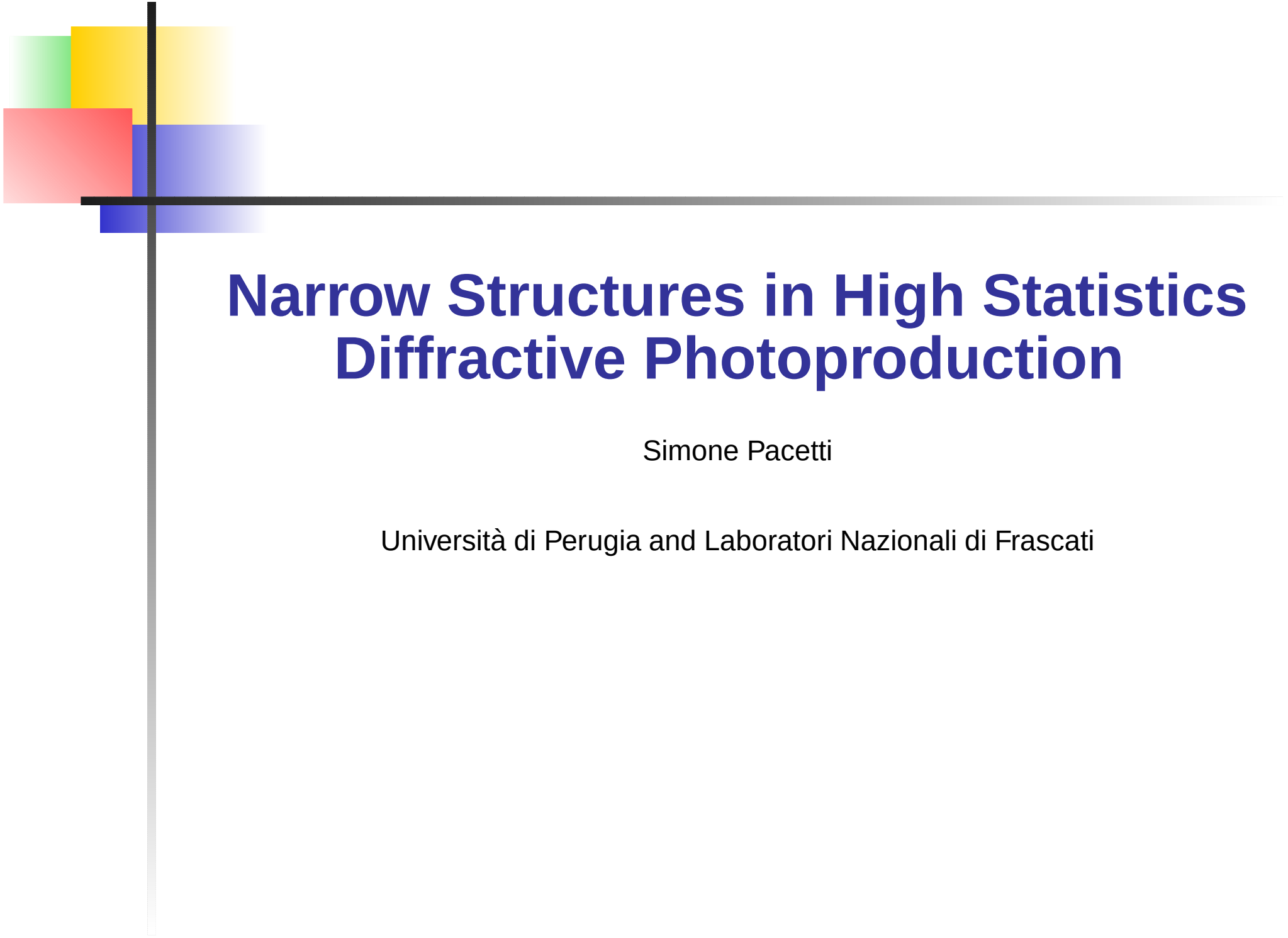

Narrow Structures in High Statistics Diffractive Photoproduction

Simone Pacetti

Università di Perugia and Laboratori Nazionali di Frascati

Summary

- A narrow structure ($\Gamma \simeq 30\ MeV$ and $M \simeq 1900\ MeV$) observed by E687 in the 6 pions final state data of the diffractive photoproduction and possible interpretations

(P.L. Frabetti *et al.* Phys. Lett. **B514** (2001) 240)

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- Set of data and fit
- Properties of the dip
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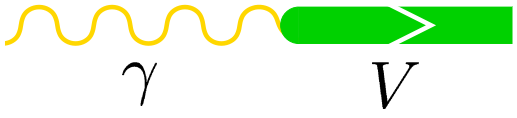

Naive Vector Meson Dominance

$$\sigma^{\rm diff}_{\gamma N\to VN} \propto \Gamma^{ee}_V$$

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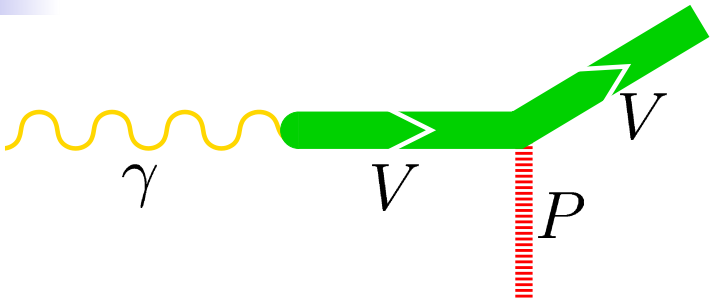

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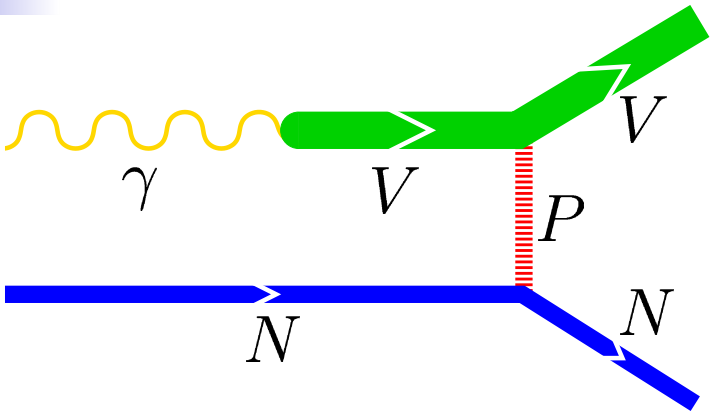

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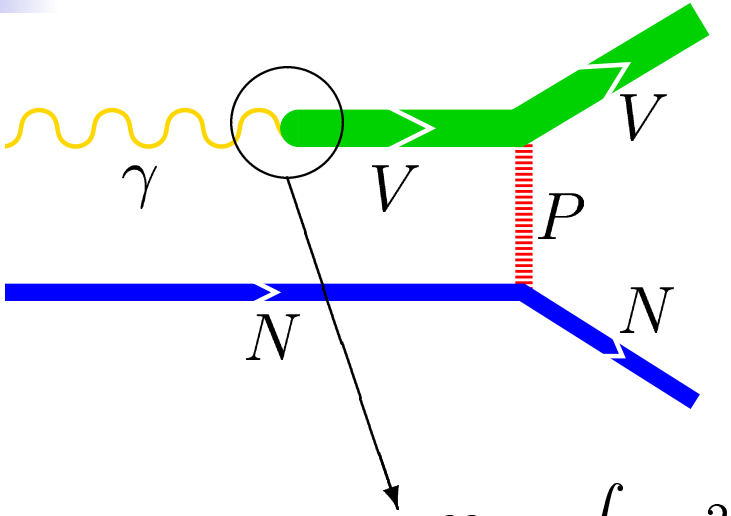

