

# STATUS OF THE E00-102 EXPERIMENT

## Testing the Limits of the Single-Particle Model in $^{16}\text{O}(e,e'p)$

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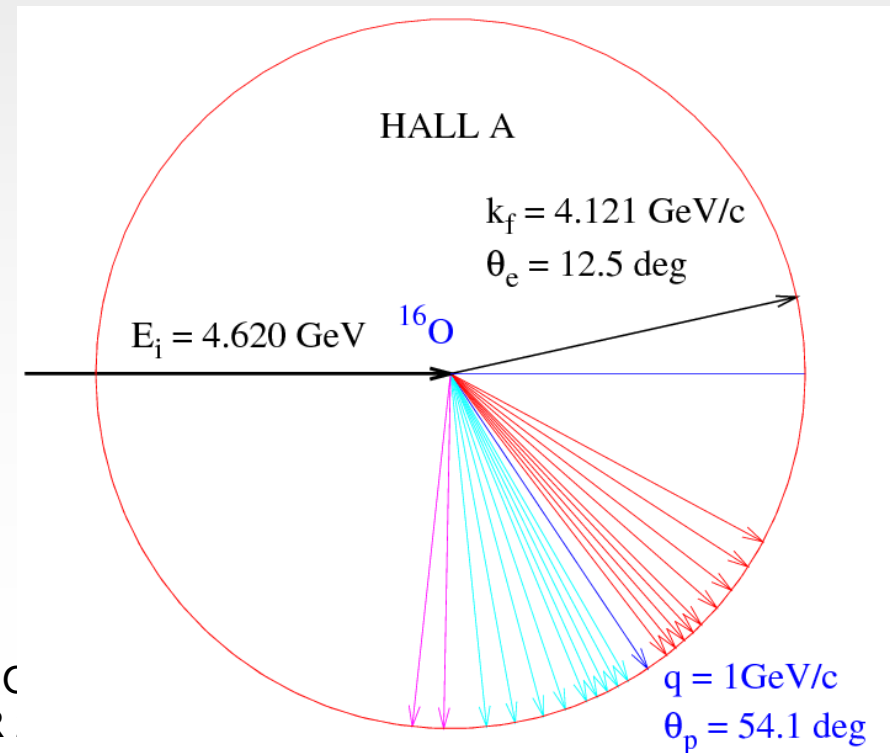
**and the Jefferson Lab Hall A Collaboration**

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# 1. Experiment (E00-102)

- A continuation of E89-003: **A Measurement of the Cross Section,  $R_{LT}$ , and  $A_{LT}$  for the  $^{16}\text{O}(e,e'p)$  Reaction.**
- E89-003 measured O(e,e'p) cross section,  $R_L$ ,  $R_T$ , and  $R_{LT}$  at  $\omega = 0.45$  GeV and  $Q = 0.8$  GeV<sup>2</sup>, up to  $p_m = 0.35$  GeV/c.
- E00-102
  - Higher  $p_{\text{miss}}$  (0.75 GeV/c)
  - Higher precision
  - Sigma,  $R_{LT}$  and  $A_{LT}$



# 1. Goals of E00-102

Determine:

- the limits of validity of the single-particle model of valence proton knock-out.
- effects of relativity and spinor distortion on valence proton knock-out using the  $A_{LT}$  asymmetry.
- bound-state wave function\* and spectroscopic factors for valence proton knockout.

\*The wave function is not an observable

## 2. Tasks completed – I

- Beam position/Beam energy calibrations.
- Optics calibration and spectrometer mispointing.
- First pass replay using ESPACE.
- Water-foil thickness measurement from O(e,e'p) to BeO(e,e'p) yield comparison.
- Converted end-of-run-file information to MySQL
- Determination of  $1p_{1/2}$  cross section relative to H(e,e')

## 2. Tasks completed – II

- Conversion from ESPACE to C++ analyzer
- Waterfall target model (with energy loss) added to analyzer
- R-function calculation added to analyzer
- Coincidence timing added to analyzer, and CT calibration
- Luminosity/deadtime monitoring with elastic scattering

