NODE=B037

$\Lambda(1405)$ 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). NODE=B037

For a recent discussion and earlier references on evidence for a 2-pole structure of the $\Lambda(1405)$, see MAGAS 05. For a recent experiment that gives no support to the 2-pole model, see ZYCHOR 08. The $\Lambda(1405)$ presumably belongs to a $J^P = 1/2^+$ SU(4) $\overline{4}$ multiplet, whose other members are the $\Lambda_c(2595)^+$, $\Xi_c(2790)^+$, and $\Xi_c(2790)^0$; see Fig. 1 of our note on "Charmed Baryons." Each of these charmed particles is followed by one of slightly higher mass: the $\Lambda_c(2625)^+$, $\Xi_c(2815)^+$, and $\Xi_c(2815)^0$. Although the evidence for their J^P assignments is not strong, they presumably belong to a $J^P = 3/2^+$ SU(4) $\overline{4}$ multiplet with the $\Lambda(1520)$. The charmed baryons have clear, narrow signals, with no complications of threshold behavior. The conclusion here is that there is no room for two *ordinary* 3-quark states near 1405 MeV.

$\Lambda(1405)$ MASS

NODE=B037205

PRODUCTION EXPERIMENTS

NODE=B037M1

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1406.5± 4.0		[1] DALITZ	91		M-matrix fit
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1391 ± 1	700	[1] HEMINGWAY	85	HBC	K^-p 4.2 GeV/c
~ 1405	400	[2] THOMAS	73	HBC	π^-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	π^-p, π^+d 1.68 GeV/c
1400 ±24		MUSGRAVE	65	HBC	$\overline{p}p$ 3–4 GeV/c
1410		ALEXANDER	62	HBC	π^-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

NODE=B037M1

EXTRAPOLATIONS BELOW $N\overline{K}$ THRESHOLD

NODE=B037M2

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1407.56 or 1407.50	[3] KIMURA	00		potential model
1411	[4] MARTIN	81		K-matrix fit
1406	[5] 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	[6] KITTEL	66	HBC	0–effective-range fit
1410.7±1.0	KIM	65	HBC	0–effective-range fit
1409.6±1.7	[6] SAKITT	65	HBC	0–effective-range fit

NODE=B037M2 OCCUR=2

$\Lambda(1405)$ WIDTH

NODE=B037210

PRODUCTION EXPERIMENTS

NODE=B037W1

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
50± 2		[1] DALITZ	91		M-matrix fit
• • • We do not use the following data for averages, fits, limits, etc. • • •					
32± 1	700	[1] HEMINGWAY	85	HBC	K^-p 4.2 GeV/c
45 to 55	400	[2] THOMAS	73	HBC	π^-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	

NODE=B037W1

EXTRAPOLATIONS BELOW $N\overline{K}$ THRESHOLD

NODE=B037W2
NODE=B037W2

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
50.24 or 50.26	[3] KIMURA	00		potential model
30	[4] MARTIN	81		K-matrix fit
55	[5,7] 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	[6] KITTEL	66	HBC	
37.0±3.2	KIM	65	HBC	
28.2±4.1	[6] SAKITT	65	HBC	

OCCUR=2

Λ(1405) DECAY MODES

NODE=B037215;NODE=B037

	Mode	Fraction (Γ_i/Γ)	
Γ_1	$\Sigma\pi$	100 %	DESIG=1;OUR EST
Γ_2	$\Lambda\gamma$		DESIG=3
Γ_3	$\Sigma^0\gamma$		DESIG=4
Γ_4	$N\overline{K}$		DESIG=2

Λ(1405) PARTIAL WIDTHS

NODE=B037217

$\Gamma(\Lambda\gamma)$ Γ_2

NODE=B037G1
NODE=B037G1

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

$\Gamma(\Sigma^0\gamma)$ Γ_3

NODE=B037G2
NODE=B037G2

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

Λ(1405) BRANCHING RATIOS

NODE=B037220

$\Gamma(N\overline{K})/\Gamma(\Sigma\pi)$ Γ_4/Γ_1

NODE=B037R1
NODE=B037R1

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

Λ(1405) FOOTNOTES

NODE=B037

[1] DALITZ 91 fits the HEMINGWAY 85 data.
NODE=B037;LINKAGE=C

[2] THOMAS 73 data is fit by CHAO 73 (see next section).
NODE=B037;LINKAGE=B

[3] The KIMURA 00 values are from fits A and B from a coupled-channel potential model using low-energy $\overline{K}N$ and $\Sigma\pi$ data, kaonic-hydrogen x-ray measurements, and our Λ(1405) mass and width. The results bear mainly on the *nature* of the Λ(1405): three-quark state or $\overline{K}N$ bound state.
NODE=B037;LINKAGE=KM

[4] The MARTIN 81 fit includes the $K^\pm p$ forward scattering amplitudes and the dispersion relations they must satisfy.
NODE=B037;LINKAGE=AA

[5] See also the accompanying paper of THOMAS 73.
NODE=B037;LINKAGE=T

[6] Data of SAKITT 65 are used in the fit by KITTEL 66.
NODE=B037;LINKAGE=S

[7] An asymmetric shape, with $\Gamma/2$ = 41 MeV below resonance, 14 MeV above.
NODE=B037;LINKAGE=X

Λ(1405) REFERENCES

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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 *et al.*	(RHEL, CMU, LOUC)
THOMAS	73	NP B56 15	D.W. Thomas *et al.*	(CMU) J
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MARTIN	69	PR 183 1352	B.R. Martin, M. Sakitt	(LOUC, BNL)
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BIRMINGHAM	66	PR 152 1148	M. Haque *et al.*	(BIRM, GLAS, LOIC, OXF+)
KITTEL	66	PL 21 349	W. Kittel, G. Otter, I. Wacek	(VIEN)
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