NODE=B038

$\Lambda(1520)$ $3/2^-$

$I(J^P) = 0(\frac{3}{2}^-)$ Status: ∗∗∗∗

NODE=B038

Discovered by FERRO-LUZZI 62; the elaboration in WATSON 63 is the classic paper on the Breit-Wigner analysis of a multichannel resonance.

The measurements of the mass, width, and elasticity published before 1975 are now obsolete and have been omitted. They were last listed in our 1982 edition Physics Letters **111B** 1 (1982).

Production and formation experiments agree quite well, so they are listed together here.

$\Lambda(1520)$ POLE POSITION

NODE=B038225

REAL PART

NODE=B038RE
NODE=B038RE

VALUE (MeV)		DOCUMENT ID		TECN	COMMENT
1517 to 1518 (≈ 1517.5) OUR ESTIMATE					
1517.5±0.4 OUR AVERAGE					
1517.5±0.4		SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
1517 $^{+4}_{-4}$	[1]	KAMANO	15	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1518		ZHANG	13A	DPWA	$\overline{K}N$ multichannel
1518.8		QIANG	10	SPEC	$e p \to e' K^+ X$ (fit to X)

→ UNCHECKED ←

[1] From the preferred solution A in KAMANO 15.

NODE=B038RE;LINKAGE=A

−2×IMAGINARY PART

NODE=B038IM
NODE=B038IM

VALUE (MeV)		DOCUMENT ID		TECN	COMMENT
14 to 18 (≈ 16) OUR ESTIMATE					
15.3± 0.9 OUR AVERAGE					
15.3± 0.9		SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
15 $^{+10}_{-8}$	[1]	KAMANO	15	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
16		ZHANG	13A	DPWA	$\overline{K}N$ multichannel
17.2		QIANG	10	SPEC	$e p \to e' K^+ X$ (fit to X)

→ UNCHECKED ←

[1] From the preferred solution A in KAMANO 15.

NODE=B038IM;LINKAGE=A

$\Lambda(1520)$ POLE RESIDUES

NODE=B038250

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

NODE=B038250

Normalized residue in $N\overline{K} \to \Lambda(1520) \to N\overline{K}$

NODE=B038A00
NODE=B038A00

MODULUS	PHASE (°)		DOCUMENT ID		TECN	COMMENT
0.45 ±0.01	**−10 ± 3**		SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.431	−11	[1]	KAMANO	15	DPWA	$\overline{K}N$ multichannel

[1] From the preferred solution A in KAMANO 15.

NODE=B038A00;LINKAGE=A

Normalized residue in $N\overline{K} \to \Lambda(1520) \to \Sigma\pi$

NODE=B038A01
NODE=B038A01

MODULUS	PHASE (°)		DOCUMENT ID		TECN	COMMENT
0.44 ±0.01	**−15 ± 3**		SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.435	−10	[1]	KAMANO	15	DPWA	$\overline{K}N$ multichannel

[1] From the preferred solution A in KAMANO 15.

NODE=B038A01;LINKAGE=A

Normalized residue in $N\overline{K} \to \Lambda(1520) \to \Lambda\eta$

NODE=B038A04
NODE=B038A04

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.013±0.003	**116 ± 3**	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel

Normalized residue in $N\overline{K} \to \Lambda(1520) \to \Sigma(1385)\pi$, S-wave

NODE=B038A02
NODE=B038A02

MODULUS	PHASE (°)		DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.431	−123	[1]	KAMANO	15	DPWA	$\overline{K}N$ multichannel

[1] From the preferred solution A in KAMANO 15.

NODE=B038A02;LINKAGE=A

Normalized residue in $N\overline{K} \to \Lambda(1520) \to \Sigma(1385)\pi$, D-wave

NODE=B038A03
NODE=B038A03

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.0141	122	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

[1] From the preferred solution A in KAMANO 15.

NODE=B038A03;LINKAGE=A

$\Lambda(1520)$ MASS

NODE=B038M
NODE=B038M

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1518 to 1520 (≈ 1519) OUR ESTIMATE					
1519.42±0.19 OUR AVERAGE	Error includes scale factor of 1.1.				
1518.5 ±0.5		SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
1519.6 ±0.5		ZHANG	13A	DPWA	$\overline{K}N$ multichannel
1520.4 ±0.6 ±1.5		QIANG	10	SPEC	$e p \to e' K^+ X$ (fit to X)
1517.3 ±1.5	300	BARBER	80D	SPEC	$\gamma p \to \Lambda(1520) K^+$
1517.8 ±1.2	5k	BARLAG	79	HBC	$K^- p$ 4.2 GeV/c
1520.0 ±0.5		ALSTON-...	78	DPWA	$\overline{K}N \to \overline{K}N$
1519.7 ±0.3	4k	CAMERON	77	HBC	$K^- p$ 0.96–1.36 GeV/c
1519 ±1		GOPAL	77	DPWA	$\overline{K}N$ multichannel
1519.4 ±0.3	2000	CORDEN	75	DBC	$K^- d$ 1.4–1.8 GeV/c

