STATUS OF THE E00-102 EXPERIMENT
Testing the Limits of the Single-Particle Model in $^{16}O(e,e'p)$

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and the Jefferson Lab Hall A Collaboration

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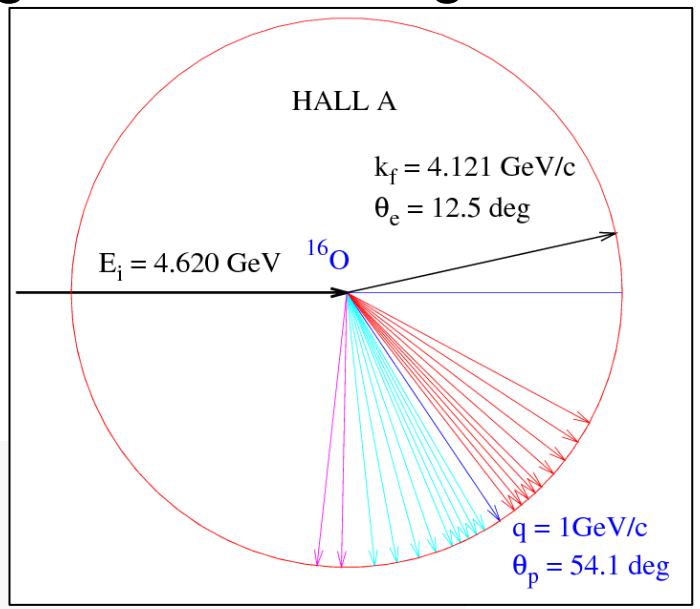
1. Experiment (E00-102)- Measurement of the Cross-Section, R_{LT}, and A_{TL} for the $^{16}O(e,e'p)$ Reaction

- A continuation of E89-003, which measured $^{16}O(e,e'p)$ cross-section, R_L, R_T, and R_{LT} using a waterfall target.
- E00-102 →
  - Q^2=0.9GeV^2 and ω=0.5GeV
  - Higher p_{miss} up to 0.75 GeV/c)
  - Higher precision
  - Sigma, R_{LT} and A_{TL}



- **GOALS:**

- 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 A_{TL}.
- Bound-state wave function and spectroscopic factors for valence proton knockout.

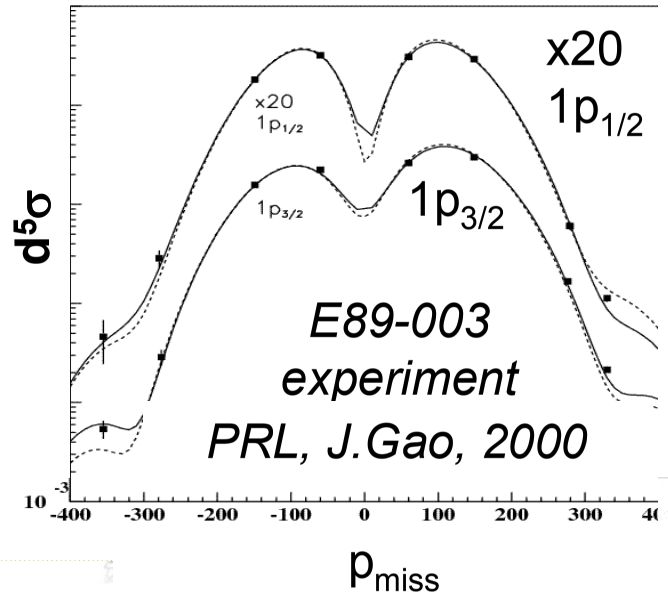
2. THEORY AND SIMULATIONS

• Response functions from Udias/Madrid model (which gave a good description of previous E89-003 experiment) has been incorporated into MCEEP.

$$\frac{d^5\sigma}{d\Omega_e d\omega d\Omega_p} = K\sigma_M(v_L R_L + v_T R_T + v_{LT} R_{LT}\cos\phi + v_{TT} R_{TT}\cos 2\phi)$$

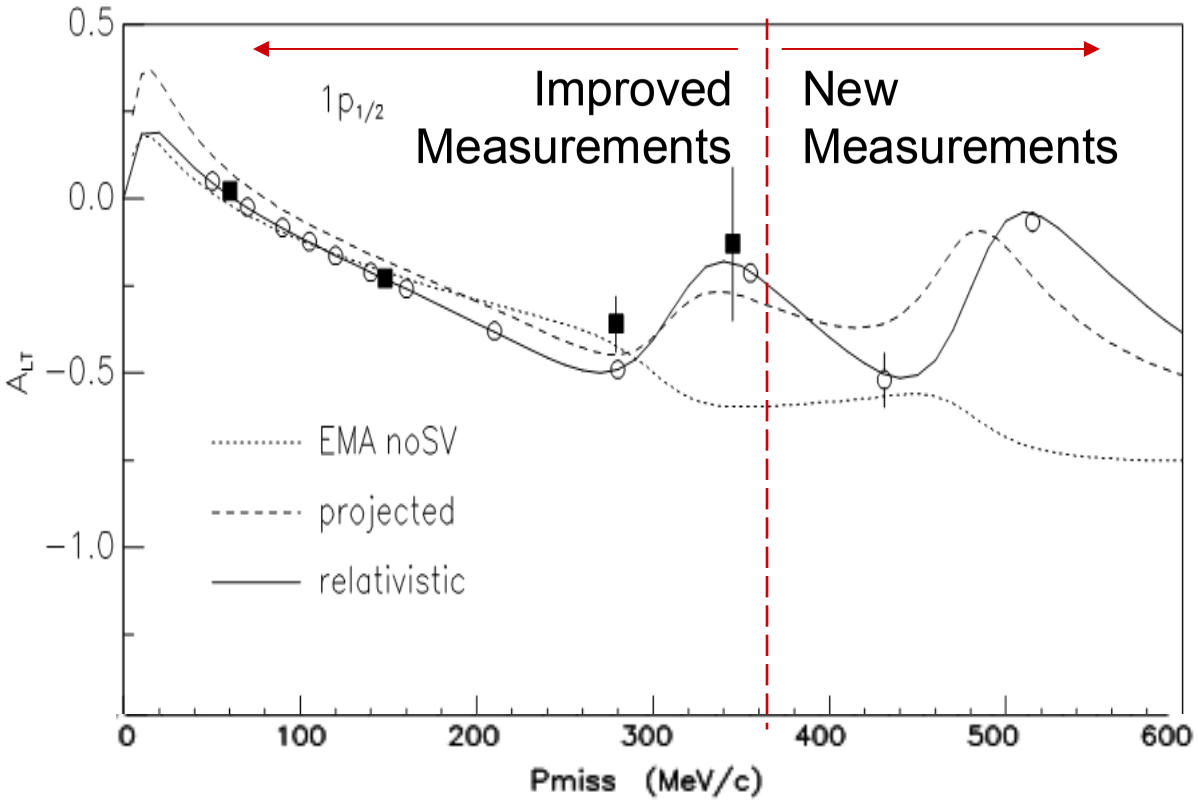
• Simulations (PWIA, DWIA, either with relativistic or projected spinor distortion) have been generated.

