Two Photon Collisions at LEP:

$K_S^0 K_S^0$ Final State

Glueball Searches

$\Lambda\bar{\Lambda}$ Production

For the L3 Collaboration

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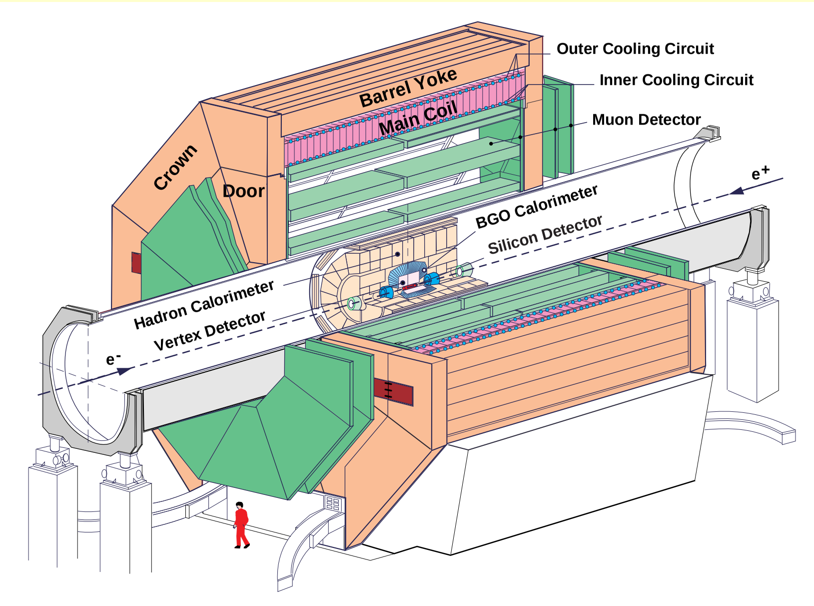
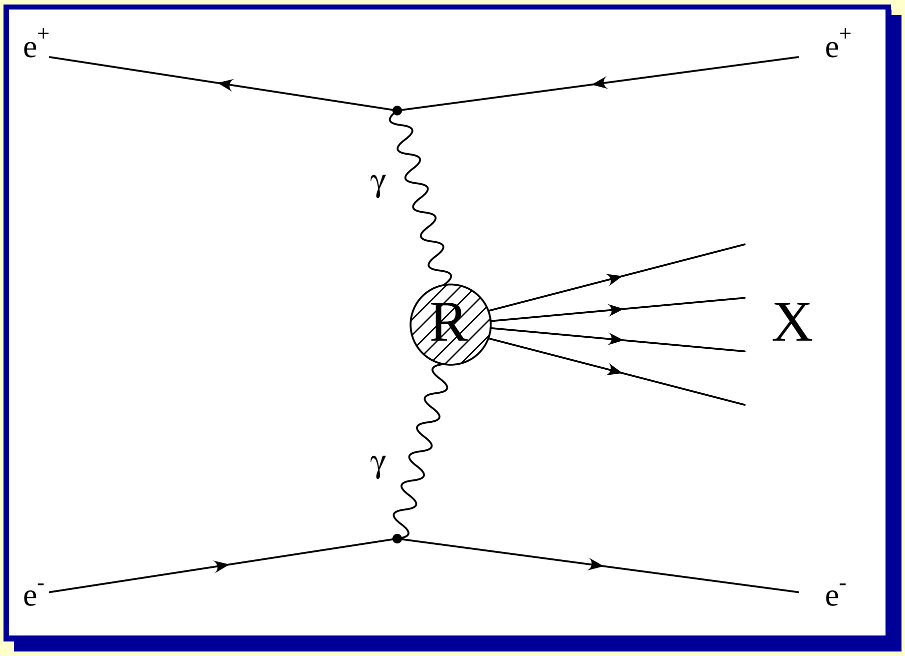