→ UNCHECKED ←

$\Lambda(1520)$ WIDTH

NODE=B038W
NODE=B038W

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
15 to 17 (≈ 16) OUR ESTIMATE					
15.73±0.26 OUR AVERAGE					
15.7 ±1.0		SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
17 ±1		ZHANG	13A	DPWA	$\overline{K}N$ multichannel
18.6 ±1.9 ±1.0		QIANG	10	SPEC	$e p \to e' K^+ X$ (fit to X)
16.3 ±3.3	300	BARBER	80D	SPEC	$\gamma p \to \Lambda(1520) K^+$
16 ±1		GOPAL	80	DPWA	$\overline{K}N \to \overline{K}N$
14 ±3	677	[1] BARLAG	79	HBC	$K^- p$ 4.2 GeV/c
15.4 ±0.5		ALSTON-...	78	DPWA	$\overline{K}N \to \overline{K}N$
16.3 ±0.5	4k	CAMERON	77	HBC	$K^- p$ 0.96–1.36 GeV/c
15.0 ±0.5		GOPAL	77	DPWA	$\overline{K}N$ multichannel
15.5 ±1.6	2000	CORDEN	75	DBC	$K^- d$ 1.4–1.8 GeV/c

→ UNCHECKED ←

[1] From the best-resolution sample of $\Lambda\pi\pi$ events only.

NODE=B038;LINKAGE=A

$\Lambda(1520)$ DECAY MODES

NODE=B038215;NODE=B038

	Mode	Fraction (Γ_i/Γ)	
Γ_1	$N\overline{K}$	(45 ±1) %	DESIG=1;OUR EST
Γ_2	$\Sigma\pi$	(42 ±1) %	DESIG=2;OUR EST
Γ_3	$\Lambda\pi\pi$	(10 ±1) %	DESIG=3;OUR EST
Γ_4	$\Sigma(1385)\pi$, S-wave		DESIG=11
Γ_5	$\Sigma(1385)\pi$, D-wave		DESIG=12
Γ_6	$\Sigma(1385)\pi$	(4.1 ±0.5) %	DESIG=7
Γ_7	$\Sigma(1385)\pi(\to \Lambda\pi\pi)$		DESIG=8;OUR EST
Γ_8	$\Lambda(\pi\pi)_{S\text{-wave}}$	(2.0 ±0.8) %	DESIG=9
Γ_9	$\Sigma\pi\pi$	(0.9 ±0.1) %	DESIG=6;OUR EST
Γ_{10}	$\Lambda\gamma$	(0.85±0.15) %	DESIG=4;OUR EST
Γ_{11}	$\Sigma^0\gamma$	(2.00±0.35) %	DESIG=5

$\Lambda(1520)$ BRANCHING RATIOS

NODE=B038220

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

NODE=B038220

$\Gamma(N\overline{K})/\Gamma_{total}$ Γ_1/Γ

NODE=B038R6
NODE=B038R6

VALUE	DOCUMENT ID		TECN	COMMENT
0.45 to 0.47 OUR ESTIMATE				
0.45 ±0.01	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
0.47 ±0.04	ZHANG	13A	DPWA	$\overline{K}N$ multichannel
0.47 ±0.02	GOPAL	80	DPWA	$\overline{K}N \to \overline{K}N$
0.45 ±0.03	ALSTON-...	78	DPWA	$\overline{K}N \to \overline{K}N$
0.448±0.014	CORDEN	75	DBC	$K^- d$ 1.4–1.8 GeV/c

→ UNCHECKED ←

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

0.43	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel
0.47 ±0.01	GOPAL	77	DPWA	See GOPAL 80
0.42	MAST	76	HBC	$K^- p \to \overline{K}^0 n$

[1] From the preferred solution A in KAMANO 15.