• Events generated in phase space and weighted by the cross-section. Unweighted phase space events used for normalization.



2. THEORY AND SIMULATIONS: A_{TL}

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



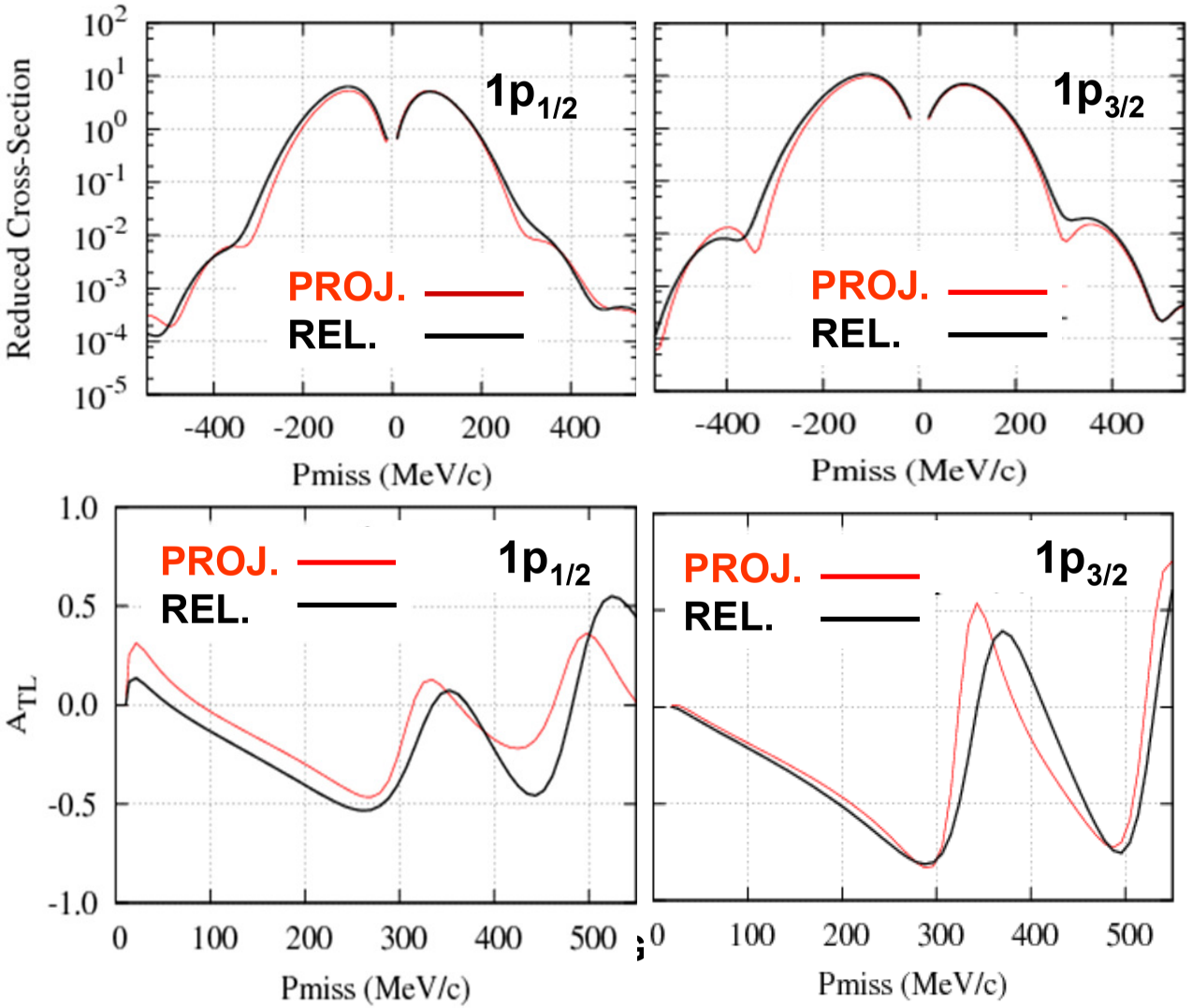
- o Anticipated data points from E00-102
- ■ Data obtained from E89003

Compared to calculations by Udias *et al.*

A_{TL} is the best observable to check dynamical relativistic effects

2. THEORY: INGREDIENTS AND RELATIVISTIC DYNAMICAL EFFECTS

INPUT PARAMETER	OPTION
BOUND-NUCLEON WAVE FUNCTION	NLSH
OPTICAL MODEL	EDAI-O
NUCLEAR SPINOR DISTORTION	**RELATIVISTIC & PROJECTED** (NON-RELATIVISTIC DYNAMICS)
ELECTRON DISTORTION	NONE (yet)
KINEMATICS	RELATIVISTIC
CURRENT OPERATOR	CC2
NUCLEON FORM FACTORS	J.ARRINGTON (ROSENBLUTH DATA FIT)
GAUGE	COULOMB



