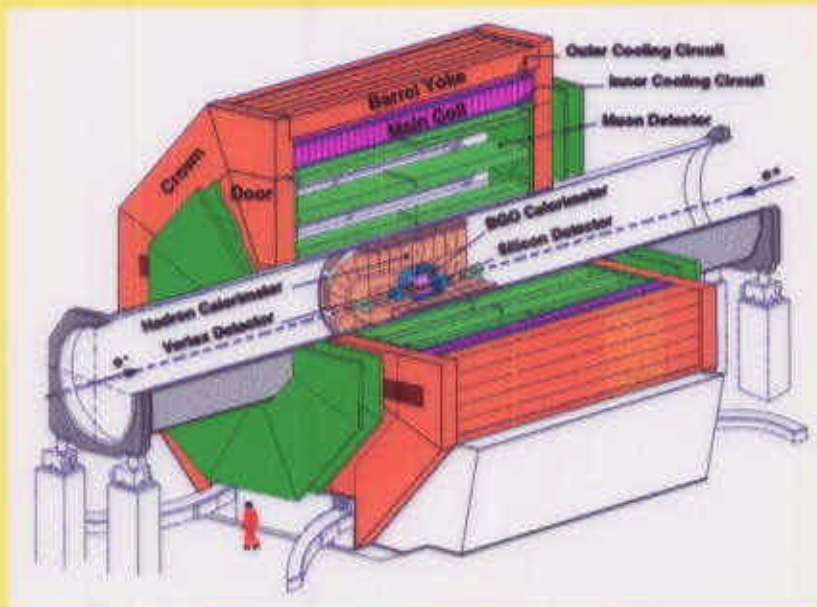




Two Photon Collisions at LEP:
 $K_S^0 K_S^0$ Final State
 Glueball Searches
 $\Lambda \bar{\Lambda}$ Production

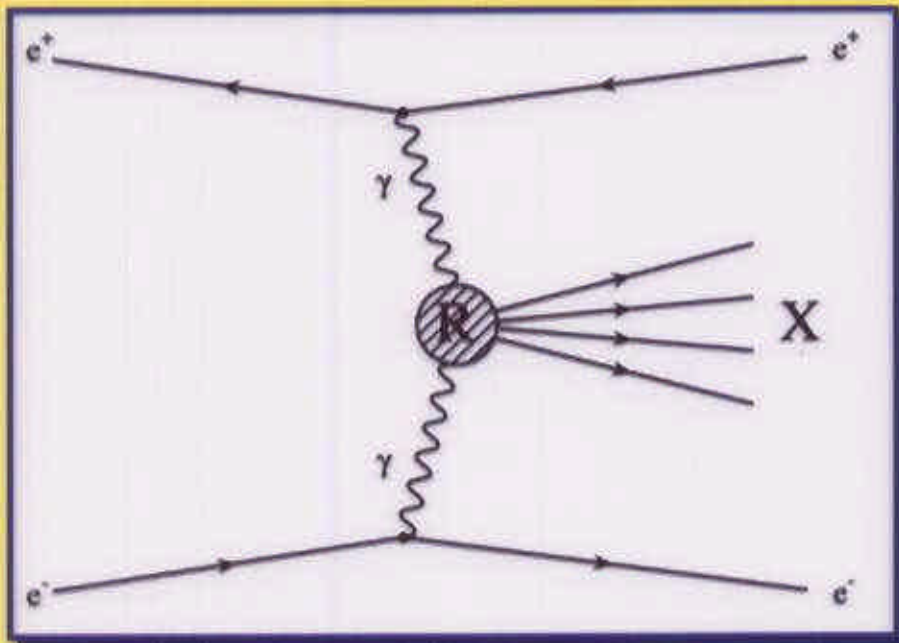
For the L3 Collaboration
 Artur J. Barczyk
 PSI Villigen, Switzerland