NODE=B038R6;LINKAGE=A

$\Gamma(\Sigma\pi)/\Gamma_{total}$ Γ_2/Γ

NODE=B038R7
NODE=B038R7
→ UNCHECKED ←

VALUE	DOCUMENT ID		TECN	COMMENT
0.42 to 0.46 OUR ESTIMATE				
0.43 ±0.01	SARANTSEV	19	DPWA	$\overline{K}N$ multichannel
0.47 ±0.05	ZHANG	13A	DPWA	$\overline{K}N$ multichannel
0.426±0.014	CORDEN	75	DBC	$K^- d$ 1.4–1.8 GeV/c
0.418±0.017	BARBARO-...	69B	HBC	$K^- p$ 0.28–0.45 GeV/c
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.446	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel
0.46	KIM	71	DPWA	K-matrix analysis

[1] From the preferred solution A in KAMANO 15.

NODE=B038R7;LINKAGE=A

$\Gamma(\Sigma\pi)/\Gamma(N\overline{K})$ Γ_2/Γ_1

NODE=B038R1
NODE=B038R1
→ UNCHECKED ←

VALUE	DOCUMENT ID		TECN	COMMENT
0.9 to 1.0 OUR ESTIMATE				
0.98±0.03	[1] GOPAL	77	DPWA	$\overline{K}N$ multichannel
0.82±0.08	BURKHARDT	69	HBC	$K^- p$ 0.8–1.2 GeV/c
1.06±0.14	SCHEUER	68	DBC	$K^- N$ 3 GeV/c
0.96±0.20	DAHL	67	HBC	$\pi^- p$ 1.6–4 GeV/c
0.73±0.11	DAUBER	67	HBC	$K^- p$ 2 GeV/c
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.06±0.12	BERTHON	74	HBC	Quasi-2-body σ
1.72±0.78	MUSGRAVE	65	HBC	

[1] The $\overline{K}N \to \Sigma\pi$ amplitude at resonance is $+0.46 \pm 0.01$.

NODE=B038;LINKAGE=B

$\Gamma(\Lambda\pi\pi)/\Gamma_{total}$ Γ_3/Γ

NODE=B038R11
NODE=B038R11
→ UNCHECKED ←

VALUE	DOCUMENT ID		TECN	COMMENT
0.09 to 0.11 OUR ESTIMATE				
0.091±0.006	CORDEN	75	DBC	$K^- d$ 1.4–1.8 GeV/c
0.11 ±0.01	[1] MAST	73B	IPWA	$K^- p \to \Lambda\pi\pi$

[1] Assumes $\Gamma(N\overline{K})/\Gamma_{total} = 0.46 \pm 0.02$.

NODE=B038;LINKAGE=J

$\Gamma(\Lambda\pi\pi)/\Gamma(N\overline{K})$ Γ_3/Γ_1

NODE=B038R2
NODE=B038R2
→ UNCHECKED ←

VALUE	DOCUMENT ID		TECN	COMMENT
0.18 to 0.22 OUR ESTIMATE				
0.22±0.03	BURKHARDT	69	HBC	$K^- p$ 0.8–1.2 GeV/c
0.19±0.04	SCHEUER	68	DBC	$K^- N$ 3 GeV/c
0.17±0.05	DAHL	67	HBC	$\pi^- p$ 1.6–4 GeV/c
0.21±0.18	DAUBER	67	HBC	$K^- p$ 2 GeV/c
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.27±0.13	BERTHON	74	HBC	Quasi-2-body σ
0.2	KIM	71	DPWA	K-matrix analysis

$\Gamma(\Sigma\pi)/\Gamma(\Lambda\pi\pi)$ Γ_2/Γ_3

NODE=B038R3
NODE=B038R3
→ UNCHECKED ←

VALUE	DOCUMENT ID		TECN	COMMENT
3.4 to 4.4 OUR ESTIMATE				
3.9±1.0	UHLIG	67	HBC	$K^- p$ 0.9–1.0 GeV/c
3.3±1.1	BIRMINGHAM	66	HBC	$K^- p$ 3.5 GeV/c
4.5±1.0	ARMENTEROS	65C	HBC	

$\Gamma(\Sigma(1385)\pi, S\text{-wave})/\Gamma_{total}$ Γ_4/Γ

NODE=B038R00
NODE=B038R00

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.121	[1] KAMANO	15	DPWA	$\overline{K}N$ multichannel

[1] From the preferred solution A in KAMANO 15.

NODE=B038R00;LINKAGE=A

$\Gamma(\Sigma(1385)\pi, D\text{-wave})/\Gamma_{total}$ Γ_5/Γ

NODE=B038R01
NODE=B038R01

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.003	[1] KAMANO	15	DPWA	Multichannel

[1] From the preferred solution A in KAMANO 15.

