Recent Results from CLAS

Ken Hicks (Ohio University)
for the CLAS collaboration

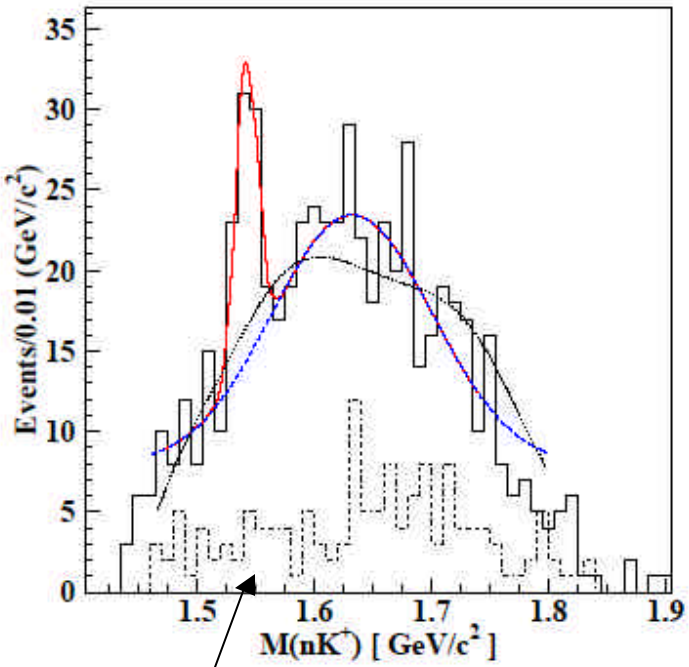
- G10 experiment and data processing
- Why is it taking so long?
- Various calibrations
- Comparison of g10 and published data

Our position regarding the published deuterium data remains unchanged.

Motivation

- Θ^+ search in $\gamma d \rightarrow K^+K^-pX$ reaction at high statistics.
  - Advantage: no Fermi motion correction
    - rescattering not uncommon
    - CLAS has wide acceptance
  - Disadvantage:
    - harder to get a cross section
    - theoretical comparison is difficult
- Comparison of data quality between g10 and g2 data sets.
  - new trigger: 2 charged particles

Published G2 analysis
$\gamma d \rightarrow K^-pK^+(n)$



Events from L(1520)

Official CLAS statement

- "Further analysis of the deuterium data find that the significance of the observed peak may not be as large as indicated."
  - We really need a calculation of the background before the statistical significance of the peak can be known.
- **Eventually the new experiment, with much higher statistics, will settle the question.**
  - The g10 experiment (x10 statistics) is now complete, and final results are expected at end of Feb. 2005.
  - "Why is it taking so long?" --> It's only 8 months!!

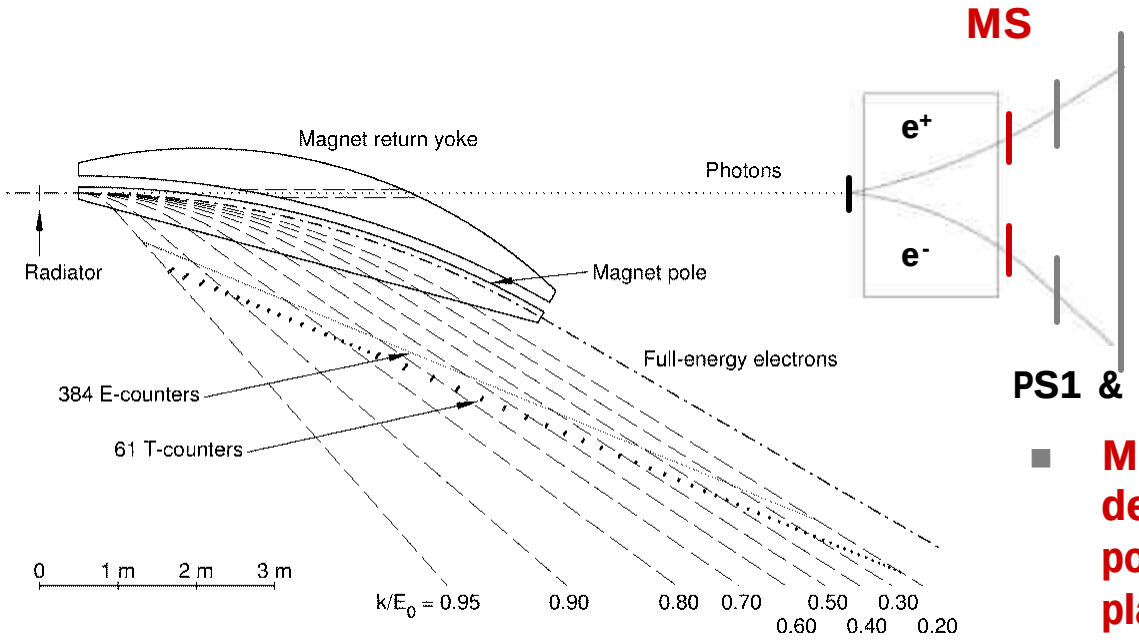
G10 run: March 13 - May 16, 2004

- Tagged photons in the energy range from 0.8 GeV to 3.59 GeV;
- Target – 24 cm long liquid deuterium at Z=-25cm;
- Trigger – two charged particles in CLAS.
- Data are taken at 2 settings of CLAS toroidal magnet.
- At each setting integrated luminosity ($25 pb^{-1}$) is about 10 times higher than in published deuterium data.

Status of data processing

- Total data volume on the tapes is ~24TB.
- Data are fully calibrated (some issues with early runs).
- Processing of 100% of data from each set (3375A and 2250A torus settings) was completed in December 2004.
- Analysis of data has taken just over one month.
- Physics analysis tools:
  - Analysis programs - 3 parallel efforts for KKp final state;
  - New photon energy and particle momentum corrections;
  - Kinematical fitting using standard code developed by CMU;
  - Development of realistic GEANT based simulation (in progress).

Independent photon energy calibration



- **Single counters of PS1 on each side.**
- **PS2 – full plane.**
- **MS – microstrip detectors from photon polarimeter: 2X and 2Y planes, 50mm pitch.**

- **At fixed acceptance of e+e-:**

$$\frac{E_i}{E_j} = \frac{B_i}{B_j}; \quad \Rightarrow \quad \frac{E_i}{E_j} = \frac{\int B_i dl}{\int B_j dl};$$

B's are defined with 10^{-4} precision.

Field saturation will play significant role

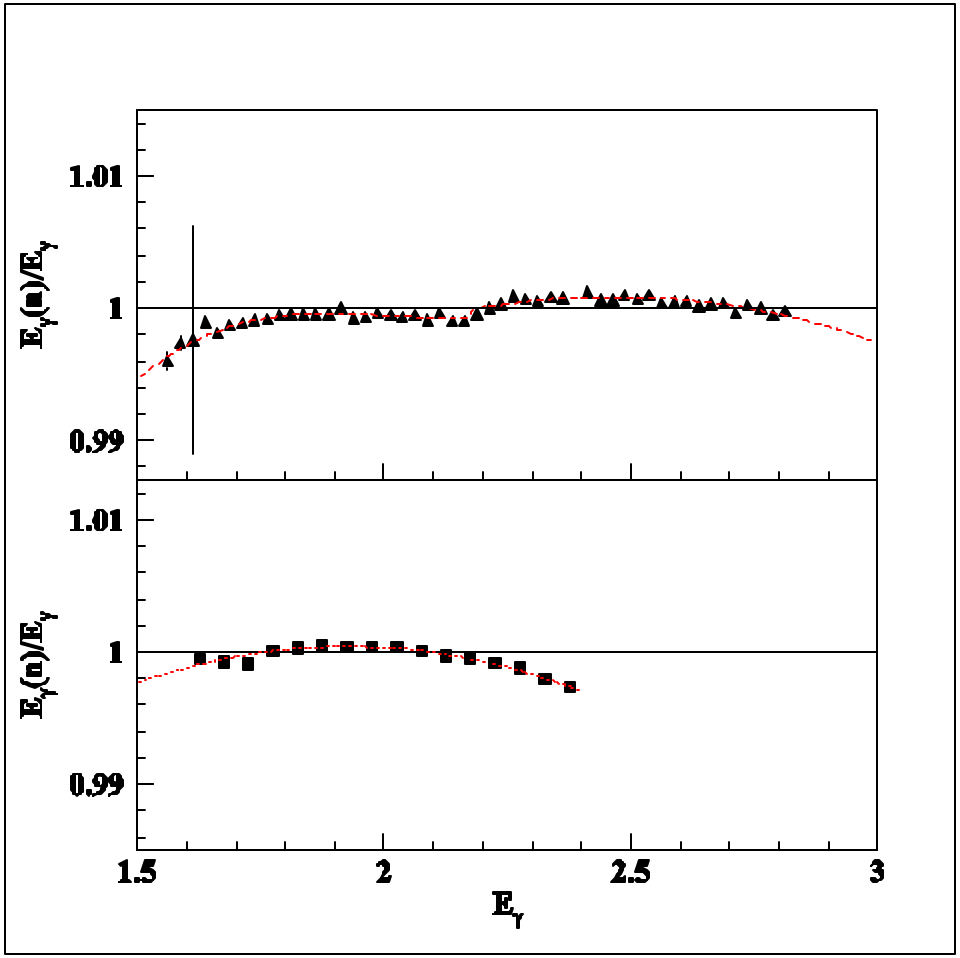
Tagger energy correction

First observation of the nonlinearities in the tagger energy spectrum in Θ^+ analysis from g2a data (S. Stepanyan et al.)

