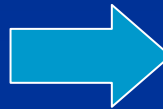


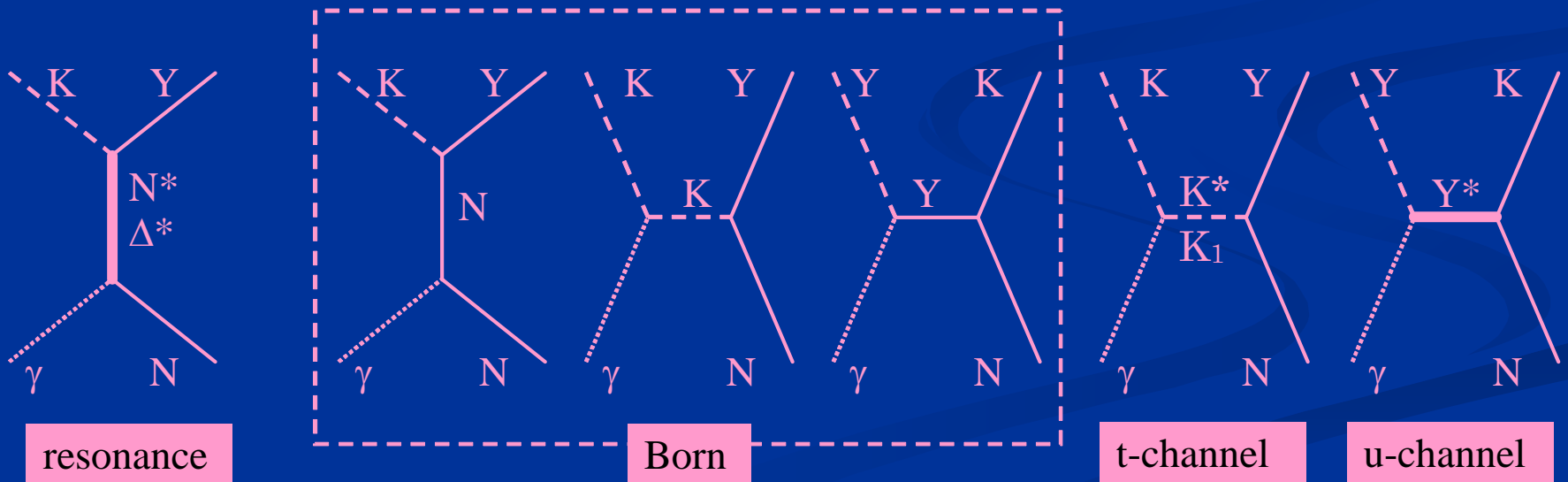
# Subject of Experiment

- Q018: Measurement of  $K^0$  Photoproduction to Investigate Reaction Mechanism at Small  $-t$  Region
  - Study the  $p(\gamma, K^0)\Sigma^+$  reaction
  - Systematic study on the  $N(\gamma, K)Y$  reaction mechanism: One necessary step
  - Measurement of differential cross section ( $d\sigma/d\Omega$ ) and photon beam asymmetry ( $\Sigma$ ) at forward angles