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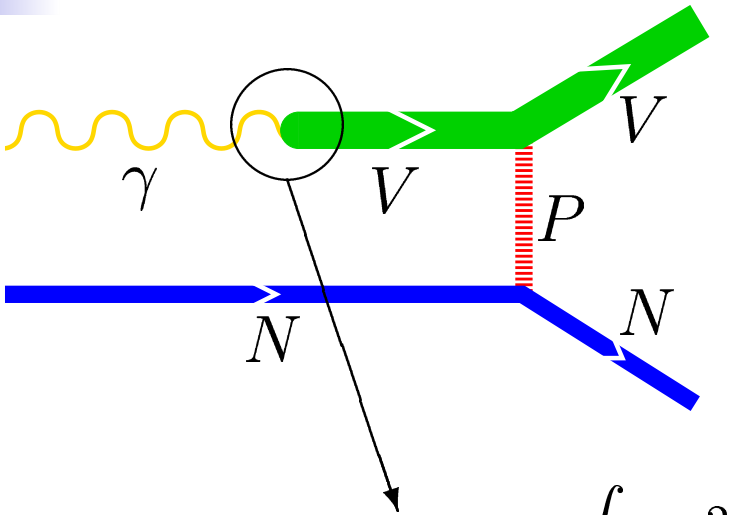

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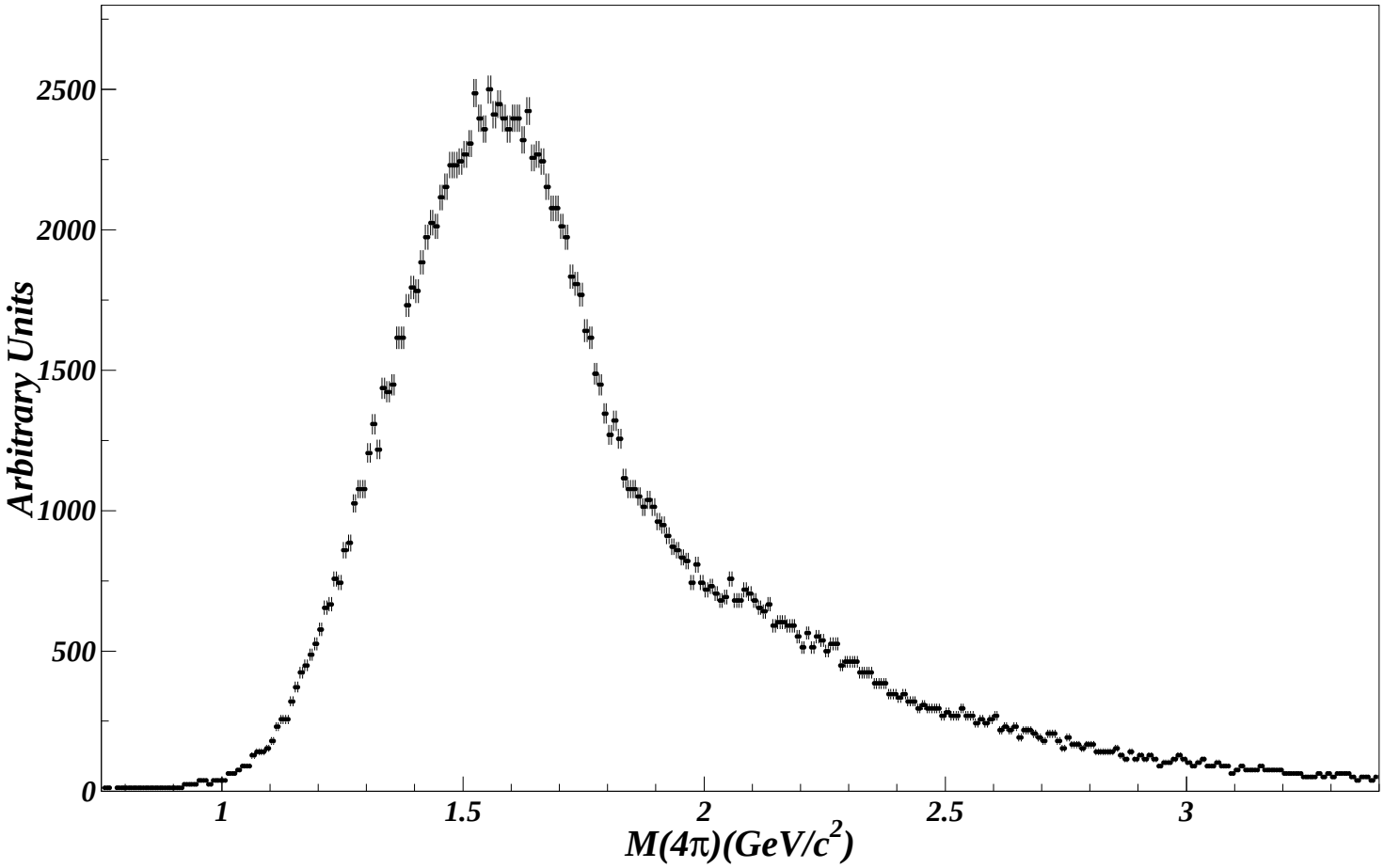
Since the cross section $\sigma_{VN\to VN}$ should vary slowly with M

$$\frac{1}{M^2} \cdot \frac{d\sigma_{\rm diff}}{dM^2}_{\gamma N\to VN} \propto \sigma_{e^+e^-\to V}(M)$$

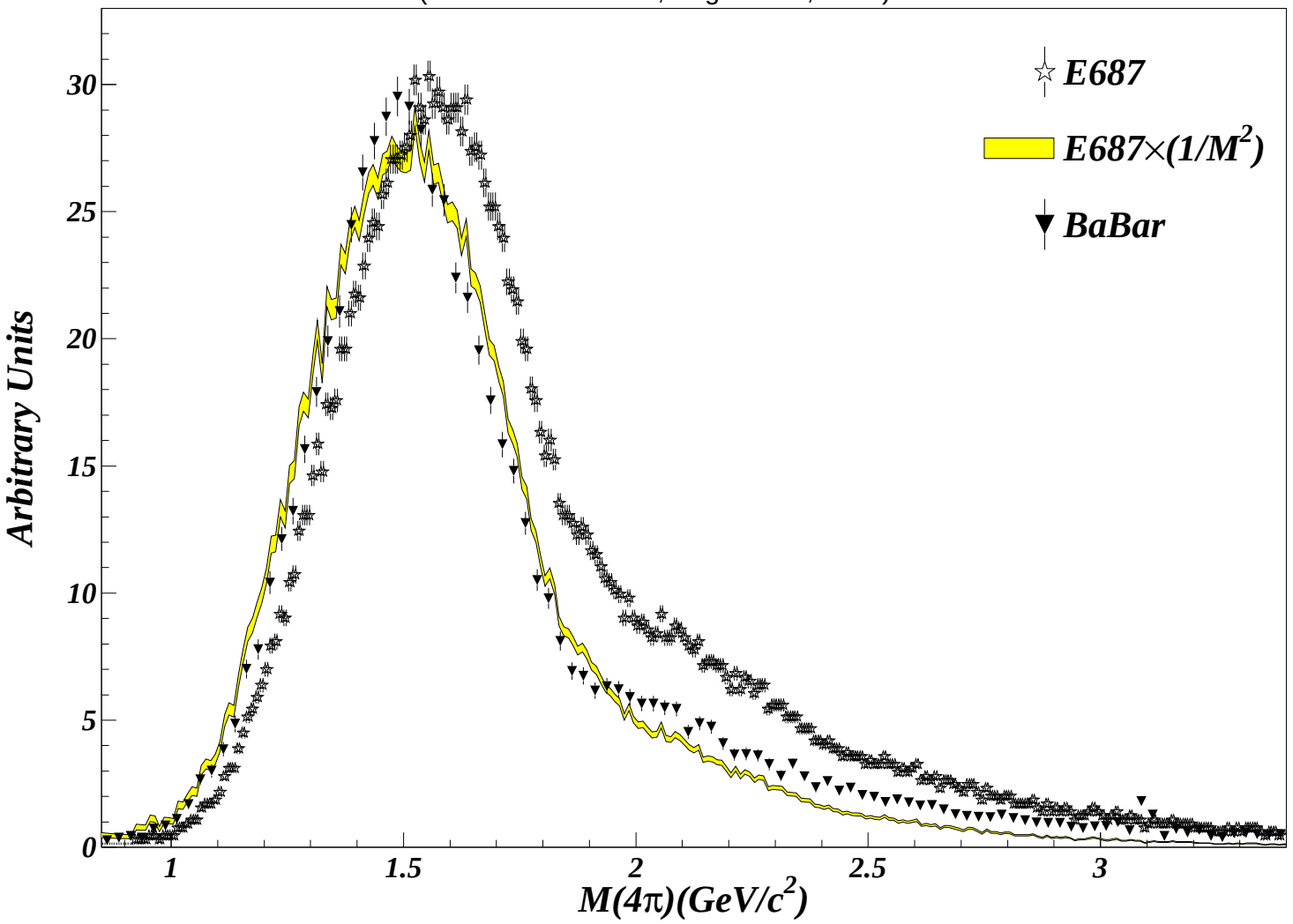
$2\pi^+2\pi^-$ E687 data

(P. Lebrun *Hadron '97*, Aug. 25-30, 1997)



