

$\Sigma(1775) 5/2^-$ $I(J^P) = 1(\frac{5}{2}^-)$ Status: ****

Discovered by GALTIERI 63, this resonance plays the same role as cornerstone for isospin-1 analyses in this region as the $\Lambda(1820)F_{05}$ does in the isospin-0 channel.

For most results published before 1974 (they are now obsolete), see our 1982 edition *Physics Letters* **111B** 1 (1982).

 $\Sigma(1775)$ MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1770 to 1780 (≈ 1775) OUR ESTIMATE			
1778 \pm 1	ZHANG	13A	DPWA Multichannel
1778 \pm 5	GOPAL	80	DPWA $\bar{K}N \rightarrow \bar{K}N$
1777 \pm 5	ALSTON-...	78	DPWA $\bar{K}N \rightarrow \bar{K}N$
1774 \pm 5	GOPAL	77	DPWA $\bar{K}N$ multichannel
1775 \pm 10	BAILLON	75	IPWA $\bar{K}N \rightarrow \Lambda\pi$
1774 \pm 10	VANHORN	75	DPWA $K^-p \rightarrow \Lambda\pi^0$
1772 \pm 6	KANE	74	DPWA $K^-p \rightarrow \Sigma\pi$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1772 or 1777	¹ MARTIN	77	DPWA $\bar{K}N$ multichannel
1765	DEBELLEFON	76	IPWA $K^-p \rightarrow \Lambda\pi^0$

 $\Sigma(1775)$ WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
105 to 135 (≈ 120) OUR ESTIMATE			
131 \pm 3	ZHANG	13A	DPWA Multichannel
137 \pm 10	GOPAL	80	DPWA $\bar{K}N \rightarrow \bar{K}N$
116 \pm 10	ALSTON-...	78	DPWA $\bar{K}N \rightarrow \bar{K}N$
130 \pm 10	GOPAL	77	DPWA $\bar{K}N$ multichannel
125 \pm 15	BAILLON	75	IPWA $\bar{K}N \rightarrow \Lambda\pi$
146 \pm 18	VANHORN	75	DPWA $K^-p \rightarrow \Lambda\pi^0$
154 \pm 10	KANE	74	DPWA $K^-p \rightarrow \Sigma\pi$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
102 or 103	¹ MARTIN	77	DPWA $\bar{K}N$ multichannel
120	DEBELLEFON	76	IPWA $K^-p \rightarrow \Lambda\pi^0$

 $\Sigma(1775)$ POLE POSITION**REAL PART**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1759	ZHANG	13A	DPWA Multichannel

-2xIMAGINARY PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
118	ZHANG	13A	DPWA Multichannel

$\Sigma(1775)$ DECAY MODES

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\bar{K}$	37–43%
Γ_2 $\Lambda\pi$	14–20%
Γ_3 $\Sigma\pi$	2–5%
Γ_4 $\Sigma(1385)\pi$	8–12%
Γ_5 $\Sigma(1385)\pi$, <i>D</i> -wave	
Γ_6 $\Lambda(1520)\pi$, <i>P</i> -wave	17–23%
Γ_7 $\Sigma\pi\pi$	
Γ_8 $\Delta(1232)\bar{K}$, <i>D</i> -wave	
Γ_9 $N\bar{K}^*(892)$, $S=1/2$	
Γ_{10} $N\bar{K}^*(892)$, $S=3/2$, <i>D</i> -wave	

The above branching fractions are our estimates, not fits or averages.

CONSTRAINED FIT INFORMATION

An overall fit to 7 branching ratios uses 18 measurements and one constraint to determine 5 parameters. The overall fit has a $\chi^2 = 363.4$ for 14 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_2	−44			
x_3	−23	10		
x_4	−23	−32	−4	
x_6	−3	1	1	−84
	x_1	x_2	x_3	x_4

 $\Sigma(1775)$ BRANCHING RATIOS

See “Sign conventions for resonance couplings” in the Note on Λ and Σ Resonances. Also, the errors quoted do not include uncertainties due to the parametrization used in the partial-wave analyses and are thus too small.