NODE=B038R01;LINKAGE=A

$\Gamma(\Sigma(1385)\pi)/\Gamma_{total}$ — Γ_6/Γ

NODE=B038R10
NODE=B038R10

VALUE	DOCUMENT ID		TECN	COMMENT
0.041±0.005	CHAN	72	HBC	$K^- p \to \Lambda\pi\pi$

$\Gamma(\Sigma(1385)\pi(\to \Lambda\pi\pi))/\Gamma(\Lambda\pi\pi)$ — Γ_7/Γ_3

NODE=B038R9
NODE=B038R9

The $\Lambda\pi\pi$ mode is largely due to $\Sigma(1385)\pi$. Only the values of $(\Sigma(1385)\pi)$ / $(\Lambda 2\pi)$ given by MAST 73B and CORDEN 75 are based on real 3-body partial-wave analyses. The discrepancy between the two results is essentially due to the different hypotheses made concerning the shape of the $(\pi\pi)_{S\text{-wave}}$ state.

NODE=B038R9

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
0.58±0.22		CORDEN	75	DBC	$K^- d$ 1.4–1.8 GeV/c
0.82±0.10		[1] MAST	73B	IPWA	$K^- p \to \Lambda\pi\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.44	90	WIELAND	11	SPHR	$\gamma p \to K^+ \Lambda(1520)$
0.39±0.10		[2] BURKHARDT	71	HBC	$K^- p \to (\Lambda\pi\pi)\pi$

[1] Both $\Sigma(1385)\pi$ DS_{03} and $\Sigma(\pi\pi)$ DP_{03} contribute.

[2] The central bin (1514–1524 MeV) gives 0.74 ± 0.10; other bins are lower by 2-to-5 standard deviations.

NODE=B038;LINKAGE=I
NODE=B038;LINKAGE=G

$\Gamma(\Lambda(\pi\pi)_{S\text{-wave}})/\Gamma(\Lambda\pi\pi)$ — Γ_8/Γ_3

NODE=B038R12
NODE=B038R12

VALUE	DOCUMENT ID		TECN	COMMENT
0.20±0.08	CORDEN	75	DBC	$K^- d$ 1.4–1.8 GeV/c

$\Gamma(\Sigma\pi\pi)/\Gamma_{total}$ — Γ_9/Γ

NODE=B038R8
NODE=B038R8
→ UNCHECKED ←

VALUE	DOCUMENT ID		TECN	COMMENT
0.007 to 0.011 OUR ESTIMATE				
0.007 ±0.002	[1] CORDEN	75	DBC	$K^- d$ 1.4–1.8 GeV/c
0.0085±0.0006	[2] MAST	73	MPWA	$K^- p \to \Sigma\pi\pi$
0.010 ±0.0015	BARBARO-...	69B	HBC	$K^- p$ 0.28–0.45 GeV/c

[1] Much of the $\Sigma\pi\pi$ decay proceeds via $\Sigma(1385)\pi$.

[2] Assumes $\Gamma(N\overline{K})/\Gamma_{total} = 0.46$.

NODE=B038;LINKAGE=F
NODE=B038;LINKAGE=E

$\Gamma(\Lambda\gamma)/\Gamma_{total}$ — Γ_{10}/Γ

NODE=B038R4
NODE=B038R4
→ UNCHECKED ←

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
7 to 11 OUR ESTIMATE					
$10.7\pm2.9^{+1.5}_{-0.4}$	32	TAYLOR	05	CLAS	$\gamma p \to K^+ \Lambda\gamma$
10.2±2.1±1.5	290	ANTIPOV	04A	SPNX	$p N(C) \to \Lambda(1520) K^+ N(C)$
8.0±1.4	238	MAST	68B	HBC	Using $\Gamma(N\overline{K})/\Gamma_{total} = 0.45$

$\Gamma(\Sigma^0\gamma)/\Gamma_{total}$ — Γ_{11}/Γ

NODE=B038R5
NODE=B038R5

VALUE	DOCUMENT ID		TECN	COMMENT
0.02±0.0035	[1] MAST	68B	HBC	Not measured; see note

[1] Calculated from $\Gamma(\Lambda\gamma)/\Gamma_{total}$, assuming SU(3). Needed to constrain the sum of all the branching ratios to be unity.

