BARYON-OMEGA MESON ELECTROPRODUCTION

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1. Introduction

- The electroproduction process $p(e,e'\omega)p$ has been measured at $Q^2 \sim 5.5$ (GeV/c)^2 from Jefferson LAB (JLab) using Hall C data.
- The reaction is exclusive to the ω channel.
- Q^2 represents the four momentum squared of the virtual photon in the excitation of the baryonic resonances by an electron projectile.
- An important aspect of our measurement is that the Q^2 falls in the region where the transition from non–pertubative processes characterised by constituent quarks dominate to the high t regime where hard processes described by current quark corrections are expected to play an increasing important role as shown in [1].
- The extraction of the ω differential cross-section was performed using an algorithm to select the signal region.
- The benefit includes fine tuning and further checks on the extracted cross-section.
- We compare our results with a Regge-based model for hadronic content in the t-channel exchange of a photon in similar Q^2 region [2].

2. Experimental setup

- The experiment consists in an electron beam incident on a cryogenic target, two spectrometers (SOS and HMS), associated electronics and software for reconstruction of events.
- The SOS and HMS were used to detect the scattered electrons and the recoil protons respectively.
- The HMS was stepped in angle and momentum to optimise the efficiency of the spectrometer acceptance for different invariant mass W points as shown in **Figure 1**.
- The SOS separates the electrons from negatively charged pions using a Cerenkov detector and a lead-

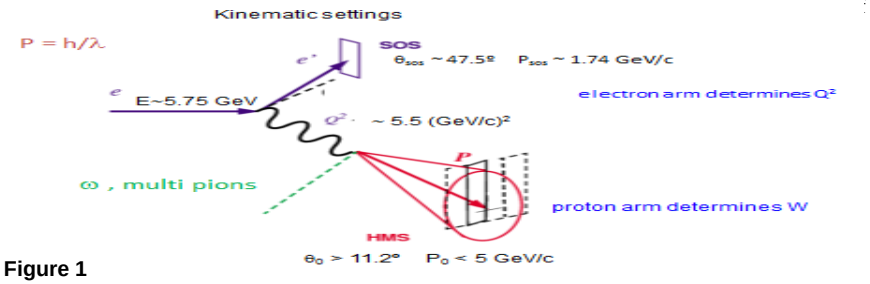


Figure 1

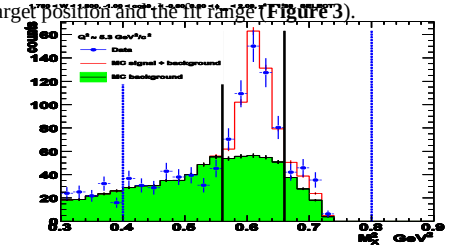
3. Analysis and discussion

- Calibrated physics quantities were produced for each event based on the stored accumulated knowledge of the spectrometers . These were stored in ntuples for offline analysis.
- Fits, refining, matching and normalising an input model to our data through iterative procedure was also done to extract reliable results from our data.

$$\sigma_{data} = \sigma_{model}\left(\frac{N_{data}}{N_{mc}}\right)$$

- To extract the cross-section the simulation needed to measure at least 10 events in each bin of the ω signal region and in addition a threshold for non-overlap of signal s and background b distributions of at least 10%. This also includes rejecting bins with low statistics for the background simulation (**Figure 2**).
- The main sources of systematics are the target position and the fit range (**Figure 3**).

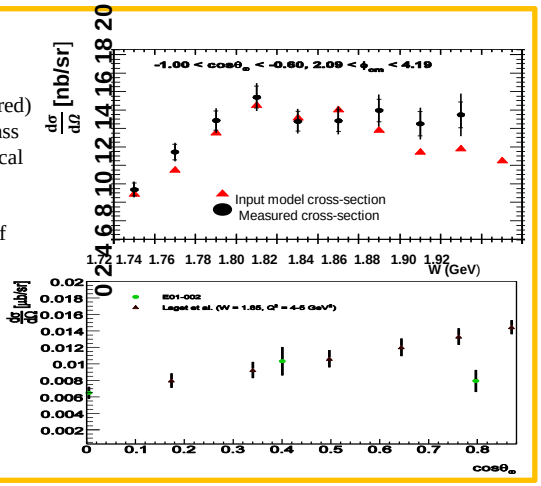
Figure 2 : **A** Plot of the missing mass squared showing the data (blue), the Monte Carlo multipion background (green) and ω signal peak (red).



4. Results: cross-section

Figure 3 : Measured cross-section (black) and the input cross-section (red) [1], as a function of the invariant mass (W). The inner error bars are statistical and the outer error bars are the quadrature sum of statistical and systematic errors (only a sample of data presented).

Figure 4 : Measured cross section (green) and model used by Laget et al. [2], as a function of the scattering angle (only a sample of data presented).