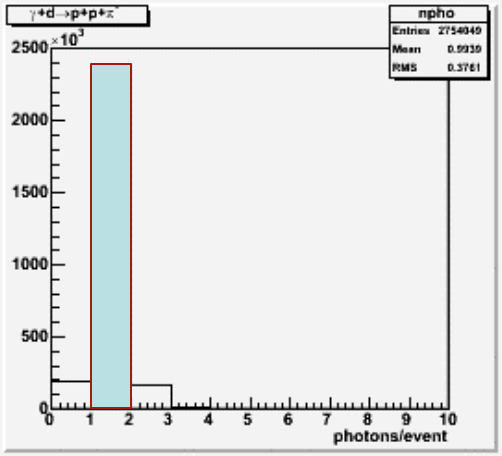
Empirical corrections were derived using exclusive reaction $\gamma d \rightarrow p\pi^+\pi^-(n)$.

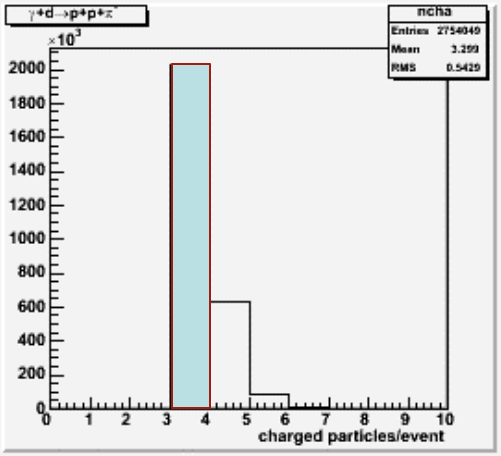
Later similar results have been obtained by M. Williams et al. from the analysis of g1c data (higher statistics, full focal plane).

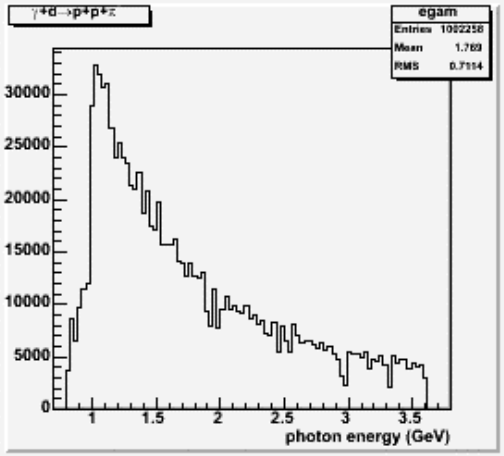
D. Sober et al. explained observed effect by a change of the location of E-counters due to a sagging of support frames (3 frames for 384 E-counters).

