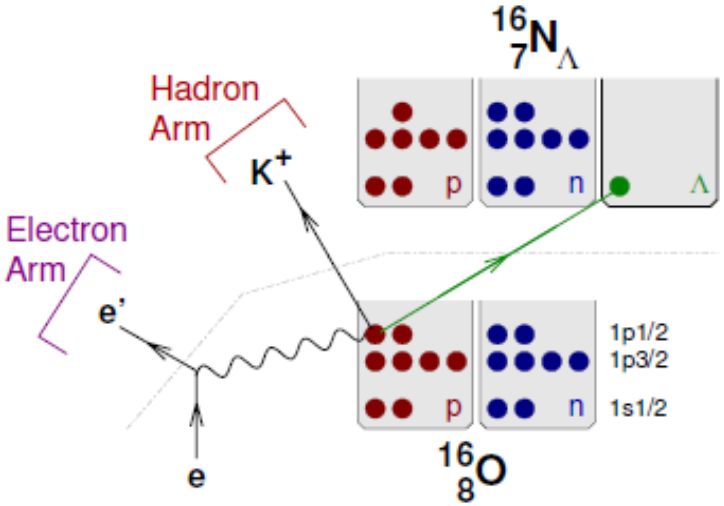
Analisi BA/RM/ISS

- **Hypernuclear Spectroscopy**
  - Franco Garibaldi, Francesco Cusanno, Guido Urciuoli, Stefano Marrone, Mauro Iodice, Evaristo Cisbani
- **Pb Quasielastic**
  - Guido Urciuoli
- **Transversity (RICH, k-analysis)**
  - Youcai Wang, Evaristo Cisbani, Guido Urciuoli, Francesco Cusanno, Mauro Iodice, Francesco Mammoliti

- Hypernuclear Spectroscopy (12C, 16O, 9Be)
  - Presa dati 2005 e anni precedenti
  - Già pubblicato articolo su 12C
  - Risottomesso articolo su 16O
  - In fase completamento analisi 9Be

Systematic Study of hypernuclei by electromagnetic probes



- Λ is a **probe** in the nucleus
- Λ can be in the s-shell (no Pauli blocking)
- Λ weakly coupled to nuclear core → shell model works well
- *Exotic topics: [Hyper/Neutron Stars]*

Λ−N described by: $V_{\Lambda N} = V + \Delta + s_{\Lambda} + s_{N} + T$ (sensitive to spin terms)

Lepton Probe

$e + p \rightarrow e' + K^+ + \Lambda$

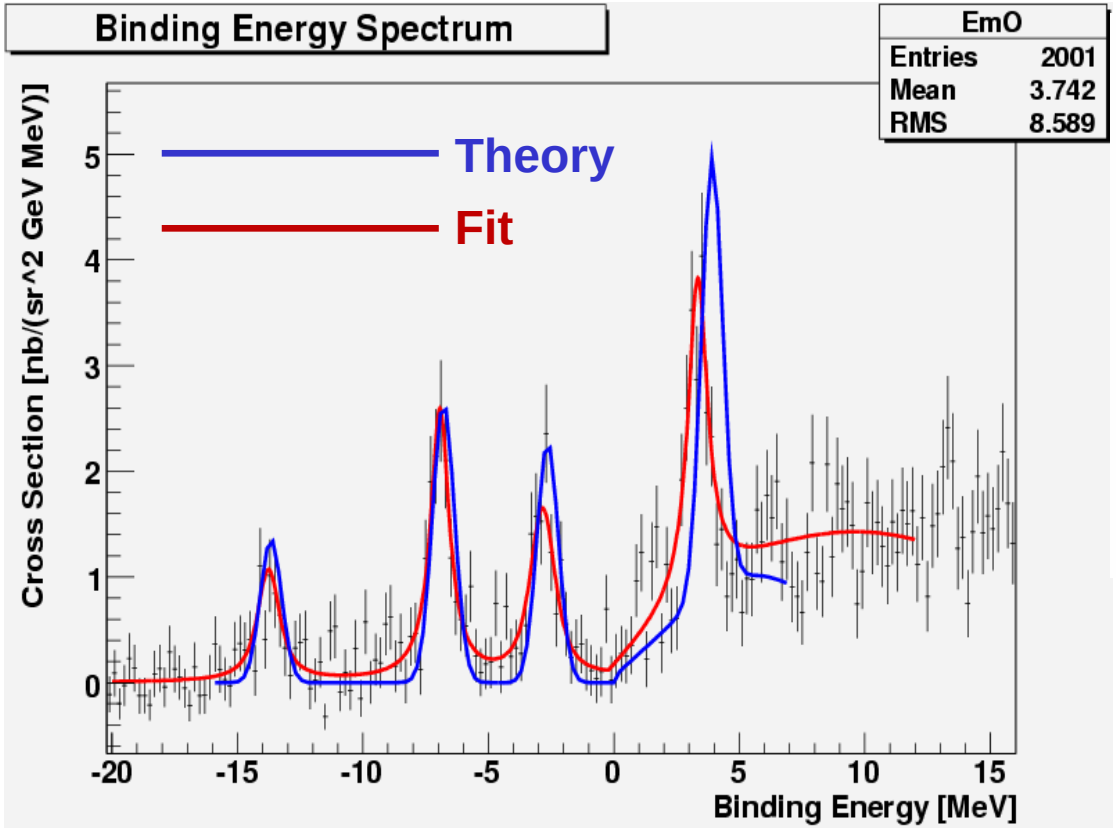
^{A}(Z-1)$_{\Lambda}$ Nuclei
Strong Spin Flip Transition
Better energy resolution
Low Rates on high background

Hadron Probe

$\pi + n \rightarrow K + \Lambda$, $K + n \rightarrow \pi + \Lambda$

$^{A}(Z)_{\Lambda}$ Nuclei
Different Energy Levels
Moderate/High Rates

Results on ^{16}O target – Hypernuclear Spectrum of $^{16}N_\Lambda$



E_x (MeV)	Width (FWHM, MeV)	Cross section $(nb/sr^2/GeV)$
0.00 / 13.76 ±0.16	1.71 ± 0.70	1.45 ± 0.26
6.83 ± 0.06	0.88 ± 0.31	3.16 ± 0.35
10.92 ± 0.07	0.99 ± 0.29	2.11 ± 0.37
17.10 ± 0.07	1.00 ± 0.23	3.44 ± 0.52

Binding Energy B_Λ=13.76 ± 0.16 (stat) ± 0.05 (sys) MeV

Measured for the first time with this level of accuracy

- Fit to the data (red line): Fit 4 regions with 4 Voigt functions $\Rightarrow \chi^2_{/ndf} = 1.19$
- Theoretical model (blu line) based on :
  - i) SLA p(e,e'K+)Λ (elementary process)
  - ii) ΛN interaction fixed parameters from KEK and BNL $^{16}_\Lambda O$ spectra (J. Millener)