28.07.2000
 ICHEP 2000, Osaka, Japan



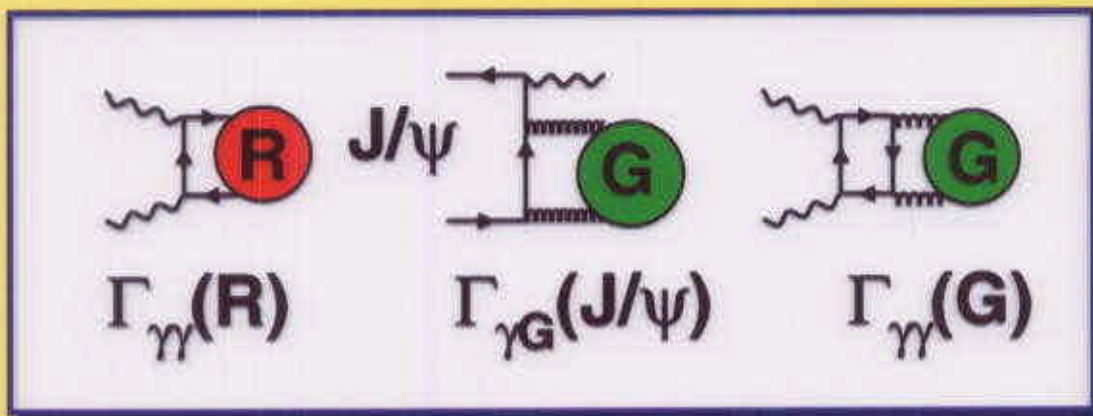


Resonances in $\gamma\gamma$ Collisions



Untagged events

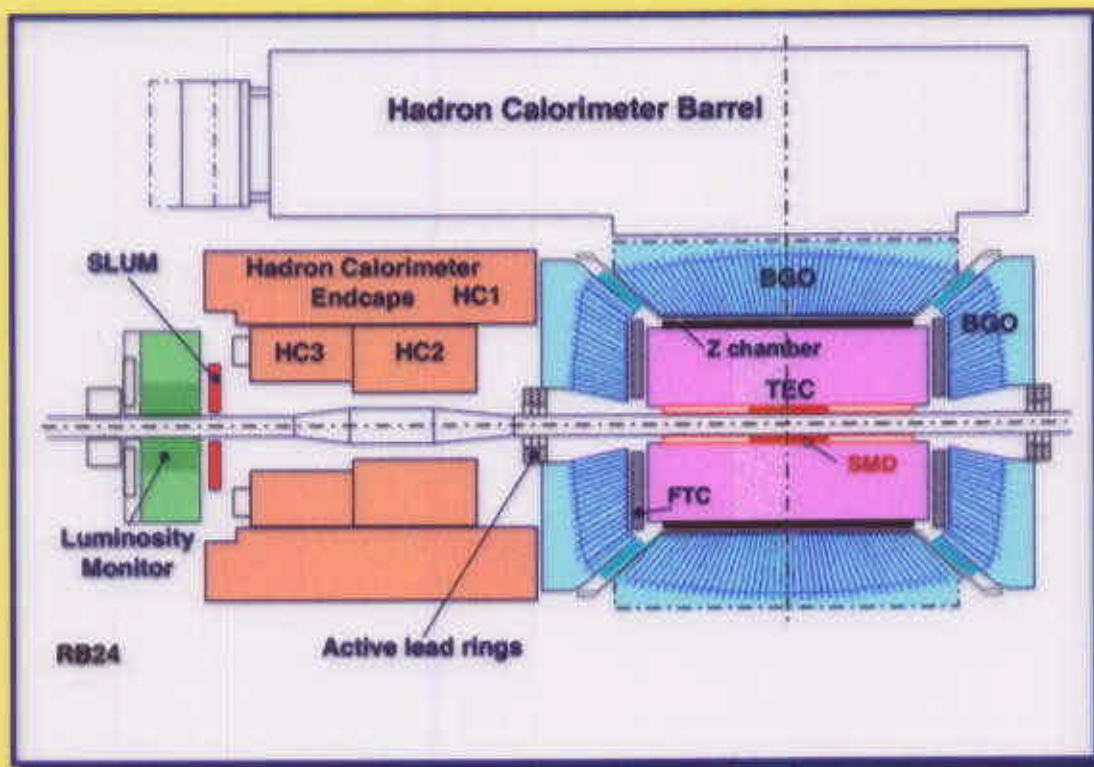
- $\Rightarrow e^+e^-$ undetected
- \Rightarrow quasi-real photons ($Q^2 \approx 0$)
- \Rightarrow R neutral, unflavoured meson, $C=+1$, $J \neq 1$



