

Cascade Spectroscopy at CLAS

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Outline: Ξ^* Resonances at CLAS

Ghosts of Ξ 's Past

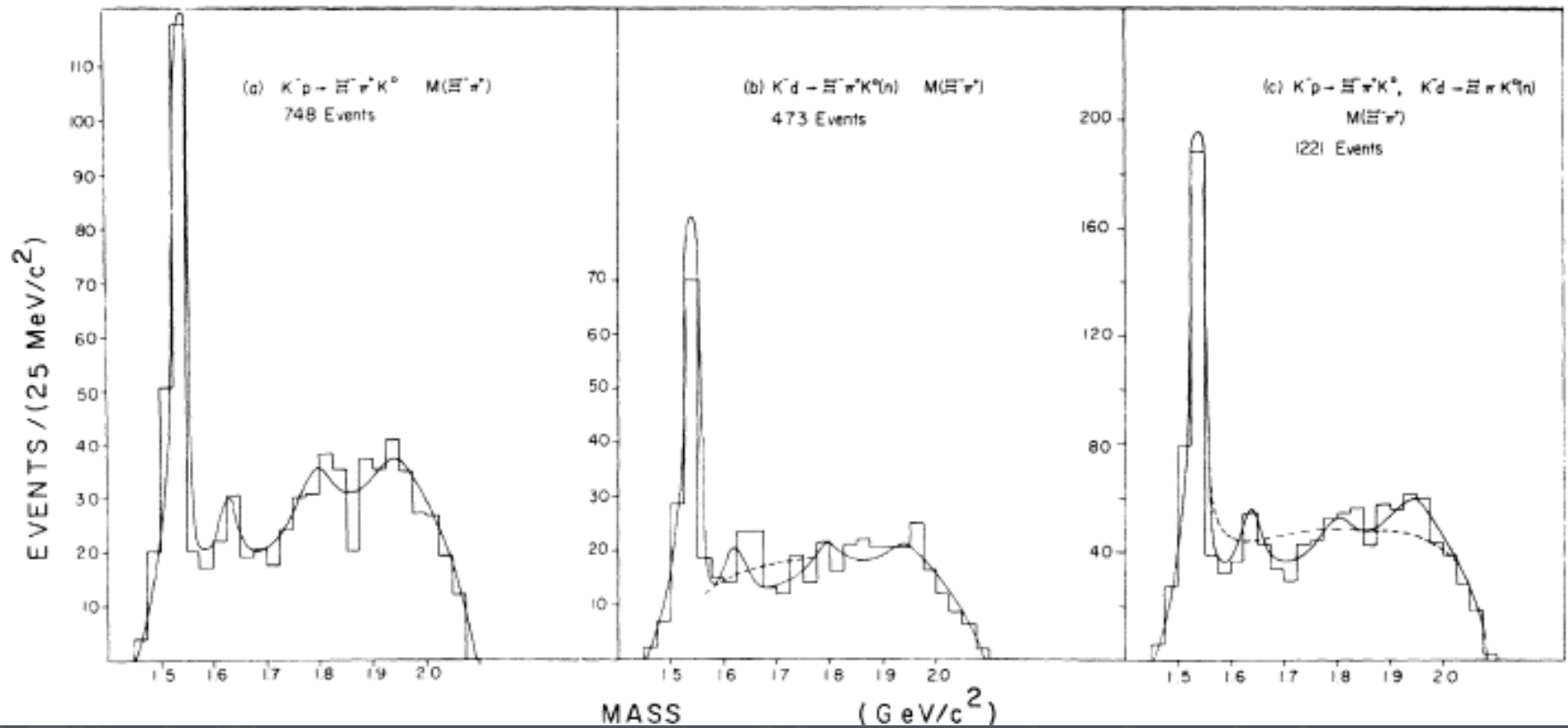
$\Xi(1620)$, High Mass Ξ^* Resonances

Ghosts of Ξ 's Present

CLAS g6,g11,eg3

Ghosts of Ξ 's Future

super-g, CLAS12



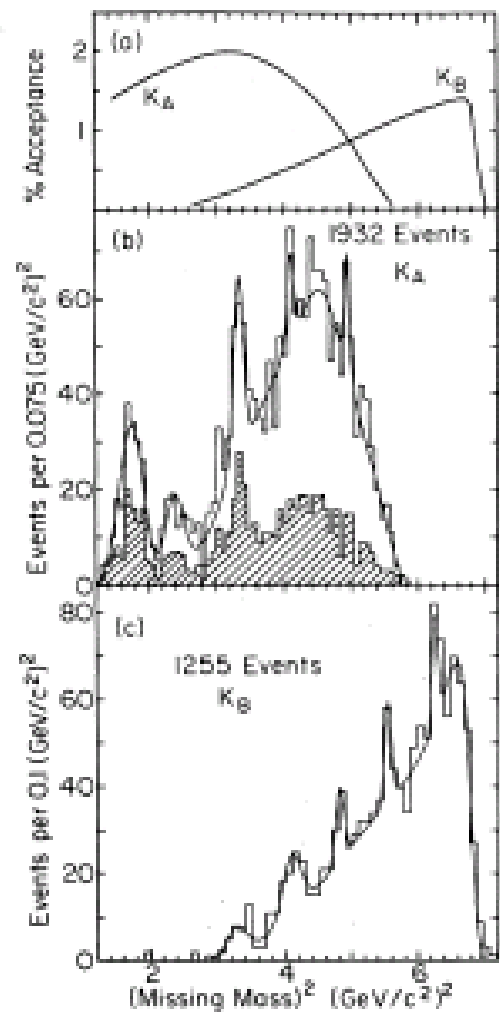
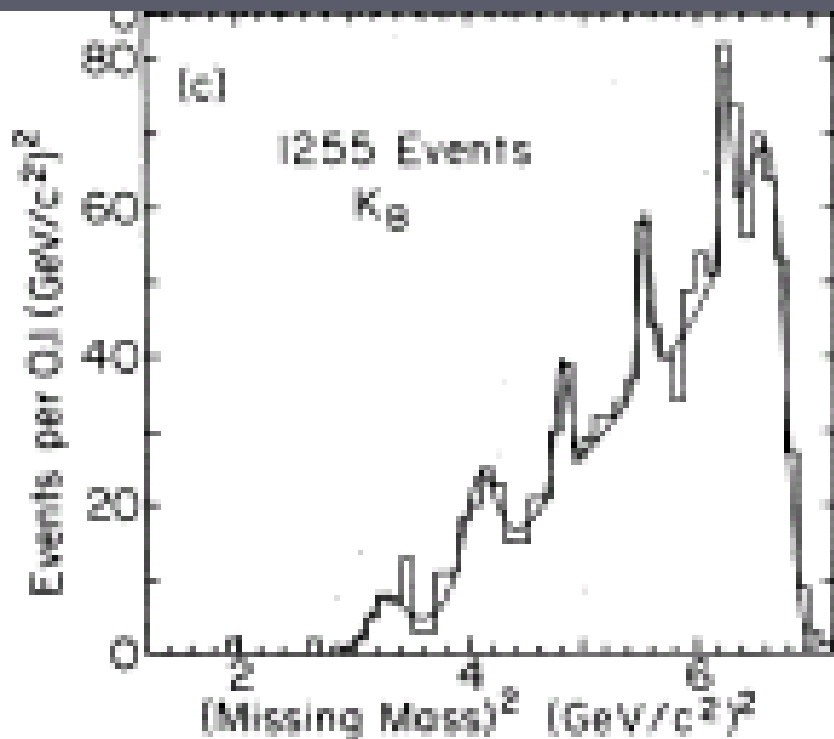
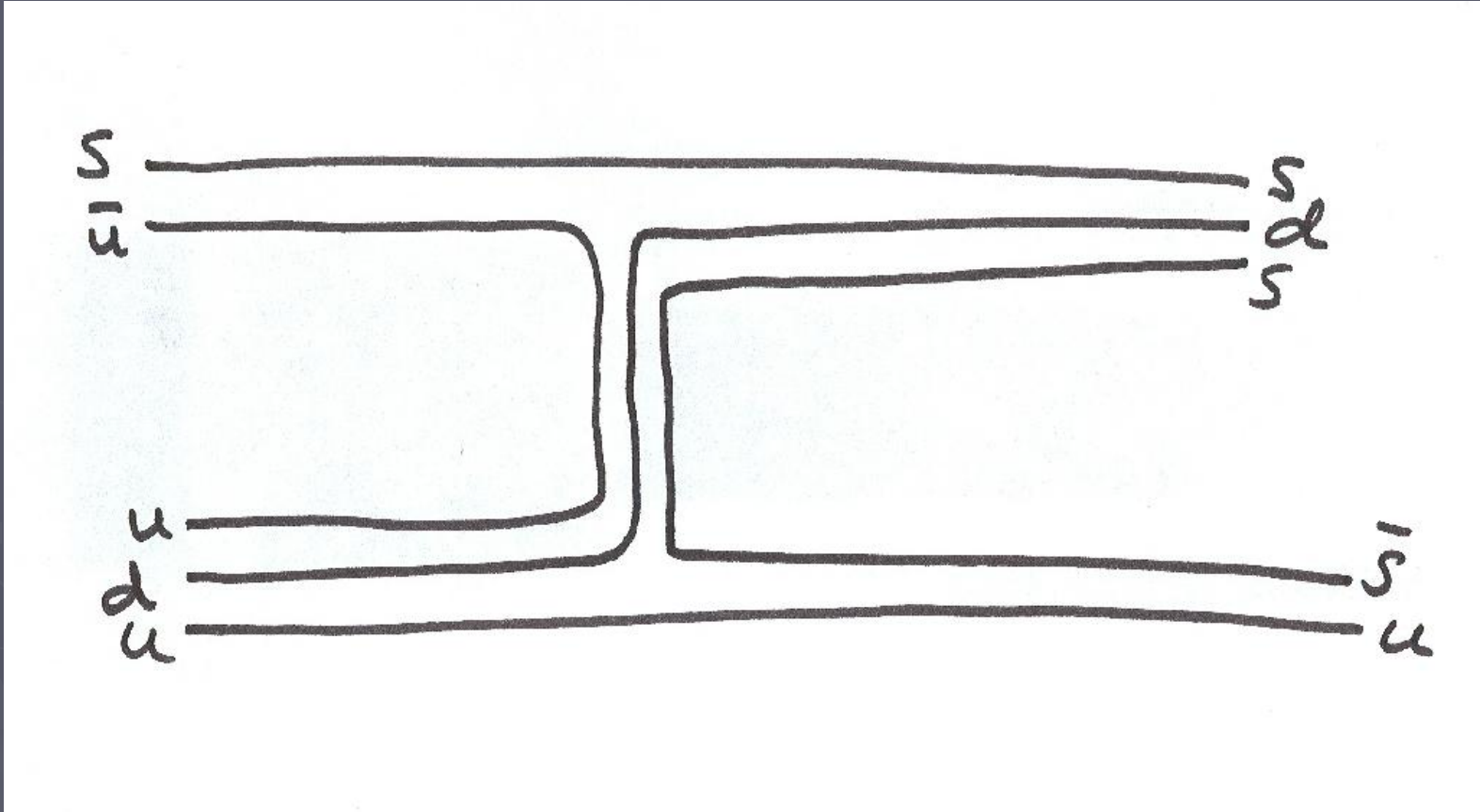


FIG. 3. Missing mass squared (X) for $K^+ + p \rightarrow K^+ + X$. (a) Acceptance. (b) K_A ; cross hatched areas are events with detected $\Lambda \rightarrow p\pi$. (c) K_B . Smooth curves in (b) and (c) are fits to background plus resonances.