## ■ Study of baryon resonance

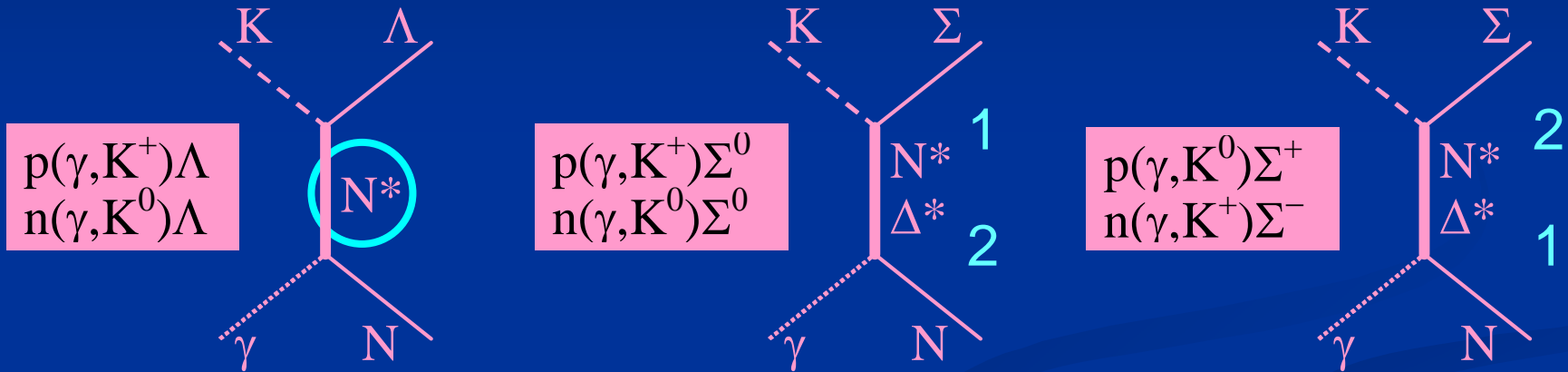
- Knowledge of baryon spectrum is important to understand **quark** interactions in **non-perturbative** energy region
- Baryon spectrum is studied mainly by  $N(\pi,\pi)$  and  $N(\gamma,\pi)$  reactions
  - Less observed baryon resonances than predicted resonances (**Missing Resonances**)
- Theoretical prediction: Missing resonances may decay dominantly to  **$K\Lambda$**  and  **$K\Sigma$**  channels
  - Missing resonance hunting by the  $N(\gamma,K)Y$  reactions

- Systematic studies are necessary for  $(\gamma, K)$ 
    - Several diagrams contribute (no dominant channel)
      - Resonance term
      - $g_{NKY}$  coupling
      - Baryon form-factor
- }  More Reaction Channels  
More Observables