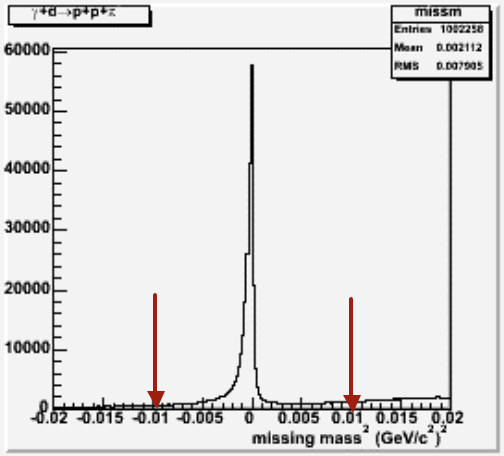


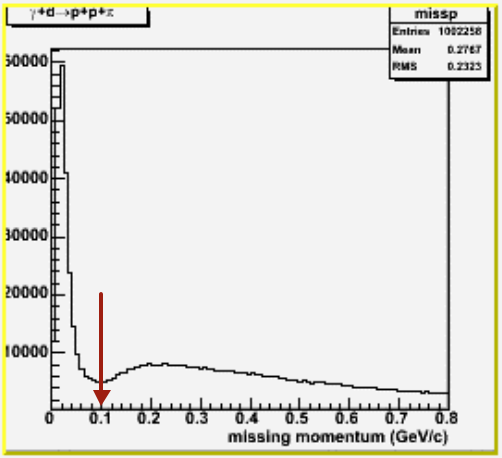
S. Stepanyan CLAS Analysis Note 03-105







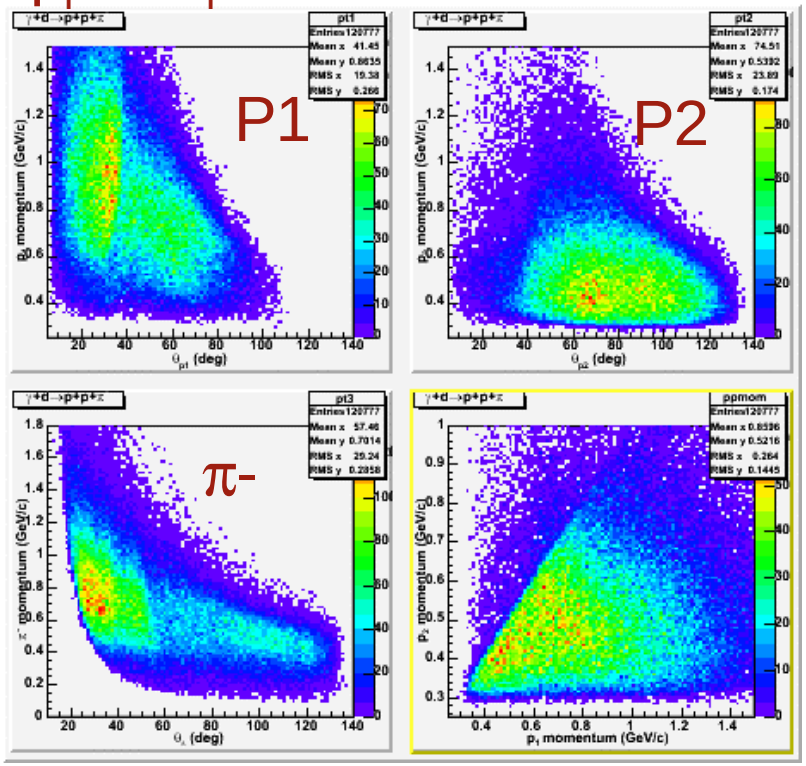




Tedeschi and Mibe – 4C fit

$$g + d \rightarrow p + p + p^{-}$$

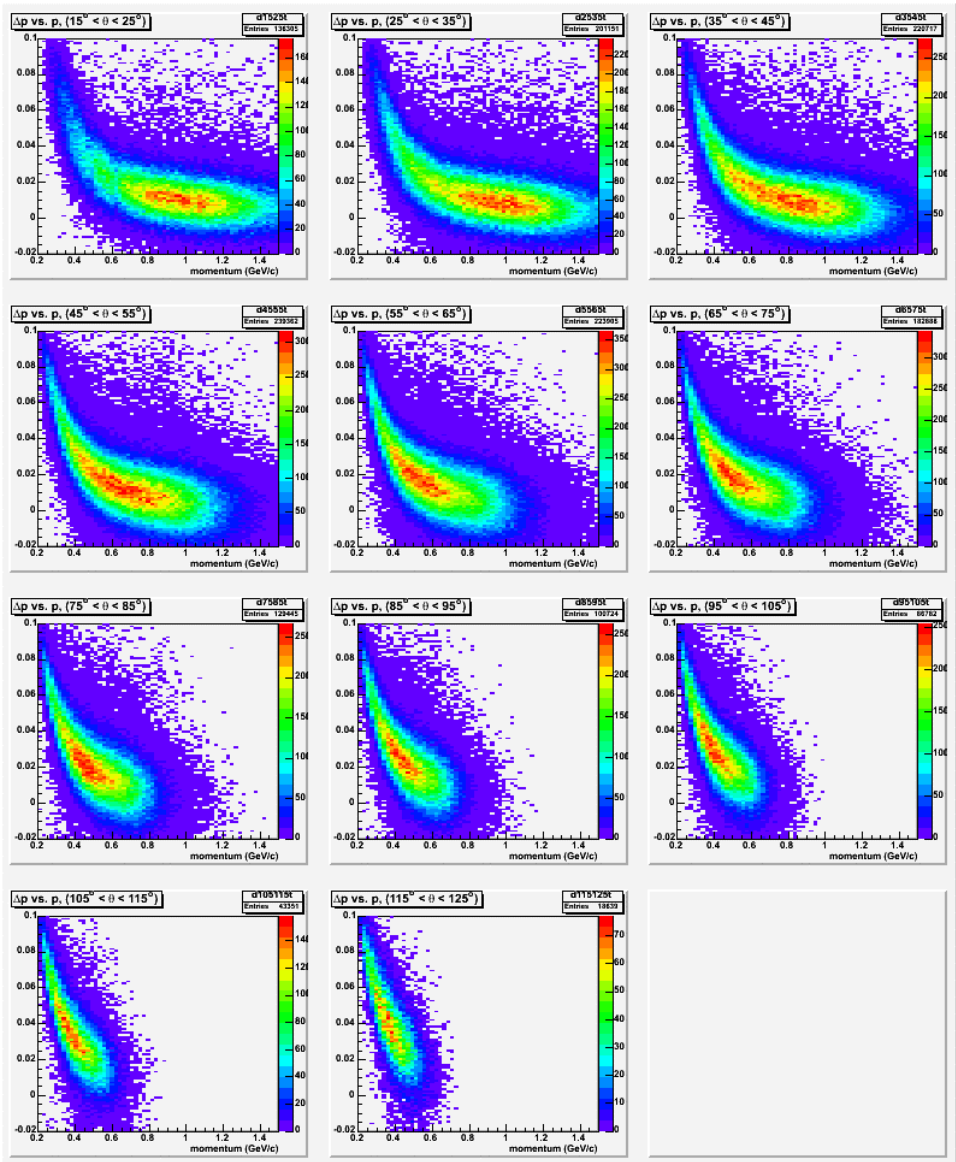
p_i vs θ_i

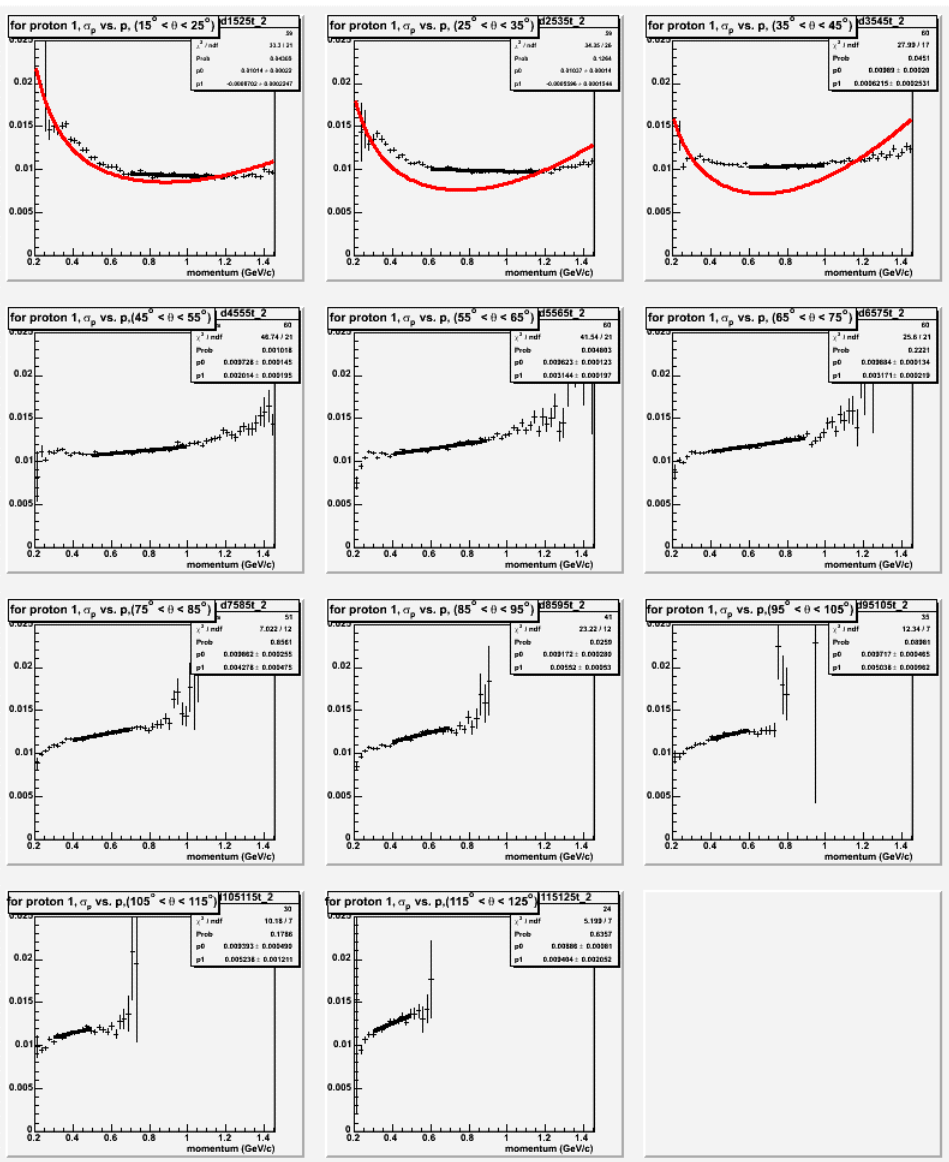


p_1 vs p_2

Note the low momentum (~400 MeV/c) and large angles (40-120 deg) of p2

Momentum Resolution





First analysis meeting (11/29)

- Discuss corrections: Eloss, E_γ, momentum;
- Kinematic fitting;
- PID, cuts
- First look on physics analysis;

$$g + d \rightarrow p + K^- + K^+ + n; \Theta^+ \rightarrow nK^+ \qquad pK^-K^+$$

$$g + d \rightarrow \Lambda^0 + K^{+(0)} + n(p); \Theta^+ \rightarrow nK^+, pK_S^0 \qquad pp^-K^+; ppp^-$$

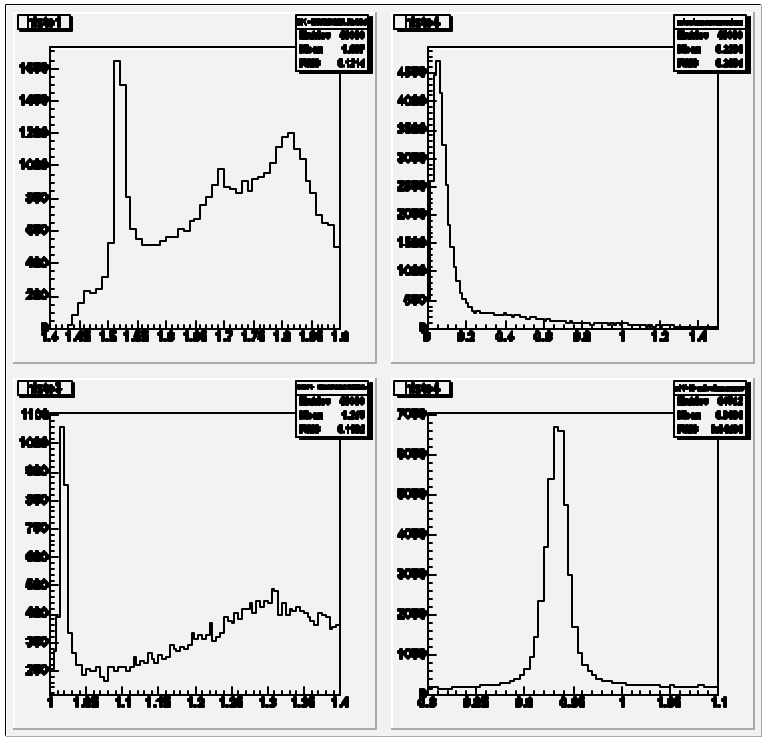
$$g + d \rightarrow p + p^+ + p^- + K^-; \Theta^+ \rightarrow pK_S^0; K_S^0 \rightarrow p^+p^- \qquad pp^-p^+K^-$$

