

$c\bar{c}$ MESONS

(including possibly non- $q\bar{q}$ states)

 $\eta_c(1S)$

$$J^{PC} = 0^+(0^-+)$$

Mass $m = 2983.9 \pm 0.5$ MeV ($S = 1.3$)Full width $\Gamma = 32.0 \pm 0.8$ MeV

$\eta_c(1S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (MeV/c)
Decays involving hadronic resonances			
$\eta'(958)\pi\pi$	(4.1 \pm 1.7) %		1323
$\rho\rho$	(1.8 \pm 0.5) %		1275
$K^*(892)^0 K^- \pi^+ + \text{c.c.}$	(2.0 \pm 0.7) %		1278
$K^*(892)\bar{K}^*(892)$	(7.1 \pm 1.3) $\times 10^{-3}$		1196
$K^*(892)^0 \bar{K}^*(892)^0 \pi^+ \pi^-$	(1.1 \pm 0.5) %		1073
$\phi K^+ K^-$	(2.9 \pm 1.4) $\times 10^{-3}$		1104
$\phi\phi$	(1.79 \pm 0.20) $\times 10^{-3}$		1089
$\phi 2(\pi^+ \pi^-)$	$< 4 \times 10^{-3}$	90%	1251
$a_0(980)\pi$	< 2 %	90%	1327
$a_2(1320)\pi$	< 2 %	90%	1196
$K^*(892)\bar{K} + \text{c.c.}$	< 1.28 %	90%	1310
$f_2(1270)\eta$	< 1.1 %	90%	1145
$\omega\omega$	$< 3.1 \times 10^{-3}$	90%	1270
$\omega\phi$	$< 2.5 \times 10^{-4}$	90%	1185
$f_2(1270)f_2(1270)$	(9.8 \pm 2.5) $\times 10^{-3}$		774
$f_2(1270)f_2'(1525)$	(9.8 \pm 3.2) $\times 10^{-3}$		513
$f_0(980)\eta$	seen		1264
$f_0(1500)\eta$	seen		1026
$f_0(2200)\eta$	seen		497
$a_0(980)\pi$	seen		1327
$a_0(1320)\pi$	seen		-
$a_0(1450)\pi$	seen		1123
$a_0(1950)\pi$	seen		860
$a_2(1950)\pi$	not seen		-
$K_0^*(1430)\bar{K}$	seen		-
$K_2^*(1430)\bar{K}$	seen		-
$K_0^*(1950)\bar{K}$	seen		-
Decays into stable hadrons			
$K\bar{K}\pi$	(7.3 \pm 0.5) %		1381
$K\bar{K}\eta$	(1.36 \pm 0.16) %		1265

$\eta\pi^+\pi^-$	(1.7 ±0.5) %		1428
$\eta 2(\pi^+\pi^-)$	(4.4 ±1.3) %		1386
$K^+K^-\pi^+\pi^-$	(6.9 ±1.1) × 10 ⁻³		1345
$K^+K^-\pi^+\pi^-\pi^0$	(3.5 ±0.6) %		1304
$K^0K^-\pi^+\pi^-\pi^++c.c.$	(5.6 ±1.5) %		—
$K^+K^-2(\pi^+\pi^-)$	(7.5 ±2.4) × 10 ⁻³		1254
$2(K^+K^-)$	(1.47±0.31) × 10 ⁻³		1055
$\pi^+\pi^-\pi^0$	< 5 × 10 ⁻⁴	90%	1476
$\pi^+\pi^-\pi^0\pi^0$	(4.7 ±1.0) %		1460
$2(\pi^+\pi^-)$	(9.7 ±1.2) × 10 ⁻³		1459
$2(\pi^+\pi^-\pi^0)$	(17.4 ±3.3) %		1409
$3(\pi^+\pi^-)$	(1.8 ±0.4) %		1407
$p\bar{p}$	(1.52±0.16) × 10 ⁻³		1160
$p\bar{p}\pi^0$	(3.6 ±1.3) × 10 ⁻³		1101
$\Lambda\bar{\Lambda}$	(1.09±0.24) × 10 ⁻³		991
$\Sigma^+\bar{\Sigma}^-$	(2.1 ±0.6) × 10 ⁻³		901
$\Xi^-\bar{\Xi}^+$	(9.0 ±2.6) × 10 ⁻⁴		692
$\pi^+\pi^-p\bar{p}$	(5.3 ±1.8) × 10 ⁻³		1027

Radiative decays

$\gamma\gamma$	(1.57±0.12) × 10 ⁻⁴		1492
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**Charge conjugation (C), Parity (P),
Lepton family number (LF) violating modes**