4. Conclusion

- **Figures 3 and 4** show the measured differential cross-section, compared respectively with the input model cross-sections used by Dalton et al [1], and Laget et al [2] in the region of invariant mass 1.72 GeV <W< 1.92 GeV and 4<Q^2 < 5 GeV^2 where there is an overlap with our data.
- In both cases there is a good agreement between model and measurement, although the measurement is limited by the available statistics at high invariant mass and scattering angle.

References

[1] Dalton M M *et al* 2009 *Phys. Rev C* **80** 015205

[2] Laget J M 2004 *Phys. Rev D* **70** 054023.

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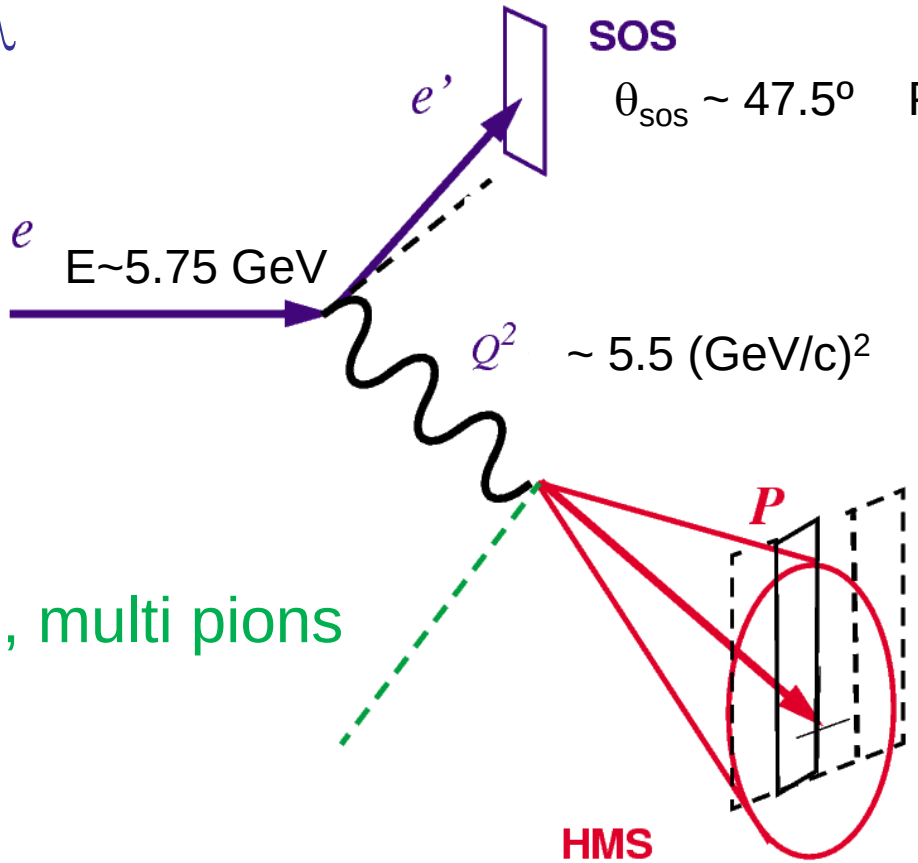
Kinematic settings

