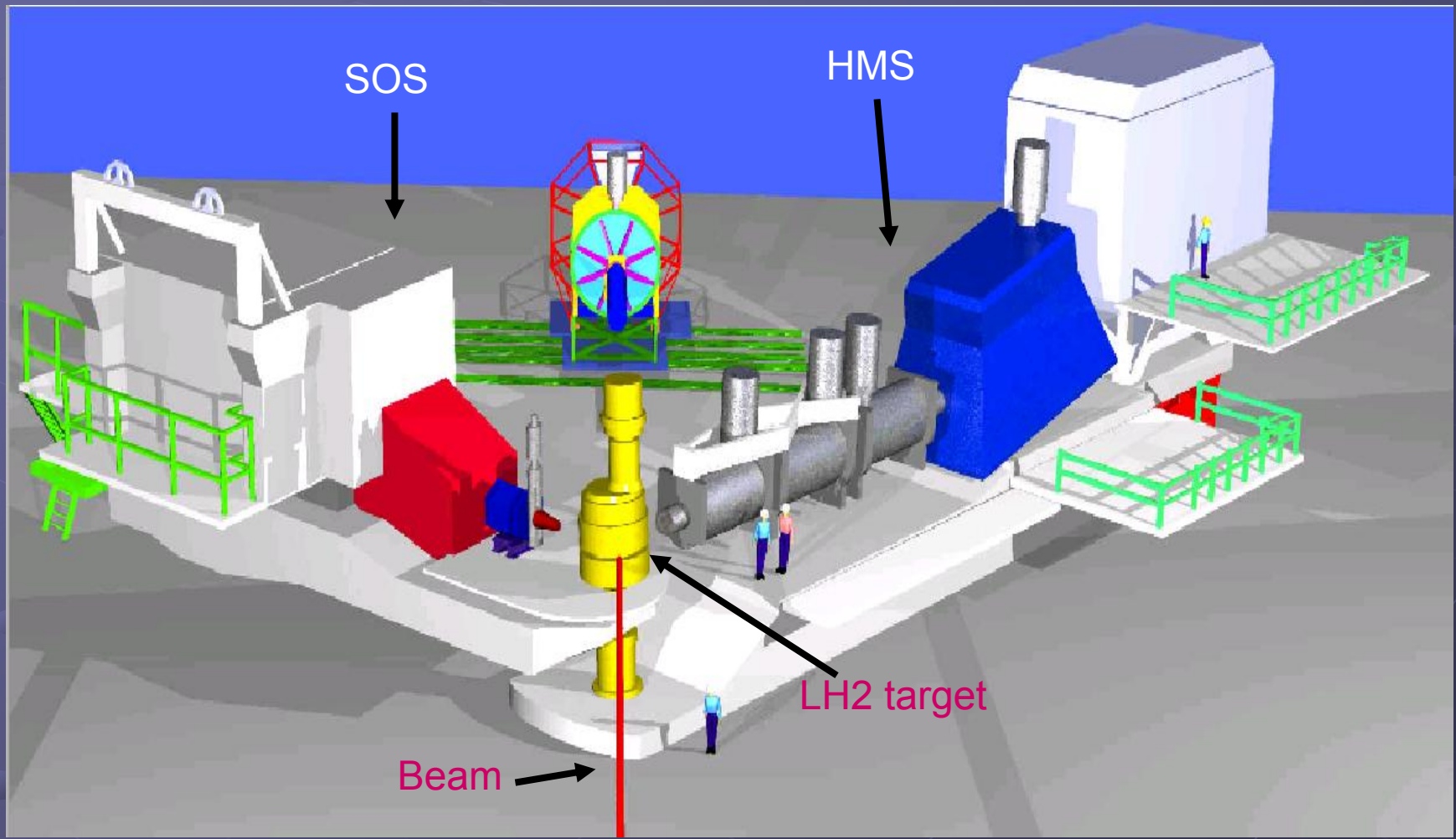
The missing mass (the neutron mass in this process) is obtained from the expression

