TABLES OF PARTICLE PROPERTIES

April 1972

"Now go, write it before them in a table, and note it in a book,
that it may be for the time to come for ever and ever."
Isaiah 30:7-8

". . . or at least until the next edition."
Particle Data Group

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(Closing date for data: Feb. 1, 1972)

Stable Particle Table

For additional parameters, see Addendum to this table.

Quantities in italics have changed by more than one (old) standard deviation since April 1971.

Particle	$I^G(J^P)C_n$	Mass (MeV) $Mass^2$ $(GeV)^2$	Mean life (sec) $c\tau$ (cm)	Partial decay mode: Mode	Fraction[a]	p or p_{max}[b] (MeV/c)
γ	$0,1(1^-)^-$	$0(<2)10^{-21}$	stable	stable		
ν	ν_e $J=\frac{1}{2}$	$0(<60$ eV)	stable	stable		
	ν_μ	$0(<1.2)$				
e	$J=\frac{1}{2}$	0.5110041 ±.0000016	stable ($>2\times10^{21}$y)	stable		
μ	$J=\frac{1}{2}$	105.6594 ±.0004	*2.1994×10⁻⁶* *±.0006* S=1.1*	$e\nu\bar{\nu}$	100	53
		$m^2=0.0112$	$c\tau=6.593\times10^4$	$e\gamma\gamma$	(<1.6)10^{-5}	53
	$m_\mu-m_{\pi^\pm}=-33.917$ ±.011			$3e$	(<6)10^{-9}	53
				$e\gamma$	(<2.2)10^{-8}	53
$\pi^\pm$	$1^-(0^-)$	139.576 ±.011	2.6024×10^{-8} ±.0024	$\mu\nu$	100 %	30
		$m^2=0.0195$	$c\tau=780.2$	$e\nu$	(1.24±0.03)10^{-4}	70
			$(\tau^+-\tau^-)/\bar{\tau}=$	$\mu\nu\gamma$	[c](1.24±0.25)10^{-4}	30
			$(0.05\pm0.07)\%$	$\pi^0e\nu$	(1.02±0.07)10^{-8}	5
			(test of CPT)	$e\nu\gamma$	[c](3.0 ±0.5)10^{-8}	70
				$e\nu e^+e^-$	(<3.4)10^{-8}	70
π^0	$1^-(0^-)^+$	134.972 ±.012	0.84×10^{-16} ±.10 S=2.1*	$\gamma\gamma$	(98.84±0.04)%	67
		$m^2=0.0182$	$c\tau=2.5\times10^{-6}$	γe^+e^-	(1.16±0.04)%	67
	$m_{\pi^\pm}-m_{\pi^0}=4.6043$ ±.0037			$\gamma\gamma\gamma$	(<5)10^{-6}	67
				$e^+e^-e^+e^-$	[d](3.47)10^{-5}	67

Stable Particle Table *(cont'd)*

Particle	$I^G(J^P)C_n$	Mass (MeV) $Mass^2$ $(GeV)^2$	Mean life (sec) $c\tau$ (cm)	Partial decay mode: Mode	Fraction[a]	p or p_{max}[b] (MeV/c)
$K^\pm$	$\frac{1}{2}(0^-)$	493.84 ±0.10	1.2371×10^{-8} ±.0026 S=1.9*	$\mu\nu$	(63.77±0.28)% S=1.1*	236
		m^2=0.244	$c\tau$=370.8	$\pi\pi^0$	(20.92±0.29)% S=1.2*	205
			$(\tau^+-\tau^-)/\bar{\tau}$=	$\pi\pi^-\pi^+$	(5.58±0.03)% S=1.1*	126
			(.11±.09)%	$\pi\pi^0\pi^0$	(1.68±0.04)%	133
			(test of CPT)	$\mu\pi^0\nu$	(3.20±0.11)% S=1.8*	215
			S=1.2*	$e\pi^0\nu$	(4.86±0.07)% S=1.1*	228
				$e\pi^0\pi^0\nu$	($1.8^{+2.4}_{-0.6}$) 10^{-5}	207
		$m_{K^\pm}-m_{K^0}$ =-3.95 ±0.13 S=1.1*		$\pi\pi^\mp e^\pm\nu$	(*3.7 ±0.2*) *10^{-5}*	204
				$\pi\pi^\pm e^\mp\nu$	(<5) 10^{-7}	204
				$\pi\pi^\mp\mu^\pm\nu$	(0.9 ±0.4) 10^{-5}	151
				$\pi\pi^\pm\mu^\mp\nu$	(<3) 10^{-6}	151
				$e\nu$	(1.30±0.18) 10^{-5}	247
				$e\nu\gamma$	[c] (<7) 10^{-5}	247
				$\pi\pi^0\gamma$	[c] (2.2 ±0.7) 10^{-4}	205
				$\pi\pi^+\pi^-\gamma$	[c] (10 ±4) 10^{-5}	126
				$\pi e\nu\gamma$	[c] (3.7 ±1.4) 10^{-4}	227
				πe^+e^-	(< 0.4) 10^{-6}	227
				$\pi^\mp e^\pm e^\pm$	(< 1.5) 10^{-5}	227
				$\pi\mu^+\mu^-$	(< 2.4) 10^{-6}	172
				$\pi\gamma\gamma$	[c] (< 3.5) 10^{-5}	227
				$\pi\gamma\gamma\gamma$	[c] (< 3) 10^{-4}	227
				$\pi\nu\bar{\nu}$	(< 1.2) 10^{-6}	227
				$\pi\gamma$	(< 4) 10^{-6}	227
K^0	$\frac{1}{2}(0^-)$	497.79 ±0.15	50% K_{Short}, 50% K_{Long}			
K^0_S	$\frac{1}{2}(0^-)$	S=1.1* m^2=0.248	0.862×10^{-10} ±.006 S=1.2*	$\pi^+\pi^-$	(68.85±0.31)% S=1.1*	206
			$c\tau$=2.58	$\pi^0\pi^0$	(31.15)%	209
				$\mu^+\mu^-$	(< .7) 10^{-5}	225
				e^+e^-	(<35) 10^{-5}	249
				$\pi^+\pi^-\gamma$	[c] (2.3 ±0.8) 10^{-3}	206
				$\gamma\gamma$	(< 2) 10^{-3}	249
K^0_L	$\frac{1}{2}(0^-)$		5.172×10^{-8} ±0.042 $c\tau$=1550	$\pi^0\pi^0\pi^0$	(21.4 ±0.7)% S=1.1*	139
				$\pi^+\pi^-\pi^0$	(12.6 ±0.3)%	133
				$\pi\mu\nu$	(26.8 ±0.6)%	216
				$\pi e\nu$	(39.0 ±0.6)%	229
				$\pi e\nu\gamma$	[c] (1.3 ±0.8)%	229
		$m_{K_L}-m_{K_S}$ = 0.5402×10^{10} $\hbar$ sec^{-1} ± 0.0035		$\pi^+\pi^-$	(0.157±0.005)%	206
				$\pi^0\pi^0$	(0.094±0.019)% S=1.5*	209
				$\pi^+\pi^-\gamma$	[c] (< 0.4) 10^{-3}	206
				$\pi^0\gamma\gamma$	(< 2.4) 10^{-4}	231
		$\frac{\Gamma(K_S\to\pi^+\pi^-\pi^0)}{\Gamma(K_L\to\pi^+\pi^-\pi^0)}$ <0.45 (test of CP)		$\gamma\gamma$	(*4.9 ±0.4*) *10^{-4}*	249
				$e\mu$	(< 1.6) 10^{-9}	238
				$\mu^+\mu^-$	(< 1.9) 10^{-9}	225
				e^+e^-	(< 1.6) 10^{-9}	249
η	$0^+(0^-)^+$	548.8 ±0.6 S=1.4* m^2=0.301	Γ=(2.63±0.58)keV	$\gamma\gamma$	(38.0 ±1.0)% S=1.2*	274
			Neutral decays 71.1%	$\pi^0\gamma\gamma$	[e] (3.1 ±1.1)% S=1.2*	258
				$3\pi^0$	(30.0 ±1.1)% S=1.1*	180
			Charged decays 28.9%	$\pi^+\pi^-\pi^0$	(24.0 ±0.6)% S=1.1*	175
				$\pi^+\pi^-\gamma$	(4.9 ±0.2)% S=1.1*	236
				$\pi^0e^+e^-$	(< 0.04)%	258
				$\pi^+\pi^-e^+e^-$	(0.1 ±0.1)%	236
				$\pi^+\pi^-\pi^0\gamma$	(< 0.2)%	175
				$\pi^+\pi^-\gamma\gamma$	(< 0.2)%	236
				$\mu^+\mu^-$	(2.2 ±0.8) 10^{-5}	253
				$\mu^+\mu^-\pi^0$	(< 5) 10^{-4}	211
p	$\frac{1}{2}(\frac{1}{2}^+)$	938.2592 ±0.0052 m^2=0.8803	stable ($> 2\times10^{28}$y)			
n	$\frac{1}{2}(\frac{1}{2}^+)$	939.5527 ±0.0052 m^2=0.8828	[e] $(0.935\pm0.014)10^3$ $c\tau = 2.80\times10^{13}$	$pe^-\nu$	100 %	1
		m_p-m_n = -1.29344 ±0.00007				

