Photoproduction of Λ(1405) and Σ(1385) at LEPS/SPring8 (II)

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FOR THE LEPS COLLABORATION

1. Physics Motivation
2. Experimental Setup
3. Data Analysis
4. Summary and Outlook

Physics Motivation

Λ(1405) : Meson-baryon resonance or 3-quark System ?

Λ(1405) with $J^P=1/2^-$, I=0, and S=-1

Σ(1385) with $J^P=3/2^+$, I=1, and S=-1

~20 MeV

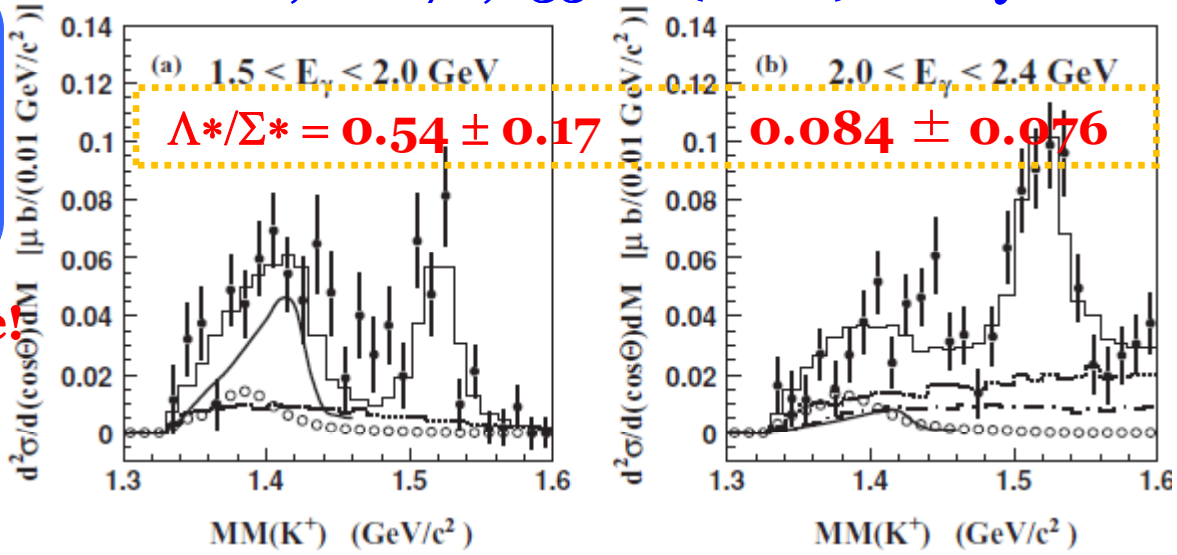
$\gamma p \rightarrow K^+ \Lambda(1405) \rightarrow K^+ \Sigma^+ \pi^-$

$K^+ \Sigma^- \pi^+$

$\gamma p \rightarrow K^+ \Sigma(1385) \rightarrow K^+ \Lambda \pi^0$

Strong Energy dependence!

LEPS data, PRC78,035202(2008)M.Niiyama



$\gamma p \rightarrow K^+ \Lambda(1405) / \Sigma(1385)$

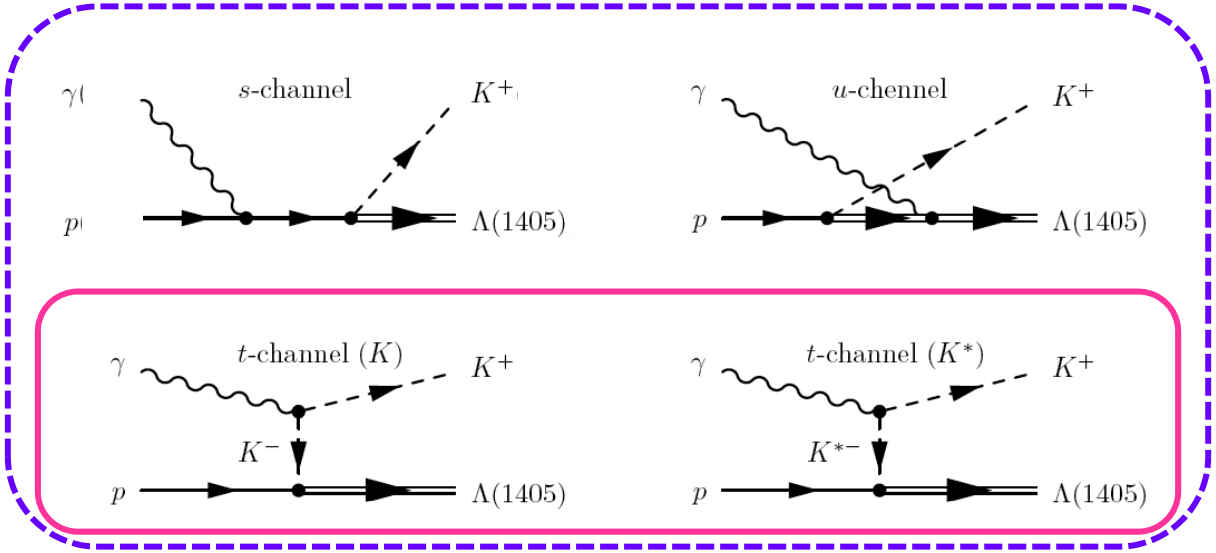
: Using missing mass of K+

High Statistics !

