



CLAS12 European Workshop
February 25-28, 2009- Genova, Italy

CLAS Hadron Spectroscopy Group Meeting

Paul Eugenio
Florida State University

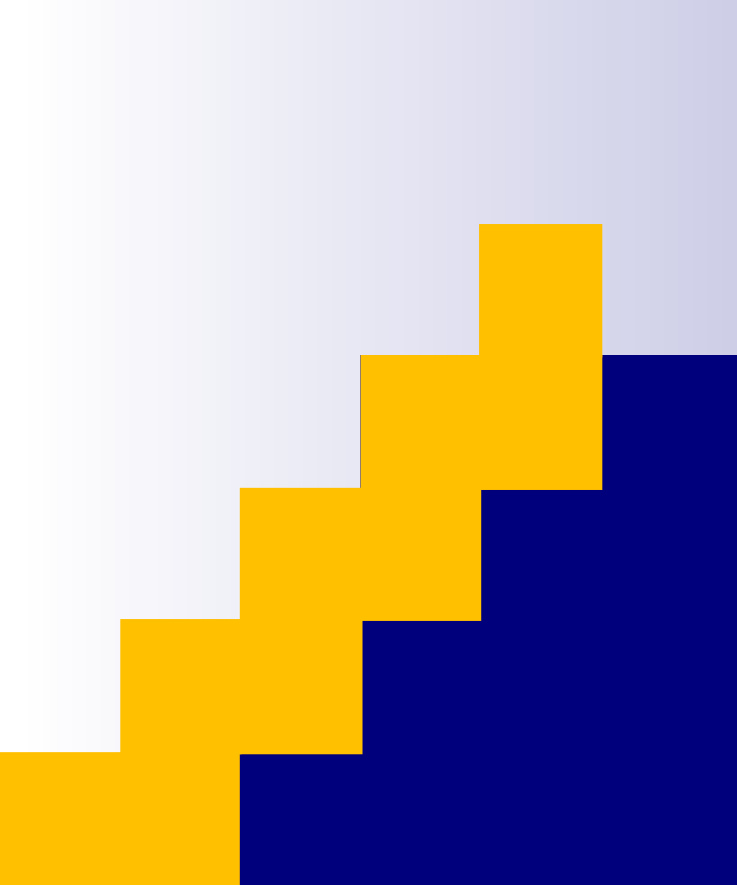
Agenda

Session 1 (14:30-16:00 CET, 08:30-10:00 EST)

- * *Status of the EBAC@JLAB effort* - Bruno Julia-Diaz
- * *Σ^* photoproduction with CLAS* - Gagik Gavalian
- * *Cross sections for $\Lambda(1405)$ and $\Lambda(1520)$ photoproduction* - Kei Moriya (EVO)
- * *Cross section for photoproduction of the $x(1280)$* - Ryan Dickson (EVO)
- * *Status of $K+\Sigma^0$ analysis from g_{11} data* - Biplab Day (EVO)

Session 2 (16:30-18:00 CET, 10:30-12:00 EST)

- * *CLAS g_{12} update and search for new strangeonia in g_{12}* - Mukesh Saini
- * *Prospects for exotic meson search in 3π* - Craig Bookwalter
- * *Beam asymmetry in $\pi^+\pi^-$ photoproduction (g_{8b})* - Charles Hanretty (EVO)
- * *Recent Progress in the Extraction of Single-Target and Double Spin Asymmetries of Pion Electroproduction Using CLAS/EG4 Data* - Xiaochao Zheng (EVO)
- * *Photon asymmetries for $K\Lambda$ production on the Deuteron* - Russell Johnstone



Status of the EBAC@JLAB effort

The players:

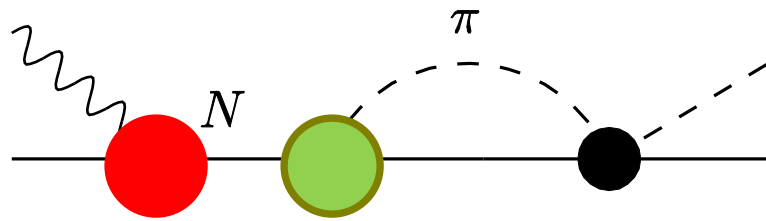
- H. Kamano (JLab)
- T.S.H. Lee (Argonne, JLab)
- A. Matsuyama (Shizuoka)
- T. Sato, **N. Suzuki** (Osaka)
- B. Saghai, **J. Durand** (Saclay)

B. Juliá-Díaz

*Departament d'Estructura i
Constituents de la Matèria*

Universitat de Barcelona (Spain)

E.m. probes



e.g: $\gamma p \rightarrow$

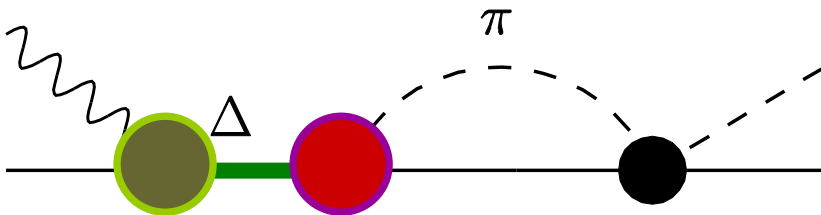
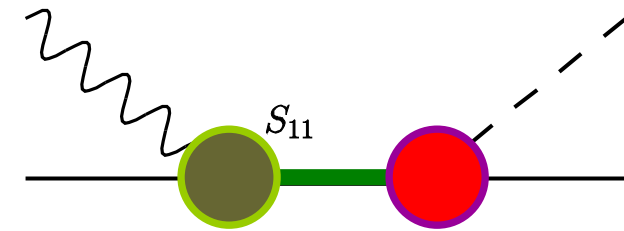
ηN

- **Key points:**

- Couplings of mesons to baryons
- **Electromagnetic vertices**



- Coupling of resonances to MB
- Electromagnetic structure of resonances



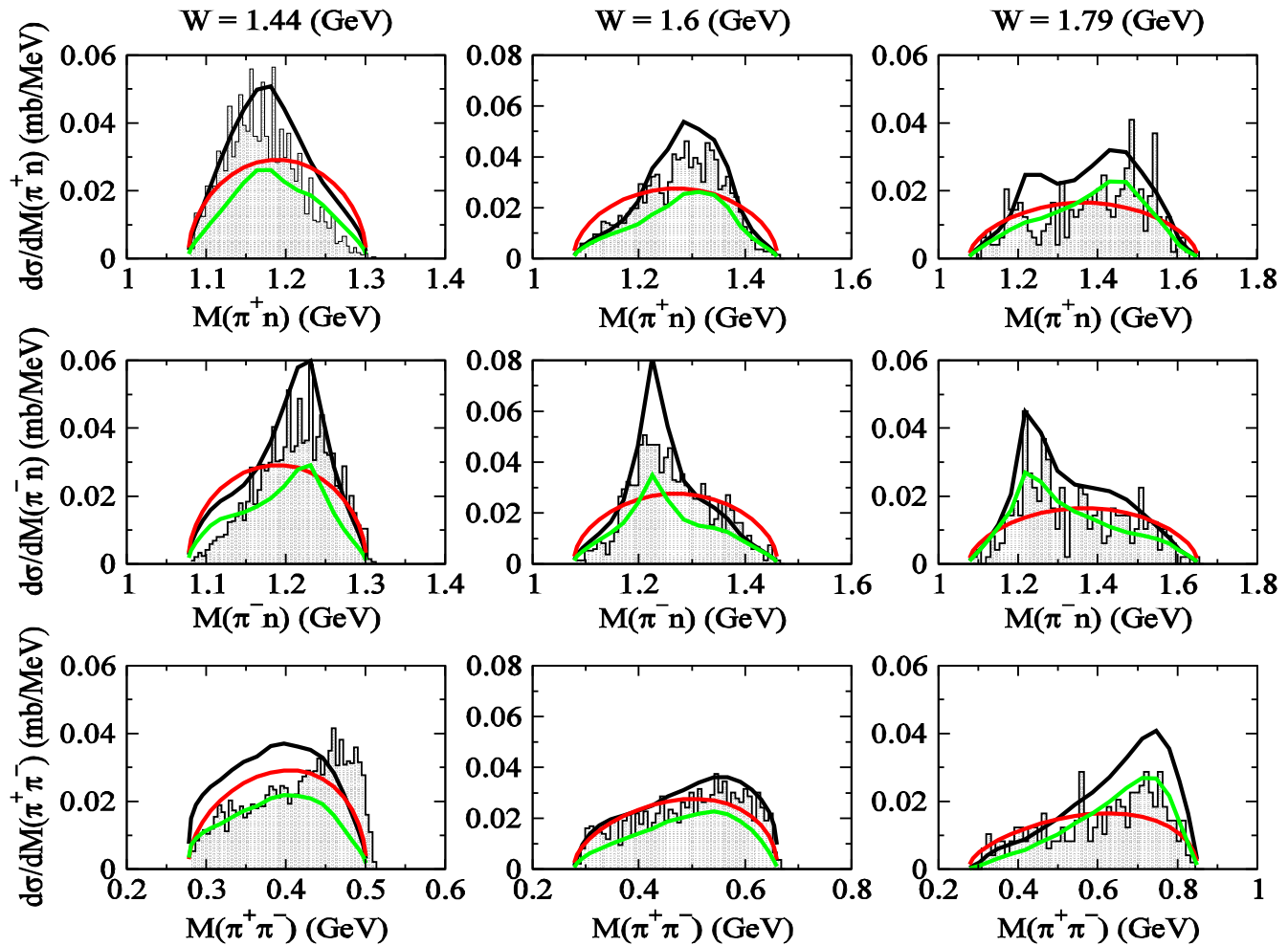
e.m.

$\pi N \rightarrow \pi\pi N$ (II)

Invariant mass distributions

Full model —

Phase space —



H. Kamano, B. Julia-Diaz, TSH Lee, A. Matsuyama, T. Sato, *PRC* (2009)

Using the MB model of BJD, AM, TSHL and TS, *Phys. Rev. C* 76, 065201 (2007)

Data handled with the help of D. Arndt

$\pi\pi$

In progress (~ 2009)

N^* properties

- N^* properties from the EBAC πN model
 - **N. Suzuki, B. Julia-Diaz, H. Kamano, A. Matsuyama, T.-S.H. Lee, T. Sato.**
-

Single and double meson production

- $\gamma^* N \rightarrow \pi N$ up to $W=1.6$ GeV (preparation)
 - **H. Kamano, B. Julia-Diaz, A. Matsuyama, T.-S.H. Lee, T. Sato**
 - Currently using CLAS structure functions to fix the Q^2 evolution of the helicity amplitudes
- $\gamma^* N \rightarrow \pi\pi N$ (preparation)
 - **B. Julia-Diaz, H. Kamano, A. Matsuyama, T.-S.H. Lee, T. Sato**

FINE

EBAC progress

Extraction of Resonances from Meson-Nucleon Reactions.

N. Suzuki, T. Sato, T.-S.H. Lee, *Phys. Rev. C* 79 (2009) 025205

Dynamical coupled-channels study of $\pi n \rightarrow \pi \pi n$ reactions

H. Kamano, B. Julia-Diaz, T.-S.H. Lee, A. Matsuyama, T. Sato, *Phys. Rev. C* 79 (2009) 025206

Coupled-channels study of the $\pi n \rightarrow \eta n$ process

J. Durand, B. Julia-Diaz, T.-S.H. Lee, B. Saghai, T. Sato, *Phys. Rev. C* 78, 025204 (2008)

Dynamical coupled-channels effects in pion photoproduction

B. Julia-Diaz, T.-S.H. Lee, A. Matsuyama, T. Sato, and L.C. Smith, *Phys. Rev. C* 77, 045205 (2008)

Dynamical coupled-channels model of πN scattering in the $W \leq 2$ -GeV nucleon resonance region.

