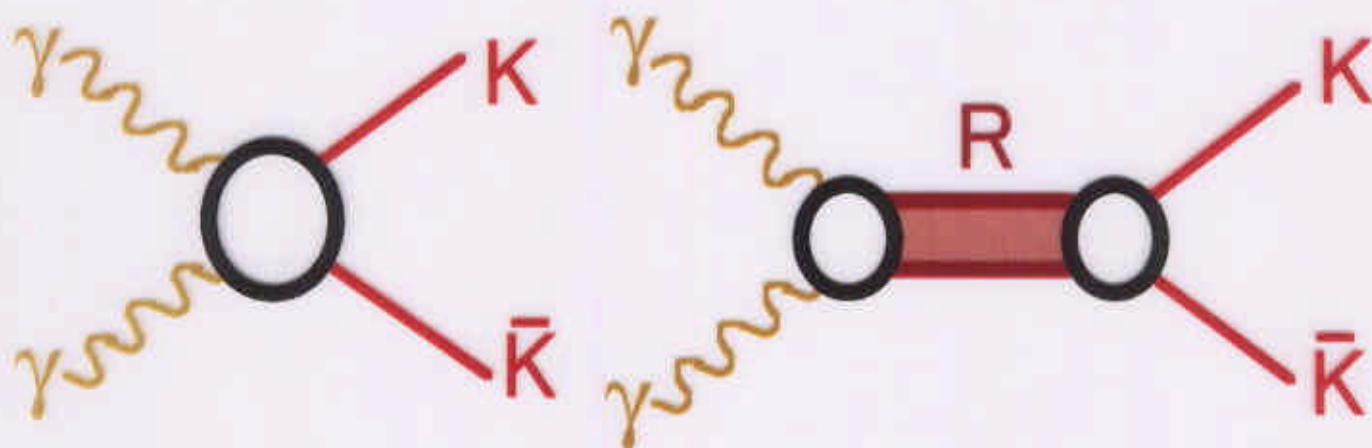


Measurement of K^+K^- production in two-photon collisions at Belle

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for the Belle Collaboration

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Contributed papers: BELLE-CONF-0017, #288
-0018, #290



KEKB accelerator and Belle detector

Selection

Invariant mass distribution

Cross section for $\gamma\gamma \rightarrow K^+K^-$

$K_S^0 K_S^0$ results

Introduction

$$\gamma\gamma \rightarrow R \rightarrow K\bar{K}$$

$$J^{PC}(R) = (\text{even})^{++}$$

$$f_2(1270), a_2^0(1320), f_2'(1525)$$

are observed in K^+K^- and $K_S^0K_S^0$ modes

No established meson is observed above the $f_2'(1525)$ mass

L3 reported a resonance-like peak around 1.75 GeV in $K_S^0K_S^0$ mode

Study of glueball candidates $f_J(1710), f_J(2220)$
small $\gamma\gamma$ couplings expected

$$\gamma\gamma \rightarrow K^+K^-$$

$$\text{in } 1.36 < W < 2.30 \text{ GeV}$$

$$K^+K^- \text{ and } K^0\bar{K}^0$$

Decay amplitude of each resonance should be same
Interference effect of resonances may be different

Experimental Apparatus

KEKB asymmetric e^+e^- collider

$E_{e^+} = 3.5 \text{ GeV}$, $E_{e^-} = 8.0 \text{ GeV}$,
 \sqrt{s} around 10.58 GeV

Belle detector

Tracking: Central drift chamber (CDC)
 Silicon vertex detector (SVD)

Particle-ID:

TOF counters -- time resolution = 100 ps

K/π separation up to $1.2 \text{ GeV}/c$

Silica-aerogel Cherenkov counters (ACC)