$\Gamma(N\bar{K})/\Gamma_{\text{total}}$				Γ_1/Γ
VALUE	DOCUMENT ID	TECN	COMMENT	
0.37 to 0.43 OUR ESTIMATE				
0.421±0.020 OUR FIT			Error includes scale factor of 2.5.	
0.398±0.009 OUR AVERAGE				
0.40 ±0.01	ZHANG	13A	DPWA Multichannel	
0.40 ±0.02	GOPAL	80	DPWA $\bar{K}N \rightarrow \bar{K}N$	
0.37 ±0.03	ALSTON-...	78	DPWA $\bar{K}N \rightarrow \bar{K}N$	
••• We do not use the following data for averages, fits, limits, etc. •••				
0.41 ±0.03	GOPAL	77	DPWA See GOPAL 80	
0.37 or 0.36	¹ MARTIN	77	DPWA $\bar{K}N$ multichannel	

$\Gamma(\Lambda\pi)/\Gamma(N\bar{K})$

Γ_2/Γ_1

VALUE	DOCUMENT ID	TECN	COMMENT
0.48±0.06 OUR FIT	Error includes scale factor of 2.3.		
0.33±0.05	UHLIG	67	HBC $K^- p$ 0.9 GeV/c

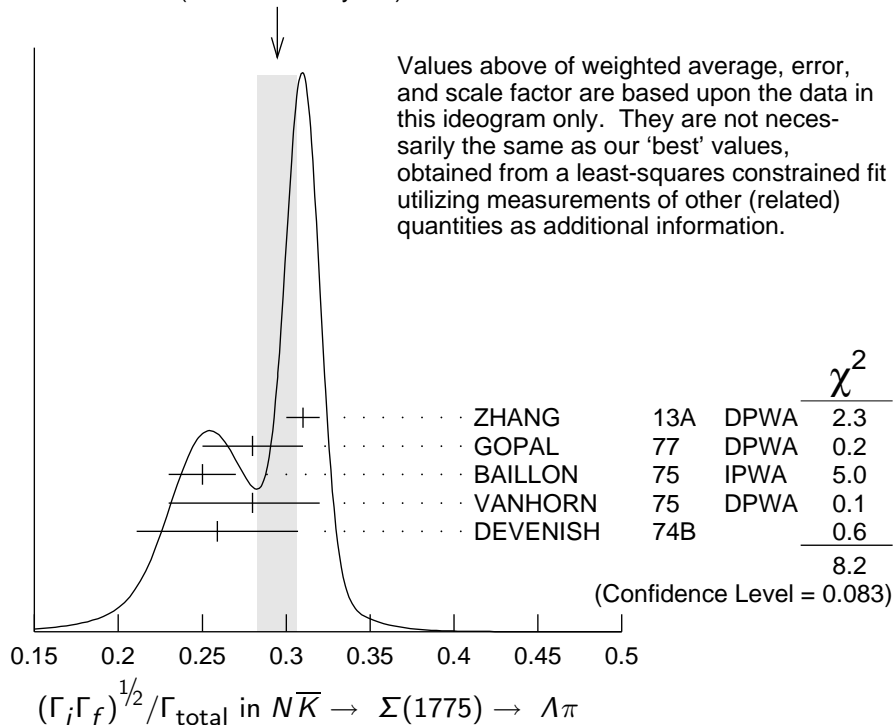
$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1775) \rightarrow \Lambda\pi$

$(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
0.293±0.013 OUR FIT	Error includes scale factor of 1.8.		
0.295±0.012 OUR AVERAGE	Signs on measurements were ignored. Error includes scale factor of 1.4. See the ideogram below.		

