

$\pi_2(1670)$

$$I^G(J^{PC}) = 1^-(2^-+)$$

$\pi_2(1670)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
1672.4 ± 3.2 OUR AVERAGE		Error includes scale factor of 1.4. See the ideogram below.			
1749 ±10 ±100	145k	LU	05	B852	18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$
1676 ± 3 ± 8		1 CHUNG	02	B852	18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$
1685 ±10 ± 30		2 BARBERIS	01		450 $p p \rightarrow p_f 3\pi^0 p_s$
1687 ± 9 ± 15		AMELIN	99	YES	37 $\pi^- A \rightarrow \omega \pi^- \pi^0 A^*$
1669 ± 4		BARBERIS	98B		450 $p p \rightarrow p_f \rho \pi p_s$
1670 ± 4		BARBERIS	98B		450 $p p \rightarrow p_f f_2(1270) \pi p_s$
1730 ±20		3 AMELIN	95B	YES	36 $\pi^- A \rightarrow \pi^+ \pi^- \pi^- A$
1690 ±14		4 BERDNIKOV	94	YES	37 $\pi^- A \rightarrow K^+ K^- \pi^- A$
1710 ±20	700	ANTIPOV	87	SIGM -	50 $\pi^- Cu \rightarrow \mu^+ \mu^- \pi^- Cu$
1676 ± 6		4 EVANGELIS...	81	OMEG -	12 $\pi^- p \rightarrow 3\pi p$
1657 ±14		4,5 DAUM	80D	SPEC -	63-94 $\pi p \rightarrow 3\pi X$
1662 ±10	2000	4 BALTAY	77	HBC +	15 $\pi^+ p \rightarrow p 3\pi$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
1742 ±31 ± 49		ANTREASYAN	90	CBAL	$e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0 \pi^0$
1624 ±21		1 BELLINI	85	SPEC	40 $\pi^- A \rightarrow \pi^- \pi^+ \pi^- A$
1622 ±35		6 BELLINI	85	SPEC	40 $\pi^- A \rightarrow \pi^- \pi^+ \pi^- A$
1693 ±28		7 BELLINI	85	SPEC	40 $\pi^- A \rightarrow \pi^- \pi^+ \pi^- A$
1710 ±20		8 DAUM	81B	SPEC -	63,94 $\pi^- p$
1660 ±10		4 ASCOLI	73	HBC -	5-25 $\pi^- p \rightarrow p \pi_2$

¹ From $f_2(1270)\pi$ decay.

² From a fit to the invariant mass distribution.

³ From a fit to $J^{PC} = 2^-+ f_2(1270)\pi, f_0(1370)\pi$ waves.

⁴ From a fit to $J^P = 2^- S$ -wave $f_2(1270)\pi$ partial wave.

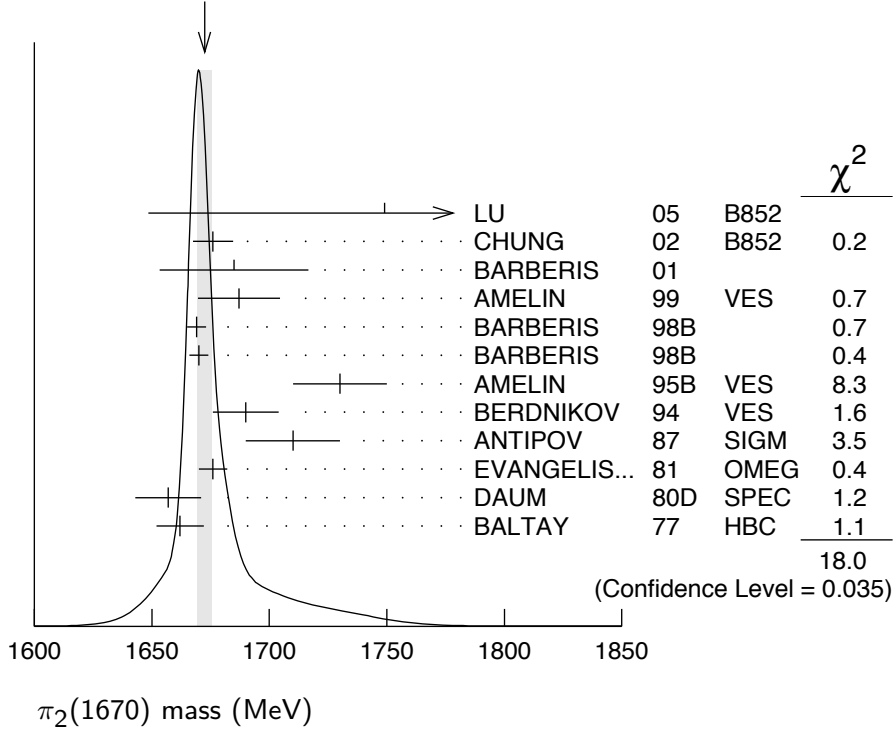
⁵ Clear phase rotation seen in $2^- S, 2^- P, 2^- D$ waves. We quote central value and spread of single-resonance fits to three channels.