$\Xi(1820)$ $\Xi(2030)$ $\Xi(2250)$

$\Xi(2370)$ $\Xi(2500)$

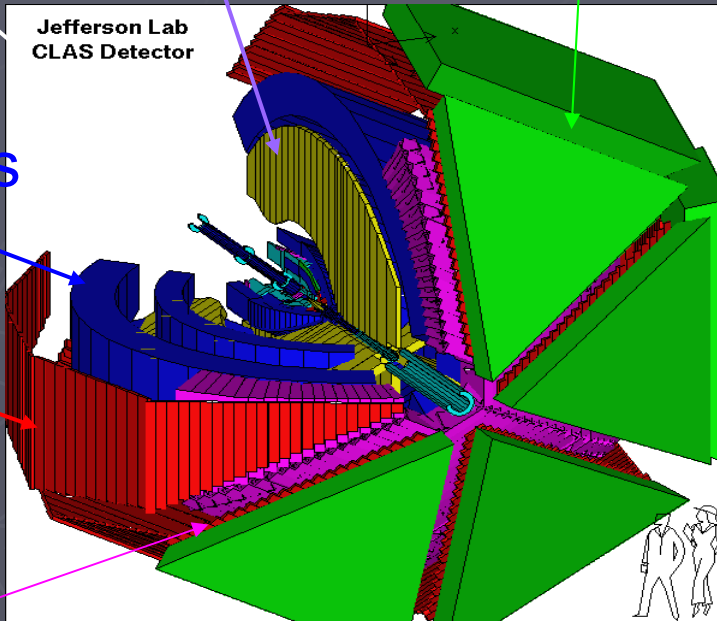
$\Xi(1950)$ $\Xi(2120)$



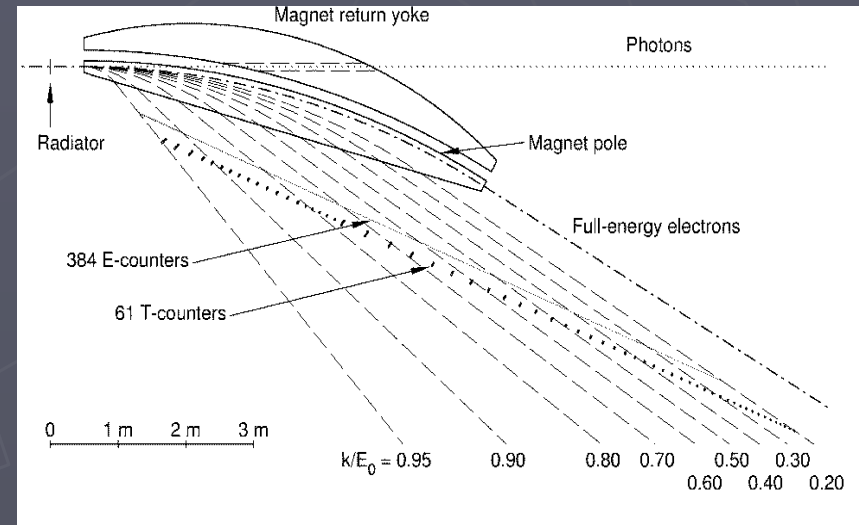
Cebaf Large Acceptance Spectrometer

6 Superconducting toroidal coils
Electromagnetic calorimeters

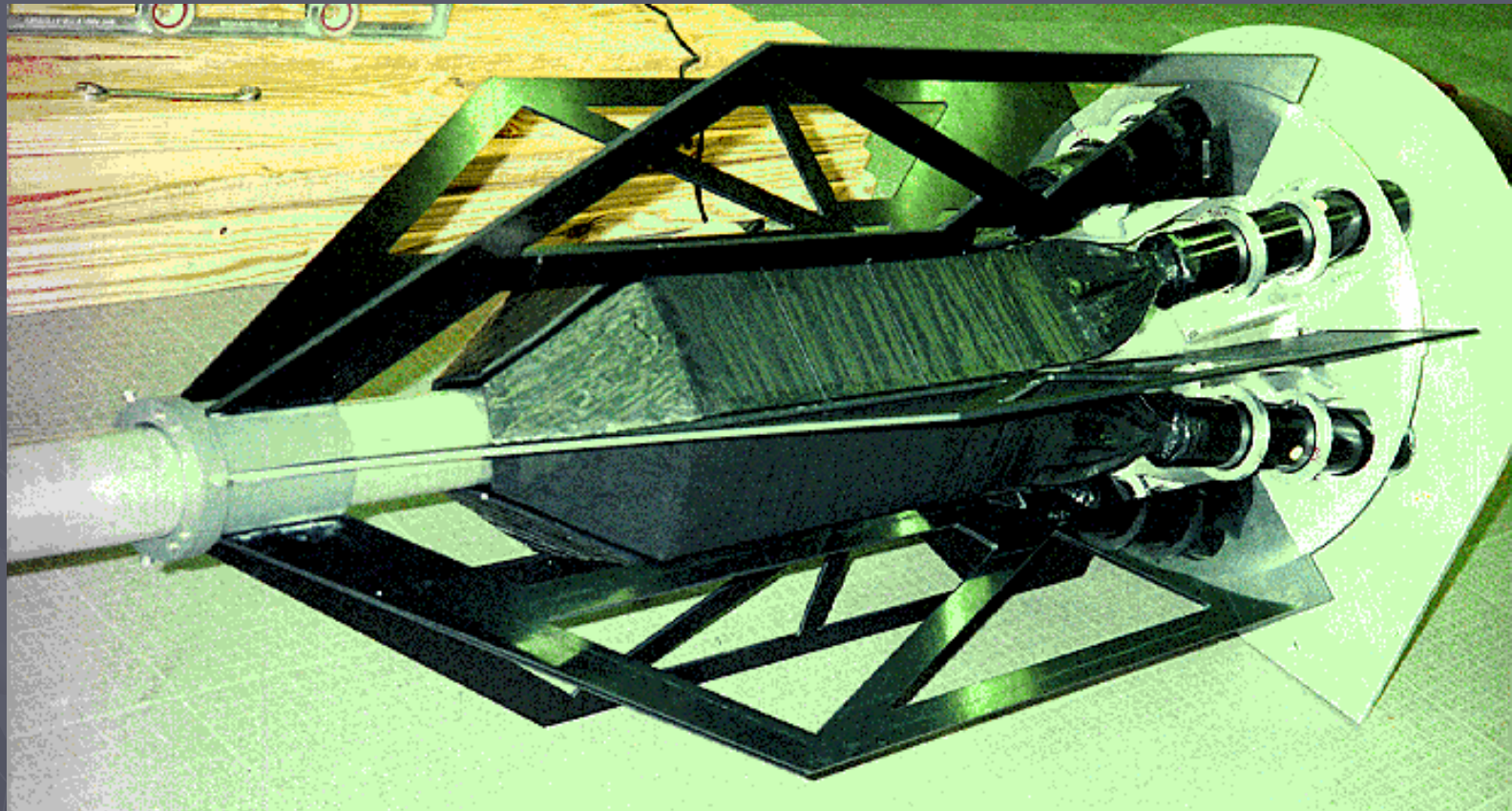
Beam line and the target

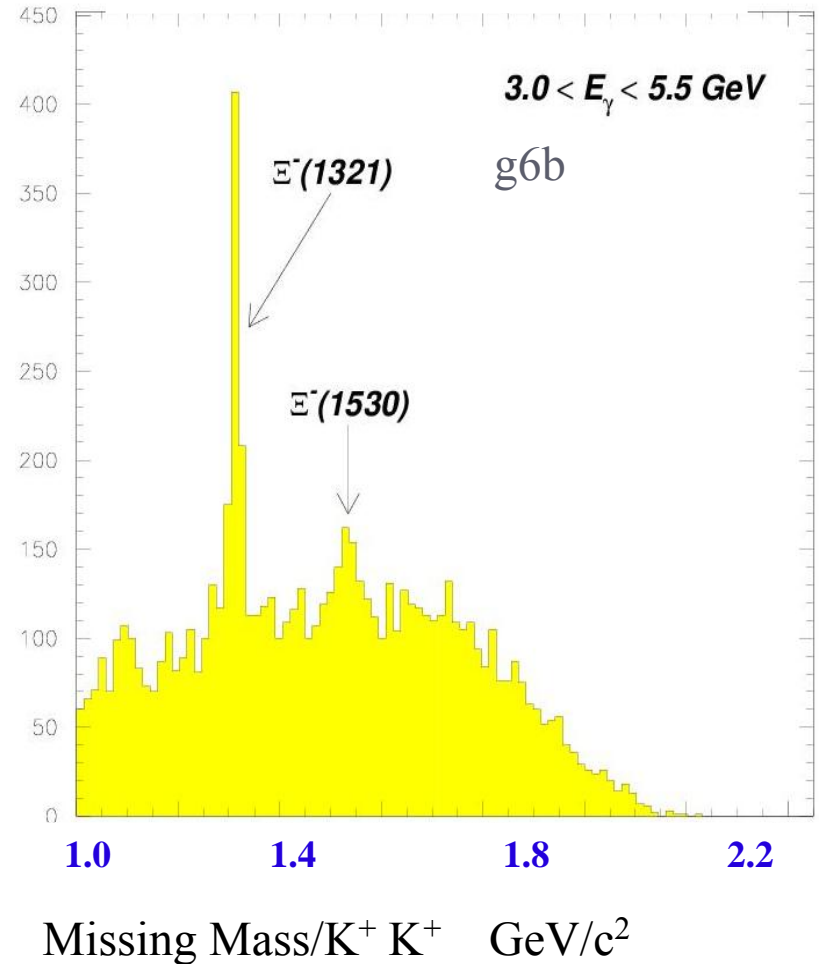
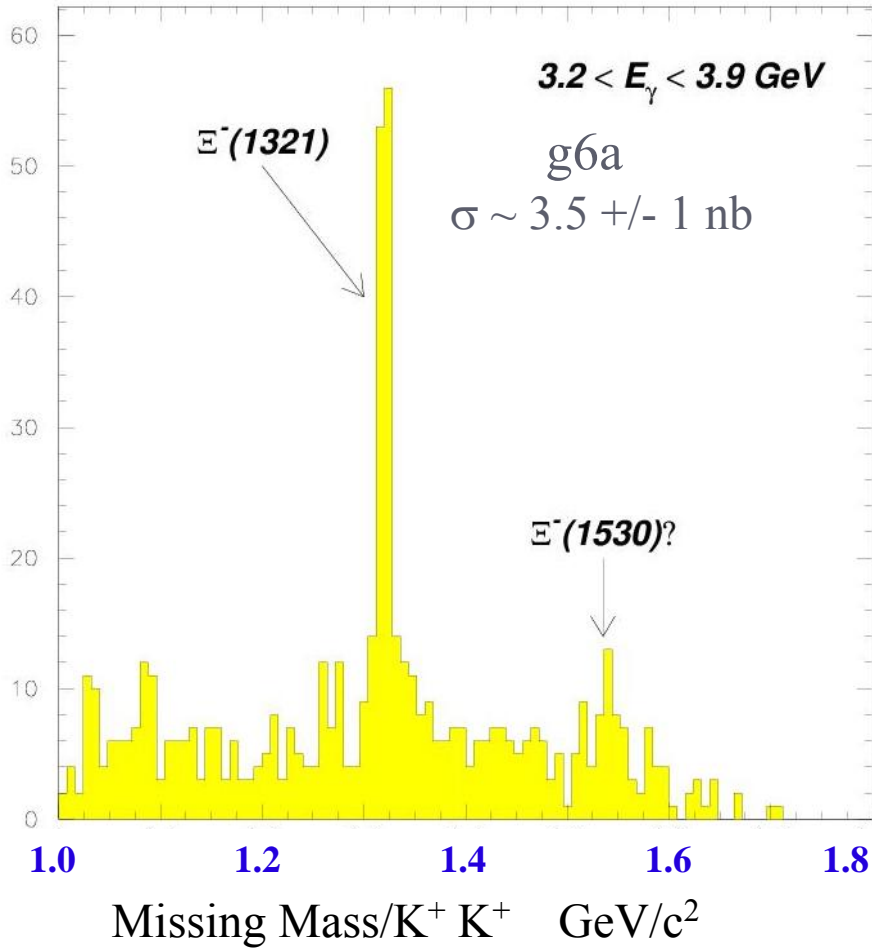


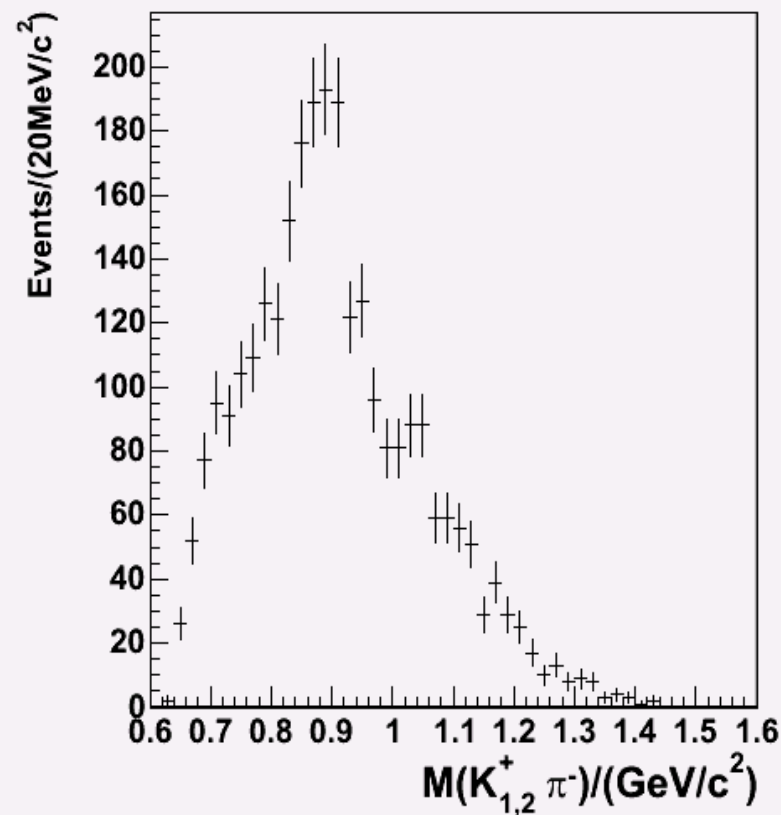
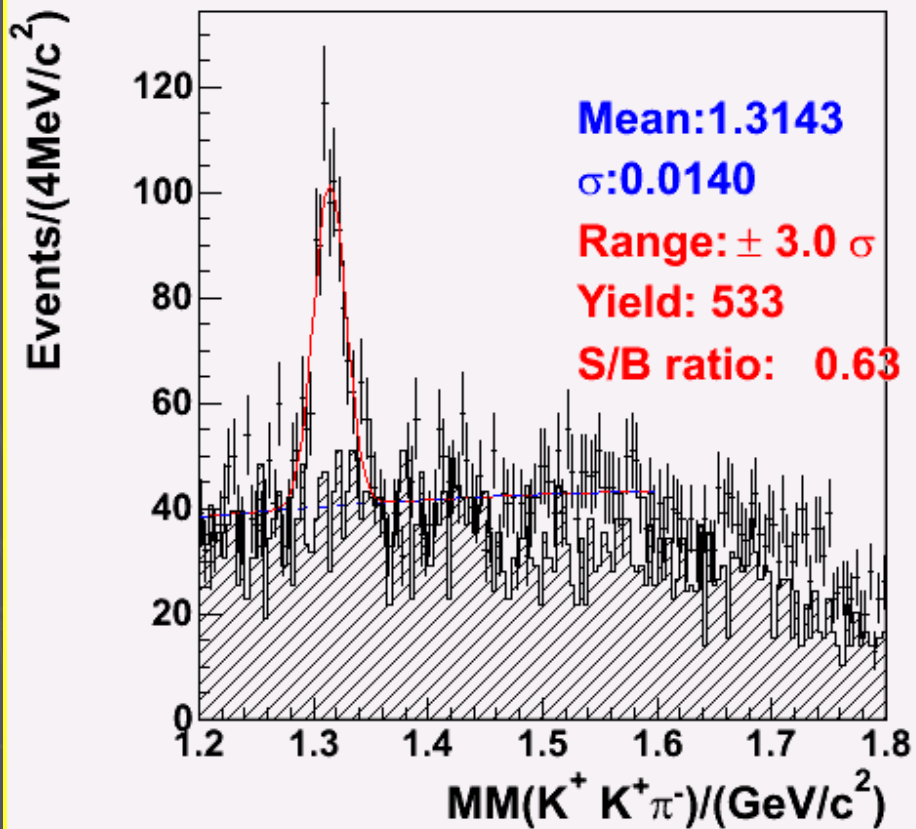
Bremsstrahlung tagged photon facility, photon energy resolution $\sim 0.2\%$ (New Tagger Energy Calibration)