$2\pi^+2\pi^-$ E687 weighted data compared to BaBar data

(P. Lebrun *Hadron '97*, Aug. 25-30, 1997)



Evidence of a narrow resonance decaying in 6 pions

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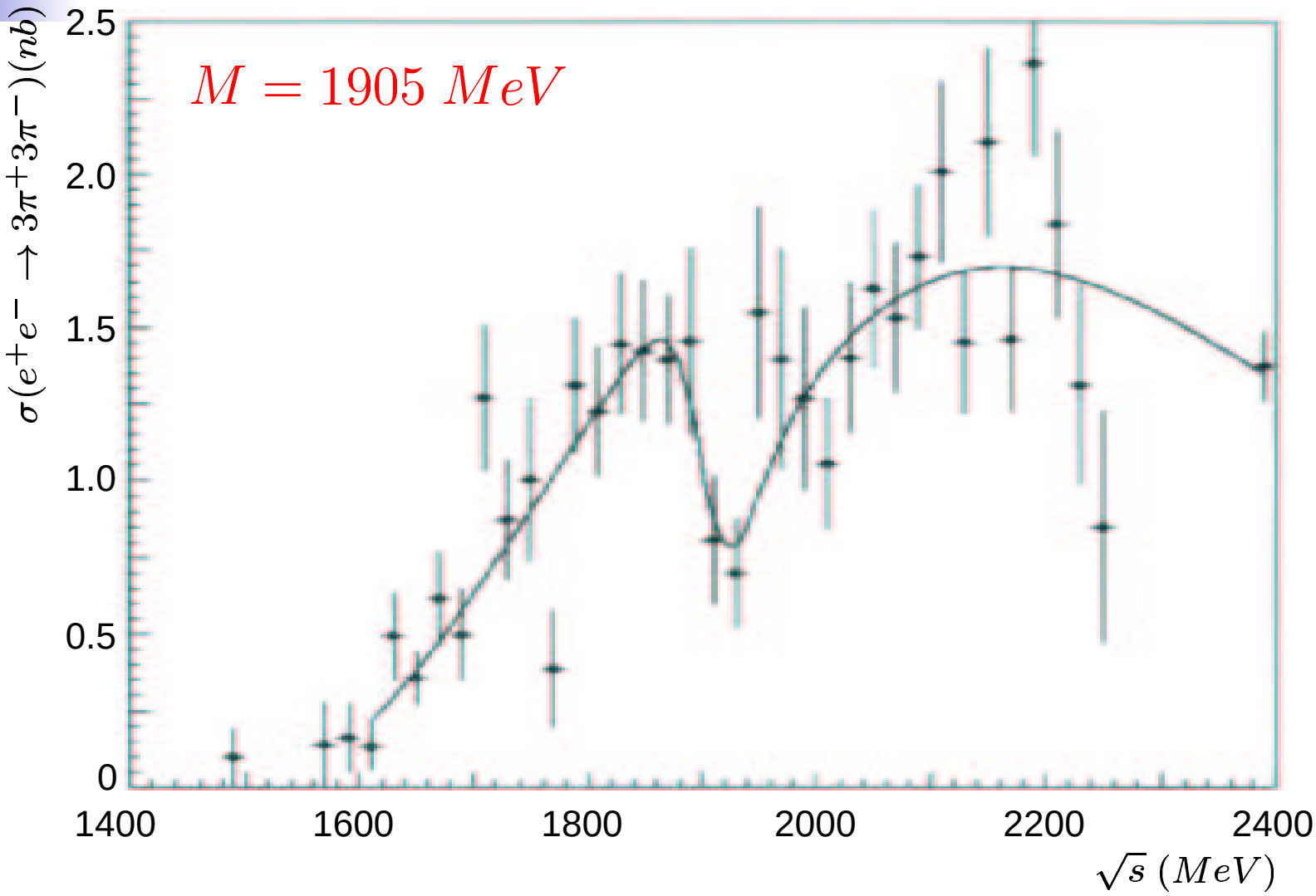
- This dip is similar to that observed by the DM2 coll. with lower statistics, in the channels $e^+e^- \to 3\pi^+3\pi^-$ and $e^+e^- \to 2\pi^+2\pi^-2\pi^0$.

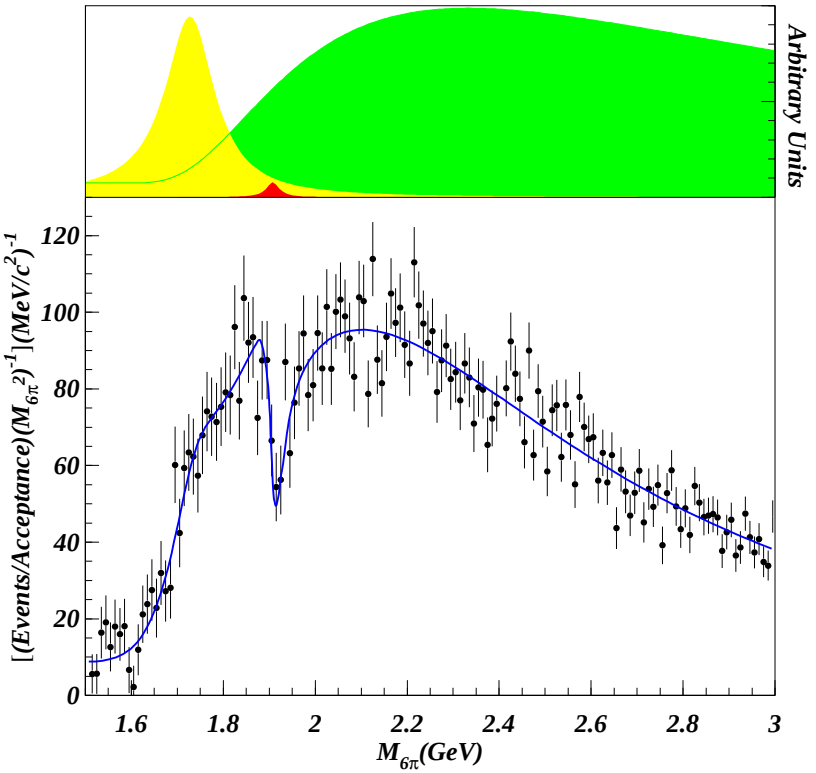
DM2 data $e^+e^- \to 3\pi^+3\pi^-$

(DM2 "Fenice" Workshop, Frascati, 1988)