⁶ From $\rho\pi$ decay.

⁷ From $\sigma\pi$ decay.

⁸ From a two-resonance fit to four 2^-0^+ waves. This should not be averaged with all the single resonance fits.

WEIGHTED AVERAGE
 1672.4 ± 3.2 (Error scaled by 1.4)

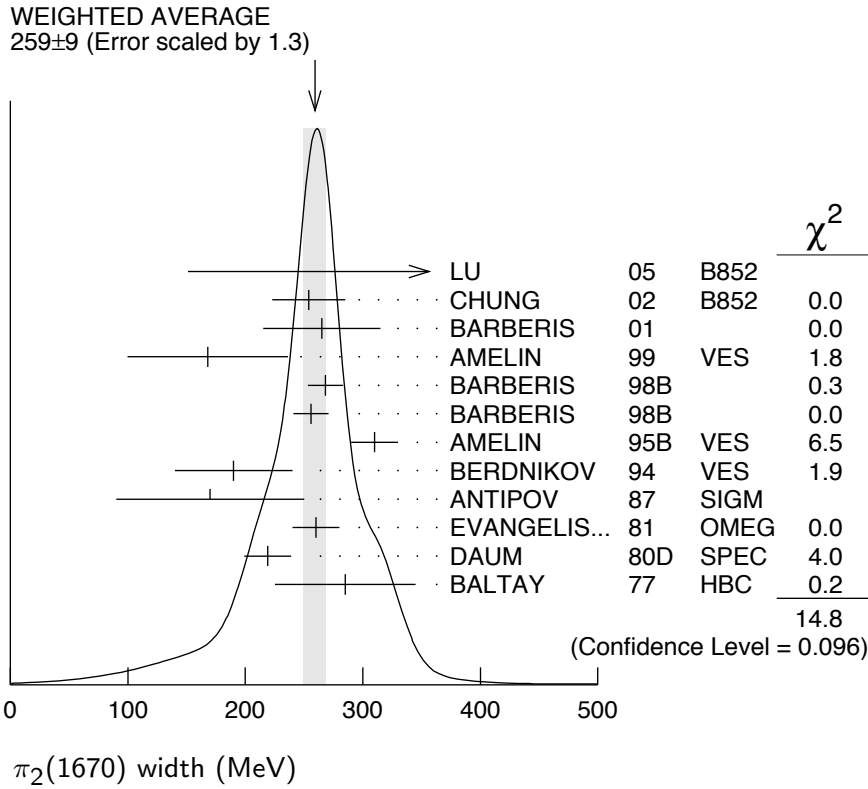


$\pi_2(1670)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	CHG	COMMENT	
259 ± 9	9 OUR AVERAGE	Error includes scale factor of 1.3. See the ideogram below.				
$408 \pm 60 \pm 250$	145k	LU	05	B852	$18 \pi^- p \rightarrow \omega \pi^- \pi^0 p$	
$254 \pm 3 \pm 31$		⁹ CHUNG	02	B852	$18.3 \pi^- p \rightarrow$ $\pi^+ \pi^- \pi^- p$	
$265 \pm 30 \pm 40$		¹⁰ BARBERIS	01		$450 p p \rightarrow p_f 3 \pi^0 p_s$	
$168 \pm 43 \pm 53$		AMELIN	99	VES	$37 \pi^- A \rightarrow$ $\omega \pi^- \pi^0 A^*$	
268 ± 15		BARBERIS	98B		$450 p p \rightarrow p_f \rho \pi p_s$	
256 ± 15		BARBERIS	98B		$450 p p \rightarrow$ $p_f f_2(1270) \pi p_s$	
310 ± 20		¹¹ AMELIN	95B	VES	$36 \pi^- A \rightarrow$ $\pi^+ \pi^- \pi^- A$	
190 ± 50		¹² BERDNIKOV	94	VES	$37 \pi^- A \rightarrow$ $K^+ K^- \pi^- A$	
170 ± 80	700	ANTIPOV	87	SIGM	-	$50 \pi^- \text{Cu} \rightarrow$ $\mu^+ \mu^- \pi^- \text{Cu}$
260 ± 20		¹² EVANGELIS...	81	OMEG	-	$12 \pi^- p \rightarrow 3 \pi p$
219 ± 20		^{12,13} DAUM	80D	SPEC	-	$63-94 \pi p \rightarrow 3 \pi X$
285 ± 60	2000	¹² BALTAY	77	HBC	+	$15 \pi^+ p \rightarrow p 3 \pi$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
$236 \pm 49 \pm 36$		ANTREASYAN	90	CBAL		$e^+ e^- \rightarrow$ $e^+ e^- \pi^0 \pi^0 \pi^0$
304 ± 22		⁹ BELLINI	85	SPEC		$40 \pi^- A \rightarrow$ $\pi^- \pi^+ \pi^- A$
404 ± 108		¹⁴ BELLINI	85	SPEC		$40 \pi^- A \rightarrow$ $\pi^- \pi^+ \pi^- A$

330 ± 90	¹⁵ BELLINI	85	SPEC	40 $\pi^- A \rightarrow \pi^- \pi^+ \pi^- A$
312 ± 50	¹⁶ DAUM	81B	SPEC	— 63,94 $\pi^- p$