K/π separation above $1.2 \text{ GeV}/c$

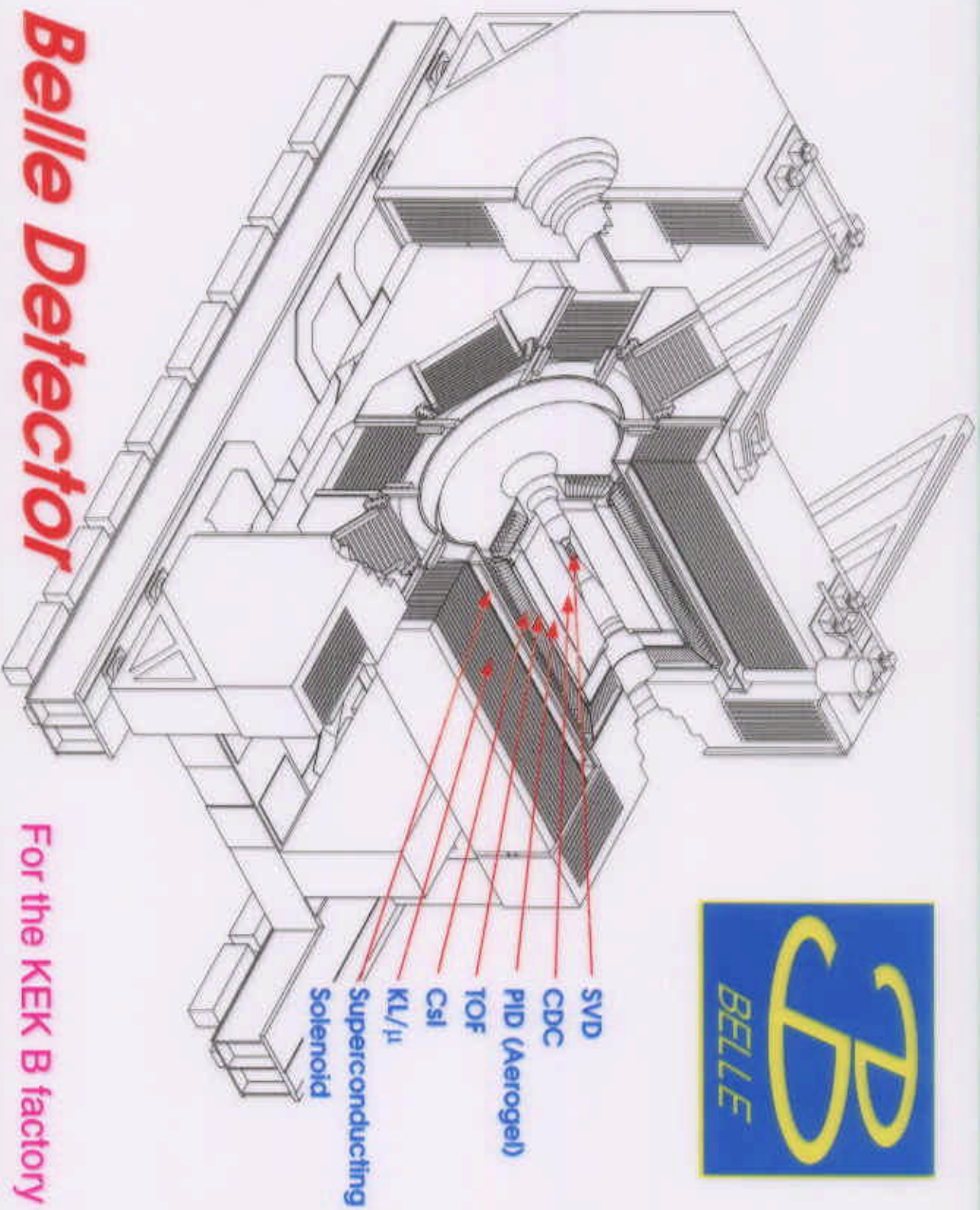
dE/dx information from CDC,

E/p information from CsI e.m. calorimeters
 (ECL)

Integrated luminosity: 3.10 fb^{-1} (Oct. 1999 – May 2000)