## 2. Tasks completed – III

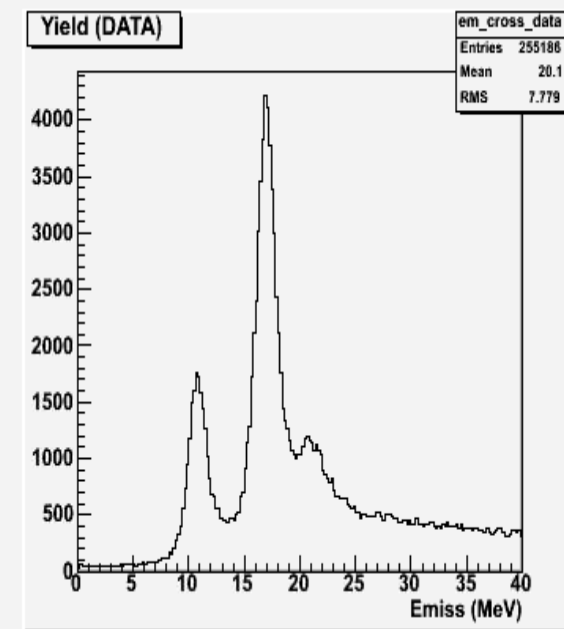
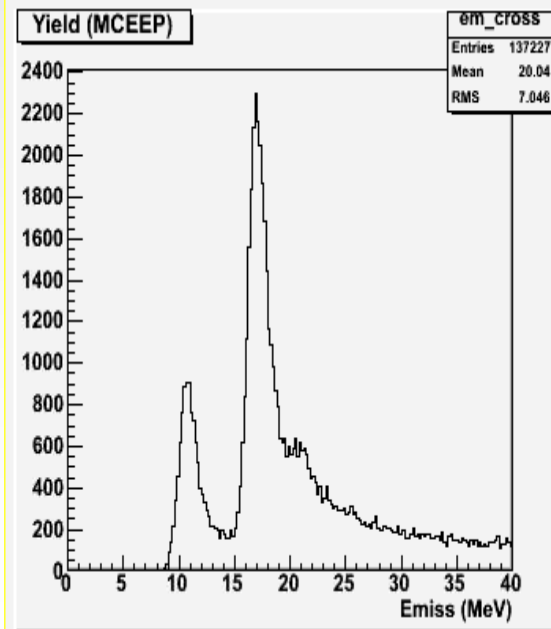
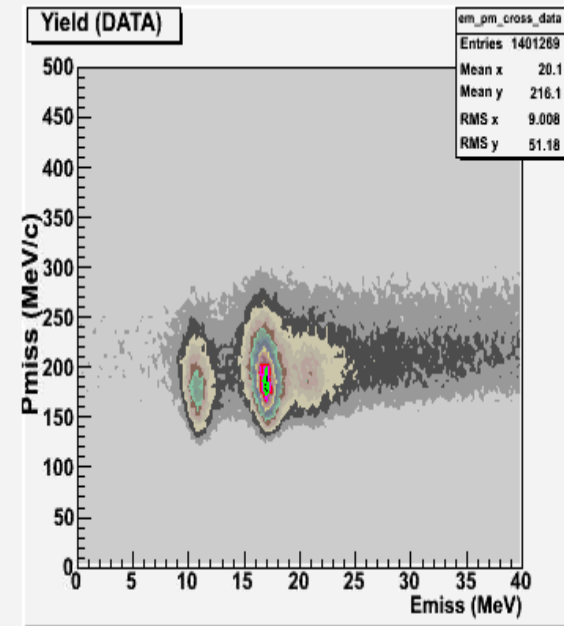
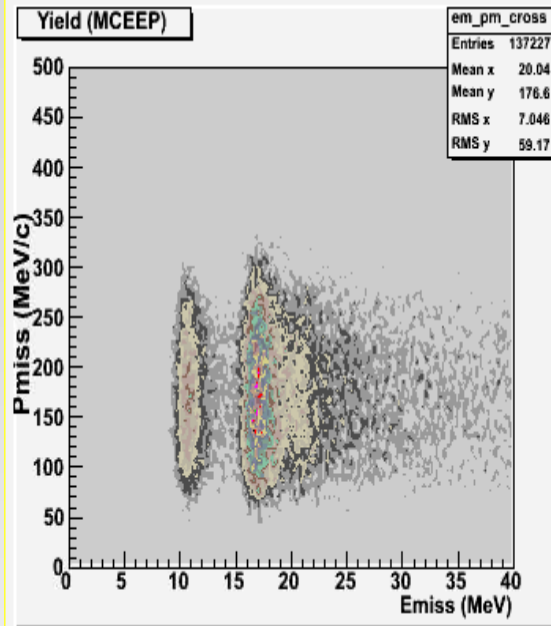
- Response functions from Udias/Madrid model has been incorporated into MCEEP.
- Simulations (PWIA and DWIA) have been performed
- Phase-space population of physical variables ( $E_{\text{miss}}, p_{\text{miss}}, q, \omega$ ) needed for normalization have been generated.

# Emiss Distributions

No energy loss and radiation were simulated in previous results.

## ENERGY LOSS

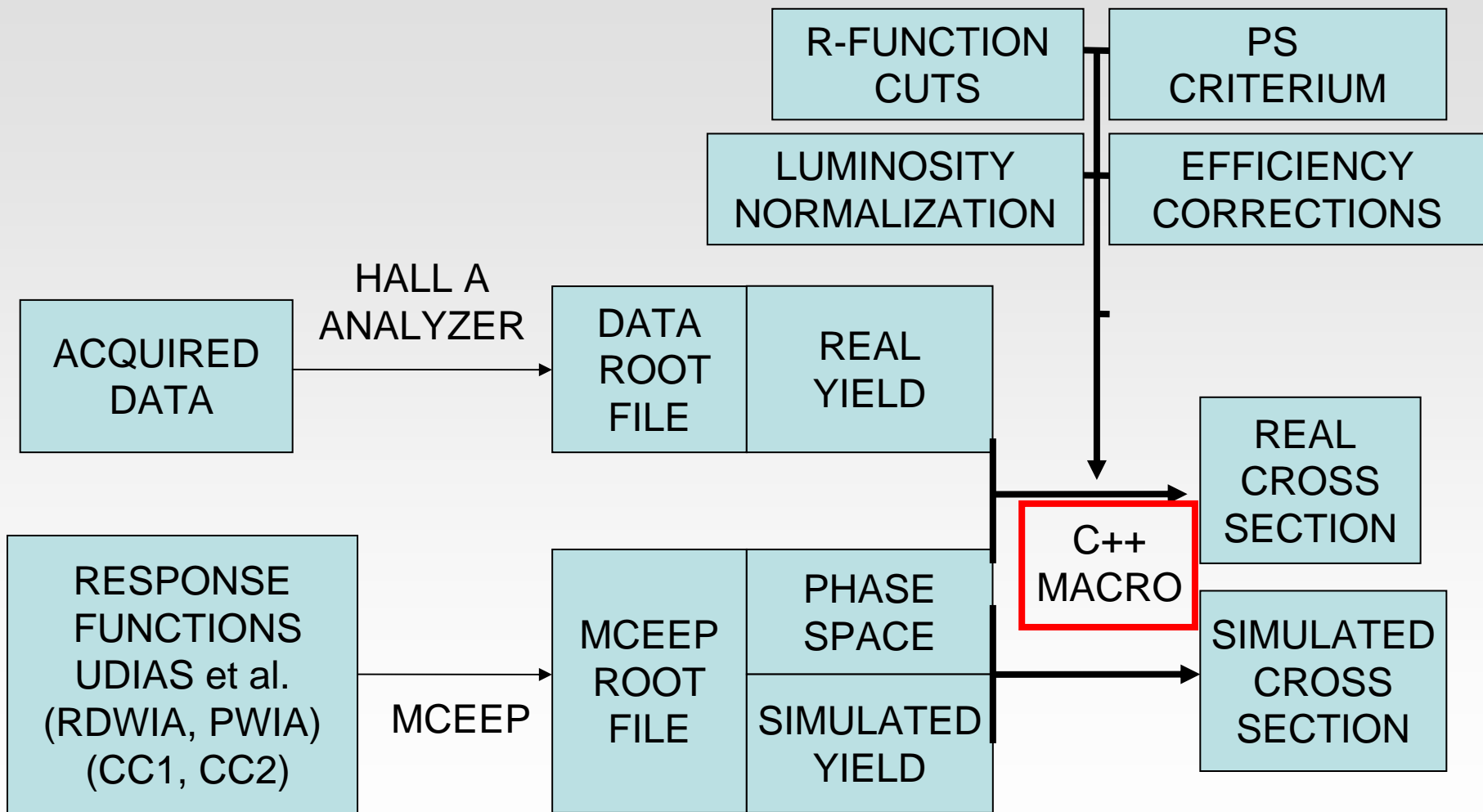
- Energy loss have now been included in all simulations.
- As the data is already corrected by the mean energy loss we have used this option in mceep.