270 ± 60	¹² ASCOLI	73	HBC	— 5–25 $\pi^- p \rightarrow p \pi_2$

- ⁹ From $f_2(1270)\pi$ decay.
- ¹⁰ From a fit to the invariant mass distribution.
- ¹¹ From a fit to $J^{PC} = 2^- + f_2(1270)\pi, f_0(1370)\pi$ waves.
- ¹² From a fit to $J^P = 2^- f_2(1270)\pi$ partial wave.
- ¹³ Clear phase rotation seen in $2^- S, 2^- P, 2^- D$ waves. We quote central value and spread of single-resonance fits to three channels.
- ¹⁴ From $\rho\pi$ decay.
- ¹⁵ From $\sigma\pi$ decay.
- ¹⁶ From a two-resonance fit to four $2^- 0^+$ waves. This should not be averaged with all the single resonance fits.



$\pi_2(1670)$ DECAY MODES

Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1 3π	(95.8 ± 1.4) %	
Γ_2 $\pi^+ \pi^- \pi^0$		
Γ_3 $\pi^0 \pi^0 \pi^0$		
Γ_4 $f_2(1270)\pi$	(56.3 ± 3.2) %	
Γ_5 $\rho\pi$	(31 ± 4) %	
Γ_6 $\sigma\pi$	(10.9 ± 3.4) %	
Γ_7 $(\pi\pi)_S$ -wave	(8.7 ± 3.4) %	

Γ_8	$K\bar{K}^*(892) + \text{c.c.}$	$(4.2 \pm 1.4) \%$	
Γ_9	$\omega\rho$	$(2.7 \pm 1.1) \%$	
Γ_{10}	$\gamma\gamma$	$< 2.8 \times 10^{-7}$	90%
Γ_{11}	$\eta\pi$		
Γ_{12}	$\pi^\pm 2\pi^+ 2\pi^-$		
Γ_{13}	$\rho(1450)\pi$	$< 3.6 \times 10^{-3}$	97.7%
Γ_{14}	$b_1(1235)\pi$	$< 1.9 \times 10^{-3}$	97.7%
Γ_{15}	$\eta 3\pi$		
Γ_{16}	$f_1(1285)\pi$	possibly seen	
Γ_{17}	$a_2(1320)\pi$	not seen	

CONSTRAINED FIT INFORMATION

An overall fit to 4 branching ratios uses 6 measurements and one constraint to determine 4 parameters. The overall fit has a $\chi^2 = 1.9$ for 3 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle \delta x_i \delta x_j \rangle / (\delta x_i \delta x_j)$, in percent, from the fit to the branching fractions, $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$. The fit constrains the x_i whose labels appear in this array to sum to one.