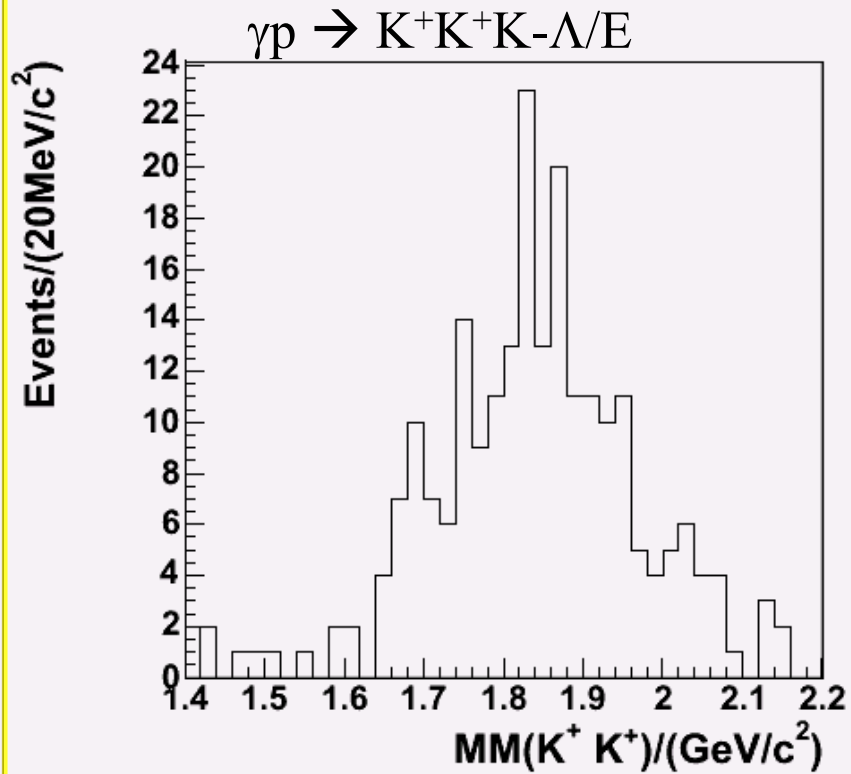
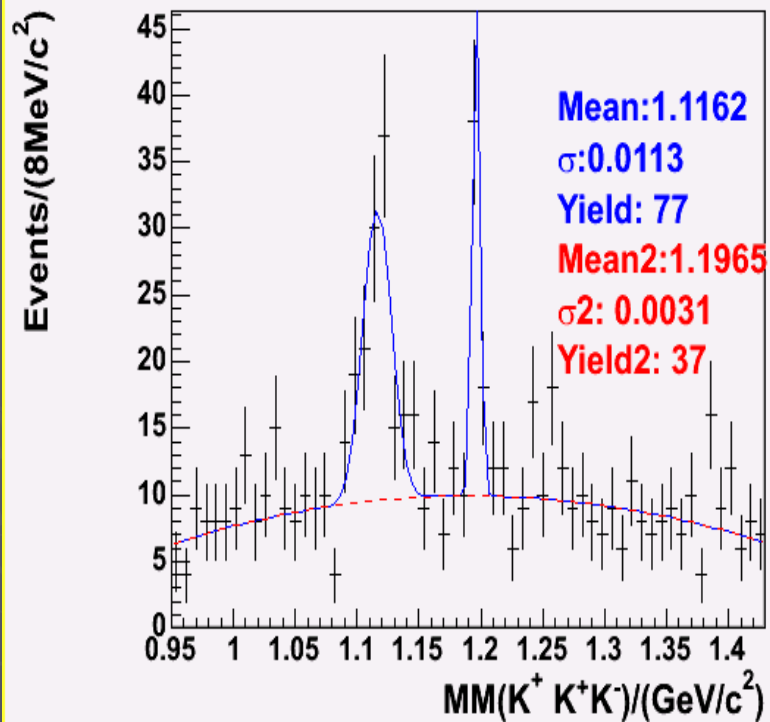
Start Counter: 1997

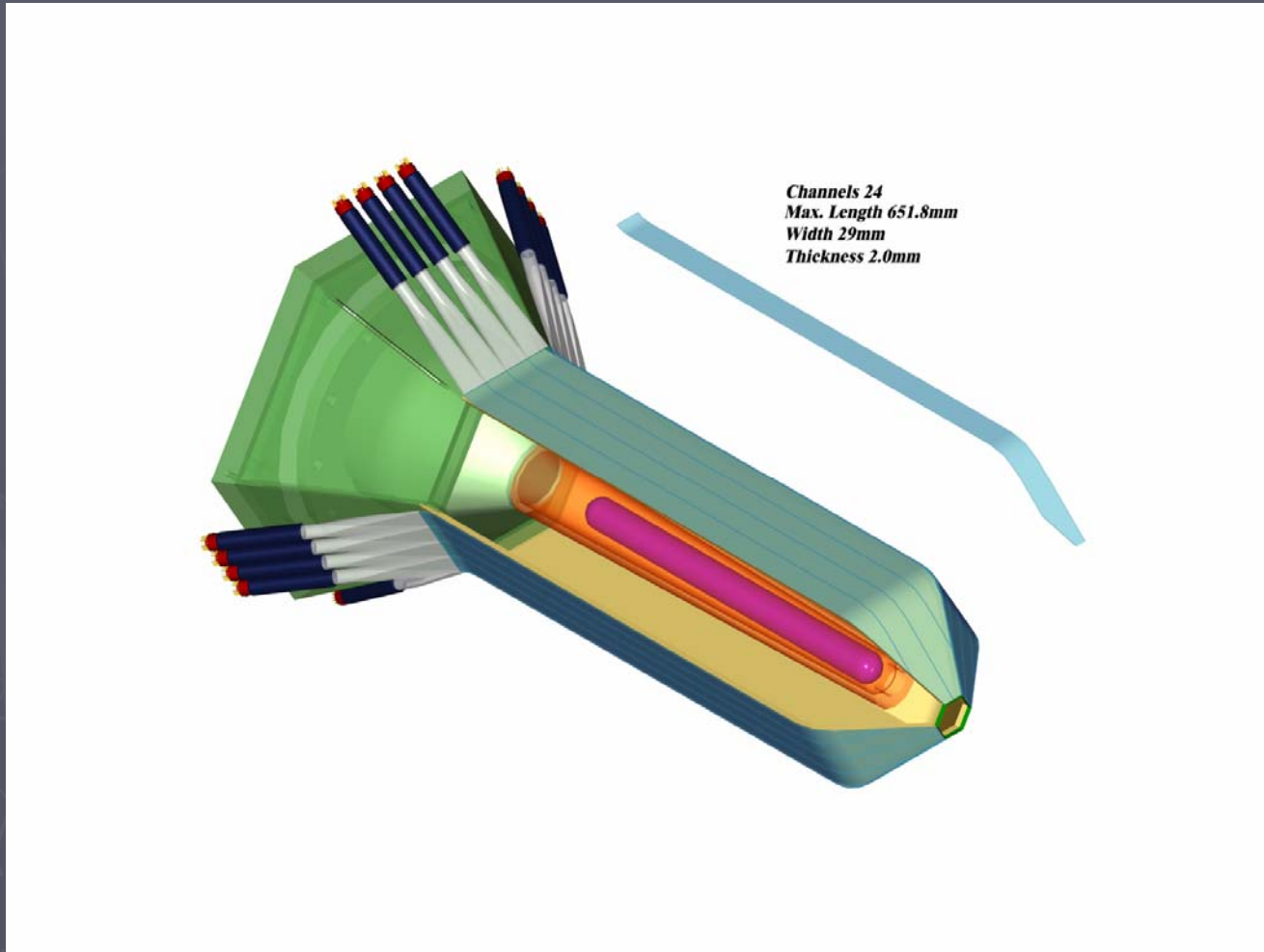


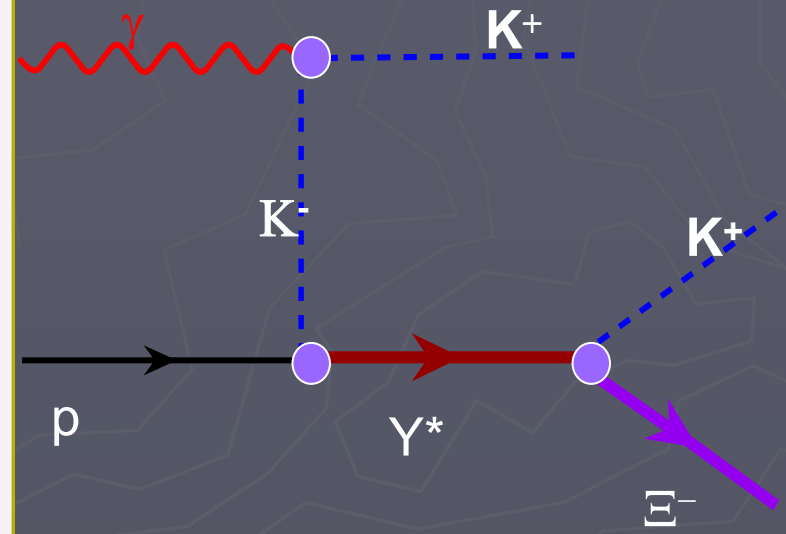
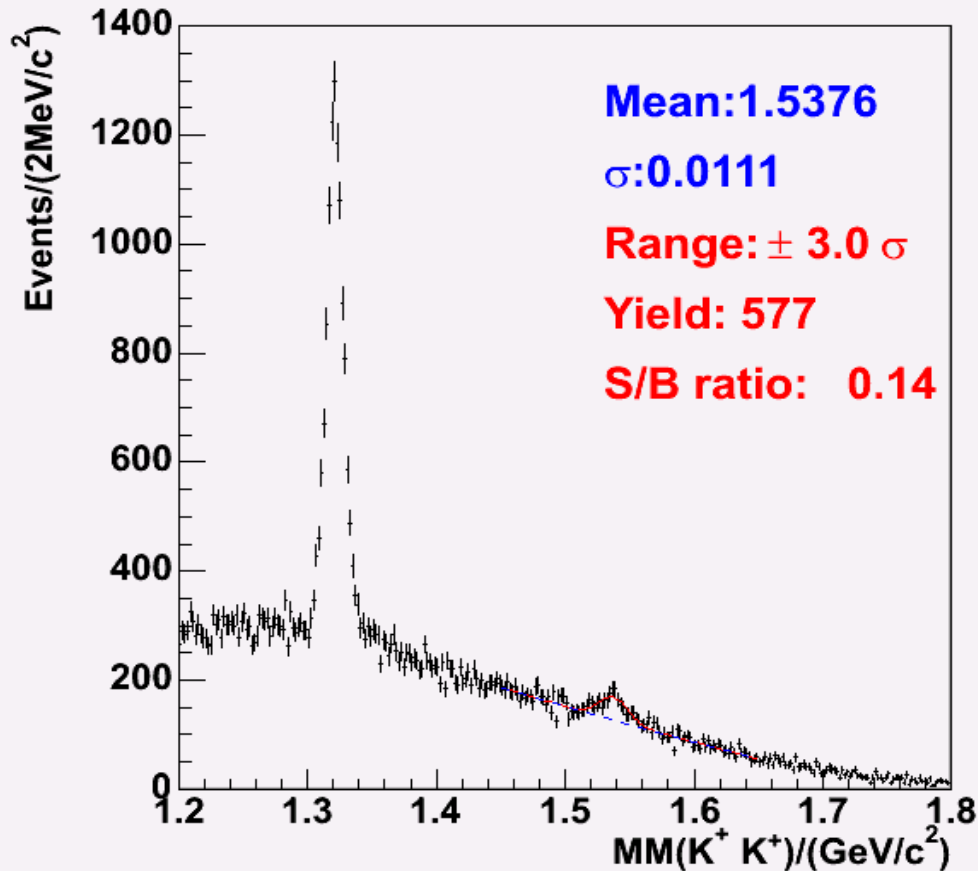