Belle Detector

For the KEK B factory



Event Selection

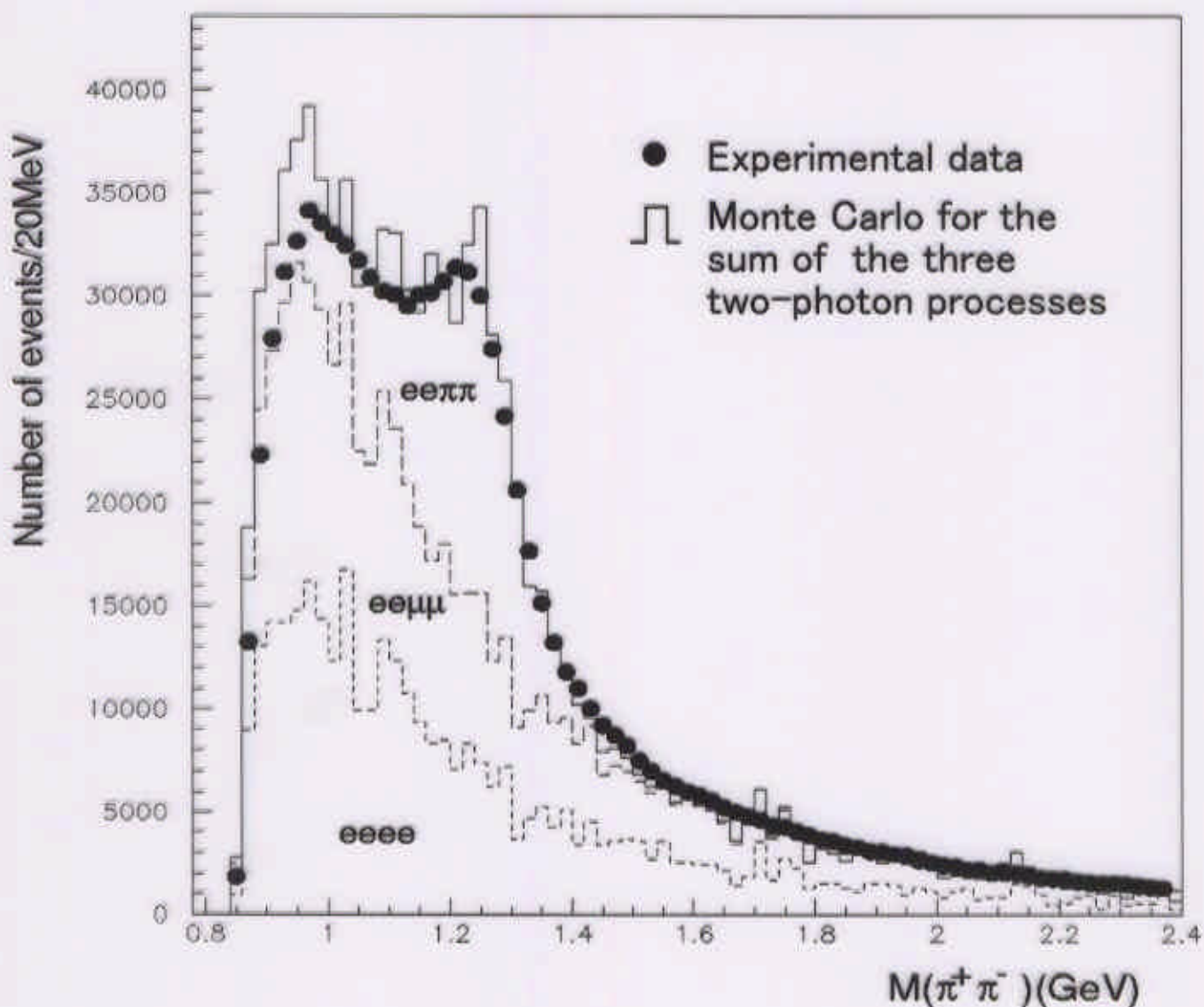
Selection of exclusive two-track events

just one positive and just one negative tracks

$$p_t > 0.4 \text{ GeV}/c, \quad -0.34 < \cos \theta < +0.82$$

$$|\Sigma p_t^*| < 0.1 \text{ GeV}/c$$

The samples *before the particle identification* are dominated by $\gamma\gamma \rightarrow ee, \mu\mu, \pi^+\pi^-$