x_5	-53		
x_7	-29	-59	
x_8	-8	-21	-9
	x_4	x_5	x_7

$\pi_2(1670)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$						Γ_{10}
VALUE (keV)	CL%	DOCUMENT ID	TECN	CHG	COMMENT	
<0.072	90	¹⁷ ACCIARRI	97T	L3	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-\pi^0$	
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
<0.19	90	¹⁷ ALBRECHT	97B	ARG	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-\pi^0$	
1.41 \pm 0.23 \pm 0.28		ANTREASYAN 90	CBAL	0	$e^+e^- \rightarrow e^+e^-\pi^0\pi^0\pi^0$	
0.8 \pm 0.3 \pm 0.12		¹⁸ BEHREND	90C	CELL	0	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-\pi^0$
1.3 \pm 0.3 \pm 0.2		¹⁹ BEHREND	90C	CELL	0	$e^+e^- \rightarrow e^+e^-\pi^+\pi^-\pi^0$

¹⁷ Decaying into $f_2(1270)\pi$ and $\rho\pi$.

¹⁸ Constructive interference between $f_2(1270)\pi, \rho\pi$ and background.

¹⁹ Incoherent Ansatz.

$\pi_2(1670) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(\pi^+\pi^-\pi^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$					$\Gamma_2\Gamma_{10}/\Gamma$
VALUE (keV)	CL%	DOCUMENT ID	TECN	COMMENT	
<0.1	95	²⁰ SCHEGELSKY 06	RVUE	$\gamma\gamma \rightarrow \pi^+\pi^-\pi^0$	
²⁰ From analysis of L3 data at 183–209 GeV.					

$\pi_2(1670)$ BRANCHING RATIOS

$\Gamma(3\pi)/\Gamma_{\text{total}}$					$\Gamma_1/\Gamma = (\Gamma_4+\Gamma_5+\Gamma_7)/\Gamma$
VALUE	DOCUMENT ID				
0.958±0.014 OUR FIT					

$\Gamma(\pi^0\pi^0\pi^0)/\Gamma(\pi^+\pi^-\pi^0)$				Γ_3/Γ_2
VALUE	DOCUMENT ID	TECN	COMMENT	
0.29±0.03±0.05	²¹ BARBERIS 01		450 $p p \rightarrow p_f 3\pi^0 p_s$	

$\Gamma(\rho\pi)/0.565\Gamma(f_2(1270)\pi)$					$\Gamma_5/0.565\Gamma_4$
(With $f_2(1270) \rightarrow \pi^+\pi^-$.)	VALUE	DOCUMENT ID	TECN	COMMENT	
0.97±0.09 OUR AVERAGE	Error includes scale factor of 1.9.				
0.76±0.07±0.10	CHUNG	02	B852	18.3 $\pi^- p \rightarrow \pi^+\pi^-\pi^- p$	
1.01±0.05	BARBERIS	98B		450 $p p \rightarrow p_f \pi^+\pi^-\pi^0 p_s$	

$\Gamma(\sigma\pi)/\Gamma(f_2(1270)\pi)$					Γ_6/Γ_4
VALUE	DOCUMENT ID	TECN	COMMENT		
0.19±0.06 OUR AVERAGE					
0.17±0.02±0.07	CHUNG	02	B852	18.3 $\pi^- p \rightarrow \pi^+\pi^-\pi^- p$	
0.24±0.10	^{22,23} BAKER	99	SPEC	1.94 $\bar{p} p \rightarrow 4\pi^0$	

$\frac{1}{2}\Gamma(\rho\pi)/\Gamma(\pi^\pm\pi^+\pi^-)$					$\frac{1}{2}\Gamma_5/(0.565\Gamma_4+\frac{1}{2}\Gamma_5+0.624\Gamma_7)$
VALUE	DOCUMENT ID	TECN	CHG	COMMENT	
0.29±0.04 OUR FIT					
0.29±0.05	²⁴ DAUM	81B	SPEC	63,94 $\pi^- p$	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.3	BARTSCH	68	HBC	+ 8 $\pi^+ p \rightarrow 3\pi p$	

