

$\Sigma(2030) 7/2^+$  $I(J^P) = 1(\frac{7}{2}^+)$  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** 1 (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** S1 (1984).

 **$\Sigma(2030)$  MASS**

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>2025 to 2040 (<math>\approx</math> 2030) OUR ESTIMATE</b>			
2030 $\pm$ 5	ZHANG	13A	DPWA Multichannel
2036 $\pm$ 5	GOPAL	80	DPWA $\bar{K}N \rightarrow \bar{K}N$
2038 $\pm$ 10	CORDEN	77B	$K^- N \rightarrow N\bar{K}^*$
2040 $\pm$ 5	GOPAL	77	DPWA $\bar{K}N$ multichannel
2030 $\pm$ 3	<sup>1</sup> CORDEN	76	DPWA $K^- n \rightarrow \Lambda\pi^-$
2035 $\pm$ 15	BAILLON	75	IPWA $\bar{K}N \rightarrow \Lambda\pi$
2038 $\pm$ 10	HEMINGWAY	75	DPWA $K^- p \rightarrow \bar{K}N$
2042 $\pm$ 11	VANHORN	75	DPWA $K^- p \rightarrow \Lambda\pi^0$
2020 $\pm$ 6	KANE	74	DPWA $K^- p \rightarrow \Sigma\pi$
2035 $\pm$ 10	LITCHFIELD	74B	DPWA $K^- p \rightarrow \Lambda(1520)\pi^0$
2020 $\pm$ 30	LITCHFIELD	74C	DPWA $K^- p \rightarrow \Delta(1232)\bar{K}$
2025 $\pm$ 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
<b>150 to 200 (<math>\approx</math> 180) OUR ESTIMATE</b>			
207 $\pm$ 17	ZHANG	13A	DPWA Multichannel
172 $\pm$ 10	GOPAL	80	DPWA $\bar{K}N \rightarrow \bar{K}N$
137 $\pm$ 40	CORDEN	77B	$K^- N \rightarrow N\bar{K}^*$
190 $\pm$ 10	GOPAL	77	DPWA $\bar{K}N$ multichannel
201 $\pm$ 9	<sup>1</sup> CORDEN	76	DPWA $K^- n \rightarrow \Lambda\pi^-$
180 $\pm$ 20	BAILLON	75	IPWA $\bar{K}N \rightarrow \Lambda\pi$
172 $\pm$ 15	HEMINGWAY	75	DPWA $K^- p \rightarrow \bar{K}N$
178 $\pm$ 13	VANHORN	75	DPWA $K^- p \rightarrow \Lambda\pi^0$
111 $\pm$ 5	KANE	74	DPWA $K^- p \rightarrow \Sigma\pi$
160 $\pm$ 20	LITCHFIELD	74B	DPWA $K^- p \rightarrow \Lambda(1520)\pi^0$
200 $\pm$ 30	LITCHFIELD	74C	DPWA $K^- p \rightarrow \Delta(1232)\bar{K}$

• • • We do not use the following data for averages, fits, limits, etc. • • •

260	DECLAIS	77	DPWA	$\bar{K}N \rightarrow \bar{K}N$
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	$K^- p \rightarrow \Lambda(1820) \pi^0$

### $\Sigma(2030)$ POLE POSITION

#### REAL PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1993	ZHANG	13A	DPWA Multichannel

#### -2×IMAGINARY PART

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
176	ZHANG	13A	DPWA Multichannel

### $\Sigma(2030)$ DECAY MODES

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $N\bar{K}$	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 %
$\Gamma_6$ $\Sigma(1385)\pi$ , <i>F</i> -wave	
$\Gamma_7$ $\Lambda(1520)\pi$	10–20 %
$\Gamma_8$ $\Lambda(1520)\pi$ , <i>D</i> -wave	
$\Gamma_9$ $\Lambda(1520)\pi$ , <i>G</i> -wave	
$\Gamma_{10}$ $\Delta(1232)\bar{K}$	10–20 %
$\Gamma_{11}$ $\Delta(1232)\bar{K}$ , <i>F</i> -wave	
$\Gamma_{12}$ $\Delta(1232)\bar{K}$ , <i>H</i> -wave	
$\Gamma_{13}$ $N\bar{K}^*(892)$	<5 %
$\Gamma_{14}$ $N\bar{K}^*(892)$ , <i>S</i> =1/2, <i>F</i> -wave	
$\Gamma_{15}$ $N\bar{K}^*(892)$ , <i>S</i> =3/2, <i>F</i> -wave	
$\Gamma_{16}$ $\Lambda(1820)\pi$ , <i>P</i> -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.

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

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.17 to 0.23 OUR ESTIMATE</b>			
0.13±0.01	ZHANG	13A	DPWA Multichannel
0.19±0.03	GOPAL	80	DPWA $\bar{K}N \rightarrow \bar{K}N$
0.18±0.03	HEMINGWAY	75	DPWA $K^-p \rightarrow \bar{K}N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.15	DECLAIS	77	DPWA $\bar{K}N \rightarrow \bar{K}N$
0.24±0.02	GOPAL	77	DPWA See GOPAL 80

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

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
+0.15 ±0.01	ZHANG	13A	DPWA Multichannel
+0.18 ±0.02	GOPAL	77	DPWA $\bar{K}N$ multichannel
+0.20 ±0.01	<sup>1</sup> CORDEN	76	DPWA $K^-n \rightarrow \Lambda\pi^-$
+0.18 ±0.02	BAILLON	75	IPWA $\bar{K}N \rightarrow \Lambda\pi$
+0.20 ±0.01	VANHORN	75	DPWA $K^-p \rightarrow \Lambda\pi^0$
+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 $K^-p \rightarrow \Lambda\pi^0$