Resonances in $\gamma\gamma$ Collisions

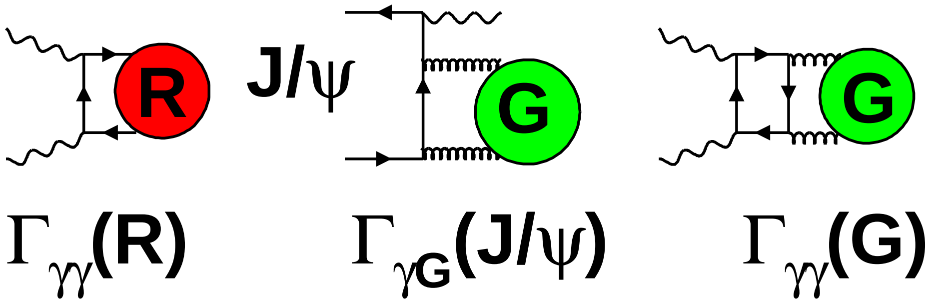


Untagged events

$\Rightarrow$ e^+e^- undetected

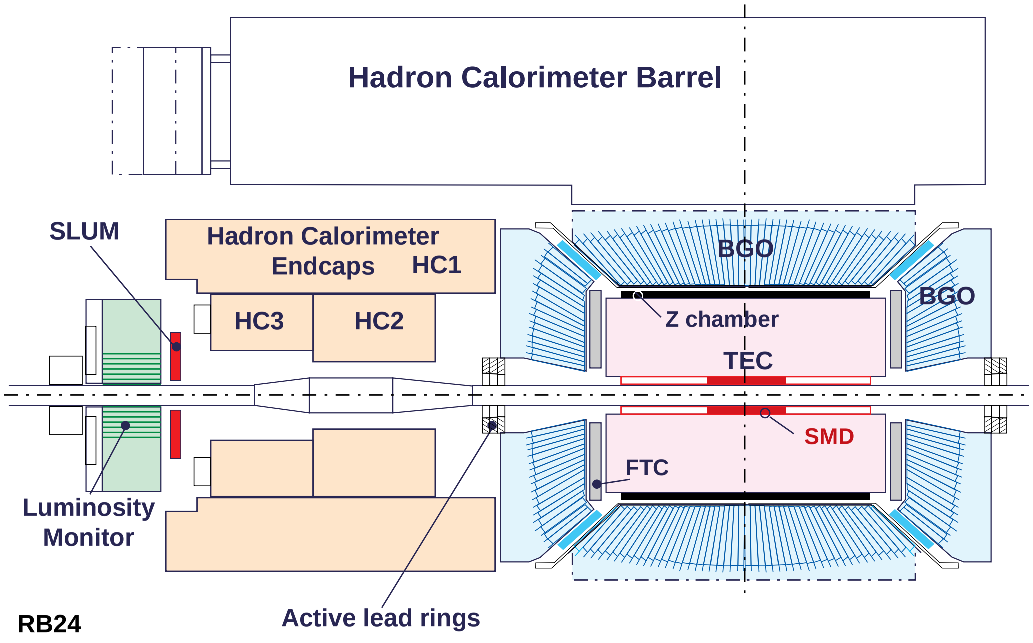
$\Rightarrow$ quasi-real photons ($Q^2 \approx 0$)