-0.31 ±0.01	ZHANG	13A	DPWA	Multichannel
-0.28 ±0.03	GOPAL	77	DPWA	$\bar{K}N$ multichannel
-0.25 ±0.02	BAILLON	75	IPWA	$\bar{K}N \rightarrow \Lambda\pi$
-0.28 ^{+0.04} _{-0.05}	VANHORN	75	DPWA	$K^- p \rightarrow \Lambda\pi^0$
-0.259±0.048	DEVENISH	74B		Fixed- <i>t</i> dispersion rel.
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
-0.29 or -0.28	¹ MARTIN	77	DPWA	$\bar{K}N$ multichannel
-0.30	DEBELLEFON	76	IPWA	$K^- p \rightarrow \Lambda\pi^0$

WEIGHTED AVERAGE
0.295±0.012 (Error scaled by 1.4)



$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1775) \rightarrow \Sigma\pi$

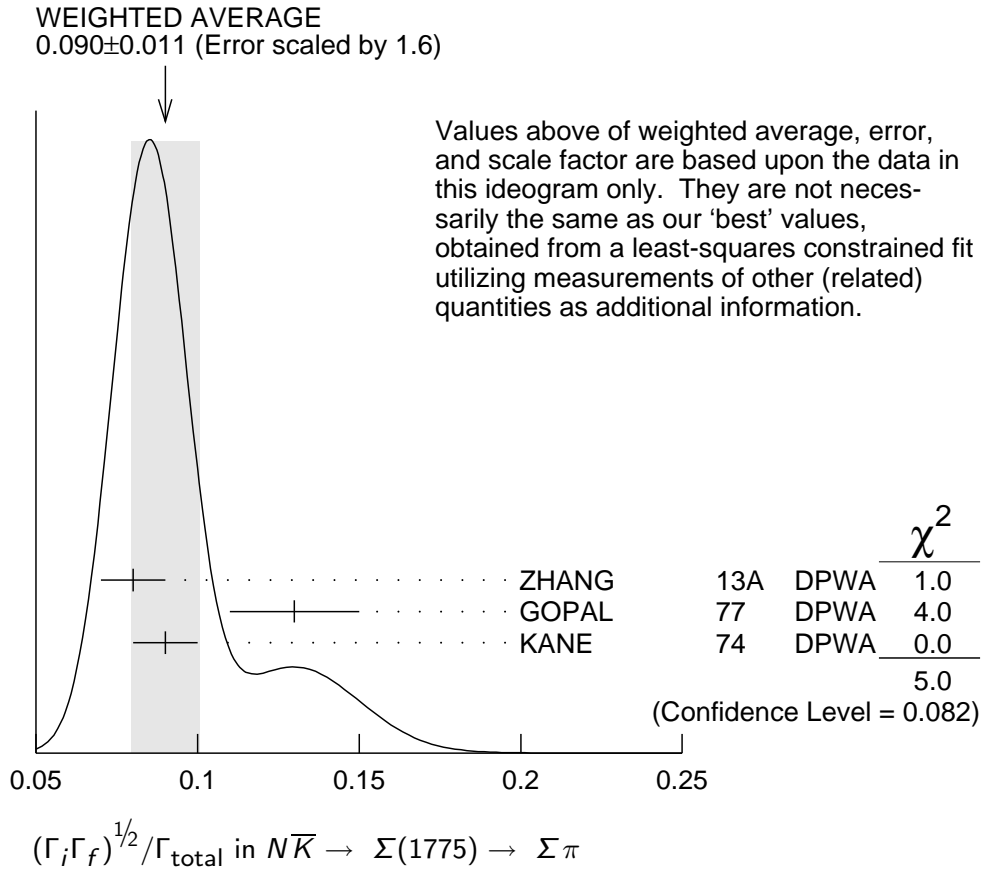
$(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
0.090±0.009 OUR FIT	Error includes scale factor of 1.4.		
0.090±0.011 OUR AVERAGE	Signs on measurements were ignored. Error includes scale factor of 1.6. See the ideogram below.		