very small $\Gamma_{\gamma\gamma}$ of Glueballs



L3 Inner Detector



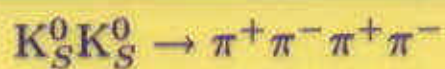
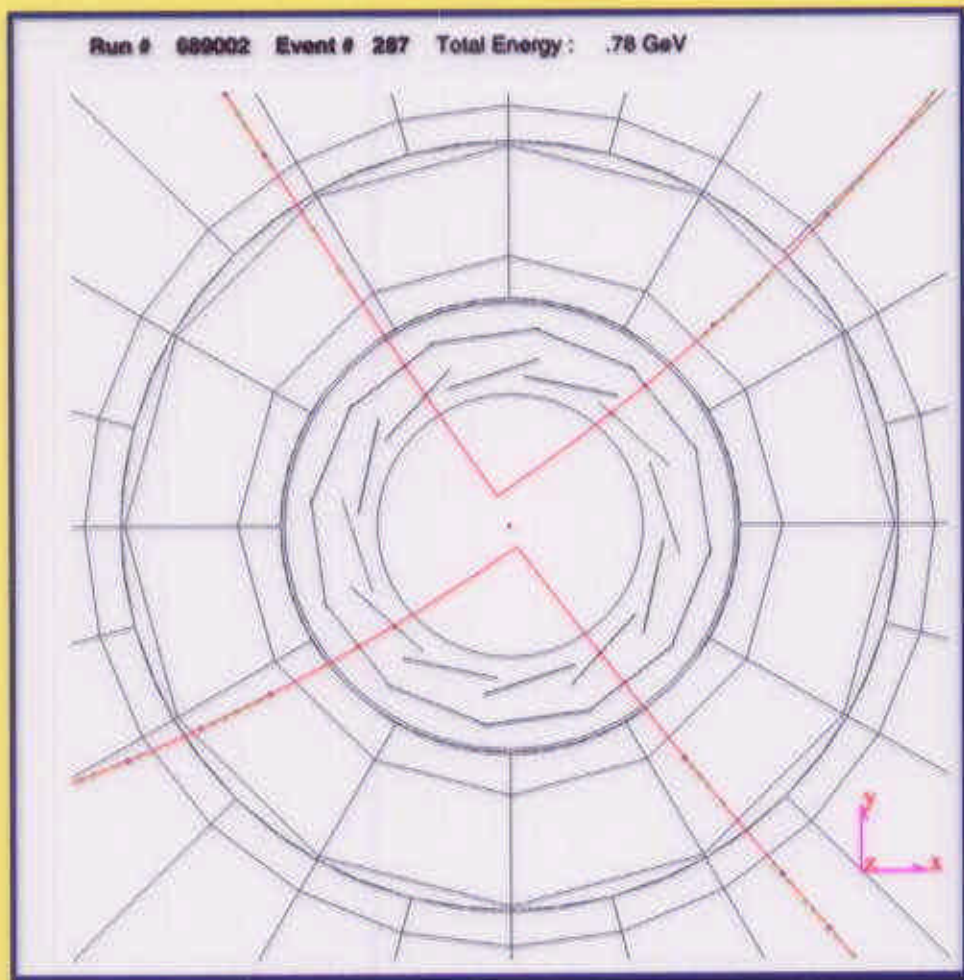
- ◆ Silicon Microstrip Detector
- ◆ Time Expansion Chamber
- ◆ High Resolution BGO Calorimeter
- ◆ Low p_T Threshold Charged Particle Trigger

Data sample analyzed:

\sqrt{s} [GeV]	Luminosity [pb^{-1}]
91	143
183	52
189-202	393
TOTAL	588



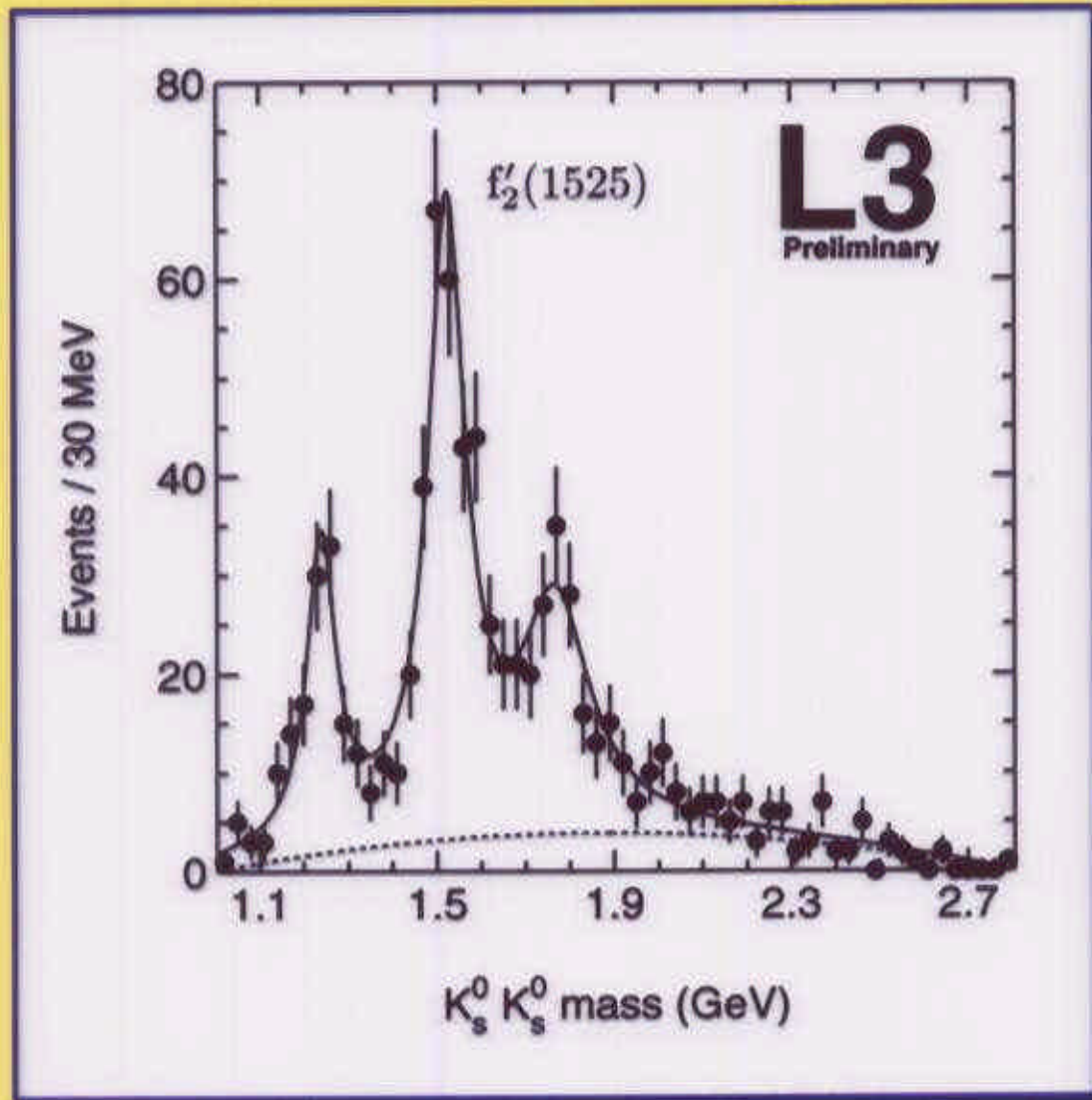
Exclusive $K_S^0 K_S^0$ Selection



- ◆ 4 charged tracks, $\Sigma q = 0$
- ◆ 2 secondary vertices
- ◆ $|\Sigma \vec{p}_T|^2 < 0.1 \text{ GeV}^2$