$$g + d \rightarrow K^- + p + X; \qquad K^-p$$

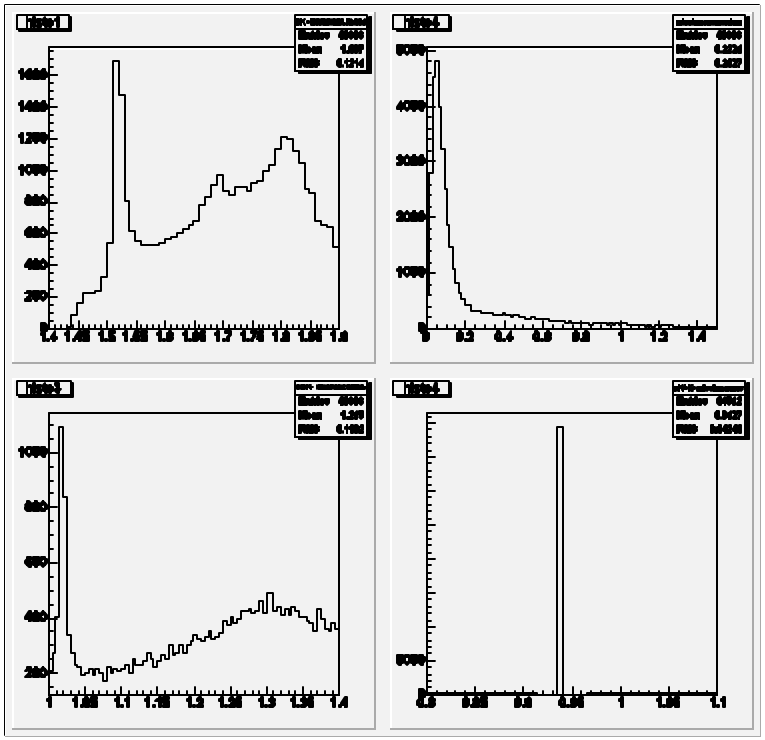
- Common rules for all analyses:
  1. Fully calibrated detector;
  2. Selected "golden" runs;
  3. Events in well defined CLAS fiducial volume;
  4. Energy and momentum corrections that use independent well-studied channels;
  5. Kinematical fitting;
  6. Inspect Θ^+ candidates in CLAS single event display.
  7. Simulation framework based on GSIM/GPP/RECSIS.
- Define analysis cuts and selections based on a portion of data, then apply the same analysis (cuts, etc) to another portion. Two parts of data can be either uniformly distributed over the entire run period (check of statistical aspects), or can be first and second half of the run period (check of the callibrations, systematics).
- Study the effect of each cut.

Ken Hicks - $\gamma d \rightarrow K^+K^-p(n)$ (3375 A)

Eloss and E_γ corrections.

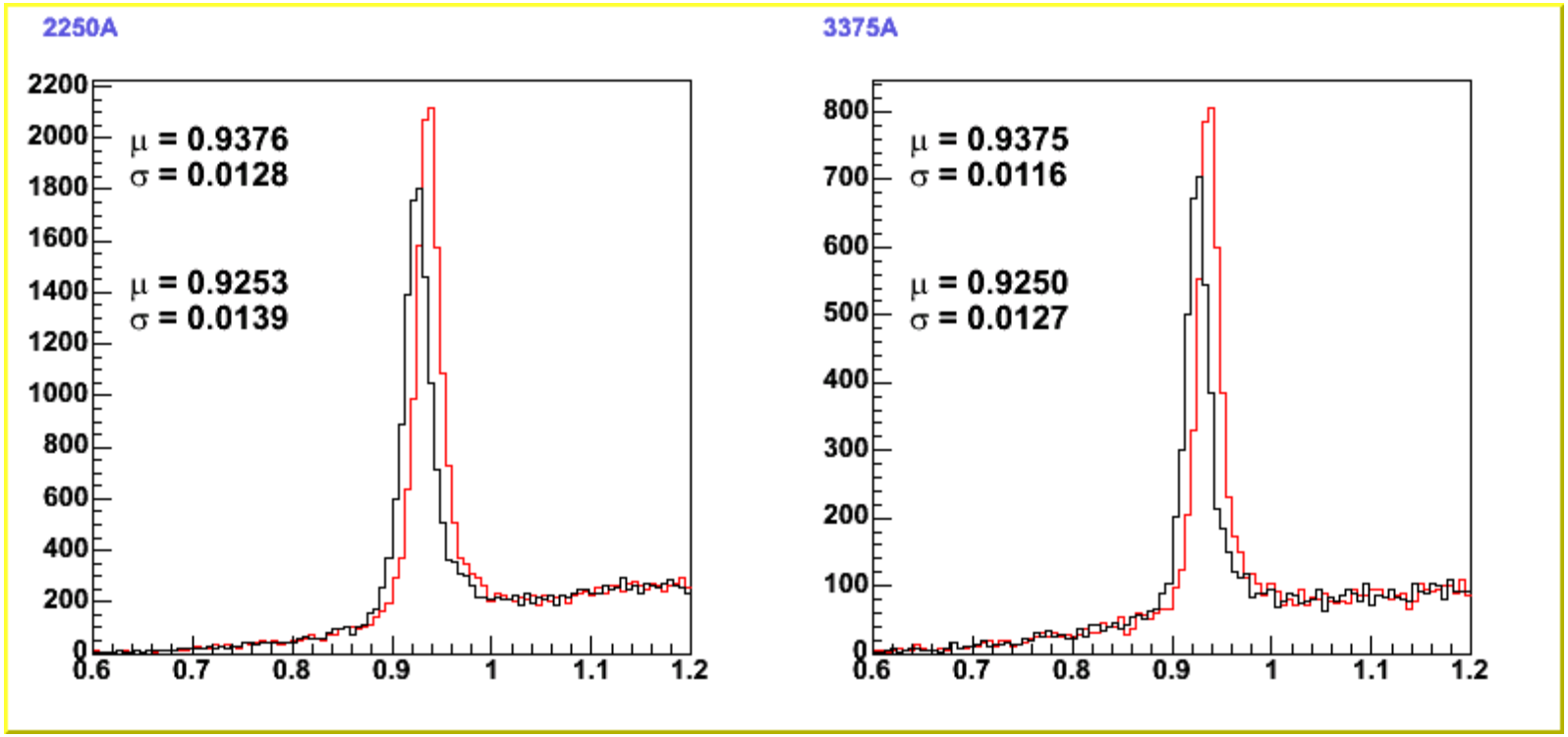


Kinematic fit



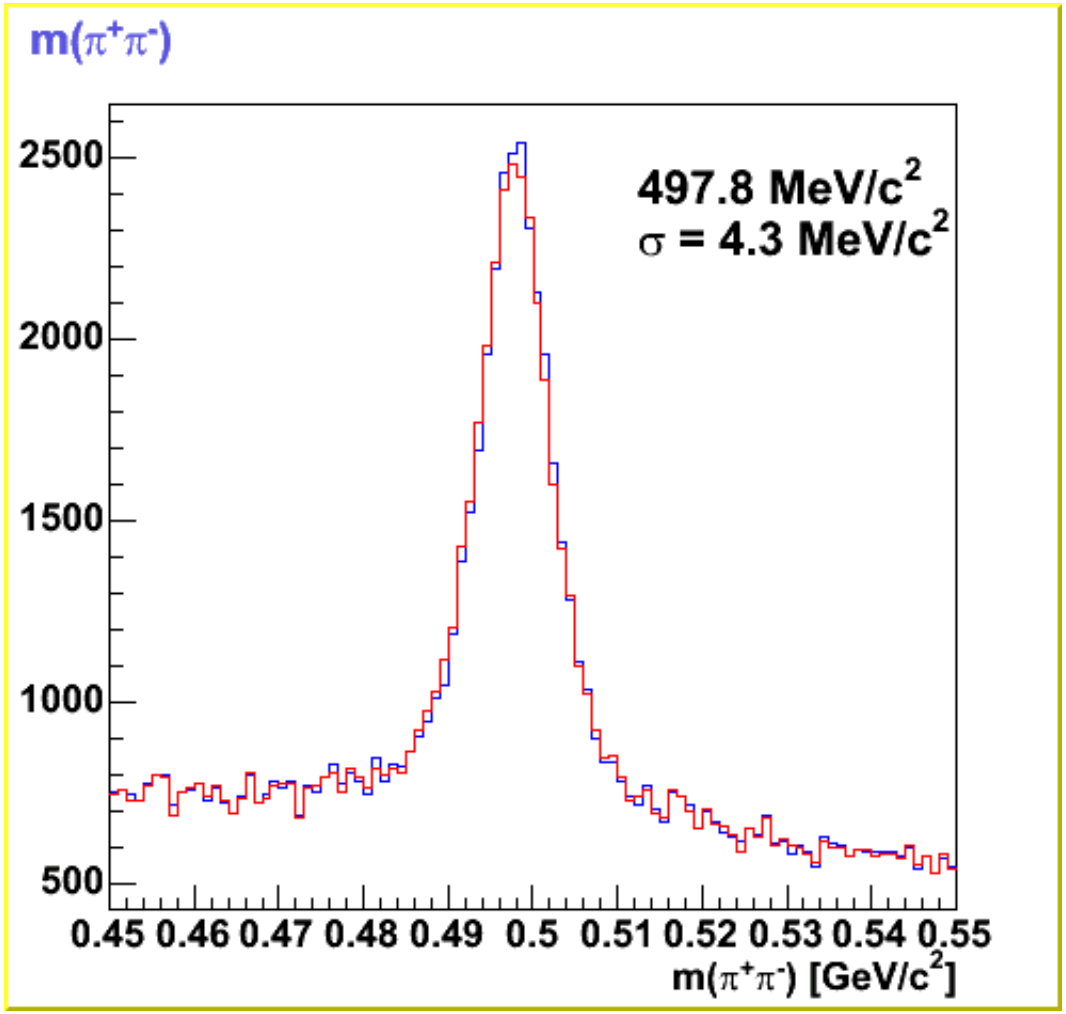
- Kinematic fit works. After corrections it has small effect on masses and resolutions.

