APPENDIX IV

DATA ON PARTICLES AND RESONANT STATES

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Data on Particles and Resonant States: Table S, Stable Particles. Rev. Mod. Phys., January 1967

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	$I^G(J^P)C_n$	Mass (MeV)	Mass difference (MeV)	Mean life (sec) cτ (cm)	Mass² (GeV)²	Decays: Partial mode	Decays: Fraction	Q (MeV)	p or p_{max} (MeV/c)[‡]
γ	$0,1(1^-)^-$	0		stable	0	stable			
ν_e ν_μ	J = ½	0(<0.2 keV) 0(<2.1 MeV)		stable	0	stable			
$e^\mp$	J = ½	0.511006 ±.000002		stable (> 2×10^{21} y)	0.000	stable	$\mu_e = \frac{1.001159622}{\pm.000000027}\frac{e\hbar}{2m_ec}$		
$\mu^\mp$	J = ½	105.659 ±.002	-33.920 ±.014	2.199×10^{-6} ±.001, S=1.3* cτ = 6.592×10^4	0.011	$e\nu\bar\nu$	100 %	105	53
	$\mu_\mu = \frac{1.001164}{\pm.000003}\frac{e\hbar}{2m_\mu c}$					eγγ	(< 1.6)10^{-5}	105	53
						3e	(< 1.3)10^{-7}	104	53
						eγ	(< 6)10^{-9}	105	53
$\pi^\pm$	$1^-(0^-)^+$	139.579 ±.014	4.6041 ±.0037	2.608×10^{-8} ±.015, S=3.5* cτ = 782; $(\tau^+-\tau^-)/\bar\tau$ = (.4±.2)% (test of CPT)	0.019	μν	100 %	34	30
						eν	(1.24± 0.03)10^{-4}	139	70
						μνγ	(1.24± 0.25)10^{-4}	34	30
						$\pi^0 e\nu$	(1.01± 0.09)10^{-8}	4	5
						eνγ	(3.0 ± 0.5)10^{-8}	139	70
π^0	$1^-(0^-)^+$	134.975 ±.014		[b]0.89×10^{-16} ±.18, S=1.6* cτ = 2.67×10^{-6}	0.018	γγ	[c](98.8)%	135	67
						γe^+e^-	[c](1.169)%	134	67
						γγγ	(< 5)10^{-6}	135	67
						$e^+e^-e^+e^-$	[c](3.47)10^{-5}	133	67
$K^\pm$	½(0^-)	493.82 ±.11	-4.05 ±.12	1.235×10^{-8} ±.006, S=2.4* cτ = 3.70; $(\tau^+-\tau^-)/\bar\tau$ = (.09±.08)% (test of CPT)	0.244	μν	[b](63.4 ±0.5)% } S=1.5*	388	236
						$\pi\pi^0$	(21.0 ±0.3)% } S=1.5*	219	205
						$\pi\pi^-\pi^+$	(5.6 ±0.1)% } S=1.5*	75	126
						$\pi\pi^0\pi^0$	(1.71± 0.08)%, S=1.5*	84	133
						$\mu\pi^0\nu$	(3.41± 0.22)%, S=1.9*	253	215
						$e\pi^0\nu$	(4.79± 0.18)%, S=2.1*	358	229
						$\pi\pi^\mp e^\pm\nu$	(3.8 ±0.8)10^{-5}	214	204
						$\pi\pi^\pm e^\mp\nu$	(< 2)10^{-6}	214	204
						$\pi\pi^\mp\mu^\pm\nu$	(≤ 1.4)10^{-5}	109	151
						$\pi\pi^\pm\mu^\mp\nu$	(< 3)10^{-6}	109	151
						eν	(1.9 ±1.2)10^{-5}	493	247
						$\pi\pi^0\gamma$	(2.2 ±0.7)10^{-4}	219	205
						$\pi\pi^+\pi^-\gamma$	(10 ±4)10^{-5}	75	126
						πe^+e^-	(< 1.1)10^{-6}	353	227
						$\pi\mu^+\mu^-$	(< 3)10^{-6}	143	172
K^0	½(0^-)	497.87 ±0.16		50% K_{Short}, 50% K_{Long}					
K_{Short}	½(0^-)		$-0.48\times\frac{1}{\tau_S}$ ±.02	0.87×10^{-10} ±.009, S=1.3* cτ = 2.61	0.248	$\pi^+\pi^-$	(69.3 ±1.2)% S=1.25*	219	206
						$\pi^0\pi^0$	(30.7 ±1.2)% S=1.25*	228	209
K_{Long}	½(0^-)			5.68×10^{-8} ±.26 cτ = 1703	0.248	$\pi^0\pi^0\pi^0$	(23.5 ±2.1)%	93	139
						$\pi^+\pi^-\pi^0$	(11.5 ± .4)%	84	133
						πμν	(27.5 ±1.8)%	253	216
						πeν	(37.4 ±1.8)%	358	229
						$\pi^+\pi^-$	(.153 ±.007)%	219	206
						$\pi^+\pi^-\gamma$	(< 0.3)%	219	206
						$\pi^0\pi^0$	(< 2.7)10^{-3}	228	209
						eμ	(< 4)10^{-5}	392	238
						γγ	(1.3 ±0.6)10^{-4}	498	249
						$\mu^+\mu^-$	(< 4)10^{-6}	287	225
						e^+e^-	(< 4)10^{-5}	497	249
η	$0^+(0^-)^+$	548.6 ±0.4		1<Γ<10 keV (2<cτ<20)10^{-10}		Neutral decays 72.9%: γγ	(31.4 ±2.2)%	549	274
						$\pi^0\gamma\gamma$	(20.5 ±3.5)% S=1.3*	414	258
						$3\pi^0$	(21.0 ±3.2)% S=1.5*	144	179
						Charged decays 27.1%: $\pi^+\pi^-\pi^0$	(22.4 ±1.8)%	135	174
						$\pi^+\pi^-\gamma$	(4.6 ±0.8)% S=1.1*	269	236
						$\pi^0e^+e^-$	(< 0.2)%	413	258
						$\pi^+\pi^-e^+e^-$	(0.1 ±0.1)%	268	236