$P = h/\lambda$



$\theta_{sos} \sim 47.5^o$ $P_{sos} \sim 1.74$ GeV/c

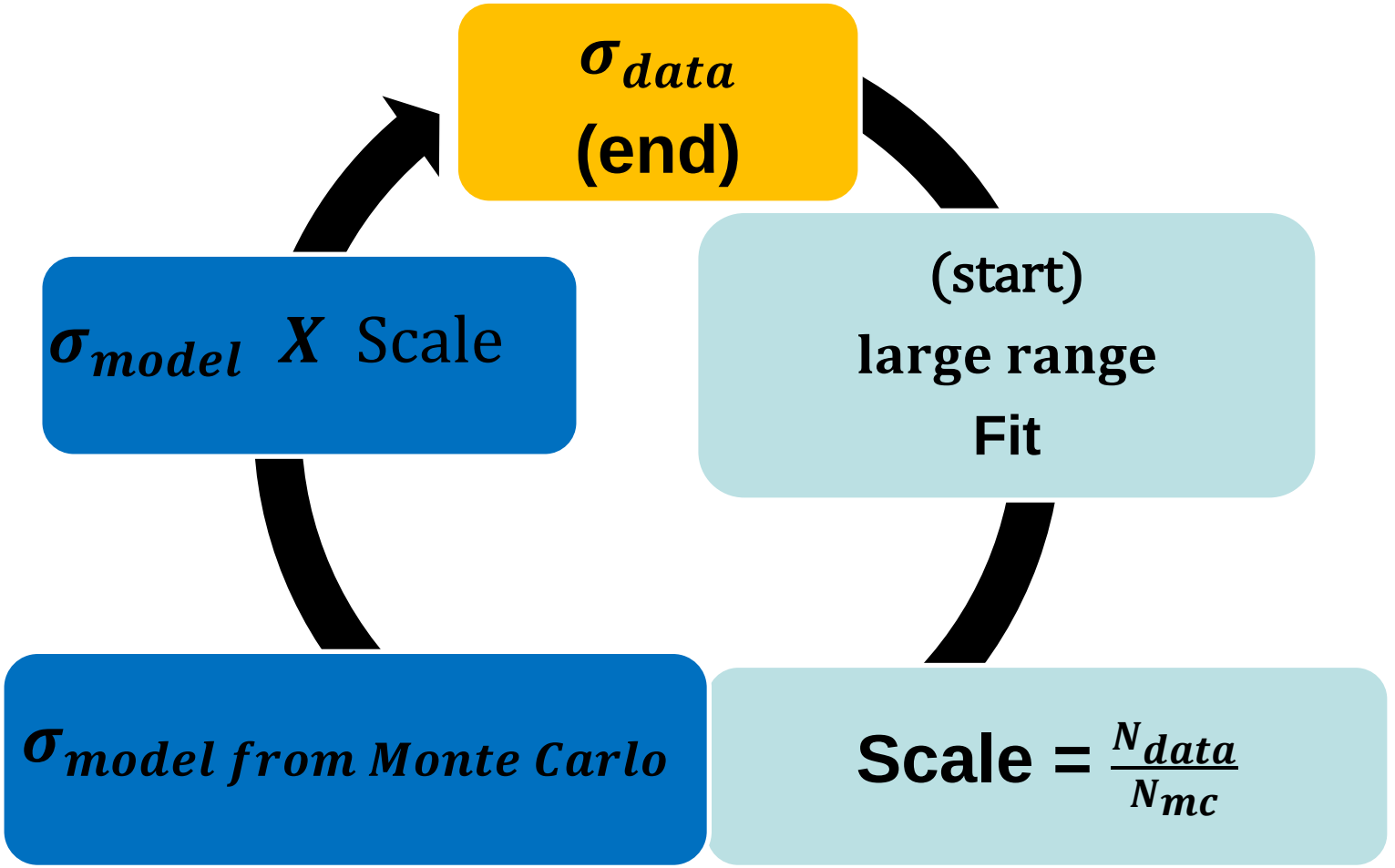
electron arm determines Q^2

~ 5.5 (GeV/c)^2

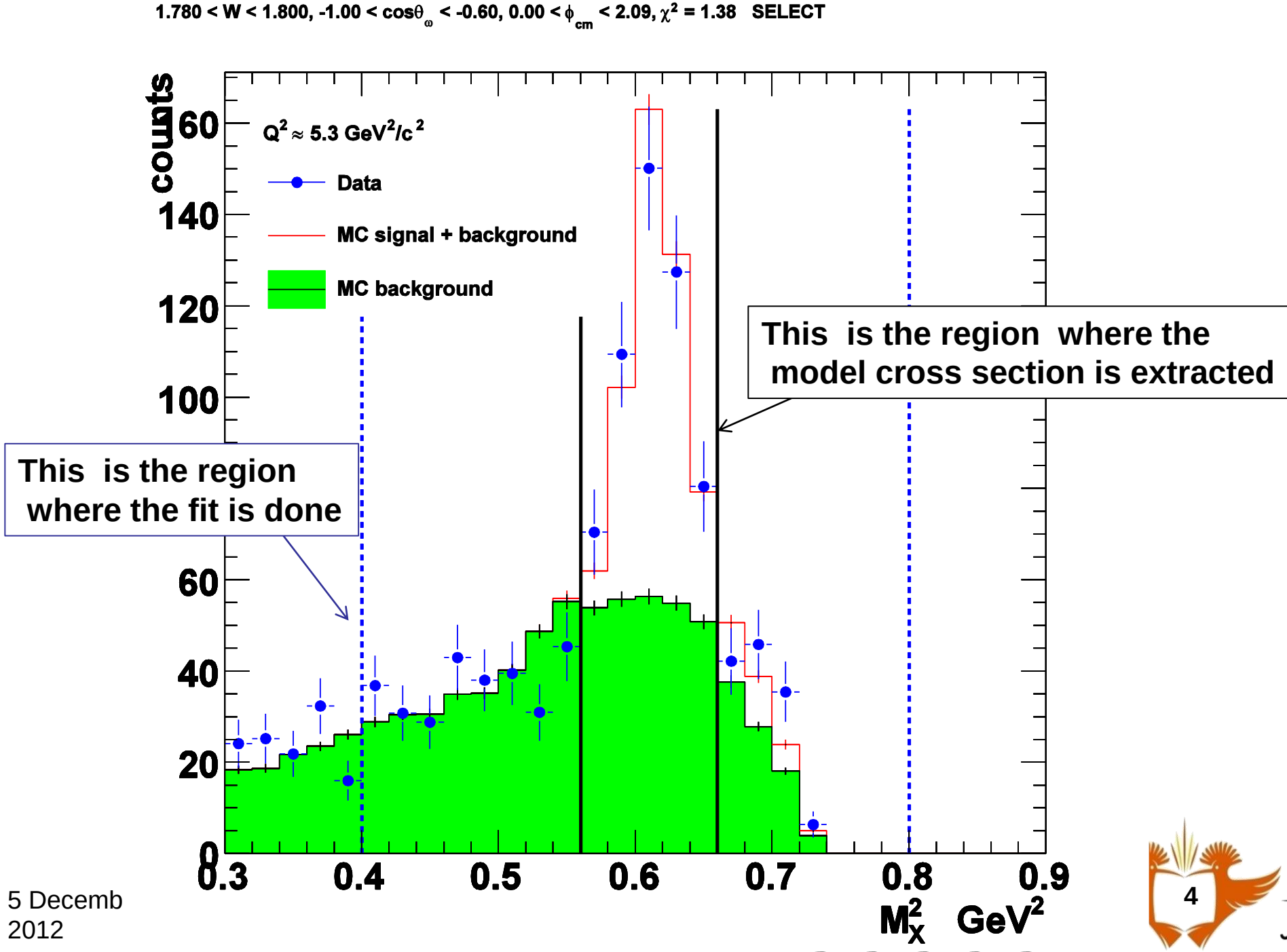
ω , multi pions

proton arm determines W

$\theta_0 > 11.2^o$ $P_0 < 5$ GeV/c



$$\sigma_{data} = \sigma_{model}\left(\frac{N_{data}}{N_{mc}}\right)$$


1.780 < W < 1.800, -1.00 < cosθω < -0.60, 0.00 < φcm < 2.09, χ² = 1.38 SELECT
counts
Q² ≈ 5.3 GeV²/c²
Data
MC signal + background
MC background
This is the region where the model cross section is extracted
This is the region where the fit is done
M²X GeV²

Sources of systematics
Central offset position: Z [= 0.15]; X [= 2.62]

- Target position
  - Z (2) [=0.0 and =0.3]
  - X (2) [=1.5 and = 3.5]
- Fit range
  - Small (1) [0.5 to 0.7 GeV]
  - Large (1) [0.3 to 0.9 GeV]
- Cross section range
  - Small (1) [0.59 to 0.63 GeV]
  - Large (1) [0.46 to 0.76 GeV]