Stable Particle Table *(cont'd)*

Particle	$I^G(J^P)C_n$	Mass (MeV) Mass^2 (GeV)^2	Mean life (sec) $c\tau$ (cm)	Partial decay mode: Mode	Fraction[a]	p or p_{max}[b] (MeV/c)
Λ	$0(\frac{1}{2}^+)$	1115.59 ±0.05 S=1.2* m^2= 1.245	2.521×10^{-10} ±.021 S=1.2* $c\tau$ = 7.56	$p\pi^-$	(64.2±0.5)%	100
				$n\pi^0$	(35.8±0.5)%	104
				$pe\nu$	(8.13±0.29)10^{-4}	163
				$p\mu\nu$	(1.62±0.35)10^{-4}	131
Σ^+	$1(\frac{1}{2}^+)$	1189.42 ±0.11 S= 1.7* m^2= 1.415 $m_{\Sigma^+}-m_{\Sigma^-}$= -7.92 ±.13 S= 1.6*	0.800×10^{-10} ±.006 $c\tau$ = 2.40	$p\pi^0$	(51.6±0.7)%	189
				$n\pi^+$	(48.4±0.7)%	185
				$p\gamma$	[c](1.24±0.18)10^{-3} S=1.4*	225
				$n\pi^+\gamma$	[c](1.31±0.24)10^{-4}	185
				$\Lambda e^+\nu$	(2.02±0.47)10^{-5}	72
			$\frac{\Gamma(\Sigma^+\to\ell^+n\nu)}{\Gamma(\Sigma^-\to\ell^-n\nu)}$ <.035 ←	$n\mu^+\nu$	(<2.4)10^{-5}	202
				$ne^+\nu$	(< 1.0)10^{-5}	224
				pe^+e^-	(<7)10^{-6}	225
Σ^0	$1(\frac{1}{2}^+)$	1192.48 ±0.11 S= 1.3* m^2=1.422	$<1.0\times10^{-14}$ $c\tau<3\times10^{-4}$	$\Lambda\gamma$	100 %	74
				Λe^+e^-	[d](5.45)10^{-3}	74
Σ^-	$1(\frac{1}{2}^+)$	1197.34 ±0.10 S= 1.5* m^2 = 1.434 $m_{\Sigma^0}-m_{\Sigma^-}$=-4.86 ±.06	[e]1.484×10^{-10} ±.019 S=1.6* $c\tau$ = 4.45	$n\pi^-$	100 %	193
				$ne^-\nu$	(1.10±0.05)10^{-3}	230
				$n\mu^-\nu$	(0.45±0.04)10^{-3}	210
				$\Lambda e^-\nu$	(0.60±0.06)10^{-4}	79
				$n\pi^-\gamma$	[c](1.0 ±0.2)10^{-4}	193
Ξ^0	$\frac{1}{2}(\frac{1}{2}^+)$[f]	1314.7 ±0.7 m^2= 1.729 $m_{\Xi^0}-m_{\Xi^-}$=-6.6 ±.7	3.03×10^{-10} ±.18 $c\tau$ = 9.08	$\Lambda\pi^0$	100 %	135
				$p\pi^-$	(<0.9)10^{-3}	299
				$pe^-\nu$	(<1.3)10^{-3}	323
				$\Sigma^+e^-\nu$	(<1.5)10^{-3}	119
				$\Sigma^-e^+\nu$	(<1.5)10^{-3}	112
				$\Sigma^+\mu^-\nu$	(<1.5)10^{-3}	64
				$\Sigma^-\mu^+\nu$	(<1.5)10^{-3}	49
				$p\mu^-\nu$	(<1.3)10^{-3}	309
Ξ^-	$\frac{1}{2}(\frac{1}{2}^+)$[f]	1321.30 ±0.15 m^2= 1.746	1.660×10^{-10} ±.037 S=1.1* $c\tau$ = 4.98	$\Lambda\pi^-$	100 %	139
				$\Lambda e^-\nu$	[g](0.70±0.21)10^{-3}	190
				$\Sigma^0e^-\nu$	(<0.5)10^{-3}	123
				$\Lambda\mu^-\nu$	(<1.3)10^{-3}	163
				$\Sigma^0\mu^-\nu$	(<0.5)%	70
				$n\pi^-$	(<1.1)10^{-3}	303
				$ne^-\nu$	(<1.0)%	327
Ω^-	$0(\frac{3}{2}^+)$[f]	1672.5±.5 m^2= 2.797	$1.3^{+0.4}_{-0.3}\times10^{-10}$ $c\tau$ = 3.9	$\Xi^0\pi^-$	Total of 28 events seen	294
				$\Xi^-\pi^0$		290
				ΛK^-		211

* S = Scale factor = $\sqrt{\chi^2/(N-1)}$, where N ≈ number of experiments. S should be ≈ 1. If S > 1, we have enlarged the error of the mean, δx, i.e., δx→Sδx. This convention is still inadequate, since if S >> 1, the experiments are probably inconsistent, and therefore the real uncertainty is probably even greater than Sδx. See text and ideogram in Stable Particle Data Card Listings.

a. Quoted upper limits correspond to a 90% confidence level.

b. In decays with more than two bodies, P_{max} is the maximum momentum that any particle can have.

c. See Stable Particle Data Card Listings for energy limits used in this measurement.

d. Theoretical value; see also Stable Particle Data Card Listings.

e. See note in Stable Particle Data Card Listings.

f. P for Ξ and J^P for Ω^- not yet measured. Values reported are SU(3) predictions.

g. Assumes rate for $\Xi^-\to\Sigma^0e^-\nu$ small compared with $\Xi^-\to\Lambda e^-\nu$.