B. Julia-Diaz, T.-S.H. Lee, A. Matsuyama, T. Sato, *Phys. Rev. C* 76, 065201 (2007)



$\Sigma^*(1385)$ photo-production with CLAS

Gagik Gavalian

Old Dominion University

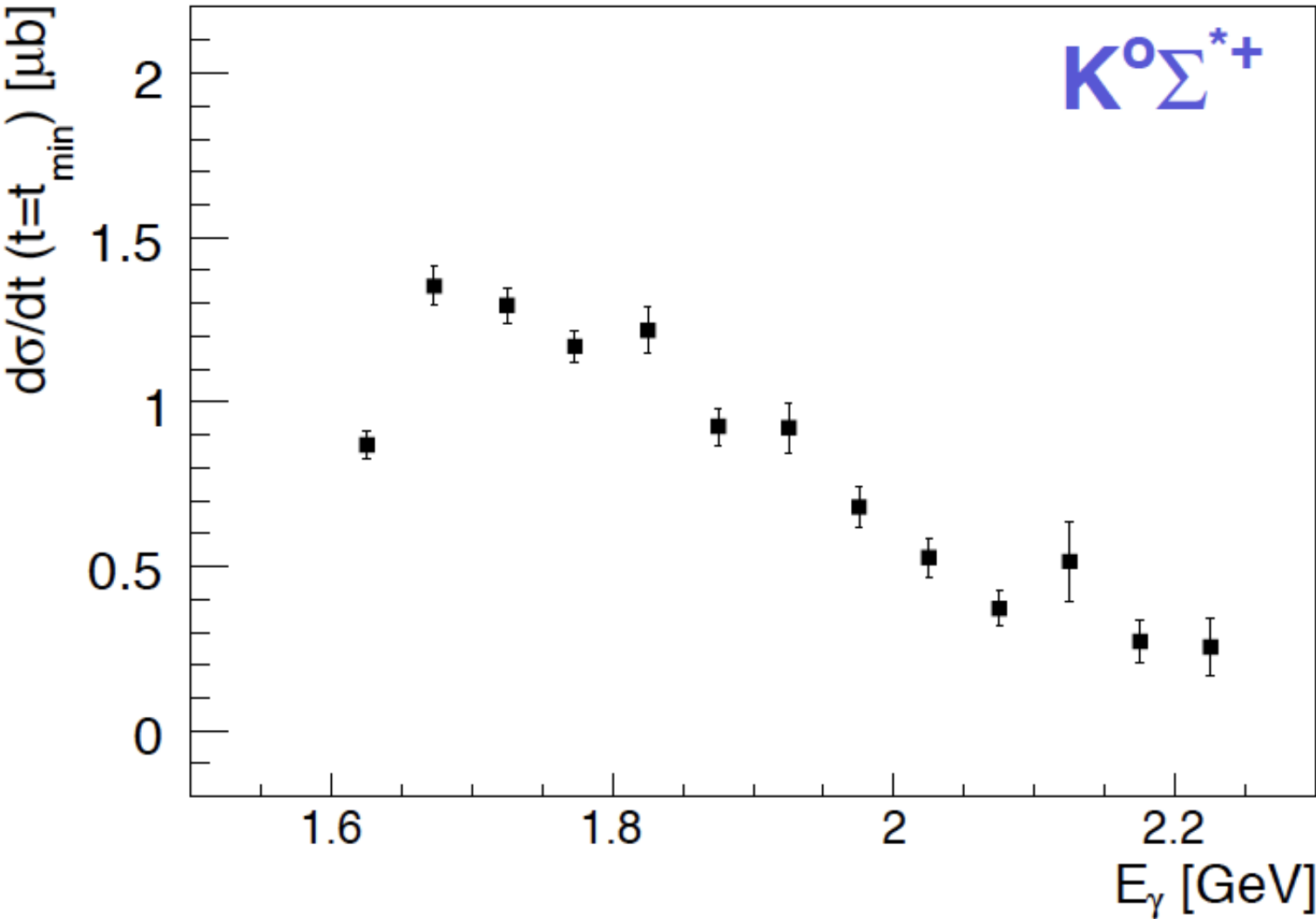
February 15, 2009

Data Selection

- g11 data was used in this analysis using tagged photon beam in CLAS incident on hydrogen target (length 40 *cm*).
- The $\Sigma^+(1385)$ was identified in the missing mass of K_S detected through it's decay to π^+, π^- .
 - ▶ $\gamma p \rightarrow K_S(\pi^+, \pi^-)\Sigma^+(\Lambda(p\pi^-), \pi^+)$
 - ▶ $\Sigma^+ \rightarrow \Lambda\pi^+$ - was considered (branching ratio 88%).
 - ▶ $H(\gamma, \pi^+\pi^-\pi^+)X(\Lambda)$
- Pythia inspired simulation of $\gamma p \rightarrow K^0\Sigma^+$ was used to understand the acceptance of CLAS detector.
- Detector efficiency was calculated for each detected particle using exclusive decays of Λ .

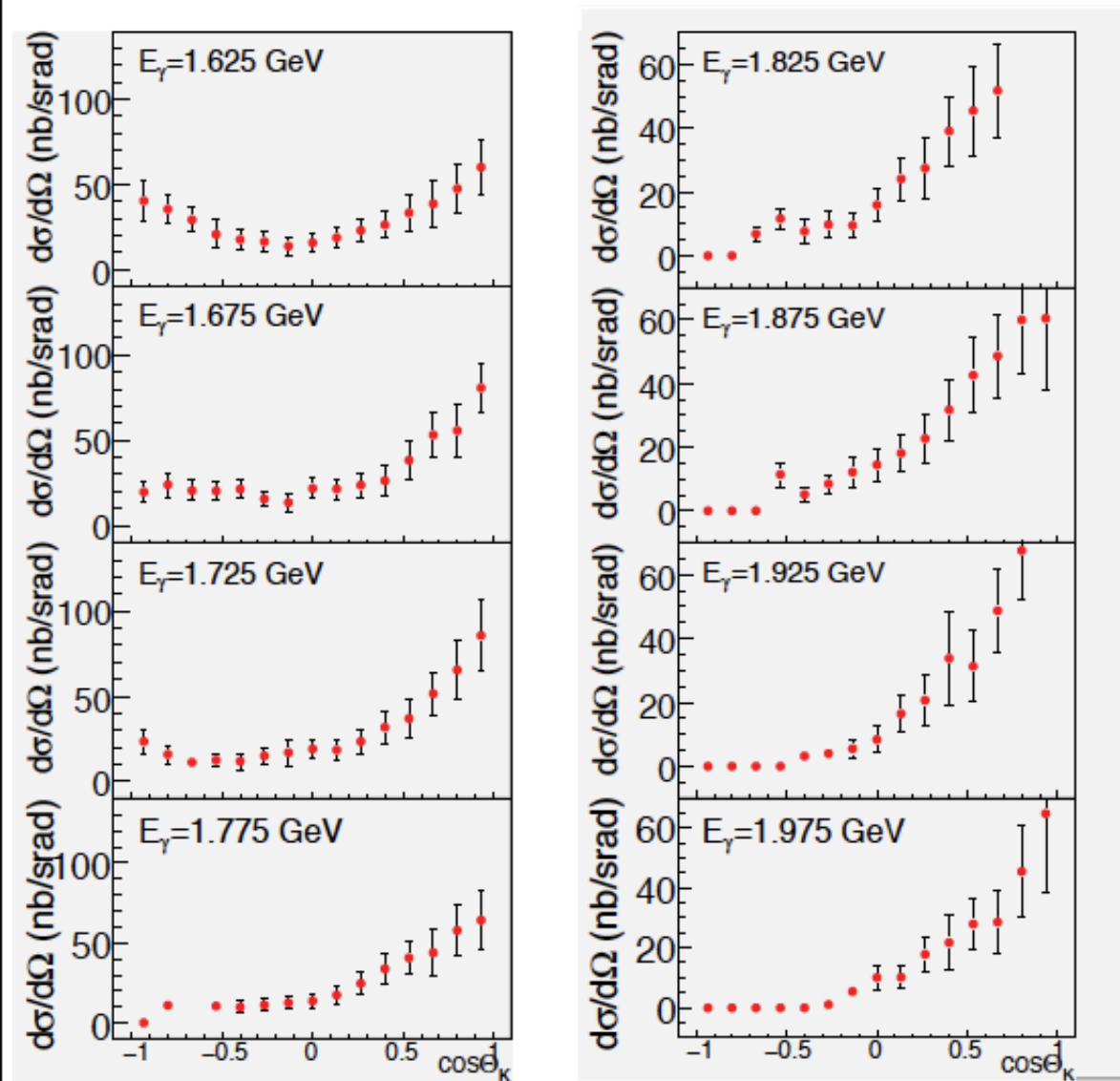
Cross Sections

CLAS Preliminary



Cross Sections

CLAS Preliminary



- Angular dependencies extracted for Σ^* for the first time.
 - ▶ with bins in energy = 50 MeV
 - ▶ with bins in $\cos\Theta_{CM}$ = 0.13

Update on $\Lambda(1405)$ Analysis Using g11a

Kei Moriya
Reinhard Schumacher

Carnegie Mellon University

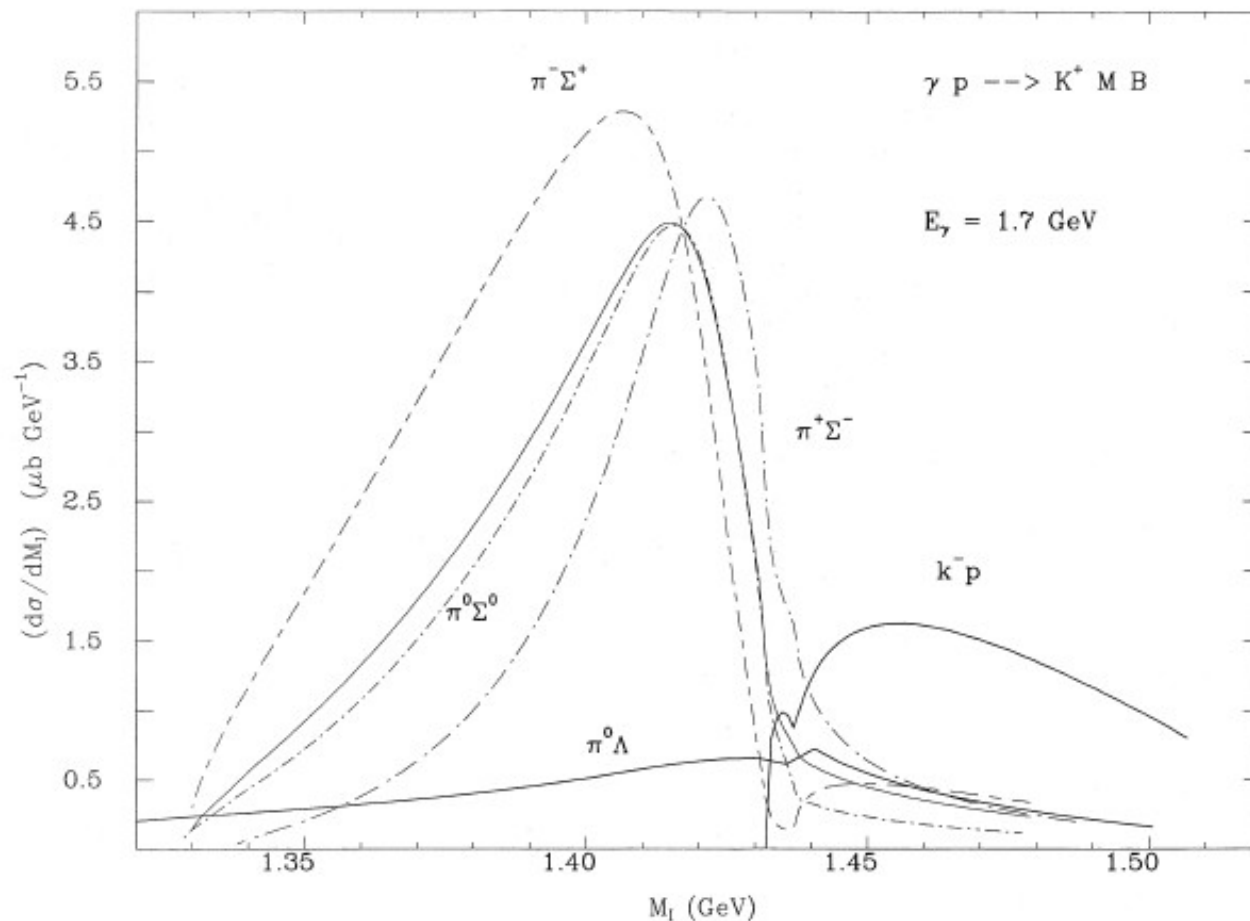
February 23, 2009

conclusions

- extracted lineshape of $\Lambda(1405)$ in 3 decay channels, each in 10 bins of energy (200 MeV wide bins in W)
- extracted diff. cross sections for each channel in same binning
- still much work in progress, but very exciting!
- will present some of this work at APS meeting in May, will upload the talk so people can comment

what is the $\Lambda(1405)$?