General Atomic and Nuclear Constants[a]

- N = 6.02252 × 10^{23} $mole^{-1}$ (based on A_{C12} = 12)
- c = 2.997925 × 10^{10} cm sec^{-1}
- e = 4.80298 × 10^{-10} esu = 1.60210×10^{-19} coulomb
- 1 MeV = 1.60210 × 10^{-6} erg
- ħ = 6.5819 × 10^{-22} MeV sec = 1.05449 × 10^{-27} erg sec
- ħc = 1.9732 × 10^{-11} MeV cm = 197.32 MeV fermi
- k = 8.6171 × 10^{-11} MeV deg^{-1} (Boltzmann const.)
- α = $e^2/\hbar c$ = 1/137.0388
- m_e = 0.511006 MeV/c^2 = 1/1836.10 m_p
- m_p = 938.256 MeV/c^2 = 1836.10 m_e = 6.721 $m_{\pi^\pm}$ = 1.00727663 m_1 (where m_1 = 1 amu = $\frac{1}{12}$ m_{C12} = 931.478 MeV/c^2)
- r_e = e^2/m_ec^2 = 2.81777 fermi (1 fermi = 10^{-13} cm)
- $\lambda\!\!\!^-_e$ = $\hbar/m_ec$ = $r_e\alpha^{-1}$ = 3.86144× 10^{-11} cm
- a_∞ Bohr = $\hbar^2/m_ee^2$ = $r_e\alpha^{-2}$ = 0.529167 A (1 A = 10^{-8} cm)
- $\sigma_{Thompson}$ = $\frac{8}{3}\pi r_e^2$ = 0.66516× 10^{-24} cm^2 = 0.66516 barn
- R_∞ = $m_ee^4/2\hbar^2$ = $m_ec^2\alpha^2/2$ = 13.60535 eV (Rydberg)
- Hydrogen-like atom (non-rel., μ = reduced mass): $E_n = \frac{\mu z^2e^4}{2(n\hbar)^2}$; $a_{n=1} = \frac{\hbar^2}{\mu ze^2}$; $\left(\frac{v}{c}\right)_{rms} = \frac{ze^2}{n\hbar c}$
- μ_{Bohr} = $e\hbar/2m_ec$ = 0.578817× 10^{-14} MeV $gauss^{-1}$
- μ_{nucl} = $e\hbar/2m_pc$ = 3.1524 × 10^{-18} MeV $gauss^{-1}$
- ½ $\omega_{cyclotron}$ = $e/2m_ec$ = 8.79404 × 10^6 rad sec^{-1} $gauss^{-1}$; = $e/2m_pc$ = 4.7895 × 10^3 rad sec^{-1} $gauss^{-1}$
- $\sigma_{natural}$ = $\pi(\hbar/m_{\pi^\pm}c)^2$ = 62.768 mb

Other Physical Constants

- 1 year = 3.1536× 10^7 sec (≈ π× 10^7 sec)
- density of air = 1.205 mg cm^{-3} (at 20°C)
- acceleration by gravity = 980.67 cm sec^{-2}
- gravitational constant = 6.670× 10^{-8} cm^3g^{-1} sec^{-2}
- 1 calorie = 4.184 joules
- 1 atmosphere = 1033.2 g cm^{-2}
- 1 eV per particle = 11604.9°K (from E = kT)

Numerical Constants

1 rad	= 57.29578 deg	e	= 2.71828
C	= 0.577216	1/e	= 0.367879
ln 2	= 0.69315	$\log_{10}e$	= 0.43429
ln 10	= 2.30259	$\log_{10}2$	= 0.30103

[a]Based mainly on E. R. Cohen and J. W. M. DuMond, Rev. Mod. Phys. 37, 537 (1965).

