# $\Sigma$ BARYONS
# $(S = -1, I = 1)$

$\Sigma^+ = uus, \quad \Sigma^0 = uds, \quad \Sigma^- = dds$

## $\Sigma(1385)$ $P_{13}$

$I(J^P) = 1(\frac{3}{2}^+)$ Status: ∗∗∗∗

Discovered by ALSTON 60. Early measurements of the mass and width for combined charge states have been omitted. They may be found in our 1984 edition Reviews of Modern Physics **56** No. 2 Pt. II (1984).

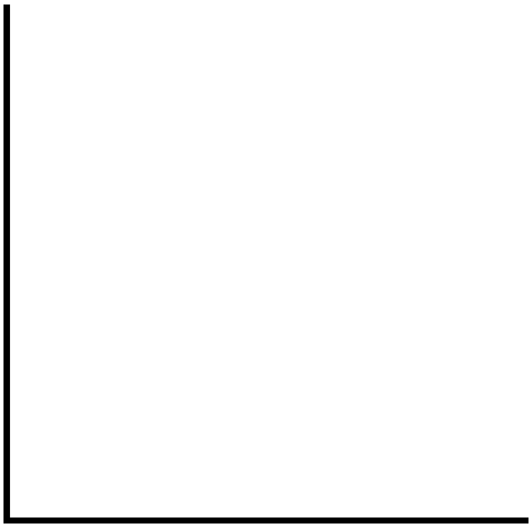
We average only the most significant determinations. We do not average results from inclusive experiments with large backgrounds or results which are not accompanied by some discussion of experimental resolution. Nevertheless systematic differences between experiments remain. (See the ideograms in the Listings below.) These differences could arise from interference effects that change with production mechanism and/or beam momentum. They can also be accounted for in part by differences in the parametrizations employed. (See BORENSTEIN 74 for a discussion on this point.) Thus BORENSTEIN 74 uses a Breit-Wigner with energy-independent width, since a $P$-wave was found to give unsatisfactory fits. CAMERON 78 uses the same form. On the other hand HOLMGREN 77 obtains a good fit to their $\Lambda\pi$ spectrum with a $P$-wave Breit-Wigner, but includes the partial width for the $\Sigma\pi$ decay mode in the parametrization. AGUILAR-BENITEZ 81D gives masses and widths for five different Breit-Wigner shapes. The results vary considerably. Only the best-fit $S$-wave results are given here.

## $\Sigma(1385)$ MASSES

### $\Sigma(1385)^+$ MASS

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **1382.8±0.4** | **OUR AVERAGE** | Error includes scale factor of 2.0. See the ideogram below. | | | |
| 1384.1±0.7 | 1897 | BAUBILLIER | 84 | HBC | $K^- p$ 8.25 GeV/$c$ |
| 1384.5±0.5 | 5256 | AGUILAR-... | 81D | HBC | $K^- p \to \Lambda\pi\pi$ 4.2 GeV/$c$ |
| 1383.0±0.4 | 9361 | AGUILAR-... | 81D | HBC | $K^- p \to \Lambda 3\pi$ 4.2 GeV/$c$ |
| 1381.9±0.3 | 6900 | CAMERON | 78 | HBC | $K^- p$ 0.96–1.36 GeV/$c$ |
| 1381 ±1 | 6846 | BORENSTEIN | 74 | HBC | $K^- p$ 2.18 GeV/$c$ |
| 1383.5±0.85 | 2300 | HABIBI | 73 | HBC | $K^- p \to \Lambda\pi\pi$ |
| 1382 ±2 | 400 | AGUILAR-... | 72B | HBC | $K^- p \to \Lambda\pi$'s |
| 1384.4±1.0 | 1260 | SIEGEL | 67 | HBC | $K^- p$ 2.1 GeV/$c$ |
| 1382 ±1 | 750 | ARMENTEROS | 65B | HBC | $K^- p$ 0.9–1.2 GeV/$c$ |
| 1381.0±1.6 | 859 | HUWE | 64 | HBC | $K^- p$ 1.22 GeV/$c$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 1385.1±1.2 | 600 | BAKER | 80 | HYBR | $\pi^+ p$ 7 GeV/$c$ |
| 1383.2±1.0 | 750 | BAKER | 80 | HYBR | $K^- p$ 7 GeV/$c$ |
| 1381 ±2 | 7k | [1] BAUBILLIER | 79B | HBC | $K^- p$ 8.25 GeV/$c$ |
| 1391 ±2 | 2k | CAUTIS | 79 | HYBR | $\pi^+ p / K^- p$ 11.5 GeV |
| 1390 ±2 | 100 | [1] SUGAHARA | 79B | HBC | $\pi^- p$ 6 GeV/$c$ |
| 1385 ±3 | 22k | [1,2] BARREIRO | 77B | HBC | $K^- p$ 4.2 GeV/$c$ |
| 1385 ±1 | 2594 | HOLMGREN | 77 | HBC | See AGUILAR 81D |
| 1380 ±2 | | [1] BARDADIN-... | 75 | HBC | $K^- p$ 14.3 GeV/$c$ |

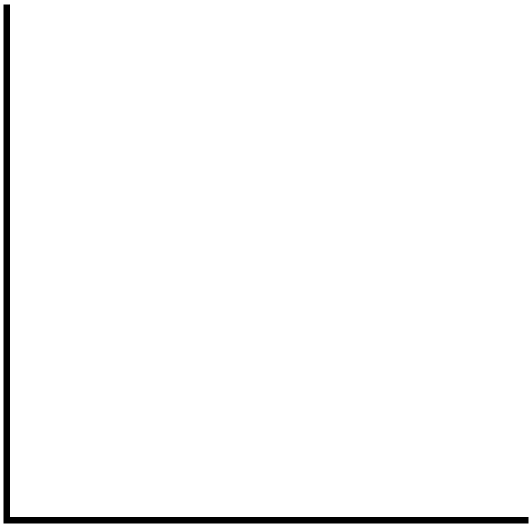
| | | | | |
|---|---|---|---|---|
| 1382 ±1 | 3740 | [3] BERTHON 74 | HBC | $K^- p$ 1263–1843 MeV/$c$ |
| 1390 ±6 | 46 | AGUILAR-... 70B | HBC | $K^- p \rightarrow \Sigma \pi$'s 4 GeV/$c$ |
| 1383 ±8 | 62 | [4] BIRMINGHAM 66 | HBC | $K^- p$ 3.5 GeV/$c$ |
| 1378 ±5 | 135 | LONDON 66 | HBC | $K^- p$ 2.24 GeV/$c$ |
| 1384.3±1.9 | 250 | [4] SMITH 65 | HBC | $K^- p$ 1.8 GeV/$c$ |
| 1382.6±2.1 | 250 | [4] SMITH 65 | HBC | $K^- p$ 1.95 GeV/$c$ |
| 1375.0±3.9 | 170 | COOPER 64 | HBC | $K^- p$ 1.45 GeV/$c$ |
| 1376.0±3.9 | 154 | [4] ELY 61 | HLBC | $K^- p$ 1.11 GeV/$c$ |



$\Sigma(1385)^+$ mass (MeV)

## $\Sigma(1385)^0$ MASS

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|---|
| **1383.7±1.0 OUR AVERAGE** | Error includes scale factor of 1.4. See the ideogram below. | | | |
| 1384.1±0.8 | 5722 | AGUILAR-... 81D | HBC | $K^- p \rightarrow \Lambda 3\pi$ 4.2 GeV/$c$ |
| 1380 ±2 | 3100 | [5] BORENSTEIN 74 | HBC | $K^- p \rightarrow \Lambda 3\pi$ 2.18 GeV/$c$ |
| 1385.1±2.5 | 240 | [4] THOMAS 73 | HBC | $\pi^- p \rightarrow \Lambda \pi^0 K^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1389 ±3 | 500 | [6] BAUBILLIER 79B | HBC | $K^- p$ 8.25 GeV/$c$ |



$\Sigma(1385)^0$ mass (MeV)

## $\Sigma(1385)^-$ MASS

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **1387.2±0.5 OUR AVERAGE** | Error includes scale factor of 2.2. See the ideogram below. | | | | |
| 1388.3±1.7 | 620 | AGUILAR-... | 81D | HBC | $K^- p \rightarrow \Lambda\pi\pi$ 4.2 GeV/$c$ |
| 1384.9±0.8 | 3346 | AGUILAR-... | 81D | HBC | $K^- p \rightarrow \Lambda 3\pi$ 4.2 GeV/$c$ |
| 1387.6±0.3 | 9720 | CAMERON | 78 | HBC | $K^- p$ 0.96–1.36 GeV/$c$ |
| 1383 ±2 | 2303 | BORENSTEIN | 74 | HBC | $K^- p$ 2.18 GeV/$c$ |
| 1390.7±1.2 | 1900 | HABIBI | 73 | HBC | $K^- p \rightarrow \Lambda\pi\pi$ |
| 1387.1±1.9 | 630 | [4] THOMAS | 73 | HBC | $\pi^- p \rightarrow \Lambda\pi^- K^+$ |
| 1390.7±2.0 | 370 | SIEGEL | 67 | HBC | $K^- p$ 2.1 GeV/$c$ |
| 1384 ±1 | 1380 | ARMENTEROS | 65B | HBC | $K^- p$ 0.9–1.2 GeV/$c$ |
| 1385.3±1.9 | 1086 | [4] HUWE | 64 | HBC | $K^- p$ 1.15–1.30 GeV/$c$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 1383 ±1 | 4.5k | [1] BAUBILLIER | 79B | HBC | $K^- p$ 8.25 GeV/$c$ |
| 1380 ±6 | 150 | [1] SUGAHARA | 79B | HBC | $\pi^- p$ 6 GeV/$c$ |
| 1387 ±3 | 12k | [1,2] BARREIRO | 77B | HBC | $K^- p$ 4.2 GeV/$c$ |
| 1391 ±3 | 193 | HOLMGREN | 77 | HBC | See AGUILAR 81D |
| 1383 ±2 | | [1] BARDADIN-... | 75 | HBC | $K^- p$ 14.3 GeV/$c$ |
| 1389 ±1 | 3060 | [3] BERTHON | 74 | HBC | $K^- p$ 1263–1843 MeV/$c$ |
| 1389 ±9 | 15 | LONDON | 66 | HBC | $K^- p$ 2.24 GeV/$c$ |
| 1391.5±2.6 | 120 | [4] SMITH | 65 | HBC | $K^- p$ 1.8 GeV/$c$ |
| 1399.8±2.2 | 58 | [4] SMITH | 65 | HBC | $K^- p$ 1.95 GeV/$c$ |
| 1392.0±6.2 | 200 | COOPER | 64 | HBC | $K^- p$ 1.45 GeV/$c$ |
| 1382 ±3 | 93 | DAHL | 61 | DBC | $K^- d$ 0.45 GeV/$c$ |
| 1376.0±4.4 | 224 | [4] ELY | 61 | HLBC | $K^- p$ 1.11 GeV/$c$ |

$\Sigma(1385)^-$ mass (MeV)

### $m_{\Sigma(1385)^-} - m_{\Sigma(1385)^+}$

| VALUE (MeV) | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| − 2 to +6 | 95 | [7] BORENSTEIN | 74 | HBC | $K^- p$ 2.18 GeV/$c$ |
| 7.2±1.4 | | [7] HABIBI | 73 | HBC | $K^- p \rightarrow \Lambda \pi \pi$ |
| 6.3±2.0 | | [7] SIEGEL | 67 | HBC | $K^- p$ 2.1 GeV/$c$ |
| 11 ±9 | | [7] LONDON | 66 | HBC | $K^- p$ 2.24 GeV/$c$ |
| 9 ±6 | | LONDON | 66 | HBC | $\Lambda 3\pi$ events |
| 2.0±1.5 | | [7] ARMENTEROS | 65B | HBC | $K^- p$ 0.9–1.2 GeV/$c$ |
| 7.2±2.1 | | [7] SMITH | 65 | HBC | $K^- p$ 1.8 GeV/$c$ |
| 17.2±2.0 | | [7] SMITH | 65 | HBC | $K^- p$ 1.95 GeV/$c$ |
| 17 ±7 | | [7] COOPER | 64 | HBC | $K^- p$ 1.45 GeV/$c$ |
| 4.3±2.2 | | [7] HUWE | 64 | HBC | $K^- p$ 1.22 GeV/$c$ |
| 0.0±4.2 | | [7] ELY | 61 | HLBC | $K^- p$ 1.11 GeV/$c$ |

### $m_{\Sigma(1385)^0} - m_{\Sigma(1385)^+}$

| VALUE (MeV) | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| −4 to +4 | 95 | [7] BORENSTEIN | 74 | HBC | $K^- p$ 2.18 GeV/$c$ |

### $m_{\Sigma(1385)^-} - m_{\Sigma(1385)^0}$

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 2.0±2.4 | [7] THOMAS | 73 | HBC | $\pi^- p \rightarrow \Lambda \pi^- K^+$ |

## $\Sigma(1385)$ WIDTHS

## $\Sigma(1385)^+$ WIDTH

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **35.8± 0.8 OUR AVERAGE** | | | | | |
| 37.2± 2.0 | 1897 | BAUBILLIER | 84 | HBC | $K^- p$ 8.25 GeV/$c$ |
| 35.1± 1.7 | 5256 | AGUILAR-... | 81D | HBC | $K^- p \to \Lambda\pi\pi$ 4.2 GeV/$c$ |
| 37.5± 2.0 | 9361 | AGUILAR-... | 81D | HBC | $K^- p \to \Lambda 3\pi$ 4.2 GeV/$c$ |
| 35.5± 1.9 | 6900 | CAMERON | 78 | HBC | $K^- p$ 0.96–1.36 GeV/$c$ |
| 34.0± 1.6 | 6846 | [8] BORENSTEIN | 74 | HBC | $K^- p$ 2.18 GeV/$c$ |
| 38.3± 3.2 | 2300 | [9] HABIBI | 73 | HBC | $K^- p \to \Lambda\pi\pi$ |
| 32.5± 6.0 | 400 | AGUILAR-... | 72B | HBC | $K^- p \to \Lambda\pi$'s |
| 36 ± 4 | 1260 | [9] SIEGEL | 67 | HBC | $K^- p$ 2.1 GeV/$c$ |
| 32.0± 4.7 | 750 | [9] ARMENTEROS | 65B | HBC | $K^- p$ 0.95–1.20 GeV/$c$ |
| 46.5± 6.4 | 859 | [9] HUWE | 64 | HBC | $K^- p$ 1.15–1.30 GeV/$c$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 40 ± 3 | 600 | BAKER | 80 | HYBR | $\pi^+ p$ 7 GeV/$c$ |
| 37 ± 2 | 750 | BAKER | 80 | HYBR | $K^- p$ 7 GeV/$c$ |
| 37 ± 2 | 7k | [1] BAUBILLIER | 79B | HBC | $K^- p$ 8.25 GeV/$c$ |
| 30 ± 4 | 2k | CAUTIS | 79 | HYBR | $\pi^+ p/K^- p$ 11.5 GeV |
| 30 ± 6 | 100 | [1] SUGAHARA | 79B | HBC | $\pi^- p$ 6 GeV/$c$ |
| 43 ± 5 | 22k | [1,2] BARREIRO | 77B | HBC | $K^- p$ 4.2 GeV/$c$ |
| 34 ± 2 | 2594 | HOLMGREN | 77 | HBC | See AGUILAR 81D |
| 40.0± 3.2 | | [1] BARDADIN-... | 75 | HBC | $K^- p$ 14.3 GeV/$c$ |
| 48 ± 3 | 3740 | [3] BERTHON | 74 | HBC | $K^- p$ 1263–1843 MeV/$c$ |
| 33 ±20 | 46 | [9] AGUILAR-... | 70B | HBC | $K^- p \to \Sigma\pi$'s 4 GeV/$c$ |
| 25 ±32 | 62 | [9] BIRMINGHAM | 66 | HBC | $K^- p$ 3.5 GeV/$c$ |
| 30.3± 7.5 | 250 | [9] SMITH | 65 | HBC | $K^- p$ 1.8 GeV/$c$ |
| 33.1± 8.3 | 250 | [9] SMITH | 65 | HBC | $K^- p$ 1.95 GeV/$c$ |
| 51 ±16 | 170 | [9] COOPER | 64 | HBC | $K^- p$ 1.45 GeV/$c$ |
| 48 ±16 | 154 | [9] ELY | 61 | HLBC | $K^- p$ 1.11 GeV/$c$ |

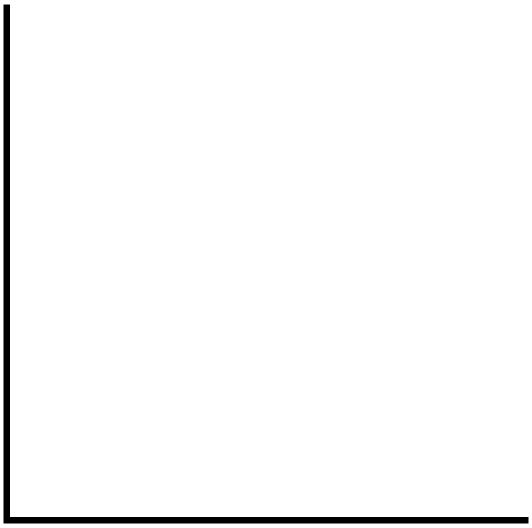
## $\Sigma(1385)^0$ WIDTH

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **36 ± 5 OUR AVERAGE** | | | | | |
| 34.8± 5.6 | 5722 | AGUILAR-... | 81D | HBC | $K^- p \to \Lambda 3\pi$ 4.2 GeV/$c$ |
| 39.3±10.2 | 240 | [9] THOMAS | 73 | HBC | $\pi^- p \to \Lambda\pi^0 K^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 53 ± 8 | 3100 | [10] BORENSTEIN | 74 | HBC | $K^- p \to \Lambda 3\pi$ 2.18 GeV/$c$ |
| 30 ± 9 | 106 | CURTIS | 63 | OSPK | $\pi^- p$ 1.5 GeV/$c$ |

## $\Sigma(1385)^-$ WIDTH

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **39.4± 2.1 OUR AVERAGE** Error includes scale factor of 1.7. See the ideogram below. | | | | | |
| 38.4±10.7 | 620 | AGUILAR-... | 81D | HBC | $K^- p \to \Lambda\pi\pi$ 4.2 GeV/$c$ |
| 34.6± 4.2 | 3346 | AGUILAR-... | 81D | HBC | $K^- p \to \Lambda 3\pi$ 4.2 GeV/$c$ |
| 39.2± 1.7 | 9720 | CAMERON | 78 | HBC | $K^- p$ 0.96–1.36 GeV/$c$ |
| 35 ± 3 | 2303 | [8] BORENSTEIN | 74 | HBC | $K^- p$ 2.18 GeV/$c$ |
| 51.9± 4.8 | 1900 | [9] HABIBI | 73 | HBC | $K^- p \to \Lambda\pi\pi$ |
| 48.2± 7.7 | 630 | [9] THOMAS | 73 | HBC | $\pi^- p \to \Lambda\pi^- K^0$ |
| 31.0± 6.5 | 370 | [9] SIEGEL | 67 | HBC | $K^- p$ 2.1 GeV/$c$ |
| 38.0± 4.1 | 1382 | [9] ARMENTEROS | 65B | HBC | $K^- p$ 0.95–1.20 GeV/$c$ |
| 62 ± 7 | 1086 | HUWE | 64 | HBC | $K^- p$ 1.15–1.30 GeV/$c$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 44 ± 4 | 4.5k | [1] BAUBILLIER | 79B | HBC | $K^- p$ 8.25 GeV/$c$ |
| 58 ± 4 | 150 | [1] SUGAHARA | 79B | HBC | $\pi^- p$ 6 GeV/$c$ |
| 45 ± 5 | 12k | [1,2] BARREIRO | 77B | HBC | $K^- p$ 4.2 GeV/$c$ |
| 35 ±10 | 193 | HOLMGREN | 77 | HBC | See AGUILAR 81D |
| 47 ± 6 | | [1] BARDADIN-... | 75 | HBC | $K^- p$ 14.3 GeV/$c$ |
| 40 ± 3 | 3060 | [3] BERTHON | 74 | HBC | $K^- p$ 1263–1843 MeV/$c$ |

| | | | | | |
|---|---|---|---|---|---|
| 29.2±10.6 | 120 | [9] SMITH | 65 | HBC | $K^- p$ 1.80 GeV/$c$ |
| 17.1± 8.9 | 58 | [9] SMITH | 65 | HBC | $K^- p$ 1.95 GeV/$c$ |
| 88 ±24 | 200 | [9] COOPER | 64 | HBC | $K^- p$ 1.45 GeV/$c$ |
| 40 | | DAHL | 61 | DBC | $K^- d$ 0.45 GeV/$c$ |
| 66 ±18 | 224 | [9] ELY | 61 | HLBC | $K^- p$ 1.11 GeV/$c$ |



$\Sigma(1385)^-$ width (MeV)

## $\Sigma(1385)$ POLE POSITIONS

### $\Sigma(1385)^+$ REAL PART

| *VALUE* | *DOCUMENT ID* | *COMMENT* |
|---|---|---|
| 1379±1 | LICHTENBERG74 | Extrapolates HABIBI 73 |

### $\Sigma(1385)^+$ −IMAGINARY PART

| *VALUE* | *DOCUMENT ID* | *COMMENT* |
|---|---|---|
| 17.5±1.5 | LICHTENBERG74 | Extrapolates HABIBI 73 |