NODE=B038;LINKAGE=C

$\Lambda(1520)$ REFERENCES

NODE=B038

SARANTSEV	19	EPJ A55 180	A.V. Sarantsev *et al.*	(BONN, PNPI)	REFID=59986
KAMANO	15	PR C92 025205	H. Kamano *et al.*	(ANL, OSAK)	REFID=57507
ZHANG	13A	PR C88 035205	H. Zhang *et al.*	(KSU)	REFID=55441
WIELAND	11	EPJ A47 47	F. Wieland *et al.*	(ELSA SAPHIR Collab.)	REFID=53763
QIANG	10	PL B694 123	Y. Qiang *et al.*	(DUKE, JEFF, PNPI, GWU+)	REFID=53557
TAYLOR	05	PR C71 054609	S. Taylor *et al.*	(JLab CLAS Collab.)	REFID=50670
Also		PR C72 039902 (errat.)	S. Taylor *et al.*	(JLab CLAS Collab.)	REFID=50978
ANTIPOV	04A	PL B604 22	Yu.M. Antipov *et al.*	(IHEP SPHINX Collab.)	REFID=50291
PDG	82	PL 111B 1	M. Roos *et al.*	(HELS, CIT, CERN)	REFID=41167
BARBER	80D	ZPHY C7 17	D.P. Barber *et al.*	(DARE, LANC, SHEF)	REFID=31754
GOPAL	80	Toronto Conf. 159	G.P. Gopal	(RHEL) IJP	REFID=31755
BARLAG	79	NP B149 220	S.J.M. Barlag *et al.*	(AMST, CERN, NIJM+)	REFID=31753
ALSTON-...	78	PR D18 182	M. Alston-Garnjost *et al.*	(LBL, MTHO+) IJP	REFID=31751
Also		PRL 38 1007	M. Alston-Garnjost *et al.*	(LBL, MTHO+) IJP	REFID=31752
CAMERON	77	NP B131 399	W. Cameron *et al.*	(RHEL, LOIC) IJP	REFID=31749
GOPAL	77	NP B119 362	G.P. Gopal *et al.*	(LOIC, RHEL) IJP	REFID=31750
MAST	76	PR D14 13	T.S. Mast *et al.*	(LBL)	REFID=31748
CORDEN	75	NP B84 306	M.J. Corden *et al.*	(BIRM)	REFID=31747
BERTHON	74	NC 21A 146	A. Berthon *et al.*	(CDEF, RHEL, SACL+)	REFID=31745
MAST	73	PR D7 3212	T.S. Mast *et al.*	(LBL) IJP	REFID=31744
MAST	73B	PR D7 5	T.S. Mast *et al.*	(LBL) IJP	REFID=32035

CHAN	72	PRL 28 256	S.B. Chan *et al.*	(MASA, YALE)	REFID=31742
BURKHARDT	71	NP B27 64	E. Burkhardt *et al.*	(HEID, CERN, SACL)	REFID=31738
KIM	71	PRL 27 356	J.K. Kim	(HARV) IJP	REFID=31740
Also		Duke Conf. 161	J.K. Kim	(HARV) IJP	REFID=31741
Hyperon Resonances, 1970					
BARBARO-...	69B	Lund Conf. 352	A. Barbaro-Galtieri *et al.*	(LRL)	REFID=31735
Also		Duke Conf. 95	R.D. Tripp	(LRL)	REFID=31736
Hyperon Resonances 1970					
BURKHARDT	69	NP B14 106	E. Burkhardt *et al.*	(HEID, EFI, CERN+)	REFID=31733
MAST	68B	PRL 21 1715	T.S. Mast *et al.*	(LRL)	REFID=31731
SCHEUER	68	NP B8 503	J.C. Scheuer *et al.*	(SABRE Collab.)	REFID=31732
DAHL	67	PR 163 1377	O.I. Dahl *et al.*	(LRL)	REFID=20321
DAUBER	67	PL 24B 525	P.M. Dauber *et al.*	(UCLA)	REFID=31729
UHLIG	67	PR 155 1448	R.P. Uhlig *et al.*	(UMD, NRL)	REFID=31730
BIRMINGHAM	66	PR 152 1148	M. Haque *et al.*	(BIRM, GLAS, LOIC, OXF+)	REFID=31692
ARMENTEROS	65C	PL 19 338	R. Armenteros *et al.*	(CERN, HEID, SACL)	REFID=31725
MUSGRAVE	65	NC 35 735	B. Musgrave *et al.*	(BIRM, CERN, EPOL+)	REFID=31691
WATSON	63	PR 131 2248	M.B. Watson, M. Ferro-Luzzi, R.D. Tripp	(LRL) IJP	REFID=31723
FERRO-LUZZI	62	PRL 8 28	M. Ferro-Luzzi, R.D. Tripp, M.B. Watson	(LRL) IJP	REFID=31721