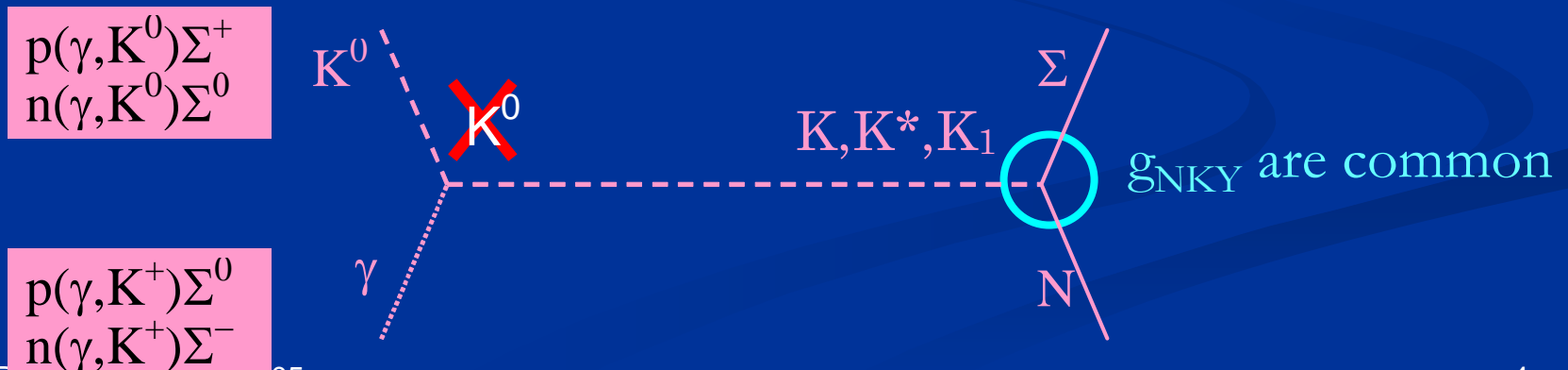


- Information from all KY channels is powerful

- Resonance term



- t-channel contribution



# ■ Status of experiments

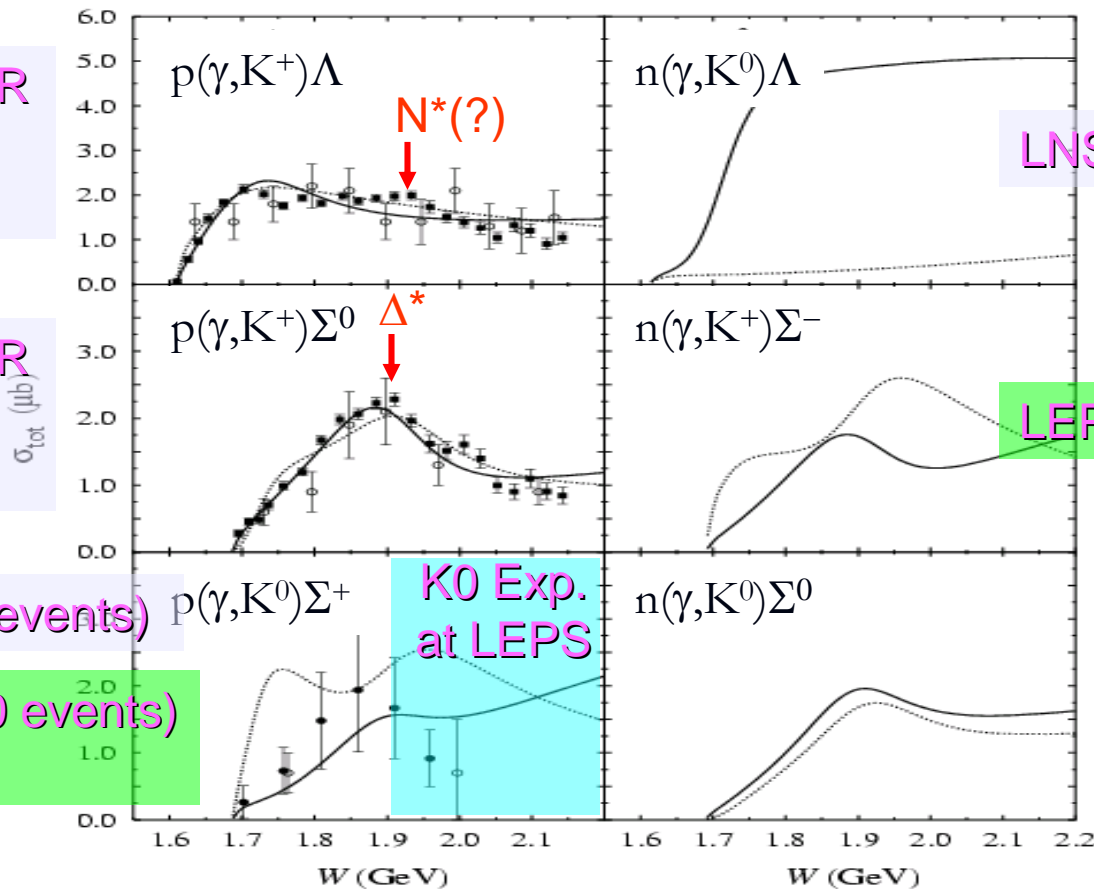
- Contributions from LEPS, SAPHIR, CLAS, ...

SAPHIR  
CLAS  
LEPS

SAPHIR  
CLAS  
LEPS

SAPHIR (405 events)