ADDENDUM TO

Stable Particle Table

e

Magnetic moment: $1.001\ 159\ 6577 \pm .000\ 000\ 0035 \quad \frac{e\hbar}{2m_e c}$

μ

Magnetic moment: $1.001\ 166\ 16 \pm .000\ 000\ 31 \quad \frac{e\hbar}{2m_\mu c}$

μ Decay parameters [a]

$\rho = 0.752 \pm 0.003 \quad \eta = -.0.12 \pm 0.21$

$\xi = 0.972 \pm 0.013 \quad \delta = 0.755 \pm 0.009 \quad h = 1.00 \pm 0.13$

$|g_A/g_V| = 0.86^{+0.33}_{-0.11} \quad \phi = 180° \pm 15°$

$K^\pm$

Mode	Partial rate (sec^{-1})	
$\mu\nu$	$(51.55 \pm 0.25)10^6$	S=1.2*
$\pi\pi^0$	$(16.91 \pm 0.24)10^6$	S=1.2*
$\pi\pi^+\pi^-$	$(4.51 \pm 0.02)10^6$	S=1.1*
$\pi\pi^0\pi^0$	$(1.36 \pm 0.04)10^6$	
$\mu\pi^0\nu$	$(2.59 \pm 0.09)10^6$	S=1.8*
$e\pi^0\nu$	$(3.92 \pm 0.06)10^6$	S=1.2*

$\Delta I = \frac{1}{2}$ rule for $K^\pm \to 3\pi$

$\pi^+\pi^+\pi^- \ c_g = -.206 \pm .007$

$\pi^-\pi^+\pi^- \ c_g = -.194 \pm .007$

$\pi^+\pi^0\pi^0 \ c_g = .527 \pm .017$

See also Stable Particle Data Card Listings and Appendix I

Form factors for leptonic decays

See Stable Particle Data Card Listings for λ and ξ

K^0_S

$\pi^+\pi^-$	$(0.799 \pm .006)10^{10}$	S=1.2*
$\pi^0\pi^0$	$(0.361 \pm .004)10^{10}$	S=1.2*

CP violation parameters

$|\eta_{+-}| = (1.96 \pm 0.03)10^{-3}, \phi_{+-} = (43 \pm 3)°$

$I = \frac{1}{2}$ rule for $K^0_L \to 3\pi$

$\pi^+\pi^-\pi^0 \ c_g = .60 \pm .03$ S=3.1*

See Data Cards & App. I

K^0_L

$\pi^0\pi^0\pi^0$	$(4.13 \pm 0.13)10^6$	S=1.1*
$\pi^+\pi^-\pi^0$	$(2.43 \pm 0.06)10^6$	
$\pi\mu\nu$	$(5.18 \pm 0.12)10^6$	
$\pi e\nu$	$(7.54 \pm 0.13)10^6$	
$\pi^+\pi^-$	$(3.03 \pm 0.10)10^4$	
$\pi^0\pi^0$	$(1.81 \pm 0.36)10^4$	S=1.5*

$|\eta_{00}| = (2.09 \pm 0.12)10^{-3} \quad \phi_{00} = (43 \pm 19)°$ S=1.2*

Charge asymmetry:

$$\delta = \frac{\Gamma(K^0_L \to \ell^+) - \Gamma(K^0_L \to \ell^-)}{\Gamma(K^0_L \to \ell^+) + \Gamma(K^0_L \to \ell^-)} = .32 \pm .03 \times 10^{-2}$$

ΔS = -ΔQ

Re x = -.003 ± .026 S=1.5*

Im x = -.007 ± .039 S=1.2

Form factors for leptonic decays

See Stable Particle Data Card Listings for λ, ξ

η

Mode	Asymmetry parameter
$\pi^+\pi^-\pi^0$	(1.2±0.5)% S=1.3*
$\pi^+\pi^-\gamma$	(1.1±1.3)%

p

Magnetic moment ($e\hbar/2m_p c$): 2.792782 ±.000017

Decay parameters [b]

	Measured α	Measured φ(degree)	Derived γ	Derived Δ(degree)	g_A/g_V [b]	g_V/g_A [b]
$pe^-\nu$					-1.242±0.008 S=1.2* [δ=(178.6±0.9)°]	

n

-1.913148 ±.000066

Λ

-0.67 ±.06

$p\pi^-$	0.645±0.016	(-6.3±3.5)°	0.76	$(7.4^{+4.0}_{-4.1})°$	
$n\pi^0$	0.649±0.046				
$pe\nu$					-0.66±0.06 S=1.2*

Σ^+

2.59 ±.46

$p\pi^0$	-0.991±0.019	(22±90)°	0.12	$(183^{+11}_{-12})°$
$n\pi^+$	+0.066±0.016	(167±20)° S=1.1*	-0.97	$(-73^{+136}_{-10})°$
$p\gamma$	$-1.03^{+.52}_{-.42}$			

Σ^-

$n\pi^-$	-0.069±0.008	(10±15)°	0.98	$(249^{+12}_{-115})°$	See Data Cds.
$ne^-\nu$					0.35±0.18
$\Lambda e^-\nu$					

Ξ^0

$\Lambda\pi^0$	-0.35±0.08	(25±21)° S=1.3*	0.85	$(228^{+16}_{-37})°$

Ξ^-

$\Lambda\pi^-$	-0.40±0.03	(-4±8)° S=1.1*	0.91	$(170^{+18}_{-17})°$

*S = scale factor. Quoted error includes scale factor; see footnote to main Stable Particle Table for definition.

a. $|g_A/g_V|$ defined by $g_A^2 = |C_A|^2 + |C'_A|^2$, $g_V^2 = |C_V|^2 + |C'_V|^2$, and $\Sigma \langle \bar{e}|\Gamma_i|\mu\rangle \langle \bar{\nu}|\Gamma_i(C_i + C'_i\gamma_5)|\nu\rangle$;

ϕ defined by $\cos\phi = -R_e(C^*_A C'_V + C'_A C^*_V)/g_A g_V$ [for more details, see text Section IV E]

b. The definition of these quantities is as follows [for more details on sign convention, see text Section IV H]:

$$\alpha = \frac{2|s||p|\cos\Delta}{|s|^2 + |p|^2}; \qquad \beta = \frac{-2|s||p|\sin\Delta}{|s|^2 + |p|^2}.$$

$$\beta = \sqrt{1-\alpha^2}\sin\phi; \qquad \gamma = \sqrt{1-\alpha^2}\cos\phi.$$

g_A/g_V defined by $\langle B_f|\gamma_\lambda(g_V - g_A\gamma_5)|B_i\rangle$;

δ defined by $g_A/g_V = |g_A/g_V|e^{i\delta}$.

c. The definition of the slope parameter of the Dalitz plot is as follows: $|M|^2 = 1 + g\left(\frac{s_3 - s_0}{m^2_{\pi^+}}\right)$.

