

$\Lambda(1405) S_{01}$

$I(J^P) = 0(\frac{1}{2}^-)$  Status: \*\*\*\*

See the note on "The  $\Lambda(1405)$ " in our 2000 edition (Eur. Phys. J. **C15**, p. 748 (2000)).

### $\Lambda(1405)$ MASS

#### PRODUCTION EXPERIMENTS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1406.5 ± 4.0</b>		<sup>1</sup> DALITZ	91	M-matrix fit
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
1391 ± 1	700	<sup>1</sup> HEMINGWAY	85 HBC	$K^- p$ 4.2 GeV/c
~ 1405	400	<sup>2</sup> THOMAS	73 HBC	$\pi^- p$ 1.69 GeV/c
1405	120	BARBARO-...	68B DBC	$K^- d$ 2.1–2.7 GeV/c
1400 ± 5	67	BIRMINGHAM	66 HBC	$K^- p$ 3.5 GeV/c
1382 ± 8		ENGLER	65 HDBC	$\pi^- p, \pi^+ d$ 1.68 GeV/c
1400 ± 24		MUSGRAVE	65 HBC	$\bar{p} p$ 3–4 GeV/c
1410		ALEXANDER	62 HBC	$\pi^- p$ 2.1 GeV/c
1405		ALSTON	62 HBC	$K^- p$ 1.2–0.5 GeV/c
1405		ALSTON	61B HBC	$K^- p$ 1.15 GeV/c

#### EXTRAPOLATIONS BELOW $N\bar{K}$ THRESHOLD

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1407.56 or 1407.50	<sup>3</sup> KIMURA	00	potential model
1411	<sup>4</sup> MARTIN	81	K-matrix fit
1406	<sup>5</sup> CHAO	73 DPWA	0–range fit (sol. B)
1421	MARTIN	70 RVUE	Constant K-matrix
1416 ± 4	MARTIN	69 HBC	Constant K-matrix
1403 ± 3	KIM	67 HBC	K-matrix fit
1407.5 ± 1.2	<sup>6</sup> KITTEL	66 HBC	0–effective-range fit
1410.7 ± 1.0	KIM	65 HBC	0–effective-range fit
1409.6 ± 1.7	<sup>6</sup> SAKITT	65 HBC	0–effective-range fit

### $\Lambda(1405)$ WIDTH

#### PRODUCTION EXPERIMENTS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
<b>50 ± 2</b>		<sup>1</sup> DALITZ	91	M-matrix fit
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
32 ± 1	700	<sup>1</sup> HEMINGWAY	85 HBC	$K^- p$ 4.2 GeV/c
45 to 55	400	<sup>2</sup> THOMAS	73 HBC	$\pi^- p$ 1.69 GeV/c
35	120	BARBARO-...	68B DBC	$K^- d$ 2.1–2.7 GeV/c
50 ± 10	67	BIRMINGHAM	66 HBC	$K^- p$ 3.5 GeV/c
89 ± 20		ENGLER	65 HDBC	
60 ± 20		MUSGRAVE	65 HBC	
35 ± 5		ALEXANDER	62 HBC	
50		ALSTON	62 HBC	
20		ALSTON	61B HBC	

## EXTRAPOLATIONS BELOW $N\bar{K}$ THRESHOLD

<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. ● ● ●			
50.24 or 50.26	<sup>3</sup> KIMURA	00	potential model
30	<sup>4</sup> MARTIN	81	K-matrix fit
55	<sup>5,7</sup> CHAO	73	DPWA 0-range fit (sol. B)
20	MARTIN	70	RVUE Constant K-matrix
29 ± 6	MARTIN	69	HBC Constant K-matrix
50 ± 5	KIM	67	HBC K-matrix fit
34.1±4.1	<sup>6</sup> KITTEL	66	HBC
37.0±3.2	KIM	65	HBC
28.2±4.1	<sup>6</sup> SAKITT	65	HBC

## $\Lambda(1405)$ DECAY MODES

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $\Sigma\pi$	100 %
$\Gamma_2$ $\Lambda\gamma$	
$\Gamma_3$ $\Sigma^0\gamma$	
$\Gamma_4$ $N\bar{K}$	