To understand the production Mechanism,

- Differential Cross section

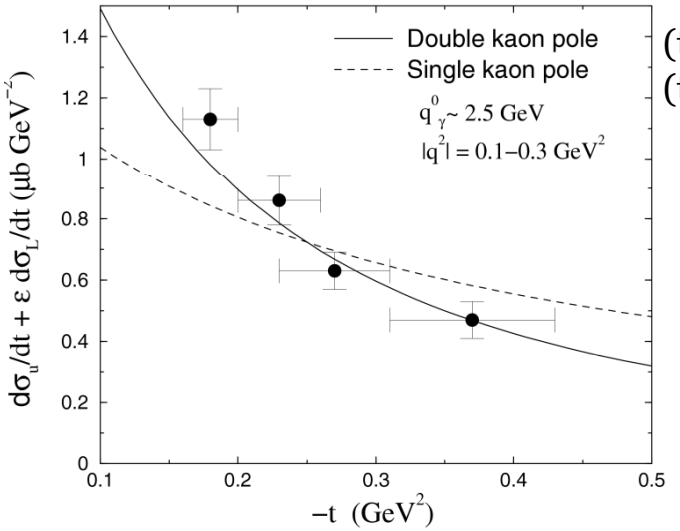
- Photon Beam Asymmetry



Photon Beam Asymmety for Λ(1405) @ S.I. Nam et al.
arXiv:0806.4029
;Strong contribution of electric coupling from the K- exchange

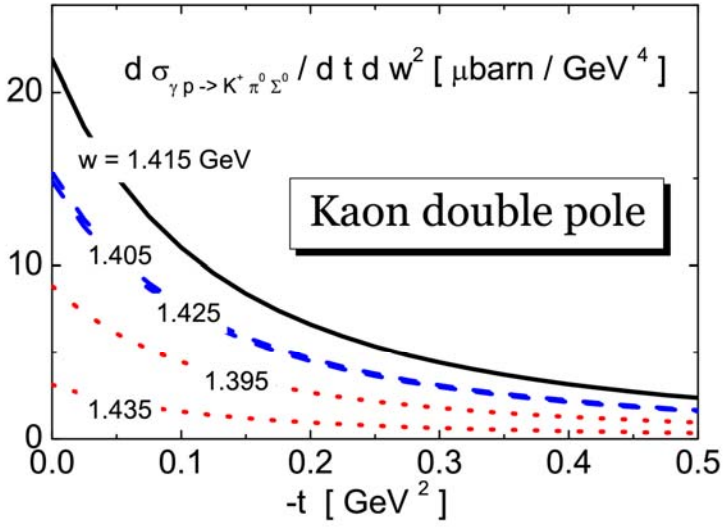
Data; T. Azemoon et al. NP B95 (1975)

γ_v p –> K^+ Σ(1385) or Λ(1405)



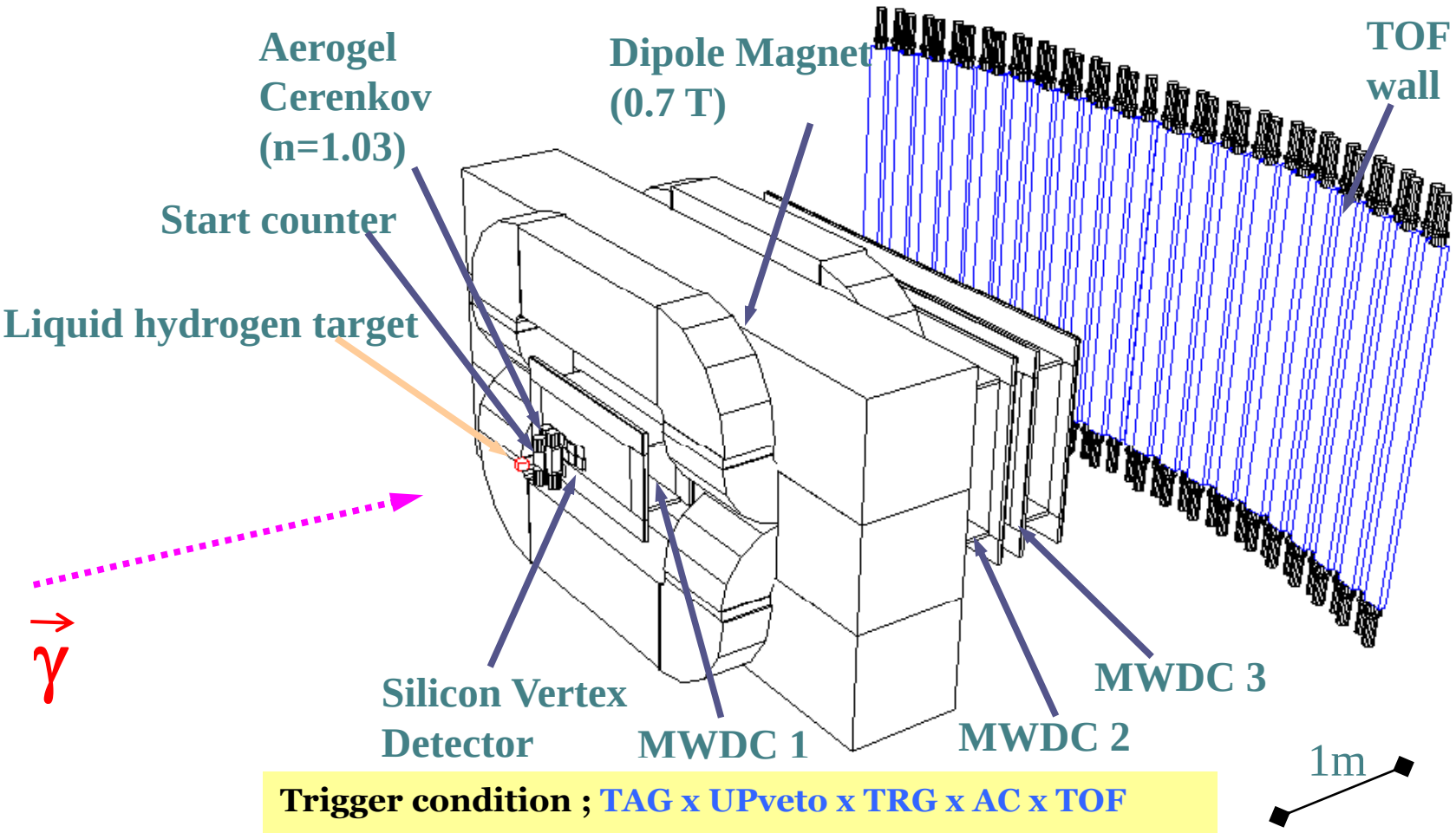
(t-m_K2)-2
(t-m_K2)-1

Nucl. Phys. A 748 (2005) 499
by M.F.M.Lutz & M.Soyeur **@ $E_\gamma \approx$ 2 GeV**