### $\Sigma(1385)^-$ REAL PART

| *VALUE* | *DOCUMENT ID* | *COMMENT* |
|---|---|---|
| 1383±1 | LICHTENBERG74 | Extrapolates HABIBI 73 |

### $\Sigma(1385)^-$ −IMAGINARY PART

| *VALUE* | *DOCUMENT ID* | *COMMENT* |
|---|---|---|
| 22.5±1.5 | LICHTENBERG74 | Extrapolates HABIBI 73 |

## $\Sigma(1385)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $\Lambda\pi$ | 88±2 % |
| $\Gamma_2$ | $\Sigma\pi$ | 12±2 % |
| $\Gamma_3$ | $\Lambda\gamma$ | |
| $\Gamma_4$ | $\Sigma\gamma$ | |
| $\Gamma_5$ | $N\overline{K}$ | |

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

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

## $\Sigma(1385)$ BRANCHING RATIOS

### $\Gamma(\Sigma\pi)/\Gamma(\Lambda\pi)$ — $\Gamma_2/\Gamma_1$

| VALUE | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| **0.135±0.011 OUR AVERAGE** | | | | | |
| 0.20 ±0.06 | DIONISI | 78B | HBC | ± | $K^- p \rightarrow Y^* K \overline{K}$ |
| 0.16 ±0.03 | BERTHON | 74 | HBC | + | $K^- p$ 1.26–1.84 GeV/$c$ |
| 0.11 ±0.02 | BERTHON | 74 | HBC | − | $K^- p$ 1.26–1.84 GeV/$c$ |
| 0.21 ±0.05 | BORENSTEIN | 74 | HBC | + | $K^- p \rightarrow \Lambda \pi^+ \pi^-$, $\Sigma^0 \pi^+ \pi^-$ |
| 0.18 ±0.04 | MAST | 73 | MPWA | ± | $K^- p \rightarrow \Lambda \pi^+ \pi^-$, $\Sigma^0 \pi^+ \pi^-$ |
| 0.10 ±0.05 | THOMAS | 73 | HBC | − | $\pi^- p \rightarrow \Lambda K \pi$, $\Sigma K \pi$ |
| 0.16 ±0.07 | AGUILAR-... | 72B | HBC | + | $K^- p$ 3.9, 4.6 GeV/$c$ |
| 0.13 ±0.04 | COLLEY | 71B | DBC | −0 | $K^- N$ 1.5 GeV/$c$ |
| 0.13 ±0.04 | PAN | 69 | HBC | + | $\pi^+ p \rightarrow \Lambda K \pi$, $\Sigma K \pi$ |
| 0.08 ±0.06 | LONDON | 66 | HBC | + | $K^- p$ 2.24 GeV/$c$ |
| 0.163±0.041 | ARMENTEROS | 65B | HBC | ± | $K^- p$ 0.95–1.20 GeV/$c$ |
| 0.09 ±0.04 | HUWE | 64 | HBC | ± | $K^- p$ 1.2–1.7 GeV |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| <0.04 | ALSTON | 62 | HBC | ±0 | $K^- p$ 1.15 GeV/$c$ |
| 0.04 ±0.04 | BASTIEN | 61 | HBC | ± | |

### $\Gamma(\Lambda\gamma)/\Gamma_{\text{total}}$ — $\Gamma_3/\Gamma$

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 0.17±0.17 | 1 | MEISNER | 72 | HBC | 1 event only |

### $\Gamma(\Lambda\gamma)/\Gamma(\Lambda\pi)$ — $\Gamma_3/\Gamma_1$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| <0.06 | 90 | COLAS | 75 | HLBC | $K^- p$ 575–970 MeV |

### $\Gamma(\Sigma\gamma)/\Gamma(\Lambda\pi)$ — $\Gamma_4/\Gamma_1$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| <0.05 | 90 | COLAS | 75 | HLBC | $K^- p$ 575–970 MeV |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \rightarrow \Sigma(1385) \rightarrow \Lambda\pi$ — $(\Gamma_5\Gamma_1)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | CHG | COMMENT |
|---|---|---|---|---|
| +0.586±0.319 | [11] DEVENISH | 74B | 0 | Fixed-$t$ dispersion rel. |

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## $\Sigma(1385)$ FOOTNOTES

[1] From fit to inclusive $\Lambda\pi$ spectrum.
[2] Includes data of HOLMGREN 77.
[3] The errors are statistical only. The resolution is not unfolded.
[4] The error is enlarged to $\Gamma/\sqrt{N}$. See the note on the $K^*(892)$ mass in the 1984 edition.
[5] From a fit to $\Lambda\pi^0$ with the width fixed at 34 MeV.
[6] From fit to inclusive $\Lambda\pi^0$ spectrum with the width fixed at 40 MeV.
[7] Redundant with data in the mass Listings.
[8] Results from $\Lambda\pi^+\pi^-$ and $\Lambda\pi^+\pi^-\pi^0$ combined by us.
[9] The error is enlarged to $4\Gamma/\sqrt{N}$. See the note on the $K^*(892)$ mass in the 1984 edition.
[10] Consistent with +, 0, and − widths equal.
[11] An extrapolation of the parametrized amplitude below threshold.

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## $\Sigma(1385)$ REFERENCES


| | | | | | |
|---|---|---|---|---|---|
| BAUBILLIER | 84 | ZPHY C23 213 | + | (BIRM, CERN, GLAS, MSU, CURIN) | |
| PDG | 84 | RMP 56 No. 2 Pt. II | Wohl, Cahn, Rittenberg+ | (LBL, CIT, CERN) | |
| AGUILAR-... | 81D | AFIS A77 144 | Aguilar-Benitez, Salicio | (MADR) | |
| BAKER | 80 | NP B166 207 | +Chima, Dornan, Gibbs, Hall, Miller+ | (LOIC) | |
| BAUBILLIER | 79B | NP B148 18 | + | (BIRM, CERN, GLAS, MSU, CURIN) | |
| CAUTIS | 79 | NP B156 507 | +Ballam, Bouchez, Carroll, Chadwick+ | (SLAC) | |
| SUGAHARA | 79B | NP B156 237 | +Ochiai, Fukui, Cooper+ | (KEK, OSKC, KINK) | |
| CAMERON | 78 | NP B143 189 | +Franek, Gopal, Bacon, Butterworth+ | (RHEL, LOIC) | |
| DIONISI | 78B | PL 78B 154 | +Armenteros, Diaz | (CERN, AMST, NIJM, OXF) | |
| BARREIRO | 77B | NP B126 319 | +Berge, Ganguli, Blokzijl+ | (CERN, AMST, NIJM) | |
| HOLMGREN | 77 | NP B119 261 | +Aguilar-Benitez, Kluyver+ | (CERN, AMST, NIJM) | |
| BARDADIN-... | 75 | NP B98 418 | Bardadin-Otwinowska+ | (SACL, EPOL, RHEL) | |
| COLAS | 75 | NP B91 253 | +Farwell, Ferrer, Six | (ORSAY) | |
| BERTHON | 74 | NC 21A 146 | +Tristram+ | (CDEF, RHEL, SACL, STRB) | |
| BORENSTEIN | 74 | PR D9 3006 | +Kalbfleisch, Strand+ | (BNL, MICH) | |
| DEVENISH | 74B | NP B81 330 | +Froggatt, Martin | (DESY, NORD, LOUC) | |
| LICHTENBERG | 74 | PR D10 3865 | | (IND) | |
| Also | 74B | Private Comm. | Lichtenberg | (IND) | |
| HABIBI | 73 | Thesis Nevis 199 | | (COLU) | |
| Also | 73 | Purdue Conf. 387 | Baltay, Bridgewater, Cooper+ | (COLU, BING) | |
| MAST | 73 | PR D7 3212 | +Bangerter, Alston-Garnjost+ | (LBL) | IJP |
| Also | 73B | PR D7 5 | Mast, Bangerter, Alston-Garnjost+ | (LBL) | IJP |
| THOMAS | 73 | NP B56 15 | +Engler, Fisk, Kraemer | (CMU) | JP |
| AGUILAR-... | 72B | PR D6 29 | Aguilar-Benitez, Chung, Eisner, Samios | (BNL) | |
| MEISNER | 72 | NC 12A 62 | | (UNC, LBL) | |
| COLLEY | 71B | NP B31 61 | +Cox, Eastwood, Fry+ | (BIRM, EDIN, GLAS, LOIC) | |
| AGUILAR-... | 70B | PRL 25 58 | Aguilar-Benitez, Barnes, Bassano+ | (BNL, SYRA) | |
| PAN | 69 | PRL 23 808 | +Forman | (PENN) | I |
| SIEGEL | 67 | Thesis UCRL 18041 | | (LRL) | |
| BIRMINGHAM | 66 | PR 152 1148 | | (BIRM, GLAS, LOIC, OXF, RHEL) | |
| LONDON | 66 | PR 143 1034 | +Rau, Goldberg, Lichtman+ | (BNL, SYRA) | J |
| ARMENTEROS | 65B | PL 19 75 | + | (CERN, HEID, SACL) | |
| SMITH | 65 | Thesis UCLA | | (UCLA) | |
| COOPER | 64 | PL 8 365 | +Filthuth, Fridman, Malamud+ | (CERN, AMST) | |
| HUWE | 64 | Thesis UCRL 11291 | | (LRL) | JP |
| Also | 69 | PR 180 1824 | Huwe | (LRL) | |
| CURTIS | 63 | PR 132 1771 | +Coffin, Meyer, Terwilliger | (MICH) | J |
| ALSTON | 62 | CERN Conf. 311 | +Alvarez, Ferro-Luzzi+ | (LRL) | |
| BASTIEN | 61 | PRL 6 702 | +Ferro-Luzzi, Rosenfeld | (LRL) | |
| DAHL | 61 | PRL 6 142 | +Horwitz, Miller, Murray, White | (LRL) | |
| ELY | 61 | PRL 7 461 | +Fung, Gidal, Pan, Powell, White | (LRL) | J |
| ALSTON | 60 | PRL 5 520 | +Alvarez, Eberhard, Good, Graziano+ | (LRL) | I |


# $\Sigma(1480)$ Bumps

$I(J^P) = 1(?^?)$ Status: $*$

OMITTED FROM SUMMARY TABLE

These are peaks seen in $\Lambda\pi$ and $\Sigma\pi$ spectra in the reaction $\pi^+ p \rightarrow (Y\pi)K^+$ at 1.7 GeV/$c$. Also, the $Y$ polarization oscillates in the same region.

MILLER 70 suggests a possible alternate explanation in terms of a reflection of $N(1675) \rightarrow \Lambda K$ decay. However, such an explanation for the $(\Sigma^+\pi^0)K^+$ channel in terms of $\Delta(1650) \rightarrow \Sigma K$ decay seems unlikely (see PAN 70). In addition such reflections would also have to account for the oscillation of the $Y$ polarization in the 1480 MeV region.

HANSON 71, with less data than PAN 70, can neither confirm nor deny the existence of this state. MAST 75 sees no structure in this region in $K^- p \rightarrow \Lambda\pi^0$.

ENGELEN 80 performs a multichannel analysis of $K^- p \rightarrow p\overline{K}^0\pi^-$ at 4.2 GeV/$c$. They observe a 3.5 standard-deviation signal at 1480 MeV in $p\overline{K}^0$ which cannot be explained as a reflection of any competing channel.

## $\Sigma(1480)$ MASS (PRODUCTION EXPERIMENTS)

| *VALUE* (MeV) | *EVTS* | *DOCUMENT ID* | | *TECN* | *CHG* | *COMMENT* |
|---|---|---|---|---|---|---|
| **≈ 1480 OUR ESTIMATE** | | | | | | |
| 1480 | 120 | ENGELEN | 80 | HBC | + | $K^- p \to (p\overline{K}^0)\pi^-$ |
| 1485±10 | | CLINE | 73 | MPWA | − | $K^- d \to (\Lambda\pi^-)p$ |
| 1479±10 | | PAN | 70 | HBC | + | $\pi^+ p \to (\Lambda\pi^+)K^+$ |
| 1465±15 | | PAN | 70 | HBC | + | $\pi^+ p \to (\Sigma\pi)K^+$ |

## $\Sigma(1480)$ WIDTH (PRODUCTION EXPERIMENTS)

| *VALUE* (MeV) | *EVTS* | *DOCUMENT ID* | | *TECN* | *CHG* | *COMMENT* |
|---|---|---|---|---|---|---|
| 80±20 | 120 | ENGELEN | 80 | HBC | + | $K^- p \to (p\overline{K}^0)\pi^-$ |
| 40±20 | | CLINE | 73 | MPWA | − | $K^- d \to (\Lambda\pi^-)p$ |
| 31±15 | | PAN | 70 | HBC | + | $\pi^+ p \to (\Lambda\pi^+)K^+$ |
| 30±20 | | PAN | 70 | HBC | + | $\pi^+ p \to (\Sigma\pi)K^+$ |

## $\Sigma(1480)$ DECAY MODES (PRODUCTION EXPERIMENTS)

| | Mode |
|---|---|
| $\Gamma_1$ | $N\overline{K}$ |
| $\Gamma_2$ | $\Lambda\pi$ |
| $\Gamma_3$ | $\Sigma\pi$ |

## $\Sigma(1480)$ BRANCHING RATIOS (PRODUCTION EXPERIMENTS)

### $\Gamma(\Sigma\pi)/\Gamma(\Lambda\pi)$ — $\Gamma_3/\Gamma_2$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *CHG* |
|---|---|---|---|---|
| 0.82±0.51 | PAN | 70 | HBC | + |

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

| *VALUE* | *DOCUMENT ID* | | *TECN* | *CHG* |
|---|---|---|---|---|
| 0.72±0.50 | PAN | 70 | HBC | + |

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

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| small | CLINE | 73 | MPWA | $K^- d \to (\Lambda\pi^-)p$ |

## $\Sigma(1480)$ REFERENCES (PRODUCTION EXPERIMENTS)


| | | | | |
|---|---|---|---|---|
| ENGELEN | 80 | NP B167 61 | +Jongejans, Dionisi+ | (NIJM, AMST, CERN, OXF) |
| MAST | 75 | PR D11 3078 | +Alston-Garnjost, Bangerter+ | (LBL) |
| CLINE | 73 | LNC 6 205 | +Laumann, Mapp | (WISC) IJP |
| HANSON | 71 | PR D4 1296 | +Kalmus, Louie | (LBL) I |
| MILLER | 70 | Duke Conf. 229 | | (PURD) |
| PAN | 70 | PR D2 49 | +Forman, Ko, Hagopian, Selove | (PENN) |
| Also | 69 | PRL 23 808 | Pan, Forman | (PENN) I |
| Also | 69B | PRL 23 806 | Pan, Forman | (PENN) I |

# $\Sigma(1560)$ Bumps

$I(J^P) = 1(?^?)$ Status: ∗∗

OMITTED FROM SUMMARY TABLE

This entry lists peaks reported in mass spectra around 1560 MeV without implying that they are necessarily related.

DIONISI 78B observes a 6 standard-deviation enhancement at 1553 MeV in the charged $\Lambda/\Sigma\pi$ mass spectra from $K^- p \to (\Lambda/\Sigma)\pi K\overline{K}$ at 4.2 GeV/$c$. In a CERN ISR experiment, LOCKMAN 78 reports a narrow 6 standard-deviation enhancement at 1572 MeV in $\Lambda\pi^\pm$ from the reaction $pp \to \Lambda\pi^+\pi^- X$. These enhancements are unlikely to be associated with the $\Sigma(1580)$ (which has not been confirmed by several recent experiments – see the next entry in the Listings).

CARROLL 76 observes a bump at 1550 MeV (as well as one at 1580 MeV) in the isospin-1 $\overline{K}N$ total cross section, but uncertainties in cross section measurements outside the mass range of the experiment preclude estimating its significance.

See also MEADOWS 80 for a review of this state.

## $\Sigma(1560)$ MASS (PRODUCTION EXPERIMENTS)

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| **≈ 1560 OUR ESTIMATE** | | | | | | |
| 1553±7 | 121 | DIONISI | 78B | HBC | ± | $K^- p \to (Y\pi)K\overline{K}$ |
| 1572±4 | 40 | LOCKMAN | 78 | SPEC | ± | $pp \to \Lambda\pi^+\pi^- X$ |

## $\Sigma(1560)$ WIDTH (PRODUCTION EXPERIMENTS)

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| 79±30 | 121 | DIONISI | 78B | HBC | ± | $K^- p \to (Y\pi)K\overline{K}$ |
| 15± 6 | 40 | [1] LOCKMAN | 78 | SPEC | ± | $pp \to \Lambda\pi^+\pi^- X$ |

## $\Sigma(1560)$ DECAY MODES (PRODUCTION EXPERIMENTS)

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $\Lambda\pi$ | seen |
| $\Gamma_2$ | $\Sigma\pi$ | |

## $\Sigma(1560)$ BRANCHING RATIOS (PRODUCTION EXPERIMENTS)

### $\Gamma(\Sigma\pi)/[\Gamma(\Lambda\pi)+\Gamma(\Sigma\pi)]$ $\Gamma_2/(\Gamma_1+\Gamma_2)$

| VALUE | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 0.35±0.12 | DIONISI | 78B | HBC | ± | $K^- p \to (Y\pi)K\overline{K}$ |

### $\Gamma(\Lambda\pi)/\Gamma_{total}$ $\Gamma_1/\Gamma$

| VALUE | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| **seen** | LOCKMAN | 78 | SPEC | ± | $pp \to \Lambda\pi^+\pi^- X$ |

## $\Sigma(1560)$ FOOTNOTES (PRODUCTION EXPERIMENTS)

[1] The width observed by LOCKMAN 78 is consistent with experimental resolution.

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

## $\Sigma$(1560) REFERENCES (PRODUCTION EXPERIMENTS)


| | | | | |
|---|---|---|---|---|
| MEADOWS | 80 | Toronto Conf. 283 | | (CINC) |
| DIONISI | 78B | PL 78B 154 | +Armenteros, Diaz | (CERN, AMST, NIJM, OXF) I |
| LOCKMAN | 78 | Saclay DPHPE 78-01 | +Meyer, Rander, Poster, Schlein+ | (UCLA, SACL) |
| CARROLL | 76 | PRL 37 806 | +Chiang, Kycia, Li, Mazur, Michael+ | (BNL) I |


# $\Sigma(1580)\ D_{13}$

$I(J^P) = 1(\frac{3}{2}^-)$ Status: ∗∗

OMITTED FROM SUMMARY TABLE

Seen in the isospin-1 $\overline{K}N$ cross section at BNL (LI 73, CARROLL 76) and in a partial-wave analysis of $K^- p \to \Lambda\pi^0$ for c.m. energies 1560–1600 MeV by LITCHFIELD 74. LITCHFIELD 74 finds $J^P = 3/2^-$. Not seen by ENGLER 78 or by CAMERON 78C (with larger statistics in $K^0_L p \to \Lambda\pi^+$ and $\Sigma^0\pi^+$).

## $\Sigma$(1580) MASS

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **≈ 1580 OUR ESTIMATE** | | | | |
| 1583±4 | [1] CARROLL | 76 | DPWA | Isospin-1 total $\sigma$ |
| 1582±4 | [2] LITCHFIELD | 74 | DPWA | $K^- p \to \Lambda\pi^0$ |

## $\Sigma$(1580) WIDTH

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 15 | [1] CARROLL | 76 | DPWA | Isospin-1 total $\sigma$ |
| 11±4 | [2] LITCHFIELD | 74 | DPWA | $K^- p \to \Lambda\pi^0$ |

## $\Sigma$(1580) DECAY MODES

| | Mode |
|---|---|
| $\Gamma_1$ | $N\overline{K}$ |
| $\Gamma_2$ | $\Lambda\pi$ |
| $\Gamma_3$ | $\Sigma\pi$ |

## $\Sigma$(1580) BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances.

### $\Gamma(N\overline{K})/\Gamma_{\rm total}$ — $\Gamma_1/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| +0.03±0.01 | [2] LITCHFIELD | 74 | DPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\rm total}$ in $N\overline{K} \to \Sigma(1580) \to \Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| not seen | CAMERON | 78C | HBC | $K^0_L p \to \Lambda\pi^+$ |
| not seen | ENGLER | 78 | HBC | $K^0_L p \to \Lambda\pi^+$ |
| +0.10±0.02 | [2] LITCHFIELD | 74 | DPWA | $K^- p \to \Lambda\pi^0$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\rm total}$ in $N\overline{K} \to \Sigma(1580) \to \Sigma\pi$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| not seen | CAMERON | 78C | HBC | $K^0_L p \to \Sigma^0\pi^+$ |
| not seen | ENGLER | 78 | HBC | $K^0_L p \to \Sigma^0\pi^+$ |
| +0.03±0.04 | [2] LITCHFIELD | 74 | DPWA | $\overline{K}N$ multichannel |

## $\Sigma$(1580) FOOTNOTES

[1] CARROLL 76 sees a total-cross-section bump with $(J+1/2)\ \Gamma_{\rm el}\ /\ \Gamma_{\rm total} = 0.06$.

[2] The main effect observed by LITCHFIELD 74 is in the $\Lambda\pi$ final state; the $\overline{K}N$ and $\Sigma\pi$ couplings are estimated from a multichannel fit including total-cross-section data of LI 73.