# 3. EXTRACTING CROSS-SECTION

- A C++ macro was developed jointly by Old Dominion University and Madrid University to obtain the cross section from the analyzed data and the simulations.
  - R-function cuts
  - Luminosity normalization
  - Efficiency correction
  - Phase-space normalization
  - Cuts in missing energy → Select  $1p_{1/2}$ ,  $1p_{3/2}$  or  $1s_{1/2}$  shells
  - $\sigma_{ep}$  for reduced cross sections
  - Cross-sections obtained are binned in ( $p_{miss}$ ,  $q$ ,  $\omega$  and  $\phi$ )

# 3. EXTRACTING CROSS-SECTION



# 3. EXTRACTING CROSS-SECTION $^{16}\text{O}(e,e'p)$

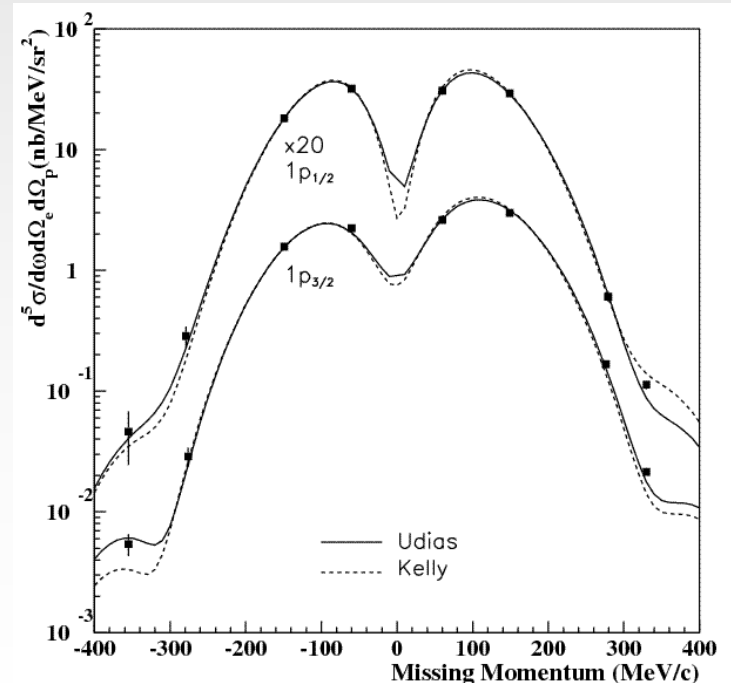
$$\frac{d^5s}{dW_e d\omega dW_p} = K s_M (v_L R_L + v_T R_T + v_{LT} R_{LT} \cos f + v_{TT} R_{TT} \cos 2f)$$

$$\frac{d^5s}{dW_e d\omega dW_p} = f(E_{miss}, p_{miss}, q, \omega, f) \otimes \left. \frac{d^5s}{dW_e d\omega dW_p} \right|_{E_{miss}} = f(p_{miss})$$

The cross-section depends on the physical variables  $E_{miss}$ ,  $p_{miss}$ ,  $q$ ,  $\omega$  and  $\phi$  (out of plane angle)  $\rightarrow$  We make bins in all these variables.

E00-102 experiment has good statistics so lots of bins can be done.

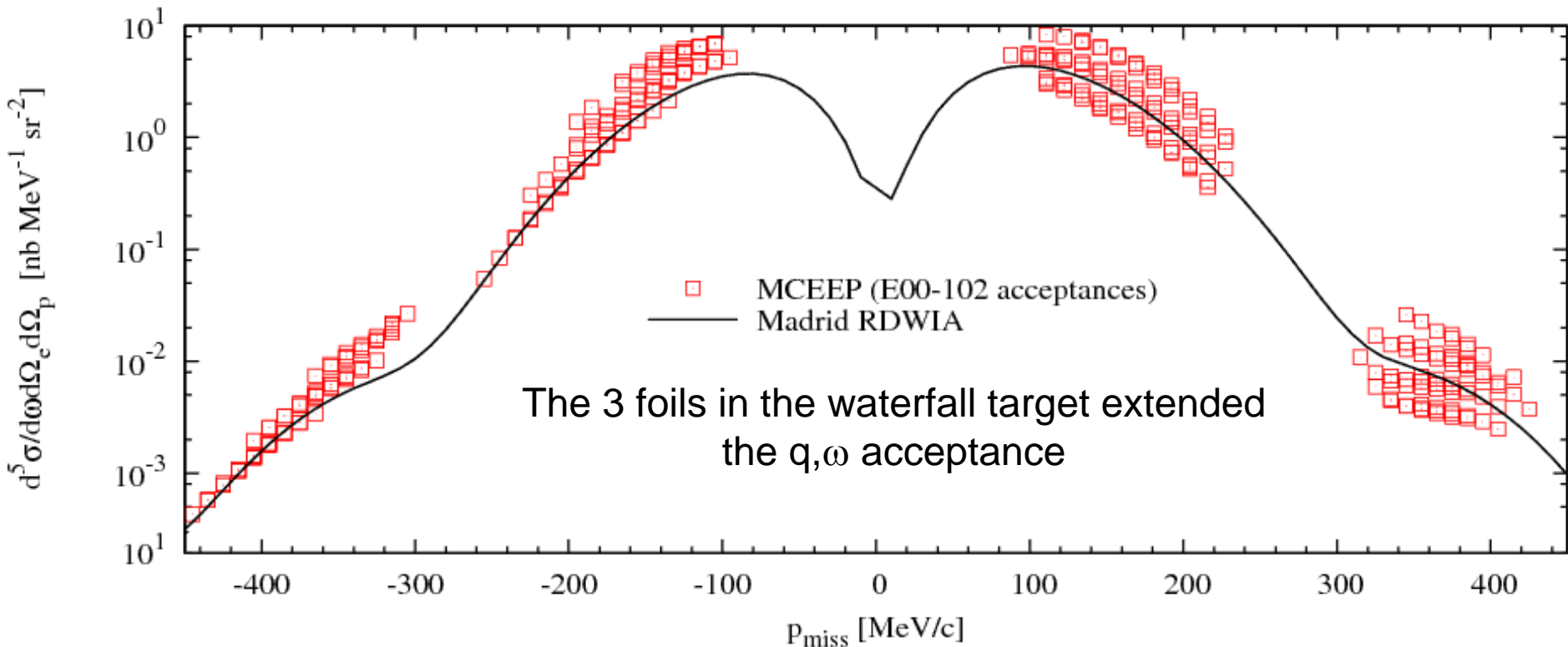
At the end we want to get the cross-section for a given  $E_{miss}$  only as a function of  $p_{miss}$ .