$g_{6c} E\gamma \sim 5.4 \text{ GeV} \quad \gamma p \rightarrow K^+K^+K^-X$

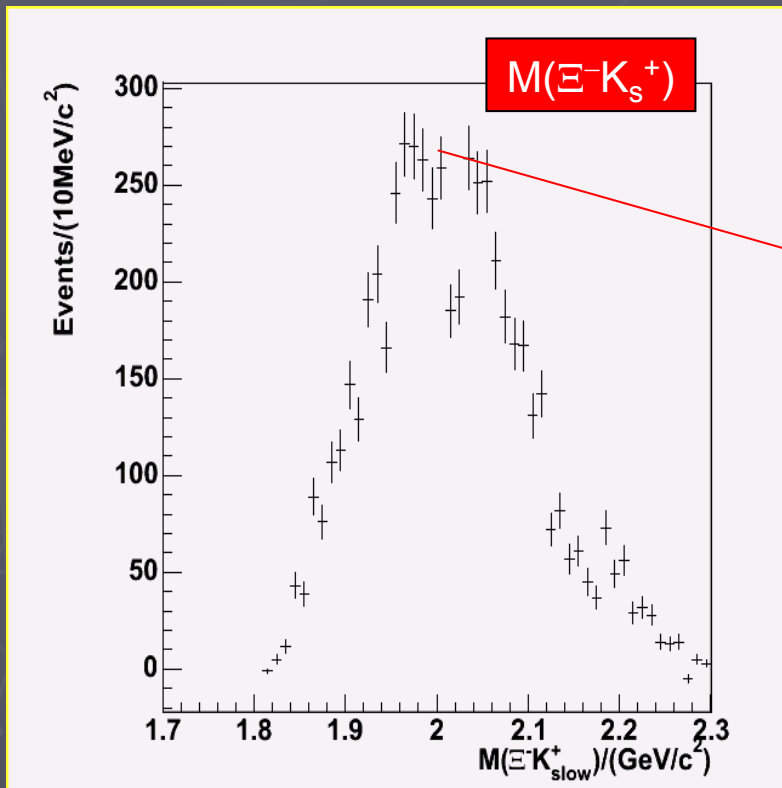




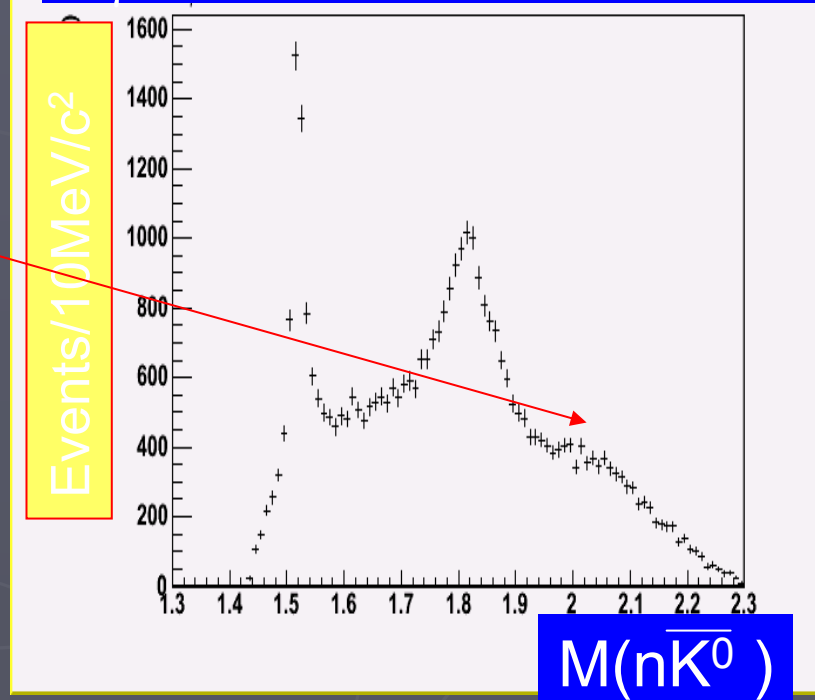


Production Mechanism

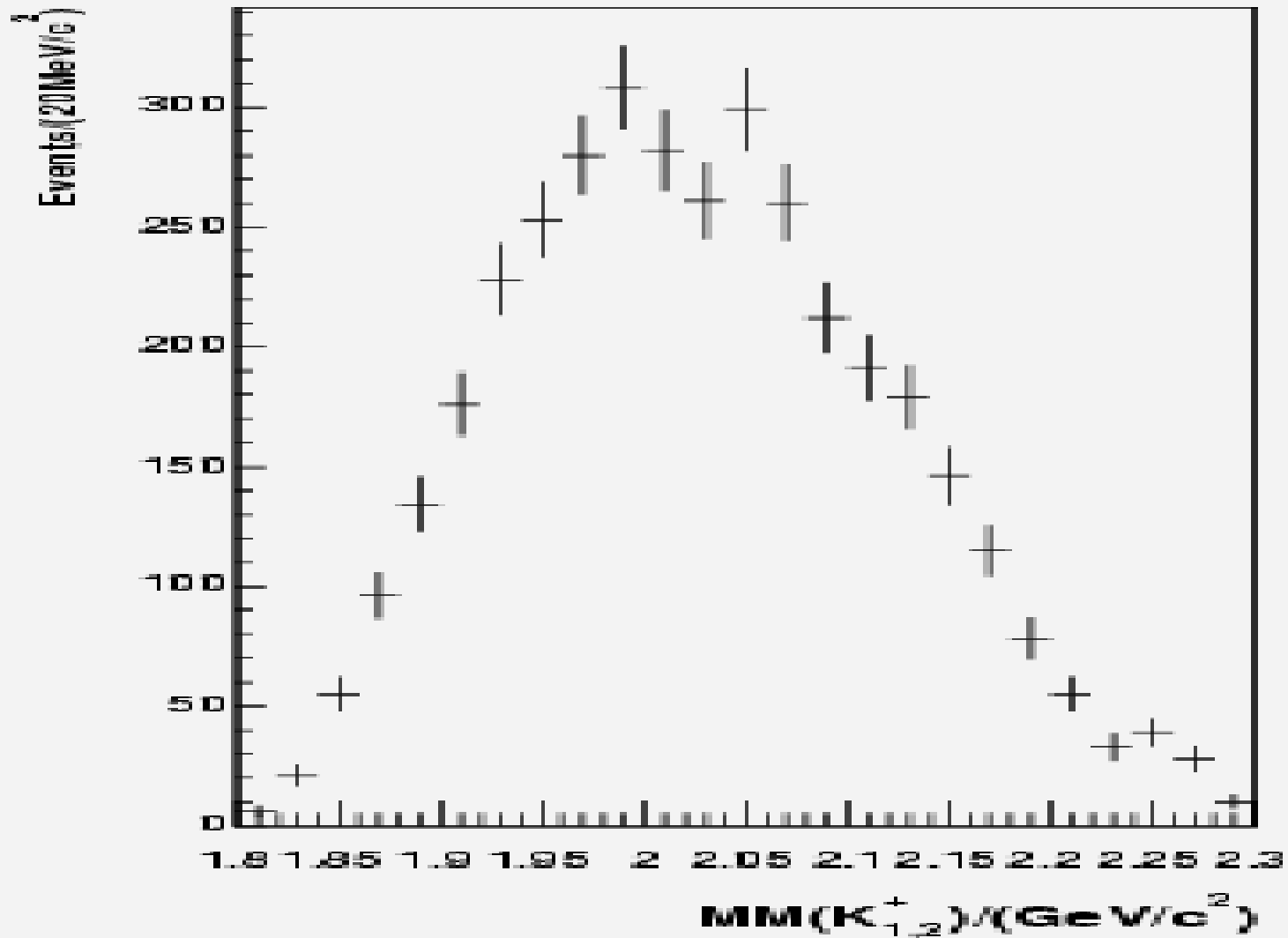
$E_\gamma > 3.4\text{ GeV } \gamma p \rightarrow K^+ K^+ \Xi^-$



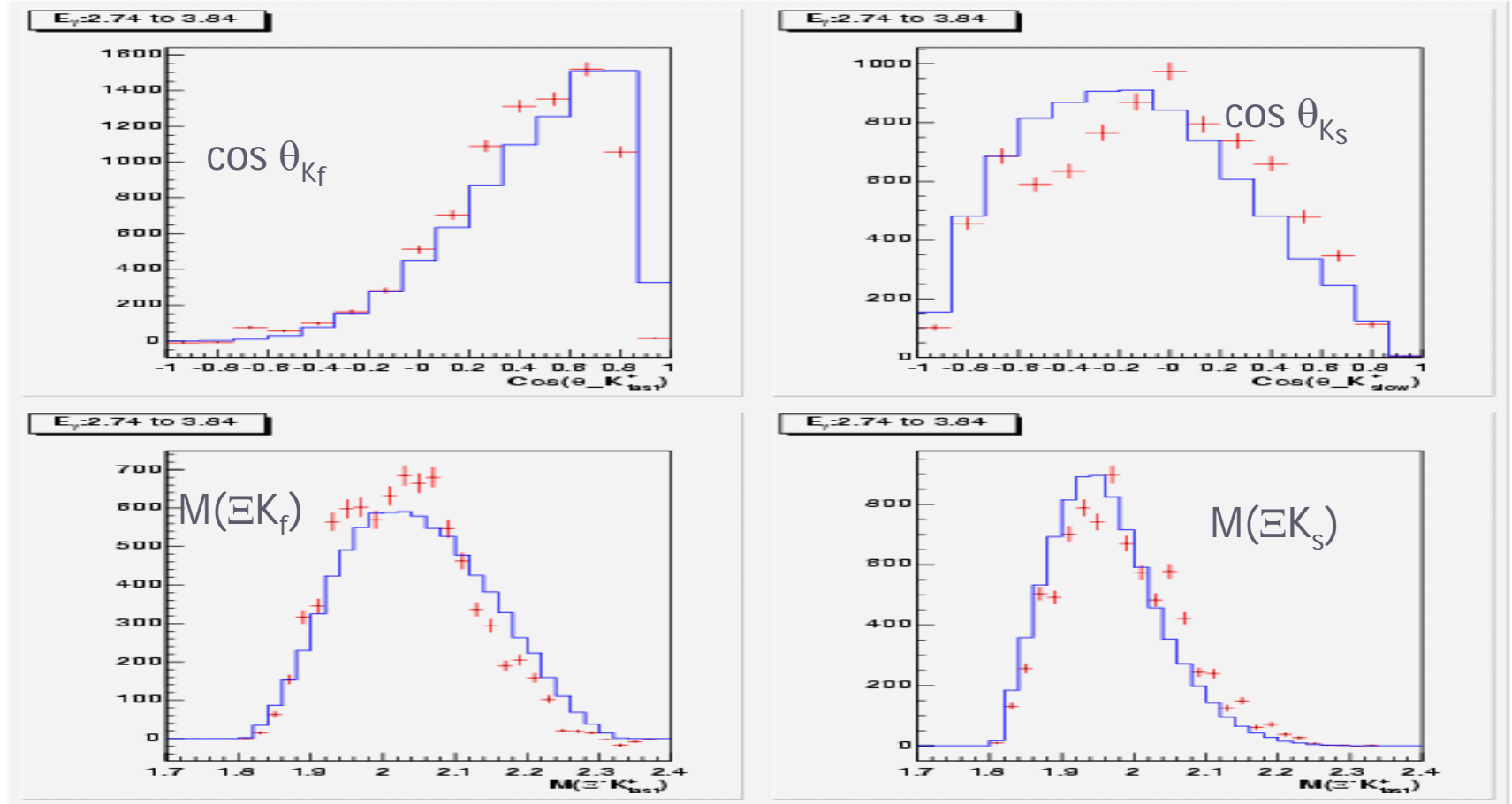
$E_\gamma > 3.4\text{ GeV } \gamma p \rightarrow K^+ n \bar{K}^0$



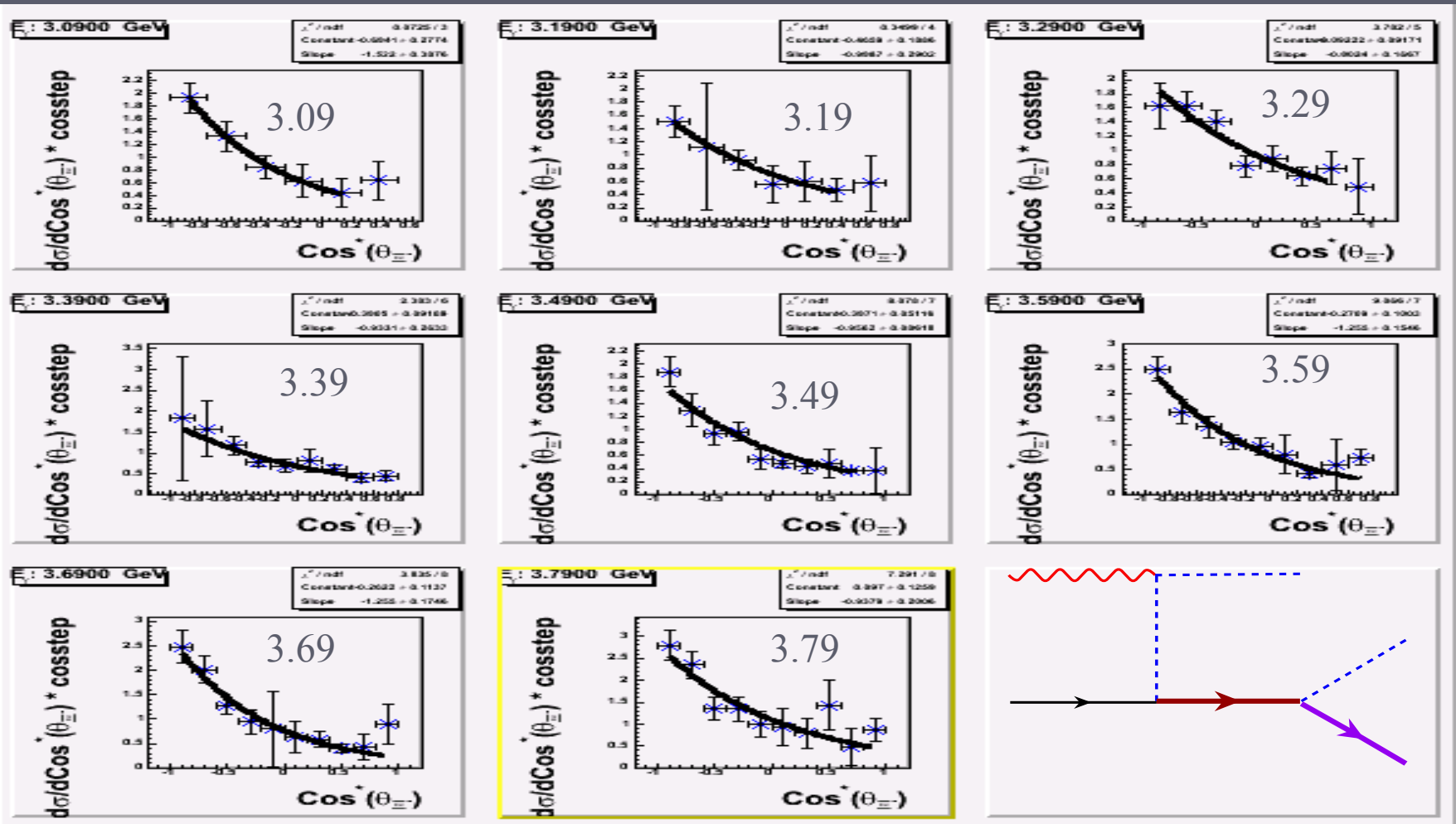
$g11 \gamma p \rightarrow K^+ K^+ \Xi^-, \Xi^- \rightarrow \pi^-(\Lambda)$