SAPHIR (3310 events)  
CLAS



LNS / Tohoku

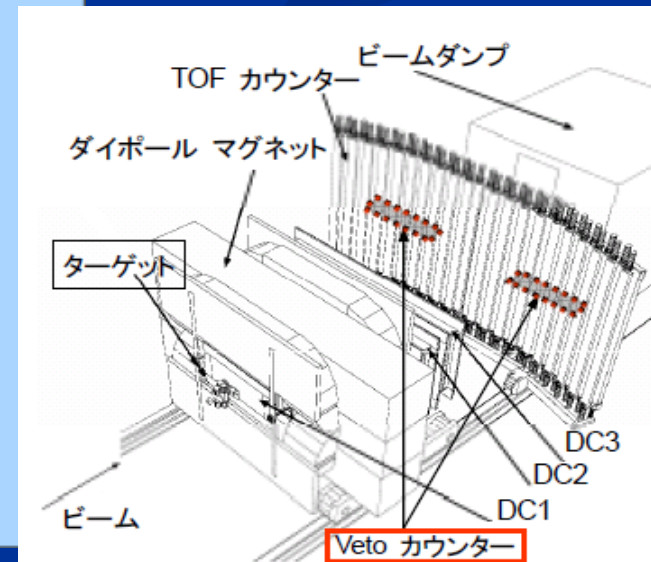
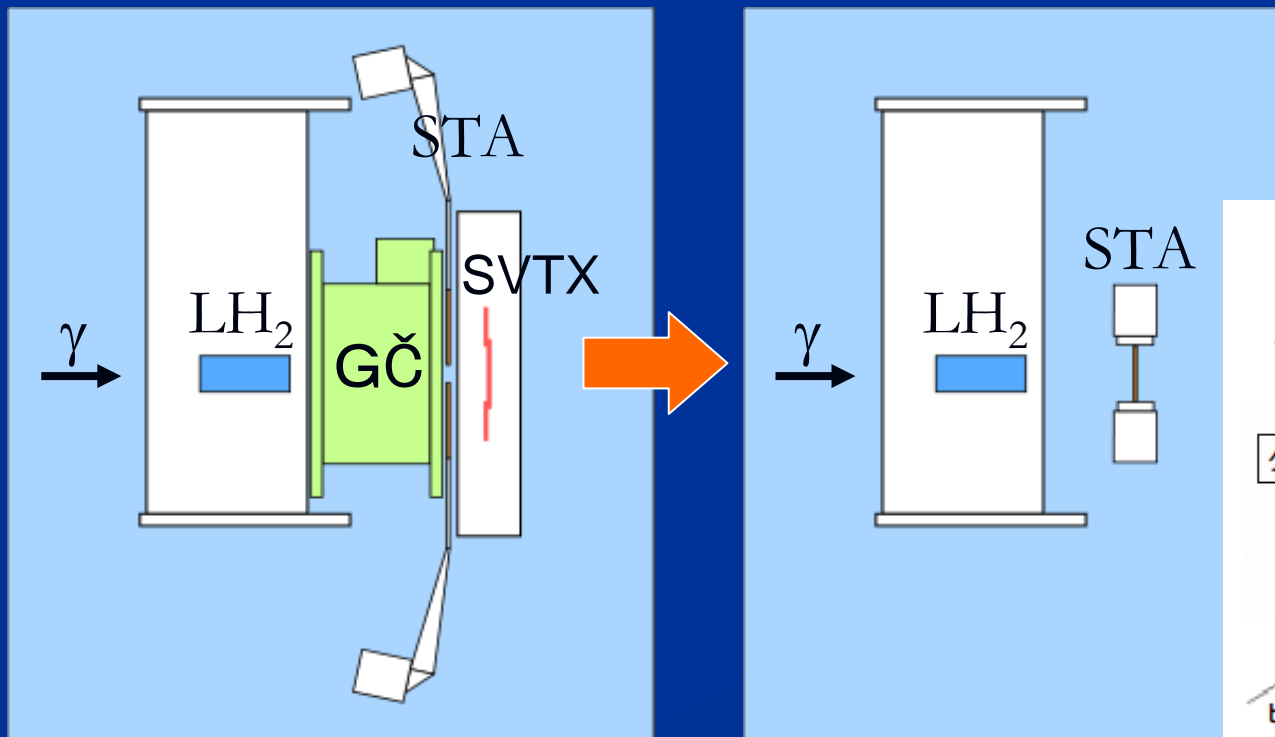
LEPS

# Experiment at LEPs

- Measurement of  $p(\gamma, K^0)\Sigma^+$  reaction
  - LH<sub>2</sub> target, LEPs photon beam and K<sup>0</sup> detection
    - 15 cm LH<sub>2</sub> target available
    - Tagged photon:  $E_\gamma = 1.5 - 2.4$  GeV
    - $0.7 < \cos\Theta_{CM} < 1.0$  (forward angle)
  - $K^0 \rightarrow K_S (\beta\gamma c\tau \sim 10\text{cm}) \rightarrow \pi^+\pi^-$  (LEPS Spectrometer)
  - Pion detection needs modification of setup
    - Aerogel Cerenkov  $e^+e^-$  veto:  $n=1.03$ ,  $\beta_C=0.97$
    - LEPs trigger rejects pions ( $p_\pi > 0.6\text{GeV}/c$ )
    - Average pion momentum from  $K_S$  decay:  $0.9\text{GeV}/c$