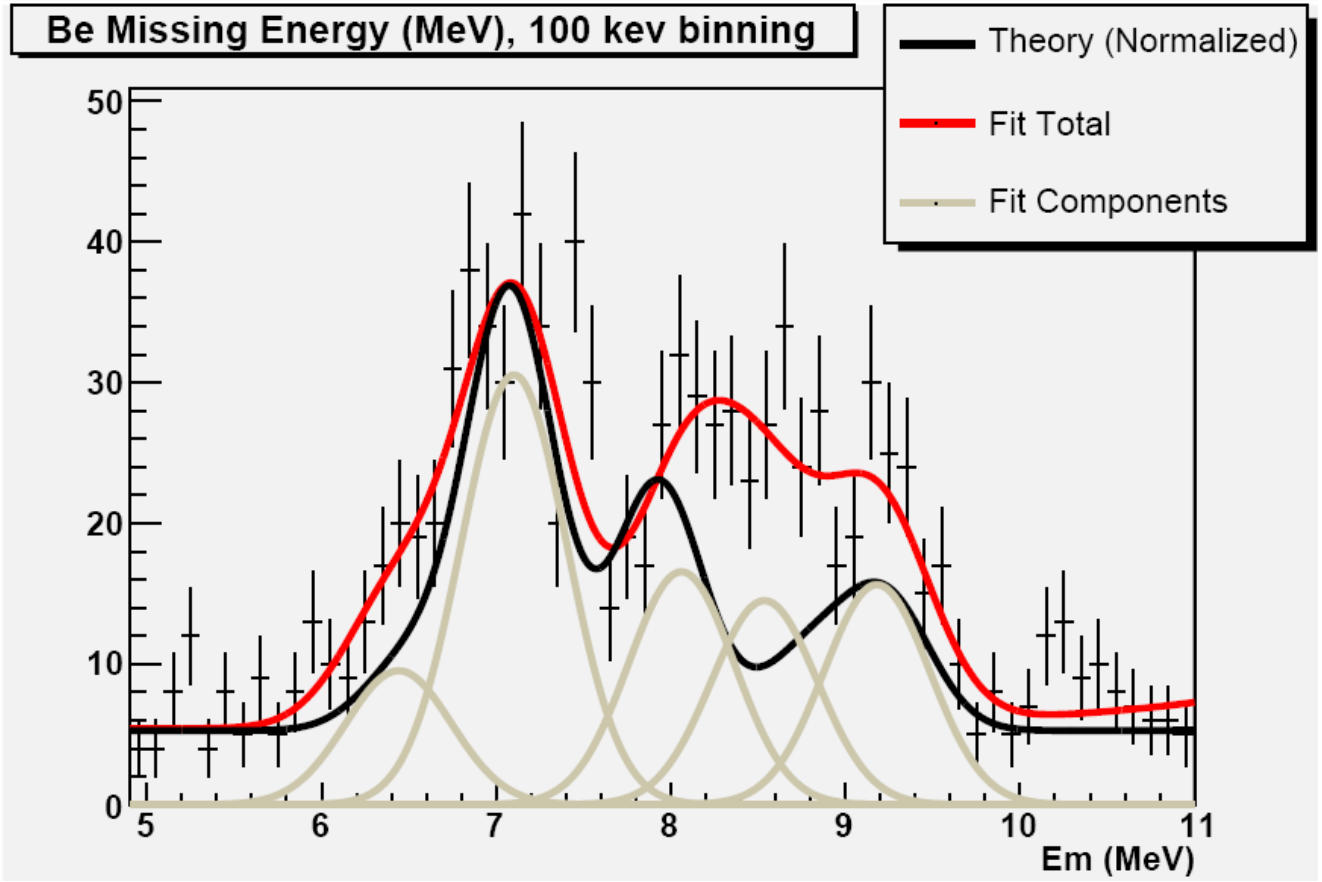
Paper resubmitted to PRL

Adapted from: F. Cusanno, Hyp-X Conference, Tokai, Ibaraki, Japan, 15th of September, 2009

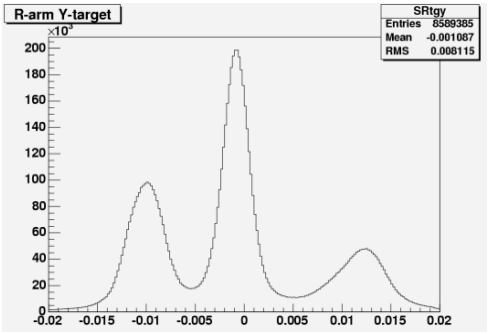
JLAB Hall A E-94107: Preliminary Results on ^{9}Be target

Analysis of the ^{9}Be(e,e'K)^{9}Li$_{\Lambda}$

Complex structure, different fits can be compared with the theoretical curve

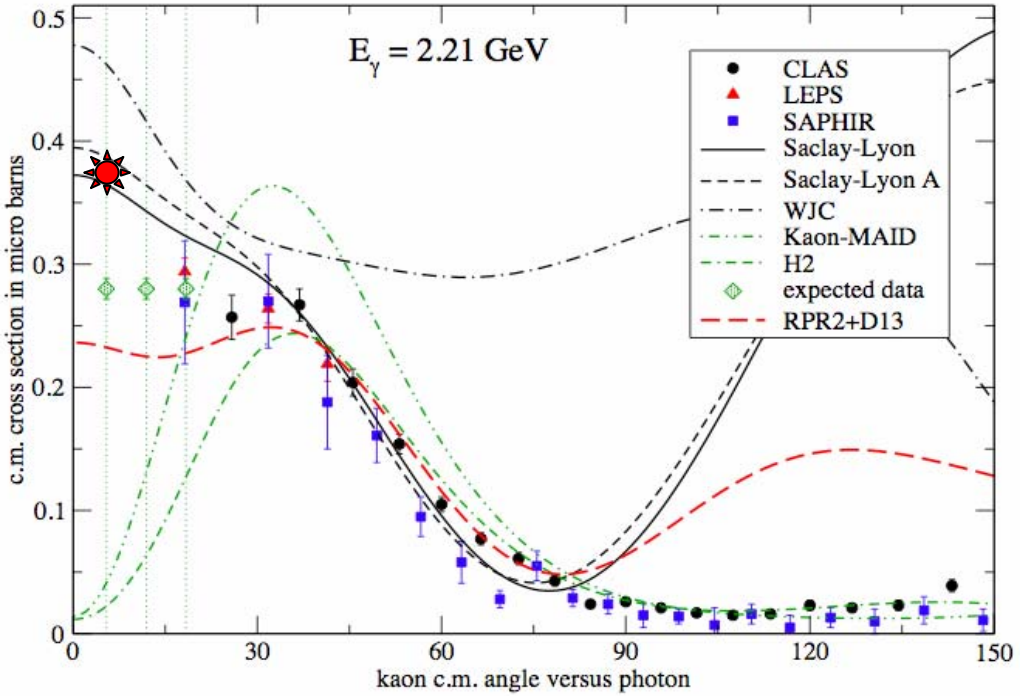


TO DO:



Use Be windows data of waterfall target to increase statistics

E-07-012 - The Angular Dependence of $^{16}O(e,e'K)^{16}N_\Lambda$ and $^{1}H(e,e'K)\Lambda$



Will run right before 6 GeV shutdown

These data and, especially, the ratio of HN to the elementary cross section will give:

- new valuable information on hypernuclear structure (including spin assignment of produced hypernuclear states), and reaction mechanisms
- the modification of the dynamics of the (e,e'K^+) process in the nuclear medium.

Parasitic test for E-08-012 Study of Light Hypernuclei by Pionic Decay at JLab

Pb-Quasielastic

- “Classico” esperimento di fisica nucleare
- Presa dati 2007
- Seguenti trasparenze da Guido Urciuoli

Impulse Approximation limitations to the (e,e'p) reaction on ^{208}Pb and ^{12}C

Jefferson Lab, Newport News, VA
and the Hall A Collaboration

E06-007

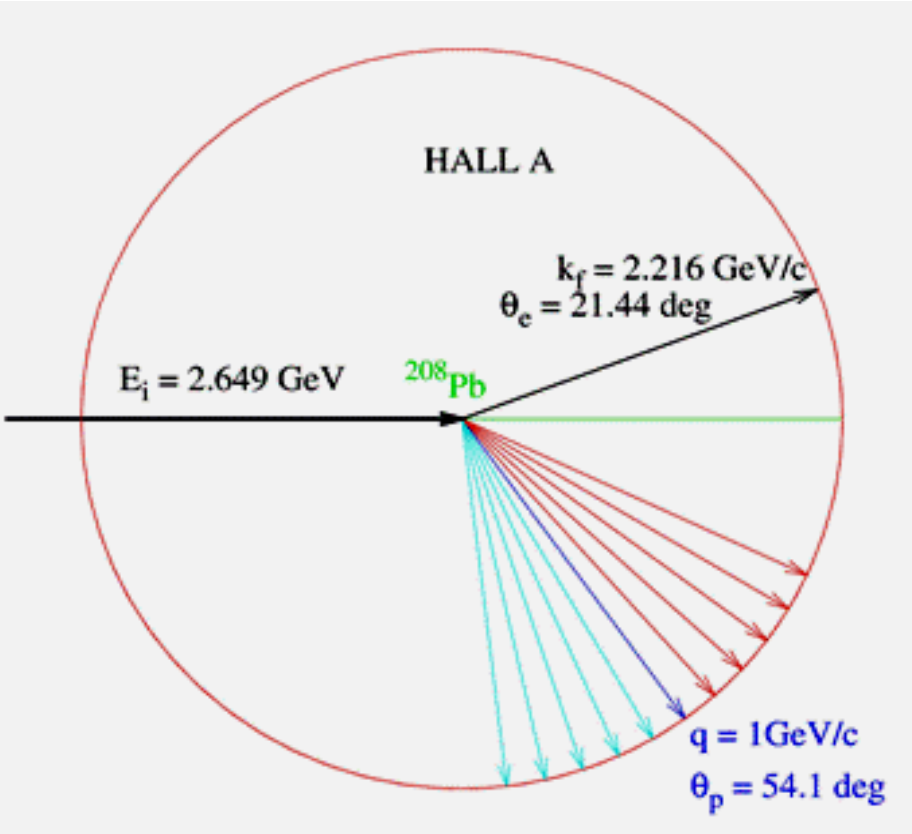
Spokepersons: *K. Aniol, A. Saha, J.M. Udías, G. Urciuoli*

Students: *Juan Carlos Cornejo, Joaquin Lopez Herraiz*

Research Associate: *Alexandre Camsonne*

Experiment (E06-007)

- We measured $^{208}Pb(e,e'p)^{207}Tl$ cross sections at true quasielastic kinematics
  (x_B=1, q=1 GeV/c, ω =0.433 GeV/c) and at both sides of q
- This has never been done before for A>16 nucleus



- **Determine momentum distributions**: $0<p_{miss}<500$ MeV/c
- **Determine A_{TL}** by measuring cross sections on either side of q
- **Determine the spectroscopic factors dependence with Q^2**