Rapid fall-off suggesting a t-channel exchange process

Experimental Setup ; LEPS Detector

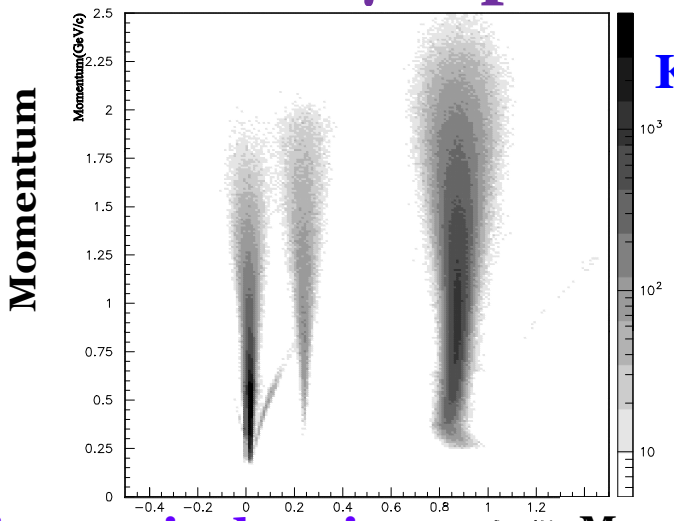


Trigger condition ; TAG x UPveto x TRG x AC x TOF
70 Hz for 800 kHz@Tagger

Charged particle spectrometer with forward acceptance
Particle Identification from momentum and Time of Flight measurement

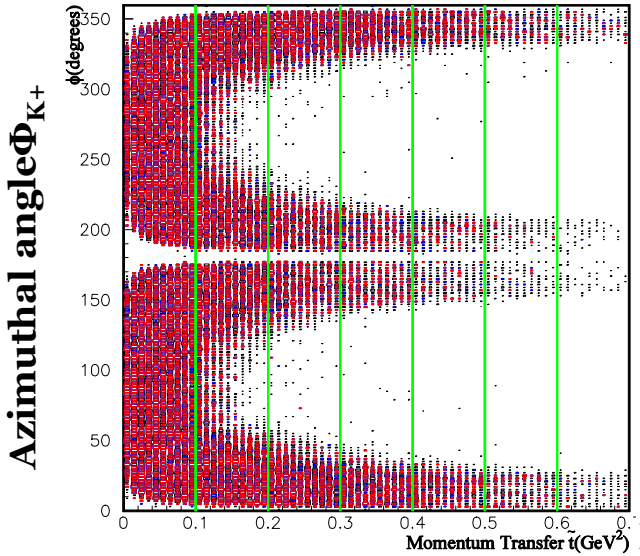
Data analysis

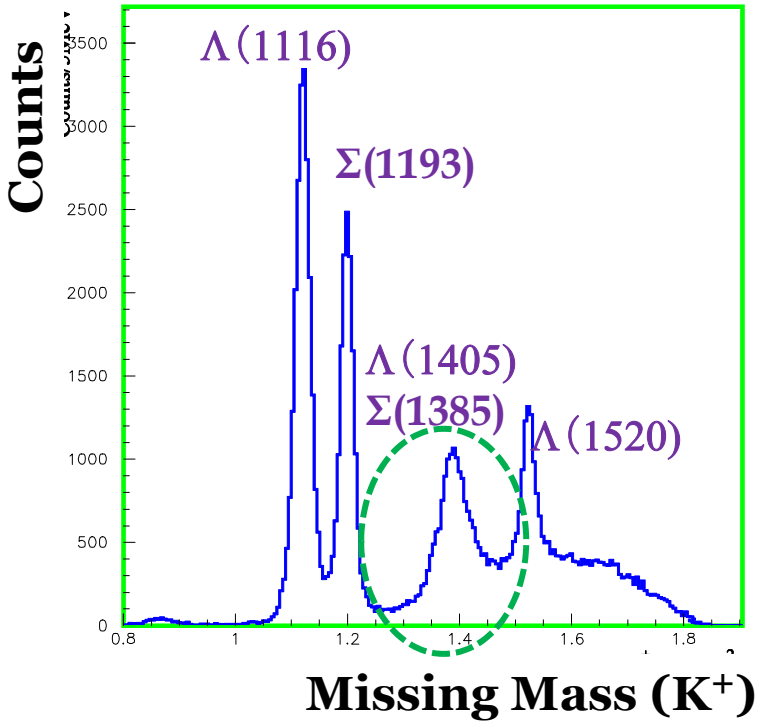
$$\gamma + p \longrightarrow K^+ + \Lambda(1405)/\Sigma(1385)$$