- qqq
- $qqq - (q\bar{q})$
- dynamically generated state (coupled chiral unitary approach)

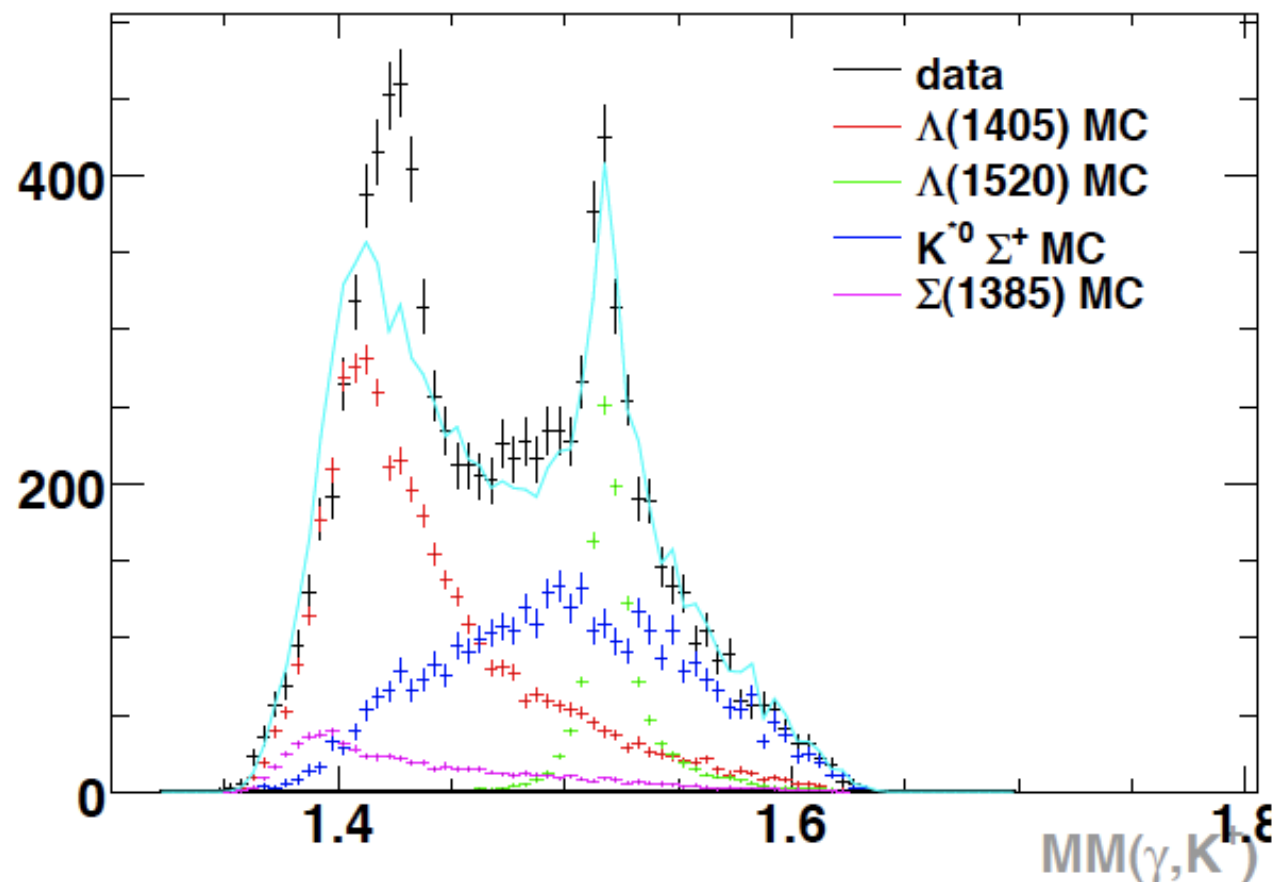


Nacher, Oset et al. Nucl. Phys. B455, 55

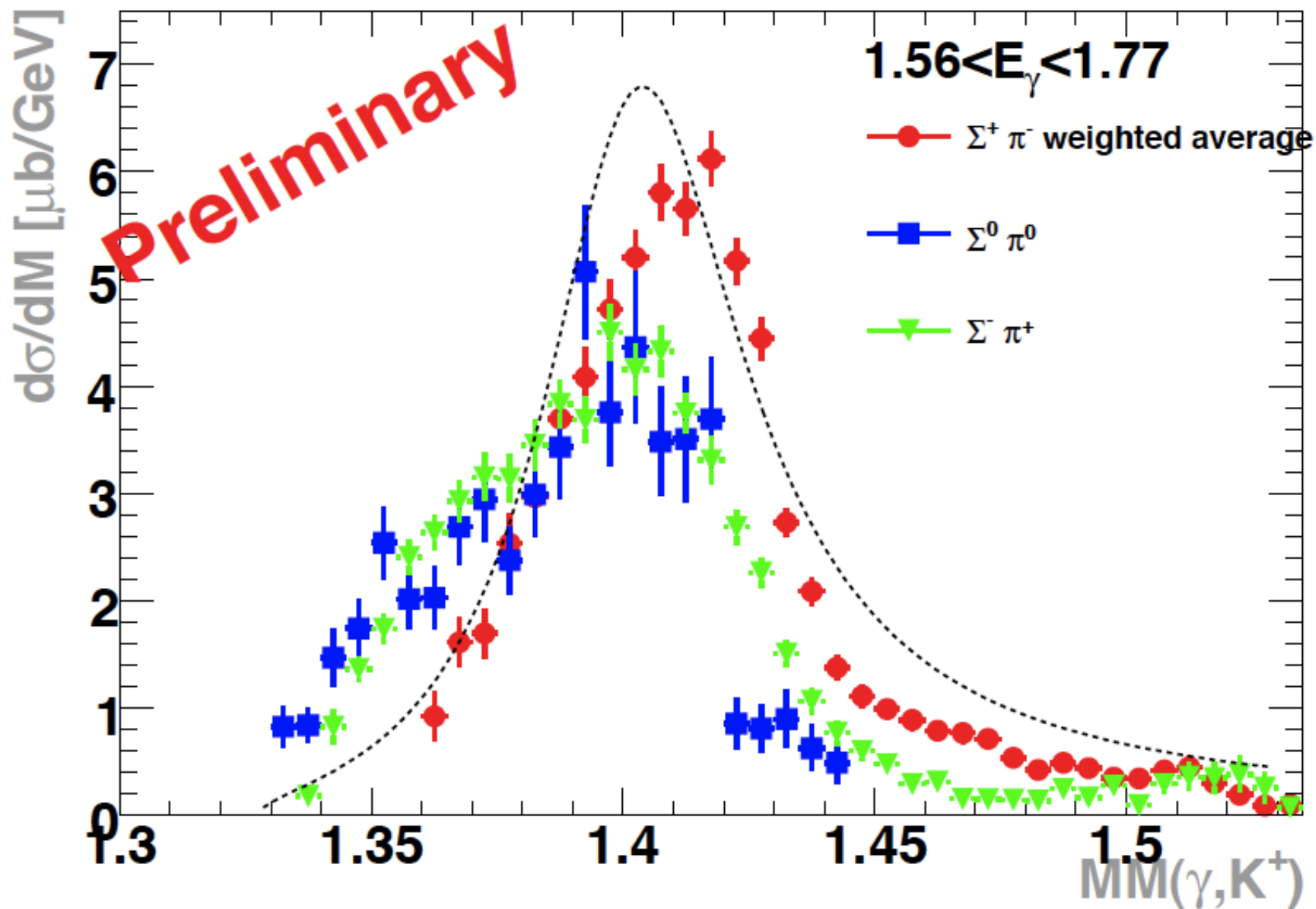
fits to extract $\Lambda(1405) - \Sigma^+ \rightarrow p\pi^0$

ingredients in low W bin:

- “nominal” $\Lambda(1405)$ MC
- scaled down $\Sigma(1385)$ MC
- $\Lambda(1520)$ MC
- $K^{*0}\Sigma^+$ MC

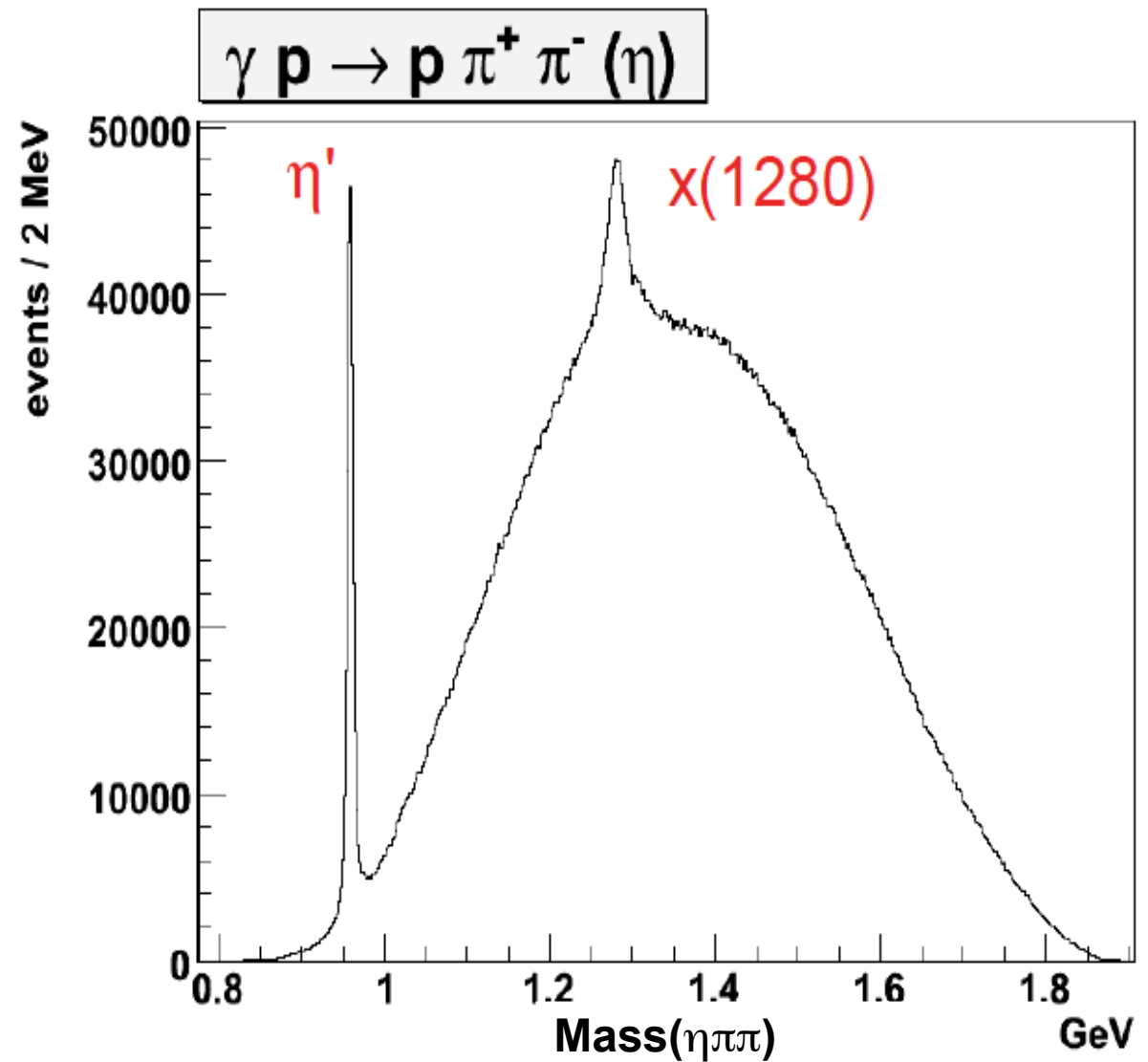


comparison of 3 lineshapes [1/3]