$0.565\Gamma(f_2(1270)\pi)/\Gamma(\pi^\pm\pi^+\pi^-)$					$0.565\Gamma_4/(0.565\Gamma_4+\frac{1}{2}\Gamma_5+0.624\Gamma_7)$
(With $f_2(1270) \rightarrow \pi^+\pi^-$.)	VALUE	DOCUMENT ID	TECN	CHG	COMMENT
0.604±0.035 OUR FIT					
0.60 ±0.05 OUR AVERAGE	Error includes scale factor of 1.3.				
0.61 ±0.04	²⁴ DAUM	81B	SPEC		63,94 $\pi^- p$
0.76 ^{+0.24} _{-0.34}	ARMENISE	69	DBC	+	5.1 $\pi^+ d \rightarrow d 3\pi$
0.35 ±0.20	BALTAY	68	HBC	+	7–8.5 $\pi^+ p$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.59	BARTSCH	68	HBC	+	8 $\pi^+ p \rightarrow 3\pi p$

$$0.624\Gamma((\pi\pi)_{S\text{-wave}})/\Gamma(\pi^\pm\pi^+\pi^-) \quad 0.624\Gamma_7/(0.565\Gamma_4+\frac{1}{2}\Gamma_5+0.624\Gamma_7)$$

(With $(\pi\pi)_{S\text{-wave}} \rightarrow \pi^+\pi^-$.)

VALUE	DOCUMENT ID	TECN	COMMENT
0.10±0.04 OUR FIT			
0.10±0.05	24 DAUM	81B SPEC	63,94 $\pi^- p$

$$\Gamma(K\bar{K}^*(892)+\text{c.c.})/\Gamma(f_2(1270)\pi) \quad \Gamma_8/\Gamma_4$$

VALUE	DOCUMENT ID	TECN	CHG	COMMENT
0.075±0.025 OUR FIT				
0.075±0.025	25 ARMSTRONG	82B OMEG	-	16 $\pi^- p \rightarrow K^+ K^- \pi^- p$

$$\Gamma(\omega\rho)/\Gamma_{\text{total}} \quad \Gamma_9/\Gamma$$

VALUE	DOCUMENT ID	TECN	COMMENT
0.027±0.004±0.010	26 AMELIN	99 VES	37 $\pi^- A \rightarrow \omega\pi^-\pi^0 A^*$

$$\Gamma(\eta\pi)/\Gamma(\pi^\pm\pi^+\pi^-) \quad \Gamma_{11}/(0.565\Gamma_4+\frac{1}{2}\Gamma_5+0.624\Gamma_7)$$

(All η decays.)

VALUE	DOCUMENT ID	TECN	CHG	COMMENT
<0.09	BALTAY	68 HBC	+	7-8.5 $\pi^+ p$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.10	CRENNELL	70 HBC	-	6 $\pi^- p \rightarrow f_2\pi^- N$
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$$\Gamma(\pi^\pm 2\pi^+ 2\pi^-)/\Gamma(\pi^\pm\pi^+\pi^-) \quad \Gamma_{12}/(0.565\Gamma_4+\frac{1}{2}\Gamma_5+0.624\Gamma_7)$$

VALUE	DOCUMENT ID	TECN	CHG	COMMENT
<0.10	CRENNELL	70 HBC	-	6 $\pi^- p \rightarrow f_2\pi^- N$
<0.1	BALTAY	68 HBC	+	7,8.5 $\pi^+ p$

$$\Gamma(\rho(1450)\pi)/\Gamma_{\text{total}} \quad \Gamma_{13}/\Gamma$$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.0036	97.7	AMELIN	99 VES	37 $\pi^- A \rightarrow \omega\pi^-\pi^0 A^*$

$$\Gamma(b_1(1235)\pi)/\Gamma_{\text{total}} \quad \Gamma_{14}/\Gamma$$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.0019	97.7	AMELIN	99 VES	37 $\pi^- A \rightarrow \omega\pi^-\pi^0 A^*$

$$\Gamma(f_1(1285)\pi)/\Gamma_{\text{total}} \quad \Gamma_{16}/\Gamma$$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
possibly seen	69k	KUHN	04 B852	18 $\pi^- p \rightarrow \eta\pi^+\pi^-\pi^- p$

$$\Gamma(a_2(1320)\pi)/\Gamma_{\text{total}} \quad \Gamma_{17}/\Gamma$$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
not seen	69k	KUHN	04 B852	18 $\pi^- p \rightarrow \eta\pi^+\pi^-\pi^- p$