## $\Lambda(1405)$ PARTIAL WIDTHS

### $\Gamma(\Lambda\gamma)$ $\Gamma_2$

<u>VALUE (keV)</u>	<u>DOCUMENT ID</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●		
27 ± 8	BURKHARDT 91	Isobar model fit

### $\Gamma(\Sigma^0\gamma)$ $\Gamma_3$

<u>VALUE (keV)</u>	<u>DOCUMENT ID</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●		
10 ± 4 or 23 ± 7	BURKHARDT 91	Isobar model fit

## $\Lambda(1405)$ BRANCHING RATIOS

### $\Gamma(N\bar{K})/\Gamma(\Sigma\pi)$ $\Gamma_4/\Gamma_1$

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
<3	95	HEMINGWAY 85	HBC	$K^- p$ 4.2 GeV/c

## $\Lambda(1405)$ FOOTNOTES

- <sup>1</sup> DALITZ 91 fits the HEMINGWAY 85 data.
- <sup>2</sup> THOMAS 73 data is fit by CHAO 73 (see next section).
- <sup>3</sup> The KIMURA 00 values are from fits A and B from a coupled-channel potential model using low-energy  $\bar{K}N$  and  $\Sigma\pi$  data, kaonic-hydrogen x-ray measurements, and our  $\Lambda(1405)$  mass and width. The results bear mainly on the *nature* of the  $\Lambda(1405)$ : three-quark state or  $\bar{K}N$  bound state.
- <sup>4</sup> The MARTIN 81 fit includes the  $K^\pm p$  forward scattering amplitudes and the dispersion relations they must satisfy.
- <sup>5</sup> See also the accompanying paper of THOMAS 73.
- <sup>6</sup> Data of SAKITT 65 are used in the fit by KITTEL 66.
- <sup>7</sup> An asymmetric shape, with  $\Gamma/2 = 41$  MeV below resonance, 14 MeV above.

## $\Lambda(1405)$ REFERENCES

KIMURA	00	PR C62 015206	M. Kimura <i>et al.</i>	
BURKHARDT	91	PR C44 607	H. Burkhardt, J. Lowe	(NOTT, UNM, BIRM)
DALITZ	91	JPG 17 289	R.H. Dalitz, A. Deloff	(OXFTP, WINR)
HEMINGWAY	85	NP B253 742	R.J. Hemingway	(CERN) J
MARTIN	81	NP B179 33	A.D. Martin	(DURH)
CHAO	73	NP B56 46	Y.A. Chao <i>et al.</i>	(RHEL, CMU, LOUC)
THOMAS	73	NP B56 15	D.W. Thomas <i>et al.</i>	(CMU) J
MARTIN	70	NP B16 479	A.D. Martin, G.G. Ross	(DURH)
MARTIN	69	PR 183 1352	B.R. Martin, M. Sakitt	(LOUC, BNL)
Also	69B	PR 183 1345	B.R. Martin, M. Sakitt	(LOUC, BNL)
BARBARO-...	68B	PRL 21 573	A. Barbaro-Galtieri <i>et al.</i>	(LRL, SLAC)
KIM	67	PRL 19 1074	J.K. Kim	(YALE)
BIRMINGHAM	66	PR 152 1148	M. Haque <i>et al.</i>	(BIRM, GLAS, LOIC, OXF+)
KITTEL	66	PL 21 349	W. Kittel, G. Otter, I. Wacek	(VIEN)
ENGLER	65	PRL 15 224	A. Engler <i>et al.</i>	(CMU, BNL) J
KIM	65	PRL 14 29	J.K. Kim	(COLU)
MUSGRAVE	65	NC 35 735	B. Musgrave <i>et al.</i>	(BIRM, CERN, EPOL+)
SAKITT	65	PR 139B 719	M. Sakitt <i>et al.</i>	(UMD, LRL)
ALEXANDER	62	PRL 8 447	G. Alexander <i>et al.</i>	(LRL) I
ALSTON	62	CERN Conf. 311	M.H. Alston <i>et al.</i>	(LRL) I
ALSTON	61B	PRL 6 698	M.H. Alston <i>et al.</i>	(LRL) I