## $\Sigma(1580)$ REFERENCES


| | | | | |
|---|---|---|---|---|
| CAMERON | 78C | NP B132 189 | +Capiluppi+ | (BGNA, EDIN, GLAS, PISA, RHEL)I |
| ENGLER | 78 | PR D18 3061 | +Keyes, Kraemer, Tanaka, Cho+ | (CMU, ANL) |
| CARROLL | 76 | PRL 37 806 | +Chiang, Kycia, Li, Mazur, Michael+ | (BNL)I |
| LITCHFIELD | 74 | PL 51B 509 | | (CERN)IJP |
| LI | 73 | Purdue Conf. 283 | | (BNL)I |


# $\Sigma(1620)$ $S_{11}$

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

OMITTED FROM SUMMARY TABLE

The $S_{11}$ state at 1697 MeV reported by VANHORN 75 is tentatively listed under the $\Sigma(1750)$. CARROLL 76 sees two bumps in the isospin-1 total cross section near this mass.

Production experiments are listed separately in the next entry.

## $\Sigma(1620)$ MASS

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **≈ 1620 OUR ESTIMATE** | | | | |
| 1600±6 | [1] MORRIS | 78 | DPWA | $K^- n \to \Lambda\pi^-$ |
| 1608±5 | [2] CARROLL | 76 | DPWA | Isospin-1 total $\sigma$ |
| 1633±10 | [3] CARROLL | 76 | DPWA | Isospin-1 total $\sigma$ |
| 1630±10 | LANGBEIN | 72 | IPWA | $\overline{K}N$ multichannel |
| 1620 | KIM | 71 | DPWA | K-matrix analysis |

## $\Sigma(1620)$ WIDTH

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 87±19 | [1] MORRIS | 78 | DPWA | $K^- n \to \Lambda\pi^-$ |
| 15 | [2] CARROLL | 76 | DPWA | Isospin-1 total $\sigma$ |
| 10 | [3] CARROLL | 76 | DPWA | Isospin-1 total $\sigma$ |
| 65±20 | LANGBEIN | 72 | IPWA | $\overline{K}N$ multichannel |
| 40 | KIM | 71 | DPWA | K-matrix analysis |

## $\Sigma(1620)$ DECAY MODES

| | Mode |
|---|---|
| $\Gamma_1$ | $N\overline{K}$ |
| $\Gamma_2$ | $\Lambda\pi$ |
| $\Gamma_3$ | $\Sigma\pi$ |

## $\Sigma(1620)$ BRANCHING RATIOS

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

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 0.22±0.02 | LANGBEIN | 72 | IPWA | $\overline{K}N$ multichannel |
| 0.05 | KIM | 71 | DPWA | K-matrix analysis |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1620) \to \Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 0.12±0.02 | [1] MORRIS | 78 | DPWA | $K^- n \to \Lambda\pi^-$ |
| not seen | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| 0.15 | KIM | 71 | DPWA | K-matrix analysis |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1620) \to \Sigma\pi$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| not seen | HEPP | 76B | DPWA | $K^- N \to \Sigma\pi$ |
| 0.40±0.06 | LANGBEIN | 72 | IPWA | $\overline{K}N$ multichannel |
| 0.08 | KIM | 71 | DPWA | K-matrix analysis |

## Σ(1620) FOOTNOTES

[1] MORRIS 78 obtains an equally good fit without including this resonance.
[2] Total cross-section bump with $(J+1/2)\ \Gamma_{el}\ /\ \Gamma_{total}$ is 0.06 seen by CARROLL 76.
[3] Total cross-section bump with $(J+1/2)\ \Gamma_{el}\ /\ \Gamma_{total}$ is 0.04 seen by CARROLL 76.

## Σ(1620) REFERENCES


| | | | | |
|---|---|---|---|---|
| MORRIS | 78 | PR D17 55 | +Albright, Colleraine, Kimel, Lannutti | (FSU) IJP |
| CARROLL | 76 | PRL 37 806 | +Chiang, Kycia, Li, Mazur, Michael+ | (BNL) I |
| HEPP | 76B | PL 65B 487 | +Braun, Grimm, Strobele+ | (CERN, HEIDH, MPIM) IJP |
| BAILLON | 75 | NP B94 39 | +Litchfield | (CERN, RHEL) IJP |
| VANHORN | 75 | NP B87 145 | | (LBL) IJP |
| Also | 75B | NP B87 157 | VanHorn | (LBL) IJP |
| LANGBEIN | 72 | NP B47 477 | +Wagner | (MPIM) IJP |
| KIM | 71 | PRL 27 356 | | (HARV) IJP |
| Also | 70 | Duke Conf. 161 | Kim | (HARV) IJP |


# Σ(1620) Production Experiments

$I(J^P) = 1(?^?)$

OMITTED FROM SUMMARY TABLE

Formation experiments are listed separately in the previous entry.

The results of CRENNELL 69B at 3.9 GeV/$c$ are not confirmed by SABRE 70 at 3.0 GeV/$c$. However, at 4.5 GeV/$c$, AMMANN 70 sees a peak at 1642 MeV which on the basis of branching ratios they do not associate with the Σ(1670). See MILLER 70 for a review of these conflicts.

## Σ(1620) MASS (PRODUCTION EXPERIMENTS)

| *VALUE* (MeV) | *EVTS* | *DOCUMENT ID* | | *TECN* | *CHG* | *COMMENT* |
|---|---|---|---|---|---|---|
| **≈ 1620 OUR ESTIMATE** | | | | | | |
| 1642±12 | | AMMANN | 70 | DBC | | $K^- N$ 4.5 GeV/$c$ |
| 1618± 3 | 20 | BLUMENFELD | 69 | HBC | + | $K^0_L p$ |
| 1619± 8 | | CRENNELL | 69B | DBC | ± | $K^- N \to \Lambda\pi\pi\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| 1616± 8 | | CRENNELL | 68 | DBC | ± | See CRENNELL 69B |

## Σ(1620) WIDTH (PRODUCTION EXPERIMENTS)

| *VALUE* (MeV) | *EVTS* | *DOCUMENT ID* | | *TECN* | *CHG* | *COMMENT* |
|---|---|---|---|---|---|---|
| 55±24 | | AMMANN | 70 | DBC | | $K^- N$ 4.5 GeV/$c$ |
| 30±10 | 20 | BLUMENFELD | 69 | HBC | + | |
| $72^{+22}_{-15}$ | | CRENNELL | 69B | DBC | ± | |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| 66±16 | | CRENNELL | 68 | DBC | ± | See CRENNELL 69B |

## Σ(1620) DECAY MODES (PRODUCTION EXPERIMENTS)

| | Mode |
|---|---|
| $\Gamma_1$ | $N\overline{K}$ |
| $\Gamma_2$ | $\Lambda\pi$ |
| $\Gamma_3$ | $\Sigma\pi$ |
| $\Gamma_4$ | $\Lambda\pi\pi$ |
| $\Gamma_5$ | $\Sigma(1385)\pi$ |
| $\Gamma_6$ | $\Lambda(1405)\pi$ |

## $\Sigma(1620)$ BRANCHING RATIOS (PRODUCTION EXPERIMENTS)

### $\Gamma(\Lambda\pi\pi)/\Gamma(\Lambda\pi)$ — $\Gamma_4/\Gamma_2$

| VALUE | EVTS | DOCUMENT ID | | TECN | CHG |
|---|---|---|---|---|---|
| $\sim$ 2.5 | 14 | BLUMENFELD | 69 | HBC | + |

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

| VALUE | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 0.4±0.4 | AMMANN | 70 | DBC | | $K^- p$ 4.5 GeV/$c$ |
| 0.0±0.1 | CRENNELL | 68 | DBC | + | See CRENNELL 69B |

### $\Gamma(\Lambda\pi)/\Gamma_{\text{total}}$ — $\Gamma_2/\Gamma$

| VALUE | DOCUMENT ID | | TECN | CHG |
|---|---|---|---|---|
| large | CRENNELL | 68 | DBC | ± |

### $\Gamma(\Sigma(1385)\pi)/\Gamma(\Lambda\pi)$ — $\Gamma_5/\Gamma_2$

| VALUE | CL% | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| <0.3 | 95 | AMMANN | 70 | DBC | | $K^- p$ 4.5 GeV/$c$ |
| 0.2±0.1 | | CRENNELL | 68 | DBC | ± | |

### $\Gamma(\Sigma\pi)/\Gamma(\Lambda\pi)$ — $\Gamma_3/\Gamma_2$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| <1.1 | 95 | AMMANN | 70 | DBC | $K^- N$ 4.5 GeV/$c$ |

### $\Gamma(\Lambda(1405)\pi)/\Gamma(\Lambda\pi)$ — $\Gamma_6/\Gamma_2$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.7±0.4 | AMMANN | 70 | DBC | $K^- p$ 4.5 GeV/$c$ |

## $\Sigma(1620)$ REFERENCES (PRODUCTION EXPERIMENTS)


| | | | | |
|---|---|---|---|---|
| AMMANN | 70 | PRL 24 327 | +Garfinkel, Carmony, Gutay+ | (PURD, IND) |
| Also | 73 | PR D7 1345 | Ammann, Carmony, Garfinkel+ | (PURD, IUPU) |
| MILLER | 70 | Duke Conf. 229 | | (PURD) |
| SABRE | 70 | NP B16 201 | Barloutaud, Merril, Schever+ | (SABRE Collab.) |
| BLUMENFELD | 69 | PL 29B 58 | +Kalbfleisch | (BNL) I |
| CRENNELL | 69B | Lund Paper 183 | +Karshon, Lai, O'Neil, Scarr+ | (BNL, CUNY) I |
| Results are quoted in LEVI-SETTI 69C. | | | | |
| Also | 69C | Lund Conf. | Levi-Setti | (EFI) |
| CRENNELL | 68 | PRL 21 648 | +Delaney, Flaminio, Karshon+ | (BNL, CUNY) I |


# $\Sigma(1660)$ $P_{11}$

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

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

## $\Sigma(1660)$ MASS

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **1630 to 1690 (≈ 1660) OUR ESTIMATE** | | | | |
| 1665.1±11.2 | [1] KOISO | 85 | DPWA | $K^- p \rightarrow \Sigma\pi$ |
| 1670 ±10 | GOPAL | 80 | DPWA | $\overline{K}N \rightarrow \overline{K}N$ |
| 1679 ±10 | ALSTON-... | 78 | DPWA | $\overline{K}N \rightarrow \overline{K}N$ |
| 1676 ±15 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 1668 ±25 | VANHORN | 75 | DPWA | $K^- p \rightarrow \Lambda\pi^0$ |
| 1670 ±20 | KANE | 74 | DPWA | $K^- p \rightarrow \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1565 or 1597 | [2] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 1660 ±30 | [3] BAILLON | 75 | IPWA | $\overline{K}N \rightarrow \Lambda\pi$ |
| 1671 ± 2 | [4] PONTE | 75 | DPWA | $K^- p \rightarrow \Lambda\pi^0$ |

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

## $\Sigma(1660)$ WIDTH

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **40 to 200 (≈ 100) OUR ESTIMATE** | | | | |
| $81.5\pm 22.2$ | [1] KOISO | 85 | DPWA | $K^- p \to \Sigma\pi$ |
| $152 \pm 20$ | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| $38 \pm 10$ | ALSTON-... | 78 | DPWA | $\overline{K}N \to \overline{K}N$ |
| $120 \pm 20$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| $230 {}^{+165}_{-60}$ | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |
| $250 \pm 110$ | KANE | 74 | DPWA | $K^- p \to \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 202 or 217 | [2] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| $80 \pm 40$ | [3] BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| $81 \pm 10$ | [4] PONTE | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |

## $\Sigma(1660)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $N\overline{K}$ | 10–30 % |
| $\Gamma_2$ | $\Lambda\pi$ | seen |
| $\Gamma_3$ | $\Sigma\pi$ | seen |

## $\Sigma(1660)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances.

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.1 to 0.3 OUR ESTIMATE** | | | | |
| $0.12\pm0.03$ | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| $0.10\pm0.05$ | ALSTON-... | 78 | DPWA | $\overline{K}N \to \overline{K}N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $<0.04$ | GOPAL | 77 | DPWA | See GOPAL 80 |
| 0.27 or 0.29 | [2] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1660) \to \Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $< 0.04$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| $0.12{}^{+0.12}_{-0.04}$ | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $-0.10$ or $-0.11$ | [2] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| $-0.04\pm0.02$ | [3] BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| $+0.16\pm0.01$ | [4] PONTE | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1660) \to \Sigma\pi$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $-0.13\pm0.04$ | [1] KOISO | 85 | DPWA | $K^- p \to \Sigma\pi$ |
| $-0.16\pm0.03$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| $-0.11\pm0.01$ | KANE | 74 | DPWA | $K^- p \to \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $-0.34$ or $-0.37$ | [2] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| not seen | HEPP | 76B | DPWA | $K^- N \to \Sigma\pi$ |

## $\Sigma(1660)$ FOOTNOTES

[1] The evidence of KOISO 85 is weak.
[2] The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.
[3] From solution 1 of BAILLON 75; not present in solution 2.
[4] From solution 2 of PONTE 75; not present in solution 1.

## $\Sigma(1660)$ REFERENCES


| | | | | |
|---|---|---|---|---|
| KOISO | 85 | NP A433 619 | +Sai, Yamamoto, Kofler | (TOKY, MASA) |
| PDG | 82 | PL 111B | Roos, Porter, Aguilar-Benitez+ | (HELS, CIT, CERN) |
| GOPAL | 80 | Toronto Conf. 159 | | (RHEL) IJP |
| ALSTON-... | 78 | PR D18 182 | Alston-Garnjost, Kenney+ | (LBL, MTHO, CERN) IJP |
| Also | 77 | PRL 38 1007 | Alston-Garnjost, Kenney+ | (LBL, MTHO, CERN) IJP |
| GOPAL | 77 | NP B119 362 | +Ross, VanHorn, McPherson+ | (LOIC, RHEL) IJP |
| MARTIN | 77 | NP B127 349 | +Pidcock, Moorhouse | (LOUC, GLAS) IJP |
| Also | 77B | NP B126 266 | Martin, Pidcock | (LOUC) |
| Also | 77C | NP B126 285 | Martin, Pidcock | (LOUC) IJP |
| HEPP | 76B | PL 65B 487 | +Braun, Grimm, Strobele+ | (CERN, HEIDH, MPIM) IJP |
| BAILLON | 75 | NP B94 39 | +Litchfield | (CERN, RHEL) IJP |
| PONTE | 75 | PR D12 2597 | +Hertzbach, Button-Shafer+ | (MASA, TENN, UCR) IJP |
| VANHORN | 75 | NP B87 145 | | (LBL) IJP |
| Also | 75B | NP B87 157 | VanHorn | (LBL) IJP |
| KANE | 74 | LBL-2452 | | (LBL) IJP |


MINIREVIEW GOES HERE

# $\Sigma(1670)$ $D_{13}$

$I(J^P) = 1(\frac{3}{2}^-)$ Status: ∗∗∗∗

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

Results from production experiments are listed separately in the next entry.

## $\Sigma(1670)$ MASS

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **1665 to 1685 (≈ 1670) OUR ESTIMATE** | | | | |
| 1665.1 ± 4.1 | KOISO | 85 | DPWA | $K^- p \to \Sigma\pi$ |
| 1682 ± 5 | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 1679 ± 10 | ALSTON-... | 78 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 1670 ± 5 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 1670 ± 6 | HEPP | 76B | DPWA | $K^- N \to \Sigma\pi$ |
| 1685 ± 20 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| 1659 $^{+12}_{-5}$ | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |
| 1670 ± 2 | KANE | 74 | DPWA | $K^- p \to \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1667 or 1668 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 1650 | DEBELLEFON | 76 | IPWA | $K^- p \to \Lambda\pi^0$ |
| 1671 ± 3 | PONTE | 75 | DPWA | $K^- p \to \Lambda\pi^0$ (sol. 1) |
| 1655 ± 2 | PONTE | 75 | DPWA | $K^- p \to \Lambda\pi^0$ (sol. 2) |

## $\Sigma(1670)$ WIDTH

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **40 to 80 (≈ 60) OUR ESTIMATE** | | | | |
| 65.0 ± 7.3 | KOISO | 85 | DPWA | $K^- p \to \Sigma\pi$ |
| 79 ± 10 | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 56 ± 20 | ALSTON-... | 78 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 50 ± 5 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 56 ± 3 | HEPP | 76B | DPWA | $K^- N \to \Sigma\pi$ |
| 85 ± 25 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| 32 ± 11 | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |
| 79 ± 6 | KANE | 74 | DPWA | $K^- p \to \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 46 or 46 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 80 | DEBELLEFON | 76 | IPWA | $K^- p \to \Lambda\pi^0$ |
| 44 ± 11 | PONTE | 75 | DPWA | $K^- p \to \Lambda\pi^0$ (sol. 1) |
| 76 ± 5 | PONTE | 75 | DPWA | $K^- p \to \Lambda\pi^0$ (sol. 2) |

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

## $\Sigma(1670)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $N\overline{K}$ | 7–13 % |
| $\Gamma_2$ | $\Lambda\pi$ | 5–15 % |
| $\Gamma_3$ | $\Sigma\pi$ | 30–60 % |
| $\Gamma_4$ | $\Lambda\pi\pi$ | |
| $\Gamma_5$ | $\Sigma\pi\pi$ | |
| $\Gamma_6$ | $\Sigma(1385)\pi$ | |
| $\Gamma_7$ | $\Sigma(1385)\pi$, $S$-wave | |
| $\Gamma_8$ | $\Lambda(1405)\pi$ | |
| $\Gamma_9$ | $\Lambda(1520)\pi$ | |

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

## $\Sigma(1670)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances.

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.07 to 0.13 OUR ESTIMATE** | | | | |
| 0.10±0.03 | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 0.11±0.03 | ALSTON-... | 78 | DPWA | $\overline{K}N \to \overline{K}N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.08±0.03 | GOPAL | 77 | DPWA | See GOPAL 80 |
| 0.07 or 0.07 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1670) \to \Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.17 ±0.03 | [2] MORRIS | 78 | DPWA | $K^- n \to \Lambda\pi^-$ |
| 0.13 ±0.02 | [2] MORRIS | 78 | DPWA | $K^- n \to \Lambda\pi^-$ |
| +0.10 ±0.02 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| +0.06 ±0.02 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| +0.09 ±0.02 | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |
| +0.018±0.060 | DEVENISH | 74B | | Fixed-$t$ dispersion rel. |
| • • • 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 |
| +0.05 | DEBELLEFON | 76 | IPWA | $K^- p \to \Lambda\pi^0$ |
| 0.08 ±0.01 | PONTE | 75 | DPWA | $K^- p \to \Lambda\pi^0$ (sol. 1) |
| 0.17 ±0.01 | PONTE | 75 | DPWA | $K^- p \to \Lambda\pi^0$ (sol. 2) |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1670) \to \Sigma\pi$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.20±0.02 | KOISO | 85 | DPWA | $K^- p \to \Sigma\pi$ |
| +0.21±0.02 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| +0.20±0.01 | HEPP | 76B | DPWA | $K^- N \to \Sigma\pi$ |
| +0.21±0.03 | KANE | 74 | DPWA | $K^- p \to \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| +0.18 or +0.17 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

### $\Gamma(\Lambda\pi\pi)/\Gamma_{\text{total}}$ — $\Gamma_4/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| <0.11 | ARMENTEROS | 68E | HBC | $K^- p$ ($\Gamma_1$=0.09) |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1670) \to \Sigma(1385)\pi$, $S$-wave — $(\Gamma_1\Gamma_7)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.11±0.03 | PREVOST | 74 | DPWA | $K^- N \to \Sigma(1385)\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.17±0.02 | [3] SIMS | 68 | DBC | $K^- N \to \Lambda\pi\pi$ |

### $\Gamma(\Sigma\pi\pi)/\Gamma_{total}$ — $\Gamma_5/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| <0.14 | [4] ARMENTEROS | 68E | HBC | $K^- p$, $K^- d$ ($\Gamma_1$=0.09) |

### $\Gamma(\Lambda(1405)\pi)/\Gamma_{total}$ — $\Gamma_8/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| <0.06 | ARMENTEROS | 68E | HBC | $K^- p$, $K^- d$ ($\Gamma_1$=0.09) |

### $\Gamma_i\Gamma_f/\Gamma^2_{total}$ in $N\overline{K} \rightarrow \Sigma(1670) \rightarrow \Lambda(1405)\pi$ — $\Gamma_1\Gamma_8/\Gamma^2$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.007±0.002 | [5] BRUCKER | 70 | DBC | $K^- N \rightarrow \Sigma\pi\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| <0.03 | BERLEY | 69 | HBC | $K^- p$ 0.6–0.82 GeV/$c$ |

### $\Gamma(\Lambda(1405)\pi)/\Gamma(\Sigma(1385)\pi)$ — $\Gamma_8/\Gamma_6$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.23±0.08 | BRUCKER | 70 | DBC | $K^- N \rightarrow \Sigma\pi\pi$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \rightarrow \Sigma(1670) \rightarrow \Lambda(1520)\pi$ — $(\Gamma_1\Gamma_9)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.081±0.016 | [6] CAMERON | 77 | DPWA | $P$-wave decay |

## $\Sigma$(1670) FOOTNOTES

[1] The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.
[2] Results are with and without an $S_{11}$ $\Sigma(1620)$ in the fit.
[3] SIMS 68 uses only cross-section data. Result used as upper limit only.
[4] Ratio only for $\Sigma 2\pi$ system in $I = 1$, which cannot be $\Sigma(1385)$.
[5] Assuming the $\Lambda(1405)\pi$ cross-section bump is due only to $3/2^-$ resonance.
[6] The CAMERON 77 upper limit on $F$-wave decay is 0.03.