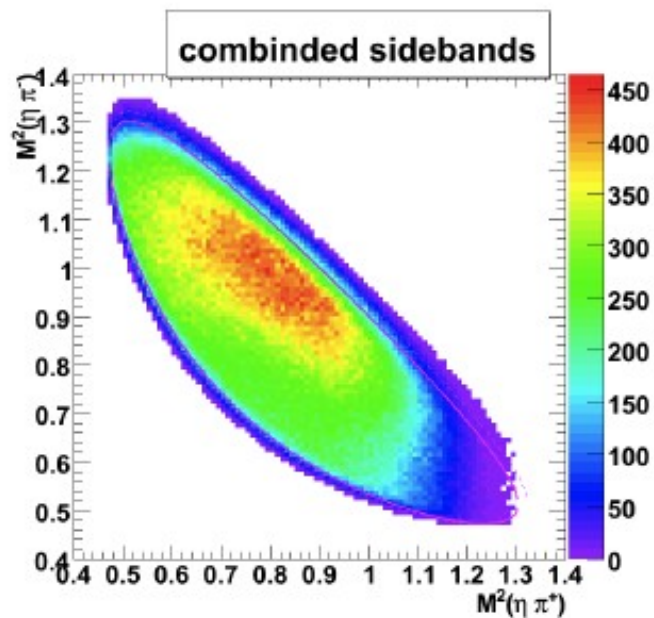
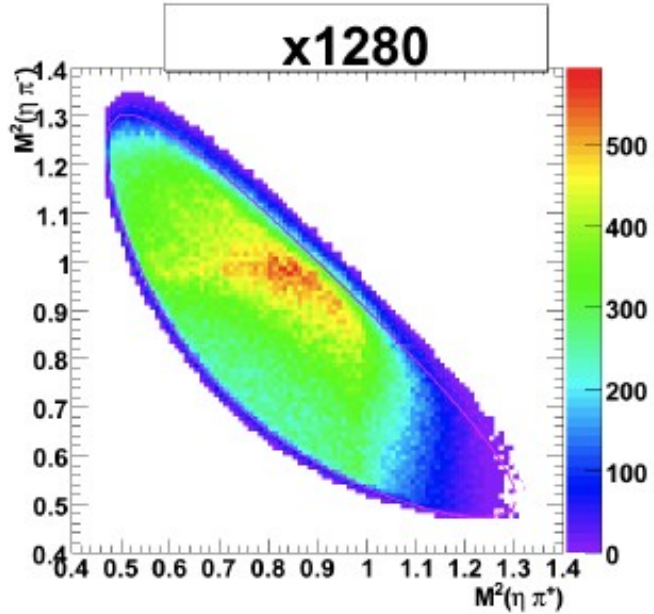
The $x(1280)$ Meson in CLAS g11 data

Ryan Dickson
Carnegie Mellon
Feb. 23rd, 2009

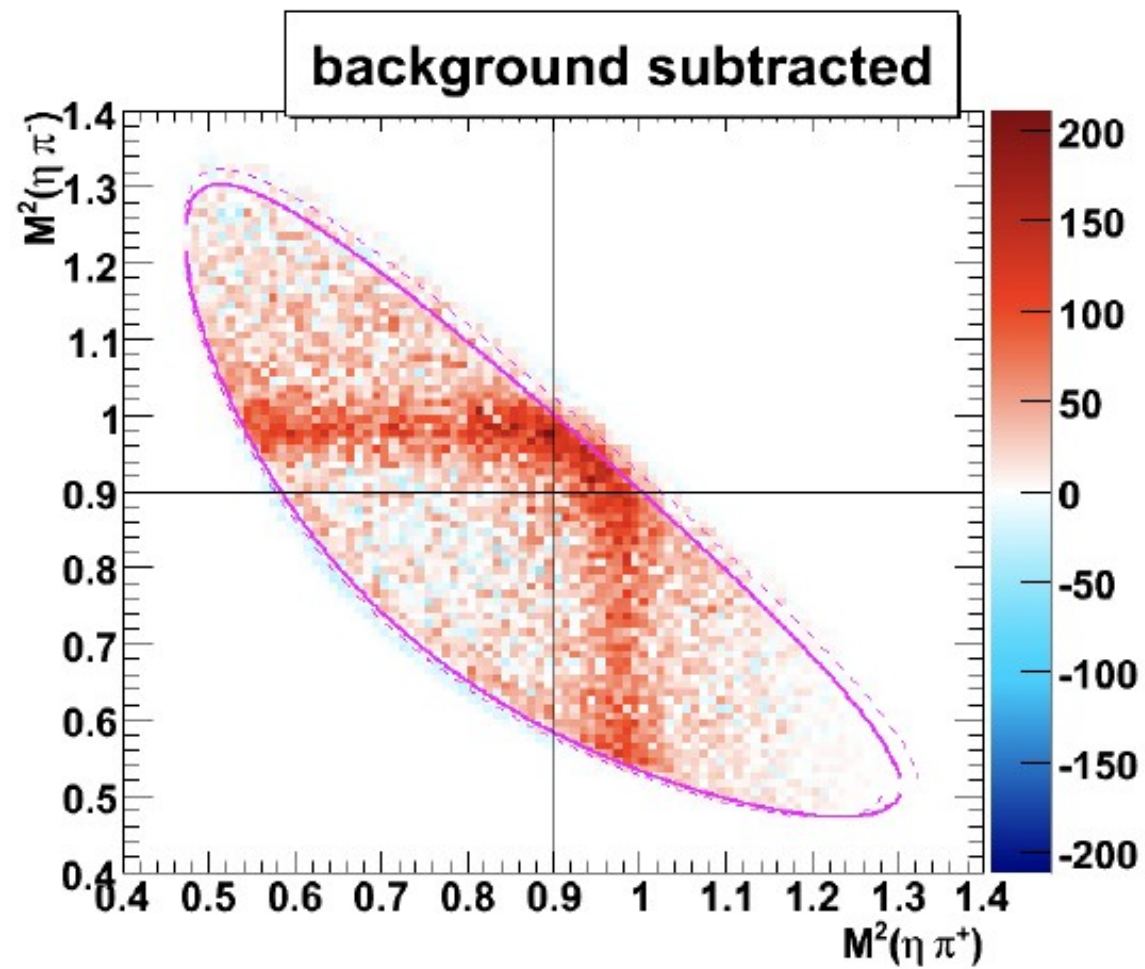


Conclusion

- First photoproduction measurements of $x(1280)$
 - η' mass and cross-sections used to calibrate methods
- Mass and width of the state consistent with the PDG values for $f_1(1285)$, not the $\eta(1295)$
- Cross-sections being compared to tree level Feynman diagram model for both 0^- and 1^+ states
- Dalitz plot analysis of $\eta\pi\pi$ final state shows clear $a_0(980)$ intermediate state, with no asymmetry.
- Branching ratio of $KK\pi/\eta\pi\pi$ measurable.



=



*$K^+\Sigma^0$ photoproduction in the CLAS g11a dataset -
Cross-sections, Polarizations and Systematics*

Biplab Dey

Department of Physics
Carnegie Mellon University
Advisor: Dr. Curtis Meyer

Feb 27th, 2009

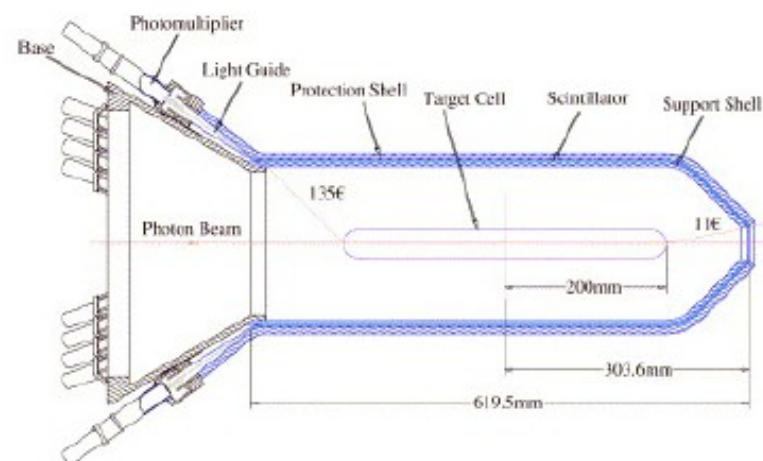
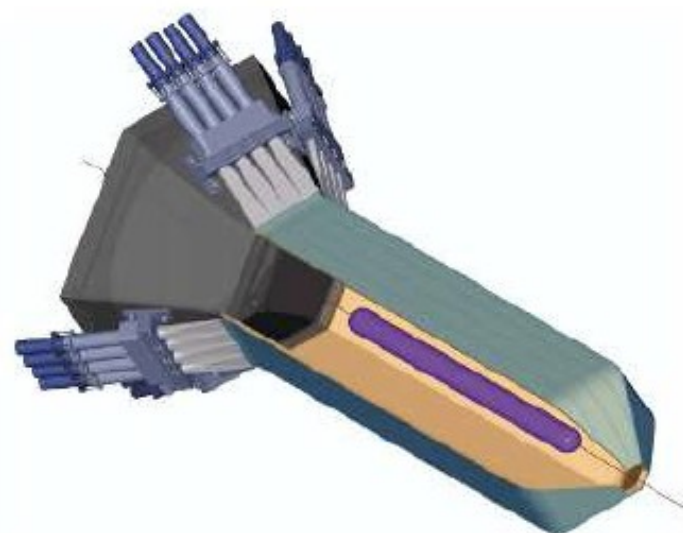
CLAS Hadron Spectroscopy Collaboration Meeting

TO SUMMARIZE ...