Studio correlazione long-range e dinamica relativistica nel mezzo nucleare

Goals of the PbQE experiment

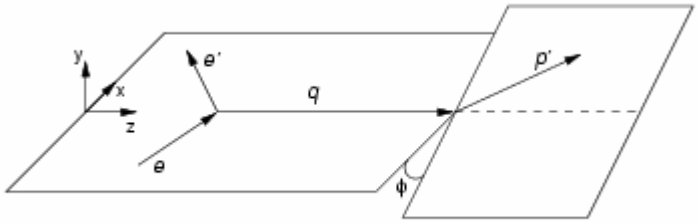
- Strength ad alto momento mancante $\Rightarrow$ long range correlation (and relativistic effects)
- ATL sensible to relativistic effects
- Spectroscopic factor below Mean Field prediction can be explained by long range correlation

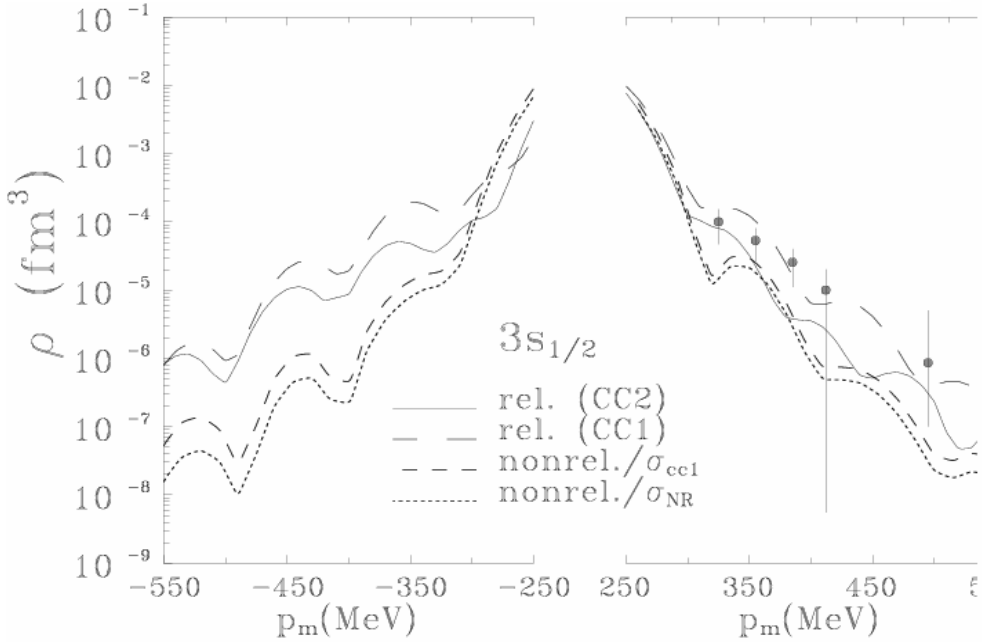
L'esperimento cerca di disaccoppiare gli effetti relativistici da quelli a lungo range

Cross Section Asymmetry A_{TL}

The cross section asymmetry is defined about $\vec{q}$

$$A_{TL} = \frac{\sigma(\phi = 0) - \sigma(\phi = 180)}{\sigma(\phi = 0) + \sigma(\phi = 180)}.$$





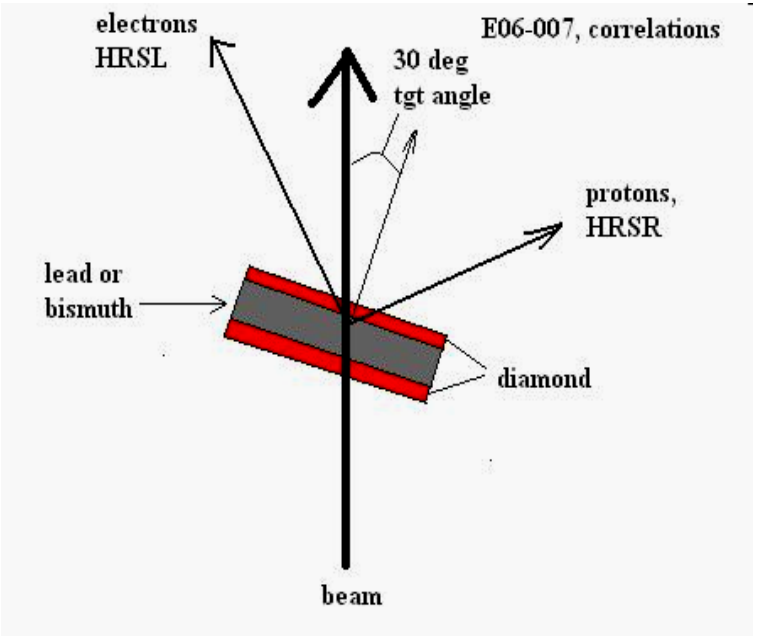
The data taken at NIKHEF [6] were backward of ***q*** where both theoretical (relativistic and nonrelativistic) are relatively closer. But forward of ***q*** the theories can disagree by two orders of magnitude

Looking for unmistakable signatures of correlations at high p_{miss} from (e,e'p) cross sections alone is a hard task for x_B <<1

Experimental challenges:

Target:

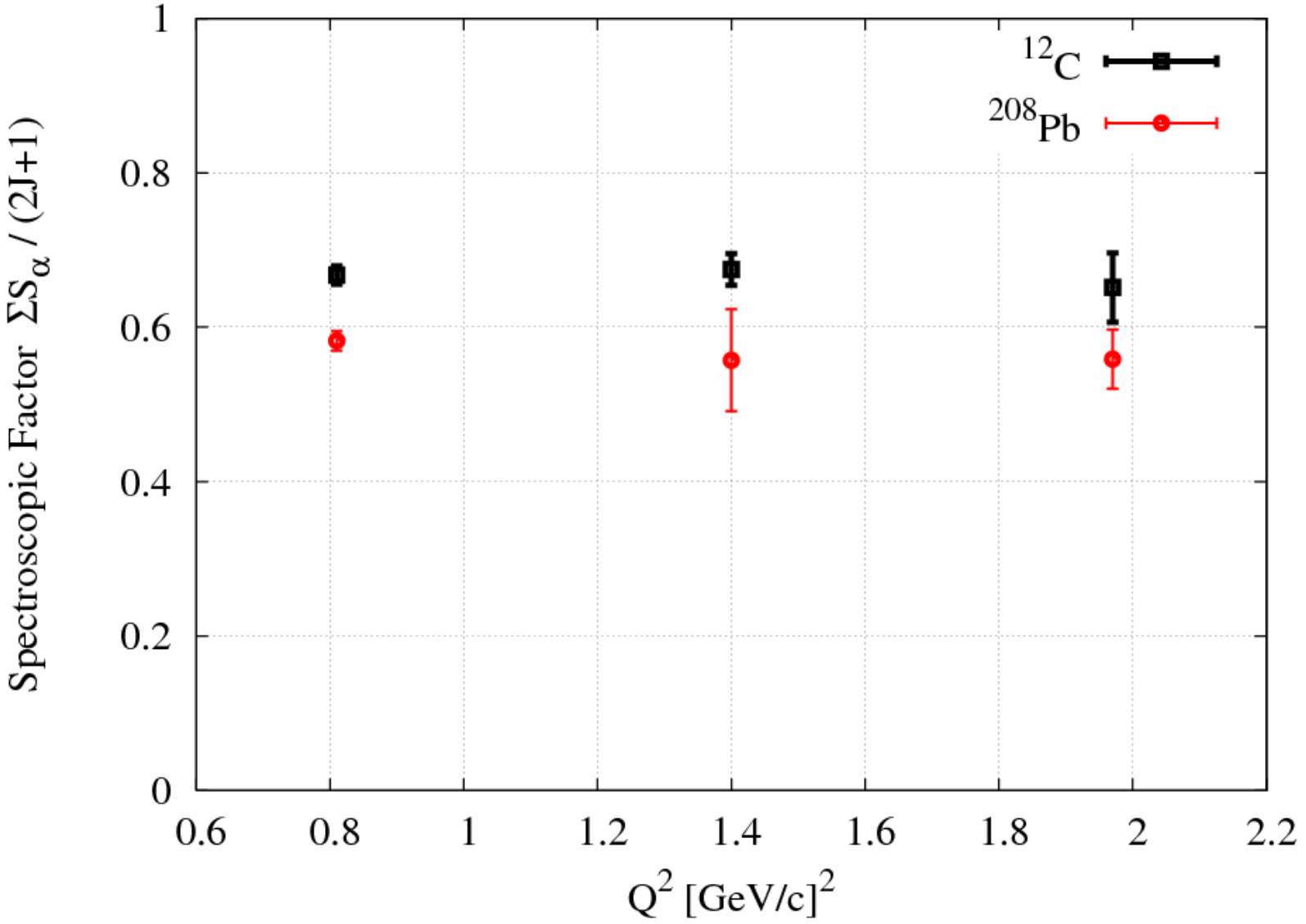
- Diamond/lead/diamond sandwich cryogenic target 0.2mm thick lead + 0.3mm diamond for high beam currents.