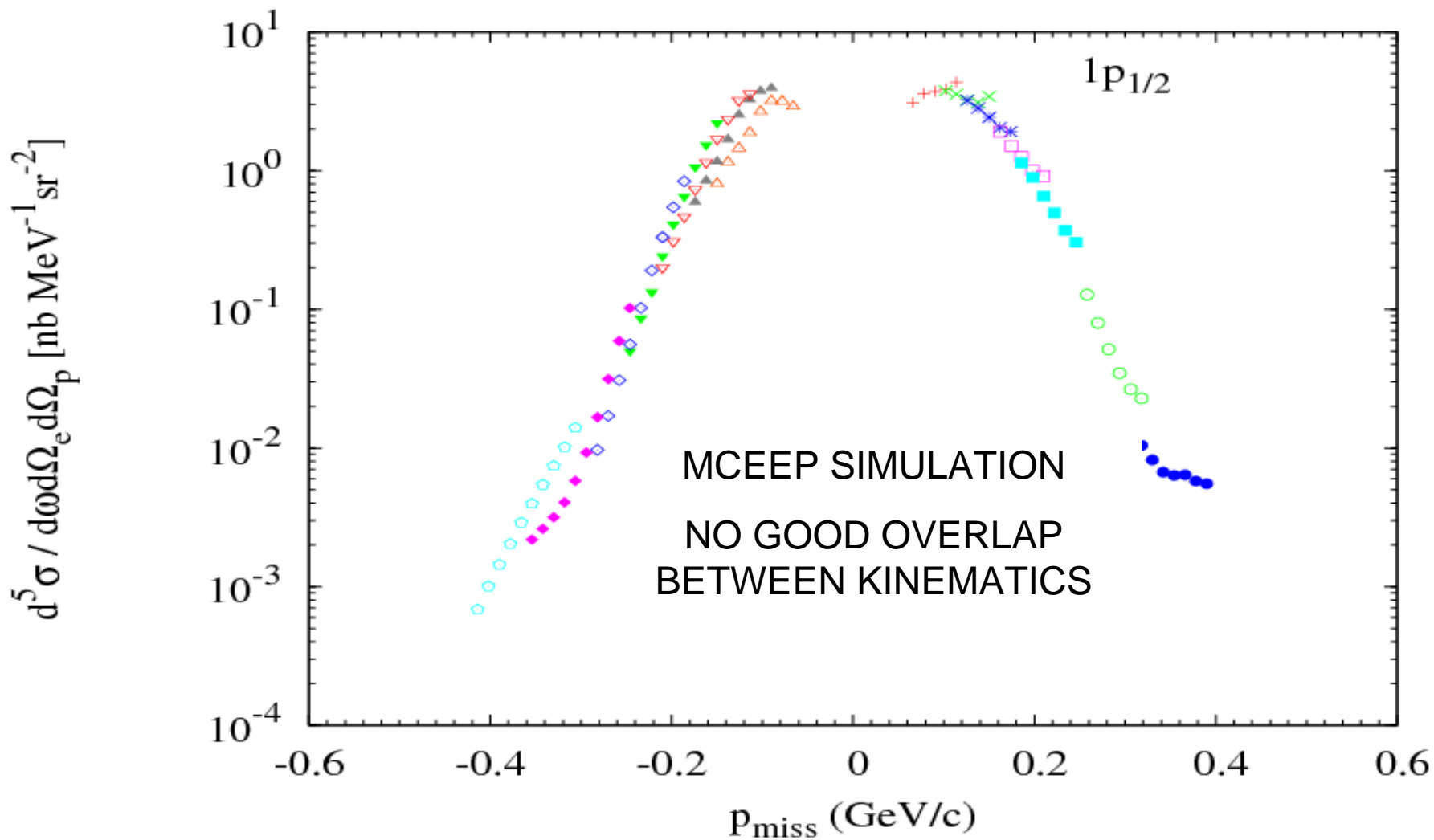
*Experimental data from the E89-003 experiment and RDWIA theoretical calculation from Udias et al.*