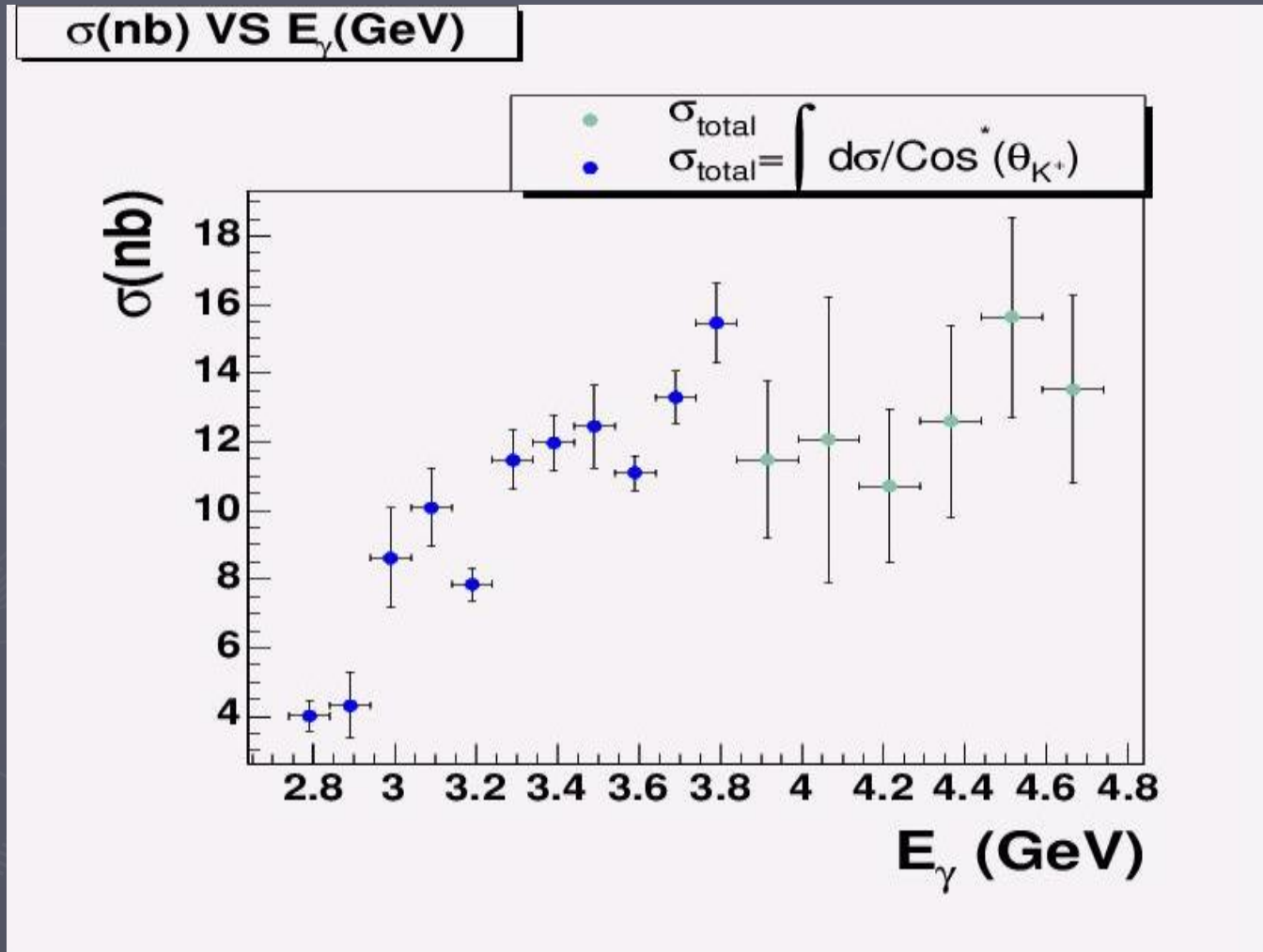
Simulation: $\gamma p \rightarrow K^+ Y^* \quad Y^* \rightarrow X K^+$



Ξ^- differential Cross section: $d\sigma / d \cos(\theta_{\Xi^-})$

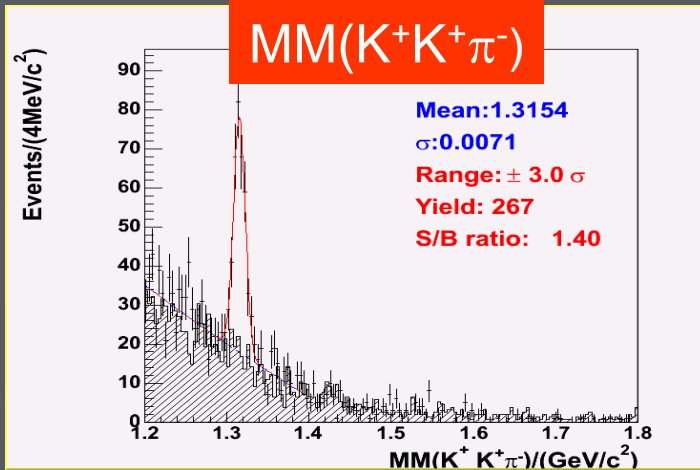


$\Xi(1321)$ cross section: g_{11} PRELIMINARY

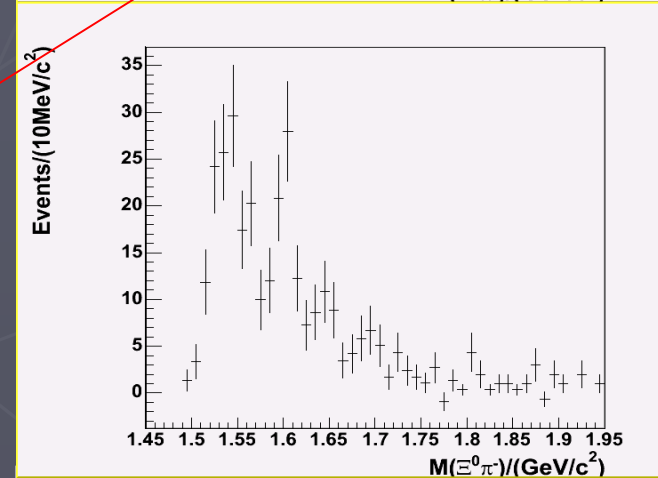
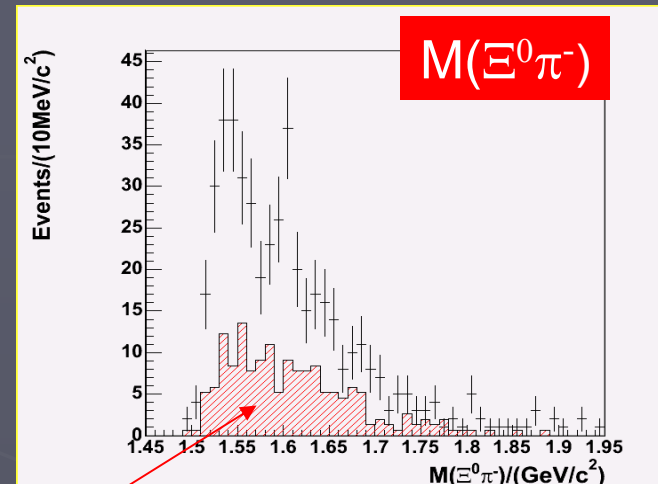
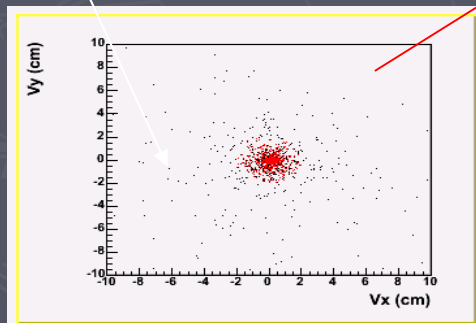


$$\gamma p \rightarrow K^+ K^+ \Xi^{*-}, \Xi^{*-} \rightarrow \pi^- (\Xi^0)$$

PRELIMINARY

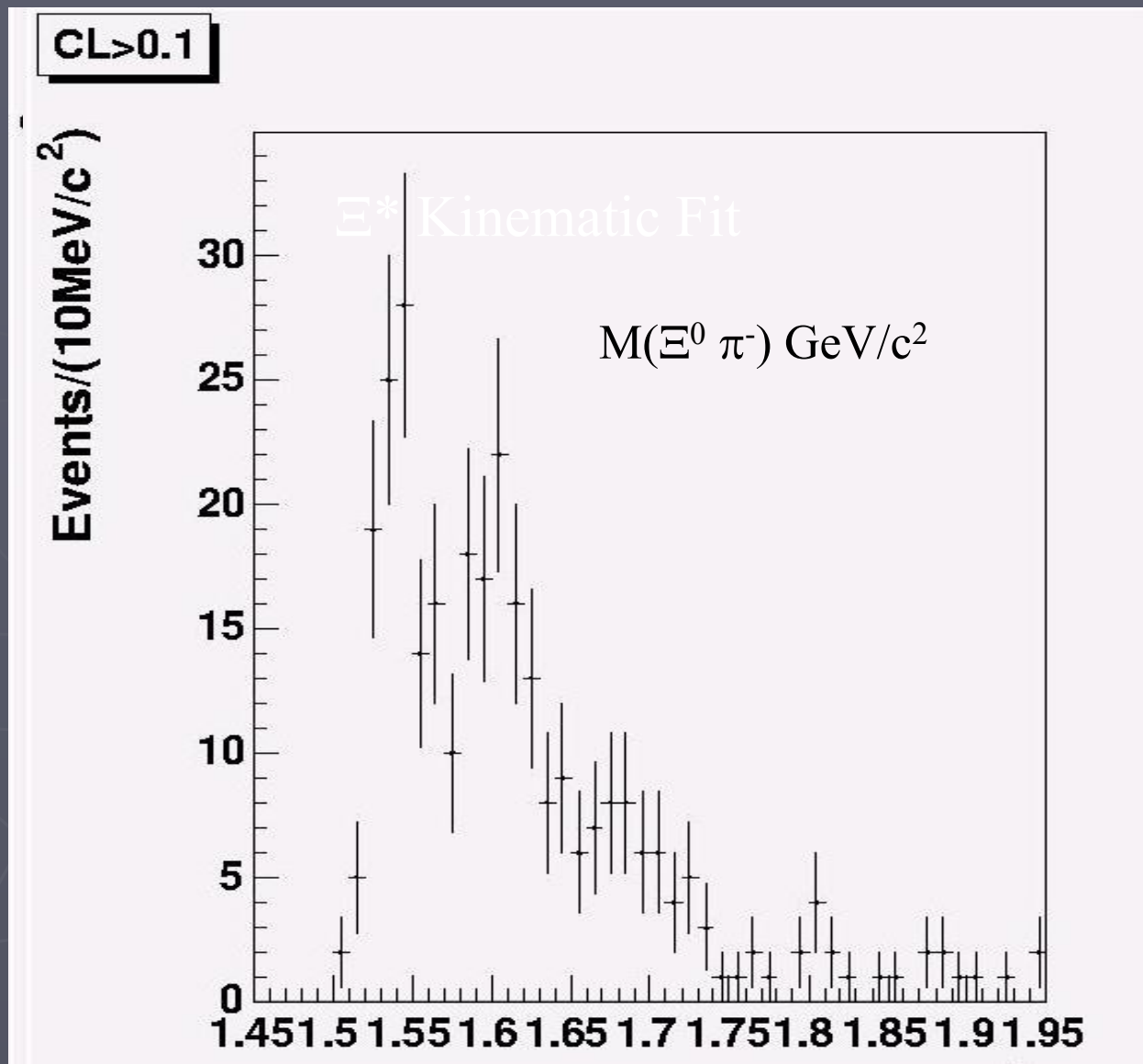


Shaded events: Background from out of target events



background subtracted

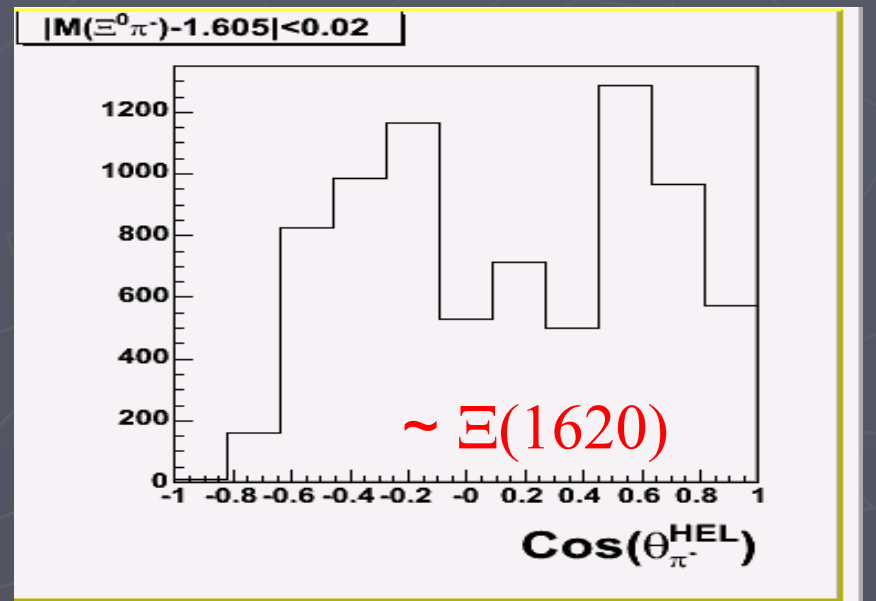
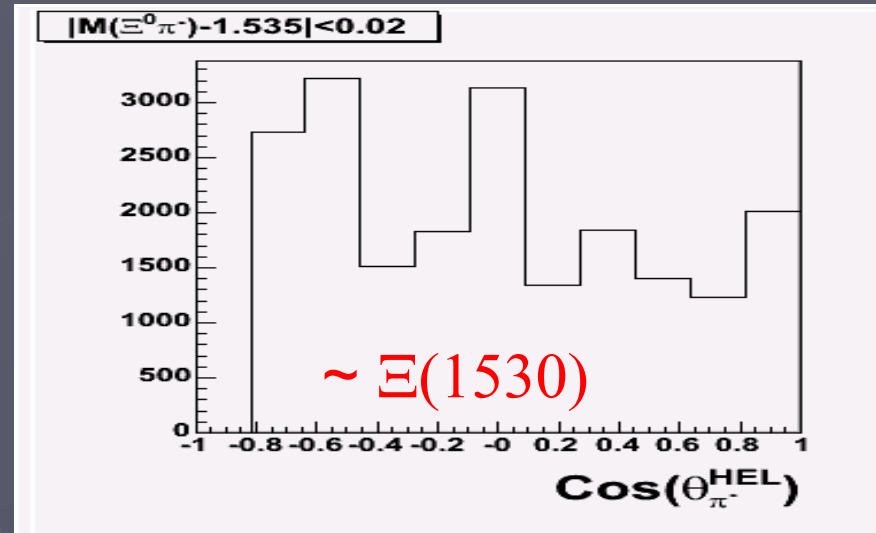
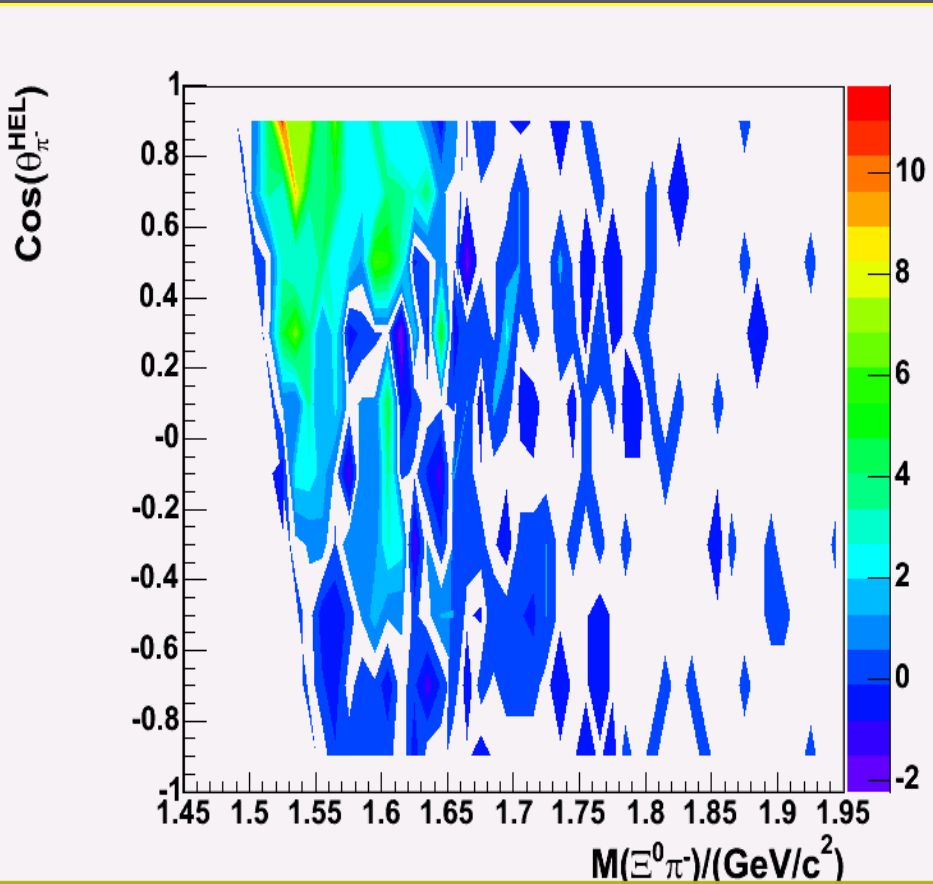
Kinematic Fit