## $\Sigma$(1670) REFERENCES


| | | | | | |
|---|---|---|---|---|---|
| KOISO | 85 | NP A433 619 | +Sai, Yamamoto, Kofler | (TOKY, MASA) | |
| PDG | 82 | PL 111B | Roos, Porter, Aguilar-Benitez+ | (HELS, CIT, CERN) | |
| GOPAL | 80 | Toronto Conf. 159 | | (RHEL) | IJP |
| ALSTON-... | 78 | PR D18 182 | Alston-Garnjost, Kenney+ | (LBL, MTHO, CERN) | IJP |
| Also | 77 | PRL 38 1007 | Alston-Garnjost, Kenney+ | (LBL, MTHO, CERN) | IJP |
| MORRIS | 78 | PR D17 55 | +Albright, Colleraine, Kimel, Lannutti | (FSU) | IJP |
| CAMERON | 77 | NP B131 399 | +Franek, Gopal, Kalmus, McPherson+ | (RHEL, LOIC) | IJP |
| GOPAL | 77 | NP B119 362 | +Ross, VanHorn, McPherson+ | (LOIC, RHEL) | IJP |
| MARTIN | 77 | NP B127 349 | +Pidcock, Moorhouse | (LOUC, GLAS) | IJP |
| Also | 77B | NP B126 266 | Martin, Pidcock | (LOUC) | |
| Also | 77C | NP B126 285 | Martin, Pidcock | (LOUC) | IJP |
| DEBELLEFON | 76 | NP B109 129 | De Bellefon, Berthon | (CDEF) | IJP |
| HEPP | 76B | PL 65B 487 | +Braun, Grimm, Strobele+ | (CERN, HEIDH, MPIM) | IJP |
| BAILLON | 75 | NP B94 39 | +Litchfield | (CERN, RHEL) | IJP |
| PONTE | 75 | PR D12 2597 | +Hertzbach, Button-Shafer+ | (MASA, TENN, UCR) | IJP |
| VANHORN | 75 | NP B87 145 | | (LBL) | IJP |
| Also | 75B | NP B87 157 | VanHorn | (LBL) | IJP |
| DEVENISH | 74B | NP B81 330 | +Froggatt, Martin | (DESY, NORD, LOUC) | |
| KANE | 74 | LBL-2452 | | (LBL) | IJP |
| PREVOST | 74 | NP B69 246 | +Barloutaud+ | (SACL, CERN, HEID) | |
| BRUCKER | 70 | Duke Conf. 155 | +Harrison, Sims, Albright, Chandler+ | (FSU) | I |
| BERLEY | 69 | PL 30B 430 | +Hart, Rahm, Willis, Yamamoto | (BNL) | |
| ARMENTEROS | 68E | PL 28B 521 | +Baillon+ | (CERN, HEID, SACL) | I |
| SIMS | 68 | PRL 21 1413 | +Albright, Bartley, Meer+ | (FSU, TUFTS, BRAN) | |

# $\Sigma(1670)$ Bumps

$I(J^P) = 1(?^?)$

OMITTED FROM SUMMARY TABLE

Formation experiments are listed separately in the preceding entry.

Probably there are two states at the same mass with the same quantum numbers, one decaying to $\Sigma\pi$ and $\Lambda\pi$, the other to $\Lambda(1405)\pi$. See the note in front of the preceding entry.

## $\Sigma(1670)$ MASS (PRODUCTION EXPERIMENTS)

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| **≈ 1670 OUR ESTIMATE** | | | | | | |
| 1670 ± 4 | | [1] CARROLL | 76 | DPWA | | Isospin-1 total $\sigma$ |
| 1675 ± 10 | | [2] HEPP | 76 | DBC | − | $K^- N$ 1.6–1.75 GeV/$c$ |
| 1665 ± 1 | | APSELL | 74 | HBC | | $K^- p$ 2.87 GeV/$c$ |
| 1688 ± 2 or 1683 ± 5 | 1200 | BERTHON | 74 | HBC | 0 | Quasi-2-body $\sigma$ |
| 1670 ± 6 | | AGUILAR-... | 70B | HBC | | $K^- p \rightarrow \Sigma\pi\pi$ 4 GeV |
| 1668 ± 10 | | AGUILAR-... | 70B | HBC | | $K^- p \rightarrow \Sigma 3\pi$ 4 GeV |
| 1660 ± 10 | | ALVAREZ | 63 | HBC | + | $K^- p$ 1.51 GeV/$c$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| 1668 ± 10 | 150 | [3] FERRERSORIA | 81 | OMEG | − | $\pi^- p$ 9,12 GeV/$c$ |
| 1655 to 1677 | | TIMMERMANS | 76 | HBC | + | $K^- p$ 4.2 GeV/$c$ |
| 1665 ± 5 | | BUGG | 68 | CNTR | | $K^- p$, $d$ total $\sigma$ |
| 1661 ± 9 | 70 | PRIMER | 68 | HBC | + | See BARNES 69E |
| 1685 | | ALEXANDER | 62C | HBC | −0 | $\pi^- p$ 2–2.2 GeV/$c$ |

## $\Sigma(1670)$ WIDTH (PRODUCTION EXPERIMENTS)

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| 67.0 ± 2.4 | | APSELL | 74 | HBC | | $K^- p$ 2.87 GeV/$c$ |
| 110 ± 12 | | AGUILAR-... | 70B | HBC | | $K^- p \rightarrow \Sigma\pi\pi$ 4 GeV |
| $135^{+40}_{-30}$ | | AGUILAR-... | 70B | HBC | | $K^- p \rightarrow \Sigma 3\pi$ 4 GeV |
| 40 ± 10 | | ALVAREZ | 63 | HBC | + | |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| 90 ± 20 | 150 | [3] FERRERSORIA | 81 | OMEG | − | $\pi^- p$ 9,12 GeV/$c$ |
| 52 | | [1] CARROLL | 76 | DPWA | | Isospin-1 total $\sigma$ |
| 48 to 63 | | TIMMERMANS | 76 | HBC | + | $K^- p$ 4.2 GeV/$c$ |
| 30 ± 15 | | BUGG | 68 | CNTR | | |
| 60 ± 20 | 70 | PRIMER | 68 | HBC | + | See BARNES 69E |
| 45 | | ALEXANDER | 62C | HBC | −0 | |

## $\Sigma(1670)$ DECAY MODES (PRODUCTION EXPERIMENTS)

| | Mode |
|---|---|
| $\Gamma_1$ | $N\overline{K}$ |
| $\Gamma_2$ | $\Lambda\pi$ |
| $\Gamma_3$ | $\Sigma\pi$ |
| $\Gamma_4$ | $\Lambda\pi\pi$ |
| $\Gamma_5$ | $\Sigma\pi\pi$ |
| $\Gamma_6$ | $\Sigma(1385)\pi$ |
| $\Gamma_7$ | $\Lambda(1405)\pi$ |

# $\Sigma(1670)$ BRANCHING RATIOS (PRODUCTION EXPERIMENTS)

## $\Gamma(N\overline{K})/\Gamma(\Sigma\pi)$ — $\Gamma_1/\Gamma_3$

| VALUE | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| <0.03 | | TIMMERMANS | 76 | HBC | + | $K^- p$ 4.2 GeV/$c$ |
| <0.10 | | BERTHON | 74 | HBC | 0 | Quasi-2-body $\sigma$ |
| <0.2 | | AGUILAR-... | 70B | HBC | | |
| <0.26 | | BARNES | 69E | HBC | + | $K^- p$ 3.9–5 GeV/$c$ |
| 0.025 | | BUGG | 68 | CNTR | 0 | Assuming $J = 3/2$ |
| <0.24 | 0 | PRIMER | 68 | HBC | + | $K^- p$ 4.6–5 GeV/$c$ |
| <0.6 | | LONDON | 66 | HBC | + | $K^- p$ 2.25 GeV/$c$ |
| <0.19 | 0 | ALVAREZ | 63 | HBC | + | $K^- p$ 1.15 GeV/$c$ |
| $\geq$ 0.5 $\pm$0.25 | | SMITH | 63 | HBC | −0 | |

## $\Gamma(\Lambda\pi)/\Gamma(\Sigma\pi)$ — $\Gamma_2/\Gamma_3$

| VALUE | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| 0.76$\pm$0.09 | | ESTES | 74 | HBC | 0 | $K^- p$ 2.1,2.6 GeV/$c$ |
| 0.45$\pm$0.15 | | BARNES | 69E | HBC | + | $K^- p$ 3.9–5 GeV/$c$ |
| 0.15$\pm$0.07 | | HUWE | 69 | HBC | + | |
| 0.11$\pm$0.06 | 33 | BUTTON-... | 68 | HBC | + | $K^- p$ 1.7 GeV/$c$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| $\leq$ 0.45$\pm$0.07 | | TIMMERMANS | 76 | HBC | + | $K^- p$ 4.2 GeV/$c$ |
| 0.55$\pm$0.11 | | BERTHON | 74 | HBC | 0 | Quasi-2-body $\sigma$ |
| 0 | 0 | PRIMER | 68 | HBC | + | See BARNES 69E |
| <0.6 | | LONDON | 66 | HBC | + | $K^- p$ 2.25 GeV/$c$ |
| 1.2 | 130 | ALVAREZ | 63 | HBC | + | $K^- p$ 1.15 GeV/$c$ |
| 1.2 | | SMITH | 63 | HBC | −0 | |

## $\Gamma(\Lambda\pi\pi)/\Gamma(\Sigma\pi)$ — $\Gamma_4/\Gamma_3$

| VALUE | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| <0.6 | | LONDON | 66 | HBC | + | $K^- p$ 2.25 GeV/$c$ |
| 0.56 | 90 | ALVAREZ | 63 | HBC | + | $K^- p$ 1.15 GeV/$c$ |
| 0.17 | | SMITH | 63 | HBC | −0 | |

## $\Gamma(\Sigma\pi\pi)/\Gamma(\Sigma\pi)$ — $\Gamma_5/\Gamma_3$

| VALUE | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| largest at small angles | | ESTES | 74 | HBC | 0 | $K^- p$ 2.1,2.6 GeV/$c$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| <0.2 | | [2] HEPP | 76 | DBC | − | $K^- N$ 1.6–1.75 GeV/$c$ |
| 0.56 | 180 | ALVAREZ | 63 | HBC | + | $K^- p$ 1.15 GeV/$c$ |

## $\Gamma(\Lambda(1405)\pi)/\Gamma(\Sigma\pi)$ — $\Gamma_7/\Gamma_3$

| VALUE | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| 1.8 $\pm$0.3 to 0.02 $\pm$ 0.07 | | [3,4] TIMMERMANS | 76 | HBC | + | $K^- p$ 4.2 GeV/$c$ |
| largest at small angles | | ESTES | 74 | HBC | $\pm$ | $K^- p$ 2.1,2.6 GeV/$c$ |
| 3.0 $\pm$1.6 | 50 | LONDON | 66 | HBC | + | $K^- p$ 2.25 GeV/$c$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | |
| 0.58$\pm$0.20 | 17 | PRIMER | 68 | HBC | + | See BARNES 69E |

## $\Gamma(\Sigma\pi)/\Gamma(\Sigma\pi\pi)$ — $\Gamma_3/\Gamma_5$

| VALUE | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| varies with prod. angle | [5] APSELL | 74 | HBC | + | $K^- p$ 2.87 GeV/$c$ |
| 1.39$\pm$0.16 | BERTHON | 74 | HBC | 0 | Quasi-2-body $\sigma$ |
| 2.5 to 0.24 | [4] EBERHARD | 69 | HBC | | $K^- p$ 2.6 GeV/$c$ |
| <0.4 | BIRMINGHAM | 66 | HBC | + | $K^- p$ 3.5 GeV/$c$ |
| 0.30$\pm$0.15 | LONDON | 66 | HBC | + | $K^- p$ 2.25 GeV/$c$ |

### $\Gamma(\Lambda(1405)\pi)/\Gamma(\Sigma\pi\pi)$ — $\Gamma_7/\Gamma_5$

| VALUE | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| $0.97 \pm 0.08$ | TIMMERMANS | 76 | HBC | | $K^- p$ 4.2 GeV/$c$ |
| $1.00 \pm 0.02$ | APSELL | 74 | HBC | | $K^- p$ 2.87 GeV/$c$ |
| $0.90^{+0.10}_{-0.16}$ | EBERHARD | 65 | HBC | + | $K^- p$ 2.45 GeV/$c$ |

### $\Gamma(\Lambda(1405)\pi)/\Gamma(\Sigma(1385)\pi)$ — $\Gamma_7/\Gamma_6$

| VALUE | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| $<0.8$ | EBERHARD | 65 | HBC | + | $K^- p$ 2.45 GeV/$c$ |

### $\Gamma(\Lambda\pi\pi)/\Gamma(\Sigma\pi\pi)$ — $\Gamma_4/\Gamma_5$

| VALUE | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| $0.35 \pm 0.2$ | BIRMINGHAM | 66 | HBC | + | $K^- p$ 3.5 GeV/$c$ |

### $\Gamma(\Lambda\pi)/\Gamma(\Sigma\pi\pi)$ — $\Gamma_2/\Gamma_5$

| VALUE | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| $<0.2$ | BIRMINGHAM | 66 | HBC | + | $K^- p$ 3.5 GeV/$c$ |

### $\Gamma(\Lambda\pi)/[\Gamma(\Lambda\pi)+\Gamma(\Sigma\pi)]$ — $\Gamma_2/(\Gamma_2+\Gamma_3)$

| VALUE | DOCUMENT ID | | TECN |
|---|---|---|---|
| $<0.6$ | AGUILAR-... | 70B | HBC |

### $\Gamma(\Sigma(1385)\pi)/\Gamma(\Sigma\pi)$ — $\Gamma_6/\Gamma_3$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $\leq 0.21 \pm 0.05$ | TIMMERMANS | 76 | HBC | $K^- p$ 4.2 GeV/$c$ |

## $\Sigma(1670)$ QUANTUM NUMBERS (PRODUCTION EXPERIMENTS)

| VALUE | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| $J^P = 3/2^-$ | 400 | BUTTON-... | 68 | HBC | $\pm$ | $\Sigma^0 \pi$ |
| $J^P = 3/2^-$ | | EBERHARD | 67 | HBC | + | $\Lambda(1405)\pi$ |
| $J^P = 3/2^+$ | | LEVEQUE | 65 | HBC | | $\Lambda(1405)\pi$ |

## $\Sigma(1670)$ FOOTNOTES

[1] Total cross-section bump with $(J+1/2)\ \Gamma_{el}\ /\ \Gamma_{total} = 0.23$.
[2] Enhancements in $\Sigma\pi$ and $\Sigma\pi\pi$ cross sections.
[3] Backward production in the $\Lambda\pi^- K^+$ final state.
[4] Depending on production angle.
[5] APSELL 74, ESTES 74, and TIMMERMANS 76 find strong branching ratio dependence on production angle, as in earlier production experiments.

## $\Sigma(1670)$ REFERENCES (PRODUCTION EXPERIMENTS)


| | | | | | |
|---|---|---|---|---|---|
| FERRERSORIA | 81 | NP B178 373 | +Treille, Rivet, Volte+ | (CERN, CDEF, EPOL, LALO) | |
| CARROLL | 76 | PRL 37 806 | +Chiang, Kycia, Li, Mazur, Michael+ | (BNL) | I |
| HEPP | 76 | NP B115 82 | +Braun, Grimm, Stroebele+ | (CERN, HEID, MPIM) | I |
| TIMMERMANS | 76 | NP B112 77 | +Engelen+ | (NIJM, CERN, AMST, OXF) | JP |
| APSELL | 74 | PR D10 1419 | +Ford, Gourevitch+ | (BRAN, UMD, SYRA, TUFTS) | I |
| BERTHON | 74 | NC 21A 146 | +Tristram+ | (CDEF, RHEL, SACL, STRB) | |
| ESTES | 74 | Thesis LBL-3827 | | (LBL) | |
| AGUILAR-... | 70B | PRL 25 58 | Aguilar-Benitez, Barnes, Bassano+ | (BNL, SYRA) | |
| BARNES | 69E | BNL 13823 | +Chung, Eisner, Flaminio+ | (BNL, SYRA) | |
| EBERHARD | 69 | PRL 22 200 | +Friedman, Pripstein, Ross | (LRL) | |
| HUWE | 69 | PR 180 1824 | | (LRL) | |
| BUGG | 68 | PR 168 1466 | +Gilmore, Knight+ | (RHEL, BIRM, CAVE) | I |
| BUTTON-... | 68 | PRL 21 1123 | Button-Shafer | (MASA, LRL) | JP |
| PRIMER | 68 | PRL 20 610 | +Goldberg, Jaeger, Barnes, Dornan+ | (SYRA, BNL) | |
| EBERHARD | 67 | PR 163 1446 | +Pripstein, Shively, Kruse, Swanson | (LRL, ILL) | IJP |
| BIRMINGHAM | 66 | PR 152 1148 | | (BIRM, GLAS, LOIC, OXF, RHEL) | |
| LONDON | 66 | PR 143 1034 | +Rau, Goldberg, Lichtman+ | (BNL, SYRA) | IJ |
| EBERHARD | 65 | PRL 14 466 | +Shively, Ross, Siegal, Ficenec+ | (LRL, ILL) | I |
| LEVEQUE | 65 | PL 18 69 | + | (SACL, EPOL, GLAS, LOIC, OXF, RHEL) | JP |
| ALVAREZ | 63 | PRL 10 184 | +Alston, Ferro-Luzzi, Huwe+ | (LRL) | I |
| SMITH | 63 | Athens Conf. 67 | | (LRL) | |
| ALEXANDER | 62C | CERN Conf. 320 | +Jacobs, Kalbfleisch, Miller+ | (LRL) | I |

# $\Sigma(1690)$ Bumps

$I(J^P) = 1(?^?)$ Status: $**$

OMITTED FROM SUMMARY TABLE

See the note preceding the $\Sigma(1670)$ Listings. Seen in production experiments only, mainly in $\Lambda\pi$.

## $\Sigma(1690)$ MASS (PRODUCTION EXPERIMENTS)

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| **≈ 1690 OUR ESTIMATE** | | | | | | |
| 1698±20 | 70 | [1] GODDARD | 79 | HBC | + | $\pi^+ p$ 10.3 GeV/$c$ |
| 1707±20 | 40 | [2] GODDARD | 79 | HBC | + | $\pi^+ p$ 10.3 GeV/$c$ |
| 1698±20 | 15 | ADERHOLZ | 69 | HBC | + | $\pi^+ p$ 8 GeV/$c$ |
| 1682± 2 | 46 | BLUMENFELD | 69 | HBC | + | $K^0_L p$ |
| 1700±20 | | MOTT | 69 | HBC | + | $K^- p$ 5.5 GeV/$c$ |
| 1694±24 | 60 | [3] PRIMER | 68 | HBC | + | $K^- p$ 4.6–5 GeV/$c$ |
| 1700± 6 | | [4] SIMS | 68 | HBC | − | $K^- N \rightarrow \Lambda\pi\pi$ |
| 1715±12 | 30 | COLLEY | 67 | HBC | + | $K^- p$ 6 GeV/$c$ |

## $\Sigma(1690)$ WIDTH (PRODUCTION EXPERIMENTS)

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| 240± 60 | 70 | [1] GODDARD | 79 | HBC | + | $\pi^+ p$ 10.3 GeV/$c$ |
| $130^{+100}_{-60}$ | 40 | [2] GODDARD | 79 | HBC | + | $\pi^+ p$ 10.3 GeV/$c$ |
| 142± 40 | 15 | ADERHOLZ | 69 | HBC | + | $\pi^+ p$ 8 GeV/$c$ |
| 25± 10 | 46 | BLUMENFELD | 69 | HBC | + | $K^0_L p$ |
| 130± 25 | | MOTT | 69 | HBC | + | $K^- p$ 5.5 GeV/$c$ |
| 105± 35 | 60 | [3] PRIMER | 68 | HBC | + | $K^- p$ 4.6–5 GeV/$c$ |
| 62± 14 | | [4] SIMS | 68 | HBC | − | $K^- N \rightarrow \Lambda\pi\pi$ |
| 100± 35 | 30 | COLLEY | 67 | HBC | + | $K^- p$ 6 GeV/$c$ |

## $\Sigma(1690)$ DECAY MODES (PRODUCTION EXPERIMENTS)

| | Mode |
|---|---|
| $\Gamma_1$ | $N\overline{K}$ |
| $\Gamma_2$ | $\Lambda\pi$ |
| $\Gamma_3$ | $\Sigma\pi$ |
| $\Gamma_4$ | $\Sigma(1385)\pi$ |
| $\Gamma_5$ | $\Lambda\pi\pi$ (including $\Sigma(1385)\pi$) |

## $\Sigma(1690)$ BRANCHING RATIOS (PRODUCTION EXPERIMENTS)

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

| VALUE | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| small | | GODDARD | 79 | HBC | + | $\pi^+ p$ 10.2 GeV/$c$ |
| <0.2 | | MOTT | 69 | HBC | + | $K^- p$ 5.5 GeV/$c$ |
| 0.4±0.25 | 18 | COLLEY | 67 | HBC | + | 6/30 events |

### $\Gamma(\Sigma\pi)/\Gamma(\Lambda\pi)$ — $\Gamma_3/\Gamma_2$

| VALUE | CL% | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| small | | GODDARD | 79 | HBC | + | $\pi^+ p$ 10.2 GeV/$c$ |
| <0.4 | 90 | MOTT | 69 | HBC | + | $K^- p$ 5.5 GeV/$c$ |
| 0.3±0.3 | | COLLEY | 67 | HBC | + | 4/30 events |

### $\Gamma(\Sigma(1385)\pi)/\Gamma(\Lambda\pi)$ — $\Gamma_4/\Gamma_2$

| VALUE | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| <0.5 | MOTT | 69 | HBC | + | $K^- p$ 5.5 GeV/$c$ |

### $\Gamma(\Lambda\pi\pi(\text{including}\,\Sigma(1385)\pi))/\Gamma(\Lambda\pi)$ — $\Gamma_5/\Gamma_2$

| VALUE | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 2.0±0.6 | BLUMENFELD | 69 | HBC | + | 31/15 events |
| 0.5±0.25 | COLLEY | 67 | HBC | + | 15/30 events |

### $\Gamma(\Sigma(1385)\pi)/\Gamma(\Lambda\pi\pi(\text{including}\,\Sigma(1385)\pi))$ — $\Gamma_4/\Gamma_5$

| VALUE | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| large | SIMS | 68 | HBC | − | $K^- N \rightarrow \Lambda\pi\pi$ |
| small | COLLEY | 67 | HBC | + | $K^- p$ 6 GeV/$c$ |

## Σ(1690) FOOTNOTES (PRODUCTION EXPERIMENTS)

[1] From $\pi^+ p \rightarrow (\Lambda\pi^+)K^+$. $J > 1/2$ is not required by the data.