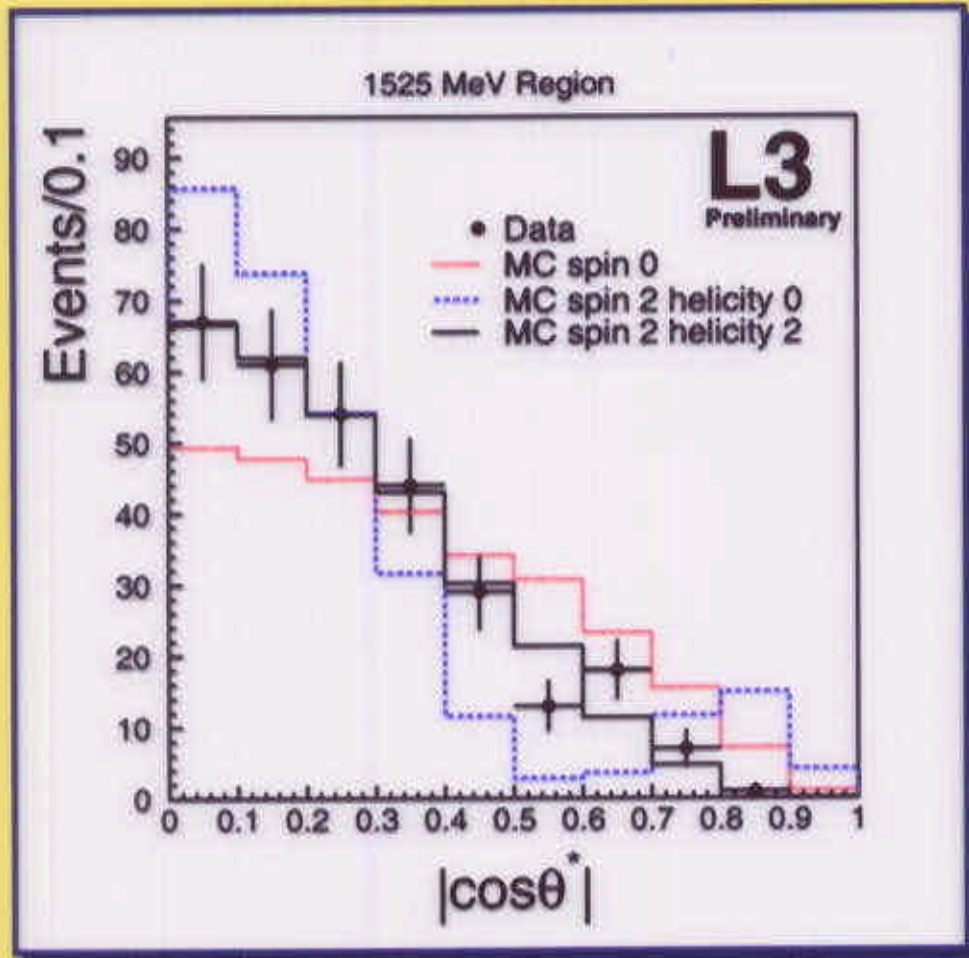


$$\gamma\gamma \rightarrow R \rightarrow K_S^0 K_S^0$$



4 "Regions of Interest":

- ⇒ $f_2 - a_2$ destructive interference (~ 1250 MeV)
- ⇒ $f_2'(1525)$ tensor meson
- ⇒ Enhancement in the 1750 MeV region
- ⇒ No Signal around 2230 MeV


 $f_2'(1525)$


Dominated by helicity 2 state:

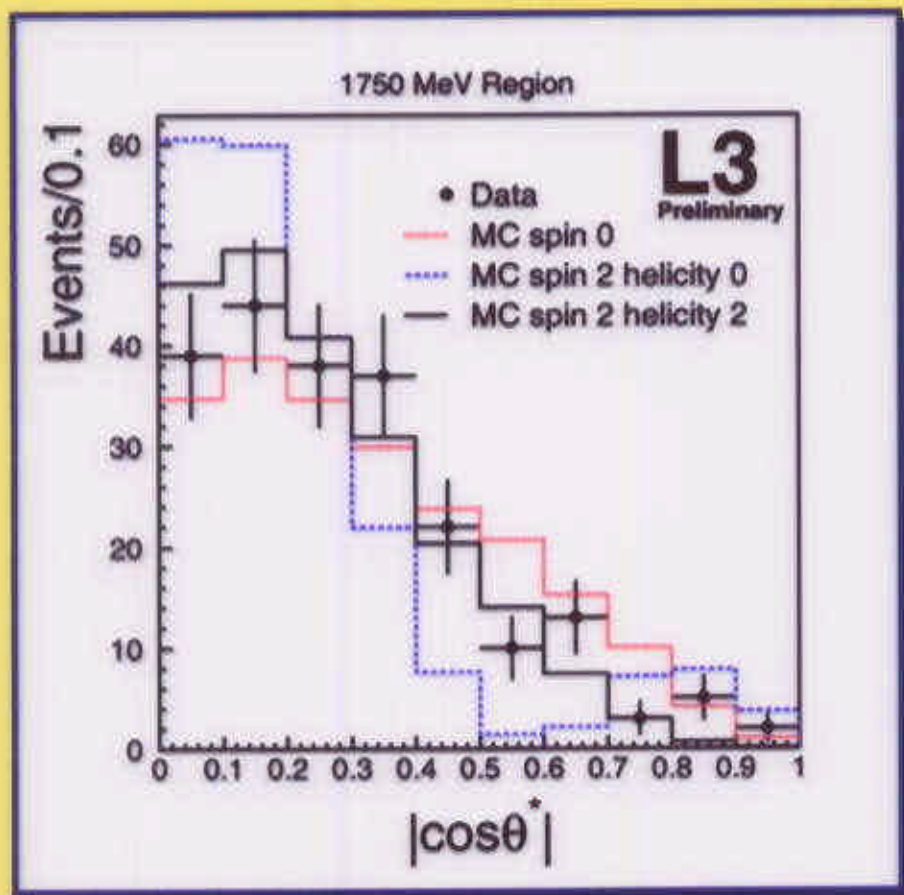
	$J = 0$	$J = 2, \lambda = 0$	$J = 2, \lambda = 2$
C.L.	10^{-6}	10^{-6}	99.9%

$$\Gamma_{\gamma\gamma}(f_2') \times \text{Br}(f_2' \rightarrow K\bar{K}) = 0.076 \pm 0.006(\text{stat.}) \pm 0.011(\text{syst.}) \text{ keV}$$