+0.08 ±0.01	ZHANG	13A	DPWA	Multichannel
+0.13 ±0.02	GOPAL	77	DPWA	$\bar{K}N$ multichannel
0.09 ±0.01	KANE	74	DPWA	$K^- p \rightarrow \Sigma\pi$

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

+0.08 or +0.08 ¹ MARTIN 77 DPWA $\bar{K}N$ multichannel



$\Gamma(\Sigma(1385)\pi) / \Gamma(N\bar{K})$

Γ_4 / Γ_1

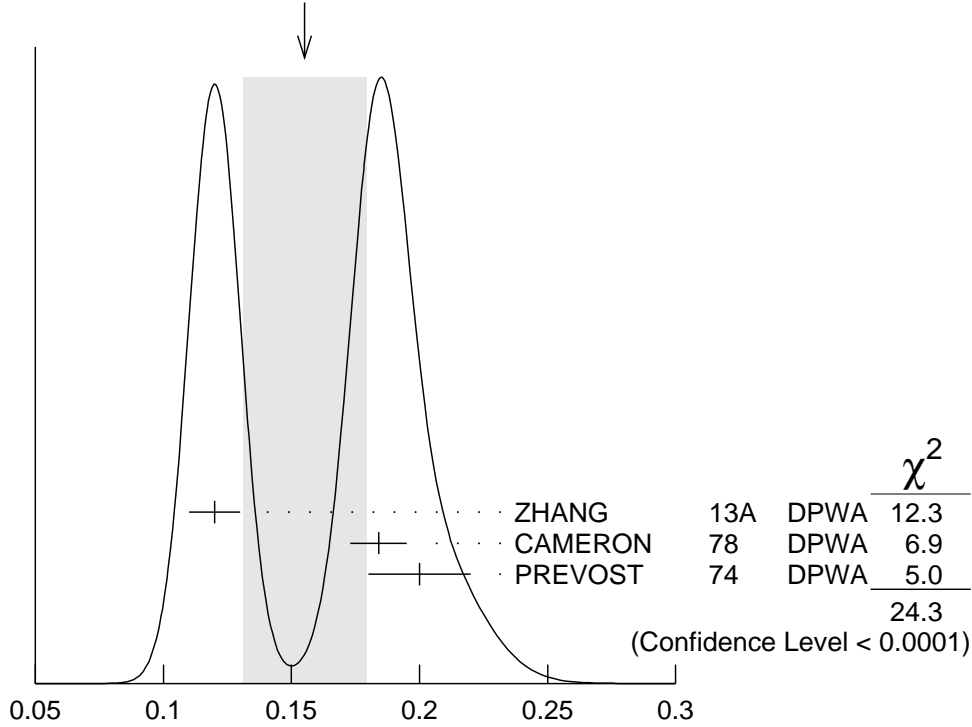
VALUE	DOCUMENT ID	TECN	COMMENT
0.79±0.11 OUR FIT			Error includes scale factor of 3.2.
0.25±0.09	UHLIG	67	HBC $K^- p$ 0.9 GeV/c

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1775) \rightarrow \Sigma(1385)\pi$, D-wave

$(\Gamma_1 \Gamma_5)^{1/2} / \Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
0.155±0.024 OUR AVERAGE			Signs on measurements were ignored. Error includes scale factor of 3.5. See the ideogram below.
-0.12 ±0.01	ZHANG	13A	DPWA Multichannel
-0.184±0.011	² CAMERON	78	DPWA $K^- p \rightarrow \Sigma(1385)\pi$
+0.20 ±0.02	PREVOST	74	DPWA $K^- N \rightarrow \Sigma(1385)\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.32 ±0.06	SIMS	68	DBC $K^- N \rightarrow \Lambda\pi\pi$
0.24 ±0.03	ARMENTEROS67C	HBC	$K^- p \rightarrow \Lambda\pi\pi$

WEIGHTED AVERAGE
 0.155 ± 0.024 (Error scaled by 3.5)



$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1775) \rightarrow \Sigma(1385)\pi$, *D*-wave