Selection of K^+K^- events

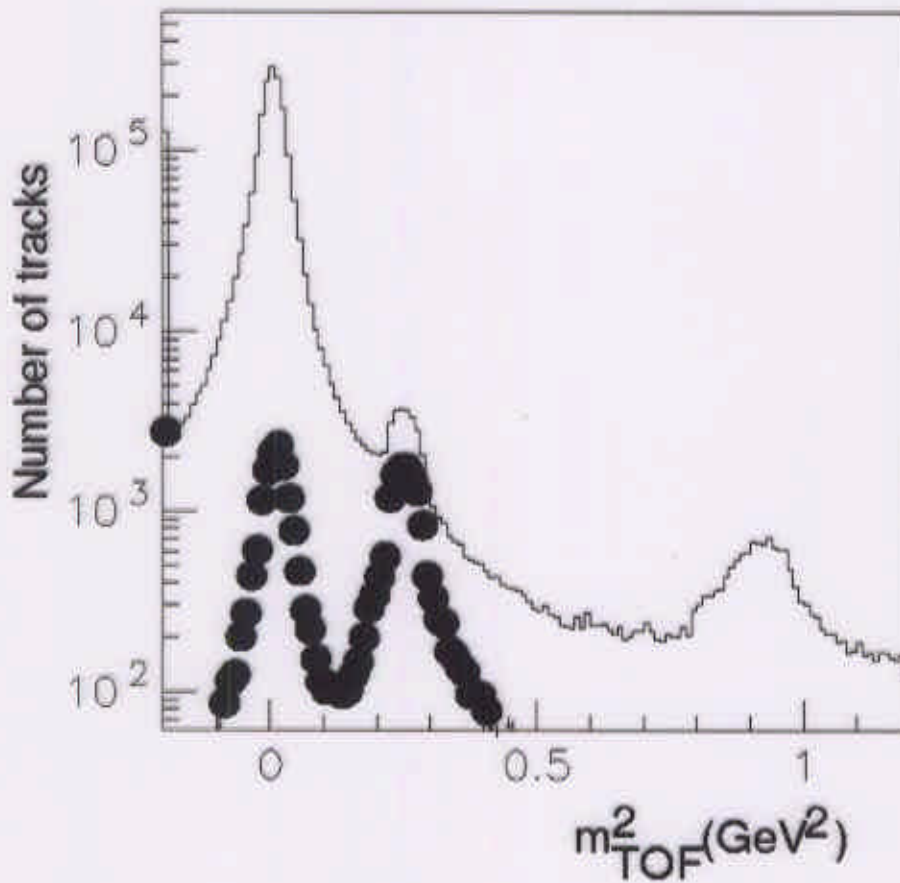
For the two tracks,

$E/p < 0.8$,

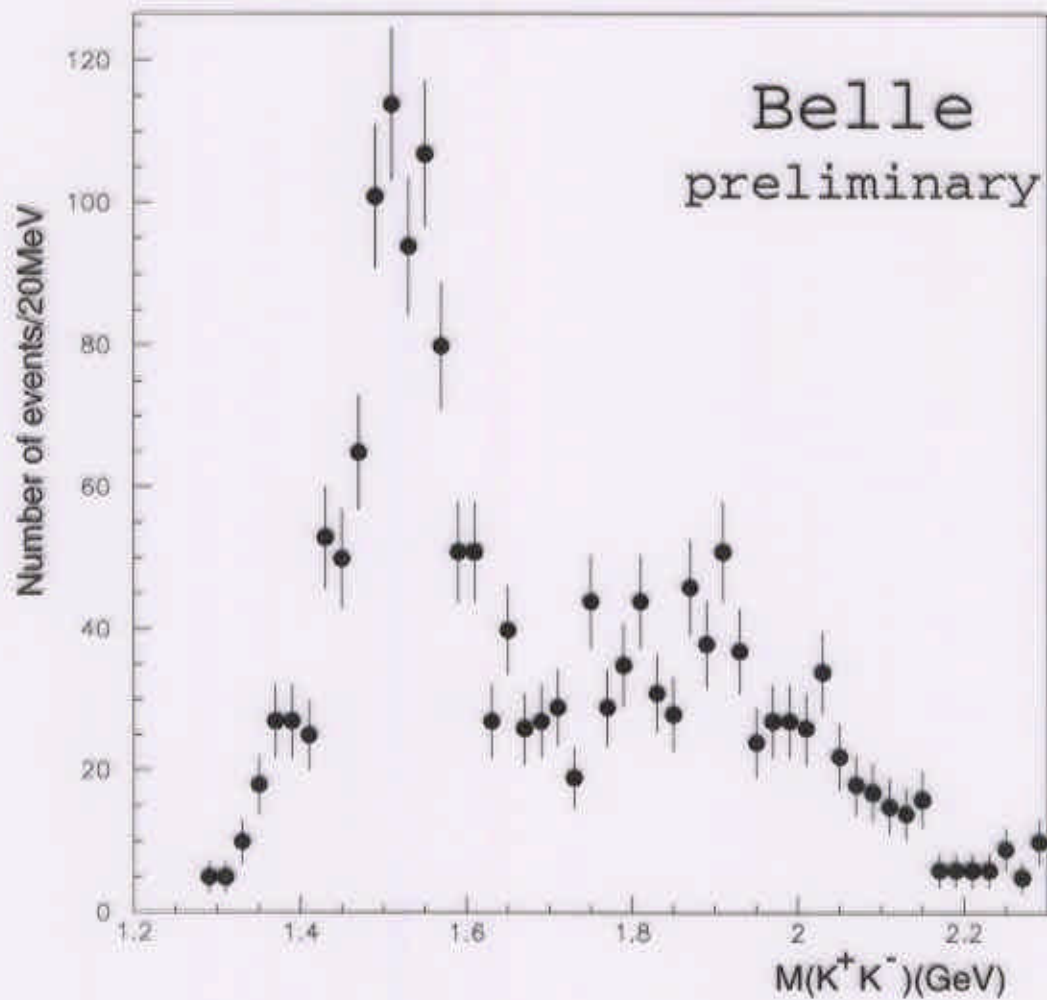
ECL

likelihood ratios $(K/\pi) > 0.8$ and $(K/p) > 0.8$

TOF, ACC



Invariant mass distribution for K^+K^- events



Cross Section for $\gamma\gamma \rightarrow K^+K^-$

$$\sigma(W) = \frac{\Delta N}{\Delta W \eta(W) L_{\gamma\gamma}(W) \int \mathcal{L} dt}$$

($|\cos \theta^*| < 0.6$)

