## $\Sigma(1775)\ D_{15}$

$I(J^P) = 1(\frac{5}{2}^-)$  Status: ∗∗∗∗

Discovered by GALTIERI 63, this resonance plays the same role as cornerstone for isospin-1 analyses in this region as the $\Lambda(1820)F_{05}$ does in the isospin-0 channel.

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

### $\Sigma(1775)$ MASS

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **1770 to 1780 (≈ 1775) OUR ESTIMATE** | | | | |
| $1778\pm 5$ | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| $1777\pm 5$ | ALSTON-... | 78 | DPWA | $\overline{K}N \to \overline{K}N$ |
| $1774\pm 5$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| $1775\pm 10$ | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| $1774\pm 10$ | VANHORN | 75 | DPWA | $K^-p \to \Lambda\pi^0$ |
| $1772\pm 6$ | KANE | 74 | DPWA | $K^-p \to \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1772 or 1777 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 1765 | DEBELLEFON | 76 | IPWA | $K^-p \to \Lambda\pi^0$ |

### $\Sigma(1775)$ WIDTH

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **105 to 135 (≈ 120) OUR ESTIMATE** | | | | |
| $137\pm 10$ | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| $116\pm 10$ | ALSTON-... | 78 | DPWA | $\overline{K}N \to \overline{K}N$ |
| $130\pm 10$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| $125\pm 15$ | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| $146\pm 18$ | VANHORN | 75 | DPWA | $K^-p \to \Lambda\pi^0$ |
| $154\pm 10$ | KANE | 74 | DPWA | $K^-p \to \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 102 or 103 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 120 | DEBELLEFON | 76 | IPWA | $K^-p \to \Lambda\pi^0$ |

### $\Sigma(1775)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $N\overline{K}$ | 37–43% |
| $\Gamma_2$ | $\Lambda\pi$ | 14–20% |
| $\Gamma_3$ | $\Sigma\pi$ | 2–5% |

| $\Gamma_4$ | $\Sigma(1385)\pi$ | 8–12% |
| $\Gamma_5$ | $\Sigma(1385)\pi$, *D*-wave | |
| $\Gamma_6$ | $\Lambda(1520)\pi$ | 17–23% |
| $\Gamma_7$ | $\Sigma\pi\pi$ | |

The above branching fractions are our estimates, not fits or averages.

## CONSTRAINED FIT INFORMATION

An overall fit to 8 branching ratios uses 16 measurements and one constraint to determine 5 parameters. The overall fit has a $\chi^2 = 63.9$ for 12 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\left\langle \delta x_i \delta x_j \right\rangle / (\delta x_i \cdot \delta x_j)$, in percent, from the fit to the branching fractions, $x_i \equiv \Gamma_i/\Gamma_{\text{total}}$. The fit constrains the $x_i$ whose labels appear in this array to sum to one.

| | | | | |
|---|---|---|---|---|
| $x_2$ | $-30$ | | | |
| $x_3$ | $-17$ | $-21$ | | |
| $x_4$ | $-37$ | $-49$ | $-14$ | |
| $x_6$ | $-81$ | $6$ | $8$ | $16$ |
| | $x_1$ | $x_2$ | $x_3$ | $x_4$ |

## $\Sigma(1775)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances. Also, the errors quoted do not include uncertainties due to the parametrization used in the partial-wave analyses and are thus too small.

## $\Gamma(N\overline{K})/\Gamma_{\text{total}}$ $\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ $\Gamma_1/\Gamma$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|
| **0.37 to 0.43 OUR ESTIMATE** | | | |
| **0.45 ±0.04 OUR FIT** Error includes scale factor of 3.1. | | | |
| **0.391±0.017 OUR AVERAGE** | | | |
| 0.40 ±0.02 | GOPAL | 80 | DPWA $\overline{K}N \to \overline{K}N$ |
| 0.37 ±0.03 | ALSTON-... | 78 | DPWA $\overline{K}N \to \overline{K}N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| 0.41 ±0.03 | GOPAL | 77 | DPWA See GOPAL 80 |
| 0.37 or 0.36 | [1] MARTIN | 77 | DPWA $\overline{K}N$ multichannel |

## $(\Gamma_i\Gamma_f)^{\frac{1}{2}}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1775) \to \Lambda\pi$ $\qquad\qquad (\Gamma_1\Gamma_2)^{\frac{1}{2}}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.305±0.018 OUR FIT** Error includes scale factor of 2.4. | | | | |
| **−0.262±0.015 OUR AVERAGE** | | | | |
| −0.28 ±0.03 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| −0.25 ±0.02 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| −0.28 $^{+0.04}_{-0.05}$ | VANHORN | 75 | DPWA | $K^-p \to \Lambda\pi^0$ |
| −0.259±0.048 | DEVENISH | 74B | | Fixed-$t$ dispersion rel. |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| −0.29 or −0.28 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| −0.30 | DEBELLEFON | 76 | IPWA | $K^-p \to \Lambda\pi^0$ |