1750 MeV Mass Region

- ◆ radial recurrence of $f_2'(1525)$? (pred. $f_2''(1810)$)
- ◆ $0^{++} s\bar{s}$ state? ($f_0'(1500 - 1800)$)



Pure state fit:

	$J = 0$	$J = 2, \lambda = 0$	$J = 2, \lambda = 2$
C.L.	8%	10^{-6}	33%

Mixed state fit ($J = 0; J = 2, \lambda = 2$):

C.L.: 84% with $24 \pm 16\%$ $J = 0$



$\xi(2230)$

- ◆ $\xi(2230)$ is a glueball candidate (MARK III, BES)
- ◆ lattice QCD pred. ground state tensor glueball in this mass region
- ◆ **stickiness** expected to be large for glueballs:

$$\frac{|\langle R | gg \rangle|^2}{|\langle R | \gamma\gamma \rangle|^2} \sim S_R = N_l \left(\frac{m_R}{k_{J/\psi \rightarrow \gamma R}} \right)^{2l+1} \frac{\Gamma(J/\psi \rightarrow \gamma R)}{\Gamma(R \rightarrow \gamma\gamma)}$$

- l : orbital ang. mom. btw. gluons ($l=0$)
- $k_{J/\psi \rightarrow \gamma R}$: photon energy in J/ψ decay
- N_l : normalization, $S_{f_2(1270)} \equiv 1$

L3 measurement:

- \Rightarrow no signal at 2230 MeV
- $\Rightarrow \Gamma_{\gamma\gamma}(\xi) \times \text{Br}(\xi(2230) \rightarrow K_S^0 K_S^0) < 1.4 \text{ eV at 95\% C.L.}$
- $\Rightarrow S_{\xi(2230)} > 73 \text{ at 95\% C.L.}$

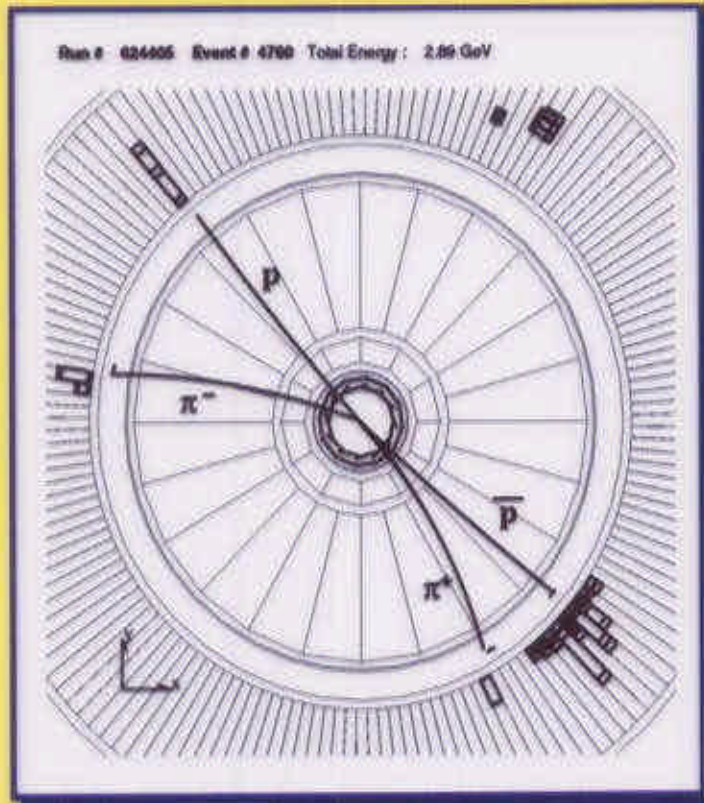
confirmation of CLEO's measurement:

- $\Rightarrow \Gamma_{\gamma\gamma}(\xi) \times \text{Br}(\xi(2230) \rightarrow K_S^0 K_S^0) < 1.3 \text{ eV at 95\% C.L.}$
- $\Rightarrow S_{\xi(2230)} > 82 \text{ at 95\% C.L.}$

