

$\Sigma(1670) \ 3/2^-$ $I(J^P) = 1(\frac{3}{2}^-)$ Status: ****

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

Results from production experiments are listed separately in the next entry.

 $\Sigma(1670)$ POLE POSITION**REAL PART**

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1669^{+7}_{-7}	¹ KAMANO	15	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1674	ZHANG	13A	DPWA Multichannel
¹ From the preferred solution A in KAMANO 15.			

-2×IMAGINARY PART

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
64^{+10}_{-14}	¹ KAMANO	15	DPWA Multichannel
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
54	ZHANG	13A	DPWA Multichannel
¹ From the preferred solution A in KAMANO 15.			

 $\Sigma(1670)$ POLE RESIDUES

The normalized residue is the residue divided by $\Gamma_{pole}/2$.

Normalized residue in $N\bar{K} \rightarrow \Sigma(1670) \rightarrow N\bar{K}$

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.129	-20	¹ KAMANO	15	DPWA Multichannel
¹ From the preferred solution A in KAMANO 15.				

Normalized residue in $N\bar{K} \rightarrow \Sigma(1670) \rightarrow \Sigma\pi$

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.249	-21	¹ KAMANO	15	DPWA Multichannel
¹ From the preferred solution A in KAMANO 15.				

Normalized residue in $N\bar{K} \rightarrow \Sigma(1670) \rightarrow \Lambda\pi$

<u>MODULUS</u>	<u>PHASE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.0818	-7	¹ KAMANO	15	DPWA Multichannel
¹ From the preferred solution A in KAMANO 15.				

Normalized residue in $N\bar{K} \rightarrow \Sigma(1670) \rightarrow \Sigma(1385)\pi$, S-wave

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.228	167	¹ KAMANO	15	DPWA Multichannel
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¹From the preferred solution A in KAMANO 15.

Normalized residue in $N\bar{K} \rightarrow \Sigma(1670) \rightarrow \Sigma(1385)\pi$, D-wave

<u>MODULUS</u>	<u>PHASE ($^\circ$)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.0915	141	KAMANO	15	DPWA Multichannel
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 $\Sigma(1670)$ MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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1665 to 1685 (≈ 1670) OUR ESTIMATE

1678 ± 2	ZHANG	13A	DPWA Multichannel
1673 ± 1	GAO	12	DPWA $\bar{K}N \rightarrow \Lambda\pi$
1665.1 ± 4.1	KOISO	85	DPWA $K^-p \rightarrow \Sigma\pi$
1682 ± 5	GOPAL	80	DPWA $\bar{K}N \rightarrow \bar{K}N$
1679 ± 10	ALSTON-...	78	DPWA $\bar{K}N \rightarrow \bar{K}N$
1670 ± 5	GOPAL	77	DPWA $\bar{K}N$ multichannel
1670 ± 6	HEPP	76B	DPWA $K^-N \rightarrow \Sigma\pi$
1685 ± 20	BAILLON	75	IPWA $\bar{K}N \rightarrow \Lambda\pi$
1659 $+^{12}_{-5}$	VANHORN	75	DPWA $K^-p \rightarrow \Lambda\pi^0$
1670 ± 2	KANE	74	DPWA $K^-p \rightarrow \Sigma\pi$

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

1667 or 1668	¹ MARTIN	77	DPWA $\bar{K}N$ multichannel
1650	DEBELLEFON	76	IPWA $K^-p \rightarrow \Lambda\pi^0$
1671 ± 3	PONTE	75	DPWA $K^-p \rightarrow \Lambda\pi^0$ (sol. 1)
1655 ± 2	PONTE	75	DPWA $K^-p \rightarrow \Lambda\pi^0$ (sol. 2)

¹The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.

 $\Sigma(1670)$ WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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40 to 80 (≈ 60) OUR ESTIMATE

55 ± 4	ZHANG	13A	DPWA Multichannel
52 $+^5_{-2}$	GAO	12	DPWA $\bar{K}N \rightarrow \Lambda\pi$
65.0 ± 7.3	KOISO	85	DPWA $K^-p \rightarrow \Sigma\pi$
79 ± 10	GOPAL	80	DPWA $\bar{K}N \rightarrow \bar{K}N$
56 ± 20	ALSTON-...	78	DPWA $\bar{K}N \rightarrow \bar{K}N$
50 ± 5	GOPAL	77	DPWA $\bar{K}N$ multichannel
56 ± 3	HEPP	76B	DPWA $K^-N \rightarrow \Sigma\pi$
85 ± 25	BAILLON	75	IPWA $\bar{K}N \rightarrow \Lambda\pi$
32 ± 11	VANHORN	75	DPWA $K^-p \rightarrow \Lambda\pi^0$
79 ± 6	KANE	74	DPWA $K^-p \rightarrow \Sigma\pi$

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

46 or 46	¹ MARTIN	77	DPWA	$\bar{K}N$ multichannel
80	DEBELLEFON	76	IPWA	$K^- p \rightarrow \Lambda \pi^0$
44 ± 11	PONTE	75	DPWA	$K^- p \rightarrow \Lambda \pi^0$ (sol. 1)
76 ± 5	PONTE	75	DPWA	$K^- p \rightarrow \Lambda \pi^0$ (sol. 2)

¹ The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.