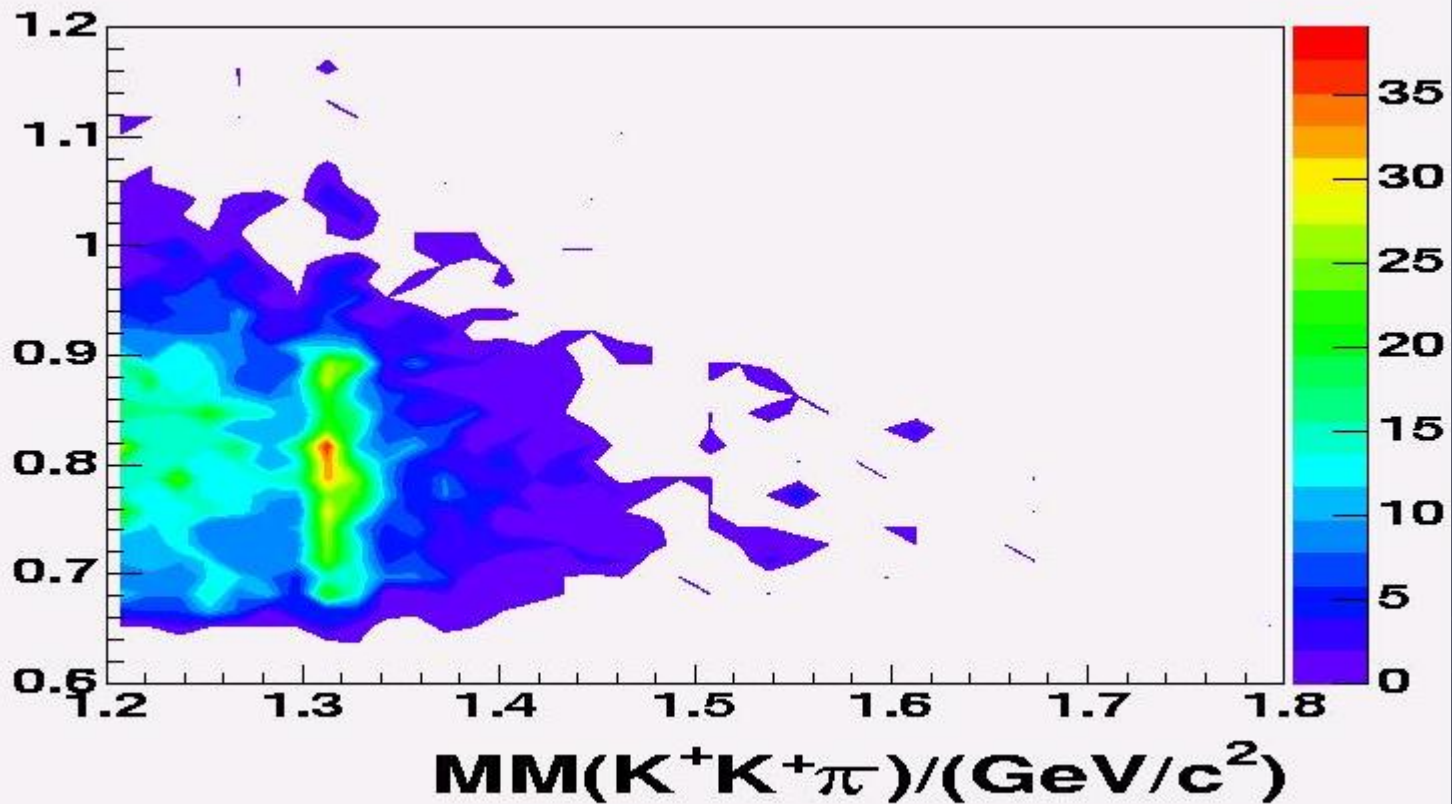
$\cos^{\text{HEL}}\theta_{\pi}$ VS $M(\Xi^0\pi^-)$

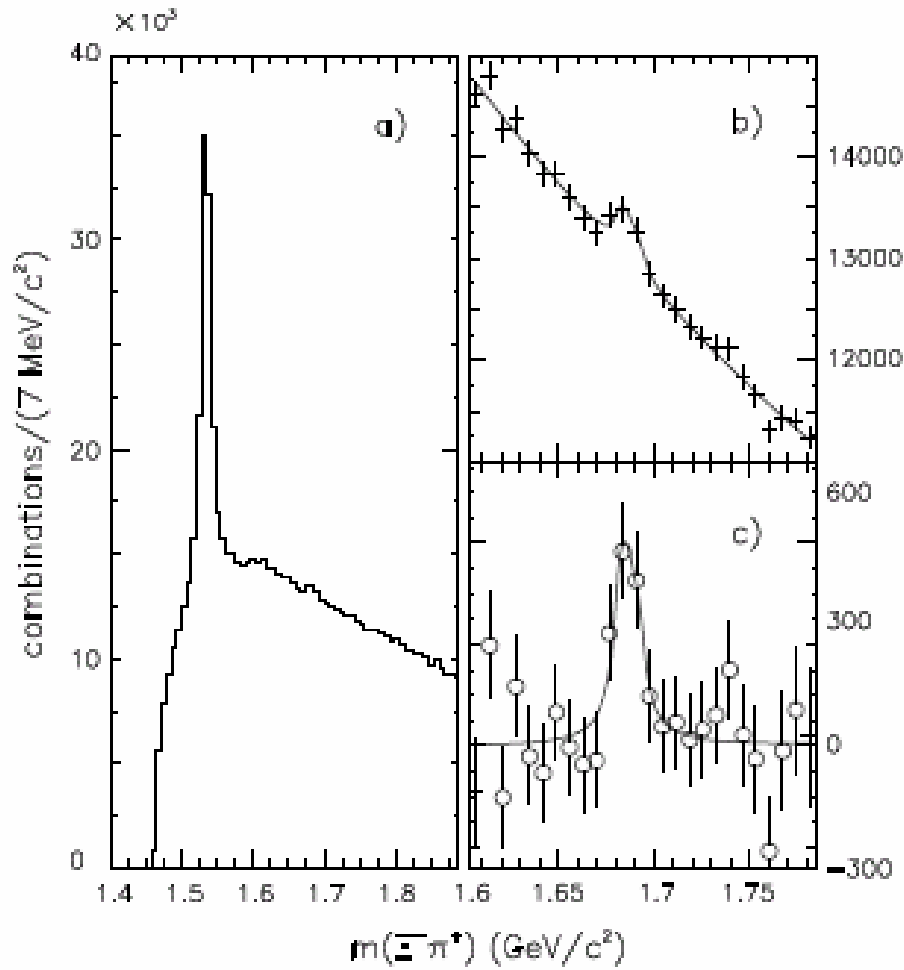
Preliminary

Acc. corrected



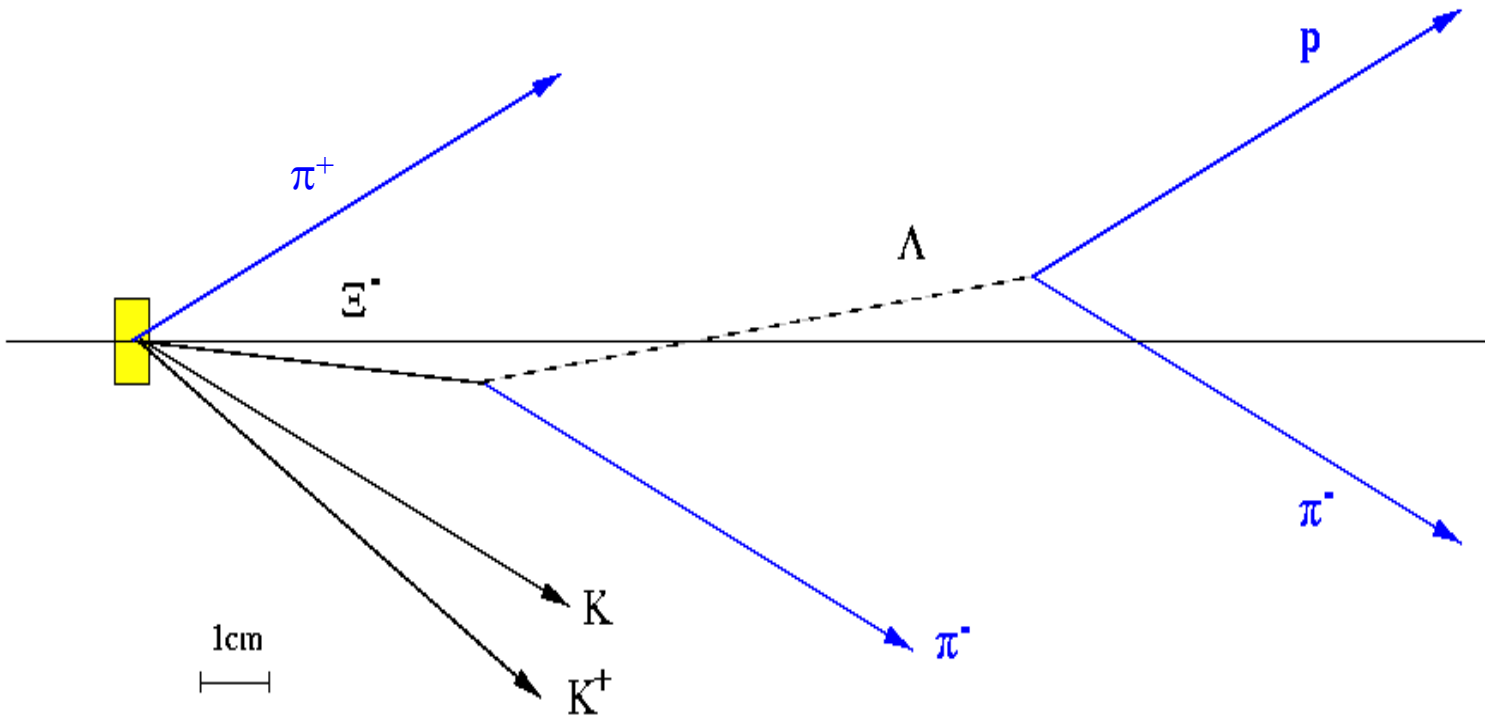
$M(K^+_{1,2}) \pi^-$ (GeV/c^2)