[2] From $\pi^+ p \rightarrow (\Lambda\pi^+)(K\pi)^+$. $J > 1/2$ is indicated, but large background precludes a definite conclusion.

[3] See the $\Sigma(1670)$ Listings. AGUILAR-BENITEZ 70B with three times the data of PRIMER 68 find no evidence for the $\Sigma(1690)$.

[4] This analysis, which is difficult and requires several assumptions and shows no unambiguous $\Sigma(1690)$ signal, suggests $J^P = 5/2^+$. Such a state would lead all previously known $Y^*$ trajectories.

## Σ(1690) REFERENCES (PRODUCTION EXPERIMENTS)


| | | | | |
|---|---|---|---|---|
| GODDARD | 79 | PR D19 1350 | +Key, Luste, Prentice, Yoon, Gordon+ | (TNTO, BNL) IJ |
| AGUILAR-... | 70B | PRL 25 58 | Aguilar-Benitez, Barnes, Bassano+ | (BNL, SYRA) |
| ADERHOLZ | 69 | NP B11 259 | +Bartsch+ | (AACH3, BERL, CERN, JAGL, WARS) I |
| BLUMENFELD | 69 | PL 29B 58 | +Kalbfleisch | (BNL) I |
| MOTT | 69 | PR 177 1966 | +Ammar, Davis, Kropac, Slate+ | (NWES, ANL) I |
| Also | 67 | PRL 18 266 | Derrick, Fields, Loken, Ammar+ | (ANL, NWES) I |
| PRIMER | 68 | PRL 20 610 | +Goldberg, Jaeger, Barnes, Dornan+ | (SYRA, BNL) I |
| SIMS | 68 | PRL 21 1413 | +Albright, Bartley, Meer+ | (FSU, TUFTS, BRAN) I |
| COLLEY | 67 | PL 24B 489 | | (BIRM, GLAS, LOIC, MUNI, OXF, RHEL) I |


# $\Sigma(1750)\ S_{11}$

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

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

There is evidence for this state in many partial-wave analyses, but with wide variations in the mass, width, and couplings. The latest analyses indicated significant couplings to $N\overline{K}$ and $\Lambda\pi$, as well as to $\Sigma\eta$ whose threshold is at 1746 MeV (JONES 74).

## Σ(1750) MASS

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **1730 to 1800 (≈ 1750) OUR ESTIMATE** | | | | |
| 1756±10 | GOPAL | 80 | DPWA | $\overline{K}N \rightarrow \overline{K}N$ |
| 1770±10 | ALSTON-... | 78 | DPWA | $\overline{K}N \rightarrow \overline{K}N$ |
| 1770±15 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1800 or 1813 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 1715±10 | [2] CARROLL | 76 | DPWA | Isospin-1 total $\sigma$ |
| 1730 | DEBELLEFON | 76 | IPWA | $K^- p \rightarrow \Lambda\pi^0$ |
| 1780±30 | BAILLON | 75 | IPWA | $\overline{K}N \rightarrow \Lambda\pi$ (sol. 1) |
| 1700±30 | BAILLON | 75 | IPWA | $\overline{K}N \rightarrow \Lambda\pi$ (sol. 2) |
| $1697^{+20}_{-10}$ | VANHORN | 75 | DPWA | $K^- p \rightarrow \Lambda\pi^0$ |
| 1785±12 | CHU | 74 | DBC | Fits $\sigma(K^- n \rightarrow \Sigma^-\eta)$ |
| 1760± 5 | [3] JONES | 74 | HBC | Fits $\sigma(K^- p \rightarrow \Sigma^0\eta)$ |
| 1739±10 | PREVOST | 74 | DPWA | $K^- N \rightarrow \Sigma(1385)\pi$ |

## $\Sigma(1750)$ WIDTH

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **60 to 160 (≈ 90) OUR ESTIMATE** | | | | |
| 64±10 | GOPAL | 80 | DPWA | $\overline{K}N \rightarrow \overline{K}N$ |
| 161±20 | ALSTON-... | 78 | DPWA | $\overline{K}N \rightarrow \overline{K}N$ |
| 60±10 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 117 or 119 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 10 | [2] CARROLL | 76 | DPWA | Isospin-1 total $\sigma$ |
| 110 | DEBELLEFON | 76 | IPWA | $K^- p \rightarrow \Lambda\pi^0$ |
| 140±30 | BAILLON | 75 | IPWA | $\overline{K}N \rightarrow \Lambda\pi$ (sol. 1) |
| 160±50 | BAILLON | 75 | IPWA | $\overline{K}N \rightarrow \Lambda\pi$ (sol. 2) |
| $66^{+14}_{-12}$ | VANHORN | 75 | DPWA | $K^- p \rightarrow \Lambda\pi^0$ |
| 89±33 | CHU | 74 | DBC | Fits $\sigma(K^- n \rightarrow \Sigma^- \eta)$ |
| 92± 7 | [3] JONES | 74 | HBC | Fits $\sigma(K^- p \rightarrow \Sigma^0 \eta)$ |
| 108±20 | PREVOST | 74 | DPWA | $K^- N \rightarrow \Sigma(1385)\pi$ |

## $\Sigma(1750)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $N\overline{K}$ | 10–40 % |
| $\Gamma_2$ | $\Lambda\pi$ | seen |
| $\Gamma_3$ | $\Sigma\pi$ | <8 % |
| $\Gamma_4$ | $\Sigma\eta$ | 15–55 % |
| $\Gamma_5$ | $\Sigma(1385)\pi$ | |
| $\Gamma_6$ | $\Lambda(1520)\pi$ | |

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

## $\Sigma(1750)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances.

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.1 to 0.4 OUR ESTIMATE** | | | | |
| 0.14±0.03 | GOPAL | 80 | DPWA | $\overline{K}N \rightarrow \overline{K}N$ |
| 0.33±0.05 | ALSTON-... | 78 | DPWA | $\overline{K}N \rightarrow \overline{K}N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.15±0.03 | GOPAL | 77 | DPWA | See GOPAL 80 |
| 0.06 or 0.05 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \rightarrow \Sigma(1750) \rightarrow \Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.04 ±0.03 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| −0.10 or −0.09 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| −0.12 | DEBELLEFON | 76 | IPWA | $K^- p \rightarrow \Lambda\pi^0$ |
| −0.12 ±0.02 | BAILLON | 75 | IPWA | $\overline{K}N \rightarrow \Lambda\pi$ (sol. 1) |
| −0.13 ±0.03 | BAILLON | 75 | IPWA | $\overline{K}N \rightarrow \Lambda\pi$ (sol. 2) |
| −0.13 ±0.04 | VANHORN | 75 | DPWA | $K^- p \rightarrow \Lambda\pi^0$ |
| −0.120±0.077 | DEVENISH | 74B | | Fixed-$t$ dispersion rel. |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \rightarrow \Sigma(1750) \rightarrow \Sigma\pi$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| −0.09±0.05 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| +0.06 or +0.06 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 0.13±0.02 | LANGBEIN | 72 | IPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1750) \to \Sigma\eta$ — $(\Gamma_1\Gamma_4)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.23±0.01 | [3] JONES | 74 | HBC | Fits $\sigma(K^- p \to \Sigma^0 \eta)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| seen | CLINE | 69 | DBC | Threshold bump |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1750) \to \Sigma(1385)\pi$ — $(\Gamma_1\Gamma_5)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.18±0.15 | PREVOST | 74 | DPWA | $K^- N \to \Sigma(1385)\pi$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1750) \to \Lambda(1520)\pi$ — $(\Gamma_1\Gamma_6)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.032±0.021 | CAMERON | 77 | DPWA | $P$-wave decay |

## $\Sigma(1750)$ FOOTNOTES

[1] The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.
[2] A total cross-section bump with $(J+1/2)\ \Gamma_{el}\ /\ \Gamma_{total} = 0.30$.
[3] An $S$-wave Breit-Wigner fit to the threshold cross section with no background and errors statistical only.

## $\Sigma(1750)$ REFERENCES



| | | | | | |
|---|---|---|---|---|---|
| PDG | 82 | PL 111B | Roos, Porter, Aguilar-Benitez+ | (HELS, CIT, CERN) | |
| GOPAL | 80 | Toronto Conf. 159 | | (RHEL) | IJP |
| ALSTON-... | 78 | PR D18 182 | Alston-Garnjost, Kenney+ | (LBL, MTHO, CERN) | IJP |
| Also | 77 | PRL 38 1007 | Alston-Garnjost, Kenney+ | (LBL, MTHO, CERN) | IJP |
| CAMERON | 77 | NP B131 399 | +Franek, Gopal, Kalmus, McPherson+ | (RHEL, LOIC) | IJP |
| GOPAL | 77 | NP B119 362 | +Ross, VanHorn, McPherson+ | (LOIC, RHEL) | IJP |
| MARTIN | 77 | NP B127 349 | +Pidcock, Moorhouse | (LOUC, GLAS) | IJP |
| Also | 77B | NP B126 266 | Martin, Pidcock | (LOUC) | |
| Also | 77C | NP B126 285 | Martin, Pidcock | (LOUC) | IJP |
| CARROLL | 76 | PRL 37 806 | +Chiang, Kycia, Li, Mazur, Michael+ | (BNL) | I |
| DEBELLEFON | 76 | NP B109 129 | De Bellefon, Berthon | (CDEF) | IJP |
| BAILLON | 75 | NP B94 39 | +Litchfield | (CERN, RHEL) | IJP |
| VANHORN | 75 | NP B87 145 | | (LBL) | IJP |
| Also | 75B | NP B87 157 | VanHorn | (LBL) | IJP |
| CHU | 74 | NC 20A 35 | +Bartley+ | (PLAT, TUFTS, BRAN) | IJP |
| DEVENISH | 74B | NP B81 330 | +Froggatt, Martin | (DESY, NORD, LOUC) | |
| JONES | 74 | NP B73 141 | | (CHIC) | IJP |
| PREVOST | 74 | NP B69 246 | +Barloutaud+ | (SACL, CERN, HEID) | |
| LANGBEIN | 72 | NP B47 477 | +Wagner | (MPIM) | IJP |
| CLINE | 69 | LNC 2 407 | +Laumann, Mapp | (WISC) | |



# $\Sigma(1770)\ P_{11}$

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

OMITTED FROM SUMMARY TABLE

Evidence for this state now rests solely on solution 1 of BAILLON 75, (see the footnotes) but the $\Lambda\pi$ partial-wave amplitudes of this solution are in disagreement with amplitudes from most other $\Lambda\pi$ analyses.

## $\Sigma(1770)$ MASS

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **≈ 1770 OUR ESTIMATE** | | | | |
| 1738±10 | [1] GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 1770±20 | [2] BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| 1772 | [3] KANE | 72 | DPWA | $K^- p \to \Sigma\pi$ |

## $\Sigma(1770)$ WIDTH

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 72±10 | [1] GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 80±30 | [2] BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| 80 | [3] KANE | 72 | DPWA | $K^- p \to \Sigma\pi$ |

## $\Sigma(1770)$ DECAY MODES

| | Mode |
|---|---|
| $\Gamma_1$ | $N\overline{K}$ |
| $\Gamma_2$ | $\Lambda\pi$ |
| $\Gamma_3$ | $\Sigma\pi$ |

## $\Sigma(1770)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances.

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $0.14\pm0.04$ | [1] GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K}\to\Sigma(1770)\to\Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $<0.04$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| $-0.08\pm0.02$ | [2] BAILLON | 75 | IPWA | $\overline{K}N\to\Lambda\pi$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K}\to\Sigma(1770)\to\Sigma\pi$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $<0.04$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| $-0.108$ | [3] KANE | 72 | DPWA | $K^-p\to\Sigma\pi$ |

## $\Sigma(1770)$ FOOTNOTES

[1] Required to fit the isospin-1 total cross section of CARROLL 76 in the $\overline{K}N$ channel. The addition of new $K^-p$ polarization and $K^-n$ differential cross-section data in GOPAL 80 find it to be more consistent with the $\Sigma(1660)$ $P_{11}$.

[2] From solution 1 of BAILLON 75; not present in solution 2.

[3] Not required in KANE 74, which supersedes KANE 72.

## $\Sigma(1770)$ REFERENCES


| | | | | |
|---|---|---|---|---|
| GOPAL | 80 | Toronto Conf. 159 | | (RHEL) |
| GOPAL | 77 | NP B119 362 | +Ross, VanHorn, McPherson+ | (LOIC, RHEL) IJP |
| CARROLL | 76 | PRL 37 806 | +Chiang, Kycia, Li, Mazur, Michael+ | (BNL) I |
| BAILLON | 75 | NP B94 39 | +Litchfield | (CERN, RHEL) IJP |
| KANE | 74 | LBL-2452 | | (LBL) IJP |
| KANE | 72 | PR D5 1583 | | (LBL) |


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

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

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

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

## $\Sigma(1775)$ MASS

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **1770 to 1780 (≈ 1775) OUR ESTIMATE** | | | | |
| $1778\pm5$ | GOPAL | 80 | DPWA | $\overline{K}N\to\overline{K}N$ |
| $1777\pm5$ | ALSTON-... | 78 | DPWA | $\overline{K}N\to\overline{K}N$ |
| $1774\pm5$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| $1775\pm10$ | BAILLON | 75 | IPWA | $\overline{K}N\to\Lambda\pi$ |
| $1774\pm10$ | VANHORN | 75 | DPWA | $K^-p\to\Lambda\pi^0$ |
| $1772\pm6$ | 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±10 | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 116±10 | ALSTON-... | 78 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 130±10 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 125±15 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| 146±18 | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |
| 154±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.

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

| *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 |

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

| 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 | $K^- p \to \Lambda\pi^0$ |

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

| 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 |

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

| 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 | ARMENTEROS | 65C | HBC | $K^- p \to \Lambda(1520)\pi^0$ |

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

| 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 | ARMENTEROS | 67C | HBC | $K^- p \to \Lambda\pi\pi$ |

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

| 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/$c$ |

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.12 | [4] ARMENTEROS | 68C | HDBC | $K^- N \to \Sigma\pi\pi$ |

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

| 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/$c$ |

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

| 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 $\Sigma(1775) \rightarrow \Sigma(1385)\pi$ rate, as seen in $\Lambda\pi\pi$.

## $\Sigma(1775)$ REFERENCES


| | | | | |
|---|---|---|---|---|
| PDG | 82 | PL 111B | Roos, Porter, Aguilar-Benitez+ | (HELS, CIT, CERN) |
| GOPAL | 80 | Toronto Conf. 159 | | (RHEL) IJP |
| ALSTON-... | 78 | PR D18 182 | Alston-Garnjost, Kenney+ | (LBL, MTHO, CERN) IJP |
| Also | 77 | PRL 38 1007 | Alston-Garnjost, Kenney+ | (LBL, MTHO, CERN) IJP |
| CAMERON | 78 | NP B143 189 | +Franek, Gopal, Bacon, Butterworth+ | (RHEL, LOIC) IJP |
| CAMERON | 77 | NP B131 399 | +Franek, Gopal, Kalmus, McPherson+ | (RHEL, LOIC) IJP |
| GOPAL | 77 | NP B119 362 | +Ross, VanHorn, McPherson+ | (LOIC, RHEL) IJP |
| MARTIN | 77 | NP B127 349 | +Pidcock, Moorhouse | (LOUC, GLAS) IJP |
| Also | 77B | NP B126 266 | Martin, Pidcock | (LOUC) |
| Also | 77C | NP B126 285 | Martin, Pidcock | (LOUC) IJP |
| DEBELLEFON | 76 | NP B109 129 | De Bellefon, Berthon | (CDEF) IJP |
| BAILLON | 75 | NP B94 39 | +Litchfield | (CERN, RHEL) IJP |
| VANHORN | 75 | NP B87 145 | | (LBL) IJP |
| Also | 75B | NP B87 157 | VanHorn | (LBL) IJP |
| DEVENISH | 74B | NP B81 330 | +Froggatt, Martin | (DESY, NORD, LOUC) |
| KANE | 74 | LBL-2452 | | (LBL) IJP |
| PREVOST | 74 | NP B69 246 | +Barloutaud+ | (SACL, CERN, HEID) |
| BARLETTA | 72 | NP B40 45 | | (EFI) IJP |
| Also | 66 | PRL 17 841 | Fenster, Gelfand, Harmsen+ | (CHIC, ANL, CERN) IJP |
| ARMENTEROS | 68C | NP B8 216 | +Baillon+ | (CERN, HEID, SACL) I |
| SIMS | 68 | PRL 21 1413 | +Albright, Bartley, Meer+ | (FSU, TUFTS, BRAN) |
| ARMENTEROS | 67C | ZPHY 202 486 | +Ferro-Luzzi+ | (CERN, HEID, SACL) |
| UHLIG | 67 | PR 155 1448 | +Charlton, Condon, Glasser, Yodh+ | (UMD, NRL) |
| ARMENTEROS | 65C | PL 19 338 | +Ferro-Luzzi+ | (CERN, HEID, SACL) IJP |
| GALTIERI | 63 | PL 6 296 | +Hussain, Tripp | (LRL) IJ |


# $\Sigma(1840)$ $P_{13}$

$I(J^P) = 1(\frac{3}{2}^+)$ Status: $*$

OMITTED FROM SUMMARY TABLE

For the time being, we list together here all resonance claims in the $P_{13}$ wave between 1700 and 1900 MeV.

## $\Sigma(1840)$ MASS

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **≈ 1840 OUR ESTIMATE** | | | | |
| 1798 or 1802 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| $1720 \pm 30$ | [2] BAILLON | 75 | IPWA | $\overline{K}N \rightarrow \Lambda\pi$ |
| $1925 \pm 200$ | VANHORN | 75 | DPWA | $K^- p \rightarrow \Lambda\pi^0$ |
| $1840 \pm 10$ | LANGBEIN | 72 | IPWA | $\overline{K}N$ multichannel |

## $\Sigma(1840)$ WIDTH

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 93 or 93 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| $120 \pm 30$ | [2] BAILLON | 75 | IPWA | $\overline{K}N \rightarrow \Lambda\pi$ |
| $65^{+50}_{-20}$ | VANHORN | 75 | DPWA | $K^- p \rightarrow \Lambda\pi^0$ |
| $120 \pm 10$ | LANGBEIN | 72 | IPWA | $\overline{K}N$ multichannel |

## $\Sigma(1840)$ DECAY MODES

| | Mode |
|---|---|
| $\Gamma_1$ | $N\overline{K}$ |
| $\Gamma_2$ | $\Lambda\pi$ |
| $\Gamma_3$ | $\Sigma\pi$ |

## $\Sigma(1840)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances.

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0 or 0 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 0.37±0.13 | LANGBEIN | 72 | IPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1840) \to \Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.03 or +0.03 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| +0.11 ±0.02 | [2] BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| +0.06 ±0.04 | VANHORN | 75 | DPWA | $K^-p \to \Lambda\pi^0$ |
| +0.122±0.078 | DEVENISH | 74B | | Fixed-$t$ dispersion rel. |
| 0.20 ±0.04 | LANGBEIN | 72 | IPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1840) \to \Sigma\pi$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| −0.04 or −0.04 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 0.15±0.04 | LANGBEIN | 72 | IPWA | $\overline{K}N$ multichannel |

## $\Sigma(1840)$ FOOTNOTES

[1] The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.
[2] From solution 1 of BAILLON 75; not present in solution 2.