Systematic error sources

Trigger efficiency, TOF efficiency

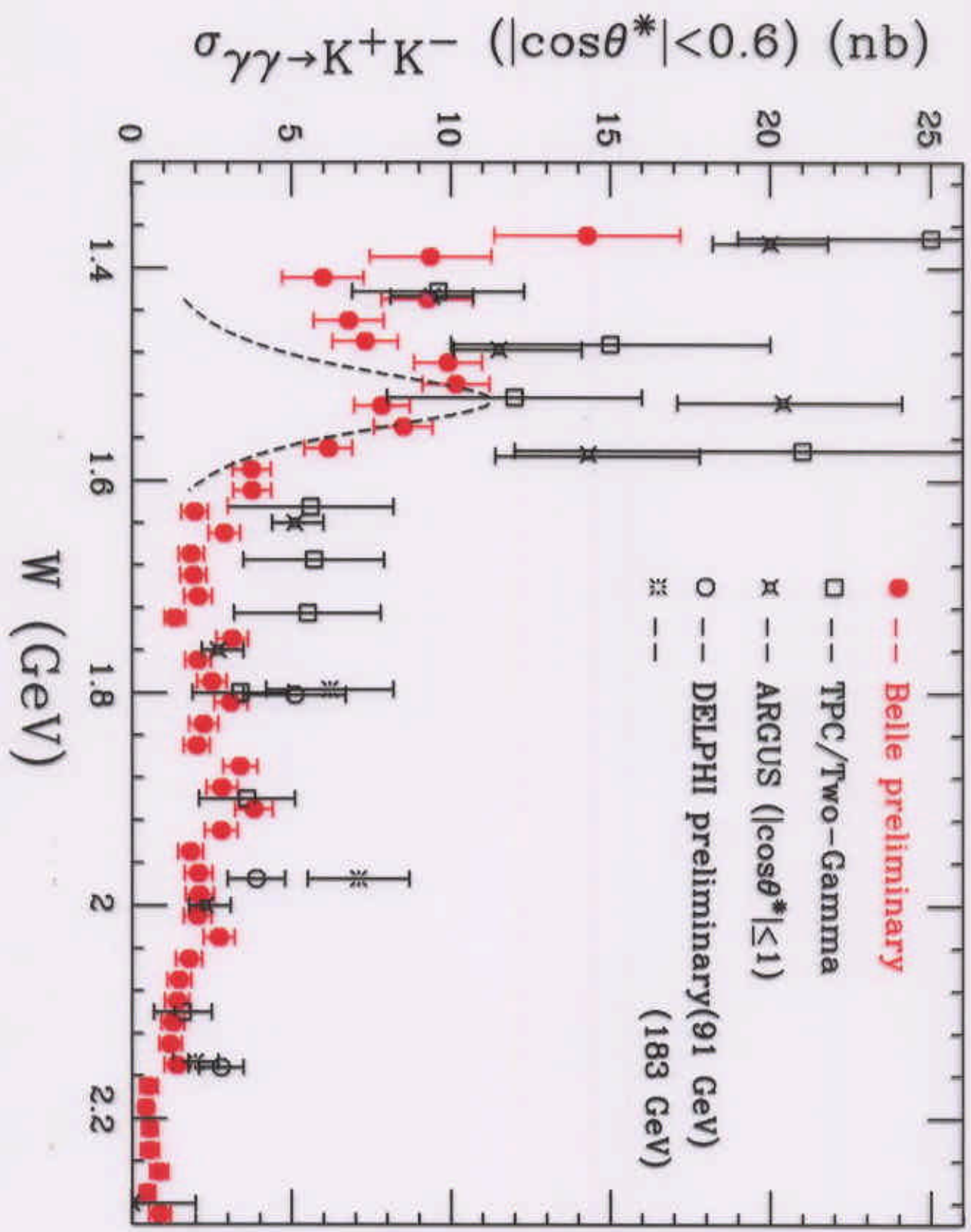
P-ID efficiency (E/p cut, likelihood ratios)

20 % systematic error is estimated for the cross section values

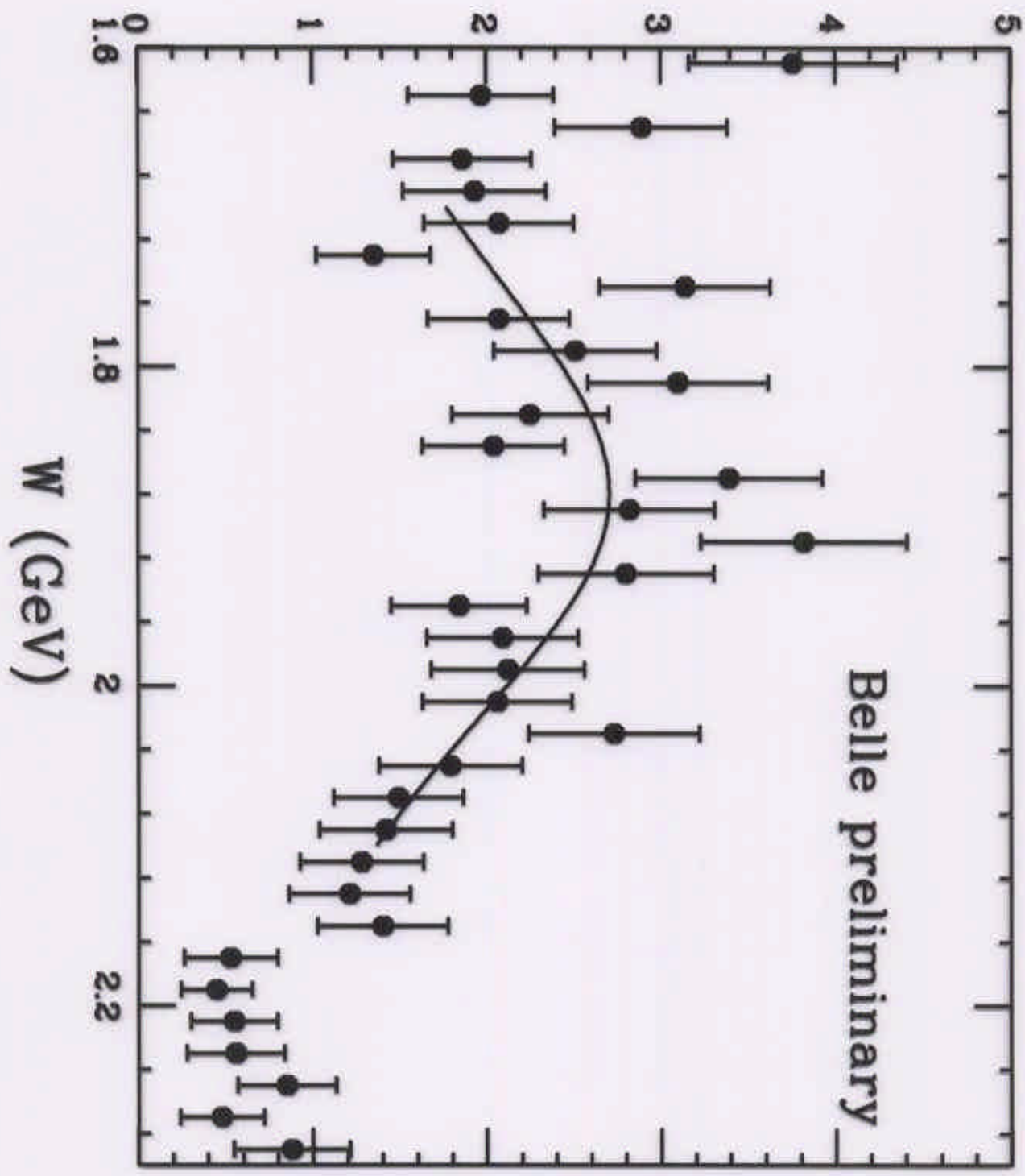
backgrounds:

Particle misID $\lesssim 8\%$

non-exclusive processes $< 8\%$
(neglected)



$$\sigma_{\gamma\gamma \rightarrow K^+K^-} (|\cos\theta^*| < 0.6) \text{ (nb)}$$



The behavior of the cross section

$f_2'(1525)$

a peak at 1.48 – 1.56 GeV

Comparison with previous experimental results:
some differences just above the $f_2'(1525)$ mass
(1.54 – 1.6 GeV)

A broad structure found in 1.7–2.1 GeV

a fit to a single Breit–Wigner curve

$$M = 1.88 \pm 0.02 \text{ GeV}/c^2, \quad \Gamma = 0.47 \pm 0.08 \text{ GeV}$$

$$\Gamma_{\gamma\gamma} \text{BR}(K^+K^-) = 104 \pm 13 \pm 21 \text{ eV} \quad [(J,\lambda)=(2,2)]$$

$$0.84 \pm 0.11 \pm 0.17 \text{ keV} \quad [J=0]$$

No significant enhancement at 2.23 GeV

an upper limit

$$\Gamma_{\gamma\gamma}(f_J(2220)) \text{BR}(f_J(2220) \rightarrow K\bar{K}) < 3.2 \text{ eV}$$

$$(95\% \text{ CL}) \quad [(J,\lambda)=(2,2)]$$

Estimated background subtracted
The interference effect neglected

Measurement of $K_S^0 K_S^0$ channel

Selection criteria:

$$K_S^0 \rightarrow \pi^+ \pi^-$$

K_S^0 reconstruction $\Delta M(K_S^0) < 10 \text{ MeV}$
finite decay length required