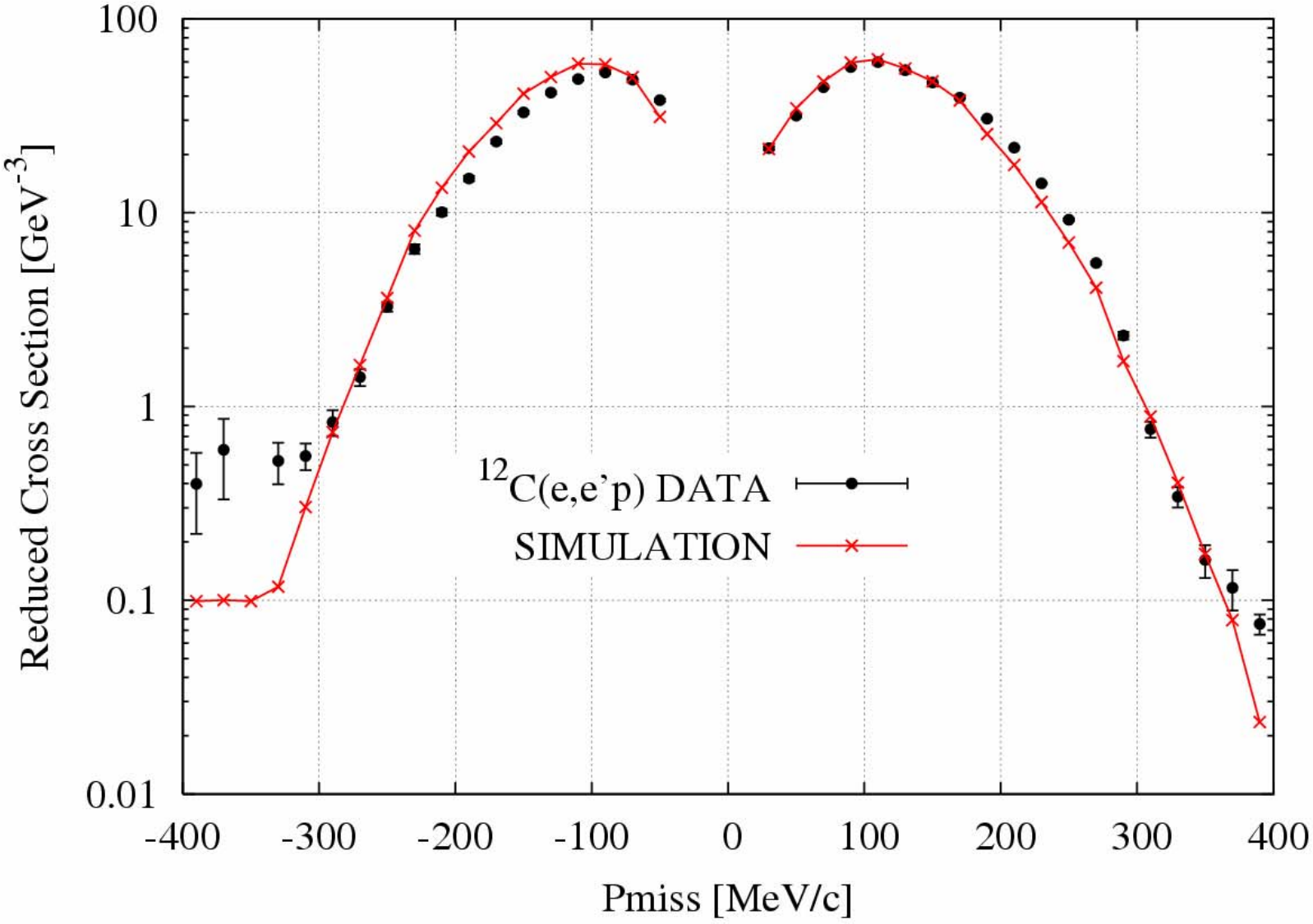


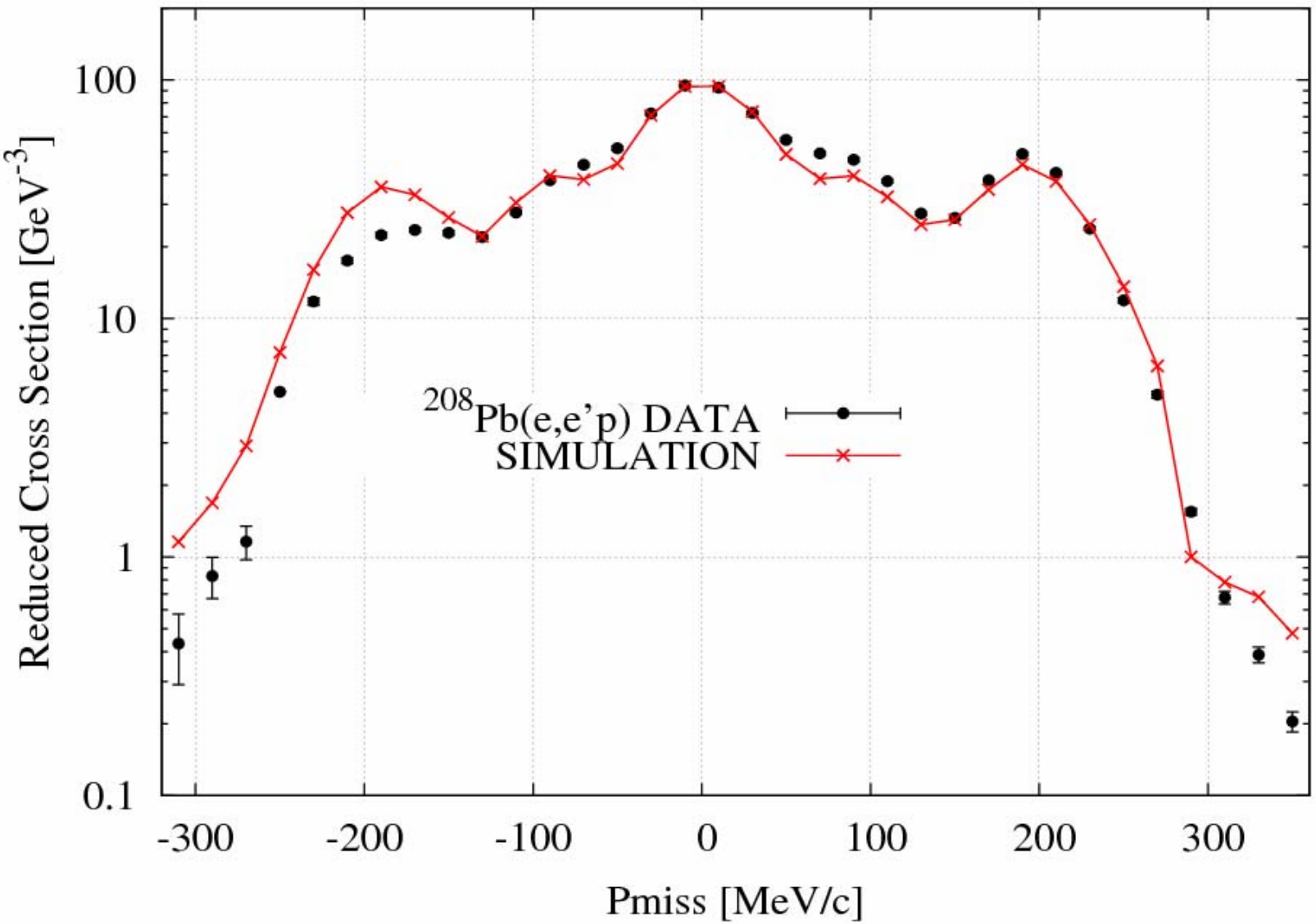
Resolution:

- In order to extract individual states we need good energy resolution.
- Beam energy = 2216 MeV
- Need stable good resolution beam: Keep beam vertical distribution < 100 um
- Unprecedented large vertical raster swing of 6mm
- GEANT simulations predict best possible resolution for perfect spectrometers to be 1 MeV FWHM. Must use a peak fitting procedure to extract individual states.