### 3. EXTRACTING CROSS-SECTION $O(e,e'p)$

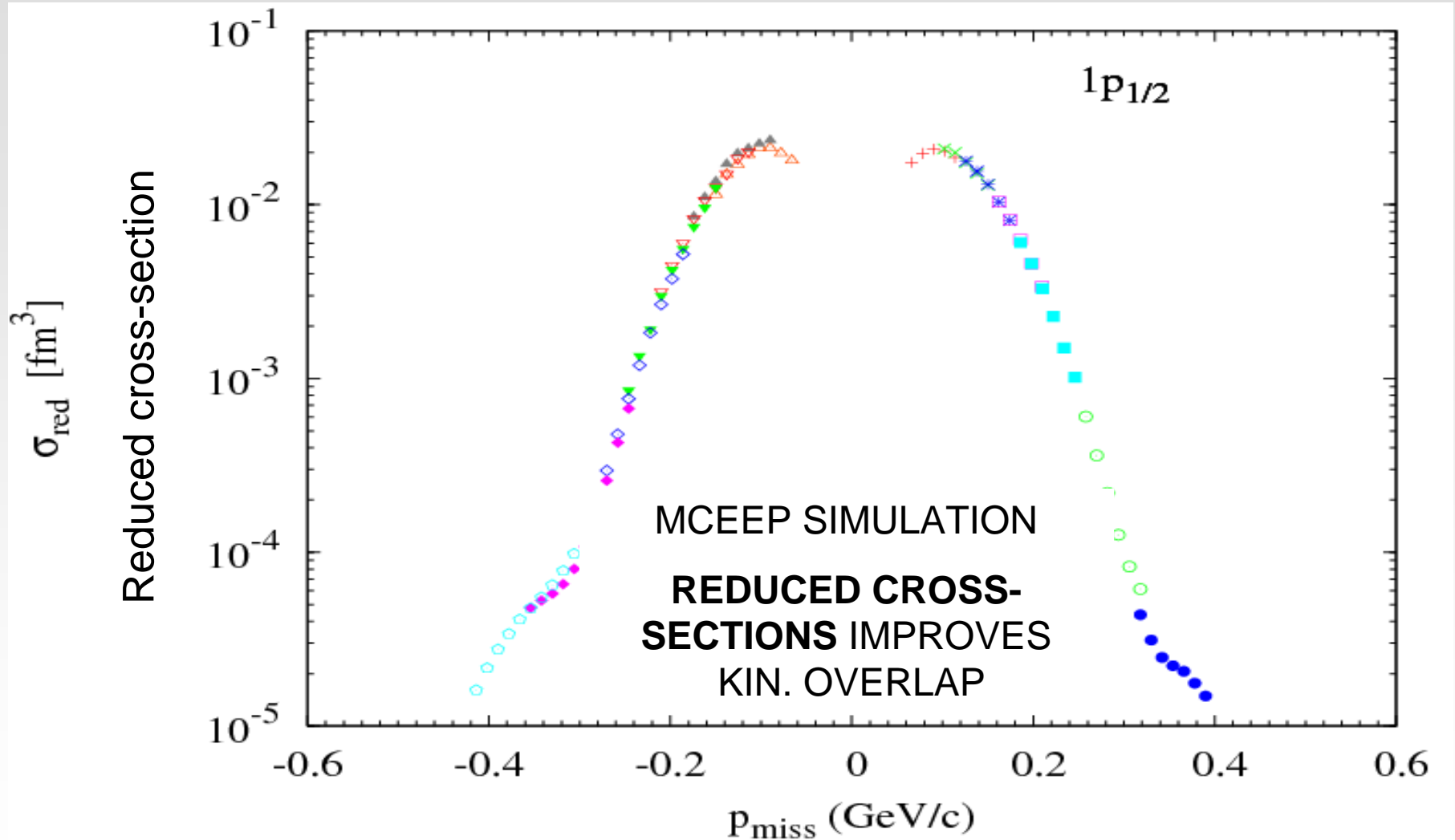
- Goal: obtain for each shell the cross-section as a function of  $p_{\text{miss}}$ .
- We remove the  $q, \omega$  dependence by using reduced cross section and isolate the  $\phi$  dependence with cuts or with a fitting procedure.



# 3. EXTRACTING CROSS-SECTION $^{16}\text{O}(e,e'p)$



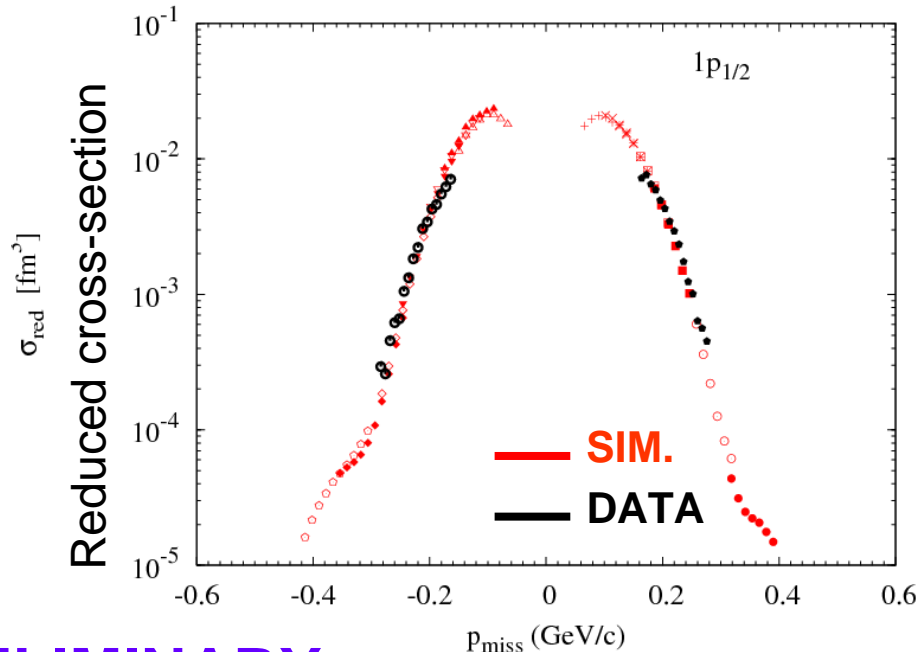
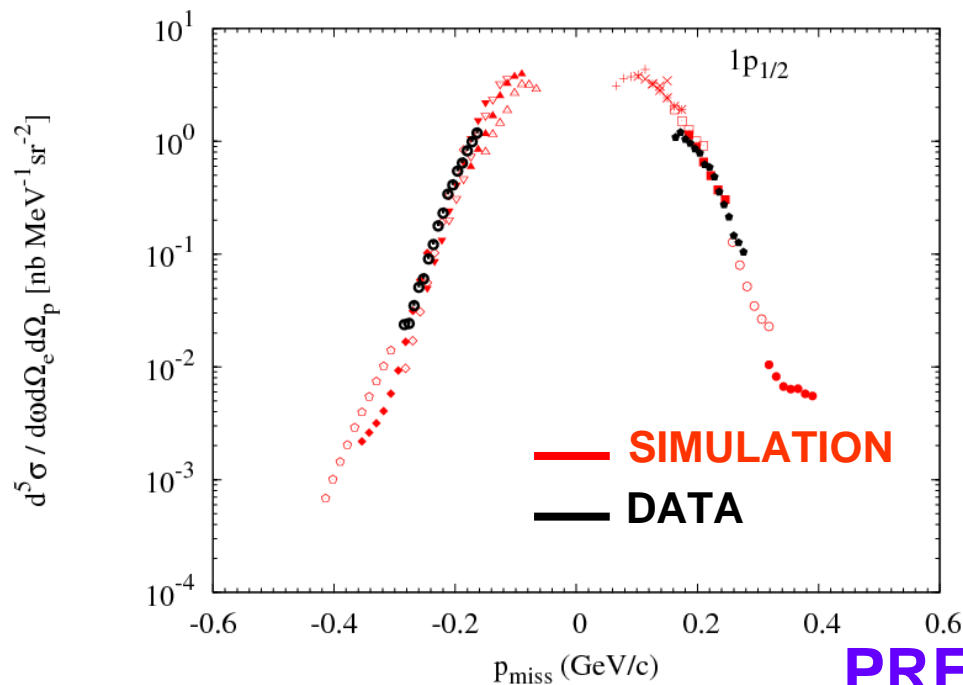
# 3. EXTRACTING CROSS-SECTION $^{16}\text{O}(e,e'p)$