K+PID with 3σ

Kinematical region

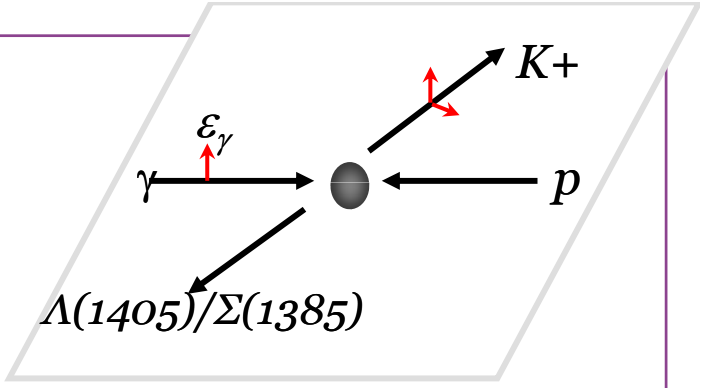


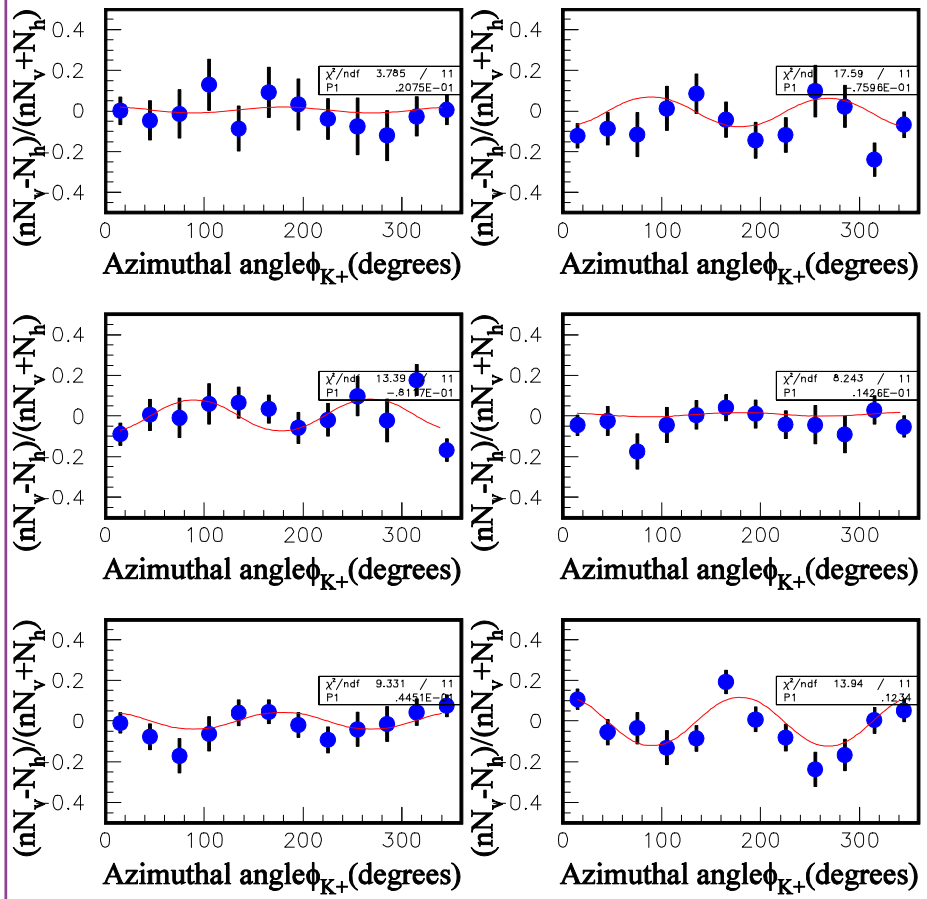


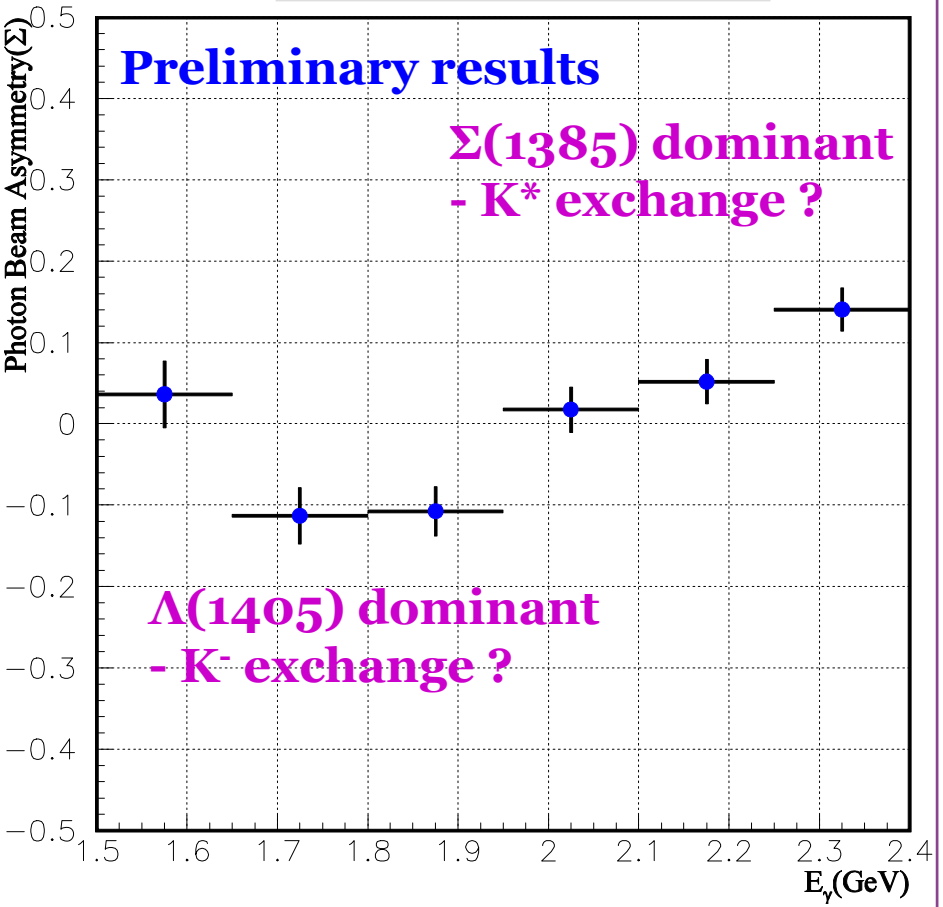
Photon Beam Asymmetry

$$\frac{{}^{n}N_{V} - N_{H}}{{}^{n}N_{V} + N_{H}} = P\Sigma\cos(2\phi_{K+}) \qquad (n = n_h / n_v)$$