	$I^G(J^P)C_n$	Mass (MeV)	Mass difference (MeV)	Mean life (sec) cτ (cm)	Mass² (GeV)²	Partial mode	Fraction	Q (MeV)	p or p_{max} (MeV/c)	Magnetic moment ($e\hbar/2m_pc$)	Decay Parameters[†] Measured: α	Measured: Φ(degree)	Derived: γ	Derived: Δ(degree)
p	½(½⁺)	938.256 ±0.005	-1.2933 ±.0001	stable (> 6×10^{27} y)	0.880					2.792763 ±.000030				
n	½(½⁺)	939.550 ±0.005		(1.01±.03)10^3 cτ = 3.03×10^{13}	0.882	$pe^-\nu$	100 %	1	1	-1.913148 ±.000066				
Λ	0(½⁺)	1115.58 ±0.10		2.51×10^{-10} ±.04, S=1.4* cτ = 7.52	1.245	$p\pi^-$	(66.4 ±1.1)% S=1.1*	38	100	-0.73 ±.16	.663±.022	(7±7)°	.74	(-8±8)°
						$n\pi^0$	(33.6 ±1.1)% S=1.1*	41	104		.73 ±.18			
						peν	(0.88 ± 0.15)10^{-3}	177	163		.06 ±.19			
						pμν	(1.35 ± 0.60)10^{-4}	72	131					
Σ^+	1(½⁺)	1189.47 ±0.08	-7.97 ±.11	0.810×10^{-10} ±.013 cτ = 2.43	1.412	$p\pi^0$	(52.8 ±1.5)%	116	189	2.3 ±.6	-.960±.067			
						$n\pi^+$	(47.2 ±1.5)%	110	185		+.008±.037	(180±30)°	-1.0	(0±85)°
						pγ	(1.9 ±0.4)10^{-3}	251	225					
						$n\pi^+\gamma$	(≈ 0.2)10^{-4}	110	185					
						$\Lambda e^+\nu$	(1.5 ±0.9)10^{-5}	73	72					
						$n\mu^+\nu$	(< 1.1)10^{-4}	144	202					
						$ne^+\nu$	(< 5)10^{-5}	249	224					
Σ^0	1(½⁺)	1192.56 ±0.11	-4.88 ±.06	<1.0×10^{-14} cτ<3×10^{-4}	1.422	Λγ	[c]100 %	77	75					
						Λe^+e^-	[c](5.45)10^{-3}							
Σ^-	1(½⁺)	1197.44 ±0.09		1.65×10^{-10} ±.03, S=1.4* cτ = 4.95	1.434	$n\pi^-$	100 %	118	193		-.010±.043			
						$ne^-\nu$	(1.25 ± 0.17)10^{-3}	257	230					
						$n\mu^-\nu$	(0.62 ± 0.12)10^{-3}	152	210					
						$\Lambda e^-\nu$	(0.61 ± 0.16)10^{-4}	81	79					
						$n\pi^-\gamma$	(≈ 1)10^{-5}	118	193					
Ξ^0	½(½⁺) ?	1314.7 ±1.0	-6.5 ±.2	3.0×10^{-10} ±.5, S=1.3* cτ = 8.99	1.728	$\Lambda\pi^0$	100 %	64	135		-.33 ±.10			
						$p\pi^-$	(< .5)%	237	299					
						$pe^-\nu$	(< .6)%	376	323					
						$\Sigma^+e^-\nu$	(< .7)%	125	119					
						$\Sigma^-e^+\nu$	(< .6)%	117	112					
						$\Sigma^+\mu^-\nu$	(< .7)%	20	64					
						$\Sigma^-\mu^+\nu$	(< .6)%	12	49					
						$p\mu^-\nu$	(< .6)%	271	309					
Ξ^-	½(½⁺) ?	1321.2 ±0.2		1.74×10^{-10} ±.05 cτ = 5.22	1.746	$\Lambda\pi^-$	100 %	66	139		-.391±.032	(6±8)°	.92	(14±15)°
						$\Lambda e^-\nu$	(2.5 ±1.8)10^{-3}	205	190					
						$n\pi^-$	(< 5)10^{-3}	242	303					
						$\Lambda\mu^-\nu$	(< 1.2)%	100	163					
						$\Sigma^0e^-\nu$	(< 0.3)%	128	122					
						$\Sigma^0\mu^-\nu$	(< 0.5)%	23	70					
						$ne^-\nu$	(< 1)%	381	327					
Ω^-	0(3/2⁺) ? ?	1674 ±3		1.5×10^{-10} ±.5, cτ = 4.5	2.802	Ξπ	(~50)%	221	296					
						$\Lambda\bar K$	(~50)%	66	216					