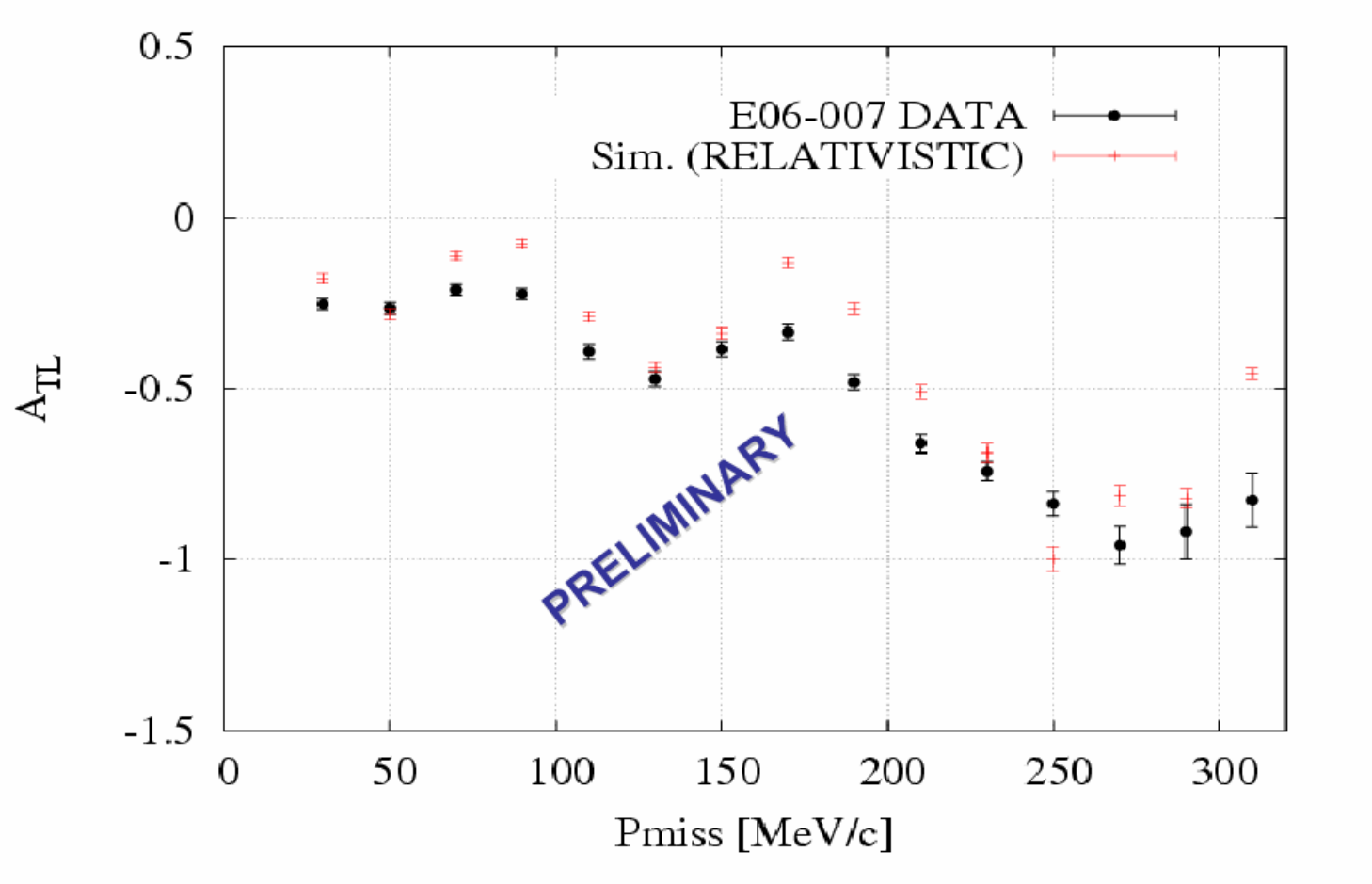
Preliminary Results Pb-QE


Spectroscopic Factor ΣS_α / (2J+1)
1
0.8
0.6
0.4
0.2
0
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
Q^2 [GeV/c]^2
^{12}C
^{208}Pb


100
10
1
0.1
0.01
Reduced Cross Section [GeV^{-3}]
^{12}C(e,e'p) DATA
SIMULATION
-400
-300
-200
-100
0
100
200
300
400
Pmiss [MeV/c]


Reduced Cross Section [GeV^{-3}]
100
10
1
0.1
-300
-200
-100
0
100
200
300
Pmiss [MeV/c]
^{208}Pb(e,e'p) DATA
SIMULATION

^{208}Pb(e,e'p) A_{TL}



Conclusions

☑ Most of the data analysis of E06-007 experiment has already been done and preliminary results have been obtained.

☑ These preliminary results are in good agreement with previous experiments.

☑ The agreement between these results and Monte Carlo simulations based on RDWIA response functions is also good.

☑ These results shows that there is no significant dependence of spectroscopic factors with Q^2.

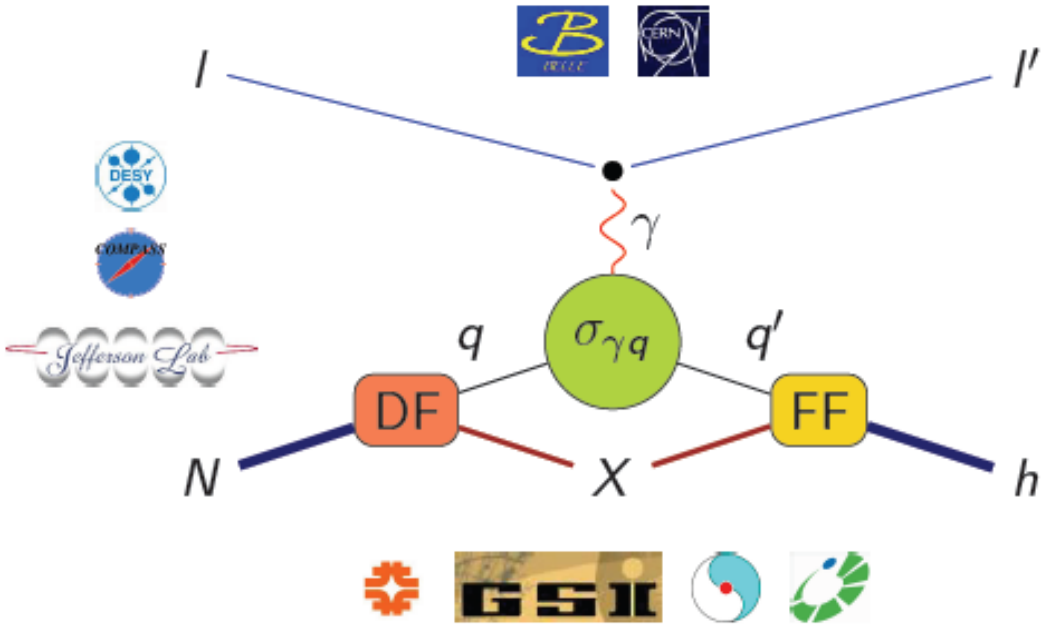
☑ Furthermore, the agreement between data and theory at high pmiss seems to indicate that there is no need for long-range correlations.

☑ These results will be checked in more detail in the following months. Specially the radiative corrections and different theoretical models will be studied.

Transversity

- Effective data taking from mid Nov/08 to Feb/09

Semi Inclusive Deep Inelastic Processes / Factorization and Universality



Q^2	γ 4-momentum
x	q long. mom. fraction
$k_\perp$	q trans. momentum
$K_\perp$	q' trans. momentum
z	h energy fraction
$P_{h\perp}$	h trans. momentum

Long: $\parallel$ to γ
Trans: $\perp$ to γ

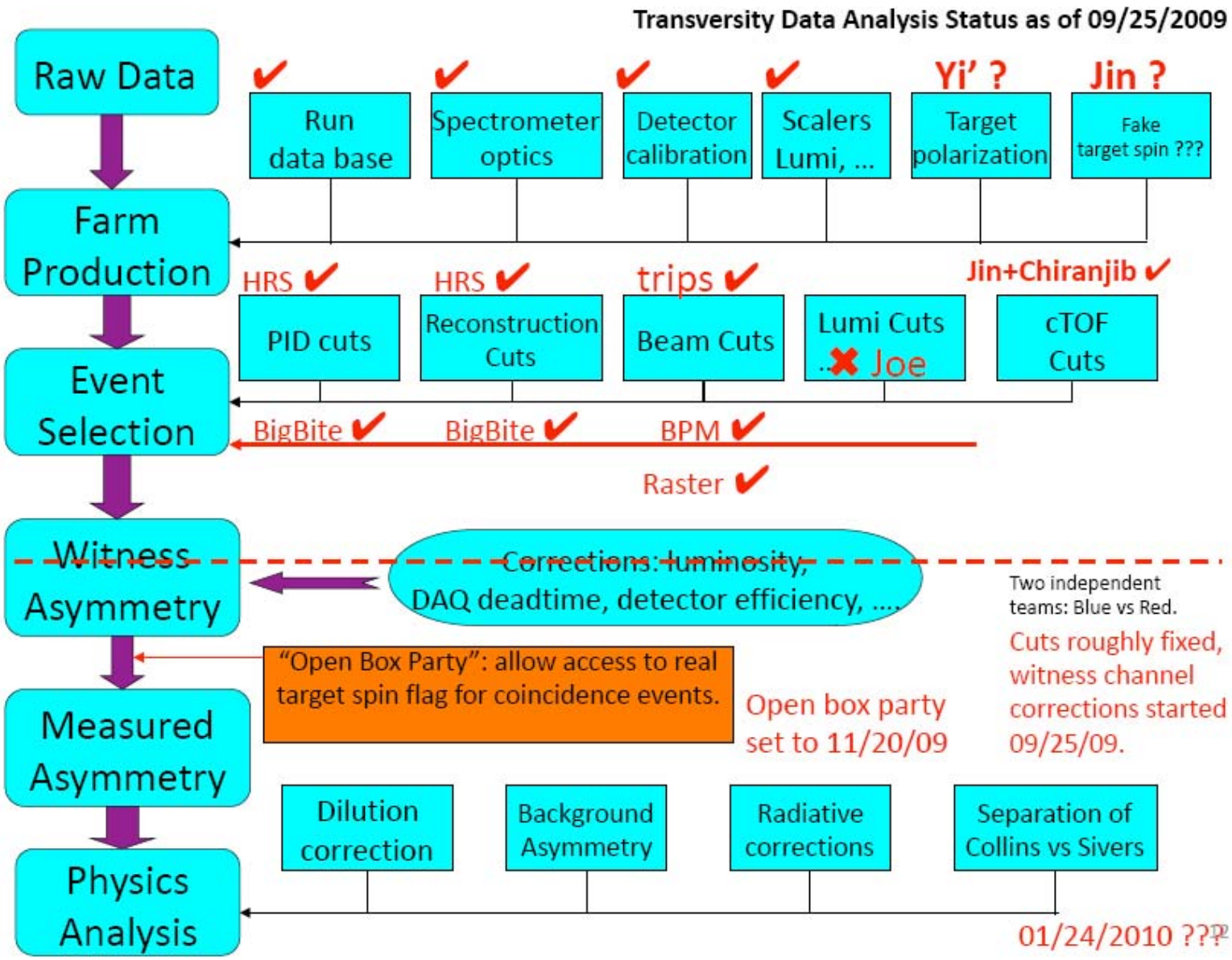
Nucleon/Hadron description at lowest twist