$$M_X^2 = M_n^2 = E_X^2 - |\boldsymbol{P}_X|^2$$

where $E_X^2 = \nu + M_P - E_\pi$

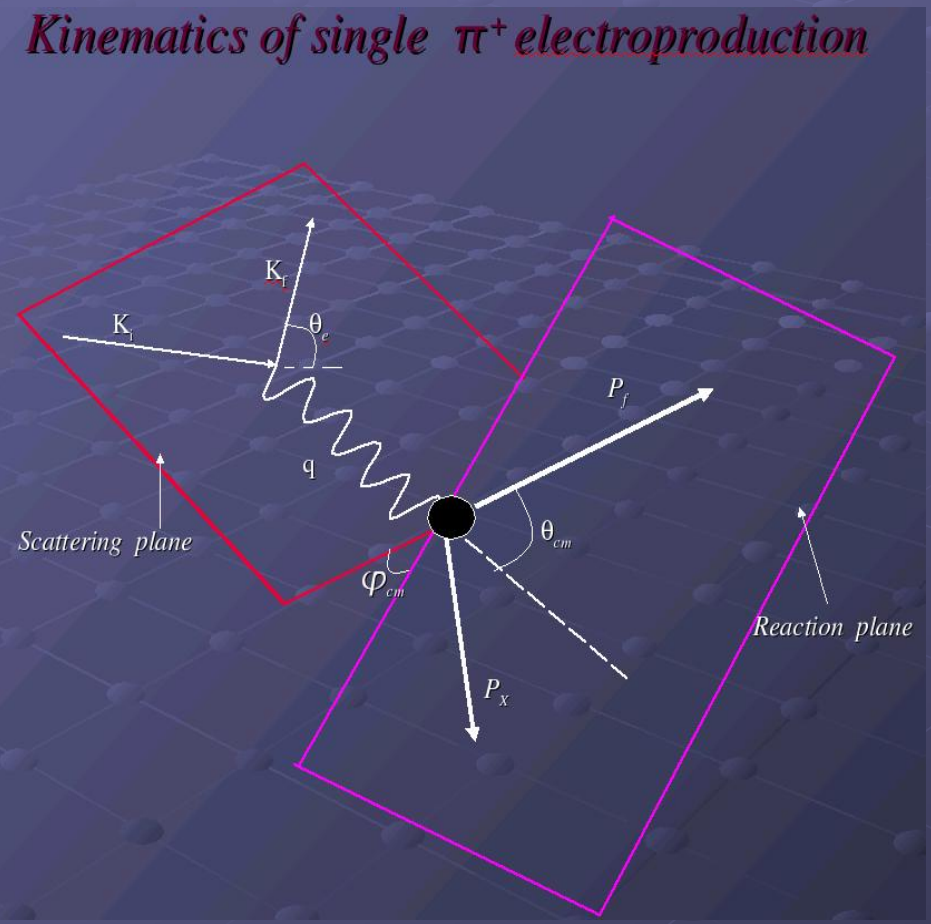
and $E_\pi^2 = M_\pi^2 + |\boldsymbol{P}_\pi|^2$