## ■ Modification of trigger detectors

- **Gas Cerenkov** detector:  $n=1.0014$ ,  $p_{\pi} < 2.6 \text{ GeV}/c$ 
  - Work very well, but too small acceptance
- Setup **without veto**: No momentum threshold



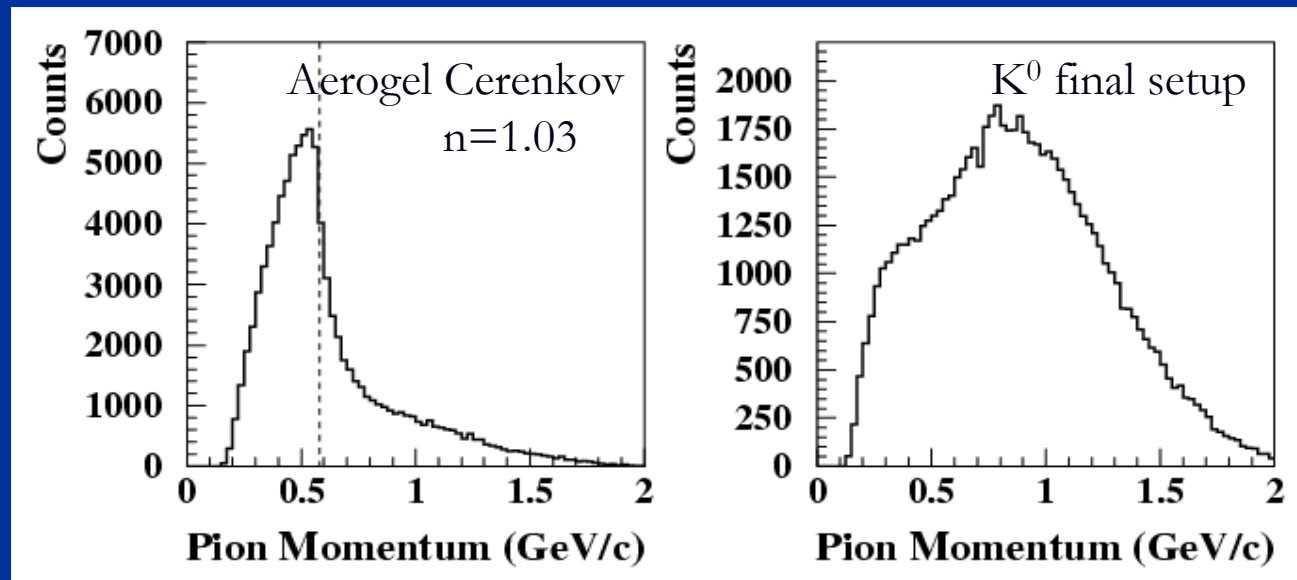
- Beamtime in Feb/Mar 2004
  - 16 days with final setup
  - Tagger rate = 600k – 900k s<sup>-1</sup>,  $N_{\text{Tagger}} = 8.2 \times 10^{11}$ ,  
 $N_{\text{Photon}} = 4.3 \times 10^{11}$  photons on target
  - Trigger rate  $\sim 300$  s<sup>-1</sup> (DAQ dead time < 10%),  
Total runs  $\sim 350$  runs, Total events = 360M triggers
- Data analysis
  - Standard LEPS analysis code + K<sup>0</sup> modification
    - No SVTX (silicon tracker)
    - Not final version, yet