3. DATA ANALYSIS – Tasks completed

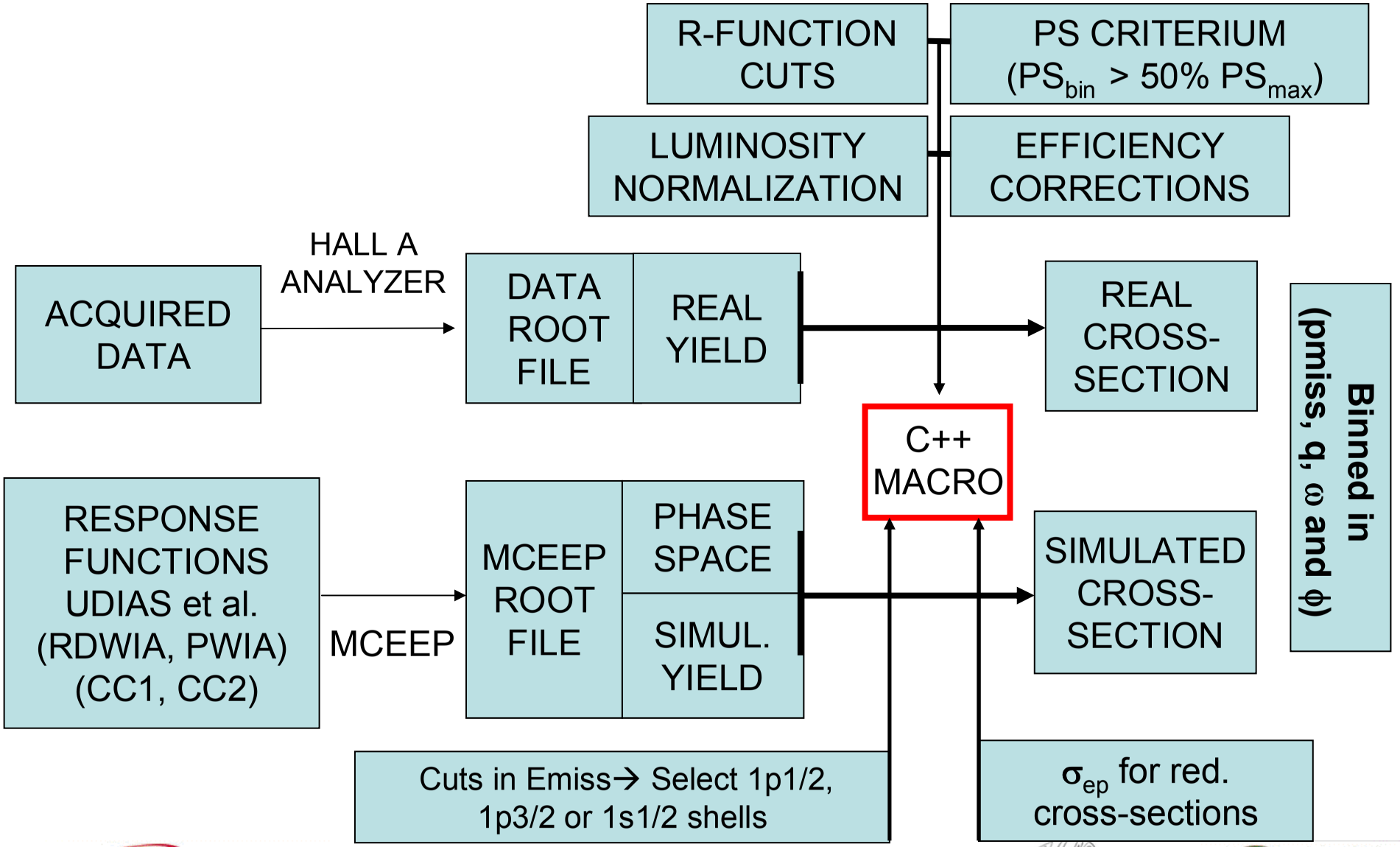
- **Calibration and Normalization:**

Energy, Position, Optics, Coincidence-Time, Water-foil thickness, Energy Loss correction, R-function for acceptances, Luminosity and dead-time monitoring with elastic scattering.

- **C++ Macro to obtain the cross-section from the analyzed data and the simulations.**

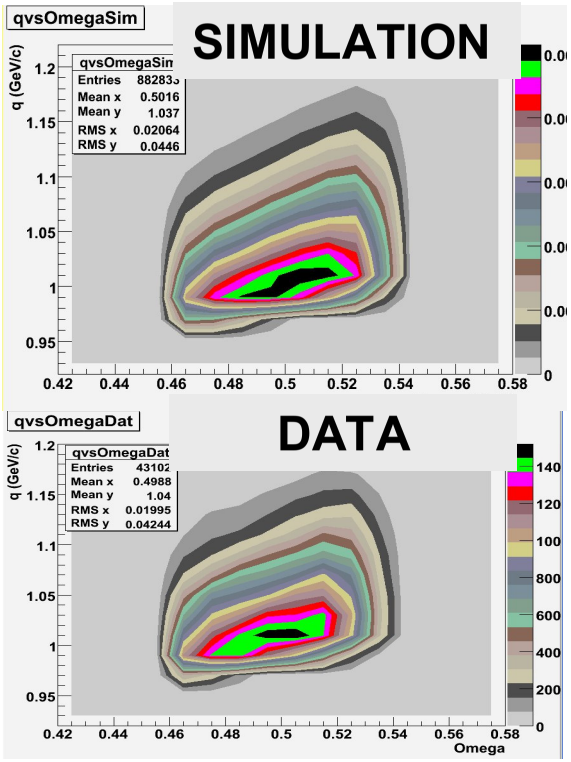
- **Absolute cross-sections:** Computing the H(e,e) cross-section (averaged in electron acceptances).

3. MACRO FOR CROSS-SECTION (I)

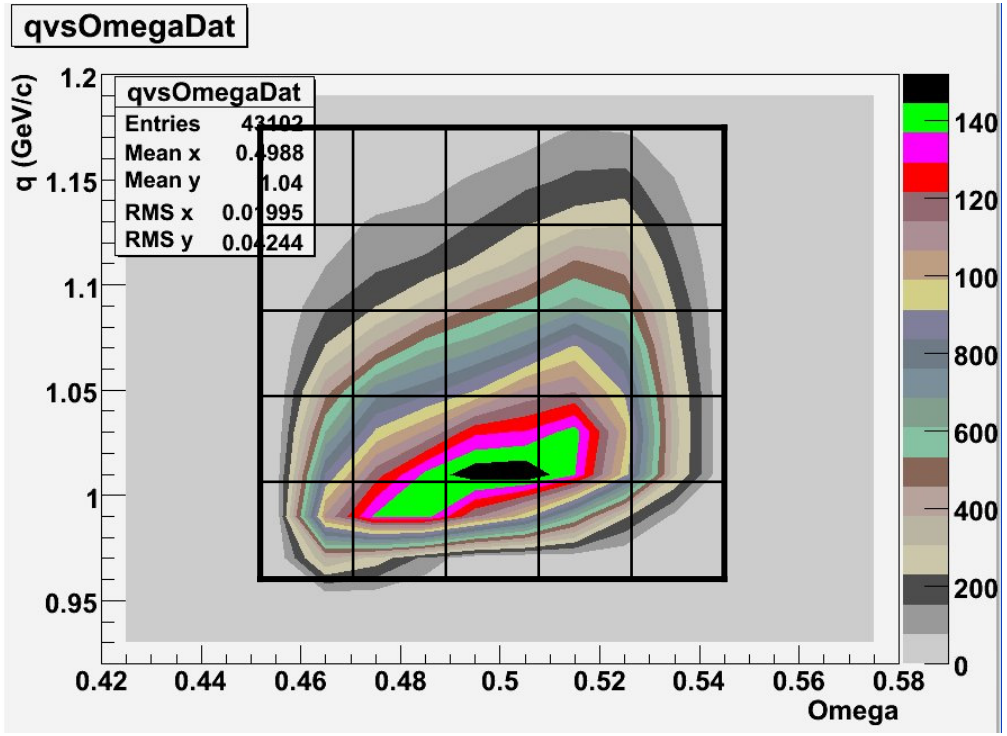


3) DATA BINNING:(q,ω) BINS

For each kinematics → Cross-section(Emiss,pmiss,ϕ,q,ω).
After that, they are all merged (taking into account statistics) into one single root file with 4D histograms (pmiss,ϕ,q,ω) for each shell.
This file contains all the relevant experimental information.