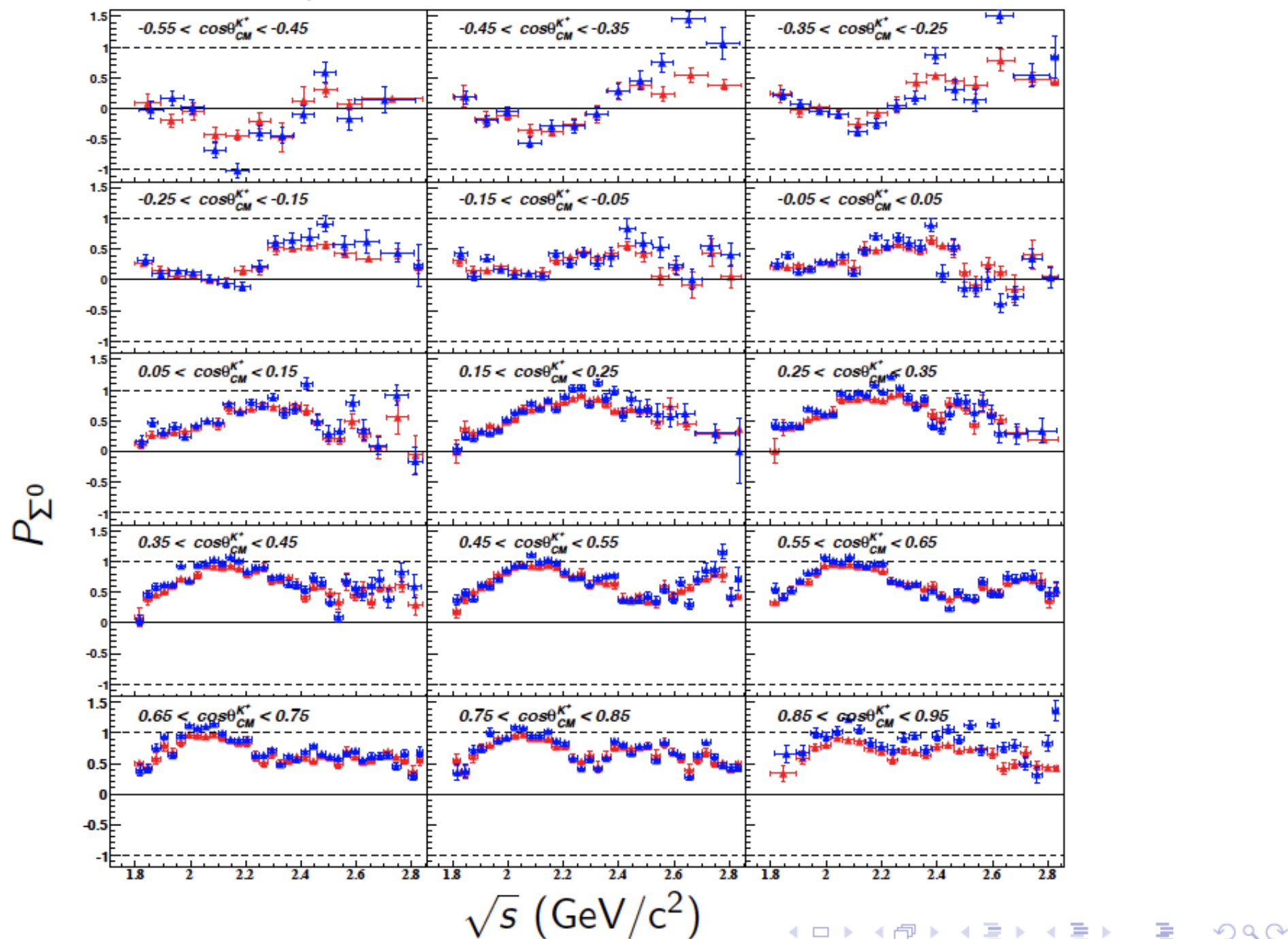
- g11a differential cross-sections agree very well with g1c - except in a *few specific kinematic regions* where g11a is $\sim 4-10\%$ lower
- Detailed systematic checks performed - **no smoking gun evidence of any large effects in g11a**
- Recoil polarizations – gross features consistent over all extraction/binning methods - **lots of structures visible!**
- Both Differential Cross Sections and Recoil Polarization **results look well cooked** at this stage
- Finally, have started running t-channel fits for final PWA analysis to look for **baryon resonances which couple to the $K^+\Sigma^0$ channel**

G11A START COUNTER CORRECTION

- g11a Start Counter – 6 “sectors”. Sits ~ 10 cm around target.



- Require **2 coincident charged hits in two different “sectors”**
- One hit from K^+ , the other from p and/or π^- from Λ decay.
- However, Λ has $c\tau \sim 7.4$ cm – can decay **outside** the Start Counter. Such events won't be triggered because Λ is neutral!
- Monte Carlo does not include this triggering - needs correction.

Compare: *PWA*/*Traditional* method of Polarization extraction

CLAS Update on g12 & a Preliminary Look at Strangeonia

Mukesh Saini

Florida State University, Tallahassee, FL

February 27, 2009



Calibrators

Detector subsystem \Rightarrow People responsible

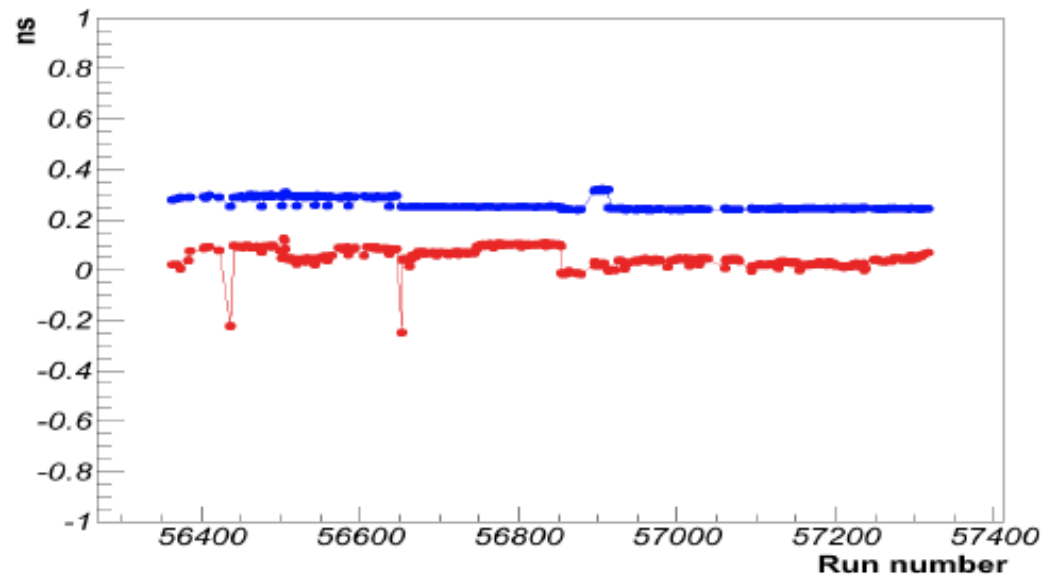
- Cherenkov \Rightarrow Rakhsha Nasseripour & Michael Paolone
- Electromagnetic Calorimeter \Rightarrow Mike Wood & Diane Schott
- Start Counter \Rightarrow Mukesh Saini
- Tagger \Rightarrow Mukesh Saini
- Time of Flight \Rightarrow Craig Bookwalter
- IC Hodoscope \Rightarrow John Price

Cooking

- Chef \Rightarrow Johann Goetz
- Troubleshooter/TroubleMaker \Rightarrow Johann Goetz

TOF Run by Run Status

Mean of Gaussian fits to sc vtime minus pion vtime by run



Craig:

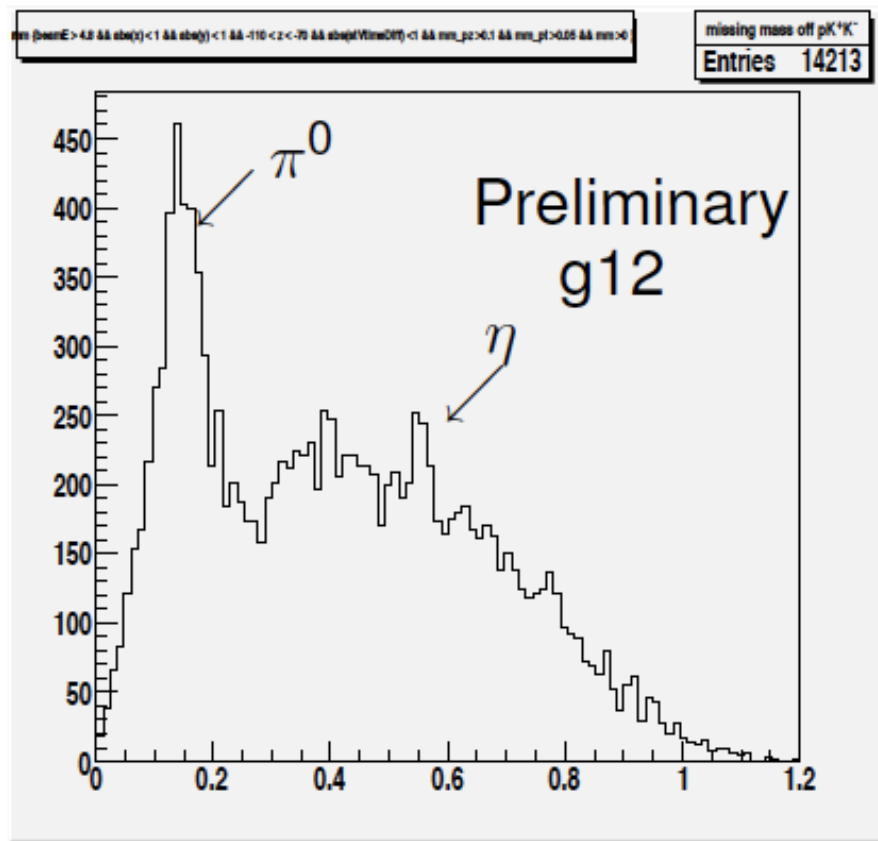
- Run-by-run stabilization is almost complete.
- Resolution issues have been sorted out. It was discovered that time-walk parameters from 8 years ago give better TOF resolution than current ones obtained from laser data.

Summary and Immediate Plans

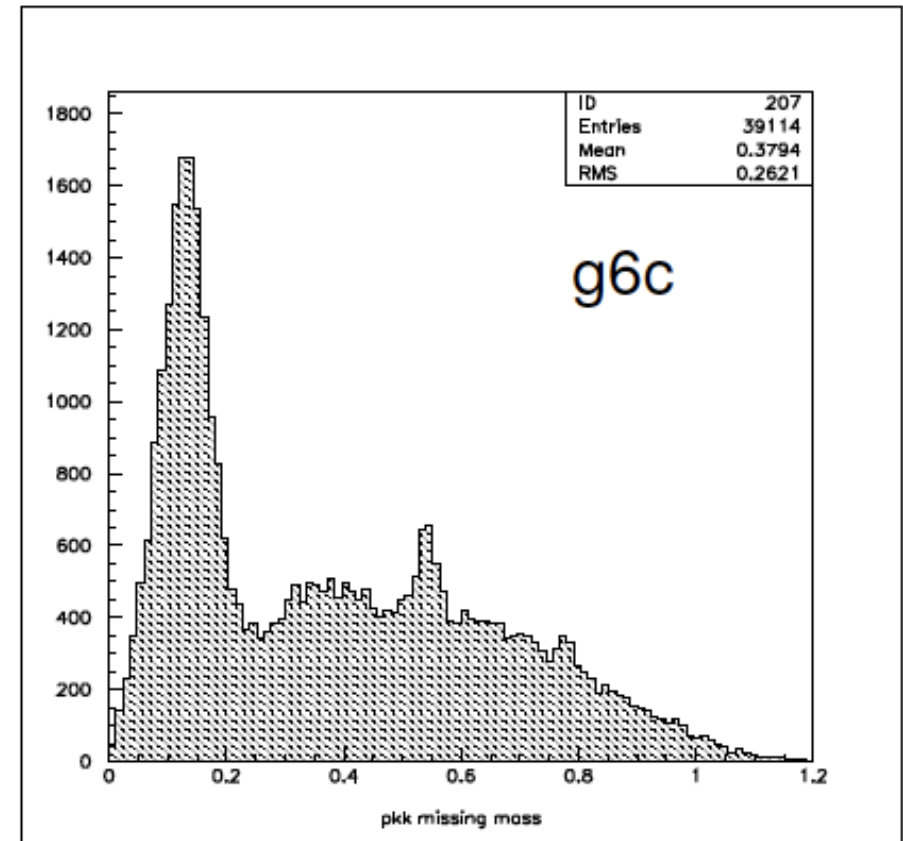
- Another pass0 (we've done 4 so far) to check the run-by-run stability of calibrations is in progress.
- Energy loss and momentum corrections.
- Continue TOF & ST resolution studies.
- Pass1 by April!

Missing mass ($m_{\text{miss}} > 0$) off $p K^+ K^-$

- Identify the missing η/π^0 meson



- Missing mass off pK^+K^- from g12 Data.



- Missing mass off pK^+K^- from g6c Data.