$\pi^+\pi^-$	<i>P,CP</i>	< 1.1 × 10 ⁻⁴	90%	1485
$\pi^0\pi^0$	<i>P,CP</i>	< 4 × 10 ⁻⁵	90%	1486
K^+K^-	<i>P,CP</i>	< 6 × 10 ⁻⁴	90%	1408
$K_S^0K_S^0$	<i>P,CP</i>	< 3.1 × 10 ⁻⁴	90%	1406

J/ψ(1S)

$$I^G(J^{PC}) = 0^-(1^{--})$$

Mass $m = 3096.900 \pm 0.006$ MeV
 Full width $\Gamma = 92.9 \pm 2.8$ keV ($S = 1.1$)
 $\Gamma_{ee} = 5.55 \pm 0.14 \pm 0.02$ keV

J/ψ(1S) DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level(MeV/c)	<i>p</i>
hadrons	(87.7 ± 0.5) %		—
virtual $\gamma \rightarrow$ hadrons	(13.50 ± 0.30) %		—
ggg	(64.1 ± 1.0) %		—
γgg	(8.8 ± 1.1) %		—
e^+e^-	(5.971± 0.032) %		1548
$e^+e^-\gamma$	[a] (8.8 ± 1.4) × 10 ⁻³		1548
$\mu^+\mu^-$	(5.961± 0.033) %		1545

Decays involving hadronic resonances

$\rho\pi$	(1.69 ± 0.15) %	S=2.4	1448
$\rho^0\pi^0$	(5.6 ± 0.7) × 10 ⁻³		1448
$\rho(770)^\mp K^\pm K_S^0$	(1.9 ± 0.4) × 10 ⁻³		–
$\rho(1450)\pi \rightarrow \pi^+\pi^-\pi^0$	(2.3 ± 0.7) × 10 ⁻³		–
$\rho(1450)^\pm\pi^\mp \rightarrow K_S^0 K^\pm\pi^\mp$	(3.5 ± 0.6) × 10 ⁻⁴		–
$\rho(1450)^0\pi^0 \rightarrow K^+K^-\pi^0$	(2.0 ± 0.5) × 10 ⁻⁴		–
$\rho(1450)\eta'(958) \rightarrow$ $\pi^+\pi^-\eta'(958)$	(3.3 ± 0.7) × 10 ⁻⁶		–
$\rho(1700)\pi \rightarrow \pi^+\pi^-\pi^0$	(1.7 ± 1.1) × 10 ⁻⁴		–
$\rho(2150)\pi \rightarrow \pi^+\pi^-\pi^0$	(8 ± 40) × 10 ⁻⁶		–
$a_2(1320)\rho$	(1.09 ± 0.22) %		1123
$\omega\pi^+\pi^+\pi^-\pi^-$	(8.5 ± 3.4) × 10 ⁻³		1392
$\omega\pi^+\pi^-\pi^0$	(4.0 ± 0.7) × 10 ⁻³		1418
$\omega\pi^+\pi^-$	(8.6 ± 0.7) × 10 ⁻³	S=1.1	1435
$\omega f_2(1270)$	(4.3 ± 0.6) × 10 ⁻³		1142