New fit $2BW+$ Jacob Slansky

$1.5\ GeV \leq M_{6\pi} \leq 3.0\ GeV$



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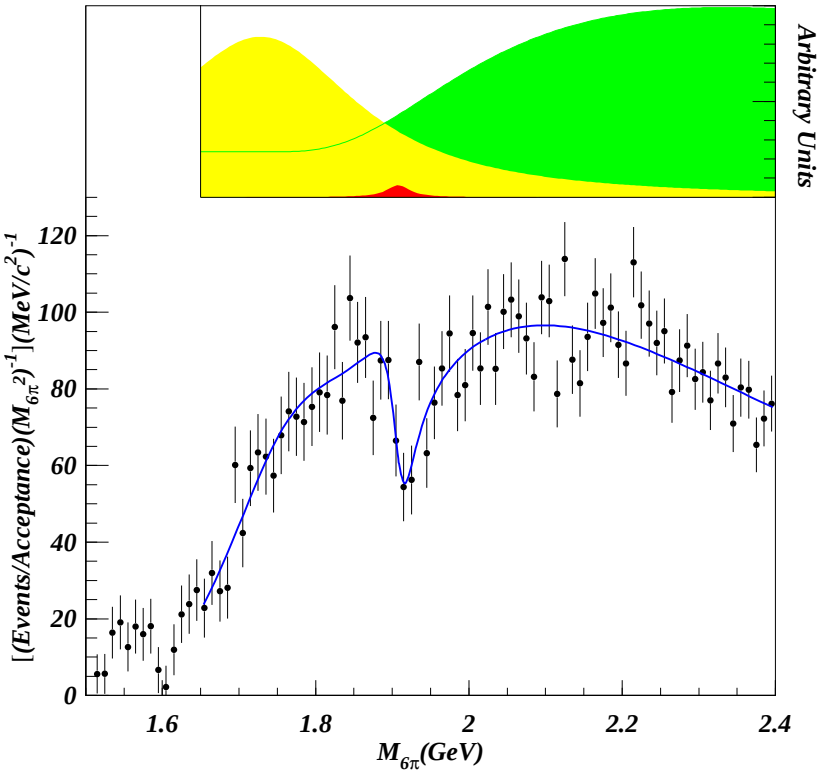

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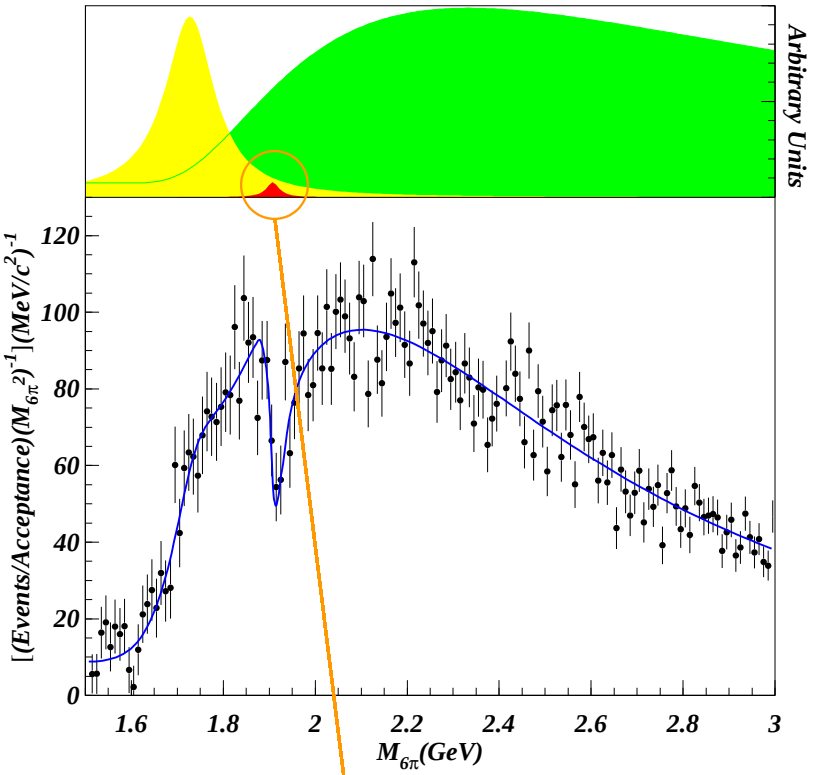

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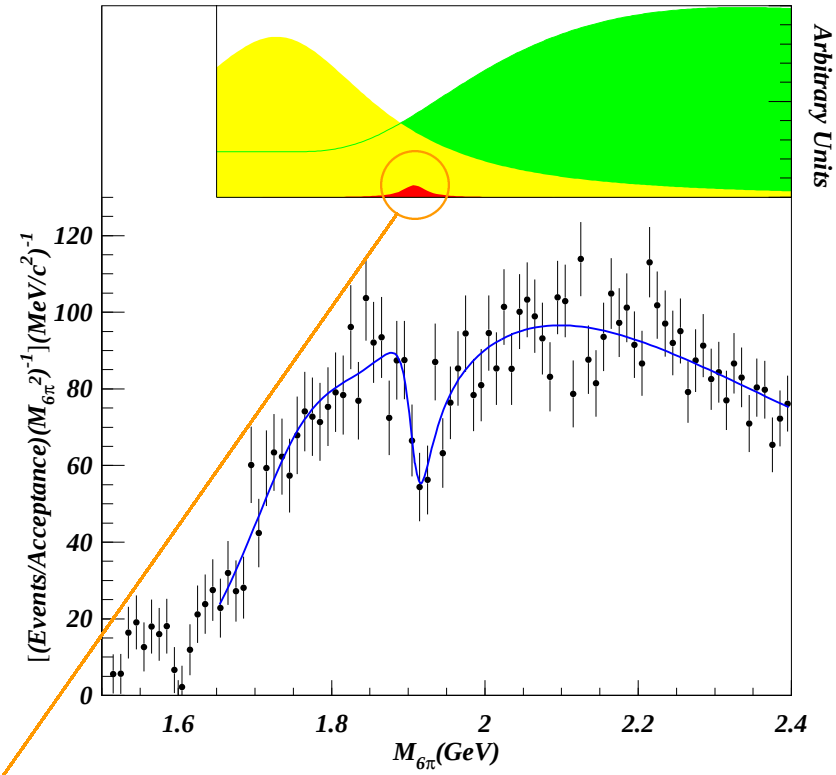

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The relative phase between the dip and the background amplifies the effect.

Fit results

Resonances	Mass (GeV/c^2)	Width (MeV/c^2)	$B_{ee}B_{3\pi^+3\pi^-}/M^2$ (Yield/10 MeV)	Phase (deg.)
V_0	1.910 ± 0.010	37 ± 13	5 ± 1	10 ± 30
V_1	1.730 ± 0.034	315 ± 100	17 ± 3	140 ± 10

Background	c_0 (GeV^{-1})	c_1 $(GeV^{1-\alpha})$	M_0 (GeV)	α	β (GeV)	Phase (deg.)
F_{JS}	84 ± 55	900 ± 400	1.65 ± 0.05	0	1.4 ± 0.2	0 (fixed)

$$F_{JS}(M) = f_{JS}^2(M) = c_0 + c_1 \frac{e^{\frac{-\beta}{M-M_0}}}{(M-M_0)^{2-\alpha}}$$

$$\frac{\chi^2}{dof} = 1.06$$

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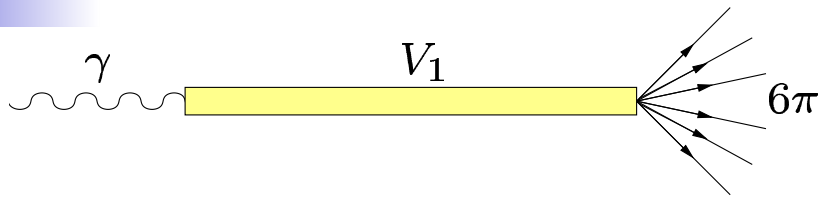
In this case interference only with real background

Mixing mechanism (P.J. Franzini-F.J. Gilman)



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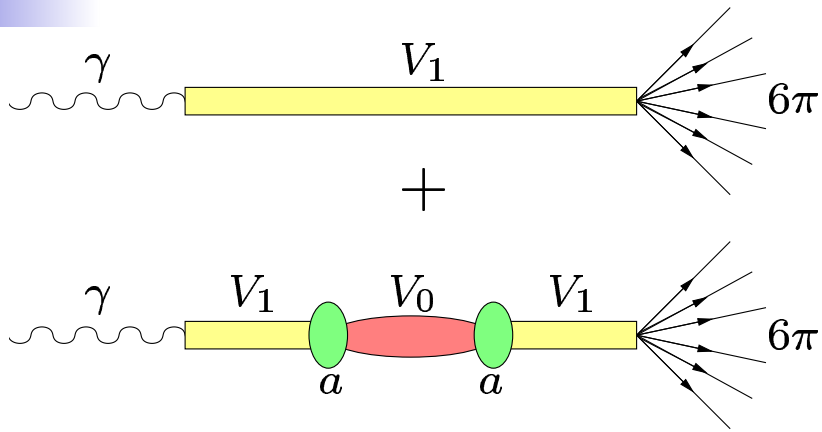