Nathan Baltzel $\gamma d \rightarrow p K^0 K^-(n)$ (both data sets)

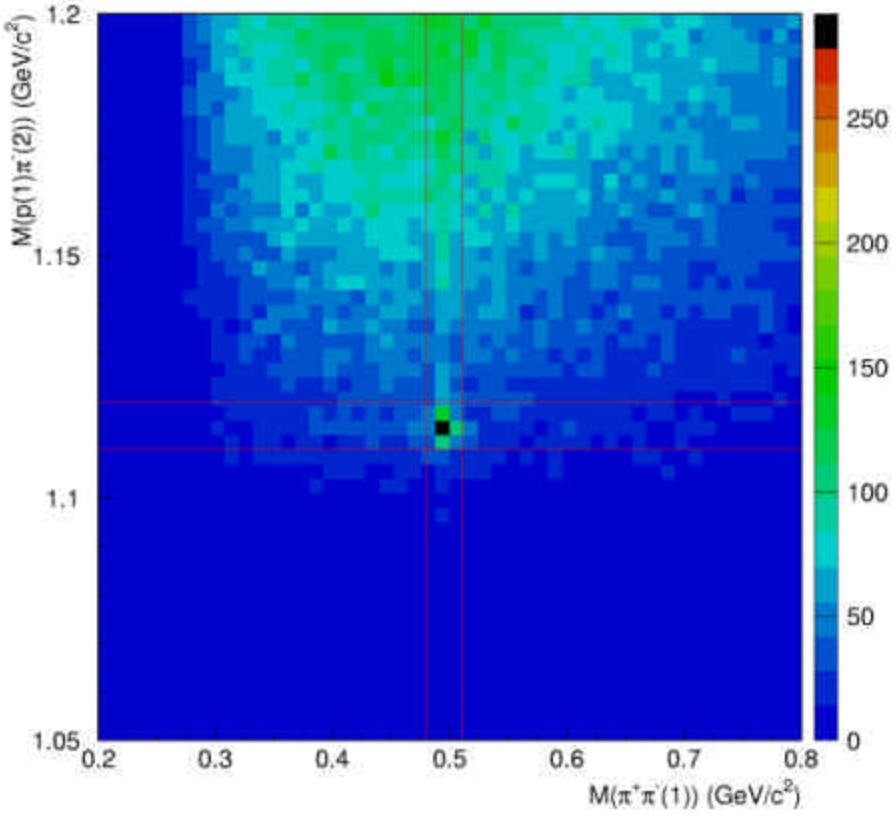


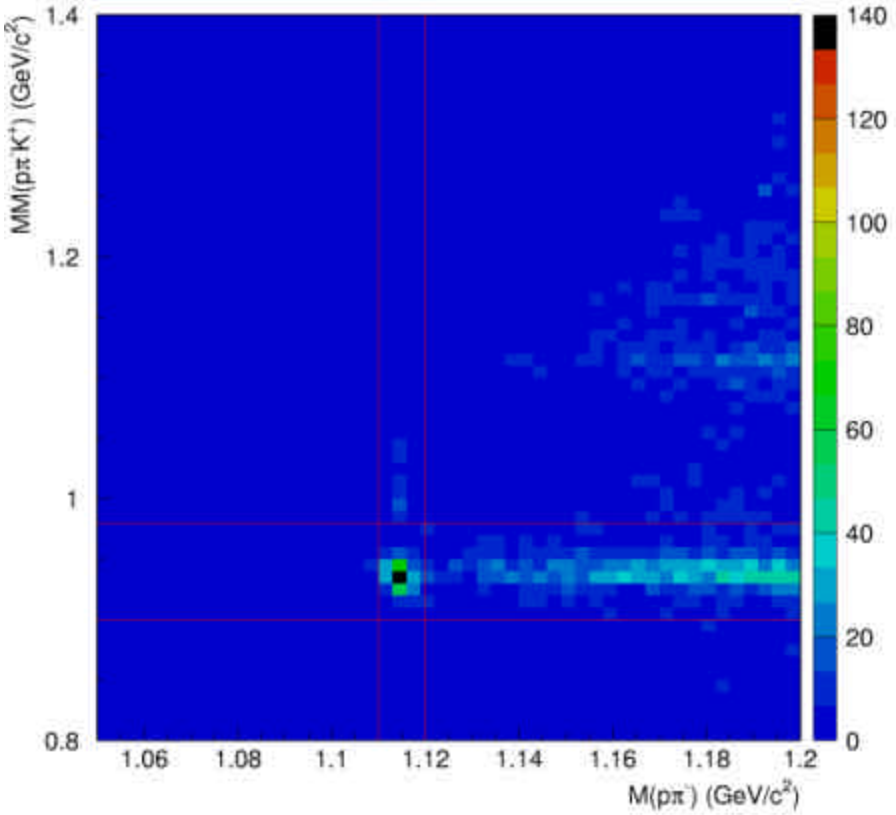
- Photon > 1.6 GeV
- Misid K-=pi-: mm > 1 GeV/c2
- 3 sigma cuts on Missing Proton Mass and K0s
- Pmiss < 150 MeV/c
- M(pK-) > 1.56 GeV/c2
- Vertex Cuts
- Timing Cuts