$K^*(892)^0\bar{K}^*(892)^0$	(2.3 ± 0.6) × 10 ⁻⁴		1266
$K^*(892)^\pm K^*(892)^\mp$	(1.00 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ $\begin{smallmatrix} 0.22 \\ 0.40 \end{smallmatrix}$) × 10 ⁻³		1266
$K^*(892)^\pm K^*(700)^\mp$	(1.1 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ $\begin{smallmatrix} 1.0 \\ 0.6 \end{smallmatrix}$) × 10 ⁻³		–
$K_S^0\pi^- K^*(892)^+ + \text{c.c.}$	(2.0 ± 0.5) × 10 ⁻³		1342
$K_S^0\pi^- K^*(892)^+ + \text{c.c.} \rightarrow$ $K_S^0 K_S^0\pi^+\pi^-$	(6.7 ± 2.2) × 10 ⁻⁴		–
$\eta K^*(892)^0\bar{K}^*(892)^0$	(1.15 ± 0.26) × 10 ⁻³		1003
$K^*(1410)\bar{K} + \text{c.c.} \rightarrow$ $K^\pm K^\mp\pi^0$	(4.9 ± 2.8) × 10 ⁻⁵		–
$K^*(1410)\bar{K} + \text{c.c.} \rightarrow$ $K_S^0 K^\pm\pi^\mp$	(8 ± 6) × 10 ⁻⁵		–
$K_2^*(1430)\bar{K} + \text{c.c.} \rightarrow$ $K^\pm K^\mp\pi^0$	(7.5 ± 3.5) × 10 ⁻⁵		–
$K_2^*(1430)\bar{K} + \text{c.c.} \rightarrow$ $K_S^0 K^\pm\pi^\mp$	(4.0 ± 1.0) × 10 ⁻⁴		–
$K^*(892)^0\bar{K}_2^*(1430)^0 + \text{c.c.}$	(4.66 ± 0.31) × 10 ⁻³		1012
$K^*(892)^+ K_2^*(1430)^- + \text{c.c.}$	(3.4 ± 2.9) × 10 ⁻³		1012
$K^*(892)^+ K_2^*(1430)^- + \text{c.c.} \rightarrow$ $K^*(892)^+ K_S^0\pi^- + \text{c.c.}$	(4 ± 4) × 10 ⁻⁴		–
$K^*(892)^0\bar{K}_2^*(1770)^0 + \text{c.c.} \rightarrow$ $K^*(892)^0 K^-\pi^+ + \text{c.c.}$	(6.9 ± 0.9) × 10 ⁻⁴		–
$\omega K^*(892)\bar{K} + \text{c.c.}$	(6.1 ± 0.9) × 10 ⁻³		1097
$\bar{K} K^*(892) + \text{c.c.} \rightarrow$ $K_S^0 K^\pm\pi^\mp$	(5.1 ± 0.5) × 10 ⁻³		–
$K^+ K^*(892)^- + \text{c.c.}$	(5.12 ± 0.30) × 10 ⁻³		1373