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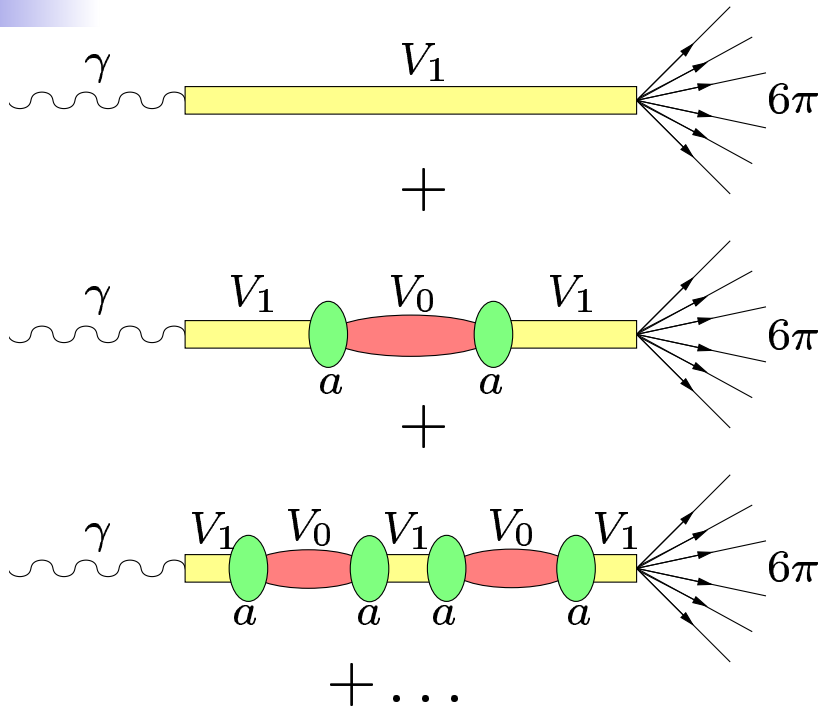

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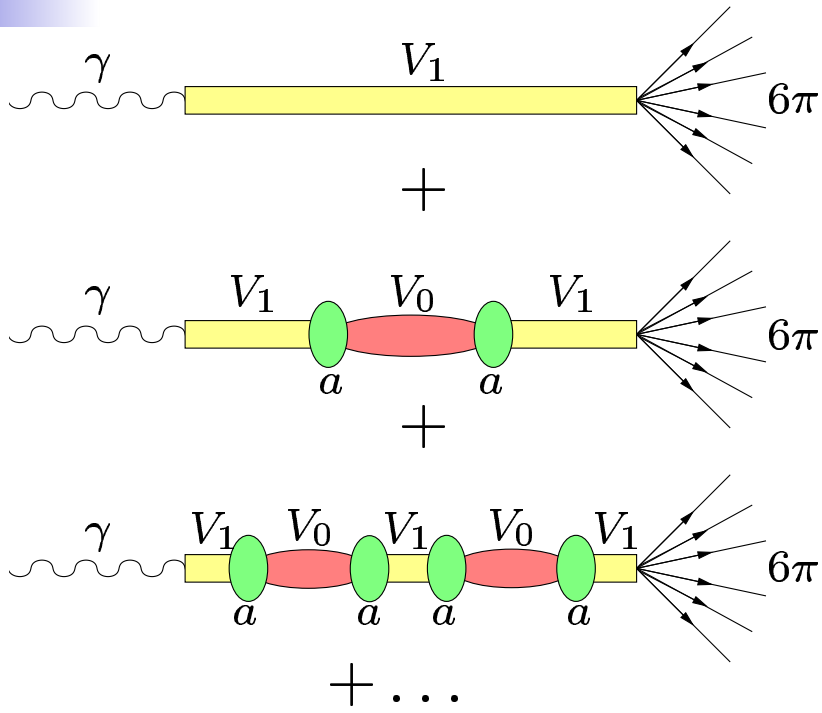

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This mixing mechanism produces a cross-section with a dip structure independent of the nature of V_0

$$\sigma \propto |A|^2 \propto \left| \frac{M^2 - M_0^2}{(M^2 - M_1^2)(M^2 - M_0^2) - a^2} \right|^2$$

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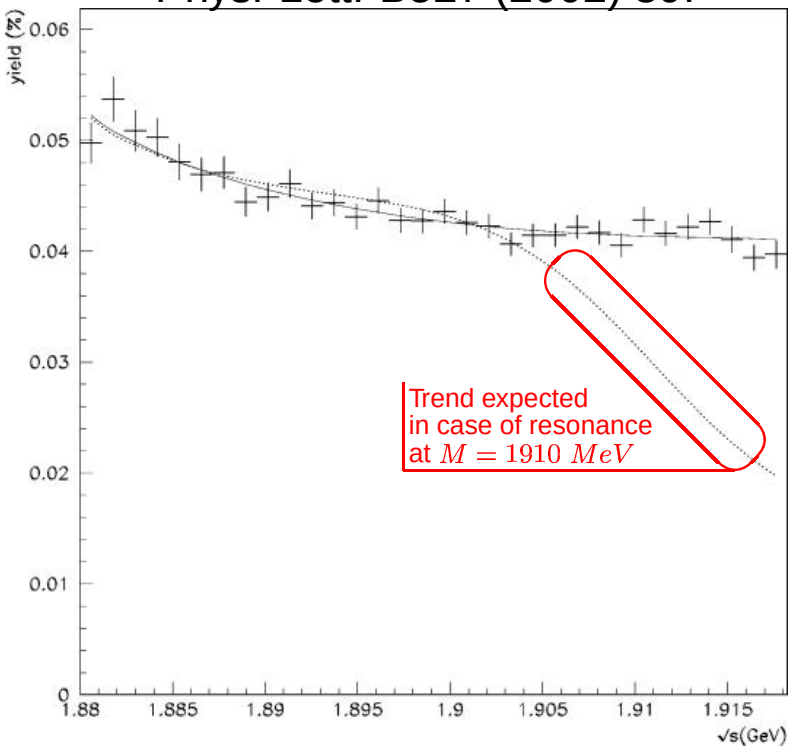
Phys. Lett. B527 (2002) 39.



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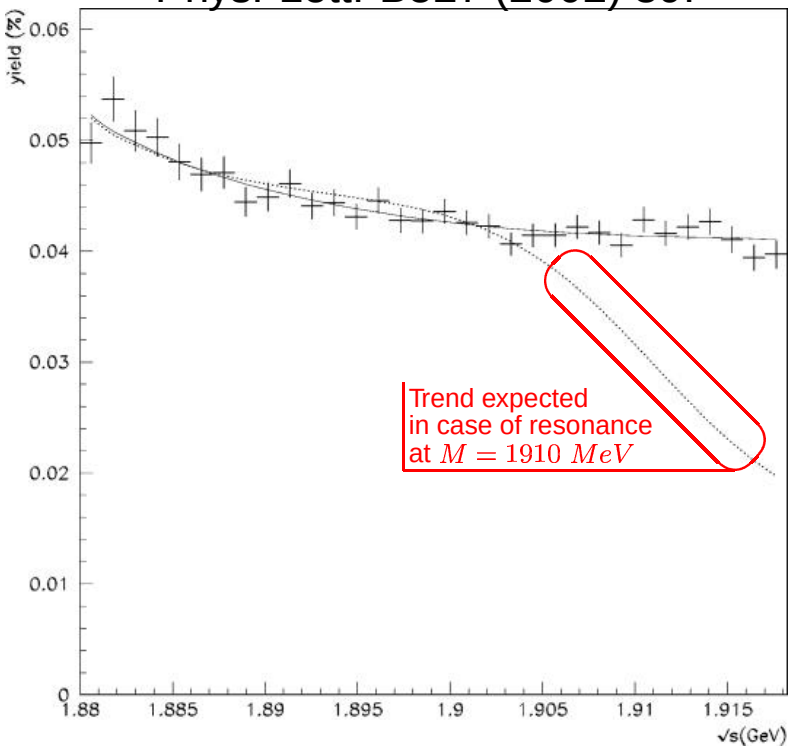
- Narrow resonances, in agreement with a $N\overline{N}$ bound state, have been observed at $\sim 1.87\ GeV$ not consistent with the E687 dip because of the $\sim 40\ MeV$ mass difference.