## OTHER RELATED PAPERS

IWASAKI	97	PRL 78 3067	M. Iwasaki <i>et al.</i>	(KEK 228 Collab.)
FINK	90	PR C41 2720	P.J.Jr. Fink <i>et al.</i>	(IBMY, ORST, ANSM)
LEINWEBER	90	ANP 198 203	D.B. Leinweber	(MCMS)
MUELLER-GROELING	90	NP A513 557	A. Mueller-Groeling, K. Holinde, J. Speth	(JULI)
BARRETT	89	NC 102A 179	R.C. Barrett	(SURR)
BATTY	89	NC 102A 255	C.J. Batty, A. Gal	(RAL, HEBR)
CAPSTICK	89	Excited Baryons 88, p.32	S. Capstick	(GUEL)
LOWE	89	NC 102A 167	J. Lowe	(BIRM)
WHITEHOUSE	89	PRL 63 1352	D.A. Whitehouse <i>et al.</i>	(BIRM, BOST, BRCO+)
SIEGEL	88	PR C38 2221	P.B. Siegel, W. Weise	(REGE)
WORKMAN	88	PR D37 3117	R.L. Workman, H.W. Fearing	(TRIU)
SCHNICK	87	PRL 58 1719	J. Schnick, R.H. Landau	(ORST)
CAPSTICK	86	PR D34 2809	S. Capstick, N. Isgur	(TNTO)
JENNINGS	86	PL B176 229	B.K. Jennings	(TRIU)
MALTMAN	86	PR D34 1372	K. Maltman, N. Isgur	(LANL, TNTO)
ZHONG	86	PL B171 471	Y.S. Zhong <i>et al.</i>	(ADLD, TRIU, SURR)
BURKHARDT	85	NP A440 653	H. Burkhardt, J. Lowe, A.S. Rosenthal	(NOTT+)
DAREWYCH	85	PR D32 1765	J.W. Darewych, R. Koniuk, N. Isgur	(YORKC, TNTO)
VEIT	85	PR D31 1033	E.A. Veit <i>et al.</i>	(TRIU, ADLD, SURR)
KIANG	84	PR C30 1638	D. Kiang <i>et al.</i>	(DALH, MCMS)
MILLER	84	Conference paper	D.J. Miller	(LOUC)
		Conf. Intersections between Particle and Nuclear Physics, p. 783		
VANDIJK	84	PR D30 937	W. van Dijk	(MCMS)
VEIT	84	PL 137B 415	E.A. Veit <i>et al.</i>	(TRIU, SURR, CERN)

DALITZ	82	Heid. Conf.	R.H. Dalitz <i>et al.</i>	(OXFTP)
		Heidelberg Conf., p. 201		
DALITZ	81	Kaon Conf.	R.H. Dalitz, J.G. McGinley	(OXFTP)
		Low and Intermediate Energy Kaon-Nucleon Physics, p.381		
MARTIN	81B	Kaon Conf.	A.D. Martin	(DURH)
		Low and Intermediate Energy Kaon-Nucleon Physics, p. 97		
OADES	77	NC 42A 462	G.C. Oades, G. Rasche	(AARH, ZURI)
SHAW	73	Purdue Conf. 417	G.L. Shaw	(UCI)
BARBARO-...	72	LBL-555	A. Barbaro-Galtieri	(LBL)
DOBSON	72	PR D6 3256	P.N. Dobson, R. McElhaney	(HAWA)
RAJASEKA...	72	PR D5 610	G. Rajasekaran	(TATA)
		Earlier papers also cited in RAJASEKARAN 72.		
CLINE	71	PRL 26 1194	D. Cline, R. Laumann, J. Mapp	(WISC)
MARTIN	71	PL 35B 62	A.D. Martin, A.D. Martin, G.G. Ross	(DURH, LOUC+)
DALITZ	67	PR 153 1617	R.H. Dalitz, T.C. Wong, G. Rajasekaran	(OXFTP+)
DONALD	66	PL 22 711	R.A. Donald <i>et al.</i>	(LIVP)
KADYK	66	PRL 17 599	J.A. Kadyk <i>et al.</i>	(LRL)
ABRAMS	65	PR 139B 454	G.S. Abrams, B. Sechi-Zorn	(UMD)

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