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# $\Lambda(1405)$ $S_{01}$

$I(J^P) = 0(\frac{1}{2}^-)$ 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* |
|---|---|---|---|---|---|
| **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 | $\pi^-p$ 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 | $\overline{p}p$ 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 $N\overline{K}$ THRESHOLD

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1407.56 or 1407.50 | [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 |

## $\Lambda(1405)$ WIDTH

### PRODUCTION EXPERIMENTS

| *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 | $\pi^-p$ 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 $N\overline{K}$ THRESHOLD

| *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 | |

## $\Lambda(1405)$ DECAY MODES

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

## $\Lambda(1405)$ PARTIAL WIDTHS

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

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

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

| *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 |

## $\Lambda(1405)$ BRANCHING RATIOS

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

| *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/$c$ |

## $\Lambda(1405)$ FOOTNOTES

[1] DALITZ 91 fits the HEMINGWAY 85 data.
[2] THOMAS 73 data is fit by CHAO 73 (see next section).
[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 $\Lambda(1405)$ mass and width. The results bear mainly on the *nature* of the $\Lambda(1405)$: three-quark state or $\overline{K}N$ bound state.
[4] The MARTIN 81 fit includes the $K^{\pm}p$ forward scattering amplitudes and the dispersion relations they must satisify.
[5] See also the accompanying paper of THOMAS 73.
[6] Data of SAKITT 65 are used in the fit by KITTEL 66.
[7] An asymmetric shape, with $\Gamma/2 = 41$ MeV below resonance, 14 MeV above.

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