[†]The definition of these quantities is as follows

$$\alpha = \frac{2\,\mathrm{Re}(S^*P)}{|S|^2+|P|^2}\ ;\ \beta = \frac{2\,\mathrm{Im}(S^*P)}{|S|^2+|P|^2}\ ;\ \gamma = \frac{|S|^2-|P|^2}{|S|^2+|P|^2}$$

$$\tan\Phi = \frac{\beta}{\gamma}\ ,\ \tan\Delta = \frac{-\beta}{\alpha}\ .$$

* 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→S δx. This new convention, is still inadequate, since if S > 1, the real uncertainty is probably even greater than Sδx. See text.

a. See notes on Stable Particles in text. b. See notes in data card listings. c. Theoretical value. See also data card listings.

‡ In decays with more than two bodies, $\bar p_{max}$ is the maximum momentum that any particle can have.

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Symbol(J^P)		$I^G(J^P)C_n$ (├─┤ = estab.)	Mass M (MeV)	Width Γ (MeV)	$M^2 \pm \Gamma M$(a) $(GeV)^2$	Partial Decay Modes: Mode	Fraction (%)	Q (MeV)	p or p_{max}(b) (MeV/c)	Nonets CP=−1 (0^-)	CP=+1 (0^+)	CP=+1 (1^-)	CP=+1 (1^+)	CP=+1 (2^+)
η(549)	$\eta(0^-)$	$0^+(0^-)+$	548.6	<0.01	0.301	all neutral	73	} See Table S		η				
			±0.4		<.000005	$\pi^+\pi^-\pi^0 + \pi^+\pi^-\gamma$	27							
σ, ε §														
ω(783)	$\phi'(1^-)$	$0^-(1^-)-$	783.4	11.9	0.614	$\pi^+\pi^-\pi^0$	≈ 90	369	328			ω		
			±0.7*	±1.5	±.009	$\pi^+\pi^-$	seen (c)	504	366					
			S=1.8			$\pi^0\gamma$	9.7±0.8	648	380					
						η + neutral	< 1.5	234	199					
						$\pi^+\pi^-\gamma$	< 5	504	366					
						e^+e^-	0.012±.003	782	392					
						$\mu^+\mu^-$	< 0.10	572	377					
η'(958) or X^0	$\eta'(0^-)$	$0^+(0^-)+$	958.3	<4	0.918	ηππ	75 ± 3 S=1.8*	131	232	η'				
			±0.8		<.004	$\pi^+\pi^-\gamma$ (incl. $\rho^0\gamma$)	25 ± 3	679	458					
						for upper limits see footnote (f)								
H§														
φ(1019)	$\phi(1^-)$	$0^-(1^-)-$	1018.6	4.0	1.039	K^+K^-	48 ± 3	31	125			φ		
			±0.5	±1.0	±.004	K_LK_S	40 ± 3	23	107					
				S=1.2*		$\pi^+\pi^-\pi^0$ (incl. ρπ)	12 ± 4	604	461					
						for upper limits see footnote (g)								
$\eta_V(1050) \to K_SK_S$	$\eta(0^+)$	$0^+(0^+)+$	1050	50	1.10	ππ	< 70	780	507		η_V			
	Some data still favor large scattering length				±.05	$K\bar{K}$	> 30	54	167					
f(1250)	$\eta'(2^+)$	$0^+(2^+)+$	1254	117	1.57	ππ	large	975	611					f
			±12	±15	±.15	$2\pi^+2\pi^-$	< 4	696	547					
						$K\bar{K}$	2.3±0.6	258	381					
D(1285)	η'(A)	$0^+(1^+)+$	1285	32	1.65	$K\bar{K}\pi$ (mainly $\pi_V(1003)\pi$) only mode seen		154	304				D	
			±4	±8	±.04	$K^*\bar{K}+\bar{K}^*K$		-100						
						ππρ	not seen	256	356					
E(1420)	η(A)	$0^+(0^-)+$	1424	76	2.03	$K^*\bar{K}+\bar{K}^*K$	50 ±10	38	157	?			E?	
			±7	±9	±.11	$\pi_V(1003)\pi$	50 ±10	284	338					
						ππρ	not seen	395	462					
K_sK_s§ ρρ														
f'(1500)	$\eta(2^+)$	$0^+(2^+)+$	1514	86	2.29	ππ	< 14	1235	744					f'
			±16	±23	±.13	$K\bar{K}$	> 60	518	570					
						$K^*\bar{K}+\bar{K}^*K$	< 40	128	294					
						ηη	not seen	417	522					
$\pi^\pm(140)$	$\pi(0^-)$	$1^-(0^-)+$	139.58		0.019	See Table S				π				
$\pi^0(135)$			134.98		0.018									
$\rho^\pm(760)$	$\rho(1^-)$	$1^+(1^-)-$	778	160	0.605	ππ	≈100	480	353			ρ		
			(h)	(h)	±.124	$\pi^\pm\pi^+\pi^-\pi^0$	< 0.2	206	243					
---------			------	------	------	$\pi^+\pi^-\pi^+\pi^-$	< 0.6	199	238					
						$\pi^0\gamma$	< 0.4	619	367					