## $\Sigma(1840)$ REFERENCES


| | | | | |
|---|---|---|---|---|
| MARTIN | 77 | NP B127 349 | +Pidcock, Moorhouse | (LOUC, GLAS) IJP |
| Also | 77B | NP B126 266 | Martin, Pidcock | (LOUC) |
| Also | 77C | NP B126 285 | Martin, Pidcock | (LOUC) IJP |
| BAILLON | 75 | NP B94 39 | +Litchfield | (CERN, RHEL) IJP |
| VANHORN | 75 | NP B87 145 | | (LBL) IJP |
| Also | 75B | NP B87 157 | VanHorn | (LBL) IJP |
| DEVENISH | 74B | NP B81 330 | +Froggatt, Martin | (DESY, NORD, LOUC) |
| LANGBEIN | 72 | NP B47 477 | +Wagner | (MPIM) IJP |


# $\Sigma(1880)$ $P_{11}$

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

OMITTED FROM SUMMARY TABLE

A $P_{11}$ resonance is suggested by several partial-wave analyses, but with wide variations in the mass and other parameters. We list here all claims which lie well above the $P_{11}$ $\Sigma(1770)$.

## $\Sigma(1880)$ MASS

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **≈ 1880 OUR ESTIMATE** | | | | |
| 1826±20 | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 1870±10 | CAMERON | 78B | DPWA | $K^-p \to N\overline{K}^*$ |
| 1847 or 1863 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 1960±30 | [2] BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| 1985±50 | VANHORN | 75 | DPWA | $K^-p \to \Lambda\pi^0$ |
| 1898 | [3] LEA | 73 | DPWA | Multichannel K-matrix |
| ∼ 1850 | ARMENTEROS | 70 | IPWA | $\overline{K}N \to \overline{K}N$ |
| 1950±50 | BARBARO-... | 70 | DPWA | $K^-N \to \Lambda\pi$ |
| 1920±30 | LITCHFIELD | 70 | DPWA | $K^-N \to \Lambda\pi$ |
| 1850 | BAILEY | 69 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 1882±40 | SMART | 68 | DPWA | $K^-N \to \Lambda\pi$ |

## $\Sigma(1880)$ WIDTH

| VALUE (MeV) | | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| 86± 15 | | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 80± 10 | | CAMERON | 78B | DPWA | $K^- p \to N\overline{K}^*$ |
| 216 or 220 | [1] | MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 260± 40 | [2] | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| 220±140 | | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |
| 222 | [3] | LEA | 73 | DPWA | Multichannel K-matrix |
| ~ 30 | | ARMENTEROS | 70 | IPWA | $\overline{K}N \to \overline{K}N$ |
| 200± 50 | | BARBARO-... | 70 | DPWA | $K^- N \to \Lambda\pi$ |
| 170± 40 | | LITCHFIELD | 70 | DPWA | $K^- N \to \Lambda\pi$ |
| 200 | | BAILEY | 69 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 222±150 | | SMART | 68 | DPWA | $K^- N \to \Lambda\pi$ |

## $\Sigma(1880)$ DECAY MODES

| | Mode |
|---|---|
| $\Gamma_1$ | $N\overline{K}$ |
| $\Gamma_2$ | $\Lambda\pi$ |
| $\Gamma_3$ | $\Sigma\pi$ |
| $\Gamma_4$ | $N\overline{K}^*(892)$, $S$=1/2, $P$-wave |
| $\Gamma_5$ | $N\overline{K}^*(892)$, $S$=3/2, $P$-wave |

## $\Sigma(1880)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances.

### $\Gamma(N\overline{K})/\Gamma_{\rm total}$ — $\Gamma_1/\Gamma$

| VALUE | | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| 0.06±0.02 | | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 0.27 or 0.27 | [1] | MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 0.31 | [3] | LEA | 73 | DPWA | Multichannel K-matrix |
| 0.20 | | ARMENTEROS | 70 | IPWA | $\overline{K}N \to \overline{K}N$ |
| 0.22 | | BAILEY | 69 | DPWA | $\overline{K}N \to \overline{K}N$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\rm total}$ in $N\overline{K} \to \Sigma(1880) \to \Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| VALUE | | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| −0.24 or −0.24 | [1] | MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| −0.12 ±0.02 | [2] | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| $+0.05\,^{+0.07}_{-0.02}$ | | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |
| −0.169±0.119 | | DEVENISH | 74B | | Fixed-$t$ dispersion rel. |
| −0.30 | [3] | LEA | 73 | DPWA | Multichannel K-matrix |
| −0.09 ±0.04 | | BARBARO-... | 70 | DPWA | $K^- N \to \Lambda\pi$ |
| −0.14 ±0.03 | | LITCHFIELD | 70 | DPWA | $K^- N \to \Lambda\pi$ |
| −0.11 ±0.03 | | SMART | 68 | DPWA | $K^- N \to \Lambda\pi$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\rm total}$ in $N\overline{K} \to \Sigma(1880) \to \Sigma\pi$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| VALUE | | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| +0.30 or +0.29 | [1] | MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| not seen | [3] | LEA | 73 | DPWA | Multichannel K-matrix |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\rm total}$ in $N\overline{K} \to \Sigma(1880) \to N\overline{K}^*(892)$, $S$=1/2, $P$-wave — $(\Gamma_1\Gamma_4)^{1/2}/\Gamma$

| VALUE | | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| −0.05±0.03 | [4] | CAMERON | 78B | DPWA | $K^- p \to N\overline{K}^*$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\rm total}$ in $N\overline{K} \to \Sigma(1880) \to N\overline{K}^*(892)$, $S$=3/2, $P$-wave — $(\Gamma_1\Gamma_5)^{1/2}/\Gamma$

| VALUE | | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| +0.11±0.03 | | CAMERON | 78B | DPWA | $K^- p \to N\overline{K}^*$ |

## $\Sigma(1880)$ FOOTNOTES

[1] The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.
[2] From solution 1 of BAILLON 75; not present in solution 2.
[3] Only unconstrained states from table 1 of LEA 73 are listed.
[4] The published sign has been changed to be in accord with the baryon-first convention.

## $\Sigma(1880)$ REFERENCES


| | | | | |
|---|---|---|---|---|
| GOPAL | 80 | Toronto Conf. 159 | | (RHEL) IJP |
| CAMERON | 78B | NP B146 327 | +Franek, Gopal, Kalmus, McPherson+ | (RHEL, LOIC) IJP |
| MARTIN | 77 | NP B127 349 | +Pidcock, Moorhouse | (LOUC, GLAS) IJP |
| Also | 77B | NP B126 266 | Martin, Pidcock | (LOUC) |
| Also | 77C | NP B126 285 | Martin, Pidcock | (LOUC) IJP |
| BAILLON | 75 | NP B94 39 | +Litchfield | (CERN, RHEL) IJP |
| VANHORN | 75 | NP B87 145 | | (LBL) IJP |
| Also | 75B | NP B87 157 | VanHorn | (LBL) IJP |
| DEVENISH | 74B | NP B81 330 | +Froggatt, Martin | (DESY, NORD, LOUC) |
| LEA | 73 | NP B56 77 | +Martin, Moorhouse+ | (RHEL, LOUC, GLAS, AARH) IJP |
| ARMENTEROS | 70 | Duke Conf. 123 | +Baillon+ | (CERN, HEID, SACL) IJP |
| BARBARO-... | 70 | Duke Conf. 173 | Barbaro-Galtieri | (LRL) IJP |
| LITCHFIELD | 70 | NP B22 269 | | (RHEL) IJP |
| BAILEY | 69 | Thesis UCRL 50617 | | (LLL) IJP |
| SMART | 68 | PR 169 1330 | | (LRL) IJP |


# $\Sigma(1915)$ $F_{15}$

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

Discovered by COOL 66. For results published before 1974 (they are now obsolete), see our 1982 edition Physics Letters **111B** (1982).

This entry only includes results from partial-wave analyses. Parameters of peaks seen in cross sections and invariant-mass distributions in this region used to be listed in in a separate entry immediately following. They may be found in our 1986 edition Physics Letters **170B** (1986).

## $\Sigma(1915)$ MASS

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **1900 to 1935 (≈ 1915) OUR ESTIMATE** | | | | |
| 1937±20 | ALSTON-... | 78 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 1894± 5 | [1] CORDEN | 77C | | $K^- n \to \Sigma\pi$ |
| 1909± 5 | [1] CORDEN | 77C | | $K^- n \to \Sigma\pi$ |
| 1920±10 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 1900± 4 | [2] CORDEN | 76 | DPWA | $K^- n \to \Lambda\pi^-$ |
| 1920±30 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| 1914±10 | HEMINGWAY | 75 | DPWA | $K^- p \to \overline{K}N$ |
| $1920^{+15}_{-20}$ | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |
| 1920± 5 | KANE | 74 | DPWA | $K^- p \to \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| not seen | DECLAIS | 77 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 1925 or 1933 | [3] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 1915 | DEBELLEFON | 76 | IPWA | $K^- p \to \Lambda\pi^0$ |

## $\Sigma(1915)$ WIDTH

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **80 to 160 (≈ 120) OUR ESTIMATE** | | | | |
| 161±20 | ALSTON-... | 78 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 107±14 | [1] CORDEN | 77C | | $K^- n \to \Sigma\pi$ |
| 85±13 | [1] CORDEN | 77C | | $K^- n \to \Sigma\pi$ |
| 130±10 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 75±14 | [2] CORDEN | 76 | DPWA | $K^- n \to \Lambda\pi^-$ |
| 70±20 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| 85±15 | HEMINGWAY | 75 | DPWA | $K^- p \to \overline{K}N$ |
| 102±18 | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |
| 162±25 | KANE | 74 | DPWA | $K^- p \to \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 171 or 173 | [3] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 60 | DEBELLEFON | 76 | IPWA | $K^- p \to \Lambda\pi^0$ |

## $\Sigma(1915)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $N\overline{K}$ | 5–15 % |
| $\Gamma_2$ | $\Lambda\pi$ | seen |
| $\Gamma_3$ | $\Sigma\pi$ | seen |
| $\Gamma_4$ | $\Sigma(1385)\pi$ | <5 % |
| $\Gamma_5$ | $\Sigma(1385)\pi$, $P$-wave | |
| $\Gamma_6$ | $\Sigma(1385)\pi$, $F$-wave | |

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

## $\Sigma(1915)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances.

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.05 to 0.15 OUR ESTIMATE** | | | | |
| 0.03±0.02 | [4] GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 0.14±0.05 | ALSTON-... | 78 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 0.11±0.04 | HEMINGWAY | 75 | DPWA | $K^-p \to \overline{K}N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.05±0.03 | GOPAL | 77 | DPWA | See GOPAL 80 |
| 0.08 or 0.08 | [3] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1915) \to \Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| −0.09 ±0.03 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| −0.10 ±0.01 | [2] CORDEN | 76 | DPWA | $K^-n \to \Lambda\pi^-$ |
| −0.06 ±0.02 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| −0.09 ±0.02 | VANHORN | 75 | DPWA | $K^-p \to \Lambda\pi^0$ |
| −0.087±0.056 | DEVENISH | 74B | | Fixed-$t$ dispersion rel. |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| −0.09 or −0.09 | [3] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| −0.10 | DEBELLEFON | 76 | IPWA | $K^-p \to \Lambda\pi^0$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1915) \to \Sigma\pi$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| −0.17±0.01 | [1] CORDEN | 77C | | $K^-n \to \Sigma\pi$ |
| −0.15±0.02 | [1] CORDEN | 77C | | $K^-n \to \Sigma\pi$ |
| −0.19±0.03 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| −0.16±0.03 | KANE | 74 | DPWA | $K^-p \to \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| −0.05 or −0.05 | [3] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1915) \to \Sigma(1385)\pi$, $P$-wave — $(\Gamma_1\Gamma_5)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| <0.01 | CAMERON | 78 | DPWA | $K^-p \to \Sigma(1385)\pi$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(1915) \to \Sigma(1385)\pi$, $F$-wave — $(\Gamma_1\Gamma_6)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.039±0.009 | [5] CAMERON | 78 | DPWA | $K^-p \to \Sigma(1385)\pi$ |

## $\Sigma(1915)$ FOOTNOTES

[1] The two entries for CORDEN 77C are from two different acceptable solutions.
[2] Preferred solution 3; see CORDEN 76 for other possibilities.
[3] The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.
[4] The mass and width are fixed to the GOPAL 77 values due to the low elasticity.
[5] The published sign has been changed to be in accord with the baryon-first convention.

## $\Sigma$(1915) REFERENCES


| | | | | |
|---|---|---|---|---|
| PDG | 86 | PL 170B | Aguilar-Benitez, Porter+ | (CERN, CIT+) |
| PDG | 82 | PL 111B | Roos, Porter, Aguilar-Benitez+ | (HELS, CIT, CERN) |
| GOPAL | 80 | Toronto Conf. 159 | | (RHEL) IJP |
| ALSTON-... | 78 | PR D18 182 | Alston-Garnjost, Kenney+ | (LBL, MTHO, CERN) IJP |
| Also | 77 | PRL 38 1007 | Alston-Garnjost, Kenney+ | (LBL, MTHO, CERN) IJP |
| CAMERON | 78 | NP B143 189 | +Franek, Gopal, Bacon, Butterworth+ | (RHEL, LOIC) IJP |
| CORDEN | 77C | NP B125 61 | +Cox, Kenyon, O'Neale, Stubbs, Sumorok+ | (BIRM) IJP |
| DECLAIS | 77 | CERN 77-16 | +Duchon, Louvel, Patry, Seguinot+ | (CAEN, CERN) IJP |
| GOPAL | 77 | NP B119 362 | +Ross, VanHorn, McPherson+ | (LOIC, RHEL) IJP |
| MARTIN | 77 | NP B127 349 | +Pidcock, Moorhouse | (LOUC, GLAS) IJP |
| Also | 77B | NP B126 266 | Martin, Pidcock | (LOUC) |
| Also | 77C | NP B126 285 | Martin, Pidcock | (LOUC) IJP |
| CORDEN | 76 | NP B104 382 | +Cox, Dartnell, Kenyon, O'Neale+ | (BIRM) IJP |
| DEBELLEFON | 76 | NP B109 129 | De Bellefon, Berthon | (CDEF) IJP |
| BAILLON | 75 | NP B94 39 | +Litchfield | (CERN, RHEL) IJP |
| HEMINGWAY | 75 | NP B91 12 | +Eades, Harmsen+ | (CERN, HEIDH, MPIM) IJP |
| VANHORN | 75 | NP B87 145 | | (LBL) IJP |
| Also | 75B | NP B87 157 | VanHorn | (LBL) IJP |
| DEVENISH | 74B | NP B81 330 | +Froggatt, Martin | (DESY, NORD, LOUC) |
| KANE | 74 | LBL-2452 | | (LBL) IJP |
| COOL | 66 | PRL 16 1228 | +Giacomelli, Kycia, Leontic, Lundby+ | (BNL) |


# $\Sigma(1940)\ D_{13}$

$I(J^P) = 1(\frac{3}{2}^-)$ Status: ∗∗∗

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

Not all analyses require this state. It is not required by the GOYAL 77 analysis of $K^- n \rightarrow (\Sigma\pi)^-$ nor by the GOPAL 80 analysis of $K^- n \rightarrow K^- n$. See also HEMINGWAY 75.

## $\Sigma$(1940) MASS

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **1900 to 1950 (≈ 1940) OUR ESTIMATE** | | | | |
| 1920±50 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 1950±30 | BAILLON | 75 | IPWA | $\overline{K}N \rightarrow \Lambda\pi$ |
| $1949^{+40}_{-60}$ | VANHORN | 75 | DPWA | $K^- p \rightarrow \Lambda\pi^0$ |
| 1935±80 | KANE | 74 | DPWA | $K^- p \rightarrow \Sigma\pi$ |
| 1940±20 | LITCHFIELD | 74B | DPWA | $K^- p \rightarrow \Lambda(1520)\pi^0$ |
| 1950±20 | LITCHFIELD | 74C | DPWA | $K^- p \rightarrow \Delta(1232)\overline{K}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1886 or 1893 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| 1940 | DEBELLEFON | 76 | IPWA | $K^- p \rightarrow \Lambda\pi^0$, $F_{17}$ wave |

## $\Sigma$(1940) WIDTH

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **150 to 300 (≈ 220) OUR ESTIMATE** | | | | |
| 170±25 | CAMERON | 78B | DPWA | $K^- p \rightarrow N\overline{K}^*$ |
| 300±80 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 150±75 | BAILLON | 75 | IPWA | $\overline{K}N \rightarrow \Lambda\pi$ |
| $160^{+70}_{-40}$ | VANHORN | 75 | DPWA | $K^- p \rightarrow \Lambda\pi^0$ |
| 330±80 | KANE | 74 | DPWA | $K^- p \rightarrow \Sigma\pi$ |
| 60±20 | LITCHFIELD | 74B | DPWA | $K^- p \rightarrow \Lambda(1520)\pi^0$ |
| $70^{+30}_{-20}$ | LITCHFIELD | 74C | DPWA | $K^- p \rightarrow \Delta(1232)\overline{K}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 157 or 159 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

## $\Sigma(1940)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $N\overline{K}$ | <20 % |
| $\Gamma_2$ | $\Lambda\pi$ | seen |
| $\Gamma_3$ | $\Sigma\pi$ | seen |
| $\Gamma_4$ | $\Sigma(1385)\pi$ | seen |
| $\Gamma_5$ | $\Sigma(1385)\pi$, S-wave | |
| $\Gamma_6$ | $\Lambda(1520)\pi$ | seen |
| $\Gamma_7$ | $\Lambda(1520)\pi$, P-wave | |
| $\Gamma_8$ | $\Lambda(1520)\pi$, F-wave | |
| $\Gamma_9$ | $\Delta(1232)\overline{K}$ | seen |
| $\Gamma_{10}$ | $\Delta(1232)\overline{K}$, S-wave | |
| $\Gamma_{11}$ | $\Delta(1232)\overline{K}$, D-wave | |
| $\Gamma_{12}$ | $N\overline{K}^*(892)$ | seen |
| $\Gamma_{13}$ | $N\overline{K}^*(892)$, $S$=3/2, S-wave | |

## $\Sigma(1940)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances.

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **<0.2 OUR ESTIMATE** | | | | |
| <0.04 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 0.14 or 0.13 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K}\to\Sigma(1940)\to\Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $-0.06\ \pm0.03$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| $-0.04\ \pm0.02$ | BAILLON | 75 | IPWA | $\overline{K}N\to\Lambda\pi$ |
| $-0.05\ ^{+0.03}_{-0.02}$ | VANHORN | 75 | DPWA | $K^-p\to\Lambda\pi^0$ |
| $-0.153\pm0.070$ | DEVENISH | 74B | | Fixed-$t$ dispersion rel. |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $-0.15$ or $-0.14$ | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K}\to\Sigma(1940)\to\Sigma\pi$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $-0.08\pm0.04$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| $-0.14\pm0.04$ | KANE | 74 | DPWA | $K^-p\to\Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $+0.16$ or $+0.16$ | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K}\to\Sigma(1940)\to\Lambda(1520)\pi$, P-wave — $(\Gamma_1\Gamma_7)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $<\ 0.03$ | CAMERON | 77 | DPWA | $K^-p\to\Lambda(1520)\pi^0$ |
| $-0.11\pm0.04$ | LITCHFIELD | 74B | DPWA | $K^-p\to\Lambda(1520)\pi^0$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K}\to\Sigma(1940)\to\Lambda(1520)\pi$, F-wave — $(\Gamma_1\Gamma_8)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $0.062\pm0.021$ | CAMERON | 77 | DPWA | $K^-p\to\Lambda(1520)\pi^0$ |
| $-0.08\ \pm0.04$ | LITCHFIELD | 74B | DPWA | $K^-p\to\Lambda(1520)\pi^0$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K}\to\Sigma(1940)\to\Delta(1232)\overline{K}$, S-wave — $(\Gamma_1\Gamma_{10})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $-0.16\pm0.05$ | LITCHFIELD | 74C | DPWA | $K^-p\to\Delta(1232)\overline{K}$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K}\to\Sigma(1940)\to\Delta(1232)\overline{K}$, D-wave — $(\Gamma_1\Gamma_{11})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $-0.14\pm0.05$ | LITCHFIELD | 74C | DPWA | $K^-p\to\Delta(1232)\overline{K}$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1940) \to \Sigma(1385)\pi$ — $(\Gamma_1\Gamma_4)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $+0.066\pm0.025$ | [2] CAMERON | 78 | DPWA | $K^- p \to \Sigma(1385)\pi$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \to \Sigma(1940) \to N\overline{K}^*(892)$ — $(\Gamma_1\Gamma_{12})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $-0.09\pm0.02$ | [3] CAMERON | 78B | DPWA | $K^- p \to N\overline{K}^*$ |

## $\Sigma(1940)$ FOOTNOTES

[1] The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.
[2] The published sign has been changed to be in accord with the baryon-first convention.
[3] Upper limits on the $D_1$ and $D_3$ waves are each 0.03.