Meson Table

April 1972

Quantities in italics have changed by more than one (old) standard deviation since April 1971

Name (G: I 0 1; - φ π; + η ρ)	$I^G(J^P)C_n$ ⟼ estab.	Mass M (MeV)	Full Width Γ (MeV)	M^2 $\pm\Gamma M$[a] $(GeV)^2$	Partial decay mode: Mode	Fraction %		p or Pmax[b] (MeV/c)
$\pi^{\pm}(140)$ $\pi^0(135)$	$1^-(0^-)+$	139.58 134.97	0.0 7.8 eV ±.9 eV	0.019483 0.018217	See Stable Particle Table			
η(549)	$0^+(0^-)+$	548.8 ±0.6	2.63 keV ±.58 keV	0.301 ±.000	All neutral $\pi^+\pi^-\pi^0 + \pi^+\pi^-\gamma$	71 29	See Stable Particle Table	
ε See note on ππ S wave¶.	$0^+(0^+)+$		δ_0^0 is near 80°-90° in mass region 800-1000 MeV, with probably only slow variation below and cusp at $K\bar{K}$ threshold. Inelasticity ≈0 below 2 m_K.					
ρ(765)	$1^+(1^-)-$	765 ±10(c)	135 ±20(c)	0.585 ±.103	ππ e^+e^- $\mu^+\mu^-$ For upper limits, see footnote (e)	≈100 *0.0042±.0004* (d) 0.0067±.0012 (d)		356 382 368
ω(784)	$0^-(1^-)-$	783.9 ±0.3 S=1.3*	*10.0* *±0.6*	0.614 ±.008	$\pi^+\pi^-\pi^0$ $\pi^+\pi^-$ $\pi^0\gamma$ e^+e^- For upper limits, see footnote (f)	89.7±4.0 *1.2±0.3* 9.0±1.0 0.0075±.0016	S=1.1* *S=1.4** S=1.8*	328 366 380 392
η′(958) or X^0 $J^P = 0^-$ or 2^-	$0^+(\ ^-)+$	957.1 ±0.6	< 4	0.916 <.004	ηππ $\pi^+\pi^-\gamma$ (mainly $\rho^0\gamma$) γγ For upper limits, see footnote (h)	68.1±2.2 30.1±2.3 *1.8±0.3*	S=1.1*	230 458 479
$\pi_N(975)$ Possibly related to the I=1 $K\bar{K}$ threshold enhancement	$1^-(0^+)+$	~ 975	~ 60	0.950	ηπ (g)			304
S*	$0^+(0^+)+$	~ 1000		1.000	Seen as I=0 $K\bar{K}$ threshold enhancement; appears coupled to the ππ channel.			
See notes on ππ and $K\bar{K}$ S wave¶.								
Φ(1019)	$0^-(1^-)-$	1019.1 ±0.5 S=1.8*	*4.4* *±.3*	1.039 ±.004	K^+K^- K_LK_S $\pi^+\pi^-\pi^0$ (incl. ρπ) ηγ e^+e^- $\mu^+\mu^-$ For upper limits, see footnote (i)	49.1±2.0 *30.7±2.4* 17.5±2.5 *2.6±1.2* .032±.003 .025±.003	 *S=1.4** S=1.1* *S=1.9** S=1.9* 	126 109 461 362 510 498
$A_1(1070)$	$1^-(1^+)+$	~ 1070		1.14	ρπ	~ 100		232
Broad enhancement in the $J^P=1^+$ ρπ partial wave; not clear if resonant¶.								
B(1235)	$1^+(1^+)-$	1233§ ±10§	100§ ±20§	1.52 ±.12	ωπ ππ $K\bar{K}$ For other upper limits, see footnote (j)	≈ 100 < 30 < 2	 Absence suggests J^P = Abnormal	348 600 369
f(1260)	$0^+(2^+)+$	1269§ ±10§	156§ ±25§	1.60 ±.20	ππ $2\pi^+2\pi^-$ $K\bar{K}$	≈ 80 6±2 ≈ 6		619 556 393

Meson Table *(cont'd)*

Name (G | I: 0 | 1; - | φ | π; + | η | ρ)	$I^G(J^P)C_n$ ⊢estab.	Mass M (MeV)	Full Width Γ (MeV)	$\pm\Gamma M^2$ [a] $(GeV)^2$	Partial decay mode: Mode	Fraction %	p or p_{max} [b] (MeV/c)
D(1285)	$0^+(A_\perp)+$	1286 ±4 S=1.3*	*21* ±10 *S=1.3**	1.65 ±.03	ηππ	Probably seen	484
					KK̄π	Seen	305
					†[$\pi_N(975)\pi$	Seen]	246
	$J^P = 0^-, 1^+, 2^-$, with 1^+ favoured				$2\pi^+2\pi^-$ (prob. $\rho^0\pi^+\pi^-$)	Seen	565
$A_2(1310)$	$1^-(2^+)+$	1310§ ±10	100§ ±20	1.72 ±.13	ρπ	76.8±1.8	416
					ηπ	16.3±1.5	529
					K̄K	5.8±0.8	428
Controversy whether unsplit or split¶.					η′(958)π	1.1±1.1 S=1.3*	280
E(1422)	$0^+(\ )+_\perp$	1422 ±4	69 ±8	2.02 ±.10	$K^*\bar{K} + \bar{K}^*K$	50±10	154
					$\pi_N(975)\pi$	50±10	357
→	$J^P = 0^-$ or 1^+				ππη	< 60	568
f′(1514)	$0^+(2^+)+$	1514 ±5	73 ±23 S=1.8*	2.29 ±.11	K K̄	72±12	570
					$K^*\bar{K} + \bar{K}^*K$	10±10	294
					ππ	< 14 (k)	744
					ηππ	18±10	624
					ηη	< 40	521
$F_1(1540)$	$1_\perp(A_\perp)$	1540 ±5	40 ±15	2.37 ±.06	$K^*\bar{K} + \bar{K}^*K$	Only mode seen	321
Evidence based on only one experiment							
$A_3(1640)$	$1^-(2^-)+$	~ 1640		2.69	fπ	Dominant	306
					ωππ (m)		597
Broad enhancement in the $J^P = 2^-$ fπ partial wave; not clear if resonant¶.							
Φ(1675)	$0^-(N_\perp)-$	1664 ±13 S=1.2*	141 ±17	2.77 ±.23	ρπ	Dominant	647
					3π	Possibly observed	804
					5π	10±10	
g(1680)	$1^+(3^-)-$	1680§ ±20	160§ ±30	2.82 ±.27	2π	~ 40	828
					4π (incl. ππρ,ρρ,$A_2\pi$,ωπ)	~ 50 (ℓ)	781
					KK̄	~ 3	677
J^P, M and Γ from the 2π mode[ℓ].					KK̄π (incl. $K^*\bar{K}$)	~ 3	617
→							
S(1930)	$1^+(\ )-$	~ 1930	30§ ±20	3.72 ±.06	p̄p	Possibly seen	226
					ππ	Possibly seen	955
Seen in $\pi^-p \to (MM)^-p$; may be related to the structure seen in 460 MeV/c p̄p backwards scattering¶.							
→ See note (p) for other possible heavy states.							
$K^+(494)$	$1/2(0^-)$	493.84		0.244	See Stable Particle Table		
$K^0(498)$		497.79		0.248			
$K^*(892)$	$1/2(1^-)$	*891.7* ±0.5	50.1 ±1.1	0.795 ±.045	Kπ	≈ 100	288
					Kππ	< 0.2	216
→		(Charged mode; $m^0 - m^\pm = 6.1\pm1.5$ MeV)					
κ	$1/2(0^+)$				δ_0^1 is near 90°, with slow variation, in mass region 1200-1400 MeV. In addition, δ_0^1 may be resonant at M ~ 890 MeV, Γ ~ 30 MeV.		
See note on Kπ S wave¶.							