$\Gamma(\Lambda(1520)\pi, P\text{-wave}) / \Gamma(N\bar{K})$

Γ_6 / Γ_1

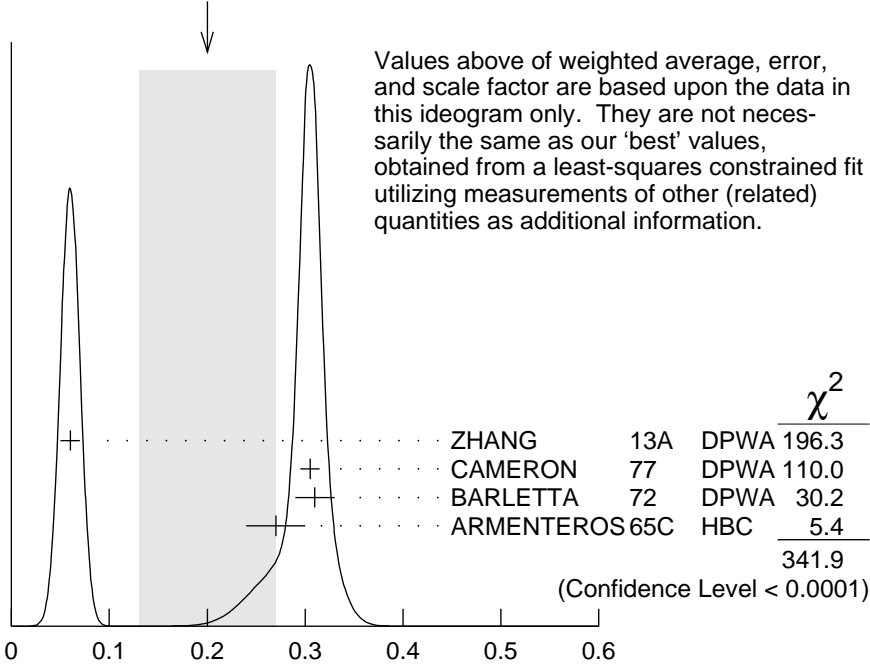
VALUE	DOCUMENT ID	TECN	COMMENT
$0.053^{+0.080}_{-0.035}$ OUR FIT			Error includes scale factor of 11.8.
0.28 ± 0.05	UHLIG	67	HBC $K^- p$ 0.9 GeV/c

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1775) \rightarrow \Lambda(1520)\pi$, *P*-wave

$(\Gamma_1 \Gamma_6)^{1/2} / \Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
0.10 ± 0.06 OUR FIT			Error includes scale factor of 11.5.
0.20 ± 0.07 OUR AVERAGE			Signs on measurements were ignored. Error includes scale factor of 10.7. See the ideogram below.
-0.06 ± 0.01	ZHANG	13A	DPWA Multichannel
-0.305 ± 0.010	³ CAMERON	77	DPWA $K^- p \rightarrow \Lambda(1520)\pi^0$
0.31 ± 0.02	BARLETTA	72	DPWA $K^- p \rightarrow \Lambda(1520)\pi^0$
0.27 ± 0.03	ARMENTEROS65C	HBC	$K^- p \rightarrow \Lambda(1520)\pi^0$

WEIGHTED AVERAGE
 0.20 ± 0.07 (Error scaled by 11.)



Values above of weighted average, error, and scale factor are based upon the data in this ideogram only. They are not necessarily the same as our 'best' values, obtained from a least-squares constrained fit utilizing measurements of other (related) quantities as additional information.

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1775) \rightarrow \Lambda(1520)\pi$, *P*-wave

$\Gamma(\Sigma\pi\pi) / \Gamma_{\text{total}}$ Γ_7 / Γ

VALUE	DOCUMENT ID	TECN	COMMENT
0.12	⁴ ARMENTEROS68C	HDBC	$K^- N \rightarrow \Sigma\pi\pi$

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1775) \rightarrow \Delta(1232)\bar{K}$, *D*-wave $(\Gamma_1 \Gamma_8)^{1/2} / \Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
$+0.06 \pm 0.03$	ZHANG	13A	DPWA Multichannel

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1775) \rightarrow N\bar{K}^*(892)$, *S*=1/2 $(\Gamma_1 \Gamma_9)^{1/2} / \Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
$+0.04 \pm 0.01$	ZHANG	13A	DPWA Multichannel