Yield as a function of |q| and ω after R-function cuts.



The (q,ω) space was divided into 25 bins.
Note that the nominal central value for the experiment was q=1.073GeV/c and ω =0.499GeV.

A

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

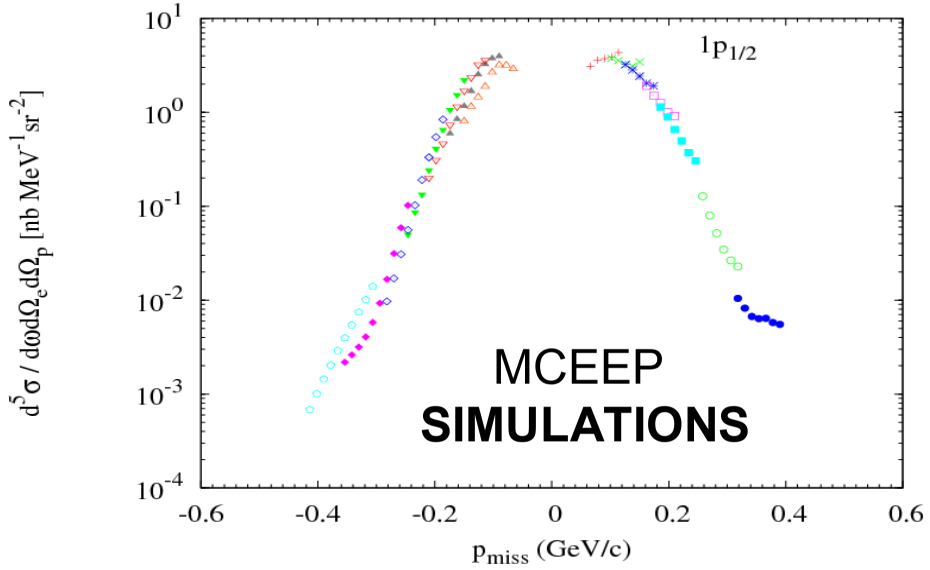
For each Emiss region → Histograms binned in (pmiss, ϕ , q and ω)

$$\frac{d^5\sigma}{d\Omega_e d\omega d\Omega_p} = f(E_{miss}, p_{miss}, q, \omega, \phi) \rightarrow \left.\frac{d^5\sigma}{d\Omega_e d\omega d\Omega_p}\right|_{Emiss} (p_{miss}, q, \omega, \phi)$$

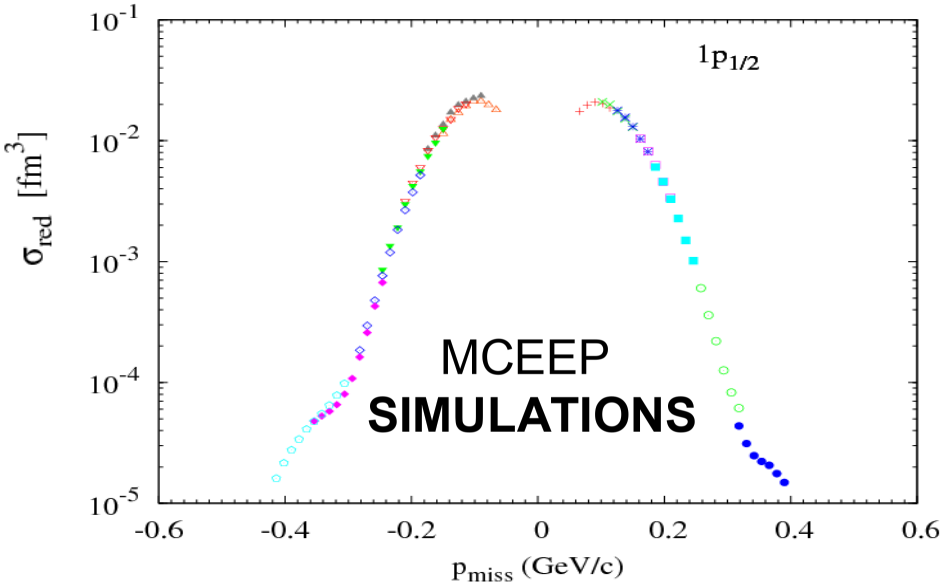
• We remove the q,ω dependence by using the reduced cross-section and isolate the ϕ dependence either with cuts or with a fitting procedure.

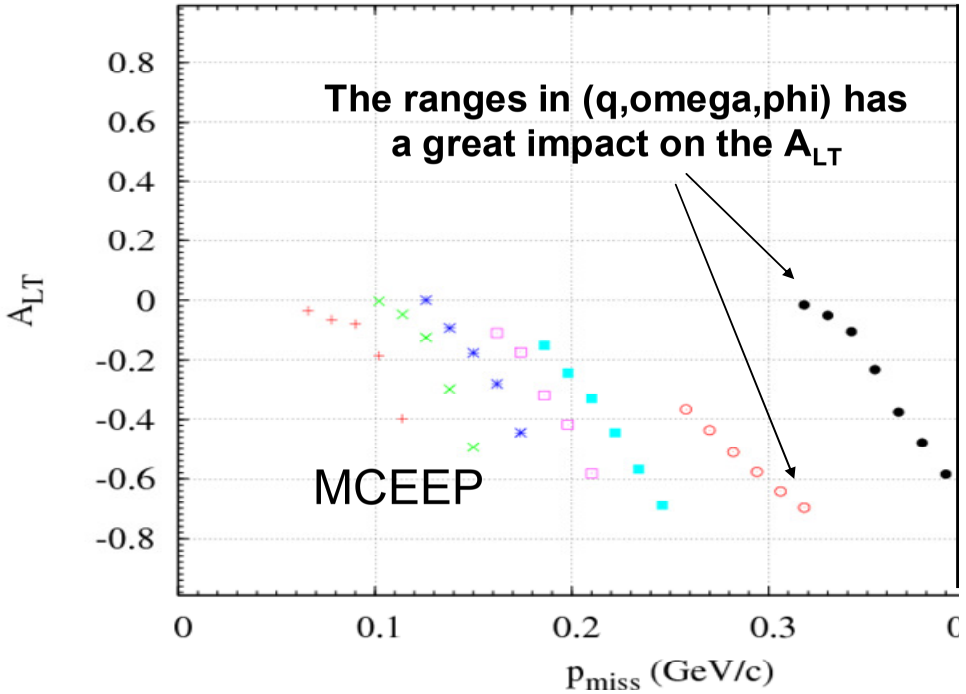
$$\left.\frac{d^5\sigma}{d\Omega_e d\omega d\Omega_p}\right|_{Emiss} (p_{miss}, q, \omega, \phi) \rightarrow \left.\frac{d^5\sigma}{d\Omega_e d\omega d\Omega_p}\right|_{Emiss} \Big/ K\sigma_{ep} = f(p_{miss})$$