$\rho^0(760)$			770	140	0.593	$\eta\pi^\pm$	< 0.8	71	135					
			(h)	(h)	±.108	e^+e^-	$.0065^{+.011}_{-.005}$	759	380					
						$\mu^+\mu^-$	$.0033^{+.0016}_{-.0007}$	549	365					
δ(965)	?( )	1( )	963.1	<5	0.927	$\delta^\pm \to$ 1 charged+neutral(s) ≈ 60								
			±4.2		<.005	$\delta^\pm \to$ ≥3 charged+neutral(s) ≈ 40								
$\pi_V(1003)$	$\pi(0^+)$	$1^-(0^+)+$	1003	70	1.006	$K^\pm K^0$	large	11	75		π_V			
				±15	±.057	ηπ	see note in data listings	315	333					
$\to K\bar{K}$	may also be interpreted as due to large scattering length													
A1(1080)	$\pi(1^+)$	$1^-(1^+)+$	1079	130	1.16	ρπ	≈100	181	245				A_1	
			±8	±40	±.14	$K\bar{K}$	< 0.25, $G=(-1)^{\ell+I}$ forbids this (Eq. 5)							
	unresolved mixture of resonance and "Deck effect"					ηπ	< 1.5	391	385					
						η'π	< 1.5	-19						
B(1210)	ρ(A) ?	$1^+(1^+)-$??	1208	119	1.46	ωπ	≈100	297	339					
			±12	±24	±.14	ππ	< 30	941	594					
				S=1.6*		$K\bar{K}$	< 2	232	358					
						4π	< 50	662	528					
						φπ	< 1.5	66	137					
A2(1300)	$\pi(2^+)$	$1^-(2^+)+$ (d)	1306	81	1.70	ρπ	93 ±3	408	417					A_2
			±8*	±8*	±.11	$K\bar{K}$	3.8±1.3	314	425					
			S=2.6	S=1.4		ηπ	2.9±2.4 S=1.5*	618	527					
						η'π	< 1.5	208	276					
						$\pi^+\pi^-\pi^0$(excl. ρπ)	< 17	892	616					
π(1640) → 3π	π(A) ?	≥1^-(A)+ ?	1640	100	2.69	3π	appears dominant	1235	792					
			±20	±20	±.16	ρπ	< 40	746	636					
						fπ	?	251	319					
						$K\bar{K}$	< 40	644	652					
ρ(1650) g→2π	ρ(V)	1^+(V)− S=1.4*	1637	150	2.68	2π	observed	1358	807					
			±23	±50	±.24	4π	probably observed	1079	758					
	$R_1R_2R_3$ bumps suggest more structure in this peak					ρππ		599	605					
$R_1R_2R_3$§														
S(1930) X^-	?(V) ? (e)	≥1^+( ) ?	1929	≤35	3.72	1 charged } +neutral(s)	6(+15/−6)							
			±14		≤.07	3 charged	92(+ 8/−20)							
						>3 charged	2(+13/−2)							
T(2200) X^-	?( )	≥1	2195	≤13	4.82	1 charged } +neutral(s)	4(+11/−4)							
			±15		≤.03	3 charged	94(+ 6/−19)							
						>3 charged	2(+13/−2)							
U(2380) X^-	?( )	≥1	2382	≤30	5.67	1 charged } +neutral(s)	30 ±10							
			±24		≤.07	3 charged	45 ±15							
						>3 charged	25 ±10							
$K^+(494)$	$K(0^-)$	$1/2(0^-)$	493.78		0.244	See Table S				K				
$K^0(498)$			497.7		0.248									
$K^*(890)$	$K(1^-)$	$1/2(1^-)$	892.4	49.8	0.796	Kπ	≈100	259	288			K^*		
			±0.8	±1.7	±.044	Kππ	< 0.2	119	216					
κ(725)§	$m_0 - m_\pm$ = 3.5±1.8 S=1.2*			S=1.1*										
$K_V(1080)$§														
$K_c(1215)$§														
$K_A(1320)$	K(A) ?	1/2(A) ?	1320	80	1.742	$K^*\pi$ } overlap	large	288	338				K_A	
			±10	± 20	±.106	Kρ		63	198					
	m and Γ values taken from Shen+. Appreciable discrepancies with other experiments. See note in data listings.					Kω	probably seen, < 10	39	155					
						Kπ	< 30	687	558					
						Kη	< 10	278	405					
$K_V(1420)$	$K(2^+)$	$1/2(2^+)$	1411	92	1.991	Kπ	52 ± 5	778	610					K_V
			±5	±7	±.130	$K^*\pi$	36 ± 6	379	407					
			S=1.8*	S=1.2*		Kρ	9 ± 5 } S=2.2*!	158	319					
						Kω	1.0±1.7	134	293					
						Kη	2.1±3.0	368	475					
$K_A(1800)$	K(A)	1/2(A)	1789	80	3.20	Kπ	< 10	1156	819					
			±10	±20	±.14	$K^*\pi$	35 ± 12	762	664					
						$K_V(1420)\pi$	8 ± 5	243	315		tentative		tentative	
$K^*_{3/2}(1175)$§						Kρ	7 ± 5	532	630					
						Remaining Kππ	40 ± 15	1021	801					
$K^*_?(1270)$§						Kω	10 ± 3	508	616					