## $\Sigma(1940)$ REFERENCES


| | | | | |
|---|---|---|---|---|
| PDG | 82 | PL 111B | Roos, Porter, Aguilar-Benitez+ | (HELS, CIT, CERN) |
| GOPAL | 80 | Toronto Conf. 159 | | (RHEL) |
| CAMERON | 78 | NP B143 189 | +Franek, Gopal, Bacon, Butterworth+ | (RHEL, LOIC) IJP |
| CAMERON | 78B | NP B146 327 | +Franek, Gopal, Kalmus, McPherson+ | (RHEL, LOIC) IJP |
| CAMERON | 77 | NP B131 399 | +Franek, Gopal, Kalmus, McPherson+ | (RHEL, LOIC) IJP |
| GOPAL | 77 | NP B119 362 | +Ross, VanHorn, McPherson+ | (LOIC, RHEL) IJP |
| GOYAL | 77 | PR D16 2746 | +Sodhi | (DELH) |
| MARTIN | 77 | NP B127 349 | +Pidcock, Moorhouse | (LOUC, GLAS) IJP |
| Also | 77B | NP B126 266 | Martin, Pidcock | (LOUC) |
| Also | 77C | NP B126 285 | Martin, Pidcock | (LOUC) IJP |
| DEBELLEFON | 76 | NP B109 129 | De Bellefon, Berthon | (CDEF) IJP |
| BAILLON | 75 | NP B94 39 | +Litchfield | (CERN, RHEL) IJP |
| HEMINGWAY | 75 | NP B91 12 | +Eades, Harmsen+ | (CERN, HEIDH, MPIM) IJP |
| VANHORN | 75 | NP B87 145 | | (LBL) IJP |
| Also | 75B | NP B87 157 | VanHorn | (LBL) IJP |
| DEVENISH | 74B | NP B81 330 | +Froggatt, Martin | (DESY, NORD, LOUC) |
| KANE | 74 | LBL-2452 | | (LBL) IJP |
| LITCHFIELD | 74B | NP B74 19 | +Hemingway, Baillon+ | (CERN, HEIDH) IJP |
| LITCHFIELD | 74C | NP B74 39 | +Hemingway, Baillon+ | (CERN, HEIDH) IJP |


# $\Sigma(2000)\ S_{11}$

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

OMITTED FROM SUMMARY TABLE

We list here all reported $S_{11}$ states lying above the $\Sigma(1750)\ S_{11}$.

## $\Sigma(2000)$ MASS

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **≈ 2000 OUR ESTIMATE** | | | | |
| $1944\pm15$ | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| $1955\pm15$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 1755 or 1834 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| $2004\pm40$ | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |

## $\Sigma(2000)$ WIDTH

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $215\pm25$ | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| $170\pm40$ | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 413 or 450 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| $116\pm40$ | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |

## $\Sigma(2000)$ DECAY MODES

| | Mode |
|---|---|
| $\Gamma_1$ | $N\overline{K}$ |
| $\Gamma_2$ | $\Lambda\pi$ |
| $\Gamma_3$ | $\Sigma\pi$ |
| $\Gamma_4$ | $\Lambda(1520)\pi$ |
| $\Gamma_5$ | $N\overline{K}^*(892)$, $S$=1/2, $S$-wave |
| $\Gamma_6$ | $N\overline{K}^*(892)$, $S$=3/2, $D$-wave |

## $\Sigma(2000)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances.

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.51±0.05 | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 0.44±0.05 | GOPAL | 77 | DPWA | See GOPAL 80 |
| 0.62 or 0.57 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(2000) \to \Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.08±0.03 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| −0.19 or −0.18 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |
| not seen | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| $+0.07^{+0.02}_{-0.01}$ | VANHORN | 75 | DPWA | $K^- p \to \Lambda\pi^0$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(2000) \to \Sigma\pi$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.20±0.04 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| +0.26 or +0.24 | [1] MARTIN | 77 | DPWA | $\overline{K}N$ multichannel |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(2000) \to \Lambda(1520)\pi$ — $(\Gamma_1\Gamma_4)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.081±0.021 | [2] CAMERON | 77 | DPWA | $P$-wave decay |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(2000) \to N\overline{K}^*(892)$, $S$=1/2, $S$-wave — $(\Gamma_1\Gamma_5)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.10±0.02 | [2] CAMERON | 78B | DPWA | $K^- p \to N\overline{K}^*$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(2000) \to N\overline{K}^*(892)$, $S$=3/2, $D$-wave — $(\Gamma_1\Gamma_6)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| −0.07±0.03 | CAMERON | 78B | DPWA | $K^- p \to N\overline{K}^*$ |

## $\Sigma(2000)$ FOOTNOTES

[1] The two MARTIN 77 values are from a T-matrix pole and from a Breit-Wigner fit.
[2] The published sign has been changed to be in accord with the baryon-first convention.

## $\Sigma(2000)$ REFERENCES


| | | | | |
|---|---|---|---|---|
| GOPAL | 80 | Toronto Conf. 159 | | (RHEL) IJP |
| CAMERON | 78B | NP B146 327 | +Franek, Gopal, Kalmus, McPherson+ | (RHEL, LOIC) IJP |
| CAMERON | 77 | NP B131 399 | +Franek, Gopal, Kalmus, McPherson+ | (RHEL, LOIC) IJP |
| GOPAL | 77 | NP B119 362 | +Ross, VanHorn, McPherson+ | (LOIC, RHEL) IJP |
| MARTIN | 77 | NP B127 349 | +Pidcock, Moorhouse | (LOUC, GLAS) IJP |
| Also | 77B | NP B126 266 | Martin, Pidcock | (LOUC) |
| Also | 77C | NP B126 285 | Martin, Pidcock | (LOUC) IJP |
| BAILLON | 75 | NP B94 39 | +Litchfield | (CERN, RHEL) IJP |
| VANHORN | 75 | NP B87 145 | | (LBL) IJP |
| Also | 75B | NP B87 157 | VanHorn | (LBL) IJP |

# $\Sigma(2030)$ $F_{17}$

$I(J^P) = 1(\frac{7}{2}^+)$ Status: ∗∗∗∗

Discovered by COOL 66 and by WOHL 66. For most results published before 1974 (they are now obsolete), see our 1982 edition Physics Letters **111B** (1982).

This entry only includes results from partial-wave analyses. Parameters of peaks seen in cross sections and invariant-mass distributions around 2030 MeV may be found in our 1984 edition, Reviews of Modern Physics **56** No. 2 Pt. II (1984).

## $\Sigma(2030)$ MASS

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **2025 to 2040 (≈ 2030) OUR ESTIMATE** | | | | |
| 2036± 5 | GOPAL | 80 | DPWA | $\overline{K}N \rightarrow \overline{K}N$ |
| 2038±10 | CORDEN | 77B | | $K^- N \rightarrow N\overline{K}^*$ |
| 2040± 5 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 2030± 3 | [1] CORDEN | 76 | DPWA | $K^- n \rightarrow \Lambda\pi^-$ |
| 2035±15 | BAILLON | 75 | IPWA | $\overline{K}N \rightarrow \Lambda\pi$ |
| 2038±10 | HEMINGWAY | 75 | DPWA | $K^- p \rightarrow \overline{K}N$ |
| 2042±11 | VANHORN | 75 | DPWA | $K^- p \rightarrow \Lambda\pi^0$ |
| 2020± 6 | KANE | 74 | DPWA | $K^- p \rightarrow \Sigma\pi$ |
| 2035±10 | LITCHFIELD | 74B | DPWA | $K^- p \rightarrow \Lambda(1520)\pi^0$ |
| 2020±30 | LITCHFIELD | 74C | DPWA | $K^- p \rightarrow \Delta(1232)\overline{K}$ |
| 2025±10 | LITCHFIELD | 74D | DPWA | $K^- p \rightarrow \Lambda(1820)\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 2027 to 2057 | GOYAL | 77 | DPWA | $K^- N \rightarrow \Sigma\pi$ |
| 2030 | DEBELLEFON | 76 | IPWA | $K^- p \rightarrow \Lambda\pi^0$ |

## $\Sigma(2030)$ WIDTH

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **150 to 200 (≈ 180) OUR ESTIMATE** | | | | |
| 172±10 | GOPAL | 80 | DPWA | $\overline{K}N \rightarrow \overline{K}N$ |
| 137±40 | CORDEN | 77B | | $K^- N \rightarrow N\overline{K}^*$ |
| 190±10 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| 201± 9 | [1] CORDEN | 76 | DPWA | $K^- n \rightarrow \Lambda\pi^-$ |
| 180±20 | BAILLON | 75 | IPWA | $\overline{K}N \rightarrow \Lambda\pi$ |
| 172±15 | HEMINGWAY | 75 | DPWA | $K^- p \rightarrow \overline{K}N$ |
| 178±13 | VANHORN | 75 | DPWA | $K^- p \rightarrow \Lambda\pi^0$ |
| 111± 5 | KANE | 74 | DPWA | $K^- p \rightarrow \Sigma\pi$ |
| 160±20 | LITCHFIELD | 74B | DPWA | $K^- p \rightarrow \Lambda(1520)\pi^0$ |
| 200±30 | LITCHFIELD | 74C | DPWA | $K^- p \rightarrow \Delta(1232)\overline{K}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 260 | DECLAIS | 77 | DPWA | $\overline{K}N \rightarrow \overline{K}N$ |
| 126 to 195 | GOYAL | 77 | DPWA | $K^- N \rightarrow \Sigma\pi$ |
| 160 | DEBELLEFON | 76 | IPWA | $K^- p \rightarrow \Lambda\pi^0$ |
| 70 to 125 | LITCHFIELD | 74D | DPWA | $K^- p \rightarrow \Lambda(1820)\pi^0$ |

## $\Sigma(2030)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $N\overline{K}$ | 17–23 % |
| $\Gamma_2$ | $\Lambda\pi$ | 17–23 % |
| $\Gamma_3$ | $\Sigma\pi$ | 5–10 % |
| $\Gamma_4$ | $\Xi K$ | <2 % |
| $\Gamma_5$ | $\Sigma(1385)\pi$ | 5–15 % |
| $\Gamma_6$ | $\Sigma(1385)\pi$, $F$-wave | |
| $\Gamma_7$ | $\Lambda(1520)\pi$ | 10–20 % |
| $\Gamma_8$ | $\Lambda(1520)\pi$, $D$-wave | |

| | | |
|---|---|---|
| $\Gamma_9$ | $\Lambda(1520)\pi$, $G$-wave | |
| $\Gamma_{10}$ | $\Delta(1232)\overline{K}$ | 10–20 % |
| $\Gamma_{11}$ | $\Delta(1232)\overline{K}$, $F$-wave | |
| $\Gamma_{12}$ | $\Delta(1232)\overline{K}$, $H$-wave | |
| $\Gamma_{13}$ | $N\overline{K}^*(892)$ | <5 % |
| $\Gamma_{14}$ | $N\overline{K}^*(892)$, $S$=1/2, $F$-wave | |
| $\Gamma_{15}$ | $N\overline{K}^*(892)$, $S$=3/2, $F$-wave | |
| $\Gamma_{16}$ | $\Lambda(1820)\pi$, $P$-wave | |

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

## $\Sigma$(2030) BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances.

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

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.17 to 0.23 OUR ESTIMATE** | | | | |
| 0.19±0.03 | GOPAL | 80 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 0.18±0.03 | HEMINGWAY | 75 | DPWA | $K^-p \to \overline{K}N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.15 | DECLAIS | 77 | DPWA | $\overline{K}N \to \overline{K}N$ |
| 0.24±0.02 | GOPAL | 77 | DPWA | See GOPAL 80 |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(2030) \to \Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.18 ±0.02 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| +0.20 ±0.01 | [1] CORDEN | 76 | DPWA | $K^-n \to \Lambda\pi^-$ |
| +0.18 ±0.02 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ |
| +0.20 ±0.01 | VANHORN | 75 | DPWA | $K^-p \to \Lambda\pi^0$ |
| +0.195±0.053 | DEVENISH | 74B | | Fixed-$t$ dispersion rel. |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.20 | DEBELLEFON | 76 | IPWA | $K^-p \to \Lambda\pi^0$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(2030) \to \Sigma\pi$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| −0.09 ±0.01 | [2] CORDEN | 77C | | $K^-n \to \Sigma\pi$ |
| −0.06 ±0.01 | [2] CORDEN | 77C | | $K^-n \to \Sigma\pi$ |
| −0.15 ±0.03 | GOPAL | 77 | DPWA | $\overline{K}N$ multichannel |
| −0.10 ±0.01 | KANE | 74 | DPWA | $K^-p \to \Sigma\pi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| −0.085±0.02 | [3] GOYAL | 77 | DPWA | $K^-N \to \Sigma\pi$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(2030) \to \Xi K$ — $(\Gamma_1\Gamma_4)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.023 | MULLER | 69B | DPWA | $K^-p \to \Xi K$ |
| <0.05 | BURGUN | 68 | DPWA | $K^-p \to \Xi K$ |
| <0.05 | TRIPP | 67 | RVUE | $K^-p \to \Xi K$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(2030) \to \Lambda(1820)\pi$, $P$-wave — $(\Gamma_1\Gamma_{16})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.14±0.02 | CORDEN | 75B | DBC | $K^-n \to N\overline{K}\pi^-$ |
| 0.18±0.04 | LITCHFIELD | 74D | DPWA | $K^-p \to \Lambda(1820)\pi^0$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(2030) \to \Lambda(1520)\pi$, $D$-wave — $(\Gamma_1\Gamma_8)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.114±0.010 | [4] CAMERON | 77 | DPWA | $K^-p \to \Lambda(1520)\pi^0$ |
| 0.14 ±0.03 | LITCHFIELD | 74B | DPWA | $K^-p \to \Lambda(1520)\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.10 ±0.03 | [5] CORDEN | 75B | DBC | $K^-n \to N\overline{K}\pi^-$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \rightarrow \Sigma(2030) \rightarrow \Lambda(1520)\pi$, G-wave $(\Gamma_1\Gamma_9)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.146±0.010 | [4] CAMERON | 77 | DPWA | $K^- p \rightarrow \Lambda(1520)\pi^0$ |
| 0.02 ±0.02 | LITCHFIELD | 74B | DPWA | $K^- p \rightarrow \Lambda(1520)\pi^0$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \rightarrow \Sigma(2030) \rightarrow \Delta(1232)\overline{K}$, F-wave $(\Gamma_1\Gamma_{11})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.16±0.03 | LITCHFIELD | 74C | DPWA | $K^- p \rightarrow \Delta(1232)\overline{K}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.17±0.03 | [5] CORDEN | 75B | DBC | $K^- n \rightarrow N\overline{K}\pi^-$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \rightarrow \Sigma(2030) \rightarrow \Delta(1232)\overline{K}$, H-wave $(\Gamma_1\Gamma_{12})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.00±0.02 | LITCHFIELD | 74C | DPWA | $K^- p \rightarrow \Delta(1232)\overline{K}$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \rightarrow \Sigma(2030) \rightarrow \Sigma(1385)\pi$ $(\Gamma_1\Gamma_5)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.153±0.026 | [4] CAMERON | 78 | DPWA | $K^- p \rightarrow \Sigma(1385)\pi$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \rightarrow \Sigma(2030) \rightarrow N\overline{K}^*(892)$, $S$=1/2, F-wave $(\Gamma_1\Gamma_{14})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.06±0.03 | [4] CAMERON | 78B | DPWA | $K^- p \rightarrow N\overline{K}^*$ |
| −0.02±0.01 | CORDEN | 77B | | $K^- d \rightarrow NN\overline{K}^*$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \rightarrow \Sigma(2030) \rightarrow N\overline{K}^*(892)$, $S$=3/2, F-wave $(\Gamma_1\Gamma_{15})^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| +0.04±0.03 | [6] CAMERON | 78B | DPWA | $K^- p \rightarrow N\overline{K}^*$ |
| −0.12±0.02 | CORDEN | 77B | | $K^- d \rightarrow NN\overline{K}^*$ |

## Σ(2030) FOOTNOTES

[1] Preferred solution 3; see CORDEN 76 for other possibilities.
[2] The two entries for CORDEN 77C are from two different acceptable solutions.
[3] This coupling is extracted from unnormalized data.
[4] The published sign has been changed to be in accord with the baryon-first convention.
[5] An upper limit.
[6] The upper limit on the $G_3$ wave is 0.03.

## Σ(2030) REFERENCES


| | | | | |
|---|---|---|---|---|
| PDG | 84 | RMP 56 No. 2 Pt. II | Wohl, Cahn, Rittenberg+ | (LBL, CIT, CERN) |
| PDG | 82 | PL 111B | Roos, Porter, Aguilar-Benitez+ | (HELS, CIT, CERN) |
| GOPAL | 80 | Toronto Conf. 159 | | (RHEL) IJP |
| CAMERON | 78 | NP B143 189 | +Franek, Gopal, Bacon, Butterworth+ | (RHEL, LOIC) IJP |
| CAMERON | 78B | NP B146 327 | +Franek, Gopal, Kalmus, McPherson+ | (RHEL, LOIC) IJP |
| CAMERON | 77 | NP B131 399 | +Franek, Gopal, Kalmus, McPherson+ | (RHEL, LOIC) IJP |
| CORDEN | 77B | NP B121 365 | +Cox, Kenyon, O'Neale, Stubbs, Sumorok+ | (BIRM) IJP |
| CORDEN | 77C | NP B125 61 | +Cox, Kenyon, O'Neale, Stubbs, Sumorok+ | (BIRM) IJP |
| DECLAIS | 77 | CERN 77-16 | +Duchon, Louvel, Patry, Seguinot+ | (CAEN, CERN) IJP |
| GOPAL | 77 | NP B119 362 | +Ross, VanHorn, McPherson+ | (LOIC, RHEL) IJP |
| GOYAL | 77 | PR D16 2746 | +Sodhi | (DELH) IJP |
| CORDEN | 76 | NP B104 382 | +Cox, Dartnell, Kenyon, O'Neale+ | (BIRM) IJP |
| DEBELLEFON | 76 | NP B109 129 | De Bellefon, Berthon | (CDEF) IJP |
| BAILLON | 75 | NP B94 39 | +Litchfield | (CERN, RHEL) IJP |
| CORDEN | 75B | NP B92 365 | +Cox, Dartnell, Kenyon, O'Neale+ | (BIRM) IJP |
| HEMINGWAY | 75 | NP B91 12 | +Eades, Harmsen+ | (CERN, HEIDH, MPIM) IJP |
| VANHORN | 75 | NP B87 145 | | (LBL) IJP |
| Also | 75B | NP B87 157 | VanHorn | (LBL) IJP |
| DEVENISH | 74B | NP B81 330 | +Froggatt, Martin | (DESY, NORD, LOUC) |
| KANE | 74 | LBL-2452 | | (LBL) IJP |
| LITCHFIELD | 74B | NP B74 19 | +Hemingway, Baillon+ | (CERN, HEIDH) IJP |
| LITCHFIELD | 74C | NP B74 39 | +Hemingway, Baillon+ | (CERN, HEIDH) IJP |
| LITCHFIELD | 74D | NP B74 12 | +Hemingway, Baillon+ | (CERN, HEIDH) IJP |
| MULLER | 69B | Thesis UCRL 19372 | | (LRL) |
| BURGUN | 68 | NP B8 447 | +Meyer, Pauli, Tallini+ | (SACL, CDEF, RHEL) |
| TRIPP | 67 | NP B3 10 | +Leith+ | (LRL, SLAC, CERN, HEID, SACL) |
| COOL | 66 | PRL 16 1228 | +Giacomelli, Kycia, Leontic, Lundby+ | (BNL) |
| WOHL | 66 | PRL 17 107 | +Solmitz, Stevenson | (LRL) IJP |

# $\Sigma(2070)\ F_{15}$

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

OMITTED FROM SUMMARY TABLE

This state suggested by BERTHON 70B finds support in GOPAL 80 with new $K^- p$ polarization and $K^- n$ angular distributions. The very broad state seen in KANE 72 is not required in the later (KANE 74) analysis of $\overline{K}N \rightarrow \Sigma\pi$.

## $\Sigma(2070)$ MASS

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **≈ 2070 OUR ESTIMATE** | | | | |
| 2051±25 | GOPAL | 80 | DPWA | $\overline{K}N \rightarrow \overline{K}N$ |
| 2057 | KANE | 72 | DPWA | $K^- p \rightarrow \Sigma\pi$ |
| 2070±10 | BERTHON | 70B | DPWA | $K^- p \rightarrow \Sigma\pi$ |

## $\Sigma(2070)$ WIDTH

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 300±30 | GOPAL | 80 | DPWA | $\overline{K}N \rightarrow \overline{K}N$ |
| 906 | KANE | 72 | DPWA | $K^- p \rightarrow \Sigma\pi$ |
| 140±20 | BERTHON | 70B | DPWA | $K^- p \rightarrow \Sigma\pi$ |

## $\Sigma(2070)$ DECAY MODES

| | Mode |
|---|---|
| $\Gamma_1$ | $N\overline{K}$ |
| $\Gamma_2$ | $\Sigma\pi$ |

## $\Sigma(2070)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances.

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

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 0.08±0.03 | GOPAL | 80 | DPWA | $\overline{K}N \rightarrow \overline{K}N$ |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{total}$ in $N\overline{K} \rightarrow \Sigma(2070) \rightarrow \Sigma\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| +0.104 | KANE | 72 | DPWA | $K^- p \rightarrow \Sigma\pi$ |
| +0.12 ±0.02 | BERTHON | 70B | DPWA | $K^- p \rightarrow \Sigma\pi$ |

## $\Sigma(2070)$ REFERENCES


| | | | | |
|---|---|---|---|---|
| GOPAL | 80 | Toronto Conf. 159 | | (RHEL) IJP |
| KANE | 74 | LBL-2452 | | (LBL) |
| KANE | 72 | PR D5 1583 | | (LBL) |
| BERTHON | 70B | NP B24 417 | +Vrana, Butterworth+ | (CDEF, RHEL, SACL) IJP |

# $\Sigma(2080)$ $P_{13}$

$I(J^P) = 1(\frac{3}{2}^+)$ Status: $**$

OMITTED FROM SUMMARY TABLE

Suggested by some but not all partial-wave analyses across this region.