3. CROSS-SECTION FROM SIMULATIONS



REDUCED CROSS-SECTION IMPROVES KIN. OVERLAP



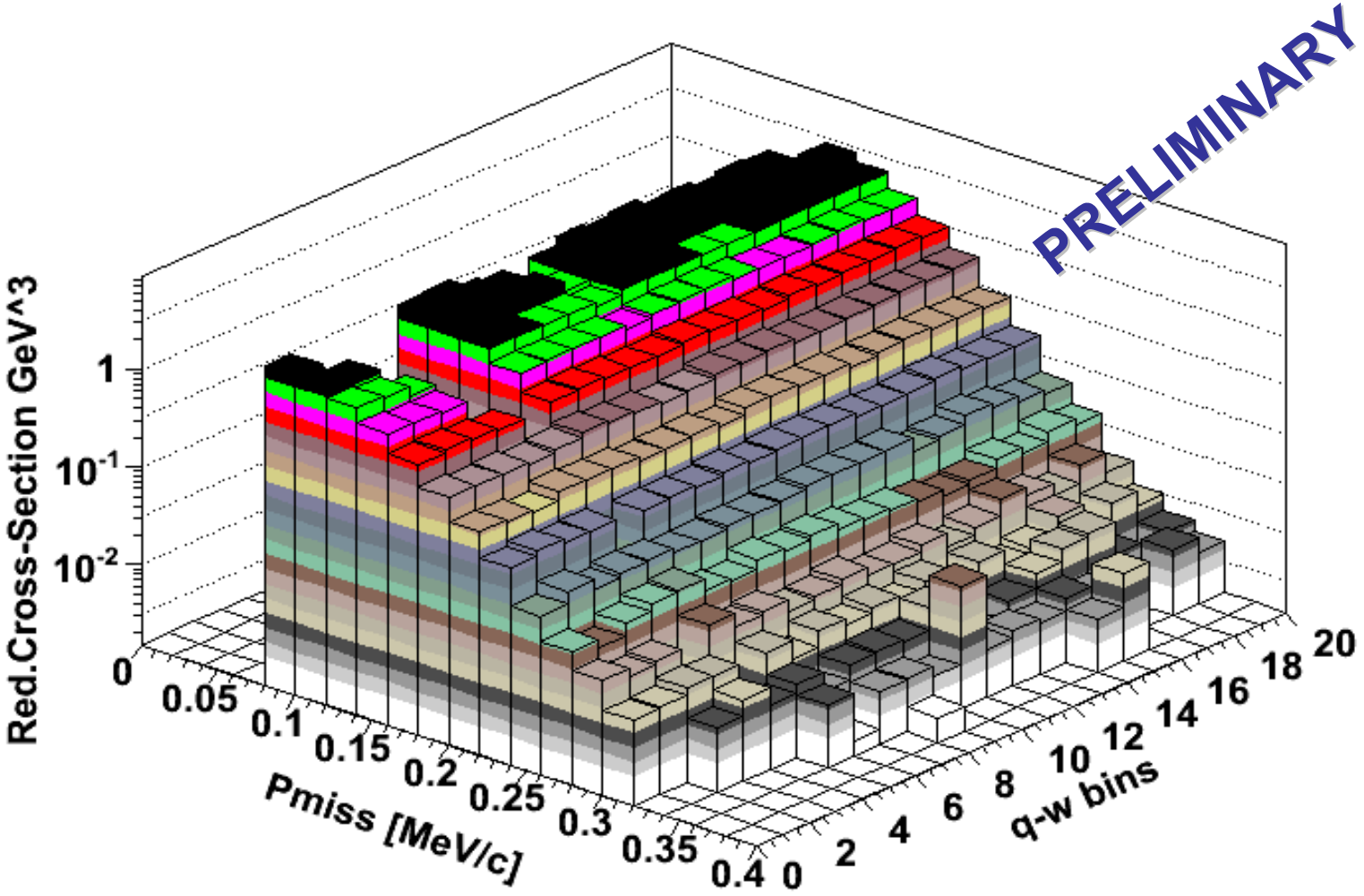


In the E00-102 experiment, several kinematics overlap in p_{miss} (specially at low p_{miss}). Nevertheless, each kinematics cover a different (q, ω and ϕ) region and yield a different cross-section.