$$\delta_v = \frac{\sigma_{data\ central} - \sigma_{data\ v}}{2}$$

Average systematics. (% of model cross section)

- Target position
  - Z [=0.0] : 2.075%
  - Z [=0.3] : 2.690%
  - X [=1.5] : 1.749%
  - X [= 3.5] :1.597%
- Fit range
  - Small [0.5 to 0.7 GeV] : 1.434%
  - Large [0.3 to 0.9 GeV] : 2.705%
- Cross section range
  - Small (1) [0.59 to 0.63 GeV] : 0.074%
  - Large (1) [0.46 to 0.76 GeV] : 0.284%

Figure 3 : Measured cross-section (black) and the input cross-section (red) [1], as a function of the invariant mass (W). The inner error bars are statistical and the outer error bars are the quadrature sum of statistical and systematic errors (only a sample of data presented).

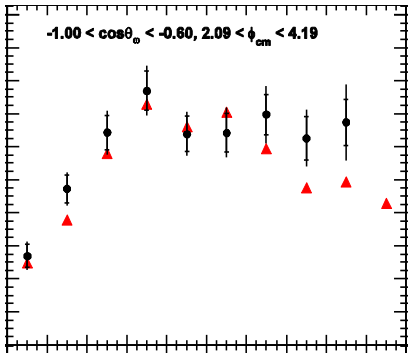
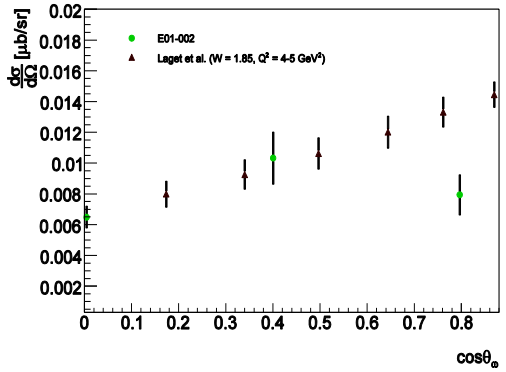


Figure 4 : Measured cross section (green) and model used by Laget et al. [2], as a function of the scattering angle (only a sample of data presented).



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