$\Sigma(1670)$ DECAY MODES

Mode	Fraction (Γ_i/Γ)
Γ_1 $N\bar{K}$	7–13 %
Γ_2 $\Lambda\pi$	5–15 %
Γ_3 $\Sigma\pi$	30–60 %
Γ_4 $\Lambda\pi\pi$	
Γ_5 $\Sigma\pi\pi$	
Γ_6 $\Sigma(1385)\pi$	
Γ_7 $\Sigma(1385)\pi$, S-wave	
Γ_8 $\Sigma(1385)\pi$, S-wave	
Γ_9 $\Sigma(1385)\pi$, D-wave	
Γ_{10} $N\bar{K}^*(892)$, S=1/2, D-wave	
Γ_{11} $N\bar{K}^*(892)$, S=3/2, S-wave	
Γ_{12} $N\bar{K}^*(892)$, S=3/2, D-wave	
Γ_{13} $\Lambda(1405)\pi$	
Γ_{14} $\Lambda(1520)\pi$	

$\Sigma(1670)$ BRANCHING RATIOS

See “Sign conventions for resonance couplings” in the Note on Λ and Σ Resonances.

$\Gamma(N\bar{K})/\Gamma_{\text{total}}$					Γ_1/Γ
VALUE	DOCUMENT ID	TECN	COMMENT		
0.07 to 0.13 OUR ESTIMATE					
0.062 \pm 0.007	ZHANG	13A	DPWA	Multichannel	
0.10 \pm 0.03	GOPAL	80	DPWA	$\bar{K}N \rightarrow \bar{K}N$	
0.11 \pm 0.03	ALSTON-...	78	DPWA	$\bar{K}N \rightarrow \bar{K}N$	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.121	¹ KAMANO	15	DPWA	Multichannel	
0.08 \pm 0.03	GOPAL	77	DPWA	See GOPAL 80	
0.07 or 0.07	² MARTIN	77	DPWA	$\bar{K}N$ multichannel	

¹ From the preferred solution A in KAMANO 15.

² The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.

$\Gamma(\Lambda\pi)/\Gamma_{\text{total}}$ **Γ_2/Γ**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.058 ¹KAMANO 15 DPWA Multichannel¹From the preferred solution A in KAMANO 15. **$\Gamma(\Sigma\pi)/\Gamma_{\text{total}}$** **$\Gamma_3/\Gamma$**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.465 ¹KAMANO 15 DPWA Multichannel¹From the preferred solution A in KAMANO 15. **$\Gamma(\Lambda\pi\pi)/\Gamma_{\text{total}}$** **$\Gamma_4/\Gamma$**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.11 ARMENTEROS68E HBC $K^- p$ ($\Gamma_1=0.09$) **$\Gamma(\Sigma\pi\pi)/\Gamma_{\text{total}}$** **$\Gamma_5/\Gamma$**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.14 ¹ARMENTEROS68E HBC $K^- p, K^- d$ ($\Gamma_1=0.09$)¹Ratio only for $\Sigma 2\pi$ system in $l = 1$, which cannot be $\Sigma(1385)$. **$\Gamma(\Sigma(1385)\pi, S\text{-wave})/\Gamma_{\text{total}}$** **$\Gamma_8/\Gamma$**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.309 ¹KAMANO 15 DPWA Multichannel¹From the preferred solution A in KAMANO 15. **$\Gamma(\Sigma(1385)\pi, D\text{-wave})/\Gamma_{\text{total}}$** **$\Gamma_9/\Gamma$**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.044 ¹KAMANO 15 DPWA Multichannel¹From the preferred solution A in KAMANO 15. **$\Gamma(N\bar{K}^*(892), S=1/2, D\text{-wave})/\Gamma_{\text{total}}$** **$\Gamma_{10}/\Gamma$**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.001 ¹KAMANO 15 DPWA Multichannel¹From the preferred solution A in KAMANO 15. **$\Gamma(N\bar{K}^*(892), S=3/2, S\text{-wave})/\Gamma_{\text{total}}$** **$\Gamma_{11}/\Gamma$**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.002 ¹KAMANO 15 DPWA Multichannel¹From the preferred solution A in KAMANO 15.

$\Gamma(N\bar{K}^*(892), S=3/2, D\text{-wave})/\Gamma_{\text{total}}$ Γ_{12}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.001	¹ KAMANO	15	DPWA Multichannel
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¹ From the preferred solution A in KAMANO 15.