$K^+ K^*(892)^- + \text{c.c.} \rightarrow$	$(1.97 \pm 0.20) \times 10^{-3}$	–
$K^+ K^- \pi^0$		
$K^+ K^*(892)^- + \text{c.c.} \rightarrow$	$(3.0 \pm 0.4) \times 10^{-3}$	–
$K^0 K^\pm \pi^\mp + \text{c.c.}$		
$K^0 \bar{K}^*(892)^0 + \text{c.c.}$	$(4.39 \pm 0.31) \times 10^{-3}$	1373
$K^0 \bar{K}^*(892)^0 + \text{c.c.} \rightarrow$	$(3.2 \pm 0.4) \times 10^{-3}$	–
$K^0 K^\pm \pi^\mp + \text{c.c.}$		
$K_1(1400)^\pm K^\mp$	$(3.8 \pm 1.4) \times 10^{-3}$	1170
$\bar{K}^*(892)^0 K^+ \pi^- + \text{c.c.}$	seen	1343
$K^*(892)^\pm K^\mp \pi^0$	$(4.1 \pm 1.3) \times 10^{-3}$	1344
$K^*(892)^0 K_S^0 \pi^0$	$(6 \pm 4) \times 10^{-4}$	1343
$\omega \pi^0 \pi^0$	$(3.4 \pm 0.8) \times 10^{-3}$	1436
$b_1(1235)^\pm \pi^\mp$	[b] $(3.0 \pm 0.5) \times 10^{-3}$	1300
$\omega K^\pm K_S^0 \pi^\mp$	[b] $(3.4 \pm 0.5) \times 10^{-3}$	1210
$b_1(1235)^0 \pi^0$	$(2.3 \pm 0.6) \times 10^{-3}$	1300
$\eta K^\pm K_S^0 \pi^\mp$	[b] $(2.2 \pm 0.4) \times 10^{-3}$	1278
$\phi K^*(892) \bar{K} + \text{c.c.}$	$(2.18 \pm 0.23) \times 10^{-3}$	969
$\omega K \bar{K}$	$(1.70 \pm 0.32) \times 10^{-3}$	1268
$\omega f_0(1710) \rightarrow \omega K \bar{K}$	$(4.8 \pm 1.1) \times 10^{-4}$	878
$\phi 2(\pi^+ \pi^-)$	$(1.66 \pm 0.23) \times 10^{-3}$	1318
$\Delta(1232)^{++} \bar{p} \pi^-$	$(1.6 \pm 0.5) \times 10^{-3}$	1030
$\omega \eta$	$(1.74 \pm 0.20) \times 10^{-3}$	S=1.6 1394
$\phi K \bar{K}$	$(1.77 \pm 0.16) \times 10^{-3}$	S=1.3 1179
$\phi K_S^0 K_S^0$	$(5.9 \pm 1.5) \times 10^{-4}$	1176
$\phi f_0(1710) \rightarrow \phi K \bar{K}$	$(3.6 \pm 0.6) \times 10^{-4}$	875
$\phi K^+ K^-$	$(8.3 \pm 1.2) \times 10^{-4}$	1179
$\phi f_2(1270)$	$(3.2 \pm 0.6) \times 10^{-4}$	1036
$\Delta(1232)^{++} \bar{\Delta}(1232)^{--}$	$(1.10 \pm 0.29) \times 10^{-3}$	938
$\Sigma(1385)^- \bar{\Sigma}(1385)^+ (\text{or c.c.})$	[b] $(1.16 \pm 0.05) \times 10^{-3}$	697
$\Sigma(1385)^0 \bar{\Sigma}(1385)^0$	$(1.07 \pm 0.08) \times 10^{-3}$	697
$K^+ K^- f_2'(1525)$	$(1.04 \pm 0.35) \times 10^{-3}$	892
$\phi f_2'(1525)$	$(8 \pm 4) \times 10^{-4}$	S=2.7 871
$\phi \pi^+ \pi^-$	$(8.7 \pm 0.9) \times 10^{-4}$	S=1.4 1365
$\phi \pi^0 \pi^0$	$(5.0 \pm 1.0) \times 10^{-4}$	1366
$\phi K^\pm K_S^0 \pi^\mp$	[b] $(7.2 \pm 0.8) \times 10^{-4}$	1114
$\omega f_1(1420)$	$(6.8 \pm 2.4) \times 10^{-4}$	1062
$\phi \eta$	$(7.5 \pm 0.8) \times 10^{-4}$	S=1.5 1320
$\Xi^0 \Xi^0$	$(1.17 \pm 0.04) \times 10^{-3}$	818
$\Xi(1530)^- \Xi^+$	$(5.9 \pm 1.5) \times 10^{-4}$	600
$p K^- \bar{\Sigma}(1385)^0$	$(5.1 \pm 3.2) \times 10^{-4}$	646
$\omega \pi^0$	$(4.5 \pm 0.5) \times 10^{-4}$	S=1.4 1446
$\omega \pi^0 \rightarrow \pi^+ \pi^- \pi^0$	$(1.7 \pm 0.8) \times 10^{-5}$	–
$\phi \eta'(958)$	$(4.6 \pm 0.5) \times 10^{-4}$	S=2.2 1192
$\phi f_0(980)$	$(3.2 \pm 0.9) \times 10^{-4}$	S=1.9 1178