$\Rightarrow$ R neutral, unflavoured meson, C=+1, J$\neq$1



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

L3 Inner Detector

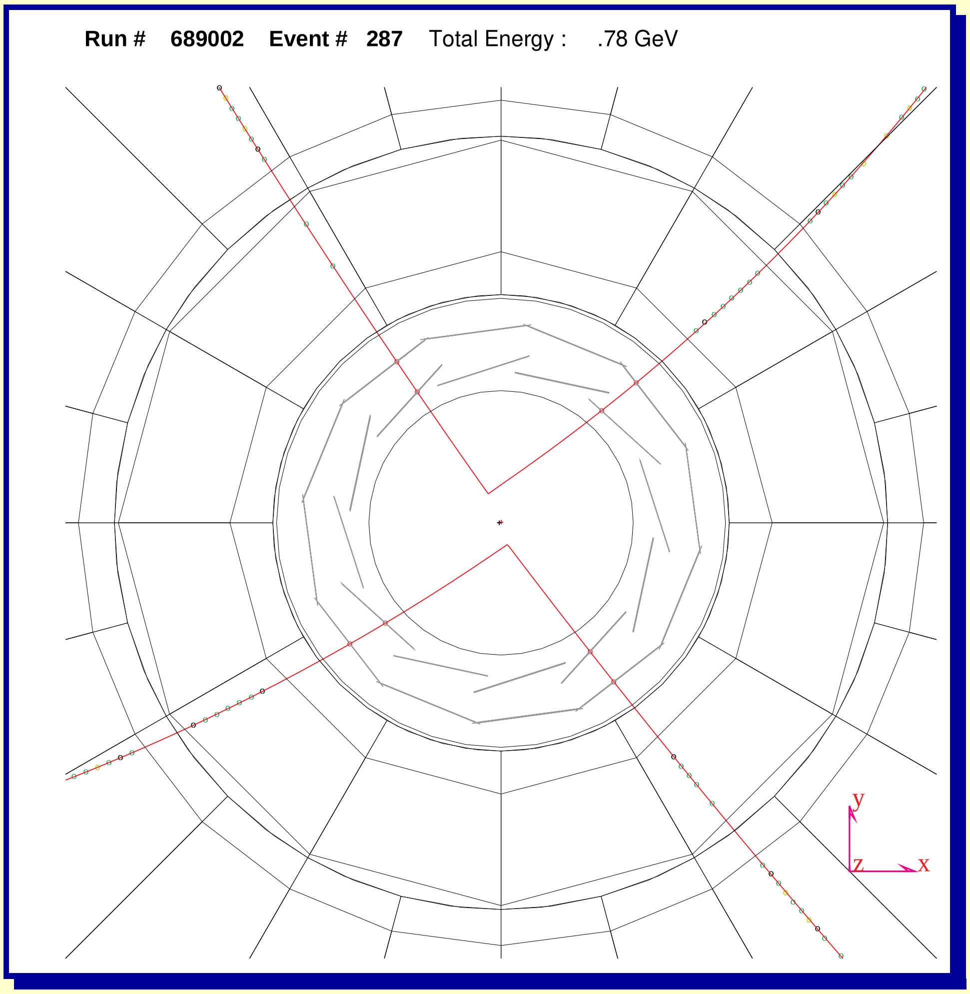


- Silicon Microstrip Detector
- Time Expansion Chamber
- High Resolution BGO Calorimeter
- Low p_T Threshold Charged Particle Trigger

Data sample analyzed:

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

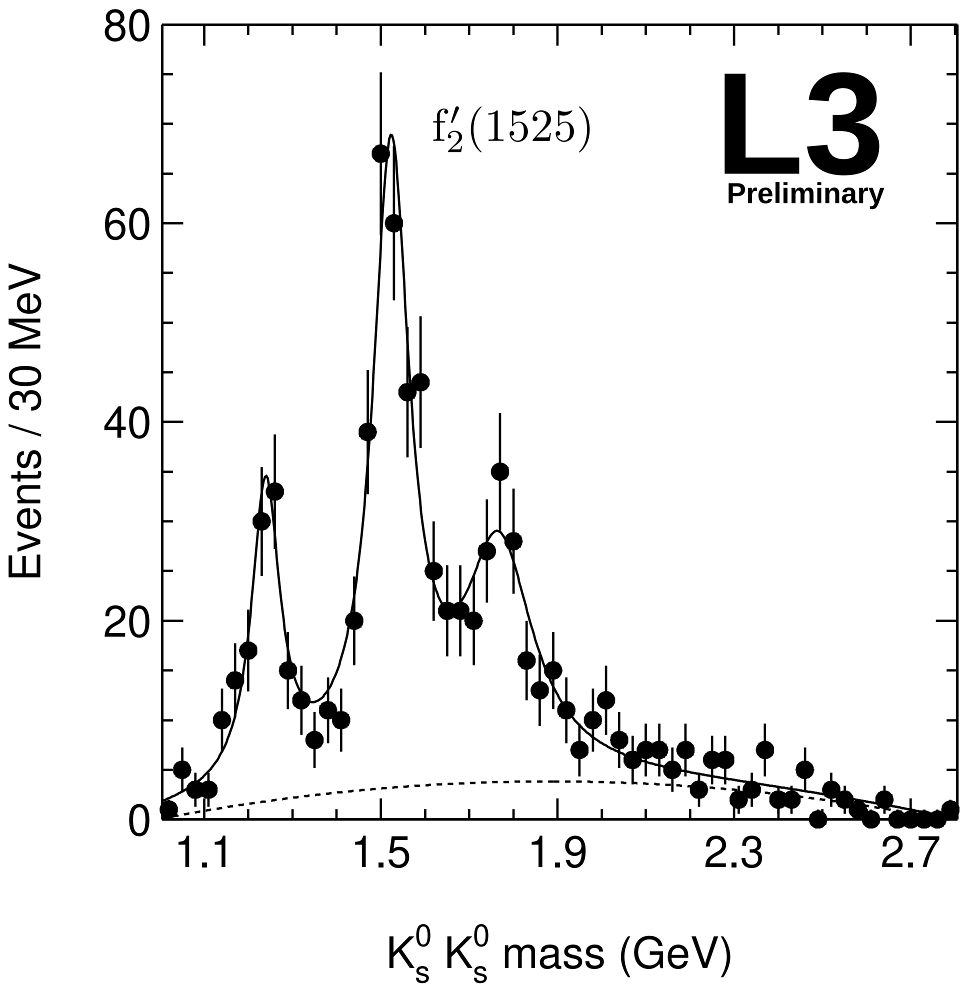
Exclusive $\mathrm{K}_S^0\mathrm{K}_S^0$ *Selection*