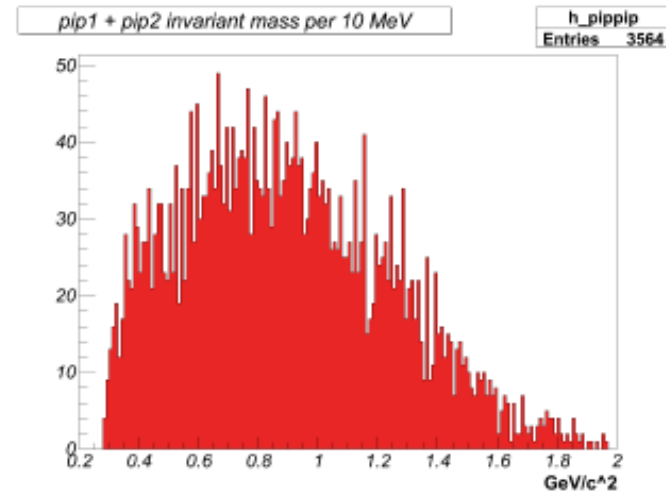
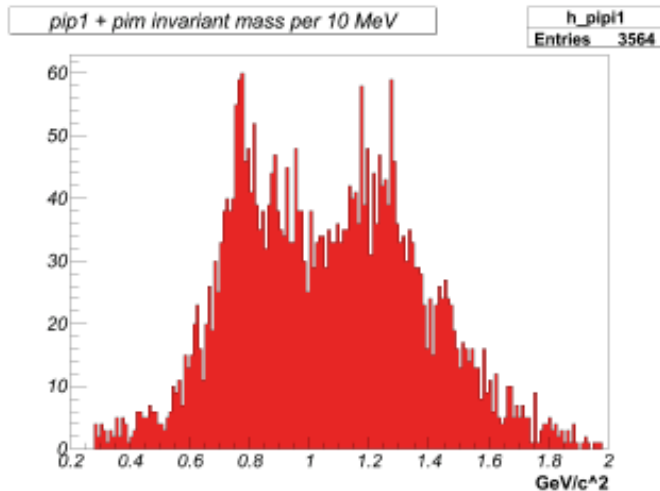
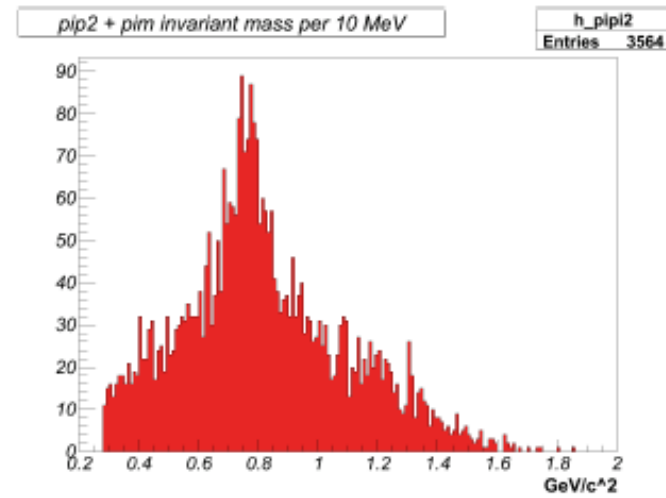
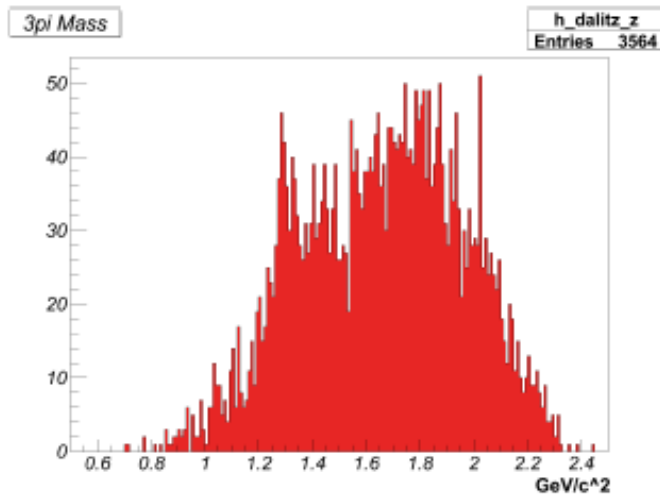
Update: $\gamma p \rightarrow \pi^+ \pi^+ \pi^- n$ in g12 Data

Craig Bookwalter

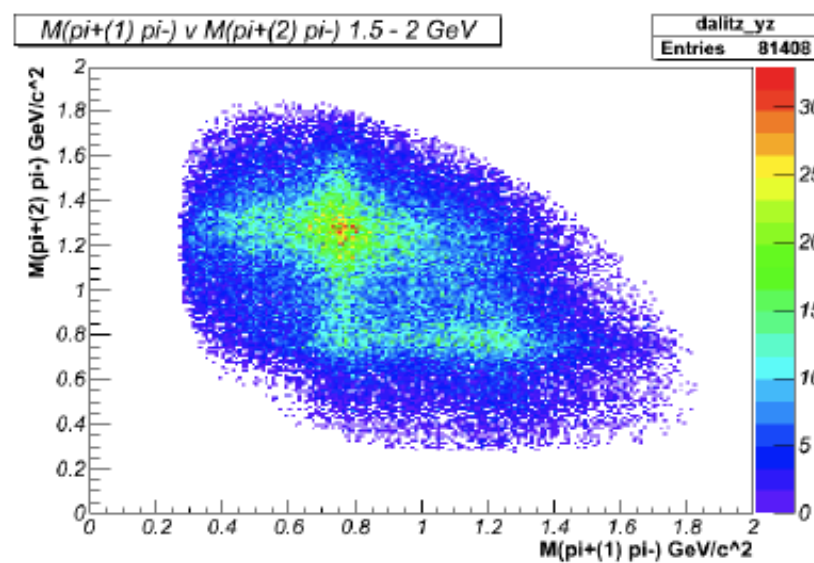
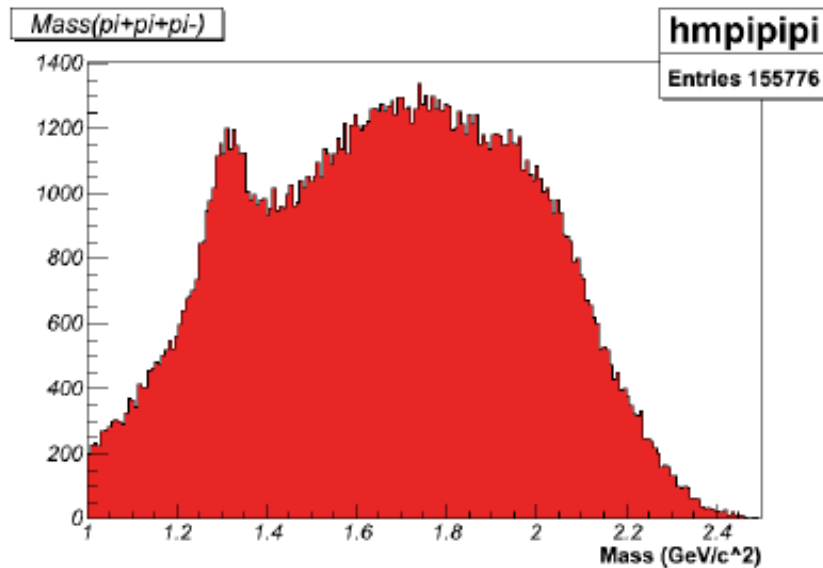
Florida State University
Tallahassee, FL

February 27, 2009

g12 3pi: Mass plots (Accepted yields, pass0_v4 data)



g12 3pi: Mass plots (Accepted yields, pass0_v2 + pass0_v3 data)



- Different `st_vtime` cut
- Different cut ordering



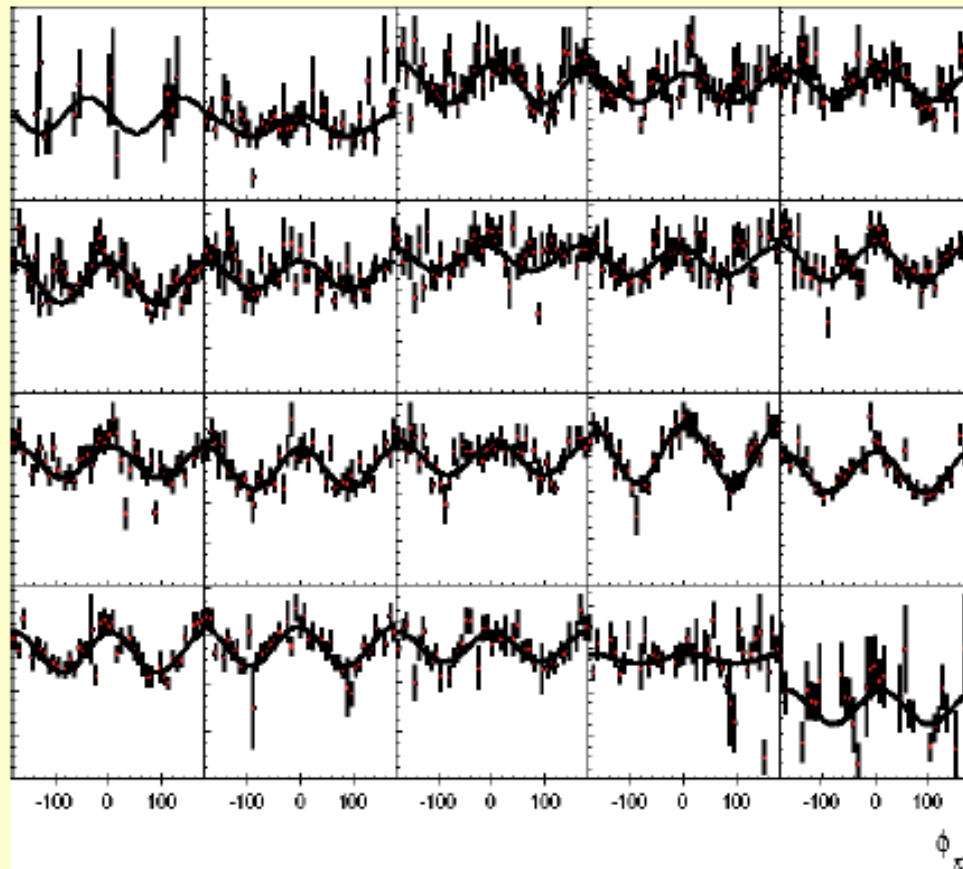
Beam Asymmetries in $\pi^+\pi^-$ photoproduction from $g\delta b$: An Update

Charles Hanretty
Florida State University
02/27/09

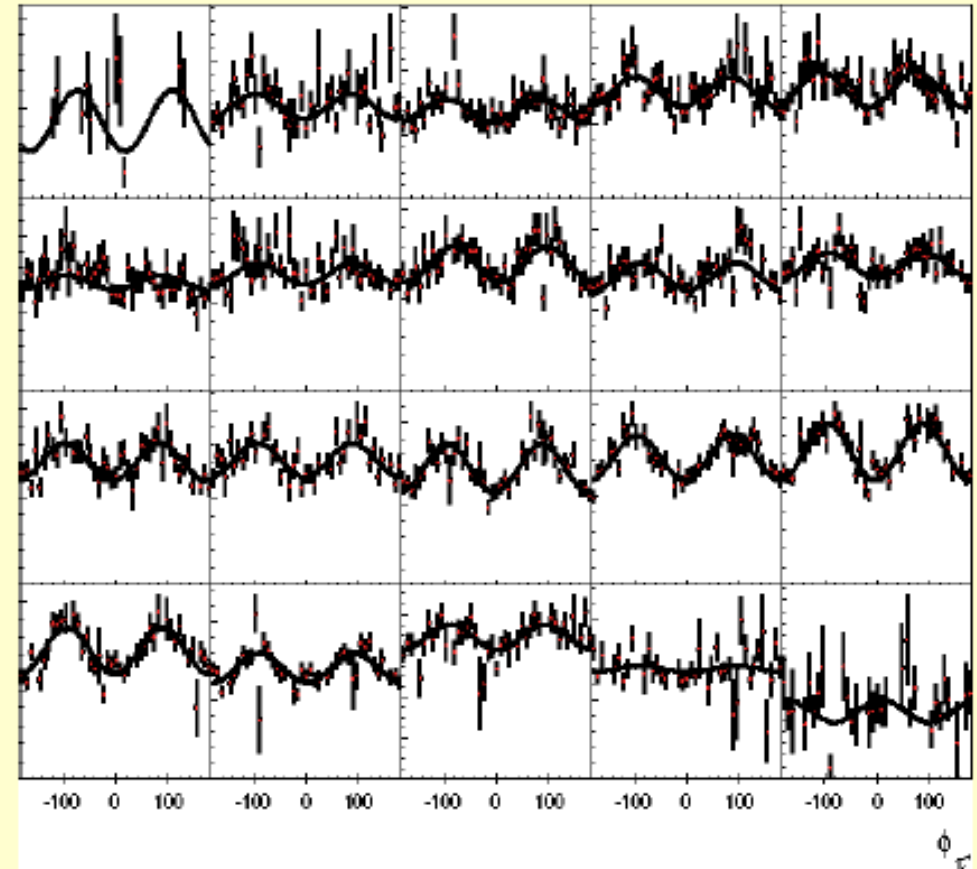


Preliminary Results

- Fit to a $p \pi^+ \pi^-()$ final state, photon energy of 1.5-1.55 GeV
- Each square is a $\cos\theta_{\text{cm}}$ (of the π^+) bin.
- Fit to : $x + \delta_l [\mathbf{I}^s \sin 2\beta + \mathbf{I}^c \cos 2\beta]$