## $\Sigma(2080)$ MASS

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **≈ 2080 OUR ESTIMATE** | | | | |
| 2091 ± 7 | [1] CORDEN | 76 | DPWA | $K^- n \to \Lambda\pi^-$ |
| 2070 to 2120 | DEBELLEFON | 76 | IPWA | $K^- p \to \Lambda\pi^0$ |
| 2120 ± 40 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ (sol. 1) |
| 2140 ± 40 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ (sol. 2) |
| 2082 ± 4 | COX | 70 | DPWA | See CORDEN 76 |
| 2070 ± 30 | LITCHFIELD | 70 | DPWA | $K^- N \to \Lambda\pi$ |

## $\Sigma(2080)$ WIDTH

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 186 ± 48 | [1] CORDEN | 76 | DPWA | $K^- n \to \Lambda\pi^-$ |
| 100 | DEBELLEFON | 76 | IPWA | $K^- p \to \Lambda\pi^0$ |
| 240 ± 50 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ (sol. 1) |
| 200 ± 50 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ (sol. 2) |
| 87 ± 20 | COX | 70 | DPWA | See CORDEN 76 |
| 250 ± 40 | LITCHFIELD | 70 | DPWA | $K^- N \to \Lambda\pi$ |

## $\Sigma(2080)$ DECAY MODES

| | Mode |
|---|---|
| $\Gamma_1$ | $N\overline{K}$ |
| $\Gamma_2$ | $\Lambda\pi$ |

## $\Sigma(2080)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances.

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(2080) \to \Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| −0.10 ± 0.03 | [1] CORDEN | 76 | DPWA | $K^- n \to \Lambda\pi^-$ |
| −0.10 | DEBELLEFON | 76 | IPWA | $K^- p \to \Lambda\pi^0$ |
| −0.13 ± 0.04 | BAILLON | 75 | IPWA | $\overline{K}N \to \Lambda\pi$ (sol. 1 and 2) |
| −0.16 ± 0.03 | COX | 70 | DPWA | See CORDEN 76 |
| −0.09 ± 0.03 | LITCHFIELD | 70 | DPWA | $K^- N \to \Lambda\pi$ |

## $\Sigma(2080)$ FOOTNOTES

[1] Preferred solution 3; see CORDEN 76 for other possibilities, including a $D_{15}$ at this mass.

## $\Sigma(2080)$ REFERENCES


| | | | | |
|---|---|---|---|---|
| CORDEN | 76 | NP B104 382 | +Cox, Dartnell, Kenyon, O'Neale+ | (BIRM) IJP |
| DEBELLEFON | 76 | NP B109 129 | De Bellefon, Berthon | (CDEF) IJP |
| Also | 75 | NP B90 1 | De Bellefon, Berthon, Brunet+ | (CDEF, SACL) IJP |
| BAILLON | 75 | NP B94 39 | +Litchfield | (CERN, RHEL) IJP |
| COX | 70 | NP B19 61 | +Islam, Colley+ | (BIRM, EDIN, GLAS, LOIC) IJP |
| LITCHFIELD | 70 | NP B22 269 | | (RHEL) IJP |

# $\Sigma(2100)$ $G_{17}$

$I(J^P) = 1(\frac{7}{2}^-)$ Status: *

OMITTED FROM SUMMARY TABLE

## $\Sigma(2100)$ MASS

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **≈ 2100 OUR ESTIMATE** | | | | |
| 2060±20 | BARBARO-... | 70 | DPWA | $K^- p \to \Lambda \pi^0$ |
| 2120±30 | BARBARO-... | 70 | DPWA | $K^- p \to \Sigma \pi$ |

## $\Sigma(2100)$ WIDTH

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 70±30 | BARBARO-... | 70 | DPWA | $K^- p \to \Lambda \pi^0$ |
| 135±30 | BARBARO-... | 70 | DPWA | $K^- p \to \Sigma \pi$ |

## $\Sigma(2100)$ DECAY MODES

| | Mode |
|---|---|
| $\Gamma_1$ | $N \overline{K}$ |
| $\Gamma_2$ | $\Lambda \pi$ |
| $\Gamma_3$ | $\Sigma \pi$ |

## $\Sigma(2100)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances.

### $(\Gamma_i \Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(2100) \to \Lambda\pi$ $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| −0.07±0.02 | BARBARO-... | 70 | DPWA | $K^- p \to \Lambda \pi^0$ |

### $(\Gamma_i \Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K} \to \Sigma(2100) \to \Sigma\pi$ $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| +0.13±0.02 | BARBARO-... | 70 | DPWA | $K^- p \to \Sigma \pi$ |

## $\Sigma(2100)$ REFERENCES

BARBARO-... 70 Duke Conf. 173 Barbaro-Galtieri (LRL) IJP

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

# $\Sigma(2250)$

$I(J^P) = 1(?^?)$ Status: ∗∗∗

Results from partial-wave analyses are too weak to warrant separating them from the production and cross-section experiments. LASINSKI 71 in $\overline{K}N$ using a Pomeron + resonances model, and DEBELLEFON 76, DEBELLEFON 77, and DEBELLEFON 78 in energy-dependent partial-wave analyses of $\overline{K}N \rightarrow \Lambda\pi$, $\Sigma\pi$, and $N\overline{K}$, respectively, suggest two resonances around this mass.

## $\Sigma(2250)$ MASS

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **2210 to 2280 (≈ 2250) OUR ESTIMATE** | | | | |
| 2270±50 | DEBELLEFON | 78 | DPWA | $D_5$ wave |
| 2210±30 | DEBELLEFON | 78 | DPWA | $G_9$ wave |
| 2275±20 | DEBELLEFON | 77 | DPWA | $D_5$ wave |
| 2215±20 | DEBELLEFON | 77 | DPWA | $G_9$ wave |
| 2300±30 | [1] DEBELLEFON | 75B | HBC | $K^- p \rightarrow \Xi^{*0} K^0$ |
| $2251^{+30}_{-20}$ | VANHORN | 75 | DPWA | $K^- p \rightarrow \Lambda\pi^0$, $F_5$ wave |
| 2280±14 | AGUILAR-... | 70B | HBC | $K^- p$ 3.9, 4.6 GeV/$c$ |
| 2237±11 | BRICMAN | 70 | CNTR | Total, charge exchange |
| 2255±10 | COOL | 70 | CNTR | $K^- p$, $K^- d$ total |
| 2250± 7 | BUGG | 68 | CNTR | $K^- p$, $K^- d$ total |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 2260 | DEBELLEFON | 76 | IPWA | $D_5$ wave |
| 2215 | DEBELLEFON | 76 | IPWA | $G_9$ wave |
| 2250±20 | LU | 70 | CNTR | $\gamma p \rightarrow K^+ Y^*$ |
| 2245 | BLANPIED | 65 | CNTR | $\gamma p \rightarrow K^+ Y^*$ |
| 2299± 6 | BOCK | 65 | HBC | $\overline{p}p$ 5.7 GeV/$c$ |

## $\Sigma(2250)$ WIDTH

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **60 to 150 (≈ 100) OUR ESTIMATE** | | | | |
| 120±40 | DEBELLEFON | 78 | DPWA | $D_5$ wave |
| 80±20 | DEBELLEFON | 78 | DPWA | $G_9$ wave |
| 70±20 | DEBELLEFON | 77 | DPWA | $D_5$ wave |
| 60±20 | DEBELLEFON | 77 | DPWA | $G_9$ wave |
| 130±20 | [1] DEBELLEFON | 75B | HBC | $K^- p \rightarrow \Xi^{*0} K^0$ |
| 192±30 | VANHORN | 75 | DPWA | $K^- p \rightarrow \Lambda\pi^0$, $F_5$ wave |
| 100±20 | AGUILAR-... | 70B | HBC | $K^- p$ 3.9, 4.6 GeV/$c$ |
| 164±50 | BRICMAN | 70 | CNTR | Total, charge exchange |
| 230±20 | BUGG | 68 | CNTR | $K^- p$, $K^- d$ total |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 100 | DEBELLEFON | 76 | IPWA | $D_5$ wave |
| 140 | DEBELLEFON | 76 | IPWA | $G_9$ wave |
| 170 | COOL | 70 | CNTR | $K^- p$, $K^- d$ total |
| 125 | LU | 70 | CNTR | $\gamma p \rightarrow K^+ Y^*$ |
| 150 | BLANPIED | 65 | CNTR | $\gamma p \rightarrow K^+ Y^*$ |
| $21^{+17}_{-21}$ | BOCK | 65 | HBC | $\overline{p}p$ 5.7 GeV/$c$ |

## $\Sigma(2250)$ DECAY MODES

| | Mode | Fraction $(\Gamma_i/\Gamma)$ |
|---|---|---|
| $\Gamma_1$ | $N\overline{K}$ | <10 % |
| $\Gamma_2$ | $\Lambda\pi$ | seen |
| $\Gamma_3$ | $\Sigma\pi$ | seen |
| $\Gamma_4$ | $N\overline{K}\pi$ | |
| $\Gamma_5$ | $\Xi(1530)K$ | |

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

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

## $\Sigma(2250)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on $\Lambda$ and $\Sigma$ Resonances.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|
| **<0.1 OUR ESTIMATE** | | | |
| 0.08±0.02 | DEBELLEFON 78 | DPWA | $D_5$ wave |
| 0.02±0.01 | DEBELLEFON 78 | DPWA | $G_9$ wave |

### $(J+\frac{1}{2})\times\Gamma(N\overline{K})/\Gamma_{\text{total}}$ — $\Gamma_1/\Gamma$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| 0.16±0.12 | BRICMAN 70 | CNTR | Total, charge exchange |
| 0.42 | COOL 70 | CNTR | $K^- p$, $K^- d$ total |
| 0.47 | BUGG 68 | CNTR | |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K}\to\Sigma(2250)\to\Lambda\pi$ — $(\Gamma_1\Gamma_2)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|
| −0.16±0.03 | VANHORN 75 | DPWA | $K^- p\to\Lambda\pi^0$, $F_5$ wave |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| +0.11 | DEBELLEFON 76 | IPWA | $D_5$ wave |
| −0.10 | DEBELLEFON 76 | IPWA | $G_9$ wave |
| −0.18 | BARBARO-... 70 | DPWA | $K^- p\to\Lambda\pi^0$, $G_9$ wave |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K}\to\Sigma(2250)\to\Sigma\pi$ — $(\Gamma_1\Gamma_3)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|
| +0.06±0.02 | DEBELLEFON 77 | DPWA | $D_5$ wave |
| −0.03±0.02 | DEBELLEFON 77 | DPWA | $G_9$ wave |
| +0.07 | BARBARO-... 70 | DPWA | $K^- p\to\Sigma\pi$, $G_9$ wave |

### $\Gamma(N\overline{K})/\Gamma(\Sigma\pi)$ — $\Gamma_1/\Gamma_3$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| <0.18 | BARNES 69 | HBC | 1 standard dev. limit |

### $\Gamma(\Lambda\pi)/\Gamma(\Sigma\pi)$ — $\Gamma_2/\Gamma_3$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| <0.18 | BARNES 69 | HBC | 1 standard dev. limit |

### $(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\overline{K}\to\Sigma(2250)\to\Xi(1530)K$ — $(\Gamma_1\Gamma_5)^{1/2}/\Gamma$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|
| 0.18±0.04 | [1] DEBELLEFON 75B | HBC | $K^- p\to\Xi^{*0}K^0$ |

## $\Sigma(2250)$ FOOTNOTES

[1] Seen in the (initial and final state) $D_5$ wave. Isospin not determined.

## $\Sigma(2250)$ REFERENCES


| | | | | |
|---|---|---|---|---|
| DEBELLEFON | 78 | NC 42A 403 | De Bellefon, Berthon, Billoir+ | (CDEF, SACL) IJP |
| DEBELLEFON | 77 | NC 37A 175 | De Bellefon, Berthon, Billoir+ | (CDEF, SACL) IJP |
| DEBELLEFON | 76 | NP B109 129 | De Bellefon, Berthon | (CDEF) IJP |
| Also | 75 | NP B90 1 | De Bellefon, Berthon, Brunet+ | (CDEF, SACL) IJP |
| DEBELLEFON | 75B | NC 28A 289 | De Bellefon, Berthon, Billoir+ | (CDEF, SACL) |
| VANHORN | 75 | NP B87 145 | | (LBL) IJP |
| Also | 75B | NP B87 157 | VanHorn | (LBL) IJP |
| LASINSKI | 71 | NP B29 125 | | (EFI) IJP |
| AGUILAR-... | 70B | PRL 25 58 | Aguilar-Benitez, Barnes, Bassano+ | (BNL, SYRA) |
| BARBARO-... | 70 | Duke Conf. 173 | Barbaro-Galtieri | (LRL) IJP |
| BRICMAN | 70 | PL 31B 152 | +Ferro-Luzzi, Perreau+ | (CERN, CAEN, SACL) |
| COOL | 70 | PR D1 1887 | +Giacomelli, Kycia, Leontic, Li+ | (BNL) I |
| Also | 66 | PRL 16 1228 | Cool, Giacomelli, Kycia, Leontic, Lundby+ | (BNL) I |
| LU | 70 | PR D2 1846 | +Greenberg, Hughes, Minehart, Mori+ | (YALE) |
| BARNES | 69 | PRL 22 479 | +Flaminio, Montanet, Samios+ | (BNL, SYRA) |
| BUGG | 68 | PR 168 1466 | +Gilmore, Knight+ | (RHEL, BIRM, CAVE) I |
| BLANPIED | 65 | PRL 14 741 | +Greenberg, Hughes, Kitching, Lu+ | (YALE, CEA) |
| BOCK | 65 | PL 17 166 | +Cooper, French, Kinson+ | (CERN, SACL) |

# $\Sigma(2455)$ Bumps

$I(J^P) = 1(?^?)$ Status: ∗∗

OMITTED FROM SUMMARY TABLE

There is also some slight evidence for $Y^*$ states in this mass region from the reaction $\gamma p \to K^+ X$ — see GREENBERG 68.

## $\Sigma(2455)$ MASS

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **≈ 2455 OUR ESTIMATE** | | | | |
| 2455±10 | ABRAMS | 70 | CNTR | $K^- p$, $K^- d$ total |
| 2455± 7 | BUGG | 68 | CNTR | $K^- p$, $K^- d$ total |

## $\Sigma(2455)$ WIDTH

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 140 | ABRAMS | 70 | CNTR | $K^- p$, $K^- d$ total |
| 100±20 | BUGG | 68 | CNTR | |

## $\Sigma(2455)$ DECAY MODES

| | Mode |
|---|---|
| $\Gamma_1$ | $N\overline{K}$ |

## $\Sigma(2455)$ BRANCHING RATIOS

**$(J+\frac{1}{2})\times\Gamma(N\overline{K})/\Gamma_{\text{total}}$** **$\Gamma_1/\Gamma$**

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 0.39 | ABRAMS | 70 | CNTR | $K^- p$, $K^- d$ total |
| 0.05±0.05 | [1] BRICMAN | 70 | CNTR | Total, charge exchange |
| 0.3 | BUGG | 68 | CNTR | |

## $\Sigma(2455)$ FOOTNOTES

[1] Fit of total cross section given by BRICMAN 70 is poor in this region.

## $\Sigma(2455)$ REFERENCES


| | | | | |
|---|---|---|---|---|
| ABRAMS | 70 | PR D1 1917 | +Cool, Giacomelli, Kycia, Leontic, Li+ | (BNL) I |
| Also | 67E | PRL 19 678 | Abrams, Cool, Giacomelli, Kycia, Leontic+ | (BNL) |
| BRICMAN | 70 | PL 31B 152 | +Ferro-Luzzi, Perreau+ | (CERN, CAEN, SACL) |
| BUGG | 68 | PR 168 1466 | +Gilmore, Knight+ | (RHEL, BIRM, CAVE) I |
| GREENBERG | 68 | PRL 20 221 | +Hughes, Lu, Minehart+ | (YALE) |


*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

# $\Sigma(2620)$ Bumps

$I(J^P) = 1(?^?)$ Status: ∗∗

OMITTED FROM SUMMARY TABLE

## $\Sigma(2620)$ MASS

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **≈ 2620 OUR ESTIMATE** | | | | |
| 2542±22 | DIBIANCA | 75 | DBC | $K^- N \to \Xi K \pi$ |
| 2620±15 | ABRAMS | 70 | CNTR | $K^- p$, $K^- d$ total |

## $\Sigma(2620)$ WIDTH

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 221±81 | DIBIANCA | 75 | DBC | $K^- N \to \Xi K \pi$ |
| 175 | ABRAMS | 70 | CNTR | $K^- p$, $K^- d$ total |

## $\Sigma(2620)$ DECAY MODES

| | Mode |
|---|---|
| $\Gamma_1$ | $N\overline{K}$ |

## $\Sigma(2620)$ BRANCHING RATIOS

**$(J+\frac{1}{2})\times\Gamma(N\overline{K})/\Gamma_{total}$** **$\Gamma_1/\Gamma$**

| *VALUE* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 0.32 | ABRAMS | 70 | CNTR | $K^- p$, $K^- d$ total |
| 0.36±0.12 | BRICMAN | 70 | CNTR | Total, charge exchange |

## $\Sigma(2620)$ REFERENCES


| | | | | |
|---|---|---|---|---|
| DIBIANCA | 75 | NP B98 137 | +Endorf | (CMU) |
| ABRAMS | 70 | PR D1 1917 | +Cool, Giacomelli, Kycia, Leontic, Li+ | (BNL) I |
| Also | 67E | PRL 19 678 | Abrams, Cool, Giacomelli, Kycia, Leontic+ | (BNL) |
| BRICMAN | 70 | PL 31B 152 | +Ferro-Luzzi, Perreau+ | (CERN, CAEN, SACL) |


# $\Sigma(3000)$ Bumps

$I(J^P) = 1(?^?)$ Status: ∗

OMITTED FROM SUMMARY TABLE

Seen as an enhancement in $\Lambda\pi$ and $\overline{K}N$ invariant mass spectra and in the missing mass of neutrals recoiling against a $K^0$.

## $\Sigma(3000)$ MASS

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *CHG* | *COMMENT* |
|---|---|---|---|---|---|
| **≈ 3000 OUR ESTIMATE** | | | | | |
| 3000 | EHRLICH | 66 | HBC | 0 | $\pi^- p$ 7.91 GeV/$c$ |

## $\Sigma(3000)$ DECAY MODES

| | Mode |
|---|---|
| $\Gamma_1$ | $N\overline{K}$ |
| $\Gamma_2$ | $\Lambda\pi$ |

## $\Sigma(3000)$ REFERENCES


EHRLICH 66 PR 152 1194 +Selove, Yuta (PENN) I

# $\Sigma(3170)$ Bumps

$I(J^P) = 1(?^?)$ Status: ∗

OMITTED FROM SUMMARY TABLE

Seen by AMIRZADEH 79 as a narrow 6.5-standard-deviation enhancement in the reaction $K^- p \rightarrow Y^{*+} \pi^-$ using data from independent high statistics bubble chamber experiments at 8.25 and 6.5 GeV/$c$. The dominant decay modes are multibody, multistrange final states and the production is via isospin-3/2 baryon exchange. Isospin 1 is favored.

Not seen in a $K^- p$ experiment in LASS at 11 GeV/$c$ (ASTON 85B).

## $\Sigma(3170)$ MASS (PRODUCTION EXPERIMENTS)

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **≈ 3170 OUR ESTIMATE** | | | | | |
| 3170±5 | 35 | AMIRZADEH | 79 | HBC | $K^- p \rightarrow Y^{*+} \pi^-$ |

## $\Sigma(3170)$ WIDTH (PRODUCTION EXPERIMENTS)

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| <20 | 35 | [1] AMIRZADEH | 79 | HBC | $K^- p \rightarrow Y^{*+} \pi^-$ |

## $\Sigma(3170)$ DECAY MODES (PRODUCTION EXPERIMENTS)

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $\Lambda K \overline{K} \pi$'s | seen |
| $\Gamma_2$ | $\Sigma K \overline{K} \pi$'s | seen |
| $\Gamma_3$ | $\Xi K \pi$'s | seen |

## $\Sigma(3170)$ BRANCHING RATIOS (PRODUCTION EXPERIMENTS)

### $\Gamma(\Lambda K \overline{K} \pi\text{'s})/\Gamma_{total}$ — $\Gamma_1/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **seen** | AMIRZADEH | 79 | HBC | $K^- p \rightarrow Y^{*+} \pi^-$ |

### $\Gamma(\Sigma K \overline{K} \pi\text{'s})/\Gamma_{total}$ — $\Gamma_2/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **seen** | AMIRZADEH | 79 | HBC | $K^- p \rightarrow Y^{*+} \pi^-$ |

### $\Gamma(\Xi K \pi\text{'s})/\Gamma_{total}$ — $\Gamma_3/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **seen** | AMIRZADEH | 79 | HBC | $K^- p \rightarrow Y^{*+} \pi^-$ |

## $\Sigma(3170)$ FOOTNOTES (PRODUCTION EXPERIMENTS)

[1] Observed width consistent with experimental resolution.

## $\Sigma(3170)$ REFERENCES (PRODUCTION EXPERIMENTS)


| | | | | |
|---|---|---|---|---|
| ASTON | 85B | PR D32 2270 | +Carnegie+ | (SLAC, CARL, CNRC, CINC) |
| AMIRZADEH | 79 | PL 89B 125 | + | (BIRM, CERN, GLAS, MSU, CURIN, CAVE+) I |
| Also | 80 | Toronto Conf. 263 | Kinson+ | (BIRM, CERN, GLAS, MSU, CURIN) I |