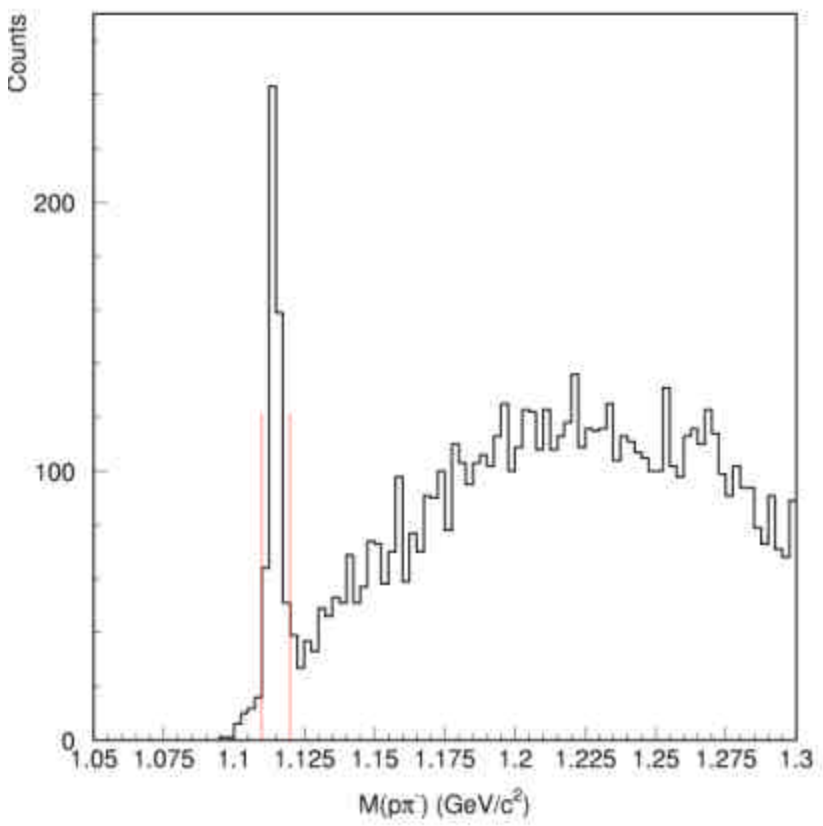
K0s - before and after 1C fit

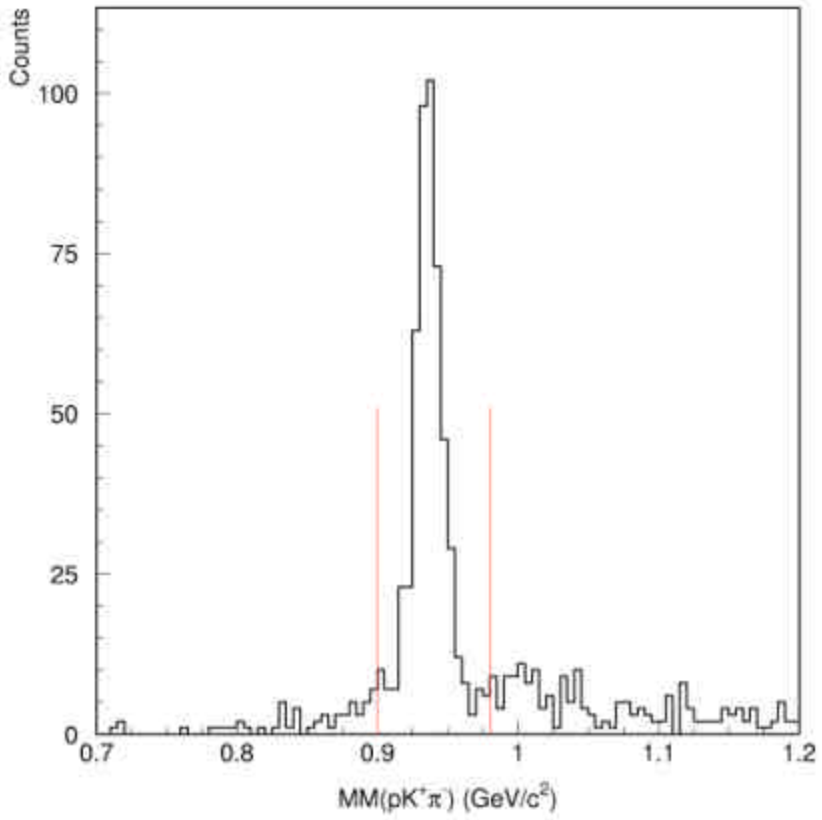


Silvia Niccolai - $\gamma d \rightarrow \Lambda K^+(n)$ and $\gamma d \rightarrow \Lambda K^0 p$ (both data set)



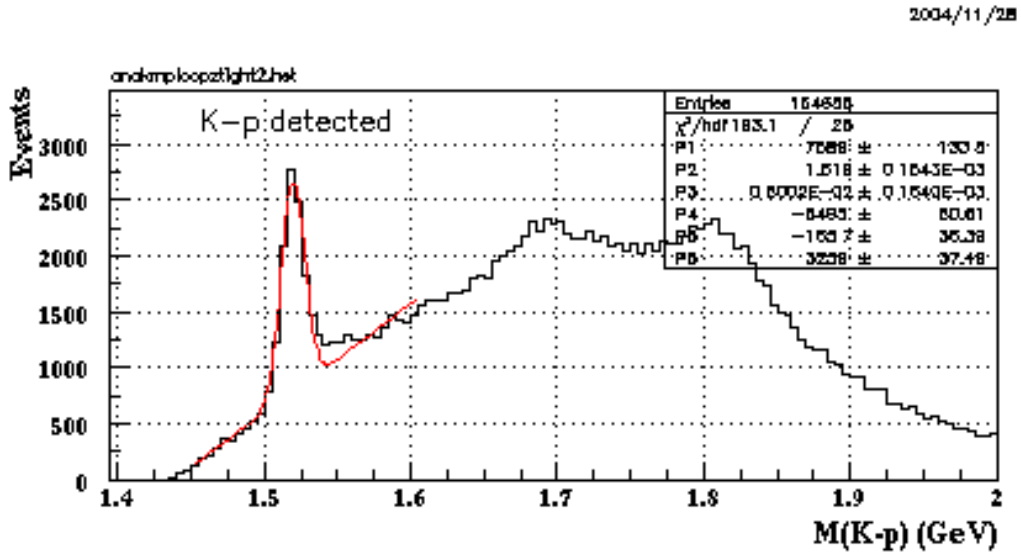




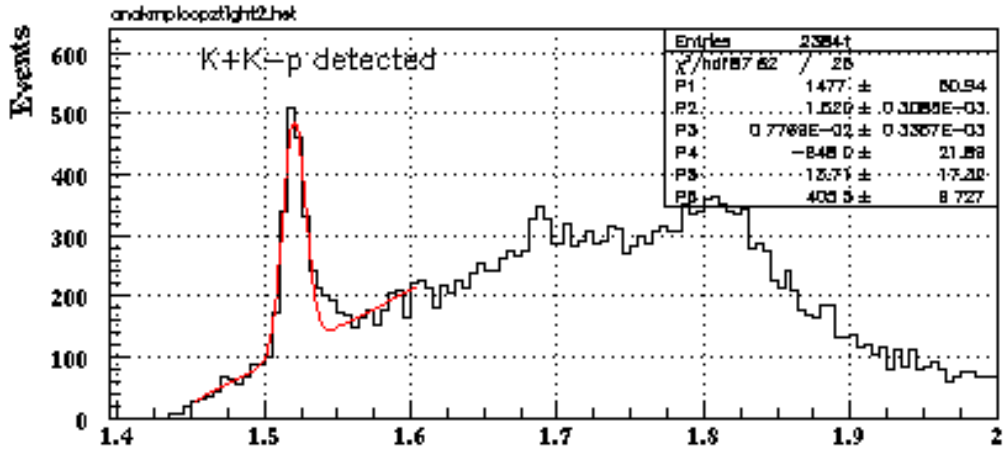


Projections of 2-D plots: Λ and neutron.

K-p invariant mass



N(Λ(1520))=7589+-133 events
S/N(M=1.5-1.54) = 1.21



N(Λ(1520))=1477+-51 events
S/N(M=1.5-1.54) = 1.68

In K-p analysis,
N(Λ(1520)) increases ~5 times
S/N decreases ~0.7

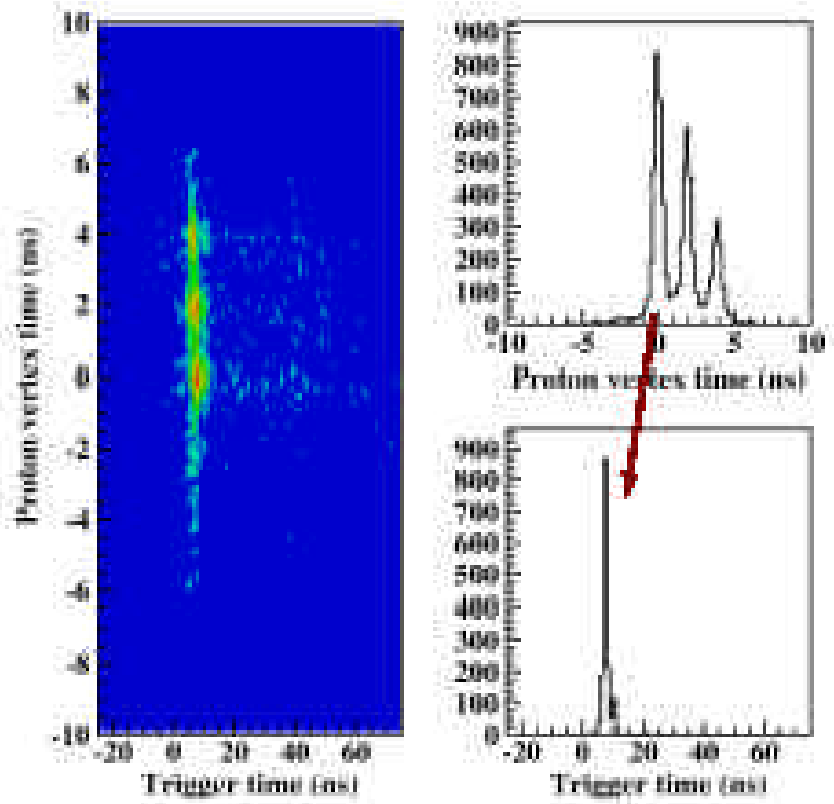
G2a and G10 comparison

$$\gamma d \rightarrow pK^{-}K^{+}(n)$$

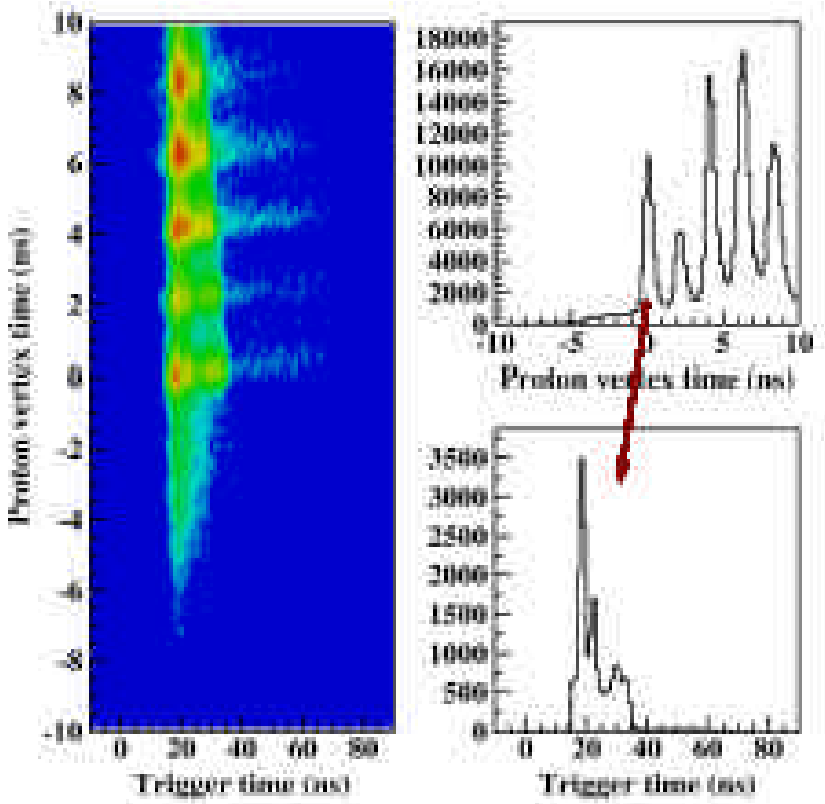
- G2a data set:
  - E_e = 2.478 GeV (2/3 of G2a)
  - E_γ < 2.35 GeV
  - Torus current 3375 A
  - Target at the center of CLAS
- G10 data set:
  - E_e = 3.775 GeV
  - E_γ < 2.35 GeV
  - Torus current 3375 A
  - Target at 25 cm upstream of CLAS center.