Meson Table *(cont'd)*

Name	$I^G(J^P)C_n$ ⟼ estab.	Mass M (MeV)	Full Width Γ (MeV)	$M^2 \pm \Gamma M$[a] $(GeV)^2$	Partial decay mode: Mode	Fraction %	p or p_{max}[b] (MeV/c)
Q $K_A(1240)$ or C	$1/2(1^+)$	1242 ±10	127 ±25	1.54 ±.16	Kππ	Only mode seen	
		seen in $\bar{p}p$ at rest					
Q $K_A(1280$ to $1400)$	$1/2(1^+)$	1280 to 1400			†[$K^*\pi$	Large]	
					†[Kρ	Seen]	
→ → Resonance interpretation unclear[n].							
$K_N(1420)$	$1/2(2^+)$	*1421*§ ±5	100§ ±10	2.02 ±.14	Kπ	< 56.3±3.0	616
					$K^*\pi$	> 27.8±2.7	415
					Kρ	> 9.5±2.5	324
		See note (o).			Kω	> 4.5±1.7	304
→ →					Kη	> 2.0±2.0	482
L(1770)	$1/2(A)$	1763§ ±10	100^{+100}_{-50}§	3.11 ±.18	Kππ	Dominant	787
					Kπππ	Seen	756
‡ ‡	$J^P=2^-$ favoured, 1^+ and 3^+ not excluded.				†[$K_N(1420)\pi$ and other subreactions¶]		

→ Data on the following candidates, excluded above, are listed among the data cards¶ :

M(953), H(990), $\eta_N(1080)$, $A_{1.5}(1170)$, $X_{I=0}(1430)$, $X_{I=1}(1440)$, $X^-(1795)$, η/ρ(1830), φ/π(1830), ρ(2100), T(2200), ρ(2275), $N\bar{N}(2350)$, U(2375), $N\bar{N}(2375)$, $X^-(2500)$, $X^-(2620)$, X(2800), $X^-(2880)$, X(3030), $X^-(3075)$, $X^-(3145)$, $X^-(3475)$, $X^-(3535)$; $K_A^{I=3/2}(1175)$, $K_A^{I=3/2}(1265)$, $K_N(1370)$, $K_N(1660)$, $K_N(1760)$, $K_N(1850)$, $K^*(2200)$, $K^*(2800)$.

¶ See Meson Data Card Listings.

* Quoted error includes scale factor $S = \sqrt{\chi^2/(N-1)}$. See footnote to Stable Particle Table.

† Square brackets indicate a subreaction of the previous (unbracketed) decay mode(s).

§ This is only an educated guess; the error given is larger than the error of the average of the published values. (See Meson Data Card Listings for the latter.)

(a) ΓM is approximately the half-width of the resonance when plotted against M^2.

(b) For decay modes into ≥ 3 particles, p_{max} is the maximum momentum that any of the particles in the final state can have. The momenta have been calculated by using the averaged central mass values, without taking into account the widths of the resonances.

(c) The values given for M(ρ) and Γ(ρ) and their errors are not average values from various experiments, but rather are intended to give the range where we believe the actual values are most likely to fall. Contrast the results tabulated in this note (references in the Meson Data Card Listings).

	M(MeV)	Γ(MeV)	
ρ^0	775±7	149±23	} From $e^+e^- \to \pi^+\pi^-$, fitted to
ρ^0	768±10	140±14	} Gounaris-Sakurai formula.
ρ^-	764±2	147±4	} From physical region fits to
ρ^0	775±3	145±9	} $\pi N \to \pi\pi N$, using energy-dep. width.
ρ^0	768±2	132±13	}
ρ^0	759±7	119±20	} From pole extrapol. in $\pi N \to \pi\pi N$
ρ^-	760	131	}

(d) The e^+e^- branching ratio is from $e^+e^- \to \pi^+\pi^-$ experiments only. The ωρ interference is then due to ωρ mixing only, and is expected to be small. See note in Meson Data Card Listings. The $\mu^+\mu^-$ branching ratio is compiled from 3 experiments; each possibly with substantial ωρ interference. The error reflects this uncertainty; see notes in Meson Data Card Listings. If eμ universality holds, $\Gamma(\rho^0 \to \mu^+\mu^-) = \Gamma(\rho^0 \to e^+e^-) \times$ phase space correction.

(e) Empirical limits on fractions for other decay modes of ρ(765) are $\pi^\pm\gamma < 0.5\%$, $\pi^\pm\eta < 0.8\%$, $\pi^+\pi^+\pi^-\pi^- < 0.15\%$, $\pi^\pm\pi^+\pi^-\pi^0 < 0.2\%$.

(f) Empirical limits on fractions for other decay modes of ω(784) are $\pi^+\pi^-\gamma < 5\%$, $\pi^0\pi^0\gamma < 1\%$, η + neutral(s) < 1.5%, $\mu^+\mu^- < 0.02\%$, $\pi^0\mu^+\mu^- < 0.2\%$.

(g) See Meson Data Card Listings for a typed note and an entry "π(950-1020)", which contains the data referred to as δ(962), $\pi_N(975)$, and $\pi_N(1016)$ in our April 1971 edition.

(h) Empirical limits on fractions for other decay modes of η′(958): $\pi^+\pi^- < 2\%$, $\pi^+\pi^-\pi^0 < 5\%$, $\pi^+\pi^+\pi^-\pi^- < 1\%$, $\pi^+\pi^+\pi^-\pi^-\pi^0 < 1\%$, $6\pi < 1\%$, $\pi^+\pi^-e^+e^- < 0.6\%$, $\pi^0e^+e^- < 1.3\%$, $\eta e^+e^- < 1.1\%$, $\pi^0\rho^0 < 4\%$, $\pi^0\omega < 8\%$.

Meson Table *(cont'd)*

(i) Empirical limits on fractions for other decay modes of $\phi(1019)$ are $\pi^+\pi^- < 0.03\%$, $\pi^+\pi^-\gamma < 4\%$, $\omega\gamma < 5\%$, $\rho\gamma < 2\%$, $\pi^0\gamma < 0.35\%$.

(j) Empirical limits on fractions for decay modes of B(1235): $\pi\pi < 30\%$, $K\bar{K} < 2\%$, $4\pi < 50\%$, $\phi\pi < 1.5\%$, $\eta\pi < 25\%$, $(\bar{K}K)^{\pm}\pi^0 < 8\%$, $K_SK_S\pi^{\pm} < 2\%$, $K_SK_L\pi^{\pm} < 6\%$.

(k) There is only a weak indication for a $K^*\bar{K} + \bar{K}^*K$ mode of the f'(1514). If this mode does not exist, the $K\bar{K}$ branching fraction will have to be reported as 80 ± 13% (rather than 72 ± 12% as given in the table), and $\eta\pi\pi$ as 20 ± 13%.

(ℓ) We assume as a working hypothesis that peaks with $I^G = 1^+$ observed around 1.7 GeV all come from g(1680). For indications to the contrary see Meson Data Card Listings.

(m) A possible $\omega\pi\pi$ decay mode of the A3 has mass 1690 MeV and width 80 MeV.

(n) See Q-region note in Meson Data Card Listings. Some investigators see a broad enhancement in mass $(K\pi\pi)$ from 1250-1400 MeV (the Q region), and others see structure. Only the $K_A(1240)$ or C seems well established, whereas possible structures from 1280 to 1400 MeV cannot be disentangled. For the whole Q region the decay rate into $K^*(892)\pi$ is large, and a $K\rho$ decay is seen. The $K\eta$, $K\omega$, and $K\pi$ are less than a few percent.

(o) $K_N(1420)$ properties are uncertain because both principal modes have energy-dependent backgrounds:-$K\pi$ mode: Firestone et al. (LBL 516, subm. Phys. Rev. 1972) find a large S-wave phase shift with $\sin^2\delta_0$ peaking at ≈1350 MeV, which probably caused older experiments to overestimate both Γ and the $K\pi$ branching fraction. Instead of our average of 56%, $K\pi$ fraction could be 40-50%, with other fractions raised accordingly. $K\pi\pi$ mode is contaminated with diffractively produced $Q^{\pm}$.