$$\mathrm{K}_S^0\mathrm{K}_S^0 \to \pi^+\pi^-\pi^+\pi^-$$

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

$\gamma\gamma \rightarrow \mathrm{R} \rightarrow \mathrm{K}^0_S\mathrm{K}^0_S$



4 "Regions of Interest":

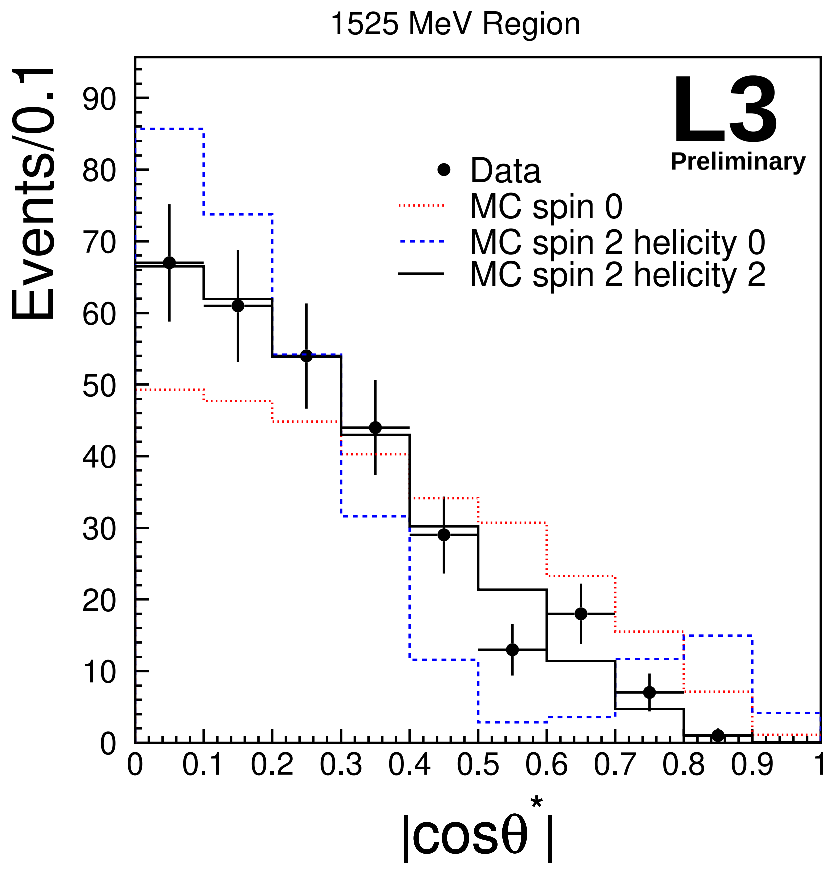
⇒ $\mathrm{f}_2 - \mathrm{a}_2$ destructive interference (~ 1250 MeV)