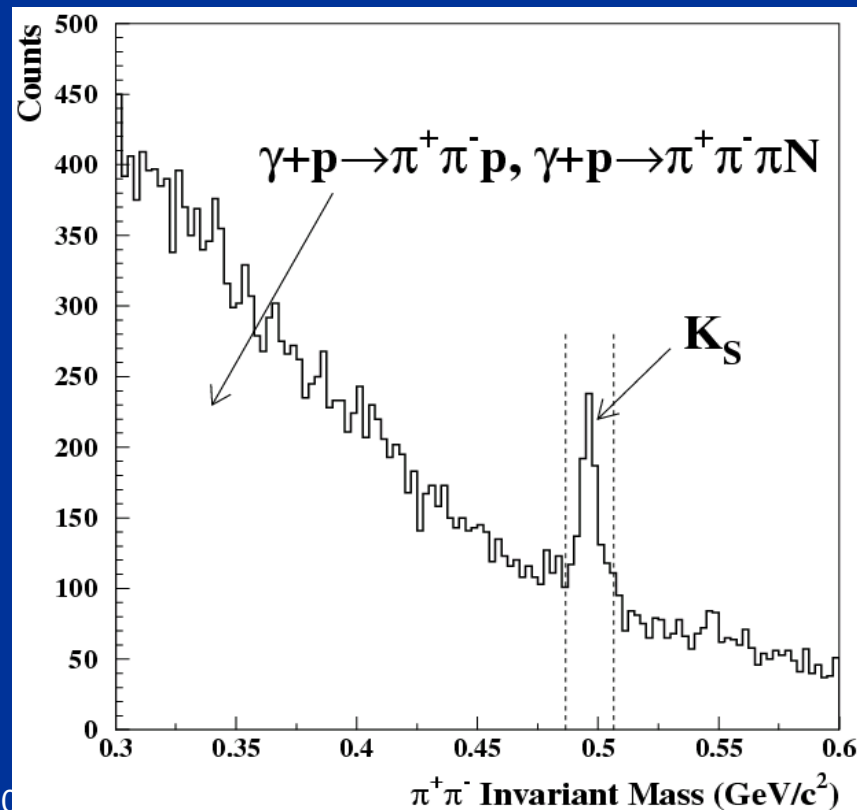
## ■ Pion detection

### ■ ‘No momentum threshold’ is confirmed

- Original LEPS setup: pion threshold at  $0.6\text{GeV}/c$
- No threshold in  $K^0$  setup