The tabulated mass of 1421 MeV comes only from charged $K_N(1420) \to K\pi$ measurements (to avoid $Q^{\pm}$ contamination); the average of the neutral $K_N(1420)$ mass is also 1420 MeV (i.e., $m^0 - m^{\pm} \approx 0$) but see typed note "K*(892) Mass" in Meson Data Card Listings.

(p) We tabulate here Y = 0 bumps with M ≥ 1700 MeV, for which no satisfactory grouping into particles is yet possible. See Meson Data Card Listings.

Name	I^G	J^P	M (MeV)	Γ (MeV)	Decay modes observed	Tentative grouping
$K\bar{K}(1740)$	1		1740	≈ 120	$K^0K^{\pm}$	R(1750)
R3(1750)	1,2		1748 ± 15	≤ 38	$(M\bar{M})^-$	R(1750)
$\pi\pi(1764)$			1764 ± 15	87^{+14}_{-20}	$\pi^+\pi^-$	R(1750)
$K\bar{K}\pi(1820)$	0,1,2		1820 ± 12	50 ± 23	$K_SK^0\pi^0$	1830 region
R4(1830)	1,2		1830 ± 15	≤ 30	$(M\bar{M})^-$	1830 region
$\eta/\rho(1830)$	+		1832 ± 6	42 ± 11	$\pi^+\pi^-\pi^+\pi^-$	1830 region
$\phi/\pi(1830)$	-		1848 ± 11	67 ± 27	$\omega\pi^+\pi^-$, possibly $\omega\rho^0$	1830 region
$X^-(2086)$	1,2		2086 ± 38	≈ 150	$(M\bar{M})^-$ backward	ρ(2100)
ρ (2120)	1^+	3^-(?)	2120	< 249	$\pi^+\pi^-$, $\bar{p}p$	ρ(2100)
$\pi\pi(2157)$	1^+	(odd)-	2157 ± 10	68 ± 22	$\pi^+\pi^0$	T region
$K\bar{K}\omega(2176)$	$0^-,1^+$		2176 ± 5	20^{+16}_{-2}	$K_SK_S\omega$	T region
$N\bar{N}(2190)$	1^-		2190	20-80	$\rho^0\rho^0\pi^0$, $\bar{p}p$	Seems to require >1 resonance
$N\bar{N}(2190)$	1		2190 ± 10	≈ 85	Structure in $N\bar{N}$ total σ	Seems to require >1 resonance
T (2195)	1,2		2195 ± 15	≤ 13	$(M\bar{M})^-$	Seems to require >1 resonance
3π(2207)	≤ 3		2207 ± 13	62 ± 52	$\pi^+\pi^-\pi^0$	Seems to require >1 resonance
4π(2207)	$1^+,2^+,3^+$		2207 ± 22	≈ 130	$\rho^-\pi^+\pi^-$	Seems to require >1 resonance
$X^-(2260)$	1,2		2260 ± 18	≤ 25	$(M\bar{M})^-$ backward	ρ(2275)
ρ (2290)	1^+	5^-(?)	2290	< 165	$\pi^+\pi^-$, $\bar{p}p$	ρ(2275)
$N\bar{N}(2350)$	1		2350 ± 10	≈ 140	Structure in $N\bar{N}$ total σ	U region
$X^-(2370)$	1,2		2370 ± 17	≈ 57	$(M\bar{M})^-$ backward	U region
$N\bar{N}(2375)$	0		2375 ± 10	≈ 190	Structure in $N\bar{N}$ total σ	U region
U (2380)	1,2		2382 ± 24	< 30	$(M\bar{M})^-$	U region
$X^-(2500)$	1,2		2500 ± 32	≈ 87	$(M\bar{M})^-$ backward	
$X^-(2620)$	1,2		2620 ± 20	85 ± 30	$(M\bar{M})^-$	2650 region
4π(2676)	(1,2,3)+		2676 ± 27	≈ 150	$\rho^-\pi^+\pi^-$	2650 region
$X^-(2800)$	1,2		2800 ± 20	46 ± 10	$(M\bar{M})^-$	2850 region
$X^+(2820)$	1,2		2820 ± 10	50 ± 10	$(K\bar{K}\pi\pi)+$	2850 region
$X^-(2880)$	1,2		2880 ± 20	≤ 15	$(M\bar{M})^-$	2850 region
$X^+(3013)$	1^-		3013 ± 5	< 40	7π	3020 region
$X^-(3025)$	1,2		3025 ± 20	≈ 25	$(M\bar{M})^-$	3020 region
NN(3035)	+		3035 ± 25	200 ± 60	4π, 6π	3020 region
$X^-(3075)$	1,2		3075 ± 20	≈ 25	$(M\bar{M})^-$	
$X^-(3145)$	1,2		3145 ± 20	≤ 10	$(M\bar{M})^-$	
$X^-(3475)$	1,2		3475 ± 20	≈ 30	$(M\bar{M})^-$	
$X^-(3535)$	1,2		3535 ± 20	≈ 30	$(M\bar{M})^-$	

Baryon Table

April 1972

[See notes on N's and Δ's, on possible Z*'s, and on Y*'s at the beginning of those sections in the Baryon Data Card Listings; also see notes on individual resonances in the Baryon Data Card Listings.]

Particle[a]	I (J^P) ⊢ estab.	π or K Beam T(GeV) p(GeV/c) σ = 4πλ̄² (mb)	Mass M[b] (MeV)	Full Width Γ[b] (MeV)	M² ± ΓM[c] (GeV²)	Partial decay mode Mode	Fraction %	p or p_max [d] (MeV/c)
p	1/2(1/2⁺)		938.3		0.880	See Stable Particle Table		
n			939.6		0.883			
N'(1470)	1/2(1/2⁺) P'_{11}	T=0.53πp p=0.66 σ=27.8	1435 to 1505	165 to 400	2.16 ±0.34	Nπ Nππ	60 40	420 368
N'(1520)	1/2(3/2⁻) D'_{13}	T=0.61 p=0.74 σ=23.5	1510 to 1540	105 to 150	2.31 ±0.18	Nπ Nππ [Δ(1236)π][e] Nη	50 50 [dominant][e] ~0.6	456 410 224
N'(1535)	1/2(1/2⁻) S'_{11}	T=0.64 p=0.76 σ=22.5	1500 to 1600	50 to 160	2.36 ±0.18	Nπ Nη[n] Nππ[n]	35 55 ~10	467 182 422
N'(1670)[i]	1/2(5/2⁻) D'_{15}	T=0.87 p=1.00 σ=15.6	1655 to 1680	105 to 175	2.79 ±0.24	Nπ Nππ [Δ(1236)π][e] ΛK Nη	40 60 [44][e] <.3 <1[j]	560 525 357 200 368
N'(1688)[i]	1/2(5/2⁺) F'_{15}	T=0.90 p=1.03 σ=14.9	1680 to 1692	105 to 180	2.85 ±0.21	Nπ Nππ [Δ(1236)+π][e] ΛK Nη	60 40 [26][e] <.2 <.5[j]	572 538 371 231 388
N''(1700)[i]	1/2(1/2⁻) S''_{11}	T=0.92 p=1.05 σ=14.3	1665 to 1765	100 to 400	2.89 ±0.42	Nπ ΛK Nη	-65 5	580 250 340
N''(1780)[i]	1/2(1/2⁺) P''_{11}	T=1.07 p=1.20 σ=12.2	1650 to 1860	50 to 450	3.17 ±0.51	Nπ ΛK Nη	30 ~7 ~10[j]	633 353 476
N(1860)	1/2(3/2⁺) P_{13}	T=1.22 p=1.36 σ=10.4	1770 to 1900	180 to 330	3.46 ±0.57	Nπ Nππ ΛK Nη	25 ~5 ~4[j]	685 657 437 545
N(2190)	1/2(7/2⁻) G_{17}	T=1.94 p=2.07 σ=6.21	2000 to 2260	270 to 325	4.80 ±0.67	Nπ Nππ	25	888 868
N(2220)	1/2(9/2⁺) H_{19}	T=2.00 p=2.14 σ=5.97	2200 to 2245	260 to 330	4.93 ±0.65	Nπ Nππ	15	905 887
N(2650)	1/2(?⁻)	T=3.12 p=3.26 σ=3.67	2650	360	7.02 ±0.95	Nπ Nππ	(J+1/2)x =0.45[f]	1154 1140
N(3030)	1/2(?)	T=4.27 p=4.41 σ=2.62	3030	400	9.18 ±1.21	Nπ Nππ	(J+1/2)x =0.05[f]	1366 1354
Δ'(1236)[m]	3/2(3/2⁺) P'_{33}	T=0.195 (++) p=0.304 σ=91.8	1230 to 1236	110 to 122	1.53 ±0.14	Nπ Nπ⁺π⁻ Nγ	99.4 0 ~0.6	231 90 262
		Pole Position[m]:	1211	±i50				
Δ(1650)	3/2(1/2⁻) S_{31}	T=0.83 p=0.96 σ=16.4	1615 to 1695	130 to 200	2.72 ±0.28	Nπ Nππ	28 72	547 511