$\phi f_0(980) \rightarrow \phi \pi^+ \pi^-$	$(2.59 \pm 0.34) \times 10^{-4}$		—
$\phi f_0(980) \rightarrow \phi \pi^0 \pi^0$	$(1.8 \pm 0.5) \times 10^{-4}$		—
$\phi \pi^0 f_0(980) \rightarrow \phi \pi^0 \pi^+ \pi^-$	$(4.5 \pm 1.0) \times 10^{-6}$		—
$\phi \pi^0 f_0(980) \rightarrow \phi \pi^0 \rho^0 \pi^0$	$(1.7 \pm 0.6) \times 10^{-6}$		1045
$\eta \phi f_0(980) \rightarrow \eta \phi \pi^+ \pi^-$	$(3.2 \pm 1.0) \times 10^{-4}$		—
$\phi a_0(980)^0 \rightarrow \phi \eta \pi^0$	$(5 \pm 4) \times 10^{-6}$		—
$\Xi(1530)^0 \Xi^0$	$(3.2 \pm 1.4) \times 10^{-4}$		608
$\Sigma(1385)^- \bar{\Sigma}^+$ (or c.c.)	[b] $(3.1 \pm 0.5) \times 10^{-4}$		855
$\phi f_1(1285)$	$(2.6 \pm 0.5) \times 10^{-4}$		1032
$\phi f_1(1285) \rightarrow$	$(9.4 \pm 2.8) \times 10^{-7}$		952
$\phi \pi^0 f_0(980) \rightarrow$			
$\phi \pi^0 \pi^+ \pi^-$			
$\phi f_1(1285) \rightarrow$	$(2.1 \pm 2.2) \times 10^{-7}$		955
$\phi \pi^0 f_0(980) \rightarrow$			
$\phi \pi^0 \pi^0 \pi^0$			
$\eta \pi^+ \pi^-$	$(4.0 \pm 1.7) \times 10^{-4}$		1487
$\eta \rho$	$(1.93 \pm 0.23) \times 10^{-4}$		1396
$\omega \eta'(958)$	$(1.89 \pm 0.18) \times 10^{-4}$		1279
$\omega f_0(980)$	$(1.4 \pm 0.5) \times 10^{-4}$		1267
$\rho \eta'(958)$	$(8.1 \pm 0.8) \times 10^{-5}$	S=1.6	1281
$a_2(1320)^\pm \pi^\mp$	[b] < 4.3	$\times 10^{-3}$	CL=90% 1263
$K \bar{K}_2^*(1430)^+ \text{ c.c.}$	< 4.0	$\times 10^{-3}$	CL=90% 1159
$K_1(1270)^\pm K^\mp$	< 3.0	$\times 10^{-3}$	CL=90% 1231
$K_S^0 \pi^- K_2^*(1430)^+ + \text{ c.c.}$	$(3.6 \pm 1.8) \times 10^{-3}$		1117
$K_S^0 \pi^- K_2^*(1430)^+ + \text{ c.c.} \rightarrow$	$(4.5 \pm 2.2) \times 10^{-4}$		—
$K_S^0 K_S^0 \pi^+ \pi^-$			
$K_2^*(1430)^0 \bar{K}_2^*(1430)^0$	< 2.9	$\times 10^{-3}$	CL=90% 604
$\phi \pi^0$	3×10^{-6} or 1×10^{-7}		1377
$\phi \eta(1405) \rightarrow \phi \eta \pi^+ \pi^-$	$(2.0 \pm 1.0) \times 10^{-5}$		946
$\omega f_2'(1525)$	< 2.2	$\times 10^{-4}$	CL=90% 1003
$\omega X(1835) \rightarrow \omega p \bar{p}$	< 3.9	$\times 10^{-6}$	CL=95% —
$\phi X(1835) \rightarrow \phi p \bar{p}$	< 2.1	$\times 10^{-7}$	CL=90% —
$\phi X(1835) \rightarrow \phi \eta \pi^+ \pi^-$	< 2.8	$\times 10^{-4}$	CL=90% 578
$\phi X(1870) \rightarrow \phi \eta \pi^+ \pi^-$	< 6.13	$\times 10^{-5}$	CL=90% —
$\eta \phi(2170) \rightarrow \eta \phi f_0(980) \rightarrow$	$(1.2 \pm 0.4) \times 10^{-4}$		628
$\eta \phi \pi^+ \pi^-$			
$\eta \phi(2170) \rightarrow$	< 2.52	$\times 10^{-4}$	CL=90% —
$\eta K^*(892)^0 \bar{K}^*(892)^0$			
$\Sigma(1385)^0 \bar{\Lambda} + \text{ c.c.}$	< 8.2	$\times 10^{-6}$	CL=90% 912
$\Delta(1232)^+ \bar{p}$	< 1	$\times 10^{-4}$	CL=90% 1100
$\Lambda(1520) \bar{\Lambda} + \text{ c.c.} \rightarrow \gamma \Lambda \bar{\Lambda}$	< 4.1	$\times 10^{-6}$	CL=90% —
$\Theta(1540) \bar{\Theta}(1540) \rightarrow$	< 1.1	$\times 10^{-5}$	CL=90% —
$K_S^0 p K^- \bar{n} + \text{ c.c.}$			
$\Theta(1540) K^- \bar{n} \rightarrow K_S^0 p K^- \bar{n}$	< 2.1	$\times 10^{-5}$	CL=90% —