N \ q	U	L	T
U	$f_1(x)$		$h_1^\perp(x,k_\perp)$
L		$g_1(x)$	$h_{1L}^\perp(x,k_\perp)$
T	$f_{1T}^\perp(x,k_\perp)$	$g_{1T}(x,k_\perp)$	$h_1(x), h_{1T}^\perp(x,k_\perp)$

$\otimes$

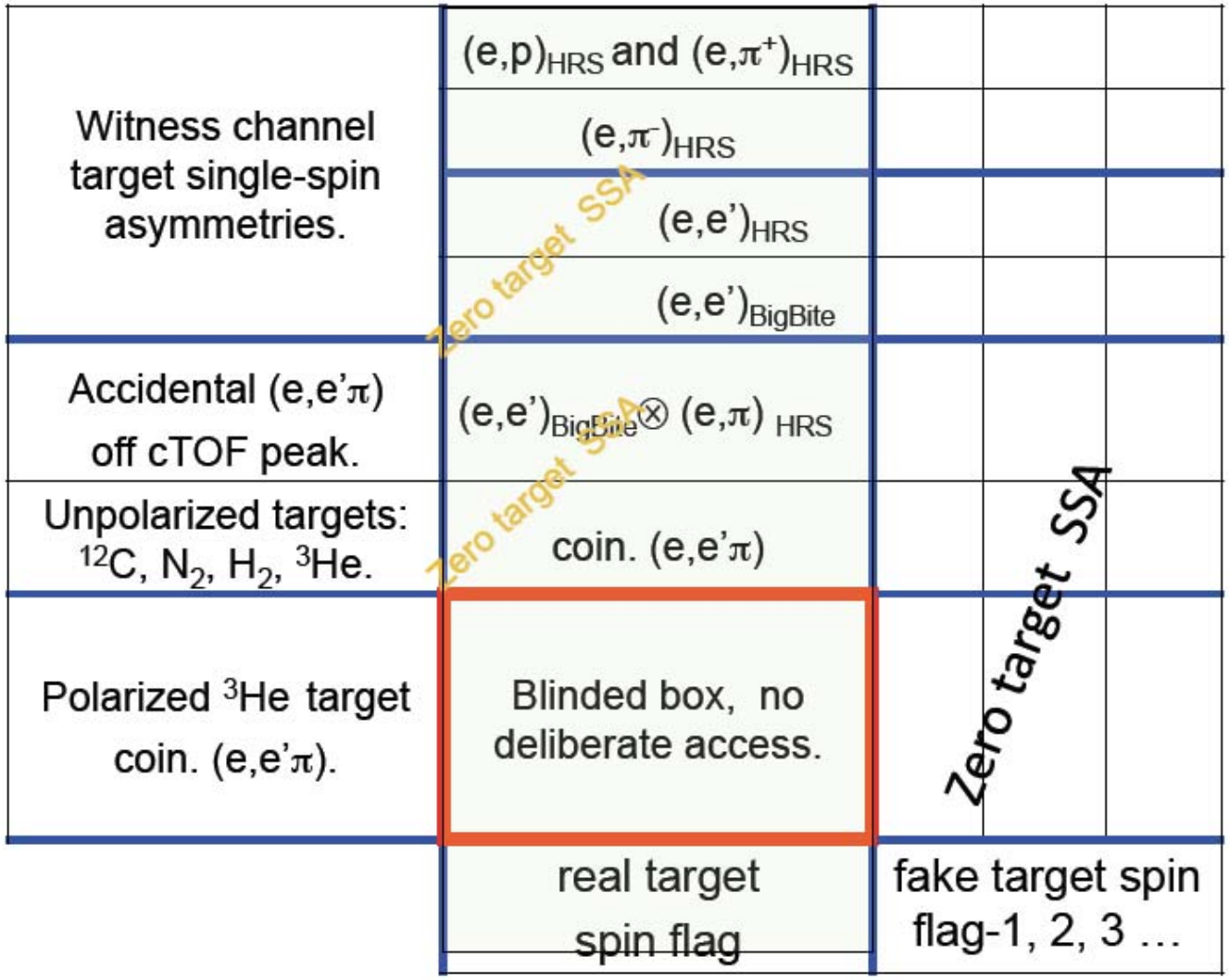
h \ q	U	L	T
U	$D_1(z)$		$D_{1T}^\perp(z,K_\perp)$
L		$G_1(z)$	$G_{1T}(z,K_\perp)$
T	$H_1^\perp(z,K_\perp)$	$H_{1L}^\perp(z,K_\perp)$	$H_1(z), H_{1T}^\perp(z,K_\perp)$

SIDIS cross section linear combination of convolutions of DF's and FF's, modulated by sin/cos of azimuthal angles



From Xiaodong Jian

Double-Blind Analysis



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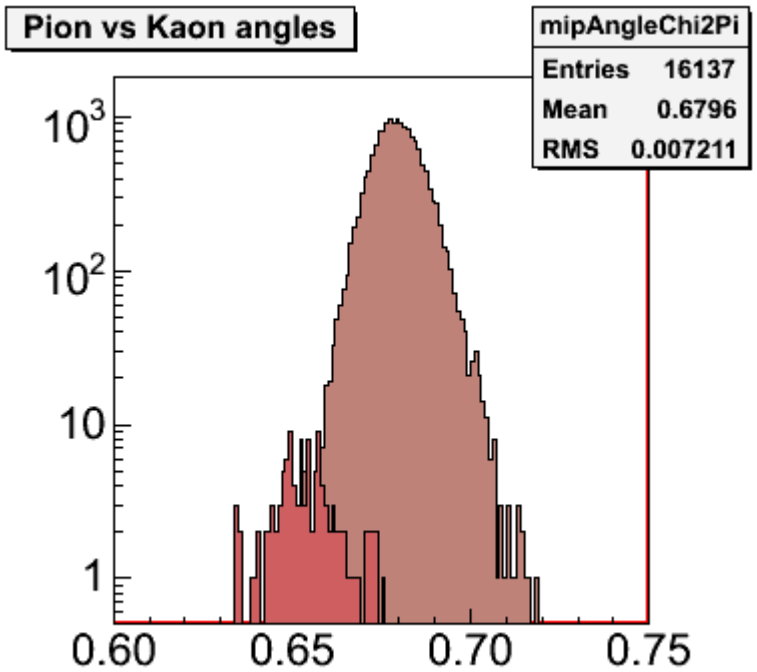
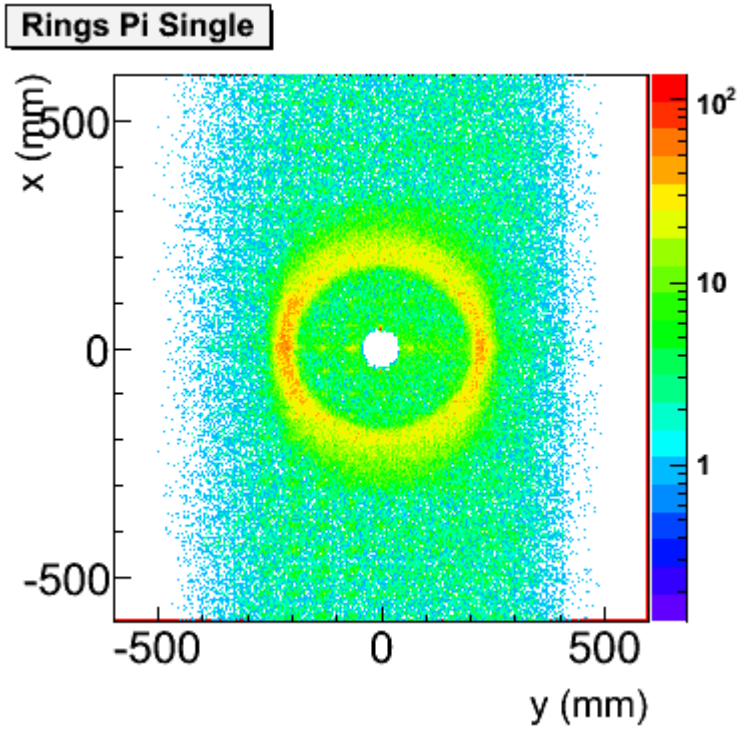
Proximity RICH / Preliminary Performance