## $(\Gamma_i\Gamma_f)^{\frac{1}{2}}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1775) \to \Sigma\pi$ $\qquad\qquad (\Gamma_1\Gamma_3)^{\frac{1}{2}}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.105±0.025 OUR FIT** Error includes scale factor of 3.1. | | | | |
| **0.098±0.016 OUR AVERAGE** Error includes scale factor of 1.8. | | | | |
| +0.13 ±0.02 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 0.09 ±0.01 | KANE | 74 | DPWA | $K^-p \to \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| +0.08 or +0.08 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

## $(\Gamma_i\Gamma_f)^{\frac{1}{2}}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1775) \to \Lambda(1520)\pi$ $\qquad (\Gamma_1\Gamma_6)^{\frac{1}{2}}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.315±0.010 OUR FIT** Error includes scale factor of 1.5. | | | | |
| **0.303±0.009 OUR AVERAGE** Signs on measurements were ignored. | | | | |
| −0.305±0.010 | [2] CAMERON | 77 | DPWA | $K^-p \to \Lambda(1520)\pi^0$ |
| 0.31 ±0.02 | BARLETTA | 72 | DPWA | $K^-p \to \Lambda(1520)\pi^0$ |
| 0.27 ±0.03 | ARMENTEROS65C | HBC | | $K^-p \to \Lambda(1520)\pi^0$ |

## $(\Gamma_i\Gamma_f)^{\frac{1}{2}}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1775) \to \Sigma(1385)\pi$ $\qquad (\Gamma_1\Gamma_4)^{\frac{1}{2}}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.211±0.022 OUR FIT** Error includes scale factor of 2.8. | | | | |
| **0.188±0.010 OUR AVERAGE** Signs on measurements were ignored. | | | | |
| −0.184±0.011 | [3] CAMERON | 78 | DPWA | $K^-p \to \Sigma(1385)\pi$ |
| +0.20 ±0.02 | PREVOST | 74 | DPWA | $K^-N \to \Sigma(1385)\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.32 ±0.06 | SIMS | 68 | DBC | $K^-N \to \Lambda\pi\pi$ |
| 0.24 ±0.03 | ARMENTEROS67C | HBC | | $K^-p \to \Lambda\pi\pi$ |

## $\Gamma(\Lambda\pi)/\Gamma(N\overline{K})$ $\qquad\qquad\qquad\qquad\qquad\qquad \Gamma_2/\Gamma_1$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.46±0.09 OUR FIT** Error includes scale factor of 2.9. | | | | |
| **0.33±0.05** | UHLIG | 67 | HBC | $K^-p$ 0.9 GeV/$c$ |

## $\Gamma(\Sigma\pi\pi)/\Gamma_{\text{total}}$ $\qquad\qquad\qquad\qquad\qquad\qquad \Gamma_7/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.12 | [4] ARMENTEROS68C | HDBC | | $K^-N \to \Sigma\pi\pi$ |

## $\Gamma\big(\Sigma(1385)\pi\big)/\Gamma\big(N\overline{K}\big)$ $\qquad\qquad$ $\Gamma_4/\Gamma_1$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.22±0.07 OUR FIT** Error includes scale factor of 3.6. | | | | |
| 0.25±0.09 | UHLIG | 67 | HBC | $K^- p$ 0.9 GeV/$c$ |

## $\Gamma\big(\Lambda(1520)\pi\big)/\Gamma\big(N\overline{K}\big)$ $\qquad\qquad$ $\Gamma_6/\Gamma_1$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.49±0.11 OUR FIT** Error includes scale factor of 3.5. | | | | |
| 0.28±0.05 | UHLIG | 67 | HBC | $K^- p$ 0.9 GeV/$c$ |

## $\Sigma(1775)$ FOOTNOTES

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

[2] This rate combines *P*-wave- and *F*-wave decays. The CAMERON 77 results for the separate *P*-wave- and *F*-wave decays are $-0.303 \pm 0.010$ and $-0.037 \pm 0.014$. The published signs have been changed here to be in accord with the baryon-first convention.

[3] The CAMERON 78 upper limit on *G*-wave decay is 0.03.

[4] For about 3/4 of this, the $\Sigma\pi$ system has $I = 0$ and is almost entirely $\Lambda(1520)$. For the rest, the $\Sigma\pi$ has $I = 1$, which is about what is expected from the known $\Sigma(1775) \to \Sigma(1385)\pi$ rate, as seen in $\Lambda\pi\pi$.

## $\Sigma(1775)$ REFERENCES

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