Baryon Table *(cont'd)*

Particle[a]	I (J^P) ⊢ estab.	π or K Beam: T(GeV) p(GeV/c) σ = 4πλ̄² (mb)	Mass M[b] (MeV)	Full Width Γ[b] (MeV)	M² ± ΓM[c] (GeV²)	Partial decay mode: Mode	Fraction %	p or p_max [d] (MeV/c)
Δ(1670)	3/2(3/2⁻) D_{33}	T=0.87 p=1.00 σ=15.6	1650 to 1720	175 to 300	2.79 ±0.40	Nπ Nππ	15	560 525
Δ(1890)	3/2(5/2⁺) F_{35}	T=1.28 p=1.42 σ=9.88	1840 to 1920	135 to 350	3.57 ±0.49	Nπ Nππ	17	704 677
Δ(1910)	3/2(1/2⁺) P_{31}	T=1.33 p=1.46 σ=9.54	1780 to 1935	230 to 420	3.65 ±0.62	Nπ Nππ	25	716 691
Δ(1950)	3/2(7/2⁺) F_{37}	T=1.41 p=1.54 σ=8.90	1930 to 1980	140 to 220	3.80 ±0.39	Nπ Δ(1236)π ΣK Σ(1385)K	45 ≈50 ~ 2 1.4	741 571 460 232
Δ(2420)	3/2(11/2⁺)	T=2.50 p=2.64 σ=4.68	2320 to 2450	270 to 350	5.86 ±0.75	Nπ Nππ	11 >20	1023 1006
Δ(2850)	3/2(? ⁺)	T=3.71 p=3.85 σ=3.05	2850	400	8.12 ±1.14	Nπ Nππ	(J+1/2)x =0.25 [f]	1266 1254
Δ(3230)	3/2(?)	T=4.94 p=5.08 σ=2.25	3230	440	10.4 ±1.4	Nπ Nππ	(J+1/2)x =0.05 [f]	1475 1464
Z*	Z*	Evidence for states with hypercharge 2 is controversial. See the Baryon Data Card Listings for discussion and display of data.						
Λ	0(1/2⁺)		1115.6		1.24	See Stable Particle Table		
Λ'(1405)	0(1/2⁻) S'_{01}	p<0 K⁻p	1405 ±5[g]	40 ±10[g]	1.97 ±0.06	Σπ	100	142
Λ'(1520)	0(3/2⁻) D'_{03}	p=0.389 σ=84.5	1518 ±2[g]	16 ±2[g]	2.30 ±0.02	NK̄ Σπ Λππ Σππ	45±1 42±1 9.6±.7 1.0±.1	234 258 250 140
Λ''(1670)	0(1/2⁻) S''_{01}	p=0.74 σ=28.5	1670	15 to 38	2.79 ±0.04	NK̄ Λη Σπ	~20 ~35 ~45	410 64 393
Λ''(1690)	0(3/2⁻) D''_{03}	p=0.78 σ=26.1	1690	27 to 85	2.86 0.09	NK̄ Σπ Λππ Σππ	~20 [h] ~60 ~ 2 ≤18	429 409 415 352
Λ'(1815)	0(5/2⁺) F'_{05}	p=1.05 σ=16.7	1820 ±5[g]	64 to 104	3.30 ±0.15	NK̄ Σπ Σ(1385)π	62 11 4	542 508 362
Λ'(1830)	0(5/2⁻) D'_{05}	p=1.09 σ=15.8	1835	74 to 150	3.37 ±0.20	NK̄ Σπ Λππ	~10 ~30 ~11	554 519 536
Λ(2100)	0(7/2⁻) G_{07}	p=1.68 σ=8.68	2100	60 to 140	4.41 ±0.22	NK̄ Σπ Λη ΞK Λω	25 ~ 5 < 3 <10	748 699 617 483 443
Λ(2350)	0(?)	p=2.29 σ=5.85	2350	140 to 324	5.52 ±0.55	NK̄	(J+1/2)x =0.7[f]	913

Baryon Table *(cont'd)*

Particle[a]	I (J^P) ⊢⊣ estab.	π or K Beam T(GeV) p(GeV/c) σ = 4πλ̄² (mb)	Mass M[b] (MeV)	Full Width Γ[b] (MeV)	M² ± ΓM[c] (GeV²)	Partial decay mode Mode	Fraction %	p or p_max [d] (MeV/c)
Σ	1(1/2⁺)		(+)1189.4 (0)1192.5 (-)1197.3		1.41 1.42 1.43	See Stable Particle Table		
Σ'(1385)	1(3/2⁺) P'₁₃	p<0 K⁻p	(+)1383±1 S=1.3* (-)1386±2 S=2.2*	(+)36±3 S=1.9* (-)36±6 S=3.5*!	1.92 ±0.05	Λπ Σπ	89±5 11±5 S=1.9*	208 117
Σ'(1670)[k]	1(3/2⁻) D'₁₃	p=0.74 σ=28.5	1670	50	2.79 ±0.08	NK̄ Σπ Λπ Σππ [Λ(1405)π][e] Λππ	~8	410 387 447 326 207 397
Mass, width and elasticity are the values obtained in partial wave analyses for a D_{13} resonance. For more results see the Baryon Data Card Listings and footnote k.								
Σ''(1750)	1(1/2⁻) S''₁₁	p=0.91 σ=20.7	1750	50 to 80	3.06 ±0.11	NK̄ Λπ Ση	~15 seen seen	483 507 54
Σ(1765)	1(5/2⁻) D₁₅	p=0.94 σ=19.6	1765 ±5[g]	~120	3.12 ±0.21	NK̄ Λπ Λ(1520)π Σ(1385)π Σπ	~42 ~15 ~14 ~4 ~1	496 518 187 315 461
Σ'(1915)[i]	1(5/2⁺) F'₁₅	p=1.25 σ=13.0	1910	70	3.65 ±0.13	NK̄ Λπ Σπ	~11	612 619 568
Formation and production experiments do not agree on Σπ/Λπ ratio.								
Σ(2030)	1(7/2⁺) F₁₇	p=1.52 σ=9.93	2030	100 to 170	4.12 ±0.27	NK̄ Λπ Σπ ΞK	~20 ~20 ~3 <2	700 700 652 412
Σ(2250)	1(?)	p=2.04 σ=6.76	2250	100 to 230	5.06 ±0.37	NK̄ Σπ Λπ	(J+1/2)x =0.3[f]	849 842 799
Σ(2455)	1(?)	p=2.57 σ=5.09	2455	~120	6.03 ±0.29	NK̄	(J+1/2)x =0.2[f]	979
Σ(2620)	1(?)	p=2.95 σ=4.30	2620	~175	6.86 ±0.46	NK̄	(J+1/2)x =0.3[f]	1064
Ξ[l]	1/2(1/2⁺)		(0)1314.7 (-)1321.3		1.73 1.75	See Stable Particle Table		
Ξ(1530)[l]	1/2(3/2⁺) p-wave	(0) 1531.3±0.5 S=1.4* (-) 1535.8±1.0		(0) 9.2±0.8 (-) 16.2±4.6	2.34 ±0.01	Ξπ	100	144
Ξ(1820)[l]	1/2(?)		1795 to 1870	12 to 99	3.31 ±0.10	ΛK̄ Ξπ Ξ(1530)π ΣK̄		396 413 234 306
All four decay modes have been seen. Branching ratios not quoted because there may be more than one state here.								
Ξ(1940)[l]	1/2(?)		1894 to 1961	42 to 140	3.72 ±0.18	Ξπ Ξ(1530)π		499 336
Seen in both final states; not clear if one, or more, states present.								
Ω⁻	0(3/2⁺)		1672.5		2.80	See Stable Particle Table		