Σ >o ; V>H
Σ <o ; V<H

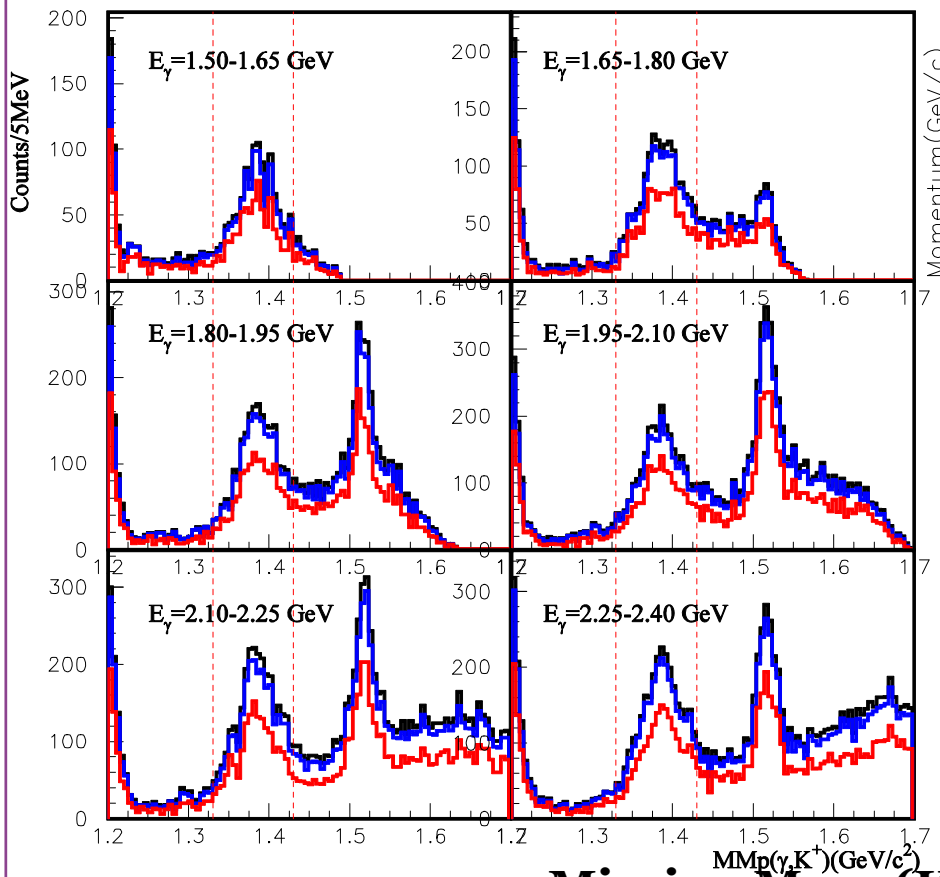




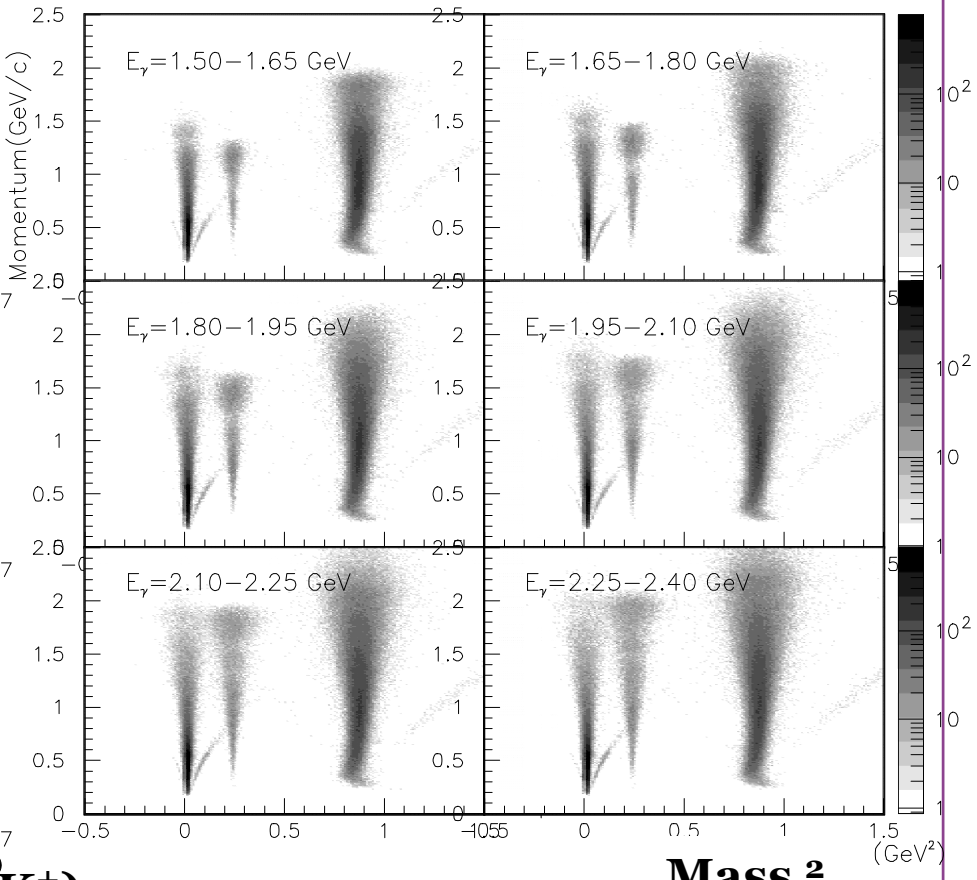


Particle Identification for Kaon – π+ contamination

K+ PID with 3σ
K+ PID with 2σ
K+PID with 1σ

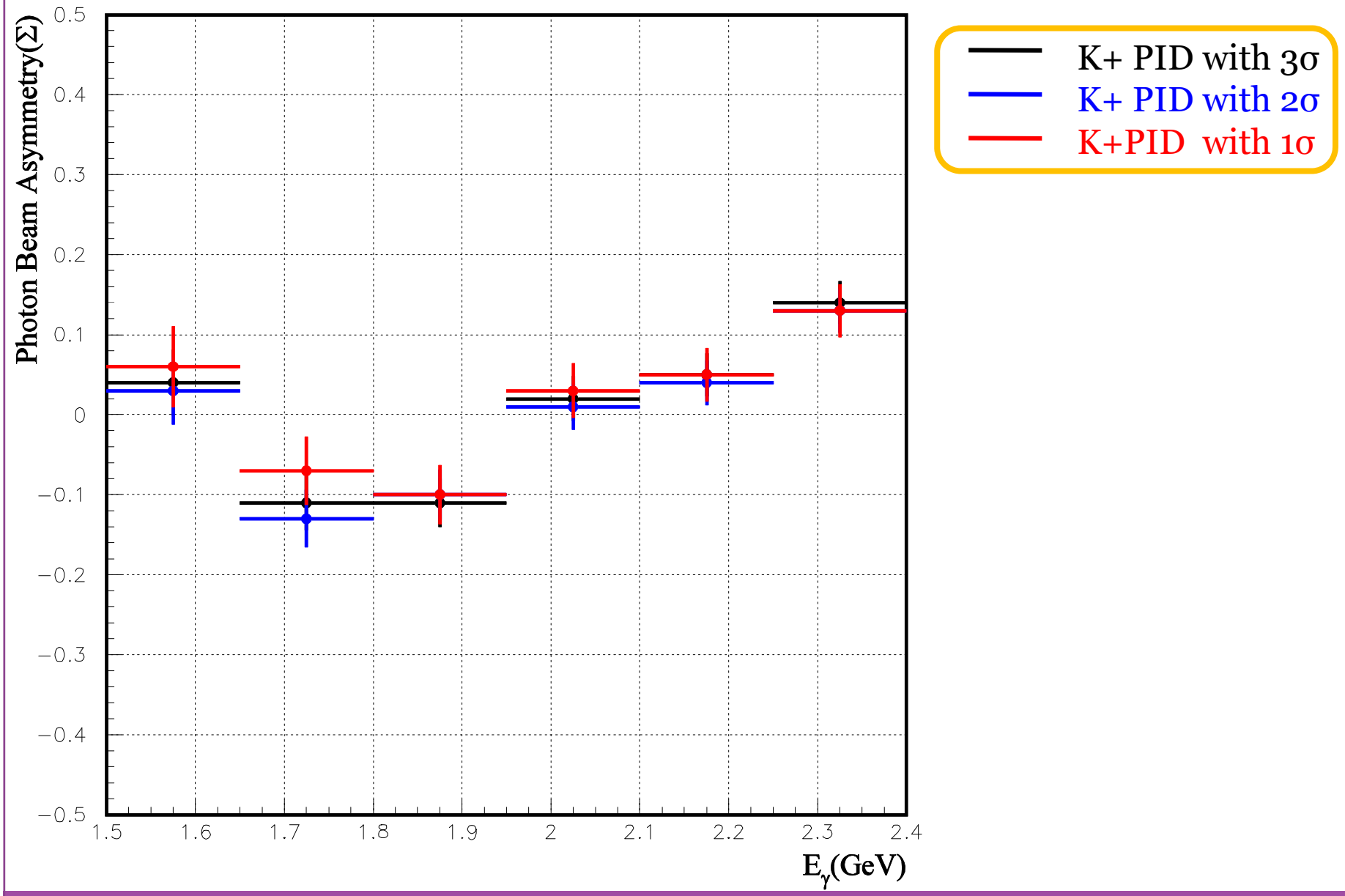


Missing Mass (K^+)