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1775) \rightarrow N\bar{K}^*(892)$, *S*=3/2, *D*-wave $(\Gamma_1 \Gamma_{10})^{1/2} / \Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
$+0.04 \pm 0.01$	ZHANG	13A	DPWA Multichannel

$\Sigma(1775)$ FOOTNOTES

- ¹ The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.
- ² The CAMERON 78 upper limit on *G*-wave decay is 0.03.
- ³ This rate combines *P*-wave- and *F*-wave decays. The CAMERON 77 results for the separate *P*-wave- and *F*-wave decays are -0.303 ± 0.010 and -0.037 ± 0.014 . The published signs have been changed here to be in accord with the baryon-first convention.

⁴ For about 3/4 of this, the $\Sigma\pi$ system has $I = 0$ and is almost entirely $\Lambda(1520)$. For the rest, the $\Sigma\pi$ has $I = 1$, which is about what is expected from the known $\Sigma(1775) \rightarrow \Sigma(1385)\pi$ rate, as seen in $\Lambda\pi\pi$.

$\Sigma(1775)$ REFERENCES

ZHANG	13A	PR C88 035205	H. Zhang <i>et al.</i>	(KSU)
PDG	82	PL 111B 1	M. Roos <i>et al.</i>	(HELS, CIT, CERN)
GOPAL	80	Toronto Conf. 159	G.P. Gopal	(RHEL) IJP
ALSTON-...	78	PR D18 182	M. Alston-Garnjost <i>et al.</i>	(LBL, MTHO+) IJP
Also		PRL 38 1007	M. Alston-Garnjost <i>et al.</i>	(LBL, MTHO+) IJP
CAMERON	78	NP B143 189	W. Cameron <i>et al.</i>	(RHEL, LOIC) IJP
CAMERON	77	NP B131 399	W. Cameron <i>et al.</i>	(RHEL, LOIC) IJP
GOPAL	77	NP B119 362	G.P. Gopal <i>et al.</i>	(LOIC, RHEL) IJP
MARTIN	77	NP B127 349	B.R. Martin, M.K. Pidcock, R.G. Moorhouse	(LOUC+) IJP
Also		NP B126 266	B.R. Martin, M.K. Pidcock	(LOUC)
Also		NP B126 285	B.R. Martin, M.K. Pidcock	(LOUC) IJP
DEBELLEFON	76	NP B109 129	A. de Bellefon, A. Berthon	(CDEF) IJP
BAILLON	75	NP B94 39	P.H. Baillon, P.J. Litchfield	(CERN, RHEL) IJP
VANHORN	75	NP B87 145	A.J. van Horn	(LBL) IJP
Also		NP B87 157	A.J. van Horn	(LBL) IJP
DEVENISH	74B	NP B81 330	R.C.E. Devenish, C.D. Froggatt, B.R. Martin	(DESY+) IJP
KANE	74	LBL-2452	D.F. Kane	(LBL) IJP
PREVOST	74	NP B69 246	J. Prevost <i>et al.</i>	(SACL, CERN, HEID)
BARLETTA	72	NP B40 45	W.A. Barletta	(EFI) IJP
Also		PRL 17 841	S. Fenster <i>et al.</i>	(CHIC, ANL, CERN) IJP
ARMENTEROS	68C	NP B8 216	R. Armenteros <i>et al.</i>	(CERN, HEID, SACL) I
SIMS	68	PRL 21 1413	W.H. Sims <i>et al.</i>	(FSU, TUFTS, BRAN)
ARMENTEROS	67C	ZPHY 202 486	R. Armenteros <i>et al.</i>	(CERN, HEID, SACL)
UHLIG	67	PR 155 1448	R.P. Uhlig <i>et al.</i>	(UMD, NRL)
ARMENTEROS	65C	PL 19 338	R. Armenteros <i>et al.</i>	(CERN, HEID, SACL) IJP
GALTIERI	63	PL 6 296	A. Galtieri, A. Hussain, R. Tripp	(LRL) IJ