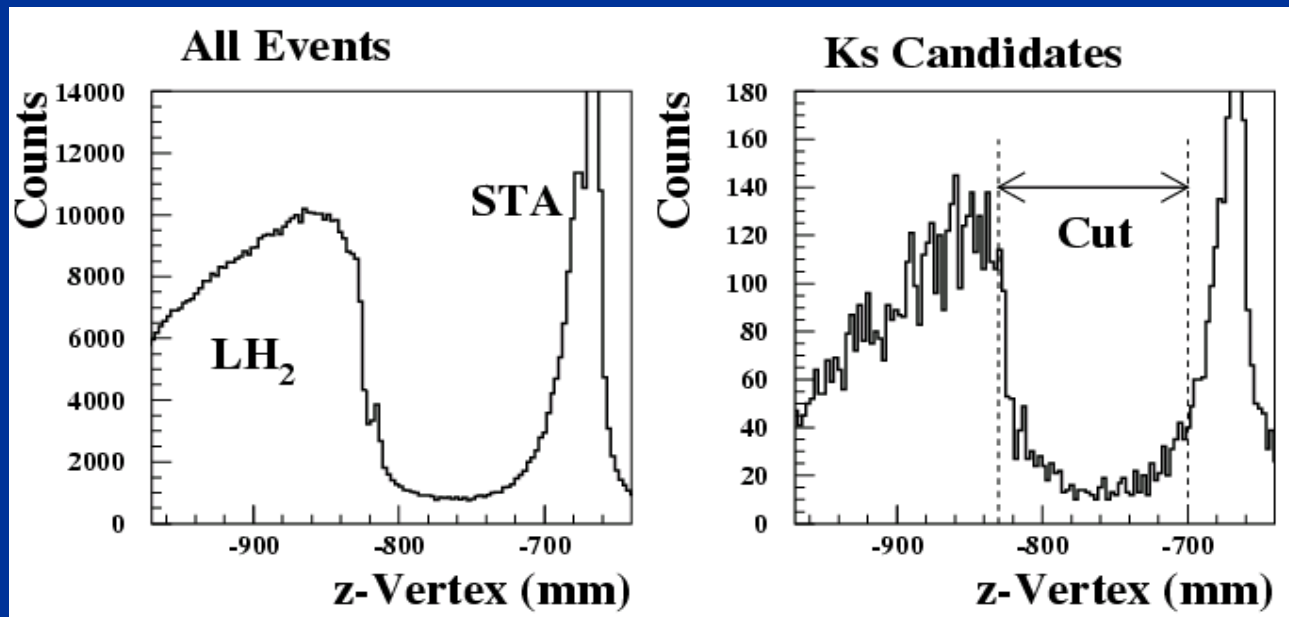


- Invariant mass analysis ( $\pi^+\pi^-\rightarrow K_S$ )
  - 2 pion background (S/N is poor)
  - Situation quite different from  $K^+K^-\rightarrow\phi$  and  $\pi^-p\rightarrow\Lambda$

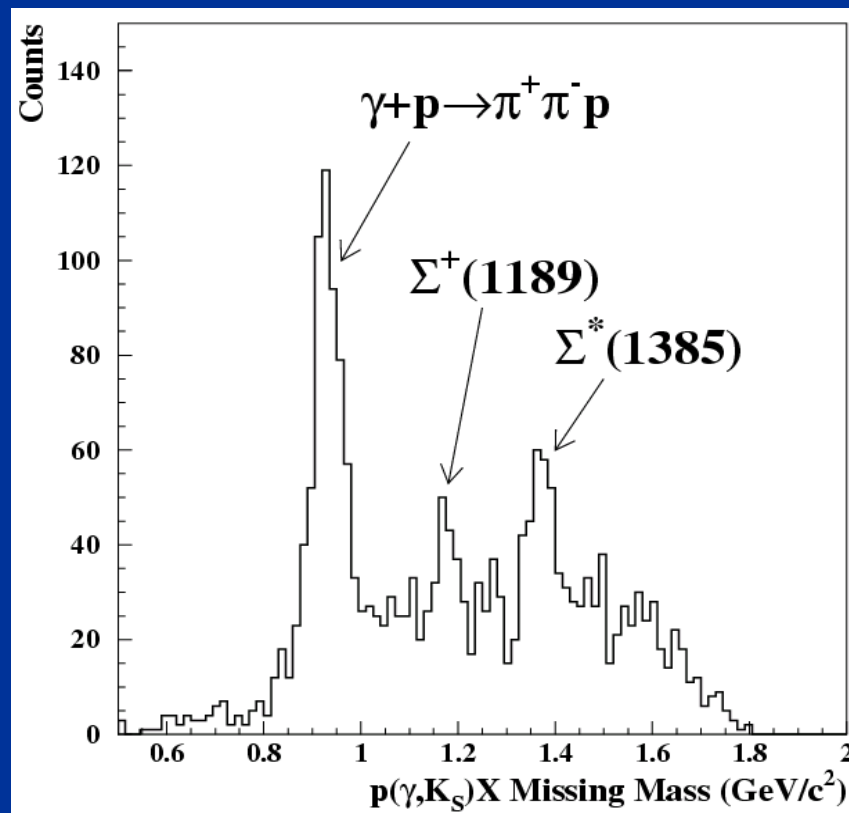


Study on analysis cuts is in progress

- Vertex distribution for  $\pi^+\pi^-$  pairs
  - Free space from LH<sub>2</sub> to STA (15 cm)
  - **Vertex cut** is necessary to improve S/N
    - Improvement of vertex resolution may be possible