PARA/AMO



PERP/AMO

Status Report on Extraction of Double and Single Spin Asymmetries for pion electroproduction from NH_3 and ND_3 targets using JLab EG4 data

Xiaochao Zheng
University of Virginia
Feb. 27, 2009

- Physics Motivation, observables;
- EG4 Run Overview;
- Analysis status and preliminary asymmetries from 3 GeV NH_3 data

Acknowledgment:

EG4 spokespeople: M. Battaglieri, R. De Vita, A. Deur, G. Dodge, M. Ripani, K. Slifer

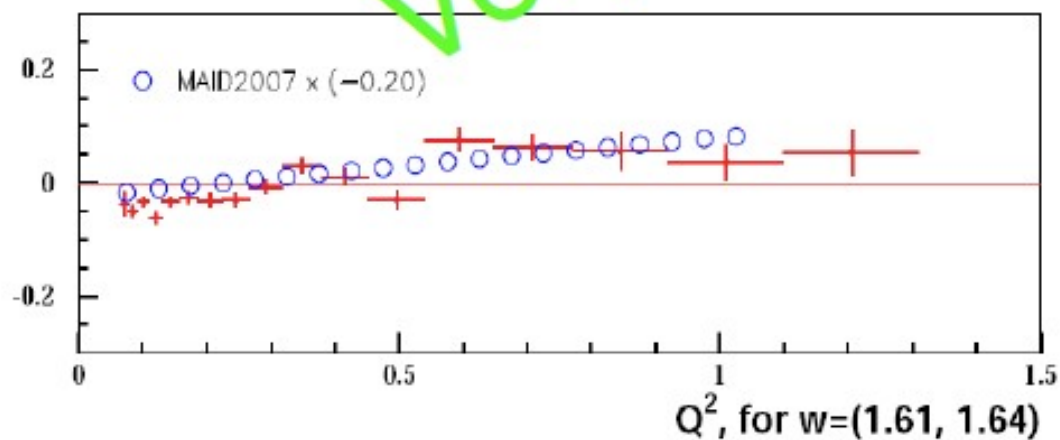
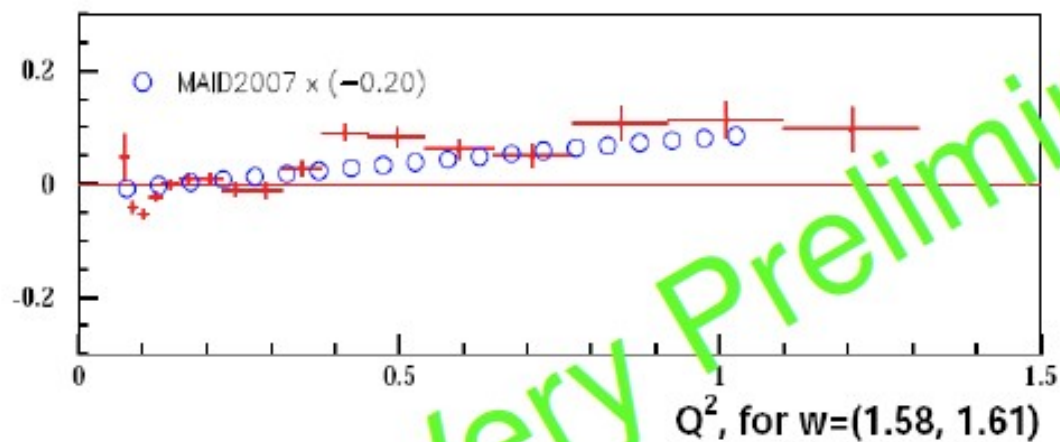
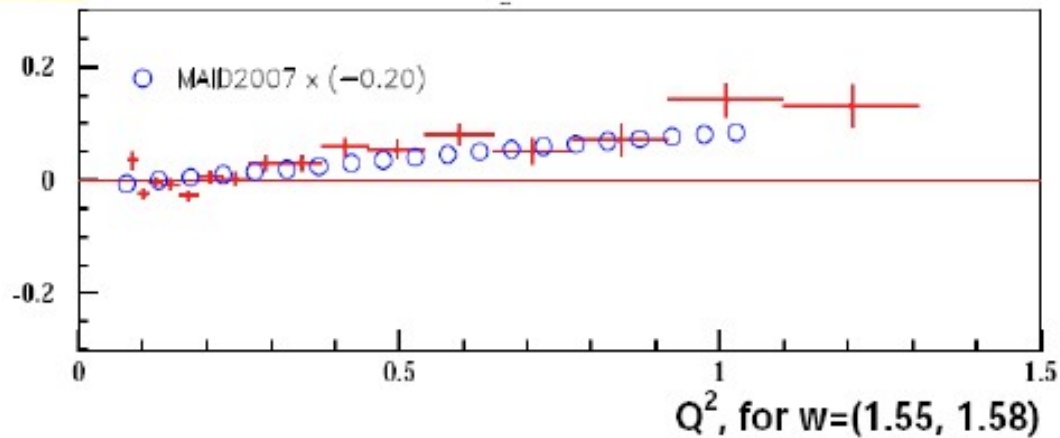
EG4 Ph.D. students: K. Adhikari, K. Kovacs, H. Kang

CAA Review committee: D. Carman, P. Eugenio, C. Smith, M. Ungaro

Summary

- EG4 will provide data on pion electroproduction asymmetries A_t , A_{et}
 - + Lower Q^2 than previous data;
 - + both polarized proton and neutron targets;
 - + May compare to Chiral Perturbation Theory.
- Preliminary asymmetry results from the 3GeV NH_3 data are very promising (will present at NStar 09 this April).
- Will analyze other beam energies within the next 1-2 years.