# 3. EXTRACTING CROSS-SECTION $^{16}\text{O}(e,e'p)$

## What happens with the data?

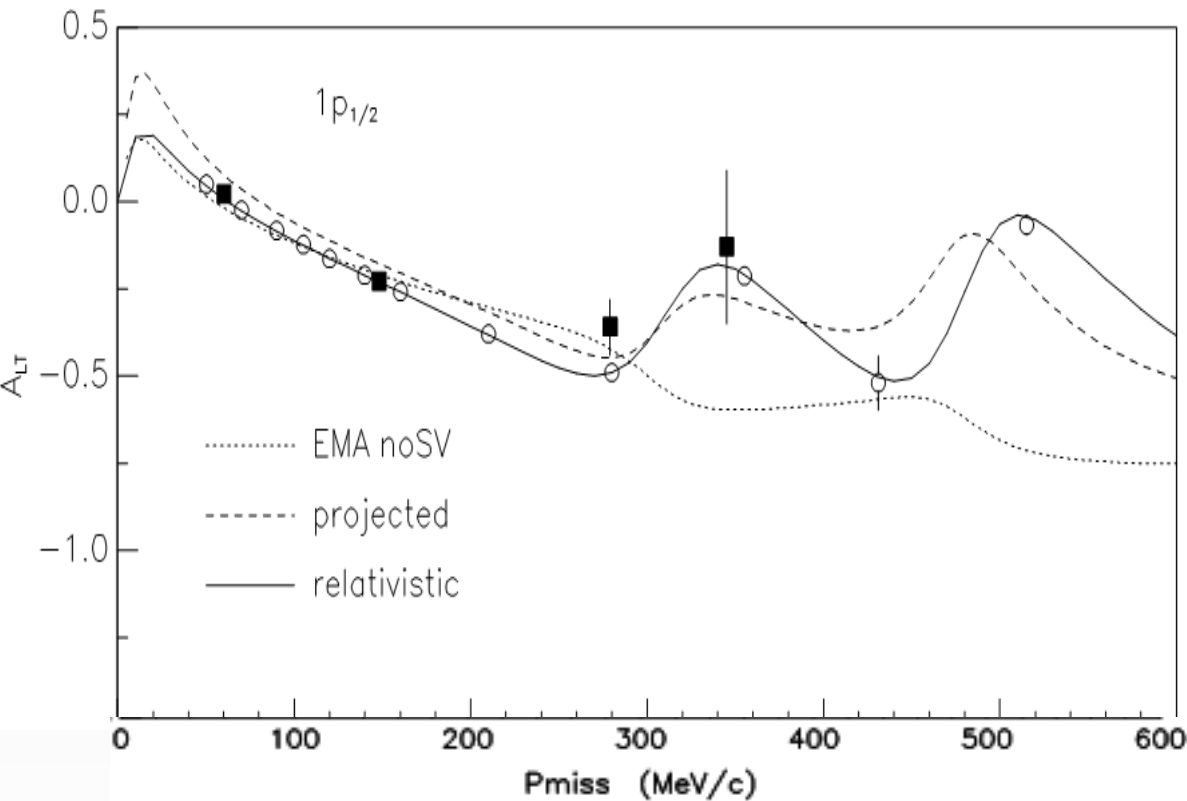
To start the analysis and check the tools developed (C++ macro, normalization, simulations...), a small amount of data was selected.



**PRELIMINARY**

# 4. EXTRACTING $A_{LT}$

$$A_{LT} = \frac{d^6\sigma(\phi = 0^\circ) - d^6\sigma(\phi = 180^\circ)}{d^6\sigma(\phi = 0^\circ) + d^6\sigma(\phi = 180^\circ)}$$