Phys. Lett. B527 (2002) 39.



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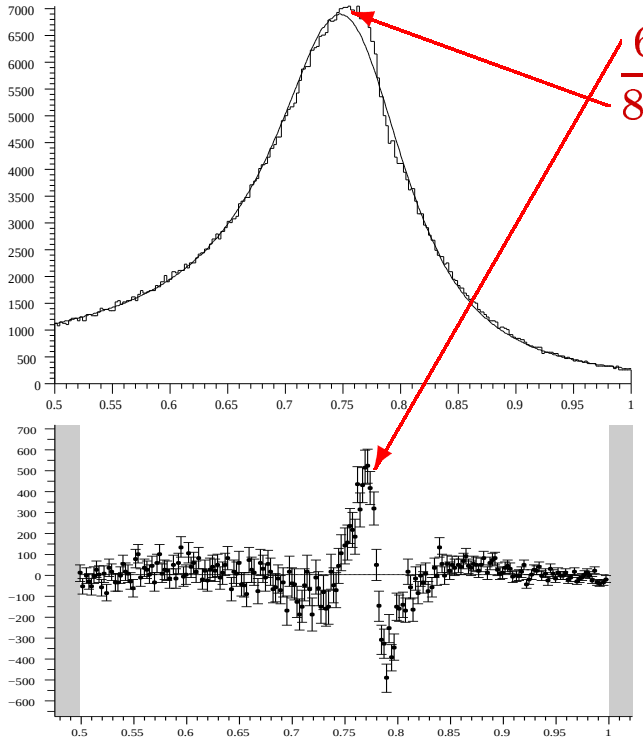
These selection rules in two-body decay, should favor high multiplicity channels and relative small widths (6π ???).

Fit and residual of $\pi^+\pi^-$ E687 data (S.P. Ratti, HEP, Jerusalem, 19-26 Aug. 1997)



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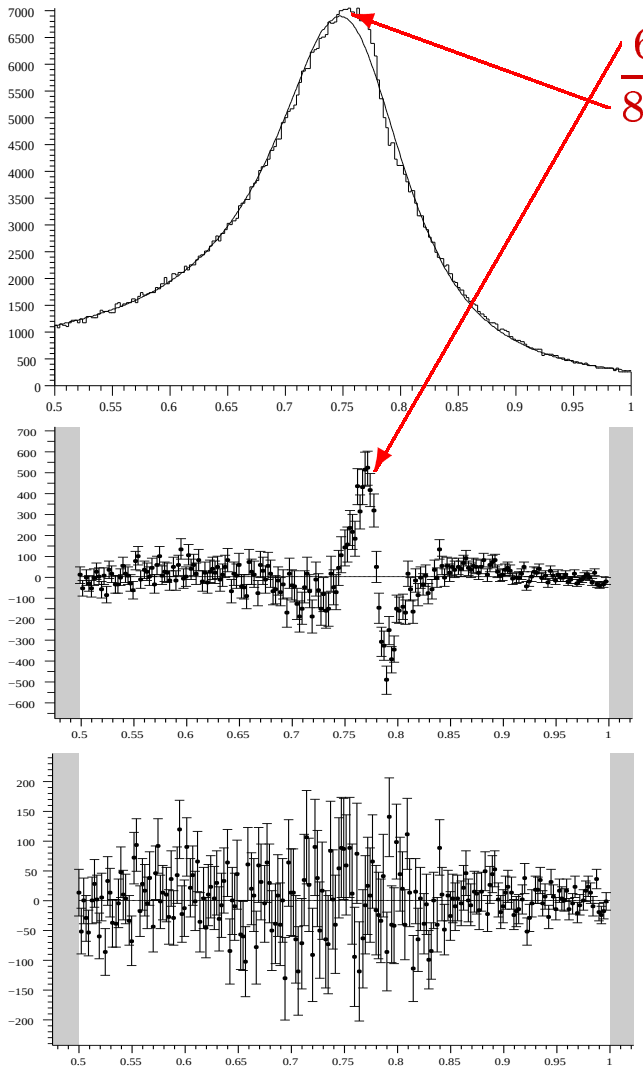

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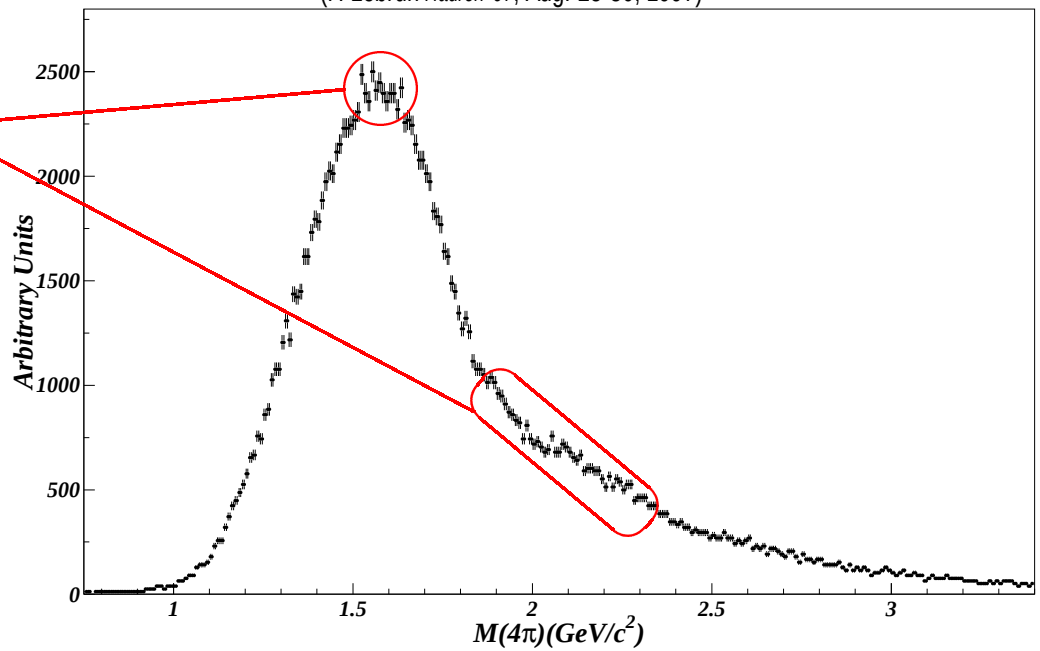
By subtracting the interference pattern the structure in the residual disappears.

Possible sub-structures in $2\pi^+2\pi^-$ final state

The $2\pi^+2\pi^-$ E687 data seem to have fluctuating behaviors in some energy regions.