$\Gamma(\Lambda(1405)\pi)/\Gamma_{\text{total}}$ Γ_{13}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.06	ARMENTEROS68E	HBC	$K^- p, K^- d$ ($\Gamma_1=0.09$)
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$\Gamma(\Lambda(1405)\pi)/\Gamma(\Sigma(1385)\pi)$ Γ_{13}/Γ_6

VALUE	DOCUMENT ID	TECN	COMMENT
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0.23±0.08	BRUCKER	70	DBC $K^- N \rightarrow \Sigma \pi \pi$
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$(\Gamma_i \Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1670) \rightarrow \Lambda\pi$ $(\Gamma_1 \Gamma_2)^{1/2}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
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+0.08 ±0.01	ZHANG	13A	DPWA Multichannel
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+0.081 ^{+0.002} _{-0.004}	GAO	12	DPWA $\bar{K} N \rightarrow \Lambda\pi$
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+0.17 ±0.03	¹ MORRIS	78	DPWA $K^- n \rightarrow \Lambda\pi^-$
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+0.13 ±0.02	¹ MORRIS	78	DPWA $K^- n \rightarrow \Lambda\pi^-$
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+0.10 ±0.02	GOPAL	77	DPWA $\bar{K} N$ multichannel
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+0.06 ±0.02	BAILLON	75	IPWA $\bar{K} N \rightarrow \Lambda\pi$
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+0.09 ±0.02	VANHORN	75	DPWA $K^- p \rightarrow \Lambda\pi^0$
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+0.018±0.060	DEVENISH	74B	Fixed- t dispersion rel.
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• • • We do not use the following data for averages, fits, limits, etc. • • •

+0.08 or +0.08	² MARTIN	77	DPWA $\bar{K} N$ multichannel
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+0.05	DEBELLEFON	76	IPWA $K^- p \rightarrow \Lambda\pi^0$
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+0.08 ±0.01	PONTE	75	DPWA $K^- p \rightarrow \Lambda\pi^0$ (sol. 1)
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+0.17 ±0.01	PONTE	75	DPWA $K^- p \rightarrow \Lambda\pi^0$ (sol. 2)
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¹ Results are with and without an S_{11} $\Sigma(1620)$ in the fit.

² The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.

$(\Gamma_i \Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1670) \rightarrow \Sigma\pi$ $(\Gamma_1 \Gamma_3)^{1/2}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
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+0.20±0.01	ZHANG	13A	DPWA Multichannel
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+0.20±0.02	KOISO	85	DPWA $K^- p \rightarrow \Sigma\pi$
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+0.21±0.02	GOPAL	77	DPWA $\bar{K} N$ multichannel
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+0.20±0.01	HEPP	76B	DPWA $K^- N \rightarrow \Sigma\pi$
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+0.21±0.03	KANE	74	DPWA $K^- p \rightarrow \Sigma\pi$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

+0.18 or +0.17	¹ MARTIN	77	DPWA $\bar{K} N$ multichannel
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¹ The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1670) \rightarrow \Sigma(1385)\pi$, S-wave $(\Gamma_1 \Gamma_7)^{1/2} / \Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
$+0.11 \pm 0.03$	PREVOST 74	DPWA	$K^- N \rightarrow \Sigma(1385)\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.17 ± 0.02	¹ SIMS 68	DBC	$K^- N \rightarrow \Lambda\pi\pi$
¹ SIMS 68 uses only cross-section data. Result used as upper limit only.			

$\Gamma_i \Gamma_f / \Gamma_{\text{total}}^2$ in $N\bar{K} \rightarrow \Sigma(1670) \rightarrow \Lambda(1405)\pi$ $\Gamma_1 \Gamma_{13} / \Gamma^2$

VALUE	DOCUMENT ID	TECN	COMMENT
0.007 ± 0.002	¹ BRUCKER 70	DBC	$K^- N \rightarrow \Sigma\pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
<0.03	BERLEY 69	HBC	$K^- p$ 0.6–0.82 GeV/c
¹ Assuming the $\Lambda(1405)\pi$ cross-section bump is due only to $3/2^-$ resonance.			

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\bar{K} \rightarrow \Sigma(1670) \rightarrow \Lambda(1520)\pi$ $(\Gamma_1 \Gamma_{14})^{1/2} / \Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
0.081 ± 0.016	¹ CAMERON 77	DPWA	P-wave decay
¹ The CAMERON 77 upper limit on F-wave decay is 0.03.			

$\Sigma(1670)$ REFERENCES

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ZHANG 13A	PR C88 035205	H. Zhang <i>et al.</i>	(KSU)
GAO 12	PR C86 025201	P. Gao, J. Shi, B.S. Zou	(BHEP, BEIJT)
Also	NP A867 41	P. Gao, B.S. Zou, A. Sibirtsev	(BHEP, BEIJT+)
KOISO 85	NP A433 619	H. Koiso <i>et al.</i>	(TOKY, MASA)
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
MORRIS 78	PR D17 55	W.A. Morris <i>et al.</i>	(FSU) 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
HEPP 76B	PL 65B 487	V. Hepp <i>et al.</i>	(CERN, HEIDH, MPIM) IJP
BAILLON 75	NP B94 39	P.H. Baillon, P.J. Litchfield	(CERN, RHEL) IJP
PONTE 75	PR D12 2597	R.A. Ponte <i>et al.</i>	(MASA, TENN, UCR) 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)
BRUCKER 70	Duke Conf. 155	E.B. Brucker <i>et al.</i>	(FSU) I
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BERLEY 69	PL 30B 430	D. Berley <i>et al.</i>	(BNL)
ARMENTEROS 68E	PL 28B 521	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)