	(0^-)	(1^-)	(1^+)	(2^+)
$m_8 = \sqrt{K^2 + \frac{K^2-\pi^2}{3}}$ =	566.8 ±0.2	928.4 (i)±3.0	1391. ±13.	1444.3 ±6.9
$\sin^2\theta = \frac{\eta - m_8}{\eta - \eta'}$ =	0.033 ±0.001	0.414 (i)±0.013	0.25 ±0.10	0.29 ±0.06
θ =	10.4°	40.1°	29.7°	32.4°

§ The following bumps, excluded above, are listed among the data cards: σ (410), ε (700), H (975), K_SK_S (1440) and ρρ (1410), R_1, R_2, R_3 (≈1700), κ (725) K_V(1080), K_c(1215), $K^*_{3/2}$(1175), $K^*_?$(1270).

* Quoted error includes scale factor $S = \sqrt{\chi^2/(N-1)}$. See footnote to Table S.
Footnotes continued in right margin.

(a) ΓM is 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 using the averaged central mass values, without taking into account the widths of the resonances.
(c) Reported values range between 1% and 10%, and depend on assumptions on ρ-ω interference.
(d) If A2 → both ρπ and $K\bar{K}$, then $J^P = 2^+$.
(e) S is ρ(V) if identified with $\pi^+\pi^-$ bump at 1910 MeV. See note on mesons.
(f) Empirical limits on fractions for other decay modes of η'(958): $\pi^+\pi^- < 7\%$, $3\pi < 7\%$, $4\pi < 1\%$, $6\pi < 1\%$, $\pi^+\pi^-e^+e^- < 0.6\%$, $\pi^0e^+e^- < 1.3\%$, $\eta e^+e^- < 1.1\%$, $\pi^0\rho^0 < 4\%$, $\pi^0\omega < 8\%$.
(g) Empirical limits on fractions for other decay modes of φ(1019): $\pi^+\pi^- < 20\%$, $\eta\gamma < 3\%$, η + neutrals < 13%, $\pi^+\pi^-\gamma < 4\%$, $e^+e^- < 0.2\%$, $\mu^+\mu^- < 0.5\%$, $\omega\gamma < 5\%$, $\rho\gamma < 2\%$.
(h) m_ρ, Γ_ρ from p-wave fit to compiled spectrum of 2-4 GeV/c $\pi^+p \to \Delta^{++}\rho^0$, $|t| < 10\ m_\pi^2$, and comparison of $\rho^\pm - \rho^0$ in similar reactions. Results depend on background and t-cut, hence real errors unknown, but larger than statistical errors ~ 5 MeV. (See Matts Roos, Phys. Letters, to be publ.) Note contrast between Roos' p-wave fit vs. weighted average of published results (see listings). m(±) 778 vs. 757; m(0) 770 vs. 760, Γ(±) 160 vs. 132, Γ(0) 140 vs. 116. This demonstrates present uncertainty.
(i) Error on m_ρ taken to be 10 MeV.