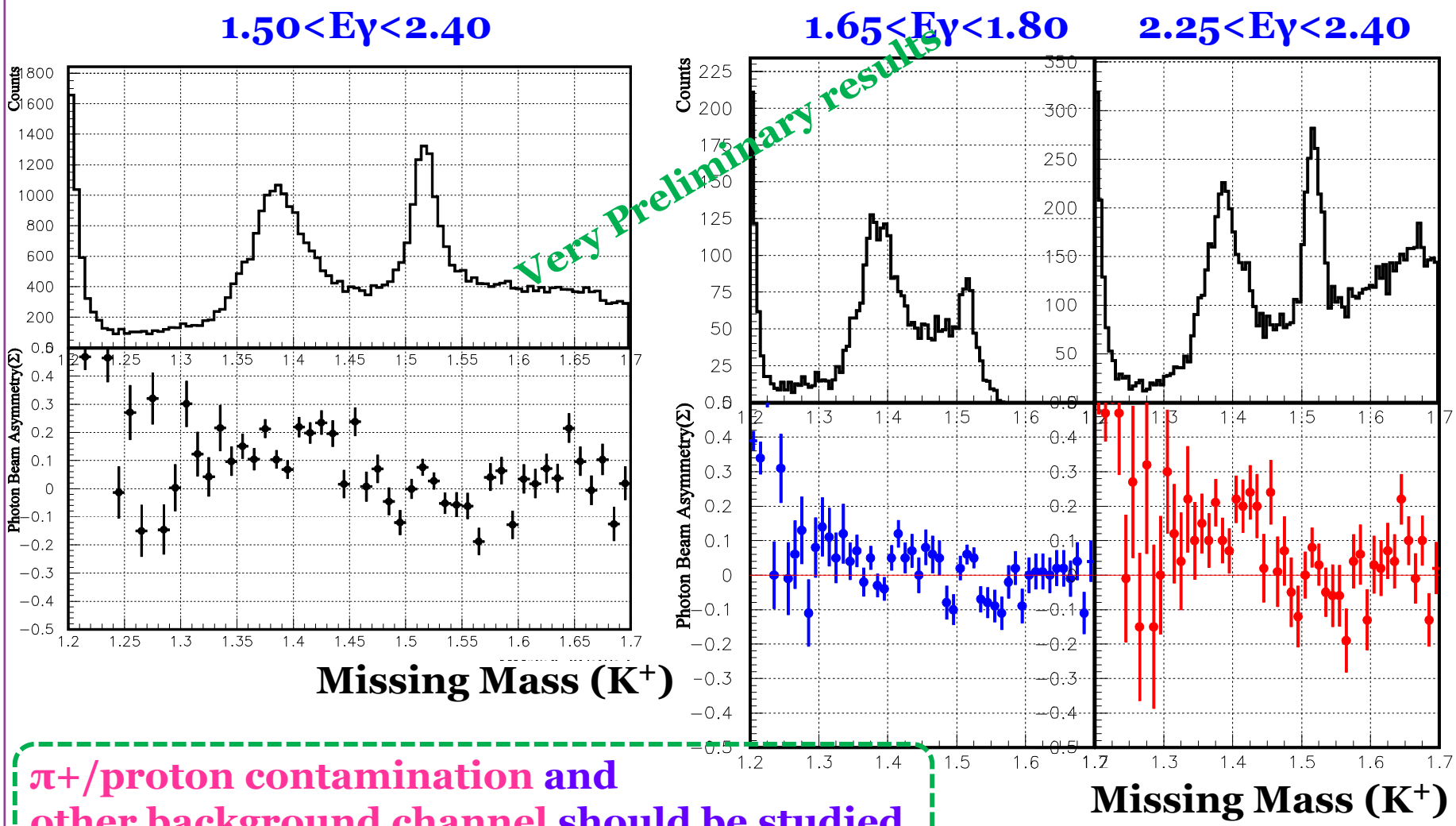


Mass ²

Photon Beam Asymmetry

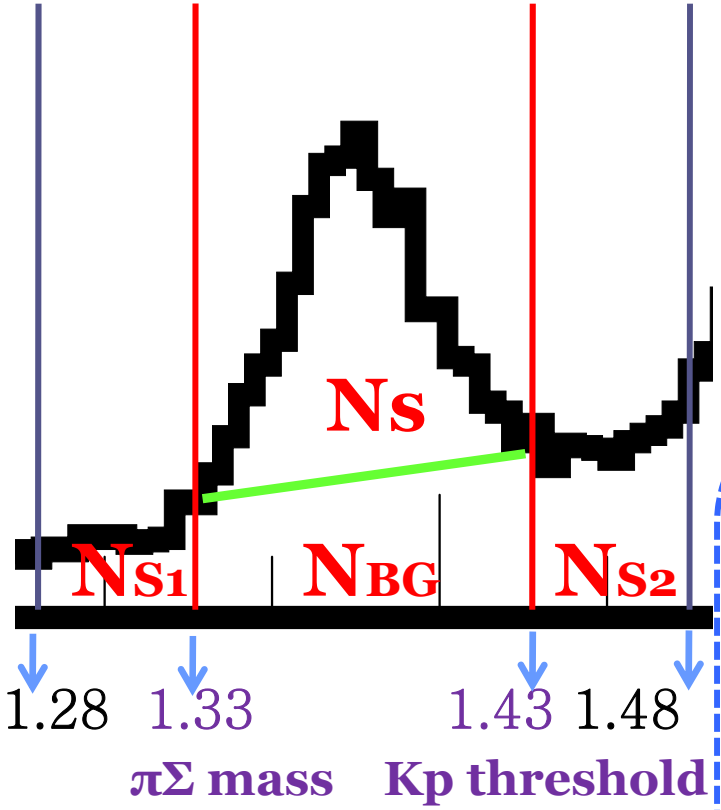


Photon Beam Asymmetry as a function of MissngMass



π+/proton contamination and other background channel should be studied.

Background



Ns+NBG : w/o sideband subtraction

Ns =(Ns+NBG)-(Ns1 +Ns2)
: w/ sideband subtraction