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

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
−0.08 ±0.01	ZHANG	13A	DPWA Multichannel
−0.09 ±0.01	<sup>2</sup> CORDEN	77C	$K^-n \rightarrow \Sigma\pi$
−0.06 ±0.01	<sup>2</sup> CORDEN	77C	$K^-n \rightarrow \Sigma\pi$
−0.15 ±0.03	GOPAL	77	DPWA $\bar{K}N$ multichannel
−0.10 ±0.01	KANE	74	DPWA $K^-p \rightarrow \Sigma\pi$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
−0.085±0.02	<sup>3</sup> GOYAL	77	DPWA $K^-N \rightarrow \Sigma\pi$

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

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

$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$  in  $N\bar{K} \rightarrow \Sigma(2030) \rightarrow \Sigma(1385)\pi$ , *F-wave*  $(\Gamma_1\Gamma_6)^{1/2}/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
+0.16 ±0.01	ZHANG	13A	DPWA Multichannel
+0.153±0.026	<sup>4</sup> CAMERON	78	DPWA $K^-p \rightarrow \Sigma(1385)\pi$

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

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

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

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

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

VALUE	DOCUMENT ID	TECN	COMMENT
+0.12 ± 0.02	ZHANG 13A	DPWA	Multichannel
0.16 ± 0.03	LITCHFIELD 74C	DPWA	$K^- p \rightarrow \Delta(1232)\bar{K}$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.17 ± 0.03	<sup>5</sup> CORDEN 75B	DBC	$K^- n \rightarrow N\bar{K}\pi^-$

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

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

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

VALUE	DOCUMENT ID	TECN	COMMENT
+0.06 ± 0.02	ZHANG 13A	DPWA	Multichannel
+0.06 ± 0.03	<sup>4</sup> CAMERON 78B	DPWA	$K^- p \rightarrow N\bar{K}^*$
-0.02 ± 0.01	CORDEN 77B		$K^- d \rightarrow NN\bar{K}^*$

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

VALUE	DOCUMENT ID	TECN	COMMENT
+0.05 ± 0.01	ZHANG 13A	DPWA	Multichannel
+0.04 ± 0.03	<sup>6</sup> CAMERON 78B	DPWA	$K^- p \rightarrow N\bar{K}^*$
-0.12 ± 0.02	CORDEN 77B		$K^- d \rightarrow NN\bar{K}^*$

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

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

**$\Sigma(2030)$  FOOTNOTES**

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

 **$\Sigma(2030)$  REFERENCES**

ZHANG	13A	PR C88 035205	H. Zhang <i>et al.</i>	(KSU)
PDG	84	RMP 56 51	C.G. Wohl <i>et al.</i>	(LBL, CIT, CERN)
PDG	82	PL 111B 1	M. Roos <i>et al.</i>	(HELS, CIT, CERN)
GOPAL	80	Toronto Conf. 159	G.P. Gopal	(RHEL) IJP
CAMERON	78	NP B143 189	W. Cameron <i>et al.</i>	(RHEL, LOIC) IJP
CAMERON	78B	NP B146 327	W. Cameron <i>et al.</i>	(RHEL, LOIC) IJP
CAMERON	77	NP B131 399	W. Cameron <i>et al.</i>	(RHEL, LOIC) IJP
CORDEN	77B	NP B121 365	M.J. Corden <i>et al.</i>	(BIRM) IJP
CORDEN	77C	NP B125 61	M.J. Corden <i>et al.</i>	(BIRM) IJP
DECLAIS	77	CERN 77-16	Y. Declais <i>et al.</i>	(CAEN, CERN) IJP
GOPAL	77	NP B119 362	G.P. Gopal <i>et al.</i>	(LOIC, RHEL) IJP
GOYAL	77	PR D16 2746	D.P. Goyal, A.V. Sodhi	(DELH) IJP
CORDEN	76	NP B104 382	M.J. Corden <i>et al.</i>	(BIRM) IJP
DEBELLEFON	76	NP B109 129	A. de Bellefon, A. Berthon	(CDEF) IJP
BAILLON	75	NP B94 39	P.H. Baillon, P.J. Litchfield	(CERN, RHEL) IJP
CORDEN	75B	NP B92 365	M.J. Corden <i>et al.</i>	(BIRM) IJP
HEMINGWAY	75	NP B91 12	R.J. Hemingway <i>et al.</i>	(CERN, HEIDH, MPIM) IJP
VANHORN	75	NP B87 145	A.J. van Horn	(LBL) IJP
		Also	A.J. van Horn	(LBL) IJP
DEVENISH	74B	NP B81 330	R.C.E. Devenish, C.D. Froggatt, B.R. Martin	(DESY+) IJP
KANE	74	LBL-2452	D.F. Kane	(LBL) IJP
LITCHFIELD	74B	NP B74 19	P.J. Litchfield <i>et al.</i>	(CERN, HEIDH) IJP
LITCHFIELD	74C	NP B74 39	P.J. Litchfield <i>et al.</i>	(CERN, HEIDH) IJP
LITCHFIELD	74D	NP B74 12	P.J. Litchfield <i>et al.</i>	(CERN, HEIDH) IJP
MULLER	69B	Thesis UCRL 19372	R.A. Muller	(LRL)
BURGUN	68	NP B8 447	G. Burgun <i>et al.</i>	(SACL, CDEF, RHEL)
TRIPP	67	NP B3 10	R.D. Tripp <i>et al.</i>	(LRL, SLAC, CERN+)
COOL	66	PRL 16 1228	R.L. Cool <i>et al.</i>	(BNL)
WOHL	66	PRL 17 107	C.G. Wohl, F.T. Solmitz, M.L. Stevenson	(LRL) IJP