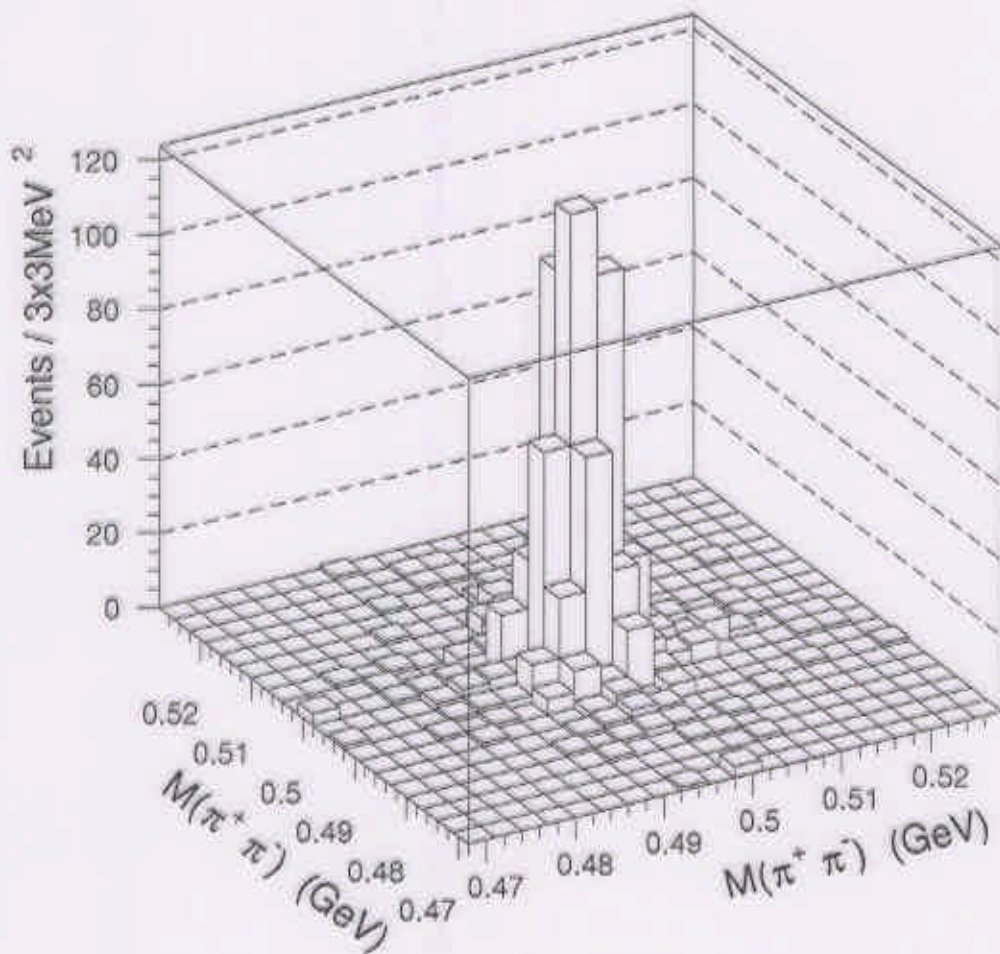
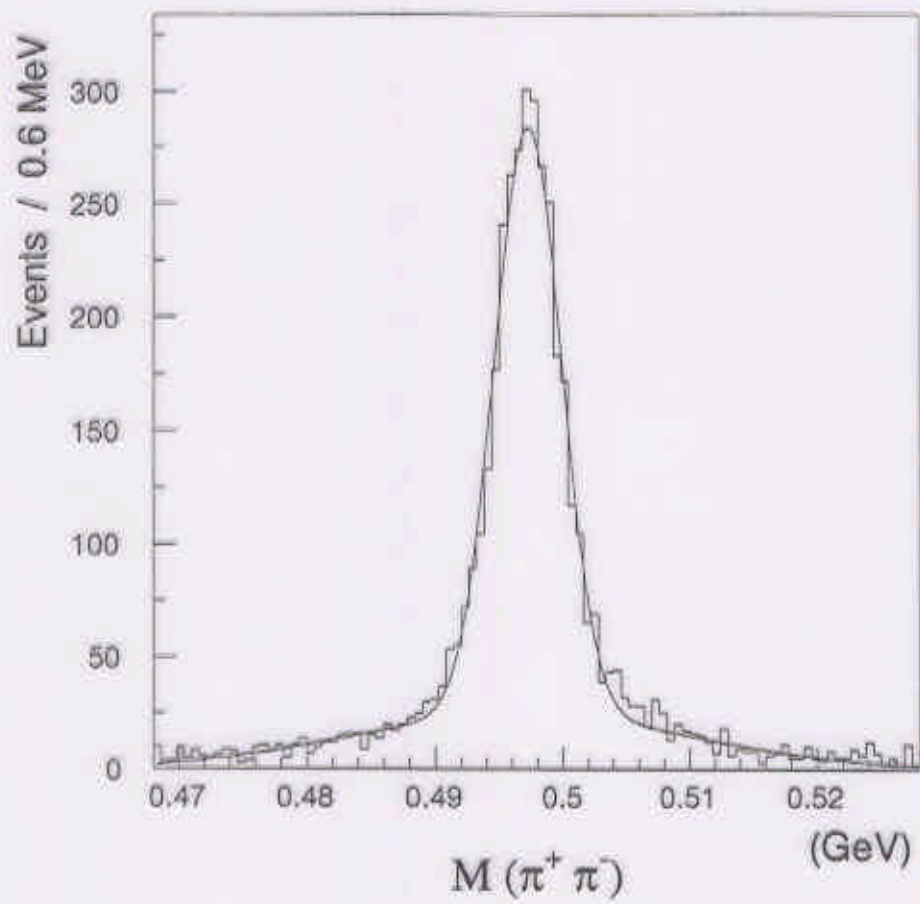
Opening angle in $r\phi$ plane $> 160^\circ$