D-wave/S-wave RATIO FOR $\pi_2(1670) \rightarrow f_2(1270)\pi$

VALUE	DOCUMENT ID	TECN	COMMENT
-0.18 ± 0.06	²² BAKER	99	SPEC 1.94 $\bar{p}p \rightarrow 4\pi^0$
0.22 ± 0.10	²⁴ DAUM	81B	SPEC 63,94 $\pi^- p$

F-wave/P-wave RATIO FOR $\pi_2(1670) \rightarrow \rho\pi$

VALUE	DOCUMENT ID	TECN	COMMENT
$-0.72 \pm 0.07 \pm 0.14$	CHUNG	02	B852 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$

²¹ Using BARBERIS 98B.

²² Using preliminary CBAR data.

²³ With the $\sigma\pi$ in $L=2$ and the $f_2(1270)\pi$ in $L=0$.

²⁴ From a two-resonance fit to four 2^-0^+ waves.

²⁵ From a partial-wave analysis of $K^+ K^- \pi^-$ system.

²⁶ Normalized to the $B(\pi_2(1670) \rightarrow f_2\pi)$.

$\pi_2(1670)$ REFERENCES

SCHEGELSKY	06	EPJ A27 199	V.A. Schegelsky <i>et al.</i>	
LU	05	PRL 94 032002	M. Lu <i>et al.</i>	(BNL E852 Collab.)
KUHN	04	PL B595 109	J. Kuhn <i>et al.</i>	(BNL E852 Collab.)
CHUNG	02	PR D65 072001	S.U. Chung <i>et al.</i>	(BNL E852 Collab.)
BARBERIS	01	PL B507 14	D. Barberis <i>et al.</i>	
AMELIN	99	PAN 62 445	D.V. Amelin <i>et al.</i>	(VES Collab.)
		Translated from YAF 62	487.	
BAKER	99	PL B449 114	C.A. Baker <i>et al.</i>	
BARBERIS	98B	PL B422 399	D. Barberis <i>et al.</i>	(WA 102 Collab.)
ACCIARRI	97T	PL B413 147	M. Acciarri <i>et al.</i>	(L3 Collab.)
ALBRECHT	97B	ZPHY C74 469	H. Albrecht <i>et al.</i>	(ARGUS Collab.)
AMELIN	95B	PL B356 595	D.V. Amelin <i>et al.</i>	(SERP, TBIL)
BERDNIKOV	94	PL B337 219	E.B. Berdnikov <i>et al.</i>	(SERP, TBIL)
ANTREASIAN	90	ZPHY C48 561	D. Antreasian <i>et al.</i>	(Crystal Ball Collab.)
BEHREND	90C	ZPHY C46 583	H.J. Behrend <i>et al.</i>	(CELLO Collab.)
ANTIPOV	87	EPL 4 403	Y.M. Antipov <i>et al.</i>	(SERP, JINR, INRM+)
BELLINI	85	SJNP 41 781	D. Bellini <i>et al.</i>	
		Translated from YAF 41	1223.	
ARMSTRONG	82B	NP B202 1	T.A. Armstrong, B. Baccari	(AACH3, BARI, BONN+)
DAUM	81B	NP B182 269	C. Daum <i>et al.</i>	(AMST, CERN, CRAC, MPIM+)
EVANGELIS...	81	NP B178 197	C. Evangelista <i>et al.</i>	(BARI, BONN, CERN+)
		Also		
		NP B186 594	C. Evangelista	
DAUM	80D	PL 89B 285	C. Daum <i>et al.</i>	(AMST, CERN, CRAC, MPIM+) JP
BALTAY	77	PRL 39 591	C. Baltay, C.V. Cautis, M. Kalelkar	(COLU) JP
ASCOLI	73	PR D7 669	G. Ascoli	(ILL, TNTO, GENO, HAMB, MILA+) JP
CRENNELL	70	PRL 24 781	D.J. Crennell <i>et al.</i>	(BNL)
ARMENISE	69	LNC 2 501	N. Armenise <i>et al.</i>	(BARI, BGNA, FIRZ)
BALTAY	68	PRL 20 887	C. Baltay <i>et al.</i>	(COLU, ROCH, RUTG, YALE) I
BARTSCH	68	NP B7 345	J. Bartsch <i>et al.</i>	(AACH, BERL, CERN) JP