(P. Lebrun *Hadron '97*, Aug. 25-30, 1997)



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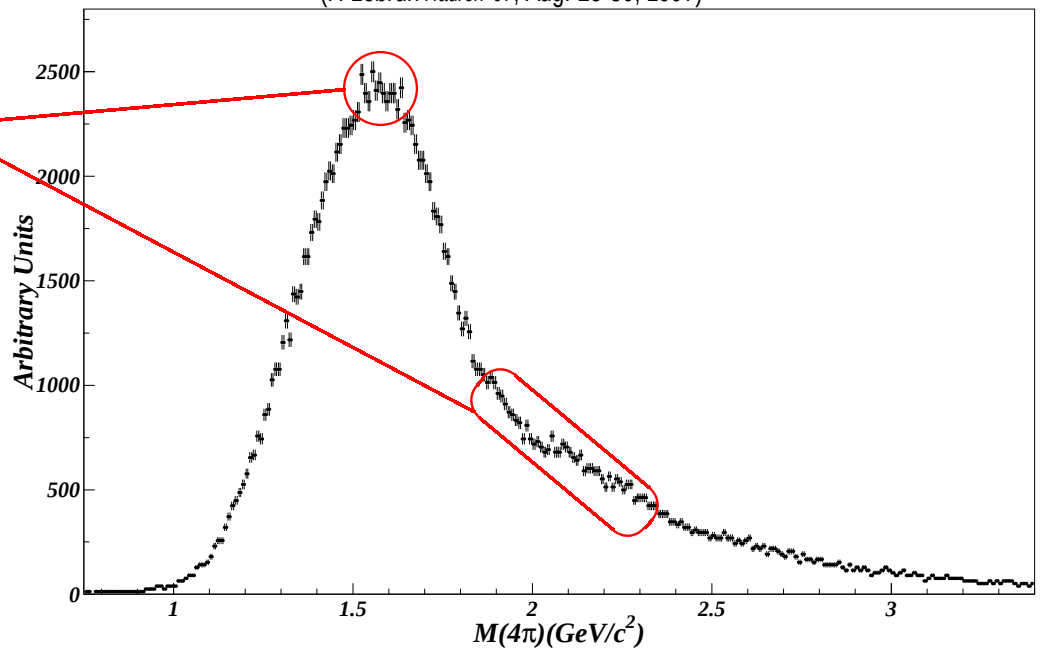
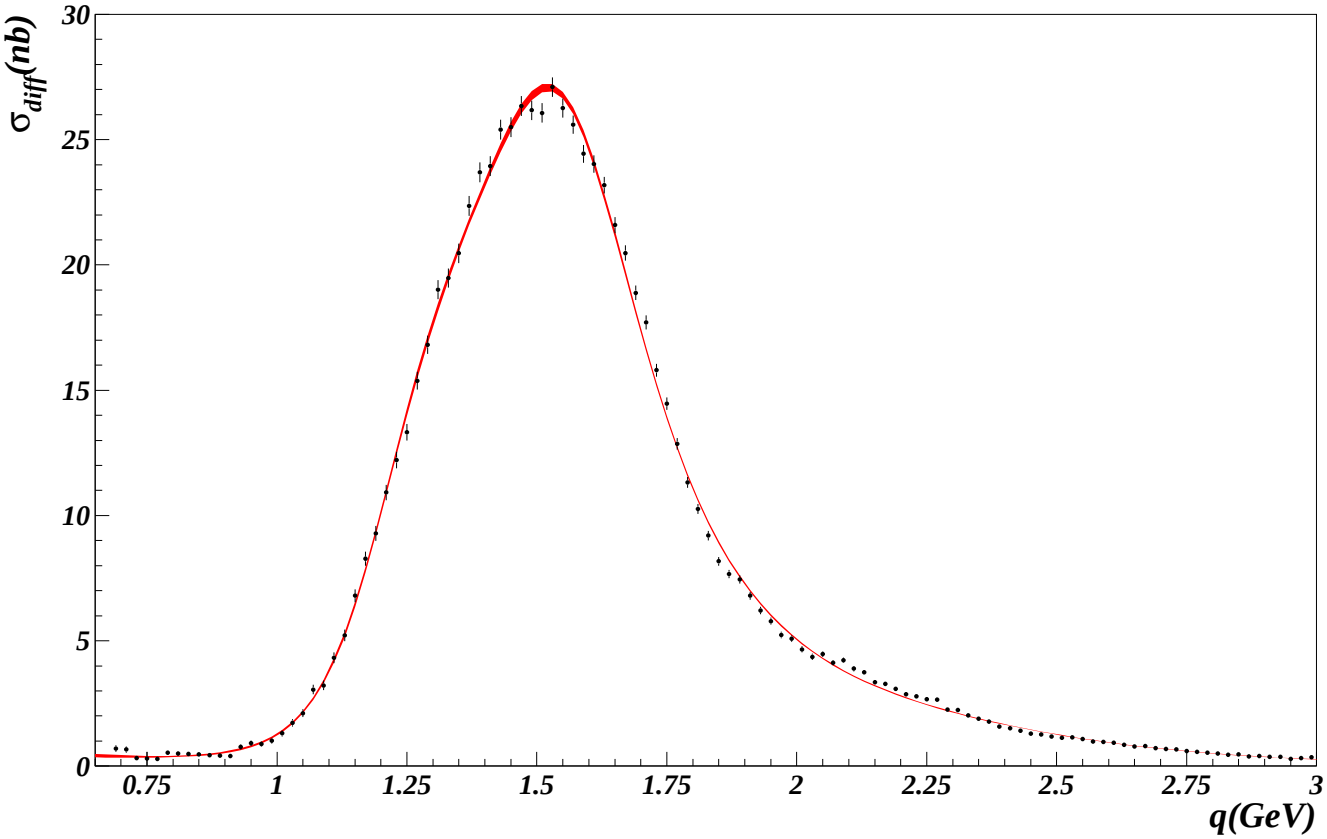


We apply the same procedure of the 2 pions.

- Doing the fit
- Computing the residual
- If there are, fitting the structures

New fit and residual of the $2\pi^+2\pi^-$ rescaled data (P. Lebrun *Hadron '97*, Aug. 25-30, 1997)

Data and Fit



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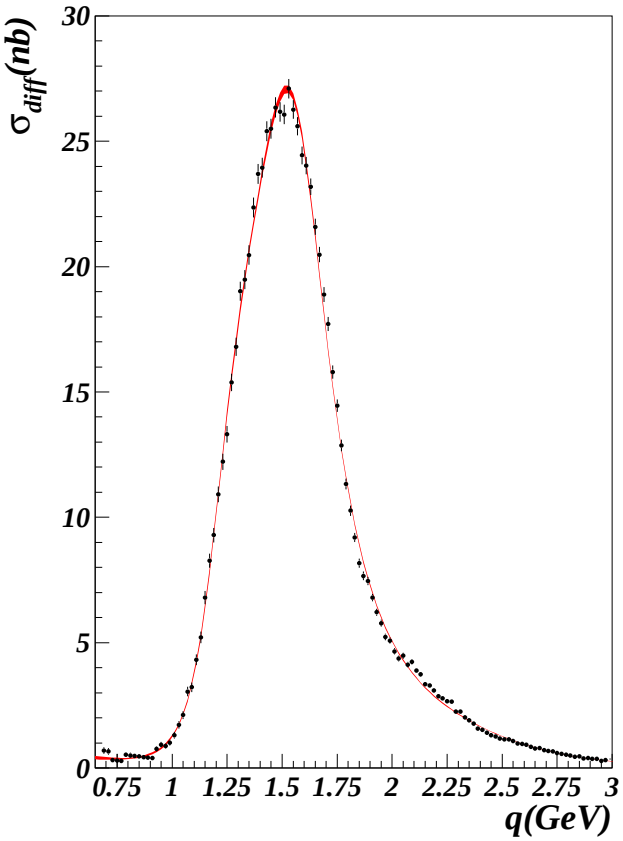
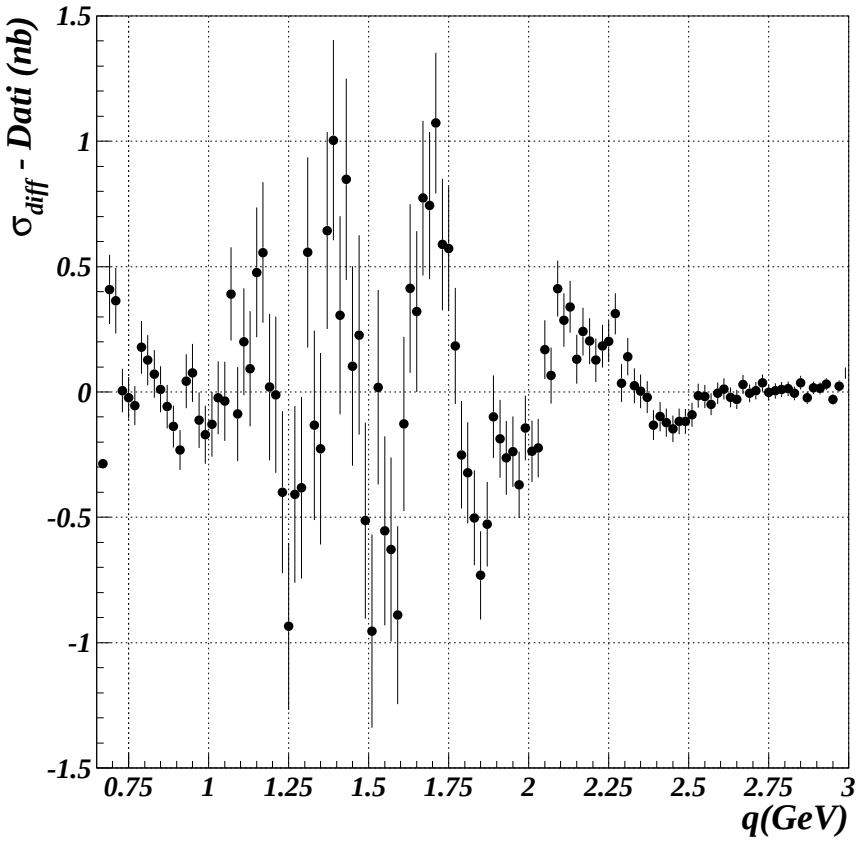