Baryon Table *(cont'd)*

* Quoted error includes an S(scale)factor. See footnote to Stable Particle Table.

→ An arrow at the left of the Table indicates a candidate that has been omitted because the evidence for the existence of the effect and (or) for its interpretation as a resonance is open to considerable question. See the Baryon Data Card Listings for information on the following: $N(1700)\,D''_{13}$, $N(1990)\,F_{17}$, $N(2040)\,D''_{13}$, $N(2100)\,S''_{11}$, $N(2100)\,D''_{15}$, $N(2175)\,F''_{15}$, $N(3245)$, $N(3690)$, $N(3755)$, $\Delta(1690)\,P''_{33}$, $\Delta(1960)\,D_{35}$, $\Delta(2160)\,P''_{33}$, $Z_0(1780)$, $Z_0(1865)$, $Z_1(1900)$, $\Lambda(1330)$, $\Lambda(1750)\,P_{01}$, $\Lambda(1860)\,P_{03}$, $\Lambda(1870)\,S''_{01}$, $\Lambda(2010)\,D''_{03}$, $\Lambda(2020)\,F_{07}$, $\Lambda(2110)\,F''_{05}$ or D''_{05}, $\Lambda(2585)$, $\Sigma(1440)$, $\Sigma(1480)$, $\Sigma(1620)\,S'_{11}$, $\Sigma(1620)\,P'_{11}$, $\Sigma(1670)^k$, $\Sigma(1690)$, $\Sigma(1880)\,P''_{11}$, $\Sigma(1940)\,D''_{13}$, $\Sigma(2070)\,F''_{15}$, $\Sigma(2080)\,P''_{13}$, $\Sigma(2100)\,G_{17}$, $\Sigma(3000)$, $\Xi(1630)$, $\Xi(2030)$, $\Xi(2250)$, $\Xi(2500)$.

a. For the baryon states, the name [such as N'(1470)] contains the mass, which may be different for each new analysis. The value chosen is the rounded average from Table I of the note on N's and Δ's in the Baryon Data Card Listings. For Y^*'s and Ξ^*'s, the mass is an educated guess obtained by looking at the reported values. The convention for using primes in the names is as follows: when there is more than one resonance on a given Argand diagram, the first has been designated with a prime, the second with a double prime, etc. The name (col. 1) is the same as can be found in large print in the Baryon Data Card Listings.

b. See note on N's and Δ's in the Baryon Data Card Listings. For M and Γ of most baryons we report here an interval instead of an average. Averages are appropriate if each result is based on independent measurements, but inappropriate here where the spread in parameters arises because different models or procedures have been applied to a common set of data. Where only one value is given it is either because only one experiment reports that state or because the various experiments agree. An error is quoted only when the various experiments averaged have taken into account the systematic errors.

c. For this column M is the rounded average which also appears in the name column. For the N's and Δ's, Γ is the average quoted on Table II of the N's and Δ's note in the Baryon Data Card Listings; for the Y^*'s and Ξ^*'s, Γ is taken as the center of the interval given in the column labeled "Γ".

d. For decay modes into ⩾3 particles p_{max} is the maximum momentum that any of the particles in the final state can have. The momenta have been calculated using the averaged central mass values, without taking into account the widths of the resonances.

e. Square brackets indicate a sub-reaction of the previous unbracketed decay mode.

f. This state has been seen only in total cross sections. J is not known; x is Γ_{el}/Γ.

g. This is only an educated guess; the error given is larger than the error of the average of the published values (see the Baryon Data Card Listings for the latter).

h. In previous editions we quoted a larger elasticity. It was required by unitarity because of the large value of $x \cdot x_e$ for the $\Lambda\pi\pi$ decay. A partial wave analysis of new data of the $\Lambda\pi\pi$ channel yields smaller values of $x \cdot x_e$ allowing a smaller elasticity, which is more consistent with partial-wave analysis in the elastic channel.

i. Only information coming from partial-wave analyses has been used here. For the production experiments results see the Baryon Data Card Listings.

j. Value obtained in an energy-dependent partial-wave analysis which uses a t-channel-poles-plus-resonance parametrization. The values of the couplings obtained for the resonances may be affected by double counting.

k. In this energy region the situation is still confused. Formation experiments suggest two states: $P_{11}(1620)$ decaying mainly into $\Sigma\pi$, and $D_{13}(1670)$ with branching fractions $\Sigma\pi(40\%)$, $\Lambda\pi(10\%)$, $\Sigma\pi\pi(< 14\%)$. Production experiments report four states: $\Sigma(1620)$ seen only in the $\Lambda\pi$ mode, $\Sigma_1(1660)$ with appreciable $\Lambda\pi$ and $\Sigma\pi$ modes. $\Sigma_2(1660)$ with main decay mode $\Lambda(1405)+\pi$ (that is, $\Sigma\pi\pi$), and $\Sigma(1690)$ seen in the $\Lambda\pi$ mode. Of these four, Σ_1 and Σ_2 seem to be on firmer ground than the other two and both seem to have $J^P = 3/2^-$ like the $D_{13}(1670)$ seen in formation experiments. Two resonances of the same spin and parity have been hypothesized as the origin of much of the complexity observed in production experiments. With the addition of the $P_{11}(1620)$, there are three candidates that eventually might be required to clarify the situation.

ℓ. Only $\Xi(1530)$ is firmly established; information on the other states comes from experiments that have poor statistics due to the fact that the cross sections for S = -2 states are very low. For Ξ states, because of the meager statistics, we lower our standards and tabulate resonant effects if they have at least a four-standard-deviation statistical significance and if they are seen by more than one group. So $\Xi(2030)$, with main decay mode $\Sigma\bar{K}$, reported as a 3.5-standard-deviation effect, is not tabulated. See the Baryon Data Card Listings for the other states.

m. See note on $\Delta(1236)$ in the Baryon Data Card Listings. Values of mass and width are dependent upon resonance shape used to fit the data. The pole position appears to be much less dependent upon the parametrization used.

n. The preliminary results of DIEM 70 quoted in the Baryon Data Card Listings have been revised so that they are now in agreement with the values quoted in the present table (G. Smadja, private communication).