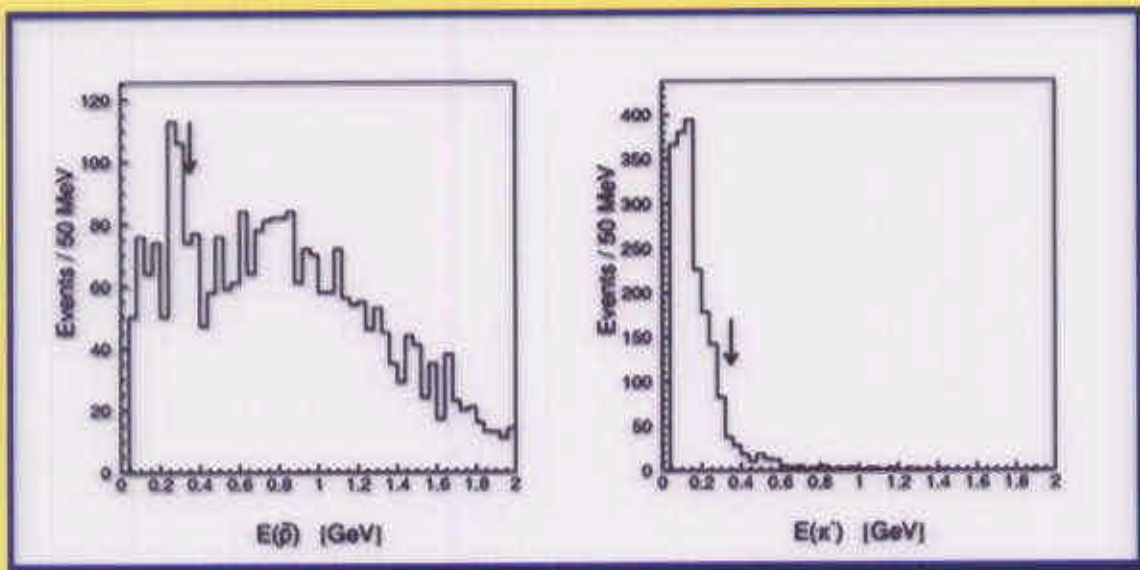
$\xi(2230)$ is a good glueball candidate



$\Lambda\bar{\Lambda}$ Selection



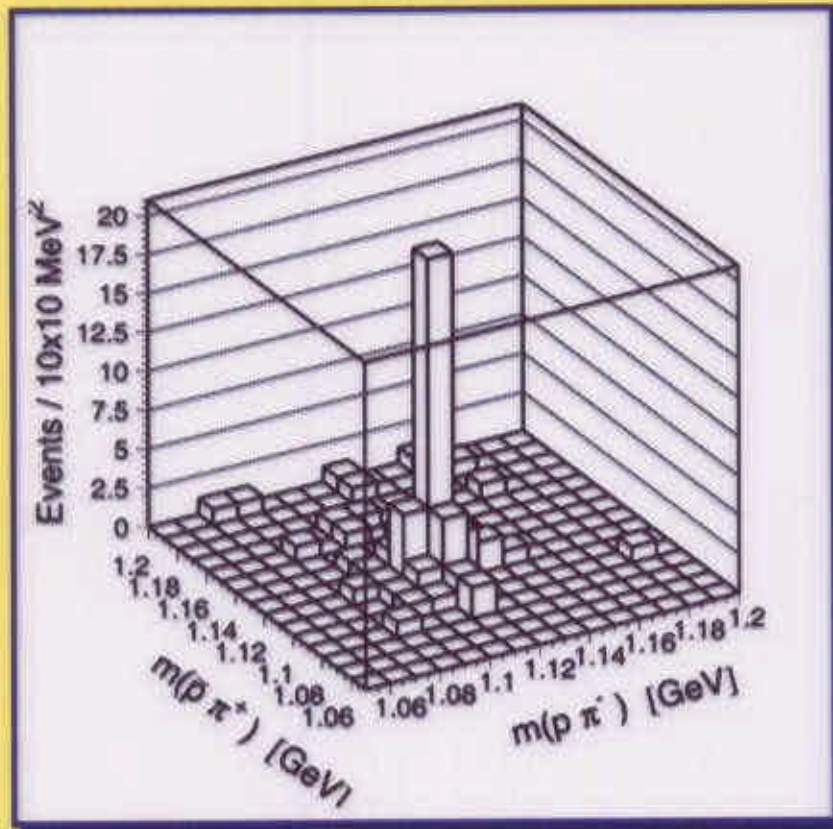
- ◆ 4 charged tracks, $\Sigma q = 0$
- ◆ 2 secondary vertices
- ◆ $E_{em}^{\bar{p}} > 0.35$ GeV, \bar{p} annihilation in BGO