⇒ $\mathrm{f}'_2(1525)$ 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%

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

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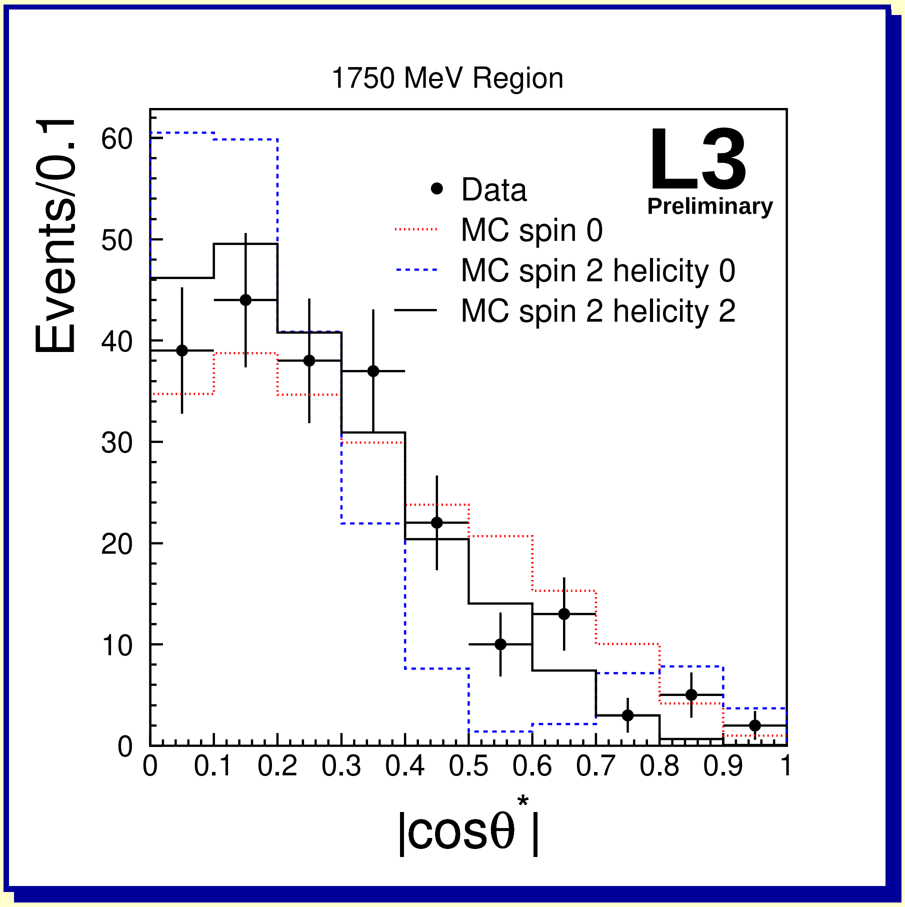
1750 MeV *Mass Region*

- radial recurrence of $\mathrm{f}_2'(1525)$? (pred. $\mathrm{f}_2''(1810)$)
- $0^{++}\mathrm{s\bar{s}}$ 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 ± 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:

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

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

L3 measurement:

$\Rightarrow$ no signal at 2230 MeV

$\Rightarrow$ $\Gamma_{\gamma\gamma}(\xi) \times \mathrm{Br}(\xi(2230) \to \mathrm{K^0_S K^0_S}) < 1.4\ \mathrm{eV}$ at 95% C.L.

$\Rightarrow$ $S_{\xi(2230)} > 73$ at 95% C.L.

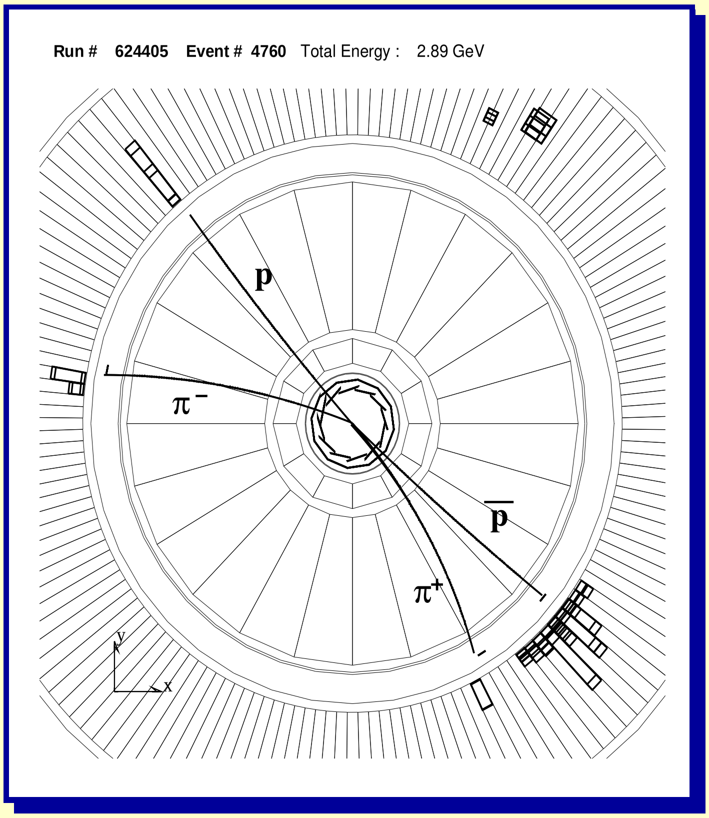
confirmation of CLEO's measurement:

$\Rightarrow$ $\Gamma_{\gamma\gamma}(\xi) \times \mathrm{Br}(\xi(2230) \to \mathrm{K^0_S K^0_S}) < 1.3\ \mathrm{eV}$ at 95% C.L.

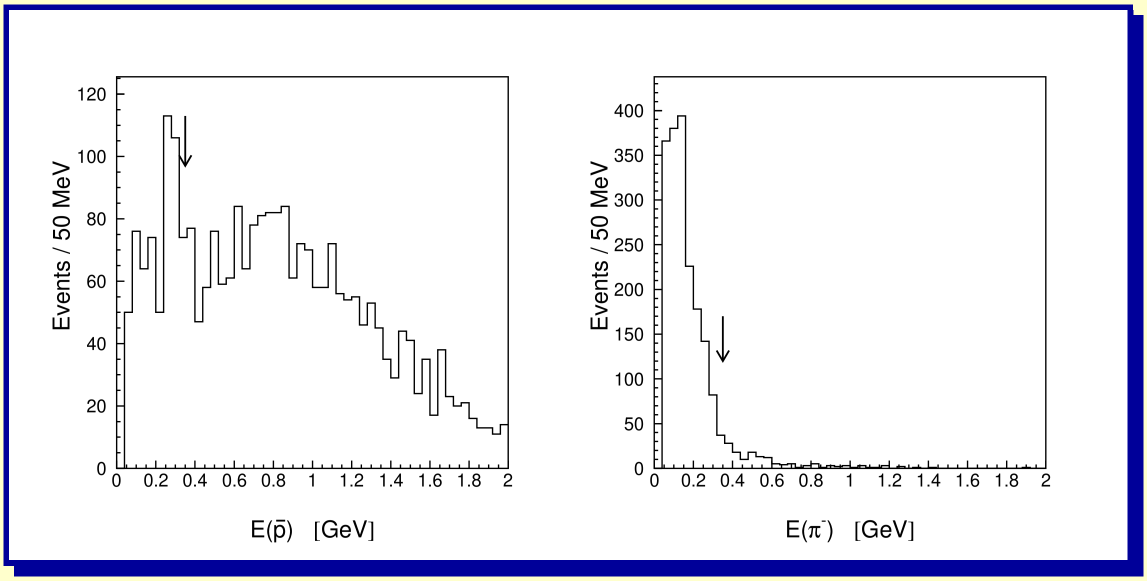
$\Rightarrow$ $S_{\xi(2230)} > 82$ at 95% C.L.