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	Particle or resonance	$I(J^P)$ ⊢⊣ = estab.	Beam π, K (BeV/c)	Mass (MeV)	Γ (MeV)	$M^2 \pm \Gamma M$ (BeV^2)	Mode	Fraction (%)	Q (MeV)	p or $p^{\ddagger}_{max}$ (MeV/c)	$4\pi\lambda\!\!\!^{-2}$ (mb)
$N^*_{1/2}$	p	1/2(1/2+)		938.3		0.880	See Table S				
	n			939.6		0.883					
	N'(1400)	1/2(1/2+) P_{11}	T=0.43πp p=0.55	~1400[a]	~200	1.96 ±0.28	Nπ	70	322	367	36.3
	N(1525)	1/2(3/2−) D_{13}	T=0.62 p=0.75	1525[a]	105	2.33 ±0.16	Nπ Nππ [Δ(1236)π][e]	65 35 [~ 20]	447 308 149	460 414 229	23.2
	N(1570)	1/2(1/2−) S_{11}	T=0.69 p=0.82	1570[a]	130	2.46 ±0.20	Nπ Nη	~ 30 ~ 70	492 82	491 242	20.3
	N(1670)	1/2(5/2−) D_{15}	T=0.87 p=1.00	1670[a]	140	2.79 ±0.23	Nπ Nππ [Δ(1236)π][e] ΛK Nη	40 dominant[a] [?] small small	592 453 294 57 182	560 526 357 200 368	15.6
	N(1688)	1/2(5/2+) F_{15}	T=0.90 p=1.03	1688[a]	110	2.85 ±0.19	Nπ Nππ [Δ(1236)π][e] ΛK Nη	65 dominant[a] [?] small small	610 471 312 75 200	572 538 372 231 388	14.9
	N'(1700)[c]	1/2(1/2−) S_{11}	T=0.92 p=1.05	1700[a]	240	2.89 ±0.41	Nπ	100	622	580	14.5
	N(2190)	1/2(7/2−)	T=1.94 p=2.07	2190	200	4.80 ±0.44	Nπ ΛK	30 ?	1112 577	888 710	6.21
	N(2650)	1/2(11/2−)[b]	T=3.12 p=3.26	2650 ± 10	~300	7.02 ±0.80	Nπ ΛK	7 ?	1572 1037	1154 1022	3.67
	N(3030)[c]	1/2(15/2−)[b]	T=4.26 p=4.40	3030	400	9.18 ±1.21	Nπ	0.7	1972	1377	2.62
$N^*_{3/2}$	Δ(1236)	3/2(3/2+) P_{33}	T=0.195 p=0.304	(++) 1236.0 ±0.6	120 ±2	1.53 ±0.15	Nπ $N\pi^+\pi^-$	100 0	158 18	231 89	91.9
		$m_0 - m_{++} = 0.45 \pm 0.85$		$m_- - m_{++} = 7.9 \pm 6.8$							
	Δ(1670)	3/2(1/2−) S_{31}	T=0.87 p=1.00	1670[a]	~180	2.79 ±0.30	Nπ Nππ	40 ?	592 453	560 526	15.6
	Δ(1920)	3/2(7/2+)	T=1.35 p=1.48	1920	200	3.69 ±0.38	Nπ ΣK	50 seen	842 229	722 423	9.37
	Δ(2420)	3/2(11/2+)[b]	T=2.51 p=2.65	2423 ±10	~275	5.87 ±0.67	Nπ ΣK	10 ?	1345 732	1024 830	4.66
	Δ(2850)	3/2(15/2+)[b]	T=3.71 p=3.85	2850 ±12	~300	8.12 ±0.86	Nπ	3	1772	1266	3.05
	Δ(3230)[c]	3/2(19/2+)[b]	T=4.94 p=5.08	3230	440	10.4 ±1.4	Nπ	0.6	2152	1475	2.24
Z^*_0	Z_0(1865)[c]	0(?)	p=1.15 K^+p	1863	150	3.47 ±0.28	NK	55 (if J = 1/2)	432	579	14.6
Y^*_0	Λ	0(1/2+)		1115.6		1.24	See Table S				
	Λ(1405)[d]	0(1/2−)	p<0 K^-p	1405	35	1.97 ±0.05	Σπ	100	68	142	
	Λ(1520)	0(3/2−)	p=0.392	1518.8 ±1.5	16 ±2	2.31 ±0.02	NK̄ Σπ Λππ	S=1.7* → { 39±5 51±6 10±2 }	81 182 124	235 258 251	83.6
	Λ(1670)[a]	0(1/2−)	p=0.74	1670	18	2.79 ±0.03	Λη NK̄	$K^-p \to \Lambda\eta$ seen	6 233	66 410	28.5
	Λ(1700)	0(3/2−)	p=0.80	1700 ±10	40 ±10	2.89 ±0.07	NK̄ Σπ	20 seen	263 363	438 411	25.0