Production Channel

$$\gamma + p \longrightarrow K^+ + \Lambda(1405)/\Sigma(1385)$$

Possible Background Channels

$$\gamma + p \to K^+ + \Lambda + \pi$$
$$\gamma + p \to K^+ + \Sigma + \pi$$
$$\gamma + p \to \phi + p \to K^+ + K^- + p$$
$$\gamma + p \to K^* + \Lambda$$
$$\gamma + p \to K^* + \Sigma$$

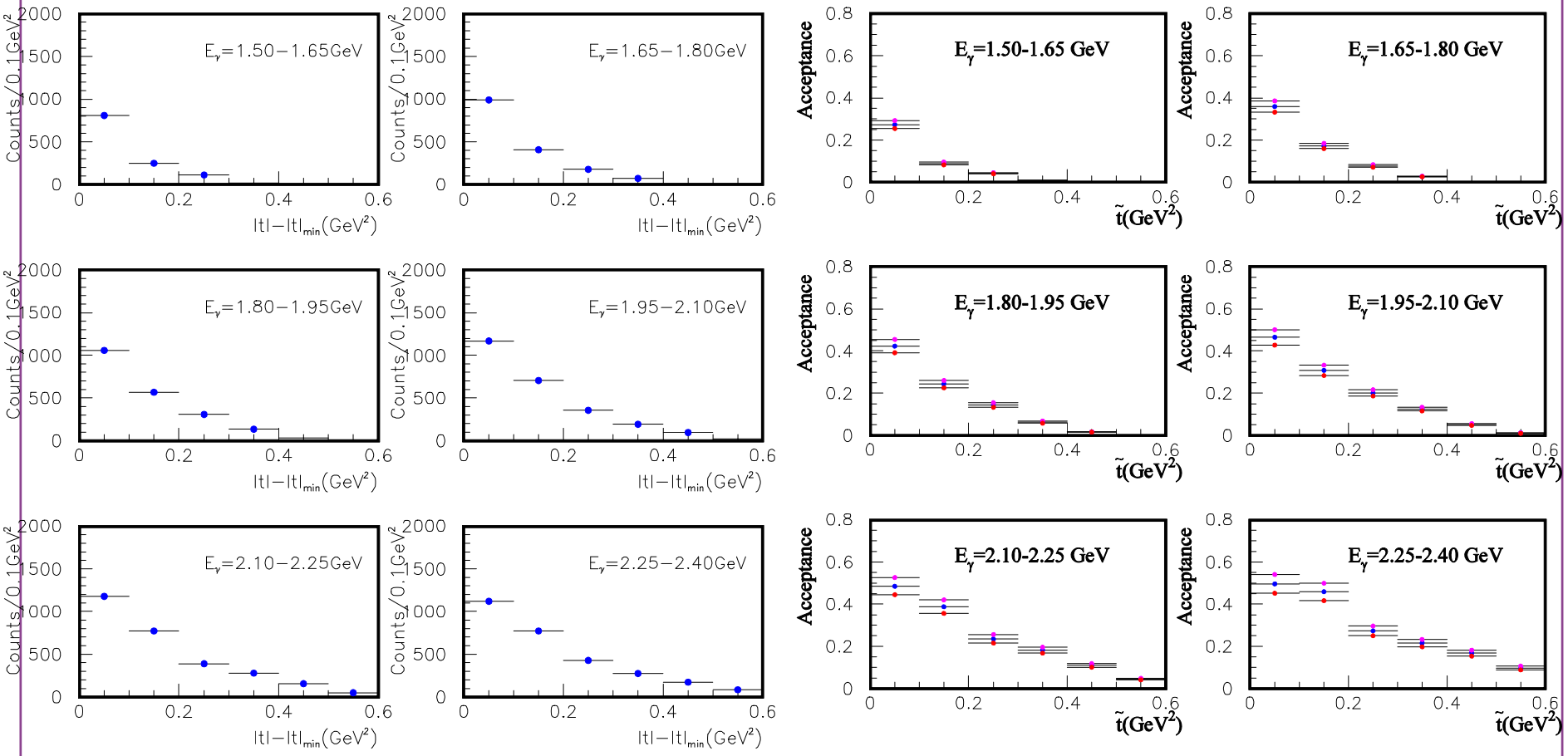
.....