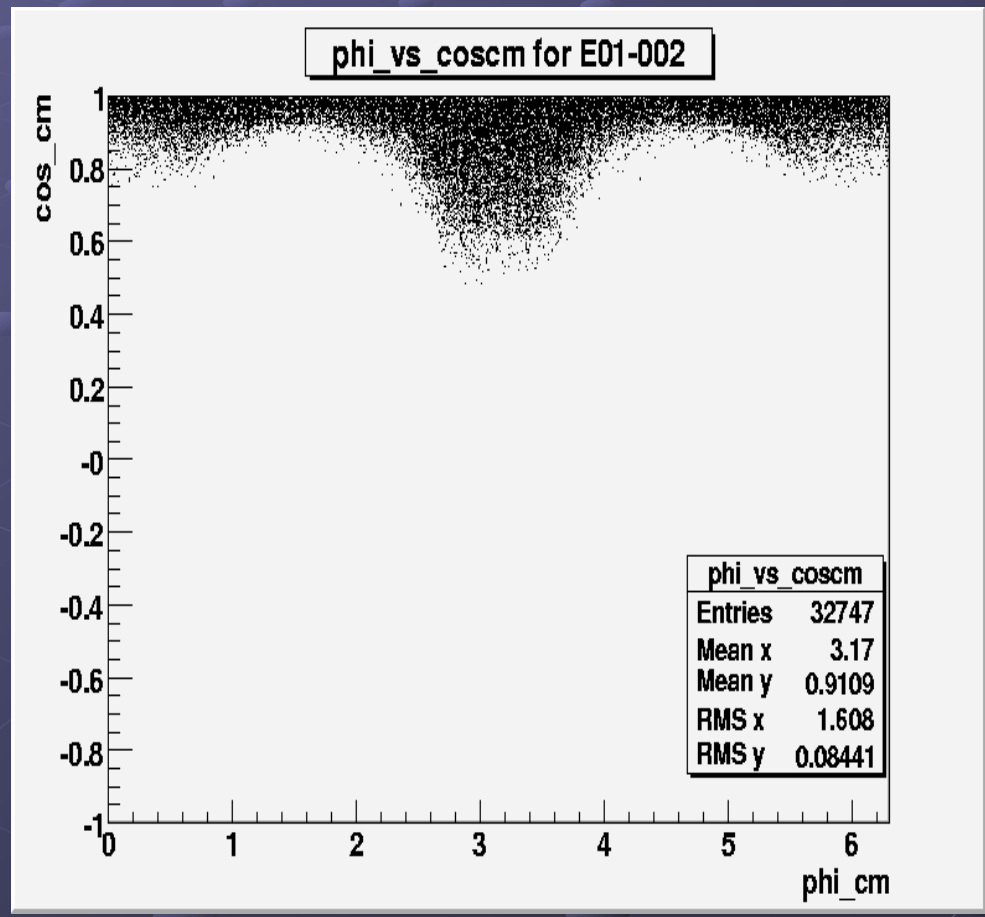
Experimental Setup



Angular Coverage

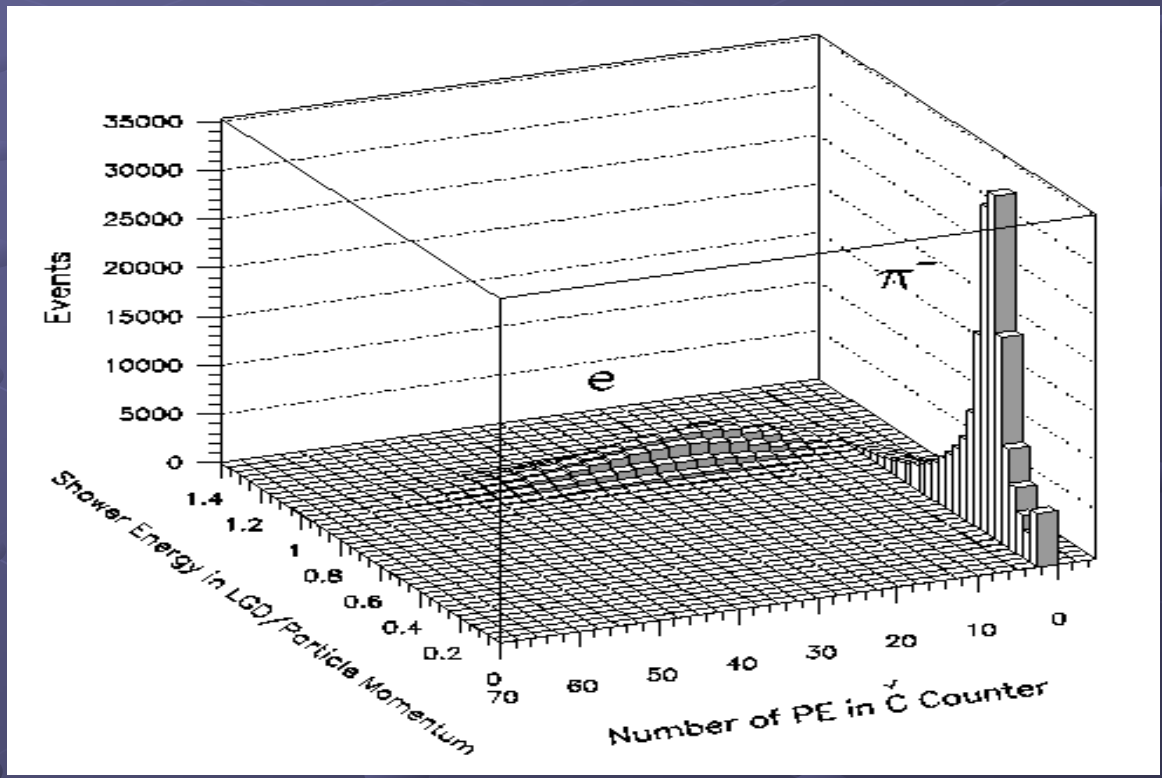
- The detected pions were very forward in the center of mass system; $\cos\theta_{cm} > 0.6$