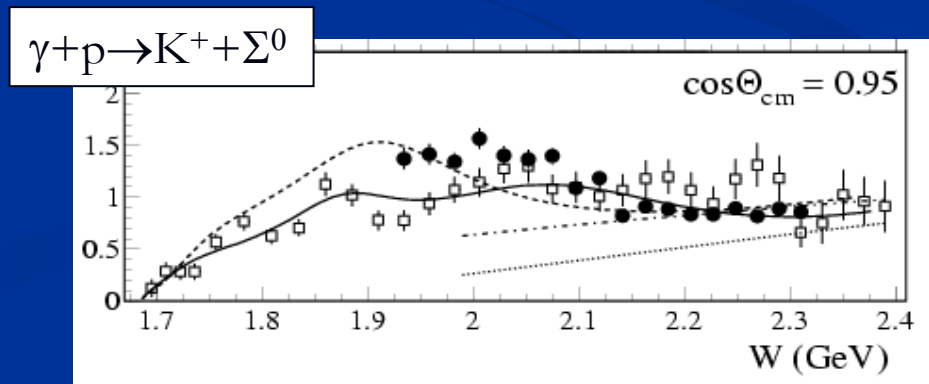
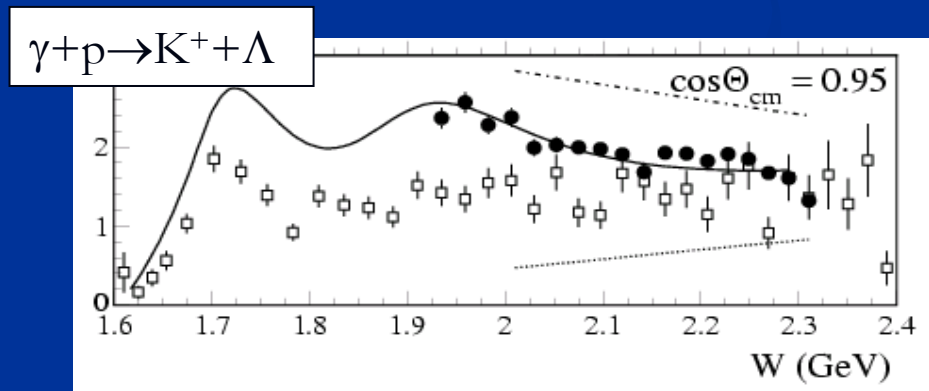
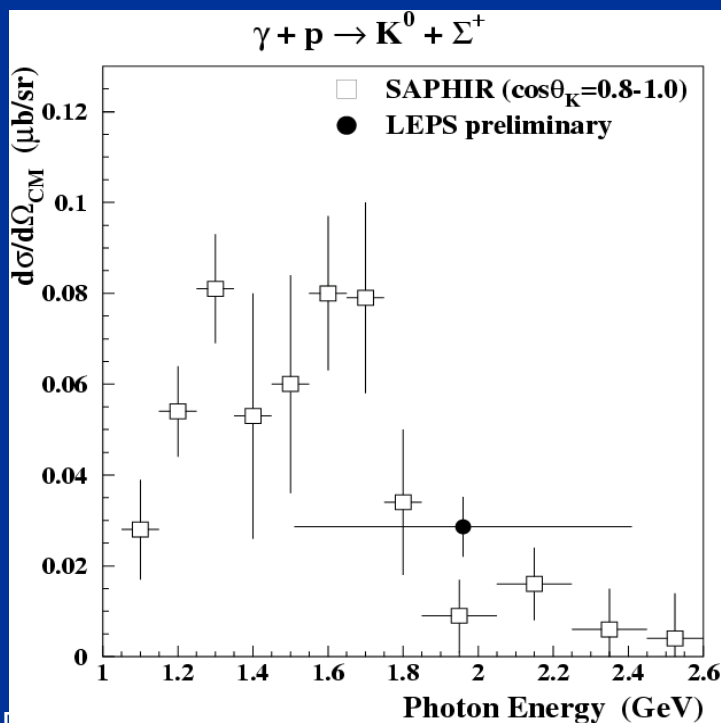
- Identify hyperon production
  - Missing mass analysis:  $p(\gamma, K_S)X$
  - $\Sigma^+(1189)$  yield small ( $\sim 100$  events)



# ■ Differential cross section

## ■ MC study of acceptance

- Effective solid angle for  $K_S$ :  $2.5 \text{ msr}$  ( $\Leftrightarrow 250 \text{ msr}$ )
- Include  $\text{BR}(K^0 \rightarrow K_S \rightarrow \pi^+ \pi^-)$  and vertex-cut



- To do list
  - Study on optimum analysis cuts
    - Improve  $S/N$  and keep yield
    - Improve  $vertex$  and  $missing\ mass$  resolutions
  - Analysis of differential cross section ( $d\sigma/d\Omega$ )
    - Tools are available
    - $E\gamma$  dependence
  - Analysis of photon beam asymmetry ( $\Sigma$ )
    - Only basic study at present