Eur.Phys.J.C5:621-624,1998

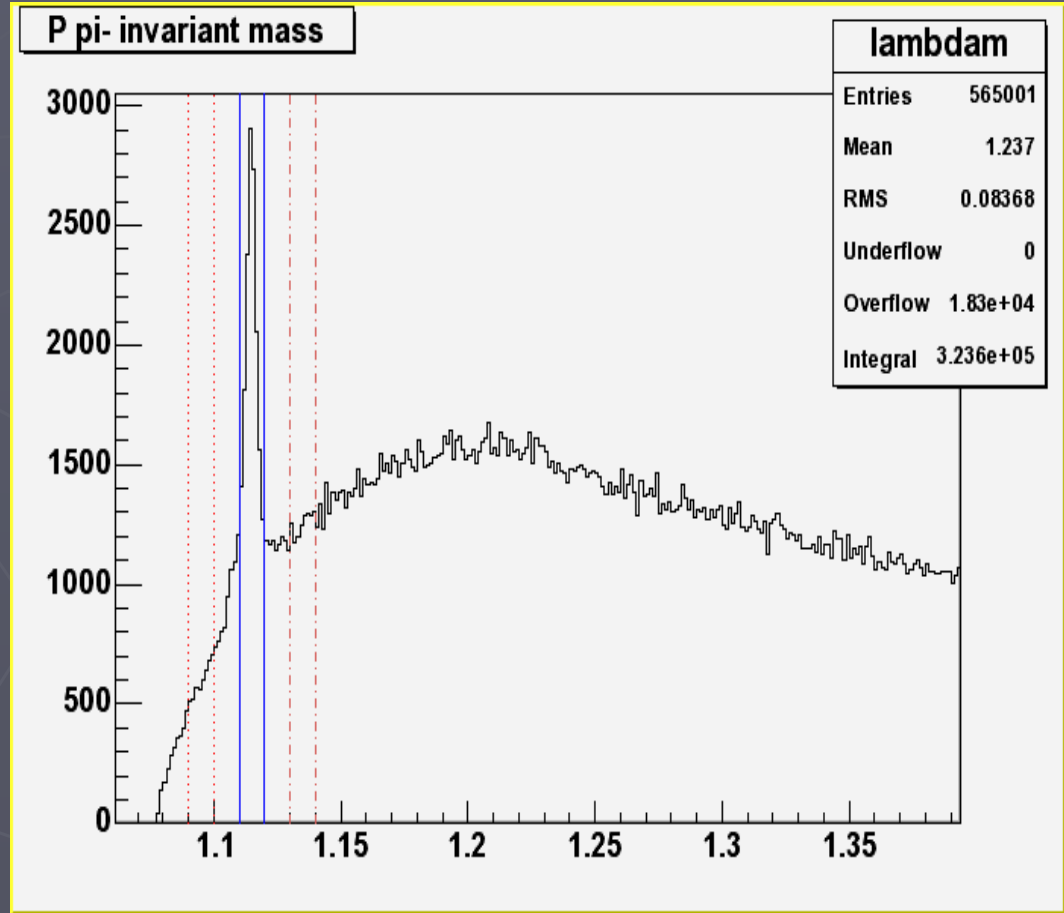
$e g_3 \gamma d \rightarrow \Xi \pi K K \quad \mathcal{L} \sim 100 \text{ pb}^{-1}$



eg₃: Intermediate State - Λ

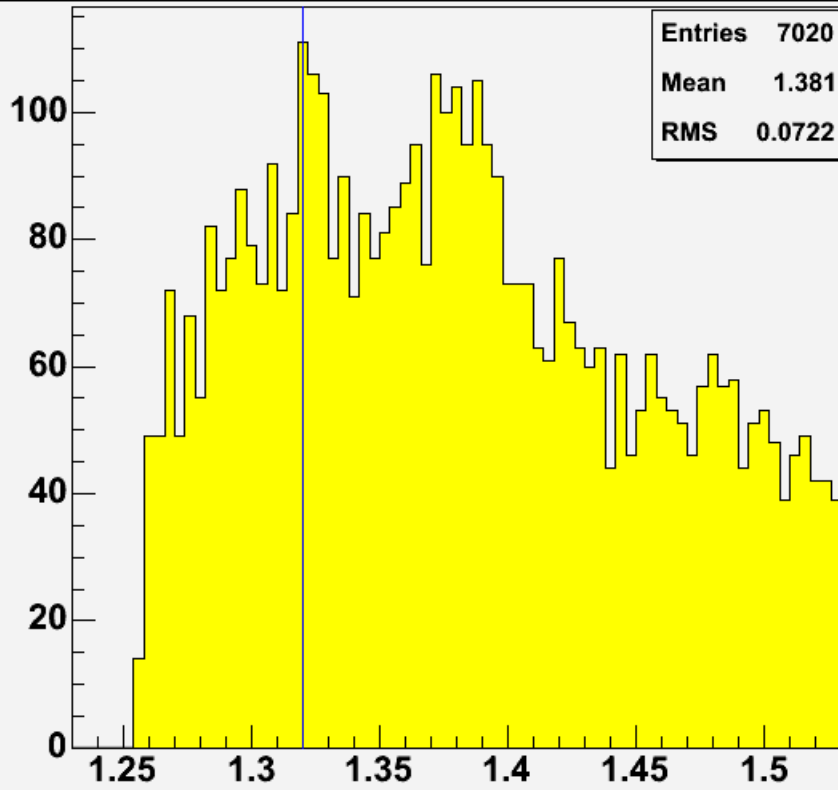
- 7% of total exposure
- tight Λ mass cuts
- $p \pi^-$ DOCA cuts

150,000 $\Lambda \pi^-$ events

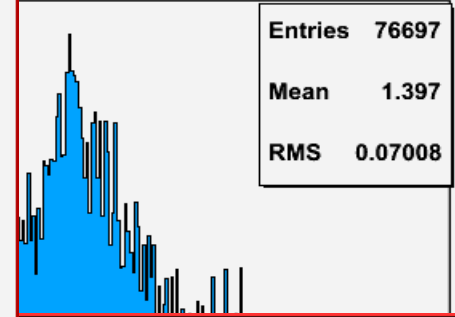


• Missin

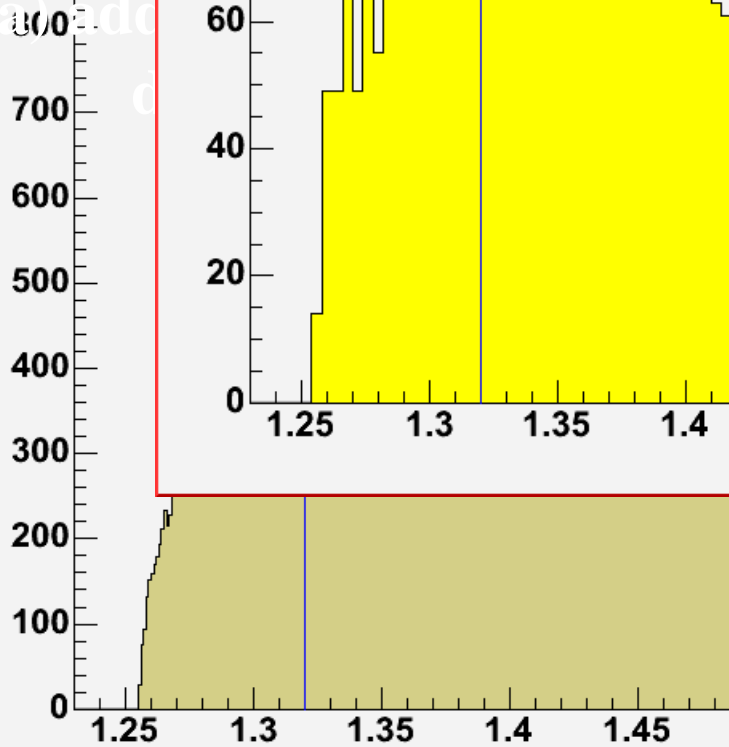
$\Lambda \pi^-$ invariant mass (dislocated vertex)



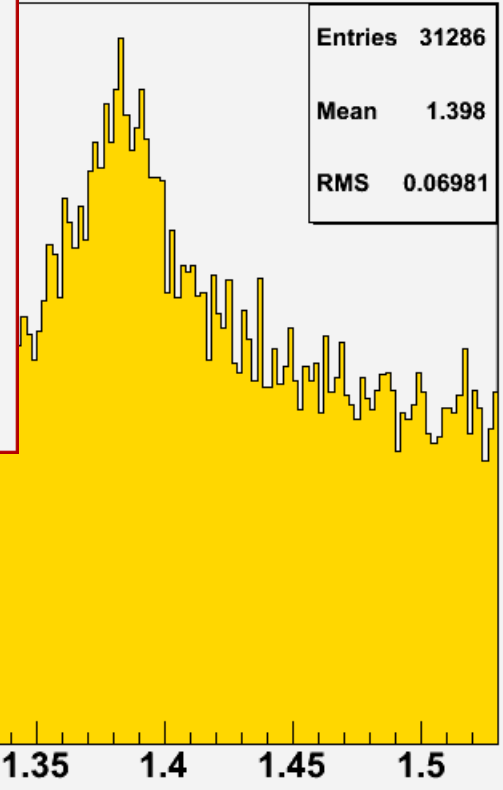
g mass above K,K threshold)



$\Lambda \pi^-$ inv



more charged particle in event)



Hall B 2005-2008 Schedule

Date	Experiment	days	Energy (GeV)	Rating	Polarization?
10/13 - 12/22/05	e8-BoNuS	25	4, 5.4	A-	yes
2006	eg4-GDH	20	1.1 – 3.2	A	High
	g9a-Frost	28	1.5 – 3.2	A-	circ/ linear
2007	g12	35	>5.75	A	-
	e1-DVCS(b)	36	6.0	A	High
2008 +	g9b-Frost	59	1.5 – 4	A-	circ/linear
	eg5-DVCS	60	6.0	A	High
	TPE	5	>5.75	A-	-
SUM		268 (195 unscheduled)			

V. Burkert : CLAS Collaboration Meeting, October 2005

Outlook for 6 GeV Cryomodule refurbishment

- ▶ In preparation for the 6 GeV program, we have started cryomodule refurbishment.
 - Refurbishment entails
 - ▶ the removal of a low performance module from the accelerator
 - ▶ opening the module,
 - ▶ reprocessing the cavities and
 - ▶ putting the cryomodule together and
 - ▶ Installing the cryomodule in the accelerator

H. Areti: CLAS Collaboration Meeting, October 2005

CLAS 12 GeV

Preshower Calorimeter

*Forward Cerenkov
(LTCC)*

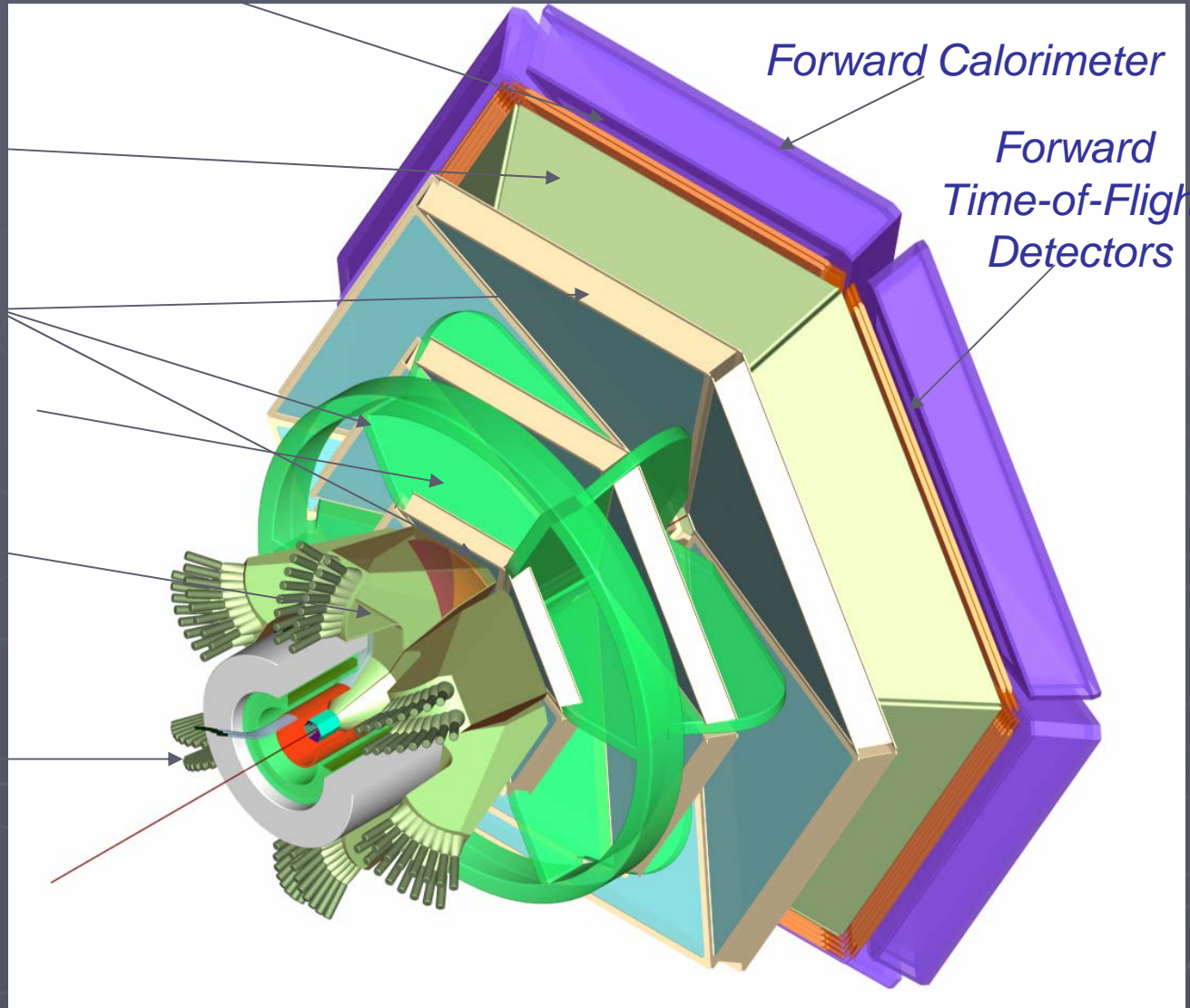
*Forward
Drift Chambers
Superconducting
Torus Magnet*