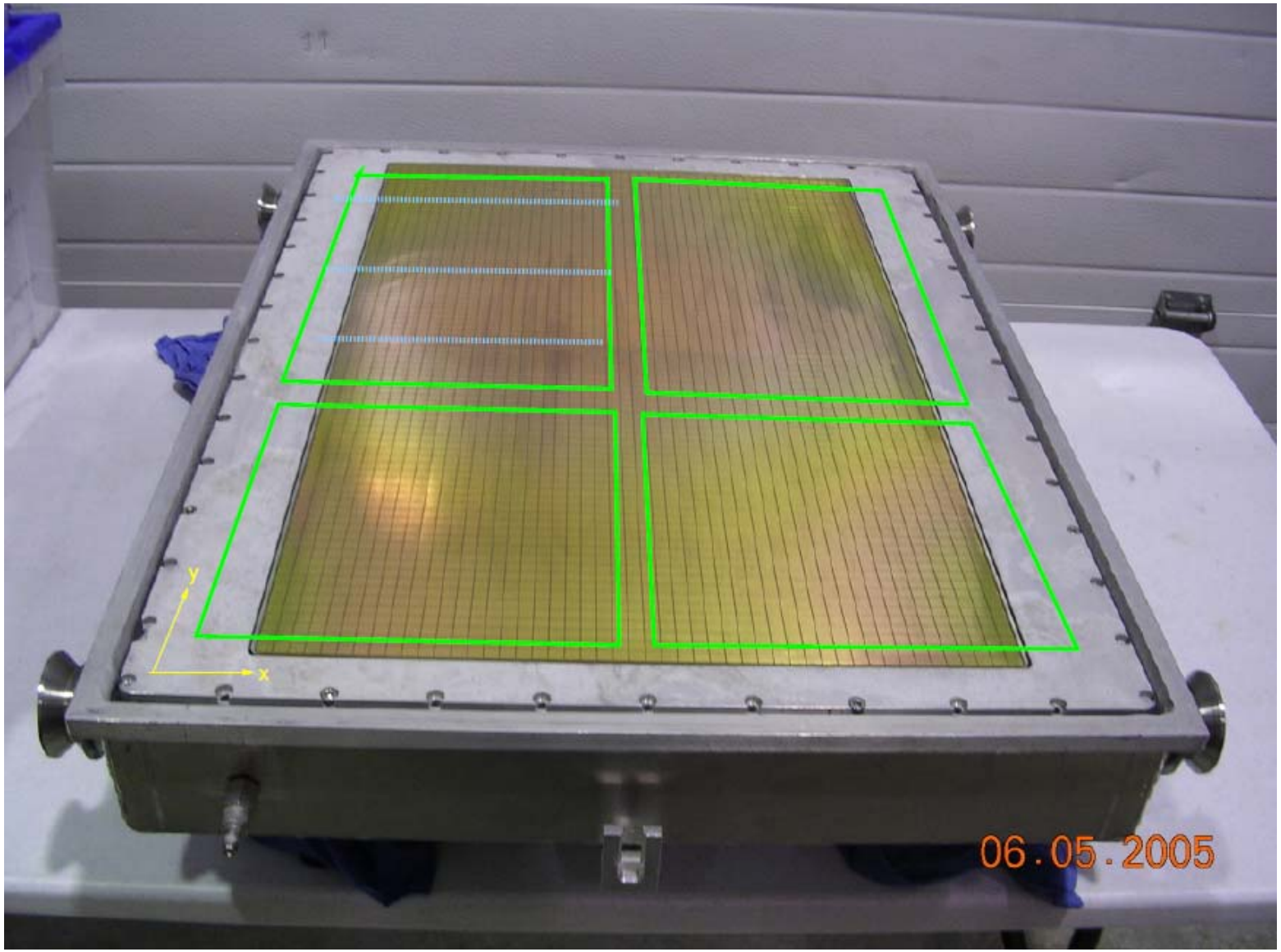
Mean number of PhotoElectrons for π: $N_{PE} \sim 9$

Error in angle reconstruction: $\sigma_{\vartheta\pi} \sim 7$ mr $\Rightarrow n\sigma_{\pi\text{-}K} \sim 4.5\ \sigma$

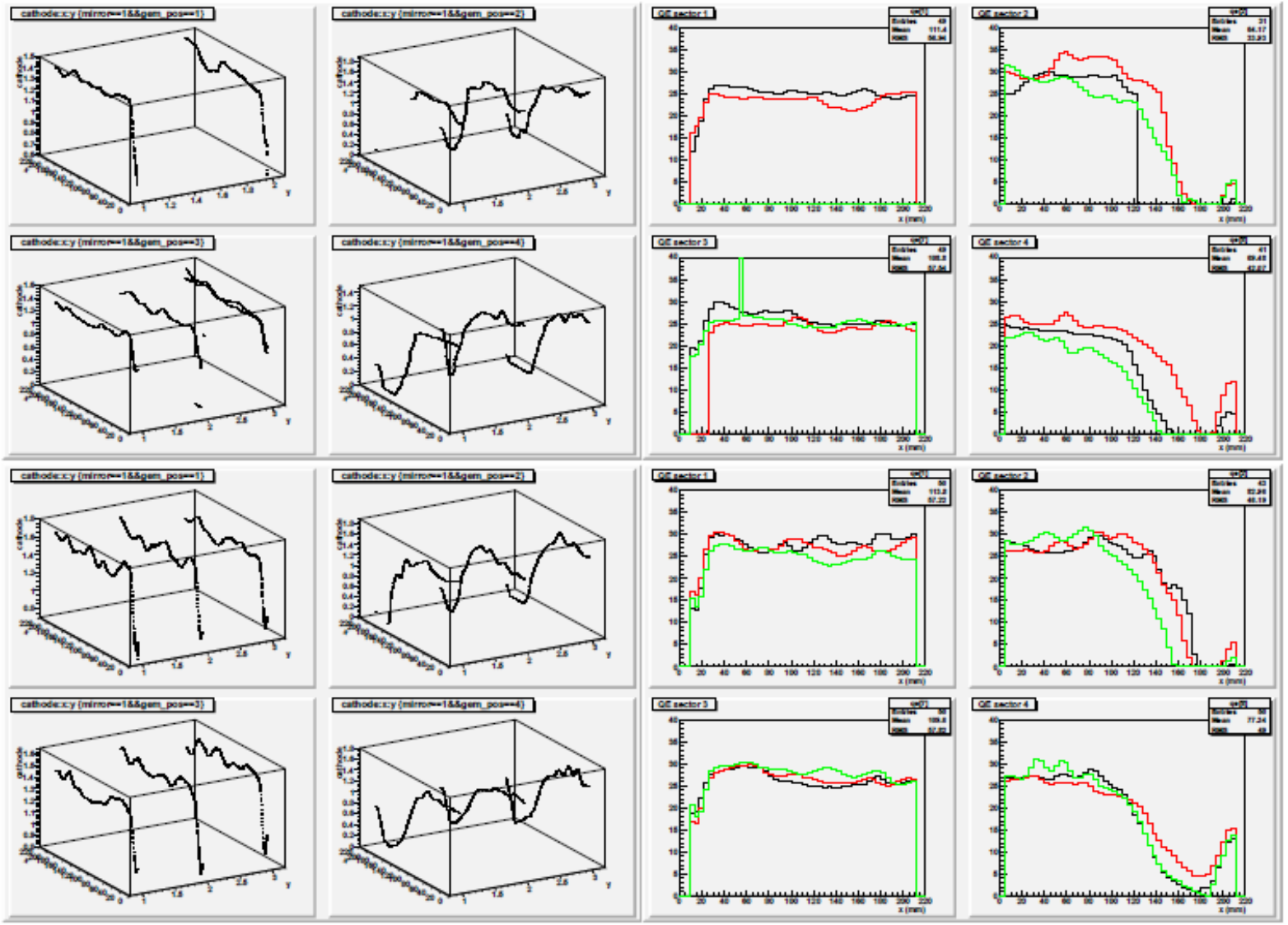
Principali difficoltà incontrare

- Significativo numero di eventi con “huge number of hits”
  - no camera (test HV negativo)
  - probabilmente segnale spurio in trigger
- Sulla base della misura di Efficienza Quantica subito dopo l’evaporazione ci saremmo aspettati almeno 12 fotoni
  - Trasporto Long Island→JLab ? (in box protetto)
  - Riapertura durante i test per fissare un filo rotto ? (in atmosfera controllata)
  - Qualità del radiatore (freon) ?