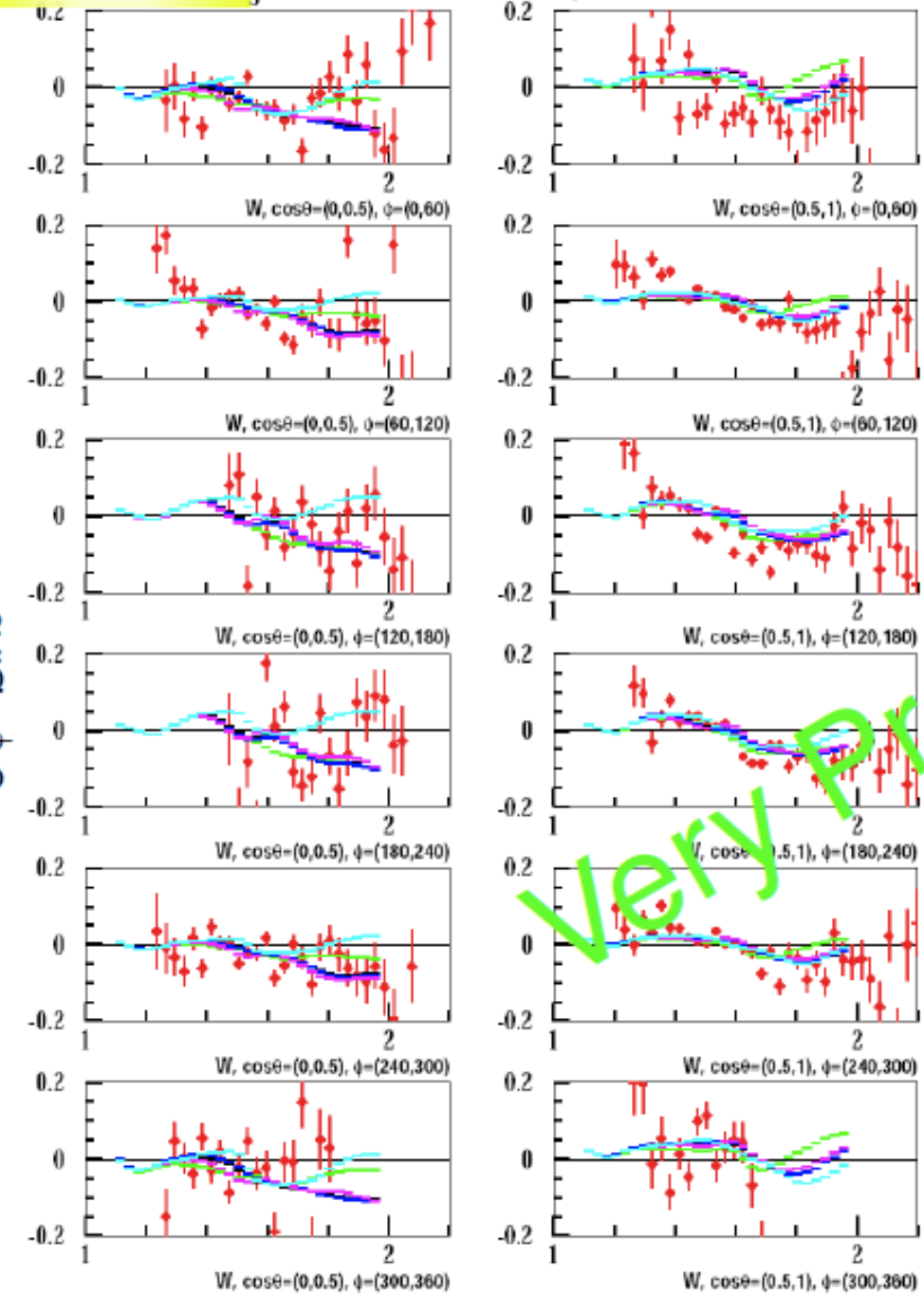
Aet vs. Q^2



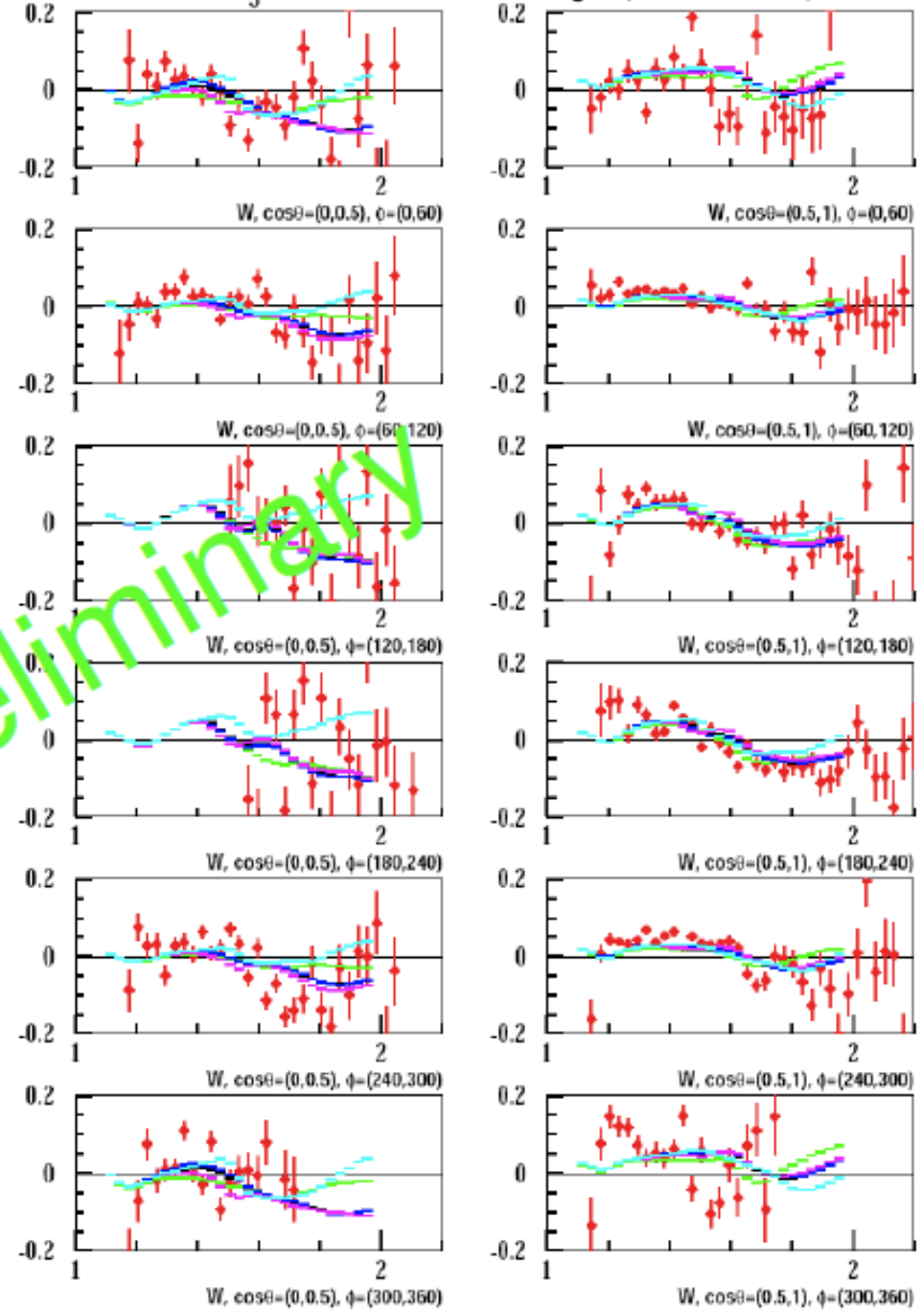
Very Preliminary

- (integrated over ϕ^* and $\cos\theta^*$)
- 0.20: overall "dilution factor"

Aet vs. W_3 , 3 GeV runs, π^+n , $Q^2=(0.0919,0.156)$



Aet, NH_3 , 3 GeV runs, π^+n , $Q^2=(0.156,0.266)$



Very Preliminary

↙ 2 cosθ* ranges ↘

Data; MAID2007; DMT; MAID2007(P11off); MAID2007(S11off); MAID2007(D13off)

Photon Asymmetries for Strangeness Photoproduction on the Deuteron

J Russell Johnstone
University of Glasgow
CLAS12 European Workshop
Genova, 27th February 2009

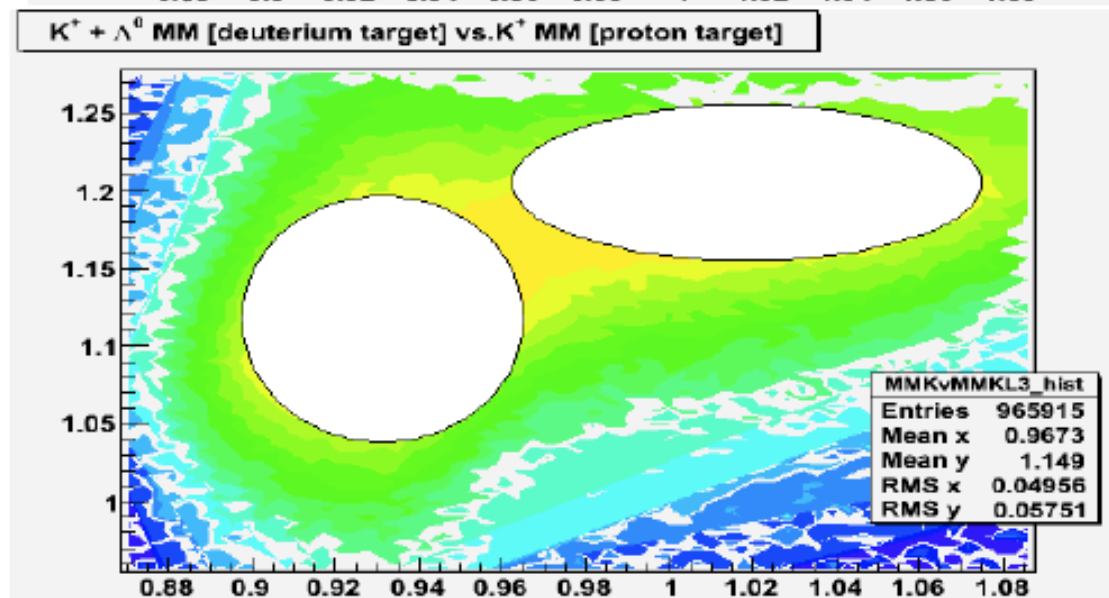
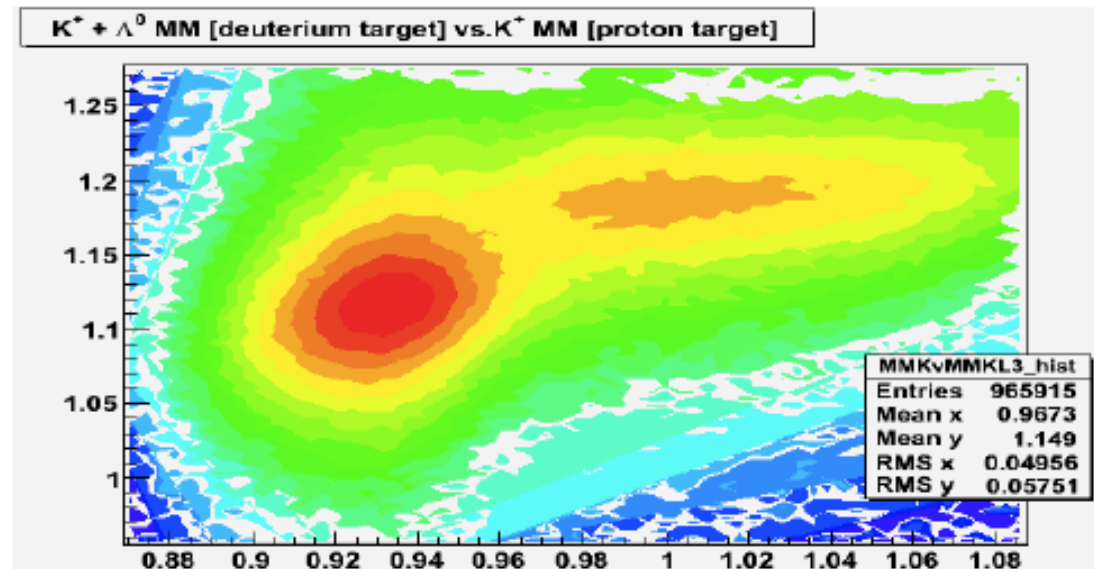


Introduction

- Part of the g13 experiment.
- Examining strangeness channels from the deuteron.
- $\gamma p(n) \rightarrow K^+ \Lambda(n)$ and $\gamma p(n) \rightarrow K^+ \Sigma^0(n)$.
- G13 used both circularly and linearly polarised photon beam.
- Only analysing g13b (linearly polarised photon beam).

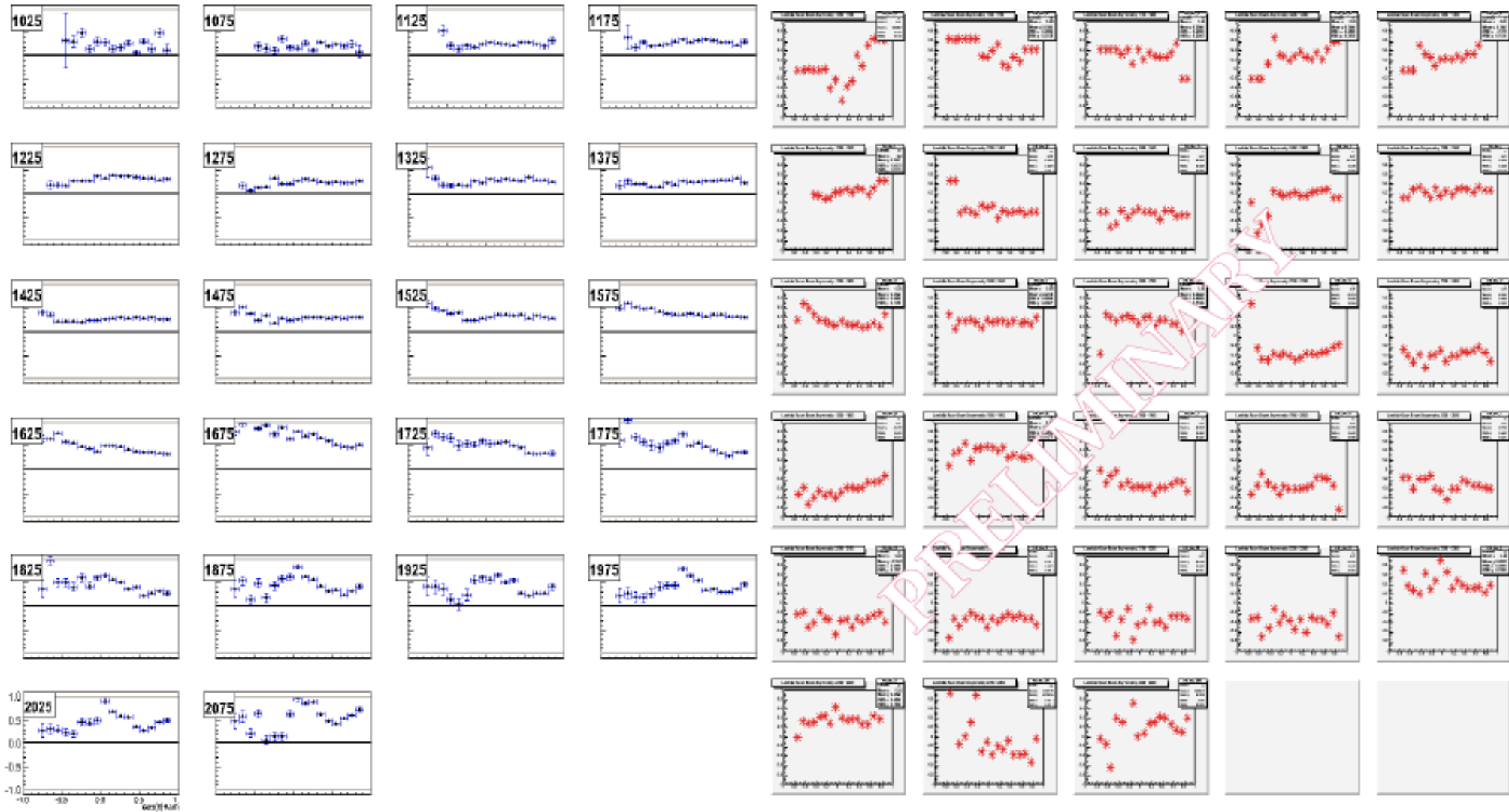
Hyperon Identification

- Hyperons identified by plotting $MM(K^+ p \pi^-)$ from deuterium target vs. $MM(K^+)$ from proton target.
- Good hyperon separation.
- Hyperons extracted with elliptical cuts.



$K^+(\Lambda)$ free/bound comparison

- Photon asymmetries for $\gamma p \rightarrow K^+\Lambda$ (left) and $\gamma p(n) \rightarrow K^+\Lambda(n)$ (right) as a function of $\cos(\theta_{K+cm})$.



$K^+(\Sigma^0)$ free/bound comparison

- Photon asymmetries for $\gamma p \rightarrow K^+\Sigma^0$ (left) and $\gamma p(n) \rightarrow K^+\Sigma^0(n)$ (right) as a function of $\cos(\theta_{K+cm})$.