$\Theta(1540) K_S^0 \bar{p} \rightarrow K_S^0 \bar{p} K^+ n$	< 1.6	$\times 10^{-5}$	CL=90%	—
$\bar{\Theta}(1540) K^+ n \rightarrow K_S^0 \bar{p} K^+ n$	< 5.6	$\times 10^{-5}$	CL=90%	—
$\bar{\Theta}(1540) K_S^0 p \rightarrow K_S^0 p K^- \bar{n}$	< 1.1	$\times 10^{-5}$	CL=90%	—
$\Sigma^0 \bar{\Lambda}$	< 9	$\times 10^{-5}$	CL=90%	1032

Decays into stable hadrons

$2(\pi^+ \pi^-) \pi^0$	$(4.1 \pm 0.5) \%$		S=2.4	1496
$3(\pi^+ \pi^-) \pi^0$	$(2.9 \pm 0.6) \%$			1433
$\pi^+ \pi^- \pi^0$	$(2.11 \pm 0.07) \%$		S=1.5	1533
$\pi^+ \pi^- \pi^0 K^+ K^-$	$(1.79 \pm 0.29) \%$		S=2.2	1368
$4(\pi^+ \pi^-) \pi^0$	$(9.0 \pm 3.0) \times 10^{-3}$			1345
$\pi^+ \pi^- K^+ K^-$	$(6.84 \pm 0.32) \times 10^{-3}$			1407
$\pi^+ \pi^- K_S^0 K_L^0$	$(3.8 \pm 0.6) \times 10^{-3}$			1406
$\pi^+ \pi^- K_S^0 K_S^0$	$(1.68 \pm 0.19) \times 10^{-3}$			1406
$\pi^\pm \pi^0 K^\mp K_S^0$	$(5.7 \pm 0.5) \times 10^{-3}$			1408
$K^+ K^- K_S^0 K_S^0$	$(4.1 \pm 0.8) \times 10^{-4}$			1127
$\pi^+ \pi^- K^+ K^- \eta$	$(1.84 \pm 0.28) \times 10^{-3}$			1221
$\pi^0 \pi^0 K^+ K^-$	$(2.12 \pm 0.23) \times 10^{-3}$			1410
$\pi^0 \pi^0 K_S^0 K_L^0$	$(1.9 \pm 0.4) \times 10^{-3}$			1408
$K \bar{K} \pi$	$(6.1 \pm 1.0) \times 10^{-3}$			1442
$K^+ K^- \pi^0$	$(2.14 \pm 0.24) \times 10^{-3}$			1442
$K_S^0 K^\pm \pi^\mp$	$(5.6 \pm 0.5) \times 10^{-3}$			1440
$K_S^0 K_L^0 \pi^0$	$(2.06 \pm 0.27) \times 10^{-3}$			1440
$K^*(892)^0 \bar{K}^0 + c.c. \rightarrow K_S^0 K_L^0 \pi^0$	$(1.21 \pm 0.18) \times 10^{-3}$			—
$K_2^*(1430)^0 \bar{K}^0 + c.c. \rightarrow K_S^0 K_L^0 \pi^0$	$(4.3 \pm 1.3) \times 10^{-4}$			—
$K_S^0 K_L^0 \eta$	$(1.44 \pm 0.34) \times 10^{-3}$			1328
$2(\pi^+ \pi^-)$	$(3.57 \pm 0.30) \times 10^{-3}$			1517
$3(\pi^+ \pi^-)$	$(4.3 \pm 0.4) \times 10^{-3}$			1466
$2(\pi^+ \pi^- \pi^0)$	$(1.62 \pm 0.21) \%$			1468
$2(\pi^+ \pi^-) \eta$	$(2.29 \pm 0.24) \times 10^{-3}$			1446
$3(\pi^+ \pi^-) \eta$	$(7.2 \pm 1.5) \times 10^{-4}$			1379
$p \bar{p}$	$(2.121 \pm 0.029) \times 10^{-3}$			1232
$p \bar{p} \pi^0$	$(1.19 \pm 0.08) \times 10^{-3}$		S=1.1	1176
$p \bar{p} \pi^+ \pi^-$	$(6.0 \pm 0.5) \times 10^{-3}$		S=1.3	1107
$p \bar{p} \pi^+ \pi^- \pi^0$	$(2.3 \pm 0.9) \times 10^{-3}$	[c]	S=1.9	1033
$p \bar{p} \eta$	$(2.00 \pm 0.12) \times 10^{-3}$			948
$p \bar{p} \rho$	< 3.1	$\times 10^{-4}$	CL=90%	774
$p \bar{p} \omega$	$(9.8 \pm 1.0) \times 10^{-4}$		S=1.3	768
$p \bar{p} \eta'(958)$	$(2.1 \pm 0.4) \times 10^{-4}$			596
$p \bar{p} a_0(980) \rightarrow p \bar{p} \pi^0 \eta$	$(6.8 \pm 1.8) \times 10^{-5}$			—
$p \bar{p} \phi$	$(5.19 \pm 0.33) \times 10^{-5}$			527