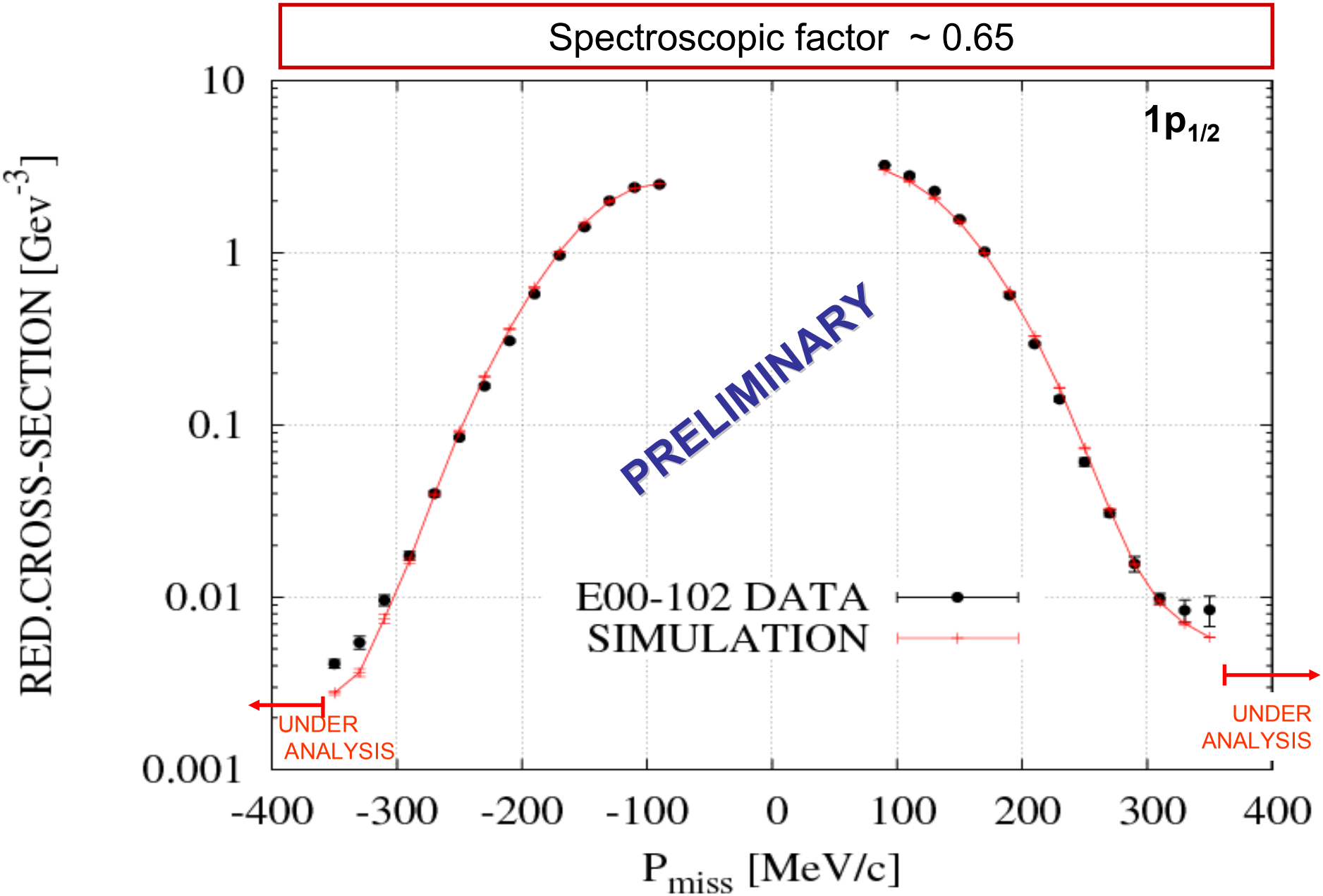
RESULTS

$1p_{1/2}$ (p_{miss}<350MeV/c)

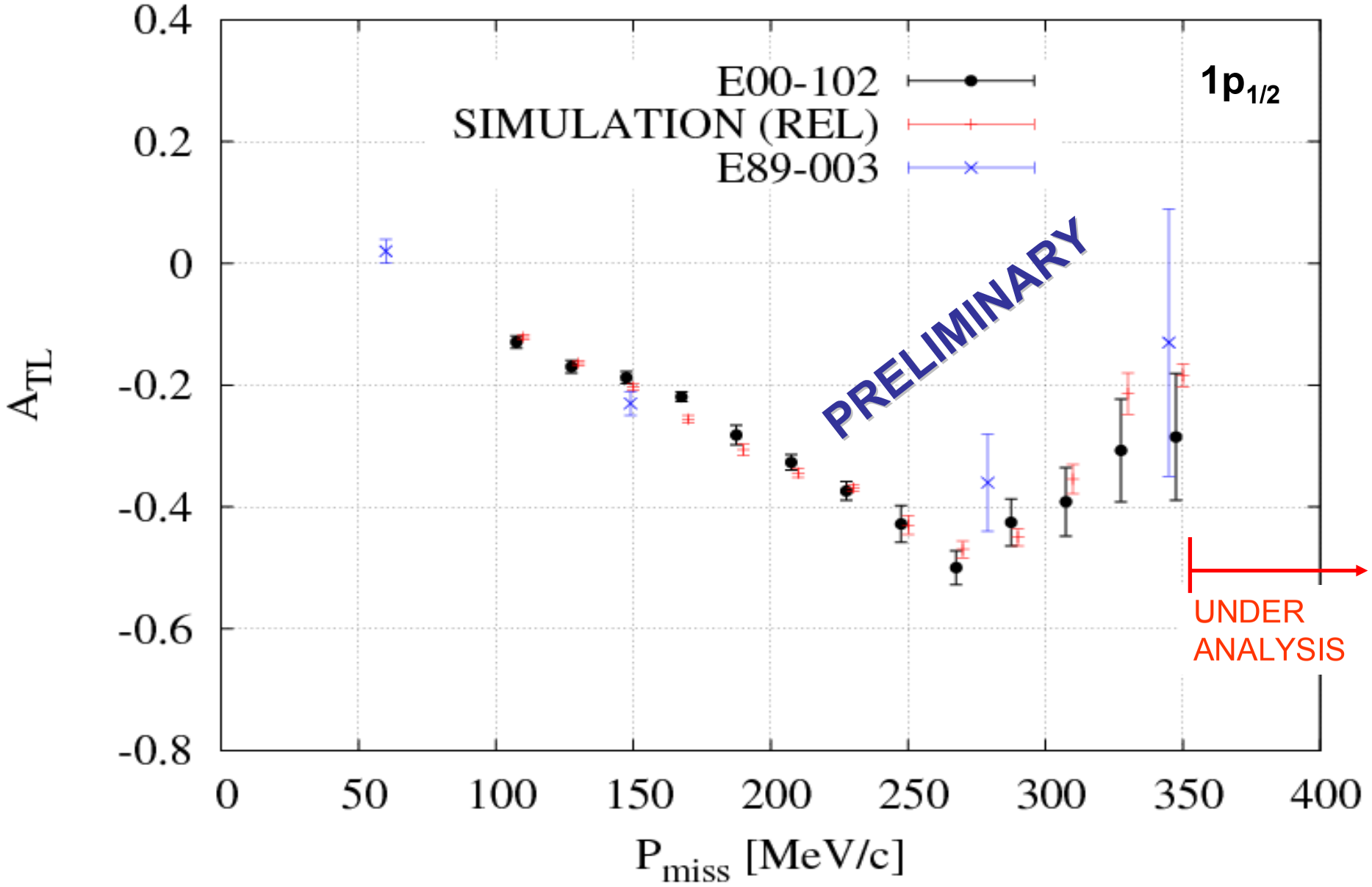
4. RESULTS: REDUCED CROSS-SECTION REMOVES q,ω DEPENDENCE