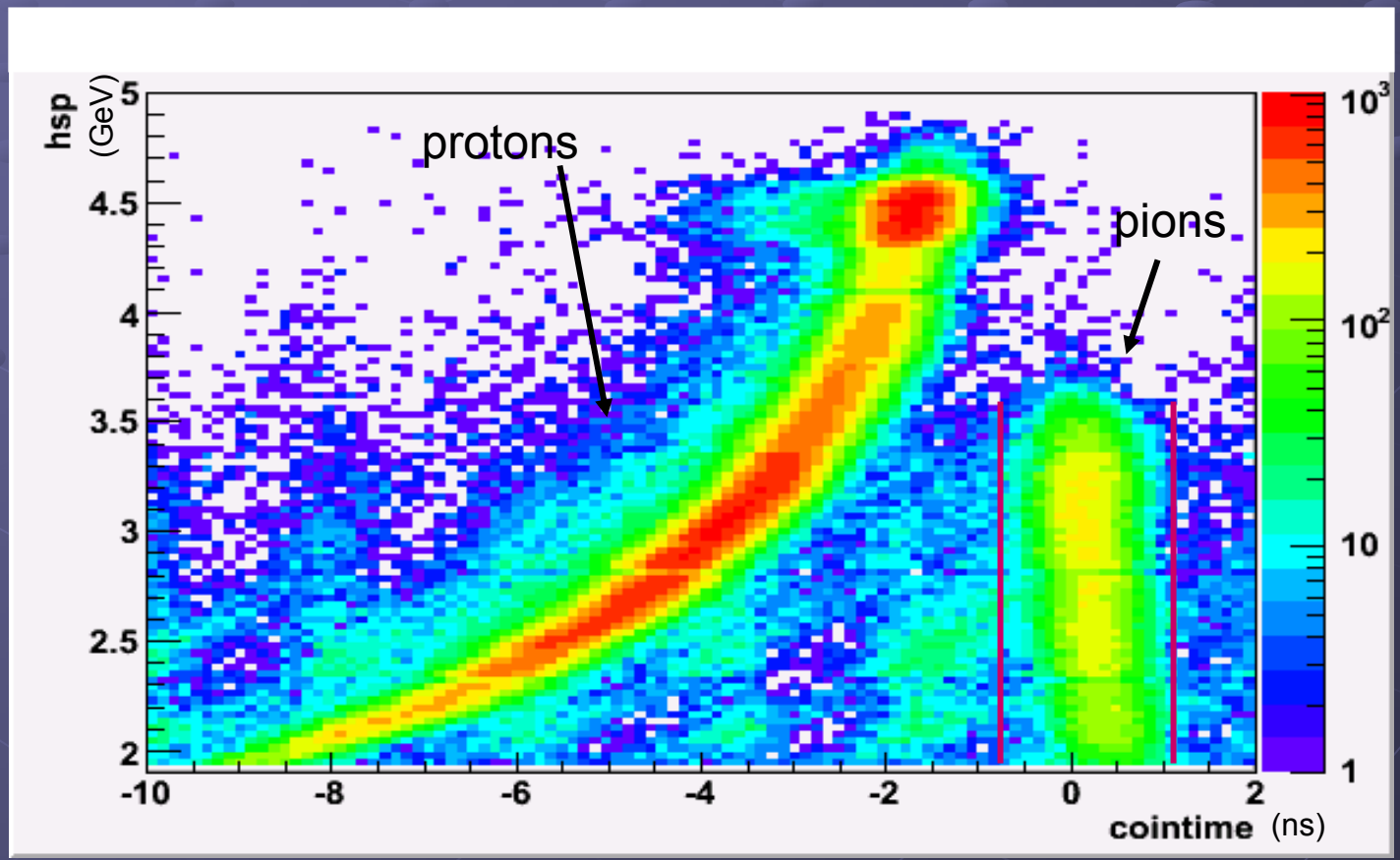
Particle Identification

- *In the HMS, π^+* were separated from protons by using *TOF calibration - a combination of coincidence time (drift between trigger times of both spectrometers) and particle velocity*
- *In the SOS, electrons were separated from π^-* by the aid of the threshold gas Cerenkov detector and the lead-glass calorimeter