$n\bar{n}$		$(2.09 \pm 0.16) \times 10^{-3}$		1231
$n\bar{n}\pi^+\pi^-$		$(4 \pm 4) \times 10^{-3}$		1106
$\Sigma^+\bar{\Sigma}^-$		$(1.50 \pm 0.24) \times 10^{-3}$		992
$\Sigma^0\bar{\Sigma}^0$		$(1.172 \pm 0.031) \times 10^{-3}$	S=1.4	988
$2(\pi^+\pi^-)K^+K^-$		$(4.7 \pm 0.7) \times 10^{-3}$	S=1.3	1320
$p\bar{n}\pi^-$		$(2.12 \pm 0.09) \times 10^{-3}$		1174
$nN(1440)$		seen		978
$nN(1520)$		seen		928
$nN(1535)$		seen		917
$\Xi^-\bar{\Xi}^+$		$(9.7 \pm 0.8) \times 10^{-4}$	S=1.4	807
$\Lambda\bar{\Lambda}$		$(1.89 \pm 0.08) \times 10^{-3}$	S=2.5	1074
$\Lambda\bar{\Sigma}^-\pi^+$ (or c.c.)	[b]	$(8.3 \pm 0.7) \times 10^{-4}$	S=1.2	950
$pK^-\bar{\Lambda}$		$(8.9 \pm 1.6) \times 10^{-4}$		876
$2(K^+K^-)$		$(7.4 \pm 0.7) \times 10^{-4}$		1131
$pK^-\bar{\Sigma}^0$		$(2.9 \pm 0.8) \times 10^{-4}$		819
K^+K^-		$(2.86 \pm 0.21) \times 10^{-4}$		1468
$K_S^0 K_L^0$		$(1.95 \pm 0.11) \times 10^{-4}$	S=2.4	1466
$\Lambda\bar{\Lambda}\pi^+\pi^-$		$(4.3 \pm 1.0) \times 10^{-3}$		903
$\Lambda\bar{\Lambda}\eta$		$(1.62 \pm 0.17) \times 10^{-4}$		672
$\Lambda\bar{\Lambda}\pi^0$		$(3.8 \pm 0.4) \times 10^{-5}$		998
$\bar{\Lambda}nK_S^0 + \text{c.c.}$		$(6.5 \pm 1.1) \times 10^{-4}$		872
$\pi^+\pi^-$		$(1.47 \pm 0.14) \times 10^{-4}$		1542
$\Lambda\bar{\Sigma} + \text{c.c.}$		$(2.83 \pm 0.23) \times 10^{-5}$		1034
$K_S^0 K_S^0$		$< 1.4 \times 10^{-8}$	CL=95%	1466

Radiative decays

3γ		$(1.16 \pm 0.22) \times 10^{-5}$		1548
4γ		$< 9 \times 10^{-6}$	CL=90%	1548
5γ		$< 1.5 \times 10^{-5}$	CL=90%	1548
$\gamma\pi^0\pi^0$		$(1.15 \pm 0.05) \times 10^{-3}$		1543
$\gamma\eta\pi^0$		$(2.14 \pm 0.31) \times 10^{-5}$		1497
$\gamma a_0(980)^0 \rightarrow \gamma\eta\pi^0$		$< 2.5 \times 10^{-6}$	CL=95%	—
$\gamma a_2(1320)^0 \rightarrow \gamma\eta\pi^0$		$< 6.6 \times 10^{-6}$	CL=95%	—
$\gamma\eta_c(1S)$		$(1.7 \pm 0.4) \%$	S=1.5	111
$\gamma\eta_c(1S) \rightarrow 3\gamma$		$(3.8 \pm 1.3 \pm 1.0) \times 10^{-6}$	S=1.1	—
$\gamma\pi^+\pi^-2\pi^0$		$(8.3 \pm 3.1) \times 10^{-3}$		1518
$\gamma\eta\pi\pi$		$(6.1 \pm 1.0) \times 10^{-3}$		1487
$\gamma\eta_2(1870) \rightarrow \gamma\eta\pi^+\pi^-$		$(6.2 \pm 2.4) \times 10^{-4}$		—
$\gamma\eta(1405/1475) \rightarrow \gamma K\bar{K}\pi$	[d]	$(2.8 \pm 0.6) \times 10^{-3}$	S=1.6	1223
$\gamma\eta(1405/1475) \rightarrow \gamma\gamma\rho^0$		$(7.8 \pm 2.0) \times 10^{-5}$	S=1.8	1223
$\gamma\eta(1405/1475) \rightarrow \gamma\eta\pi^+\pi^-$		$(3.0 \pm 0.5) \times 10^{-4}$		—
$\gamma\eta(1405/1475) \rightarrow \gamma\gamma\phi$		$< 8.2 \times 10^{-5}$	CL=95%	—
$\gamma\rho\rho$		$(4.5 \pm 0.8) \times 10^{-3}$		1340
$\gamma\rho\omega$		$< 5.4 \times 10^{-4}$	CL=90%	1338