4. RESULTS: REDUCED CROSS-SECTION



4. RESULTS: A_{TL}



5. CONCLUSIONS

☑ Analysis mostly completed

☑ $1p_{1/2}$

- Reduced cross-section and A_{TL} analyzed for $p_{miss} < 350$ MeV/c
- Great statistics
- Good agreement with previous expt. and with simulation based on fully relativistic kinematics and dynamics.
- Spectroscopic factor ~ 0.65
- Higher p_{miss} data under analysis ($350 < p_{miss} < 750$)

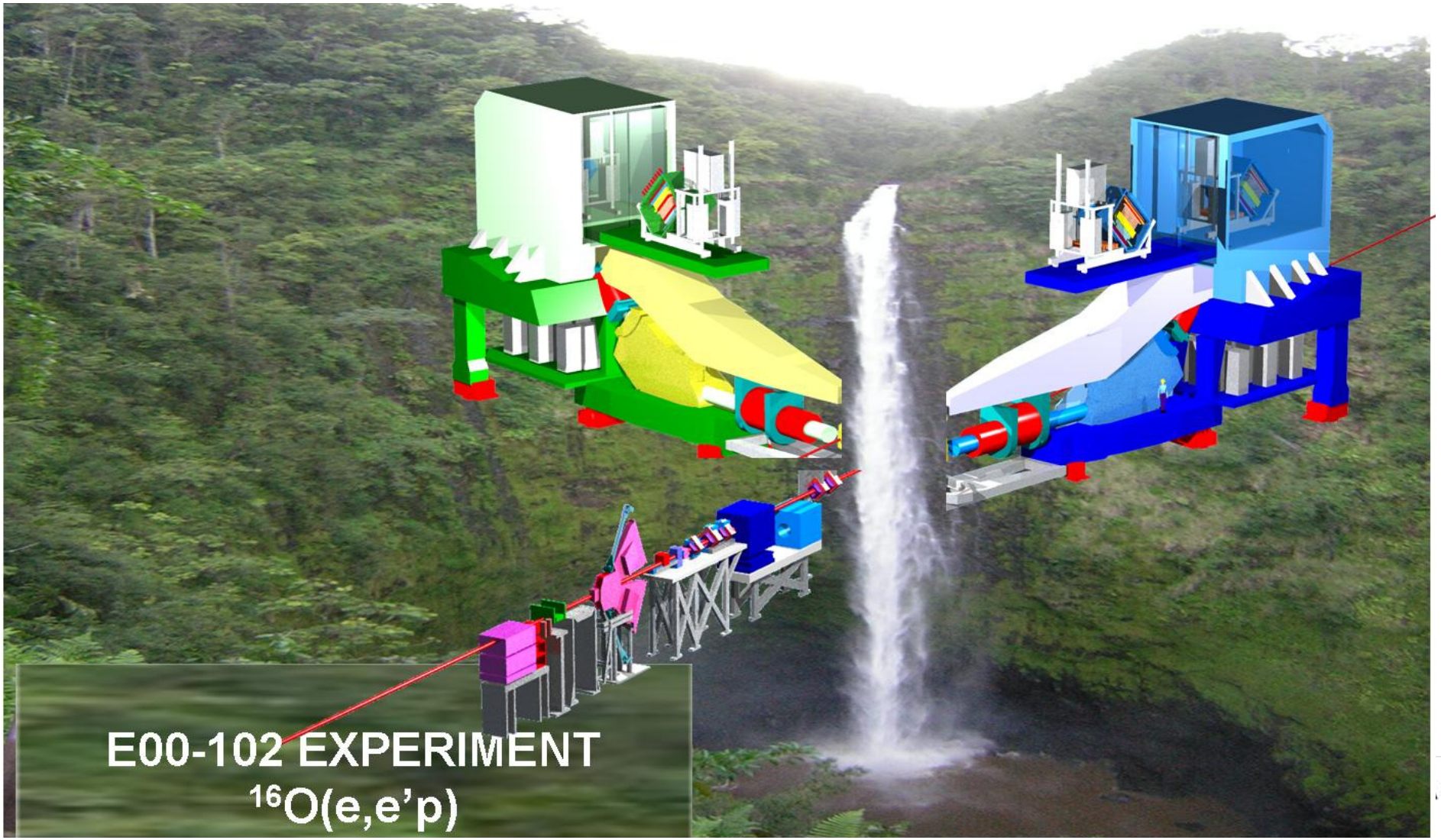
☑ $1p_{3/2}$

- Radiative tail subtraction under development

☑ Systematic errors not done yet.

☑ Anticipate completion Fall 2009

THANK YOU
FOR YOUR ATTENTION!