$$e^+e^- \rightarrow \gamma\gamma \rightarrow \Lambda\bar{\Lambda} + n\gamma$$

Mass Spectrum



44 $\Lambda\bar{\Lambda}$ candidates found

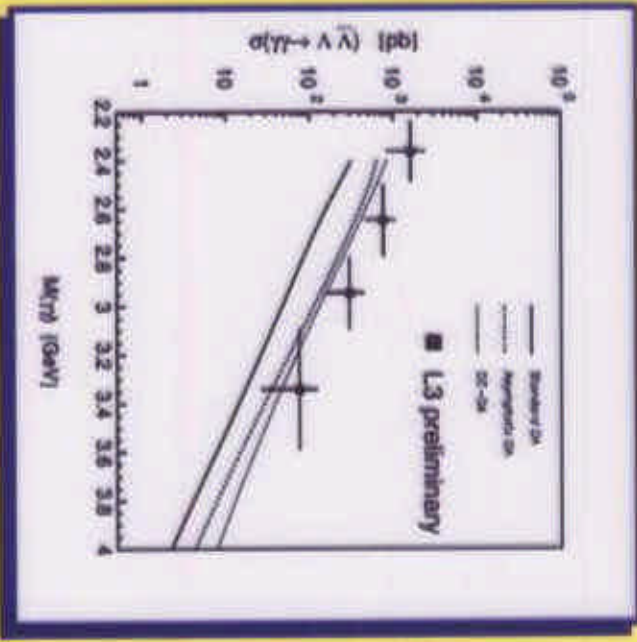
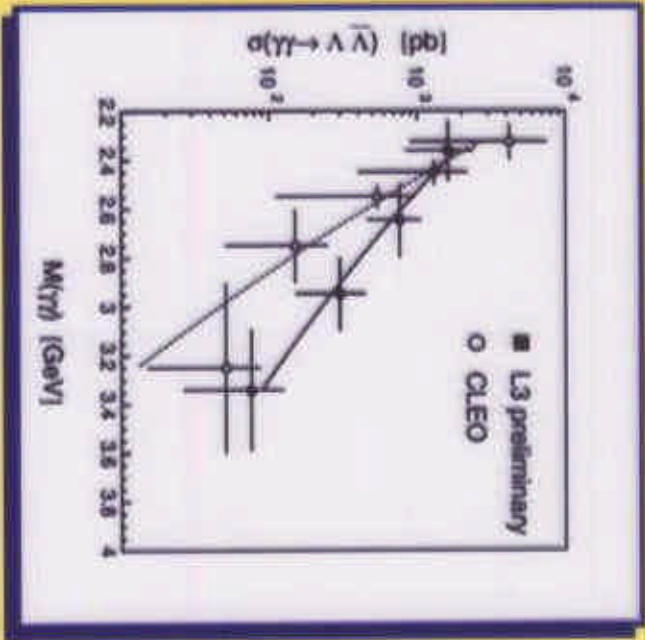
No feiddown exclusion!

Measured $e^+e^- \rightarrow e^+e^-(\Lambda/\Sigma^0)(\bar{\Lambda}/\bar{\Sigma}^0)$ cross section:

$$\sigma = 4.13 \pm 0.65(\text{stat.}) \pm 0.69(\text{syst.}) \text{ pb}$$



$\Lambda\bar{\Lambda}$ production cross section



Mass dependence of the cross section compatible to CLEO's measurement

Mass dependence well described by Quark-Diquark model prediction

However, fit $\sigma \propto M^{-n}$:

	L3	CLEO
n	8.69 ± 3.81	16.06 ± 5.78

C. Berger, B. Lechner, W. Schweiger,
 Fizika B 8 (1999) 371
 (no $\Sigma^0 \bar{\Sigma}^0$ in calculations!)

Conclusions and Outlook

- ◆ Improved analysis of $K_S^0 K_S^0$ mass spectrum
- ◆ $f_2'(1525)$ consistent with pure $J = 2, \lambda = 2$ state
- ◆ clear enhancement around 1750 MeV, dominated by $J = 2, \lambda = 2$ with admixture of $J = 0$ state
- ◆ no signal in the region of $\xi(2230)$ glueball candidate, high stickiness $S_{\xi(2230)}$
- ◆ first measurement at LEP of $\Lambda\bar{\Lambda}$ production in $\gamma\gamma$ interaction
- ◆ cross section consistent within errors with CLEO measurement
- ◆ analysis will be extended to other baryons
- ◆ **LEP data still arriving!**