Trigger and Proton vertex time

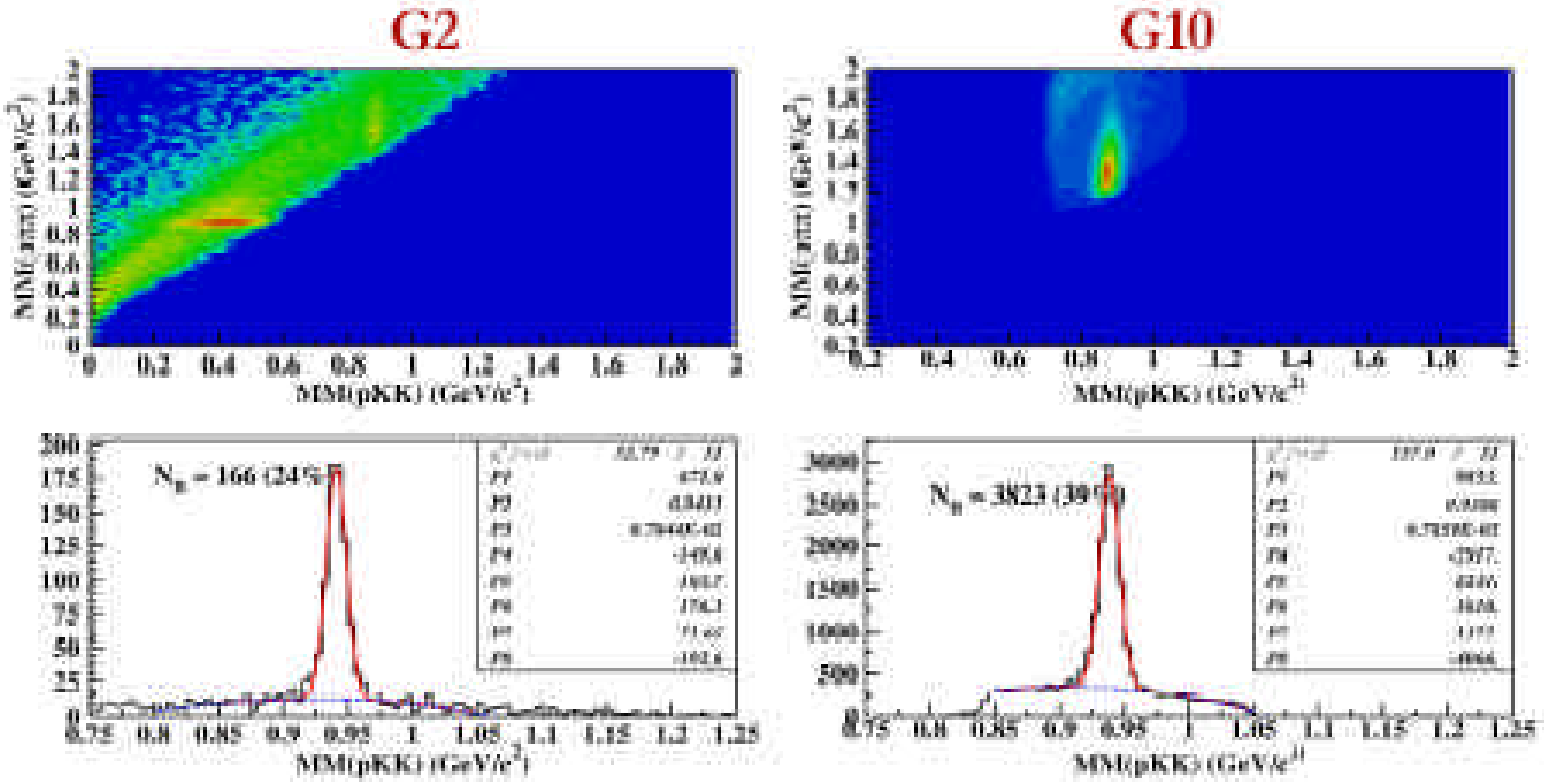
G2a



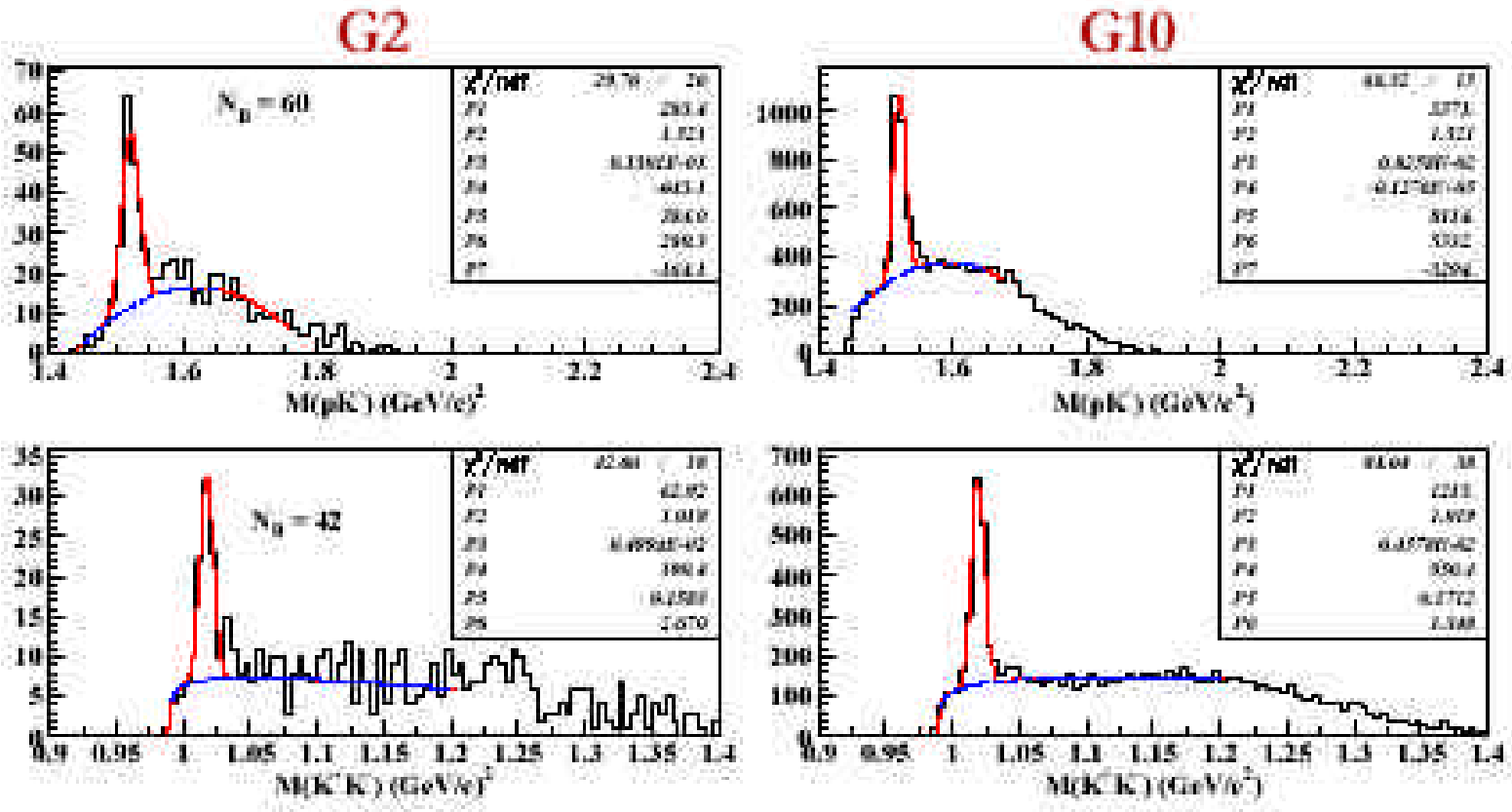
G10



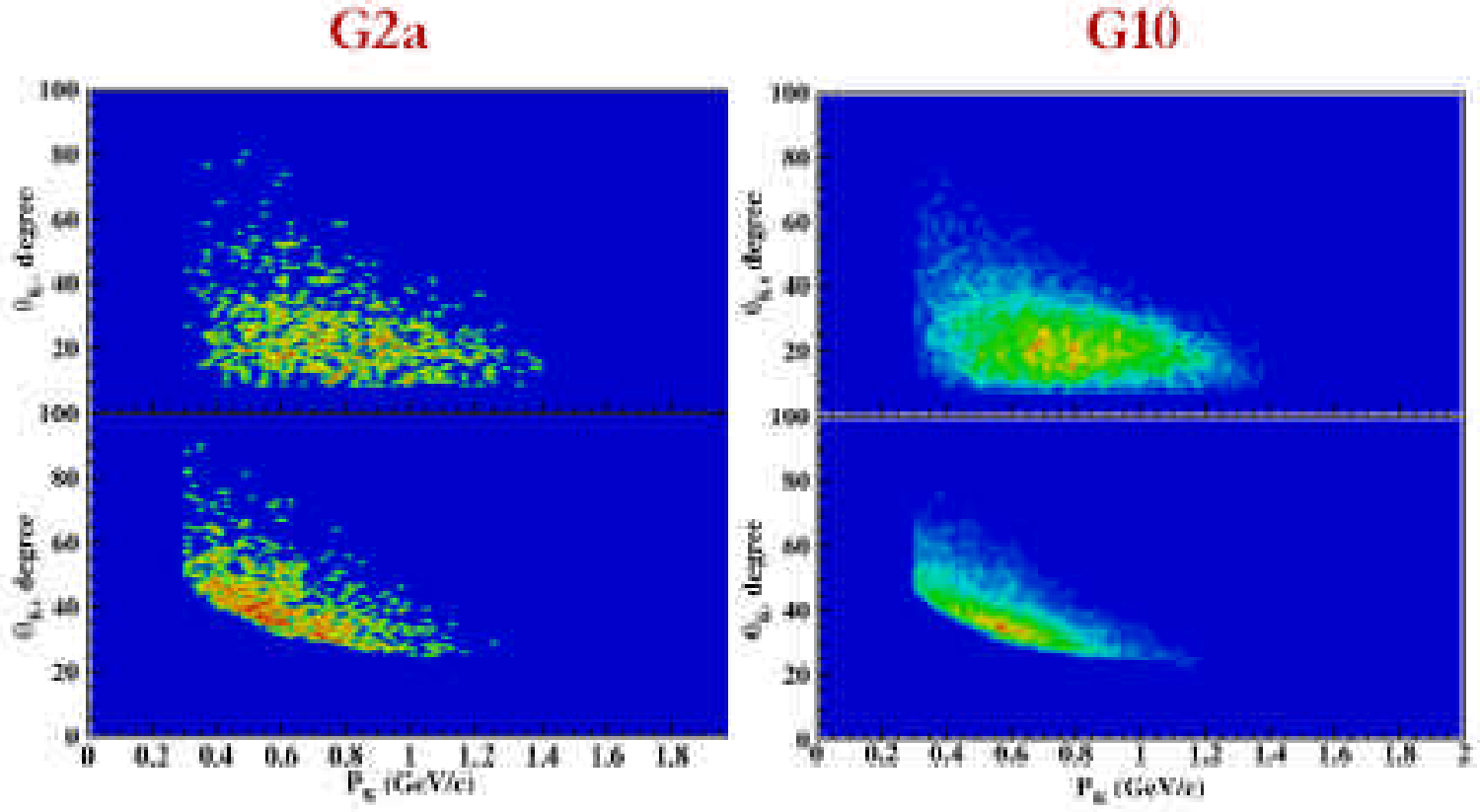
Missing neutron



$\Lambda(1520)$ and ϕ

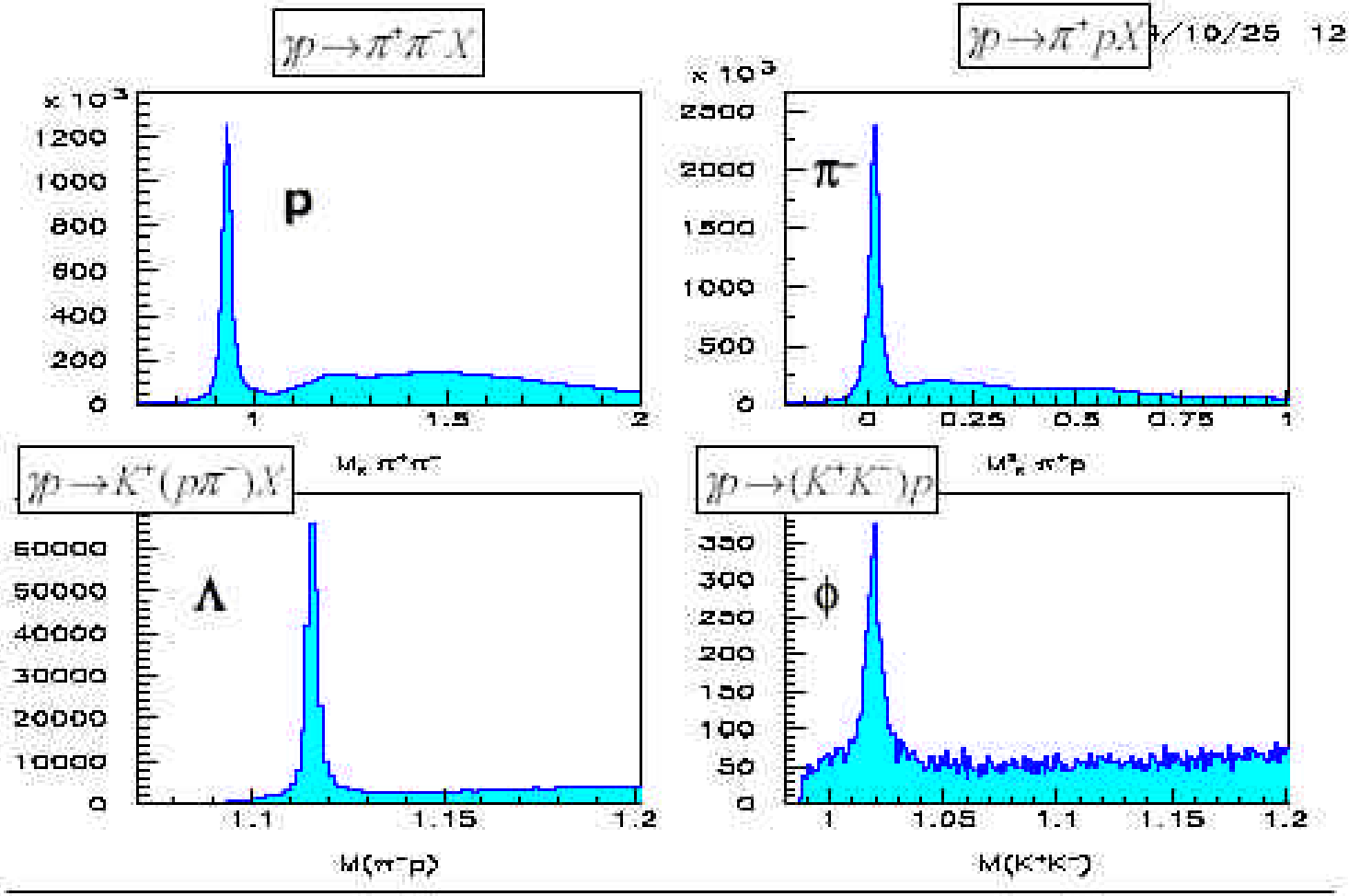


K^+ and K^-



G11 run (E-04-021): May 22 - July 26

- Photon beam energy range from 1.6 GeV to 3.8 GeV;
- Target – 40 cm long liquid hydrogen;
- Trigger – two charged particles in CLAS.
- Data are taken at 1930A of CLAS toroidal magnet.
- 10 times more integrated luminosity ($25 pb^{-1}$) than previous low energy photoproduction experiment on hydrogen.
- Total data volume - 20TB.


$\gamma p \to \pi^+\pi^- X$
$\gamma p \to \pi^+ p X$
3/10/25 12:18
p
π⁻
$\gamma p \to K^+(p\pi^-)X$
$M_{\pi^+\pi^-}$
Λ
$\gamma p \to (K^+K^-)p$
M_{π^+p}
ϕ
M(π⁻p)
M(K⁺K⁻)

6% of G11 data

Summary

- Calibrations took longer than expected
  - First full data set in mid-December 2005
- Blind analysis procedures set up
  - Additional systematic studies of cuts possible
- Many different reactions being analyzed
  - Want a coherent picture from all aspects
- Current data has very good quality
  - At same photon energy/acceptance: x10 stat.