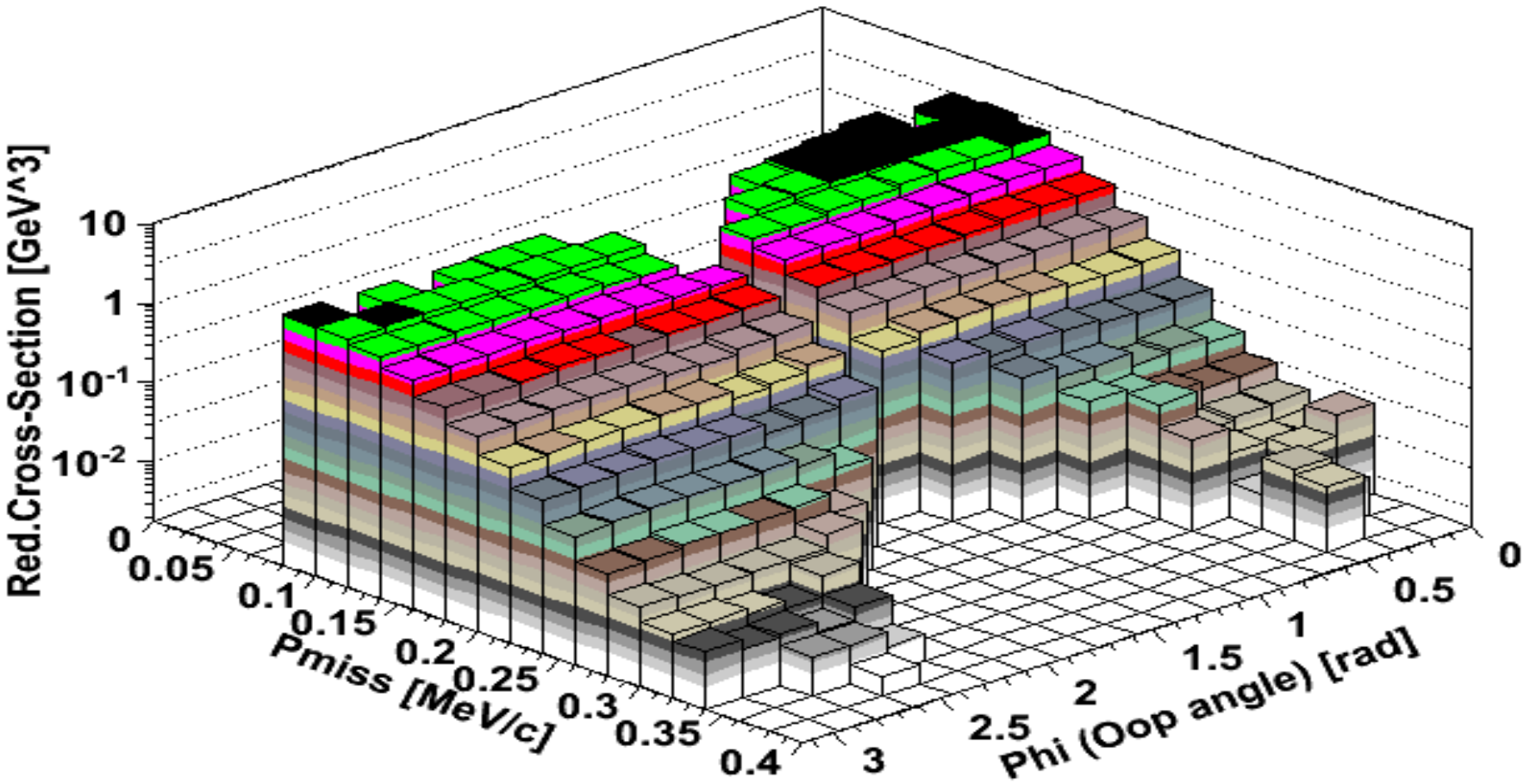


ADDITIONAL SLIDES

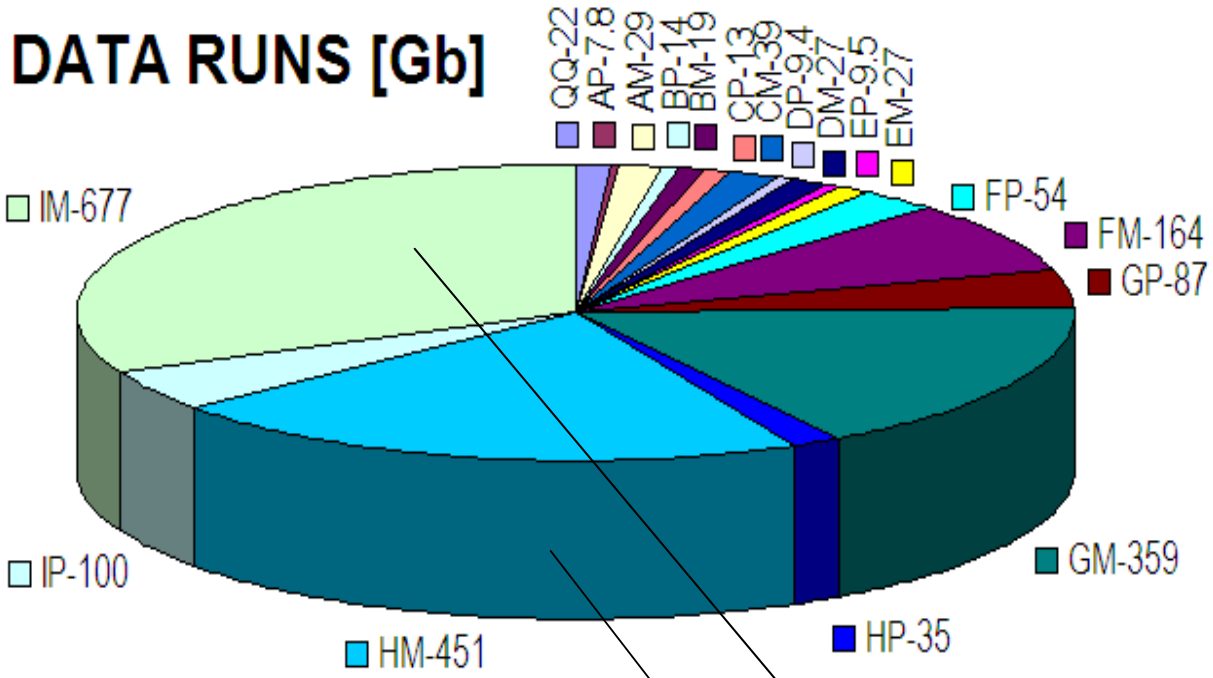
A_{TL} from fitting f(ϕ)

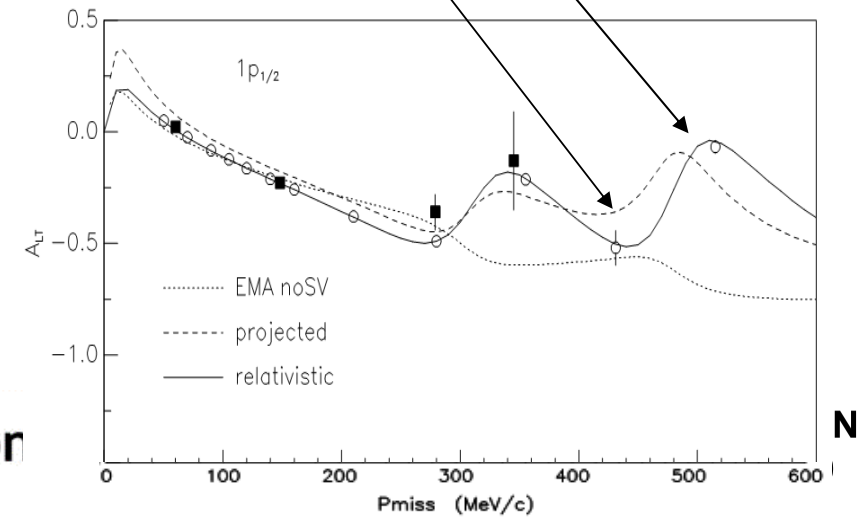
A_{TL} obtained with only ϕ=0 and ϕ=π data.

A_{TL} from fitting the cross-section ϕ dependence is in progress.



ANALYZED DATA





More than 2Tb of good data have been analyzed.