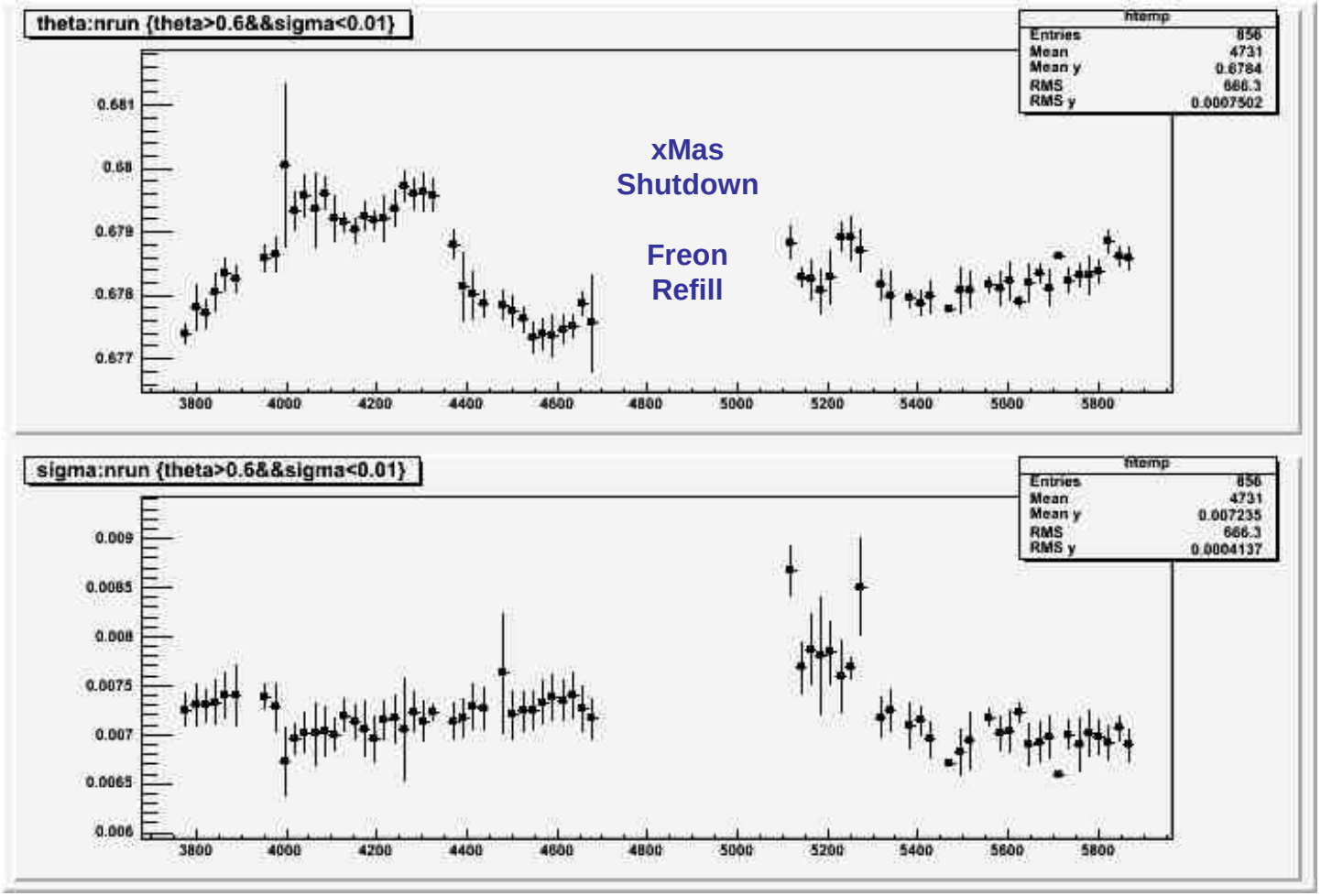
RICH Pad



QE after evaporation (~25%)

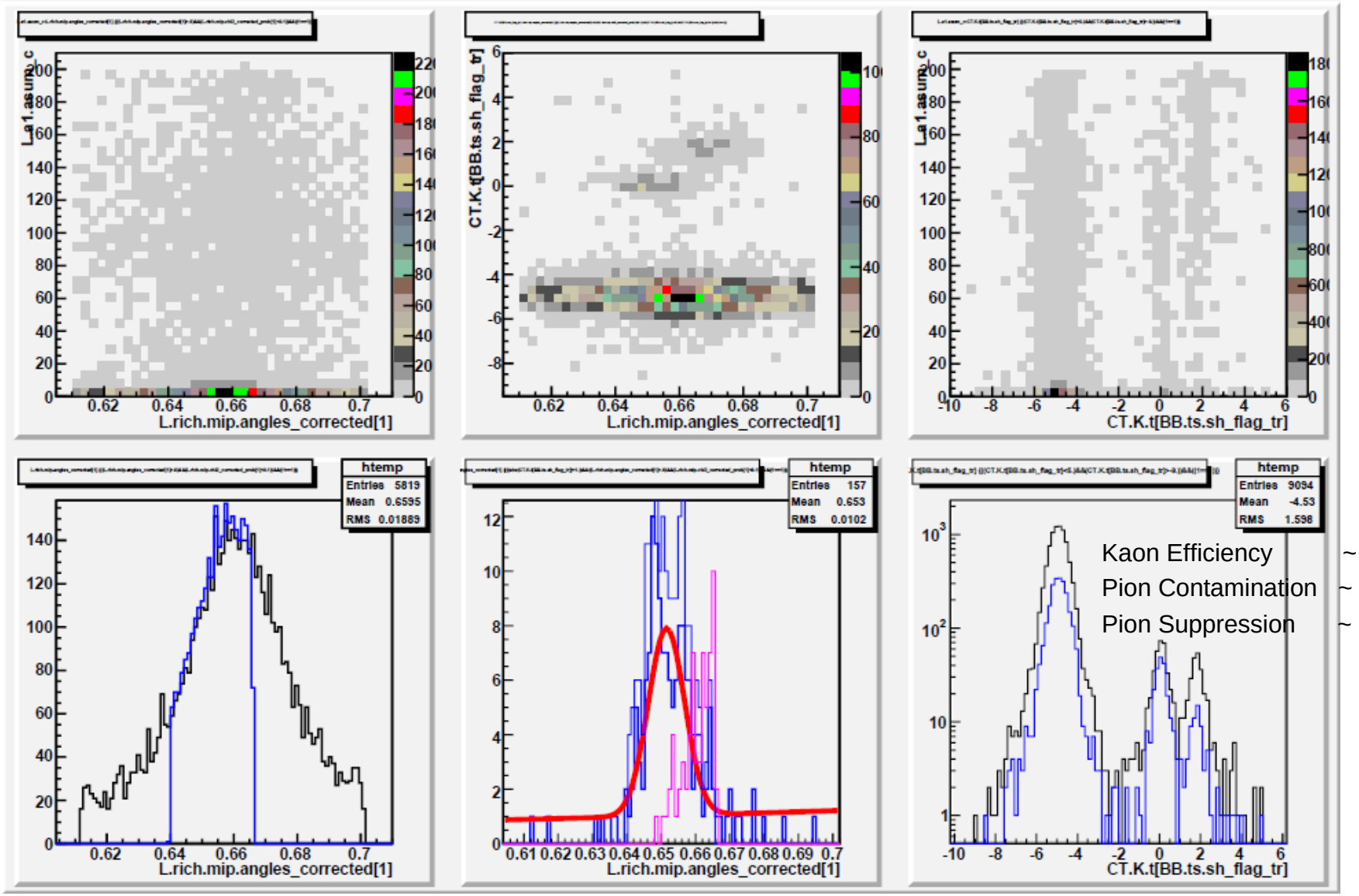


RICH - Stability Check



- Average pion angle pretty stable within sigma: average value consistent with n=1.2865
- Sigma stable, but show effects of freon
- Freon quality improved after xmas standby

Transversity Hadron ID



Yield: K+/pi+ ~ 5-8% K-/pi- ~ 2-4%

RICH lavori in corso

- Migliore tuning dei parametri di configurazione
- Ottimizzazione dei tagli (vs efficiency, rejection)
- Recupero delle tracce che passano nelle aree morte (tra due pad) del RICH (~5%)
- Tentativo di recupero dei run con “large hits”
- …. Asimmetria dei K