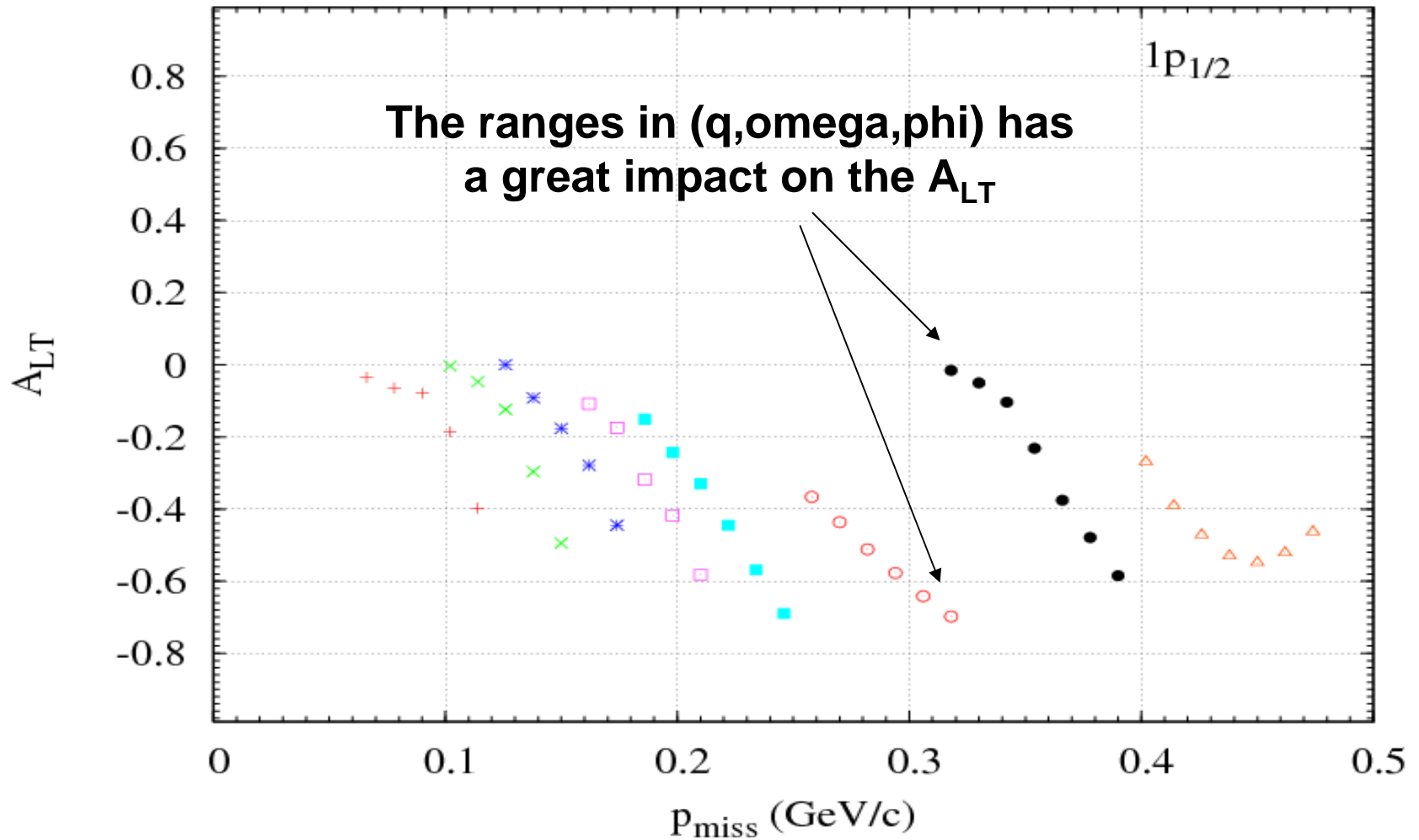


○ Anticipated data points from E00-102

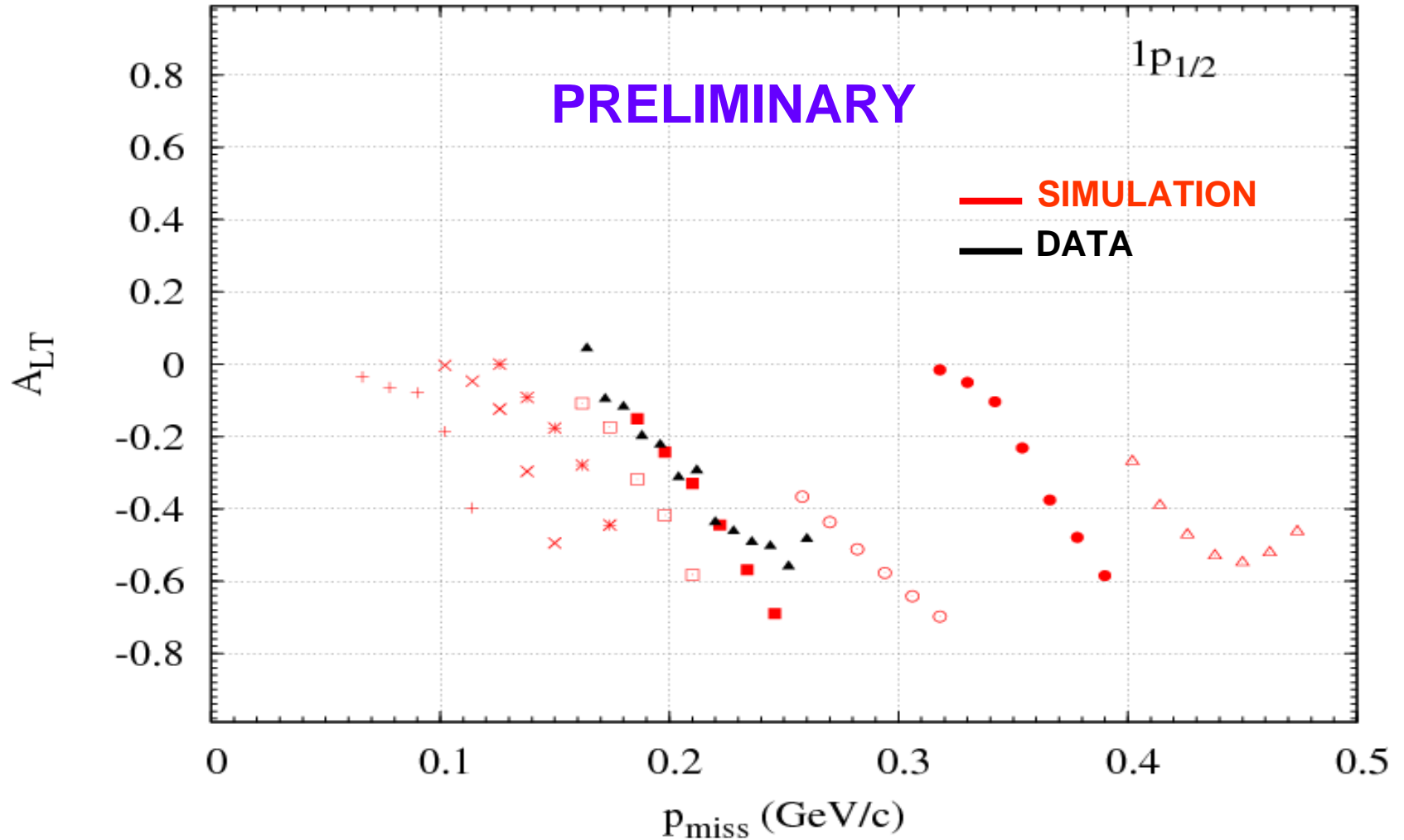
■ Data obtained from E89003

Compared to calculations by Udias *et al.*

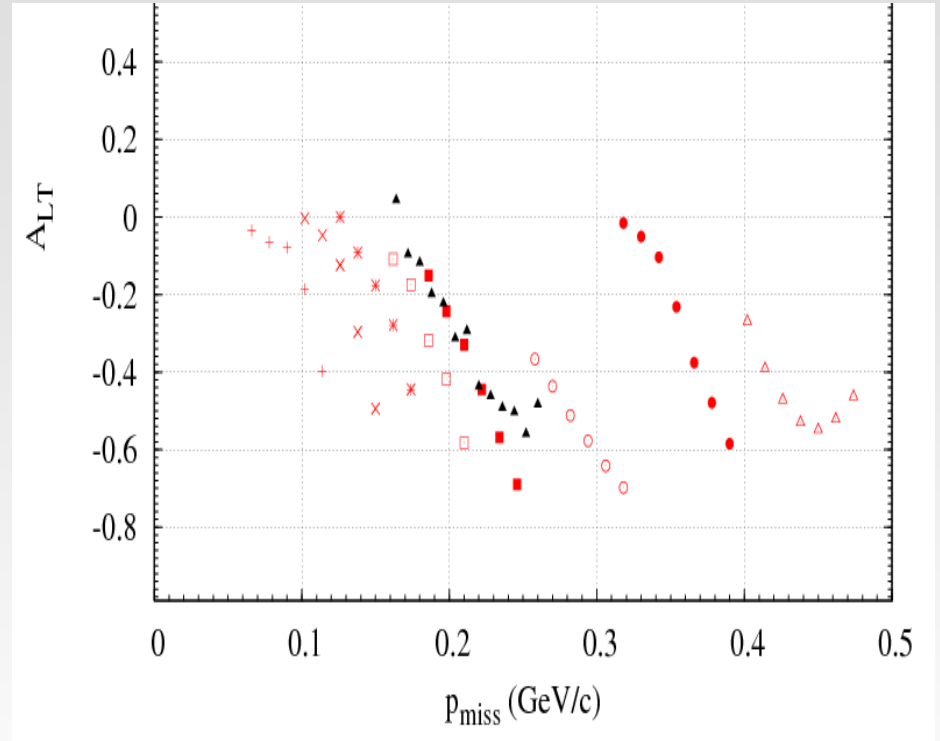
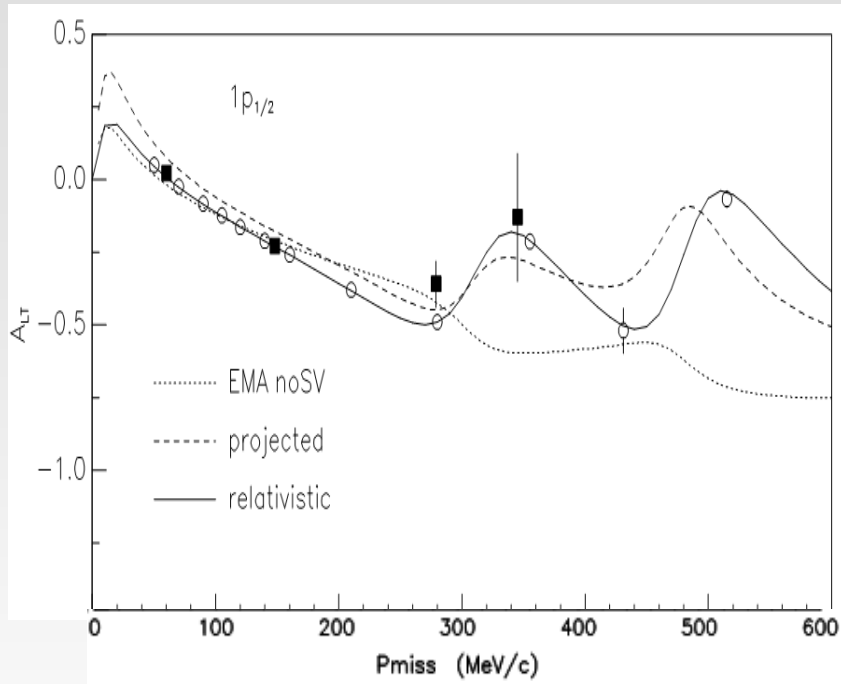
# 4. EXTRACTING ALT (SIMULATION)



# 4. EXTRACTING ALT (DATA)



# 4. EXTRACTING ALT (DATA)

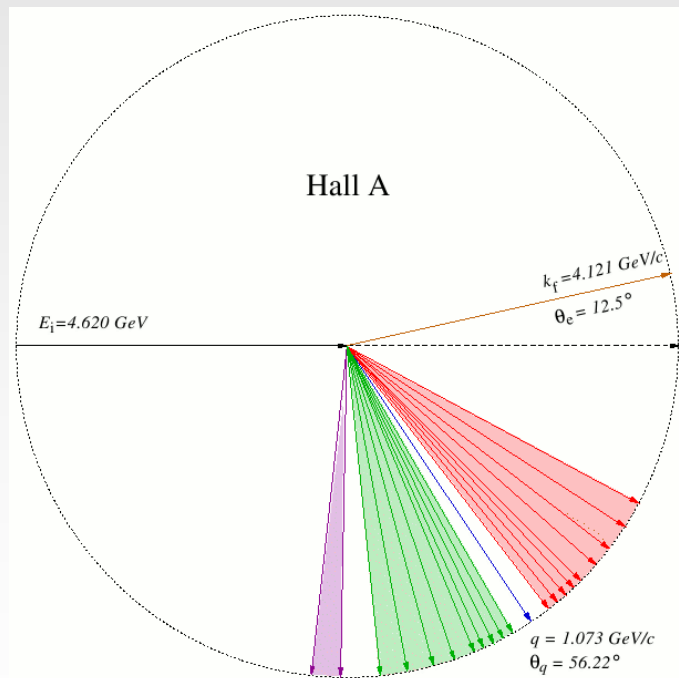


Central points for each kinematics correspond (both in data and in simulations) to what is expected from previous experiment and theory

# 7. Next Steps

- With all the necessary tools developed, we can proceed with the analysis of all the rest of the data.
- We have to get the final systematic errors for the experiment.
- Theory simulation has still to be tuned to emulate as much as possible the experimental conditions.
- More number of bins will be done in both data and simulations.

# THANK YOU FOR YOUR ATTENTION!



HALL A COLLABORATION MEETING  
05 DECEMBER 2008