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

$\Lambda\bar{\Lambda}$ *Selection*

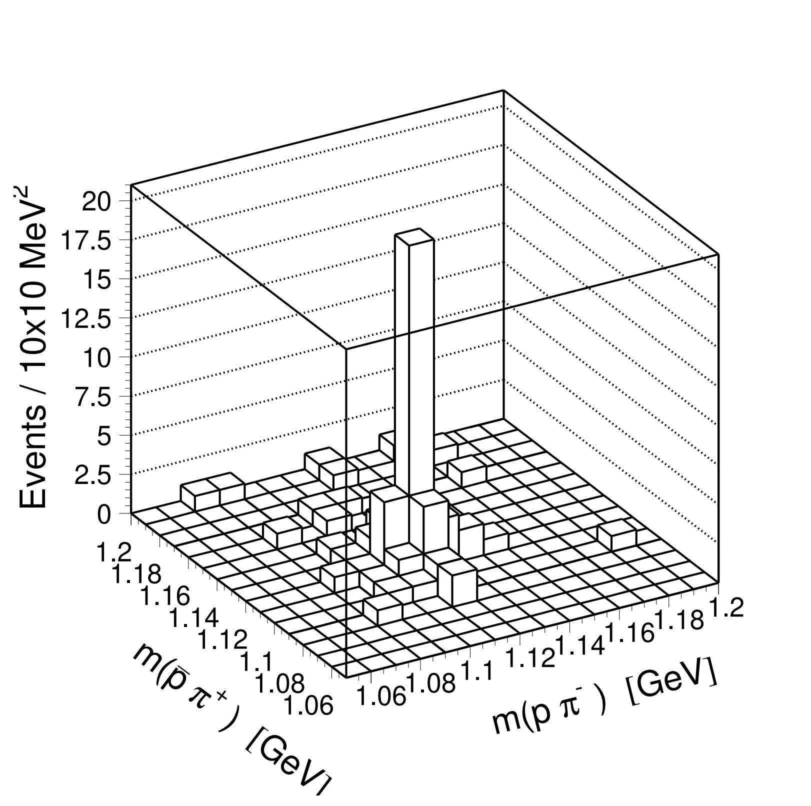


- 4 charged tracks, $\Sigma q = 0$
- 2 secondary vertices
- $E^{\bar{p}}_{em} > 0.35$ GeV, $\bar{p}$ annihilation in BGO



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

Mass Spectrum



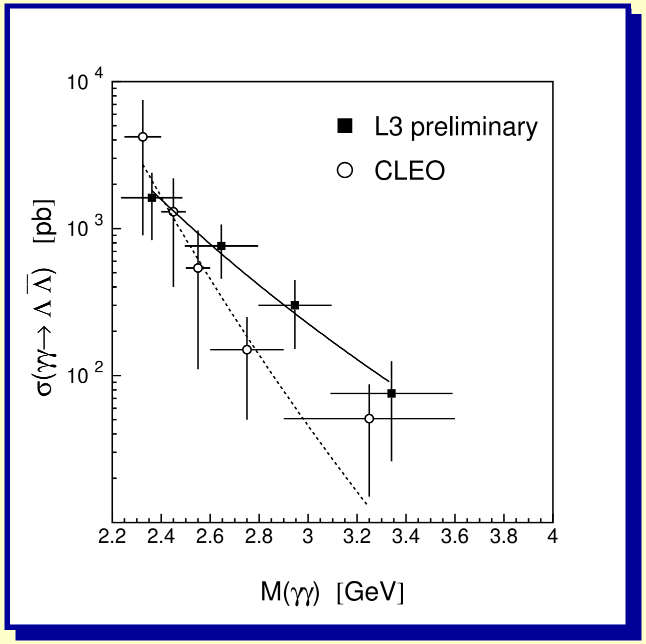
44 $\Lambda\bar{\Lambda}$ candidates found

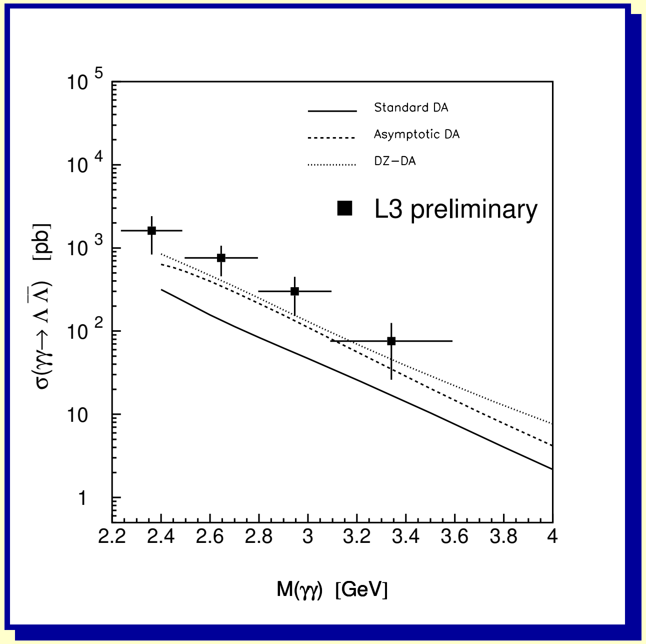
No feeddown exclusion!

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

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

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





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

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

	L3	CLEO
n	8.69 ± 3.81	16.06 ± 5.78

Mass dependence well described by Quark-Diquark model prediction

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 $1750\ \mathrm{MeV}$, 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!**