$$|\Sigma \mathbf{p}_t^*|^2 < 0.1 \text{ (GeV/c)}^2$$

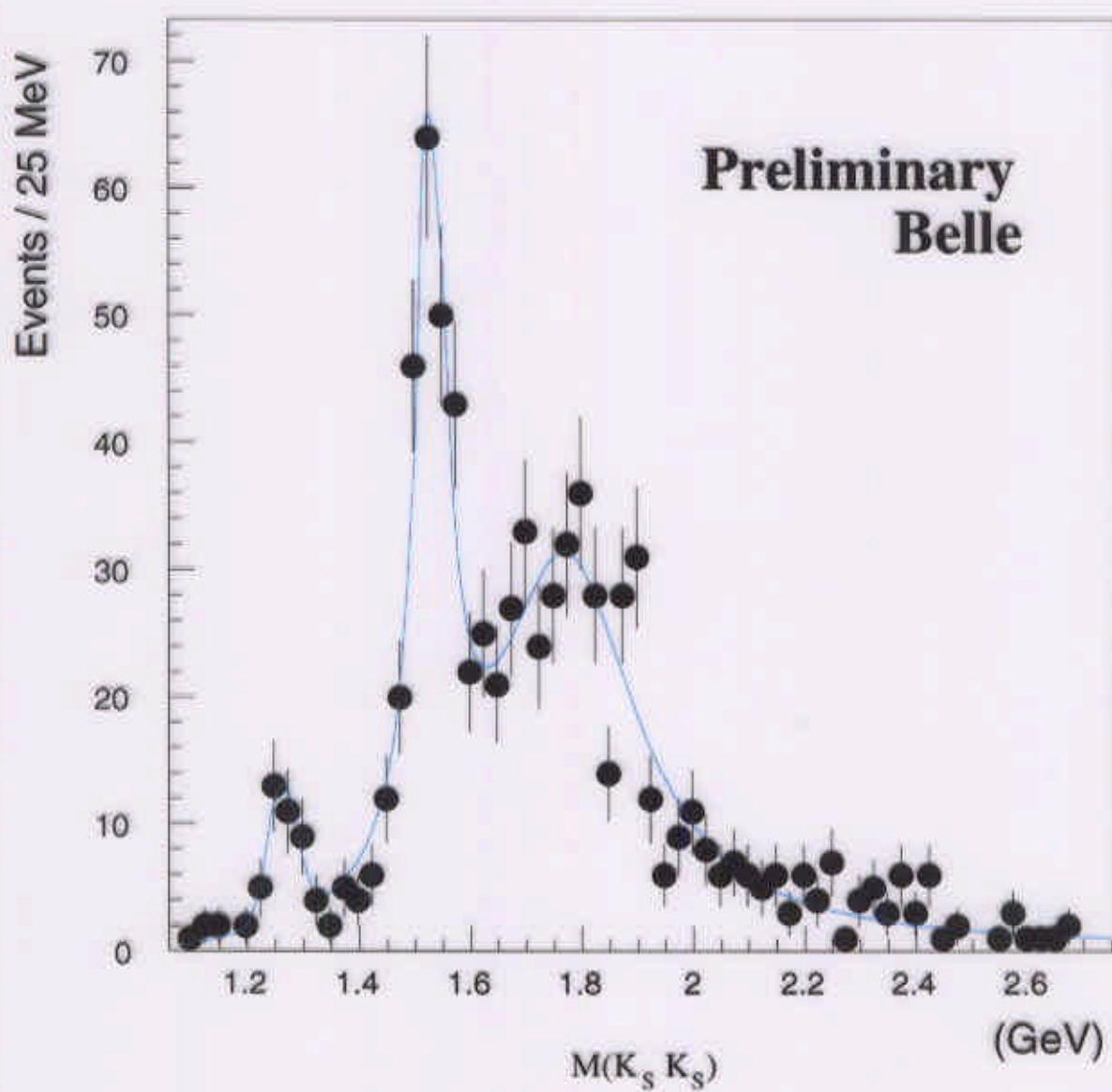
$$\int \mathcal{L} dt = 5 \text{ fb}^{-1}$$

Belle preliminary

	$f_2'(1525)$	1750 MeV
Mass (MeV)	1526 ± 4	1771 ± 13
Width (MeV)	52 ± 11	264 ± 29
Number of events	194 ± 24	413 ± 39



Invariant mass distribution for $K_S^0 K_S^0$ events



Summary

$$\gamma\gamma \rightarrow K^+ K^-$$

with high statistics also in $W > 1.6 \text{ GeV}$

A peak from $f_2'(1525)$ seen

A broad structure in $1.7 - 2.1 \text{ GeV}$

$$M = 1.88 \pm 0.02 \text{ GeV}/c^2, \quad \Gamma = 0.47 \pm 0.08 \text{ GeV},$$

preliminary

No enhancement in $f_J(2220)$ region

95%CL upper limit

$$\Gamma_{\gamma\gamma}(f_J(2220)) \text{BR}(f_J(2220) \rightarrow K\bar{K}) < 3.2 \text{ eV}$$

$$[(J, \lambda) = (2, 2)]$$

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

A peak from $f_2'(1525)$ seen

A structure peaked near 1.77 GeV

$$M = 1.771 \pm 0.013 \text{ GeV}/c^2, \quad \Gamma = 0.264 \pm 0.029 \text{ GeV},$$

preliminary