Coincidence Correction for π^+ Events

- In the HMS, the TOF was corrected to make the pion appear at a specific time independent of momentum
- So, an interval on the timing spectrum allowed us to select pion events



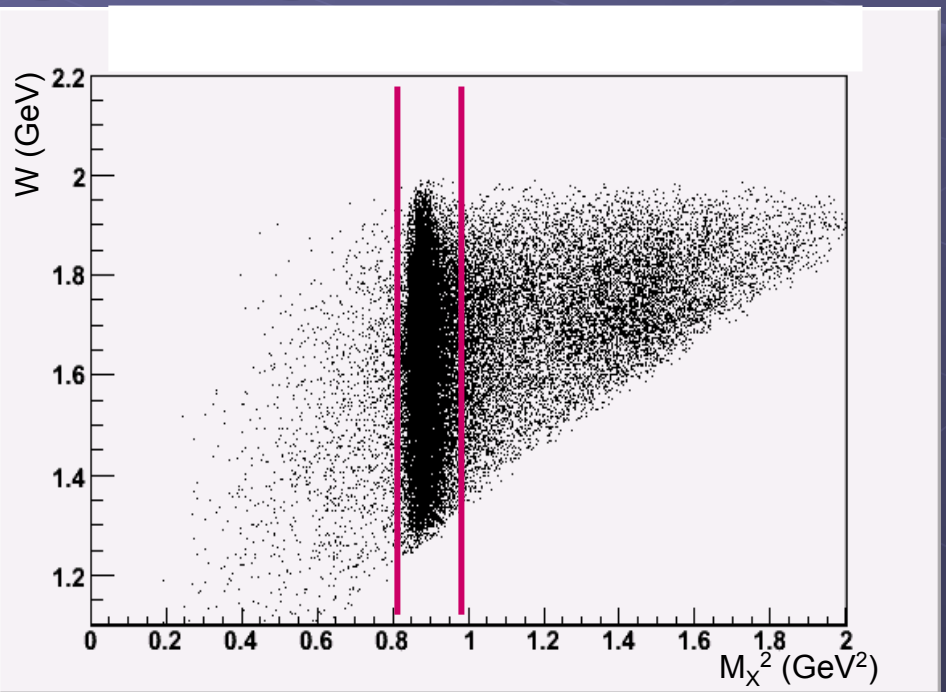
Exclusive π^+ and M_X^2 cut

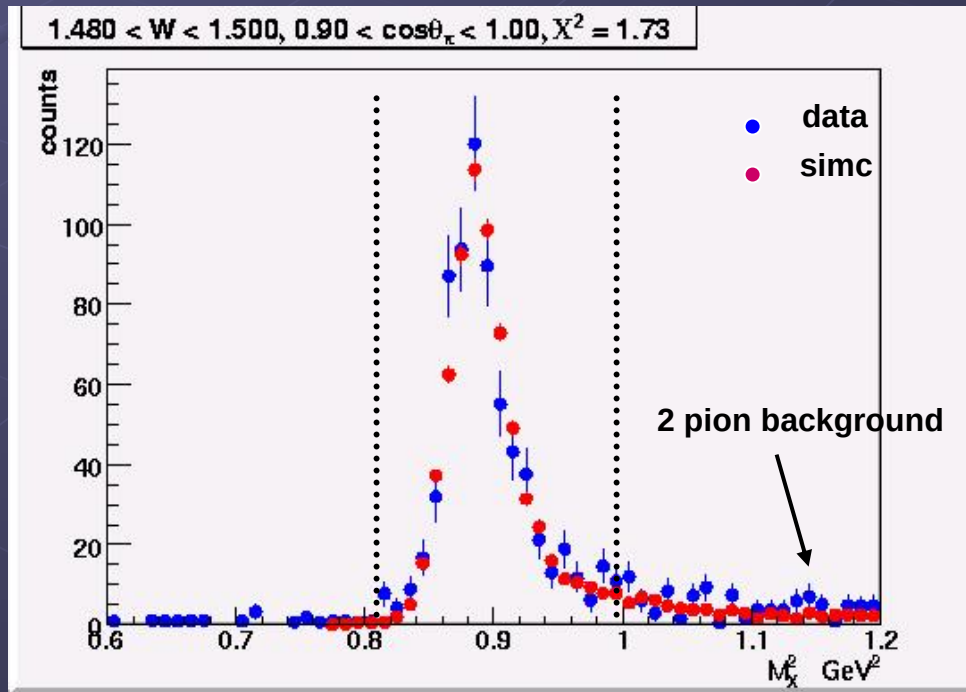
- We deal exclusively with π^+ electroproduction by introducing an M_X^2 cut
- The detected π^+ at the HMS could come from nucleon resonance decay processes such as:

$$N^* \rightarrow n + \pi^+$$

and $$N^* \rightarrow n + \pi^0 + \pi^+$$

- Introducing the cut $0.8 < M_X^2 < 1$ thereby avoids the multipion background that begins at an M_X^2 threshold of about $1.16\ GeV^2$

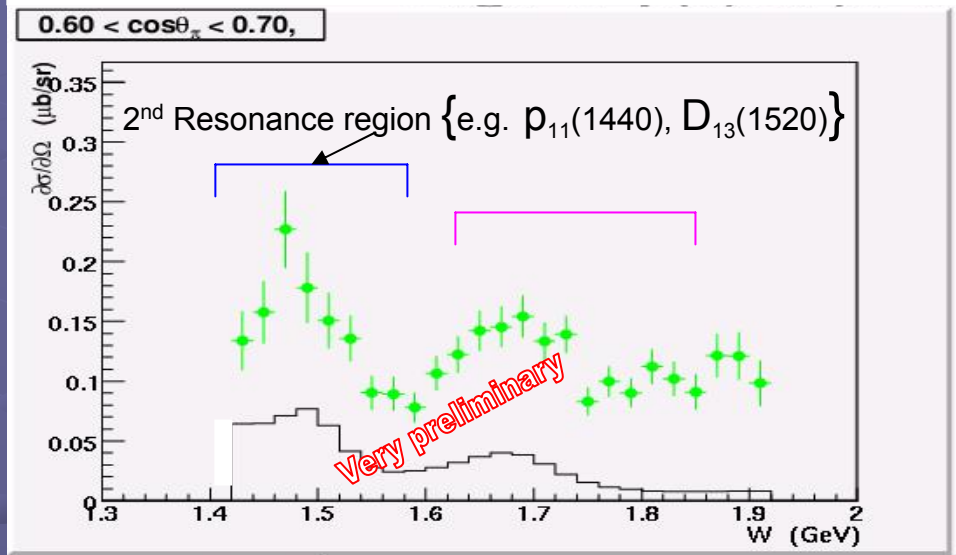


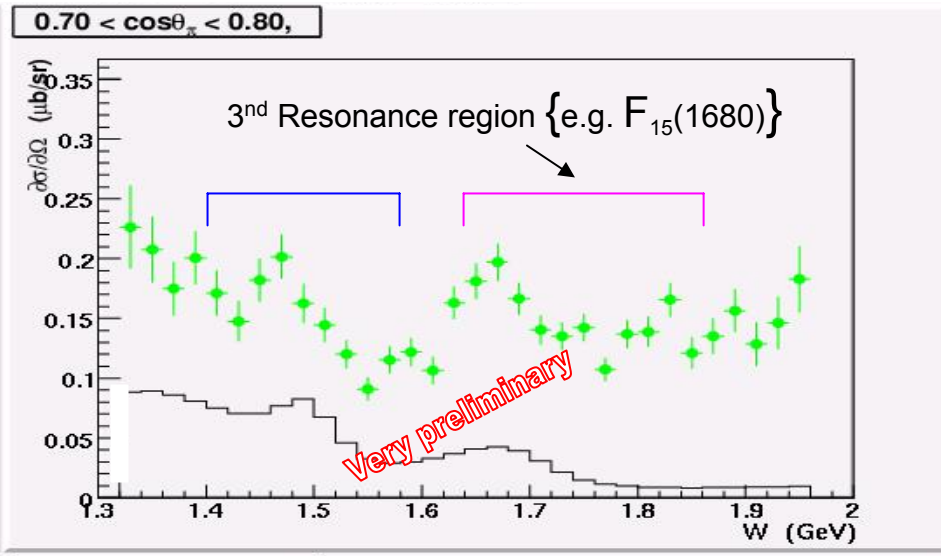


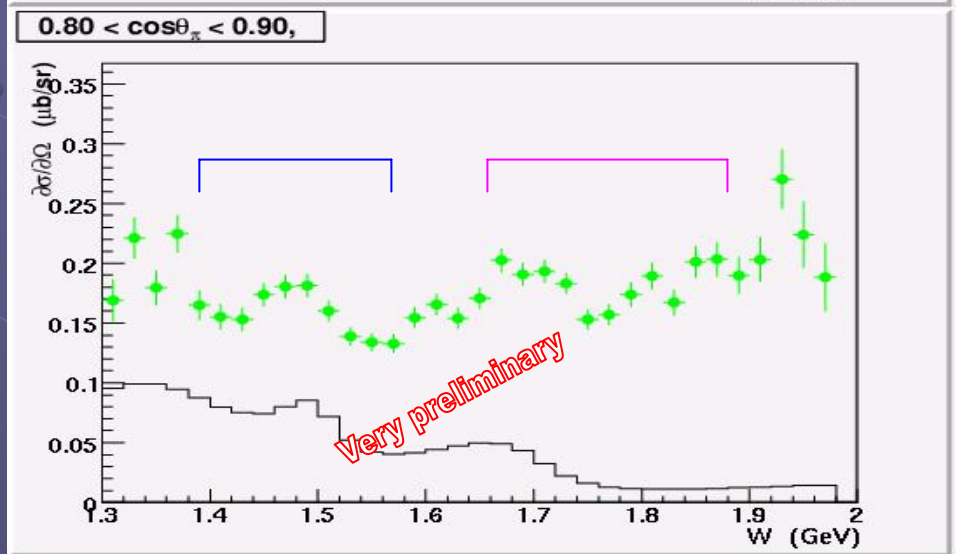
Result - Cross Sections

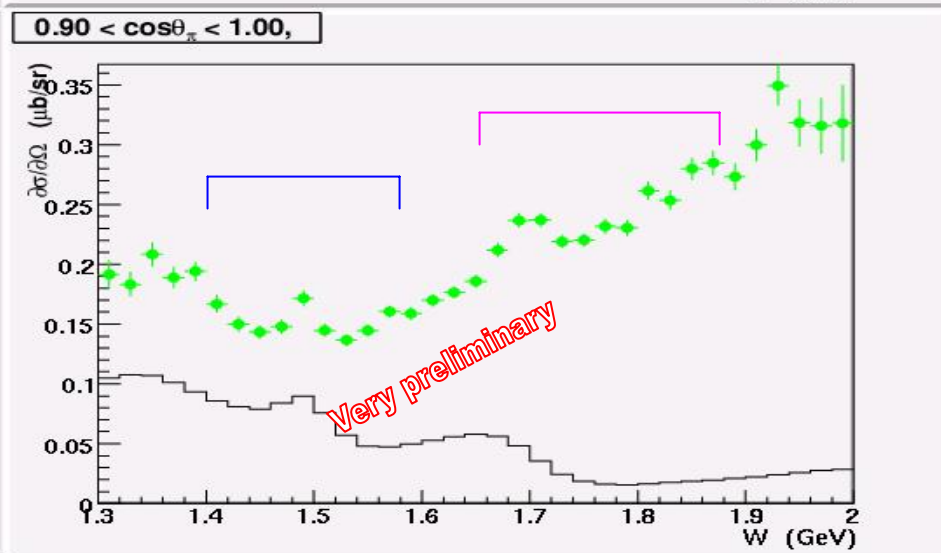
— *MAID 2003 cross section extrapolated at Q^2 = 5.5 GeV², using the dipole form factor*
$G = (1-q^2/0.71)^{-2}$

— *Extracted cross section from data of experiment integrated over all φ_{cm}*









Conclusion

- The cross section of the process

  $$e + p \rightarrow e' + \pi^+ + n$$

  was measured at $Q^2 = 5.5\ GeV^2$

- Preliminary results are sensitive to high-mass baryon resonances, as well as t-channel processes and diverge significantly from an extrapolation of the lower Q^2 data

- With results from other higher Q^2 data, the transition form factors into higher resonances can be measured.

- Systematic errors under studies