*Inner Cerenkov
(HTCC)*

Central Detector

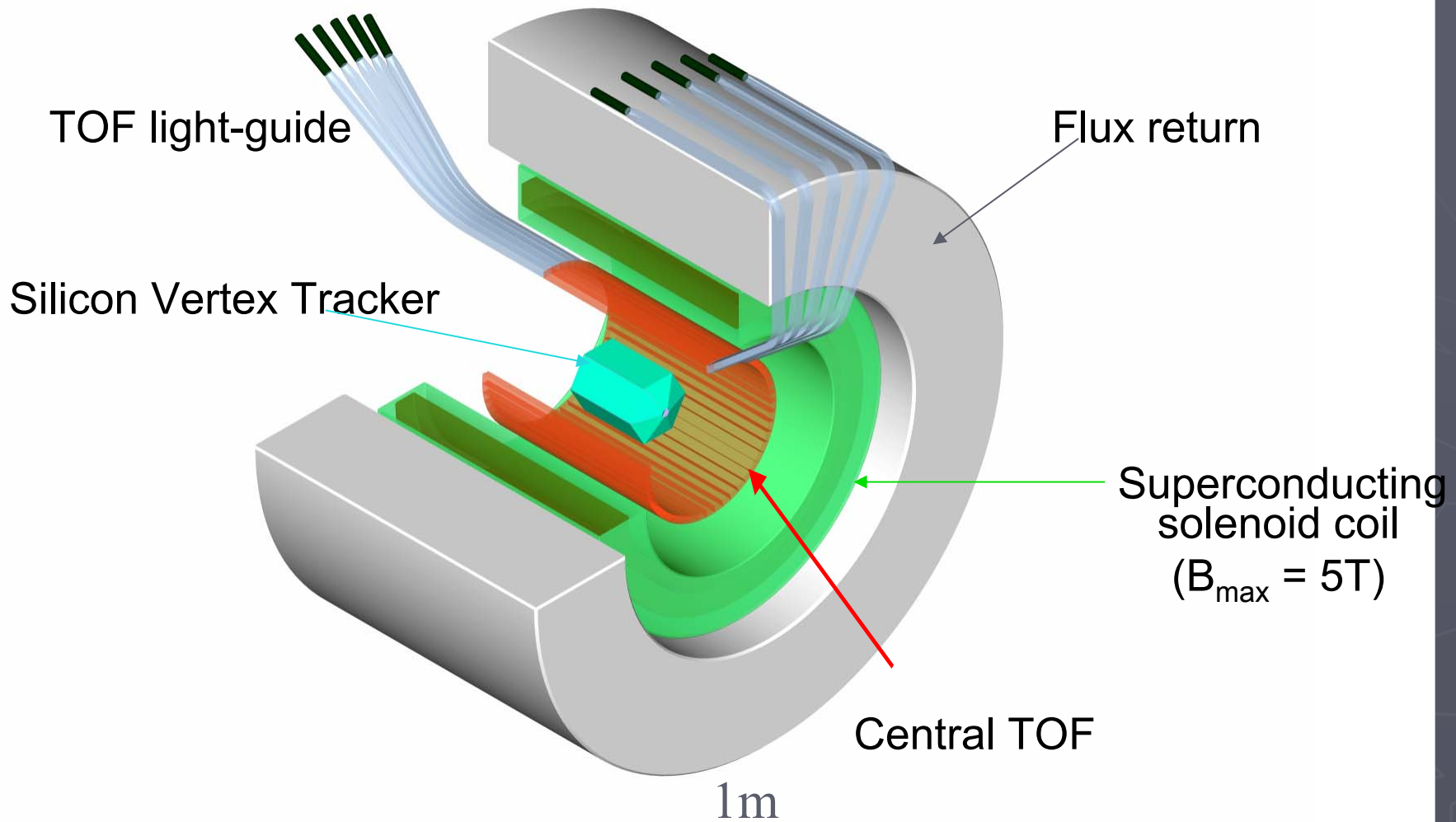
Forward Calorimeter

*Forward
Time-of-Flight
Detectors*



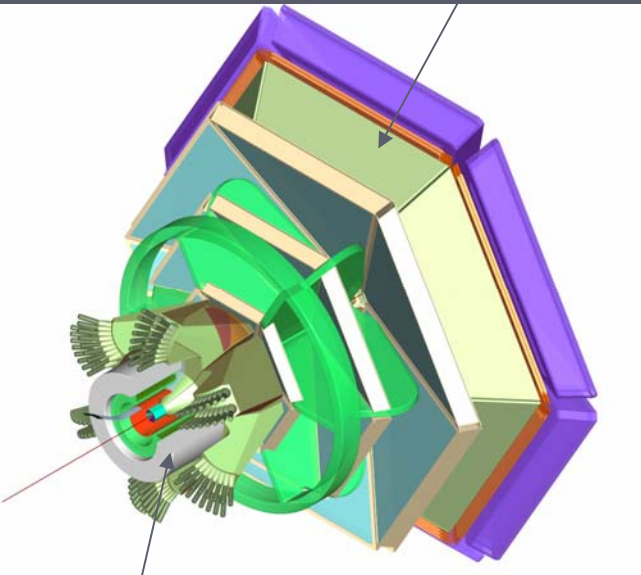
CLAS12

CLAS 12 Central Detector



CLAS12 - Design Parameters

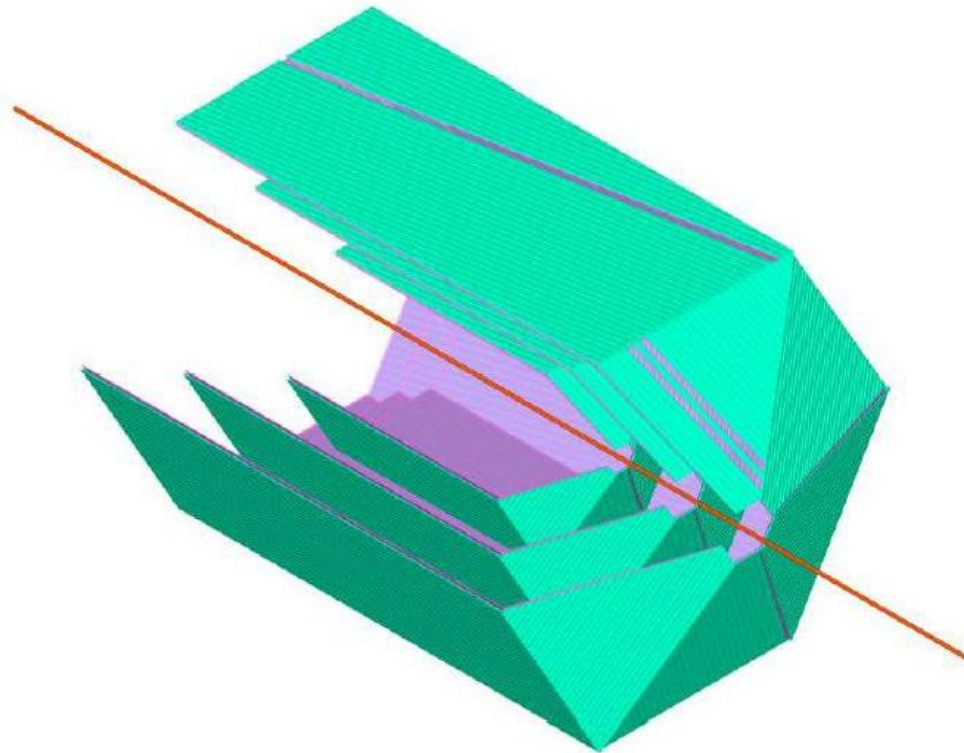
Forward Detector



	Forward Detector	Central Detector
Angle range		
Tracks	$5^{\circ} - 40^{\circ}$	$40^{\circ} - 135^{\circ}$
Photons	$3^{\circ} - 40^{\circ}$	NA
Resolution		
$\delta p/p$	$0.003 + 0.001p$	$\delta p_T/p_T = 0.03$
$\delta\theta$ (mr)	< 1.0	8
$\delta\phi$ (mr)	< 3.0	2
Photon detection		
Energy (MeV)	> 150	NA
$\delta\theta$ (mr)	4 (1GeV)	NA
Neutron detection		
N_{eff}	0.1 – 0.5	0.05
Particle ID		
e/π	Full range	NA
π/p	Full range	$< 1.2 \text{ GeV}/c$
π/K	Full range	$< 0.65 \text{ GeV}/c$
K/p	$< 4 \text{ GeV}/c$	$< 0.90 \text{ GeV}/c$
$\pi^0 \rightarrow \gamma\gamma$	Full range	NA
$\eta \rightarrow \gamma\gamma$	Full range	NA

Central Detector

CLAS12: Silicon Vertex Detector



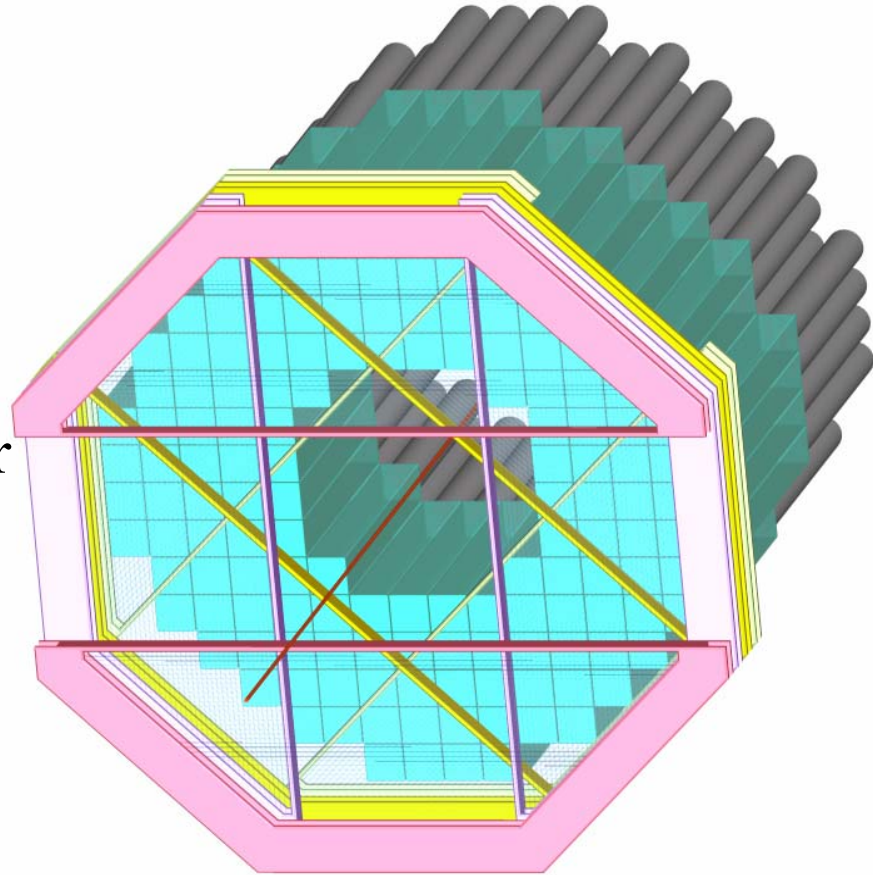
Silicon Vertex Tracker

3 double-sided layers
of stereo strip readout
On-board ADCs
strip pitch: 100–300mm
45,000 readout channels

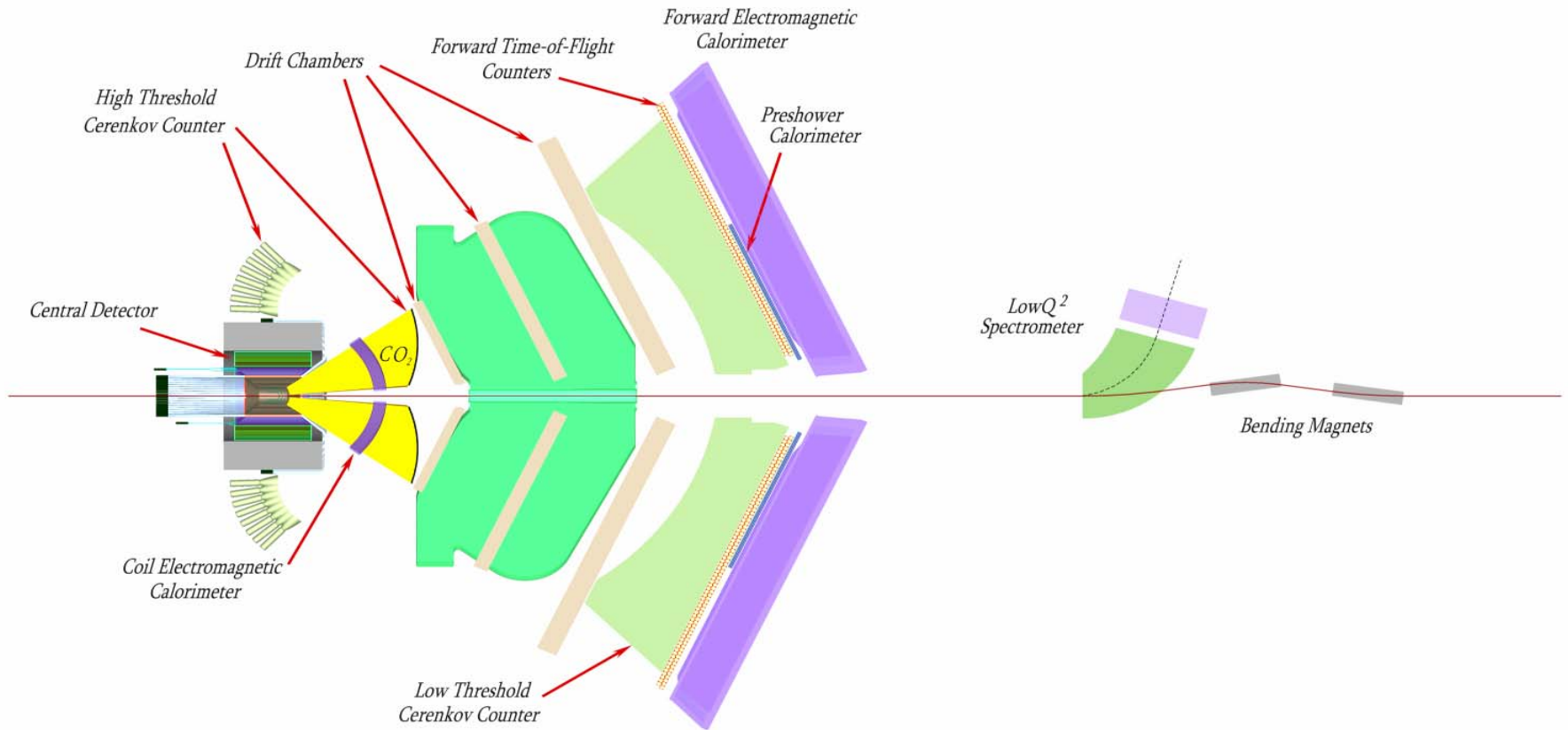
$$\Delta z \sim 100 \mu\text{m}$$

CLAS12 Low Q^2 Spectrometer

PbWO_4 or PbF_2 Calorimeter



CLAS12 Low Q^2 Spectrometer



Summary

PAST:

CLAS: First Observation of Ξ photoproduction (g6 a,b,c)

PRESENT:

g11: High integrated luminosity

Sensitive to resonance (missing) masses up to ~ 1650 MeV/c²

eg3: High integrated luminosity, Direct observation of Ξ states

FUTURE:

super-g: High integrated luminosity

Sensitive to resonance (missing) masses up to ~ 2000 MeV/c²

CLAS12