Fit – Data



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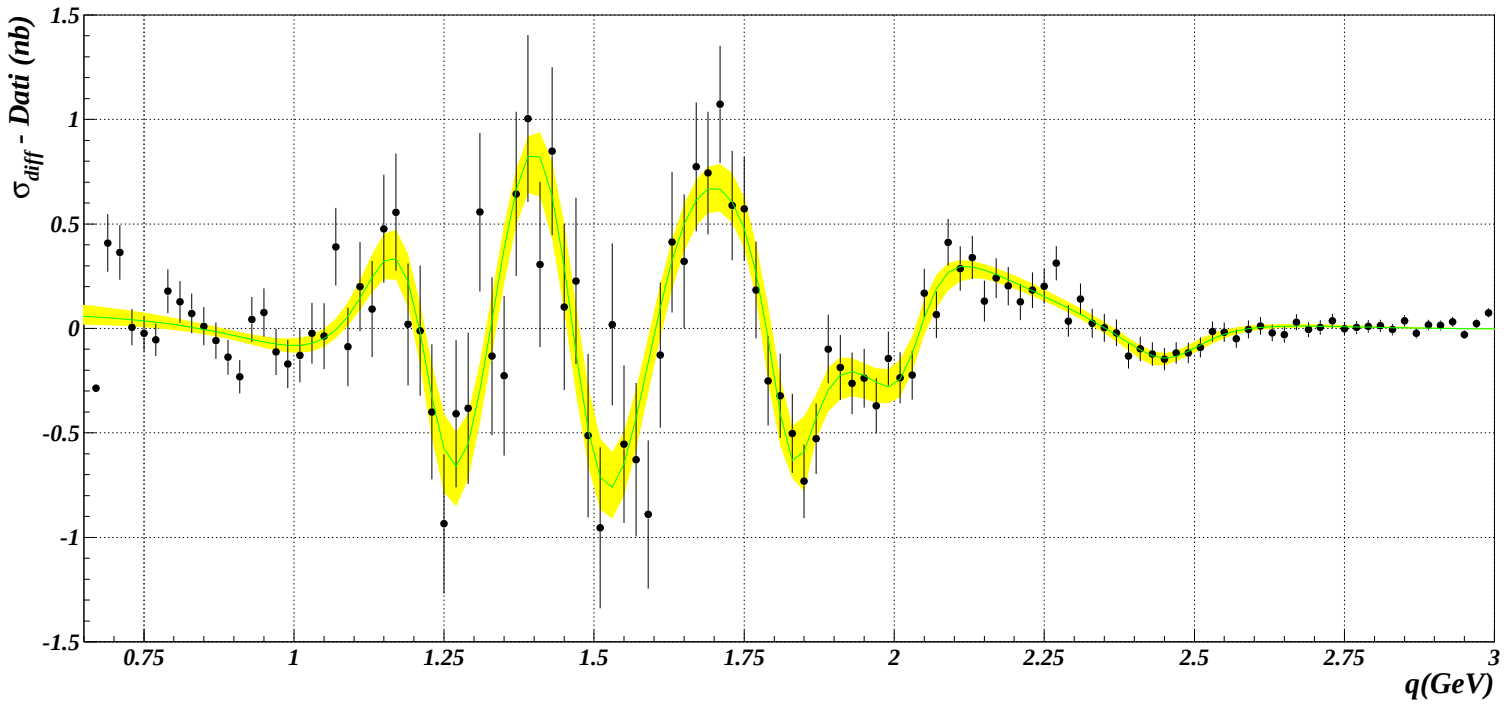

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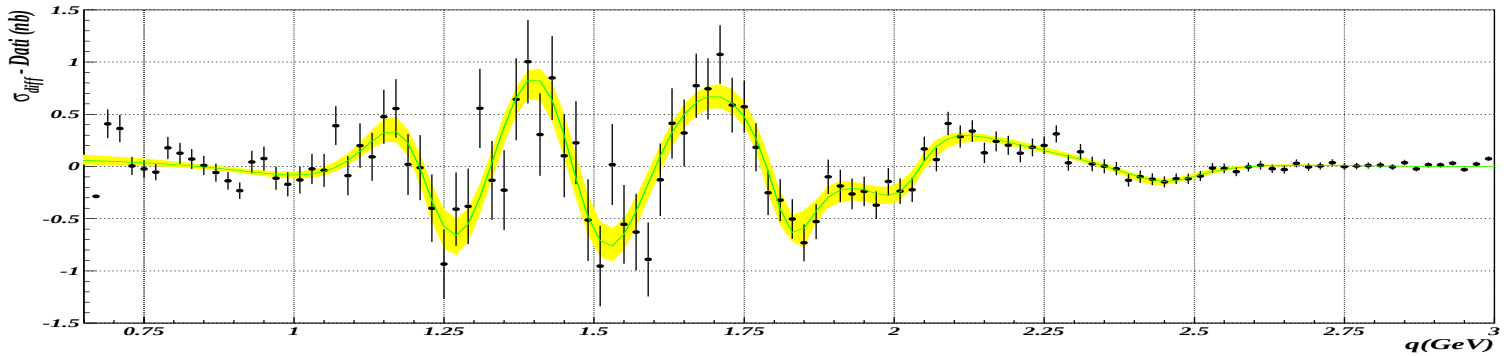

Resonances	$\Gamma_{e^+e^-}{}_j B_{j2\pi^+2\pi^-}(KeV)$	$m(MeV)$	$\Gamma(MeV)$	$\phi(rad)$
V_1	$(4 \pm 2) \times 10^{-2}$	1209 ± 6	218 ± 16	2.56 ± 0.04
V_2	$(5 \pm 2) \times 10^{-2}$	1465 ± 8	265 ± 23	4.26 ± 0.08
V_3	$(1.1 \pm 0.6) \times 10^{-3}$	1820 ± 25	100 ± 30	0.7 ± 0.6
V_4	$(3 \pm 2) \times 10^{-3}$	2030 ± 20	170 ± 80	2.6 ± 0.4
V_5	$(1.3 \pm 0.7) \times 10^{-3}$	2460 ± 24	190 ± 60	2.5 ± 0.3

Conclusions

- The dip, found at $M \sim 1.9\ GeV$ by E687 (P.L. Frabetti *et al.* Phys. Lett. **B514** (2001) 240), is investigated by means of a new fit function. Its nature appears consistent with a narrow resonance, strongly interfering with the vector meson $\rho(1700)$.
  A $N\overline{N}$ resonance is unlikely according to the negative result of OBELIX (Phys. Lett. **B527** (2002) 39).
  An interpretation of this resonance as an 1^{--}, isovector hybrid is in agreement with expected mass, width and decay mode.

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- We suggest the possible existence of some sub-structures in the 4π E687 photoproduction data (P. Lebrun *Hadron '97*, Aug. 25-30, 1997).
  The interpretation of these structures in terms of resonances needs much more precise data.
  With a statistics one order of magnitude bigger, such as the one foreseen for DAϕNE2, the *secrets* of this rich energy region could be revealed.