Yields and Acceptance for Λ(1405)/Σ(1385)

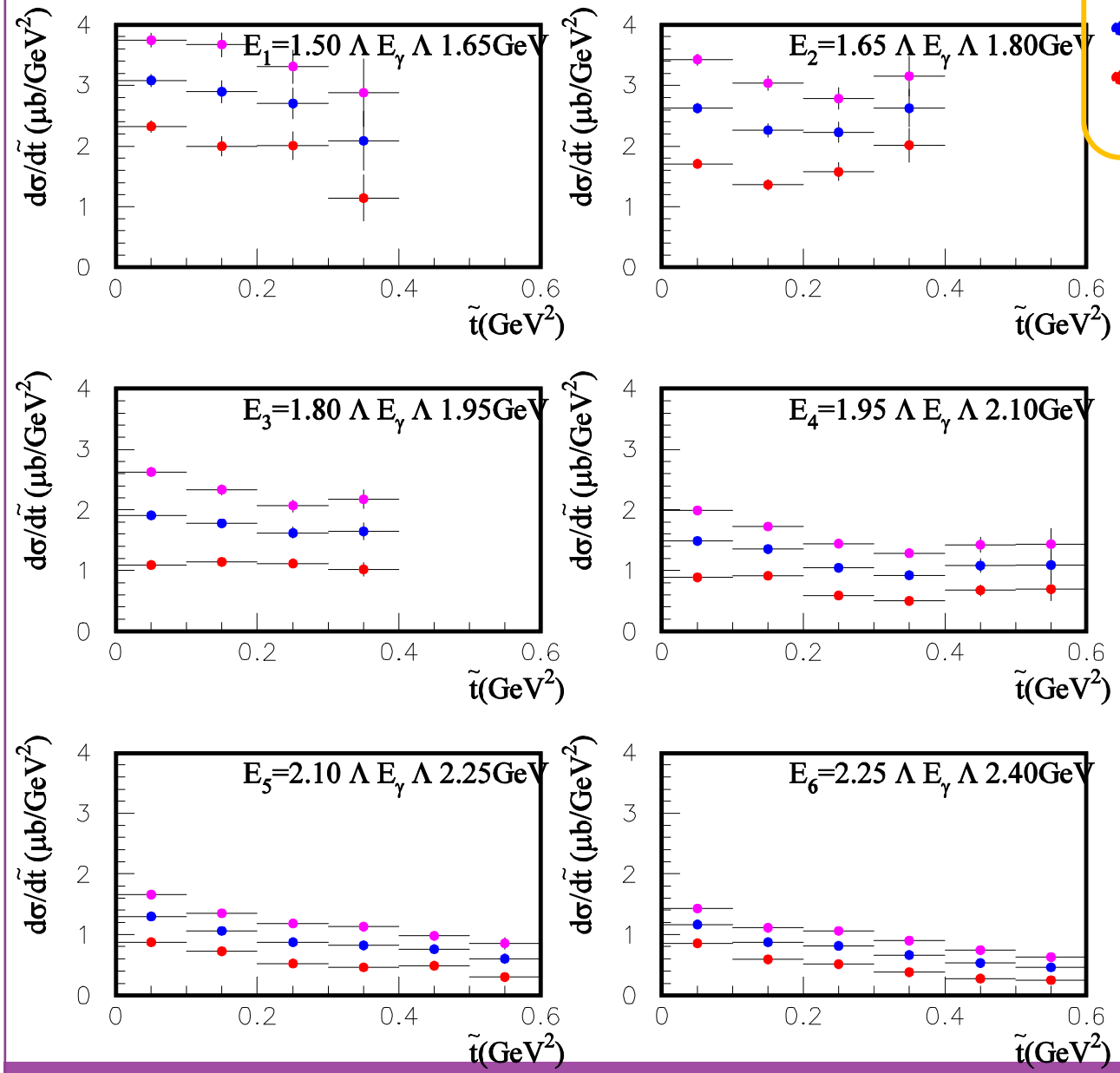
- *1.28<MM(K+)<1.48*
- *1.33<MM(K+)<1.43*
- *1.33<MM(K+)<1.43 with sideband subtraction*

Yields

Acceptance



Differential Cross Section dσ/dt



- *1.28<MM(K+)<1.48*
- *1.33<MM(K+)<1.43*
- *1.33<MM(K+)<1.43 with sideband subtraction*

Preliminary results

Summary and Outlook

- To understand production mechanism, we measured the Differential Cross Section and Photon Beam Asymmetry for $\gamma p \rightarrow K^{+}\Lambda(1405)/\Sigma(1385)$ on the Liquid Hydrogen target at $E\gamma$=1.5-2.4GeV using linearly polarized photon beam. (@ Forward region)
- The photon beam asymmetry increases above $E\gamma$~1.7GeV and the sign of photon beam asymmetry was changed $E\gamma$~2.0GeV.
- We expected production mechanism for $\Lambda(1405)/\Sigma(1385)$ is different. (K- exchange @low $E\gamma$ and K* exchange @high $E\gamma$)
- From the t-distribution,
  we can extract t-dependence is flat@low $E\gamma$ and steep@high $E\gamma$
- The Background study will be done for the $\Lambda(1405)/\Sigma(1385)$.