	Λ(1820)	0(5/2+)	p=1.06	1819.5 ±3.5	83 ± 8	3.31 ±0.15	NK̄ Σπ Σ(1385)π Λη	70 11 18 ~ 1	392 482 295 155	541 502 362 349	16.5
	Λ(2100)	0(7/2−)	p=1.68	2100	160	4.41 ±0.34	NK̄ Σπ	29 seen	663 763	748 699	8.68
	Λ(2340)	0(?)	p=2.27	2340 ±20	105	5.48 ±0.25	NK̄ seen in σ(total)	10 ↳ if J = 9/2	903	907	5.92
Y^*_1	Σ	1(1/2+)		(+)1189.5 (0)1192.6 (−)1197.4		1.41 1.42 1.43	See Table S				
	Σ(1385)	1(3/2+)	p<0 K^-p	(+)1382.2±0.9 S=1.6* S=4.8* ← (−)1388.0±3.0	(+)37±3 S=2.1* (−)38±8, S=3.7*	1.92 ±0.05	Λπ Σπ	91±3 9±3 S=1.4*	130 48	208 117	
	Σ(1660)[a]	1(3/2−)	p=0.72	1660	50	2.76 ±0.08	Λ(1405)π Σπ Λπ NK̄	large ? ? small	115 323 405 223	197 379 439 400	29.9
		Large contradictions among measured branching ratios.									
	Σ(1770)	1(5/2−)	p=0.95	1768 ±4 S=1.5*	89 ±12 S=2.0*	3.13 ±0.16	NK̄ Λπ Λ(1520)π Σ(1385)π Ση Σπ	49 17 19 12 2 < 1	331 517 110 243 27 431	498 520 192 318 143 463	19.4
	Σ(1910)[c]	1(5/2+)	p=1.25	1910 ±10	60	3.65 ±0.11	NK̄ Λπ Σπ	8 10 3	473 655 573	612 619 568	12.9
	Σ(2035)	1(7/2+)	p=1.53	2035 ±15	160	4.14 ±0.33	NK̄ Λπ Σπ	16 25 seen	598 784 698	703 703 655	9.83
	Σ(2260)[c]	1(?)	p=2.06	2260 ±20	180	5.11 ±0.41	NK̄ seen in σ(total)	14 ↳ if J = 9/2	823	855	6.66
$\Xi^*_{1/2}$	Ξ	1/2(1/2+)		(0)1314.7 (−)1321.2		1.73 1.75	See Table S				
	Ξ(1530)	1/2(3/2+) p-wave		(0)1528.9±1.1 (−)1533.8±1.9	7.3 ±1.7	2.34 ±0.01	Ξπ	100	69	145	
	Ξ(1815)	1/2(?)		1815 ±3	16 ±8 S=2.2*	3.29 ±0.03	ΛK̄ Ξπ Ξππ [Ξ(1530)π][e]	~ 65 ~ 10 ~ 25 [~ 20]	202 354 215 145	391 409 351 229	
		Branching ratios poorly known									
	Ξ(1930)	1/2(?)		1933 ±16	140 ±35	3.74 ±0.27	Ξπ ΛK̄	seen seen	472 320	501 504	
Ω^-	Ω^-	0(3/2+)		1674		2.80	See Table S				

a. See note in data listings.
b. J^P assignment based on straight-line Regge-trajectory-recurrence hypothesis and supported by fits to πp elastic scattering at 180°. See note following data listings.
c. Evidence for the existence of the effect and/or for its interpretation as a resonance is open to some question.
d. A virtual bound state of the K̄N system with negative scattering length [$a_0 = (-1.6 + 0.6i)F$]; i.e., a pole in the S matrix below the elastic threshold. See notes in main text and data listings.
e. Square brackets indicate a sub-reaction of the previous unbracketed decay mode.

† at left of 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 listings for information on the following: N_2(3245), N(3695), $N^*_{5/2}$(1560), Z^*_1(1910), Σ(1780), Σ(3000), Ξ(1705), and Ξ_2(2270).
* Quoted error includes an S (scale) factor. See footnote to Table S.
‡ 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.