$\gamma\rho\phi$	$< 8.8 \times 10^{-5}$	CL=90%	1258
$\gamma\eta'(958)$	$(5.13 \pm 0.17) \times 10^{-3}$	S=1.3	1400
$\gamma 2\pi^+ 2\pi^-$	$(2.8 \pm 0.5) \times 10^{-3}$	S=1.9	1517
$\gamma f_2(1270) f_2(1270)$	$(9.5 \pm 1.7) \times 10^{-4}$		878
$\gamma f_2(1270) f_2(1270)$ (non resonant)	$(8.2 \pm 1.9) \times 10^{-4}$		—
$\gamma K^+ K^- \pi^+ \pi^-$	$(2.1 \pm 0.6) \times 10^{-3}$		1407
$\gamma f_4(2050)$	$(2.7 \pm 0.7) \times 10^{-3}$		891
$\gamma\omega\omega$	$(1.61 \pm 0.33) \times 10^{-3}$		1336
$\gamma\eta(1405/1475) \rightarrow \gamma\rho^0\rho^0$	$(1.7 \pm 0.4) \times 10^{-3}$	S=1.3	1223
$\gamma f_2(1270)$	$(1.64 \pm 0.12) \times 10^{-3}$	S=1.3	1286
$\gamma f_0(1370) \rightarrow \gamma K\bar{K}$	$(4.2 \pm 1.5) \times 10^{-4}$		—
$\gamma f_0(1710) \rightarrow \gamma K\bar{K}$	$(1.00 \pm_{-0.09}^{+0.11}) \times 10^{-3}$	S=1.5	1075
$\gamma f_0(1710) \rightarrow \gamma\pi\pi$	$(3.8 \pm 0.5) \times 10^{-4}$		—
$\gamma f_0(1710) \rightarrow \gamma\omega\omega$	$(3.1 \pm 1.0) \times 10^{-4}$		—
$\gamma f_0(1710) \rightarrow \gamma\eta\eta$	$(2.4 \pm_{-0.7}^{+1.2}) \times 10^{-4}$		—
$\gamma\eta$	$(1.104 \pm 0.034) \times 10^{-3}$		1500
$\gamma f_1(1420) \rightarrow \gamma K\bar{K}\pi$	$(7.9 \pm 1.3) \times 10^{-4}$		1220
$\gamma f_1(1285)$	$(6.1 \pm 0.8) \times 10^{-4}$		1283
$\gamma f_1(1510) \rightarrow \gamma\eta\pi^+\pi^-$	$(4.5 \pm 1.2) \times 10^{-4}$		—
$\gamma f'_2(1525)$	$(5.7 \pm_{-0.5}^{+0.8}) \times 10^{-4}$	S=1.5	1173
$\gamma f'_2(1525) \rightarrow \gamma\eta\eta$	$(3.4 \pm 1.4) \times 10^{-5}$		—
$\gamma f_2(1640) \rightarrow \gamma\omega\omega$	$(2.8 \pm 1.8) \times 10^{-4}$		—
$\gamma f_2(1910) \rightarrow \gamma\omega\omega$	$(2.0 \pm 1.4) \times 10^{-4}$		—
$\gamma f_0(1800) \rightarrow \gamma\omega\phi$	$(2.5 \pm 0.6) \times 10^{-4}$		—
$\gamma f_2(1810) \rightarrow \gamma\eta\eta$	$(5.4 \pm_{-2.4}^{+3.5}) \times 10^{-5}$		—
$\gamma f_2(1950) \rightarrow$ $\gamma K^*(892)\bar{K}^*(892)$	$(7.0 \pm 2.2) \times 10^{-4}$		—
$\gamma K^*(892)\bar{K}^*(892)$	$(4.0 \pm 1.3) \times 10^{-3}$		1266
$\gamma\phi\phi$	$(4.0 \pm 1.2) \times 10^{-4}$	S=2.1	1166
$\gamma\rho\bar{\rho}$	$(3.8 \pm 1.0) \times 10^{-4}$		1232
$\gamma\eta(2225)$	$(3.14 \pm_{-0.19}^{+0.50}) \times 10^{-4}$		752
$\gamma\eta(1760) \rightarrow \gamma\rho^0\rho^0$	$(1.3 \pm 0.9) \times 10^{-4}$		1048
$\gamma\eta(1760) \rightarrow \gamma\omega\omega$	$(1.98 \pm 0.33) \times 10^{-3}$		—
$\gamma X(1835) \rightarrow \gamma\pi^+\pi^-\eta'$	$(2.77 \pm_{-0.40}^{+0.34}) \times 10^{-4}$	S=1.1	1006
$\gamma X(1835) \rightarrow \gamma\rho\bar{\rho}$	$(7.7 \pm_{-0.9}^{+1.5}) \times 10^{-5}$		—
$\gamma X(1835) \rightarrow \gamma K_S^0 K_S^0 \eta$	$(3.3 \pm_{-1.3}^{+2.0}) \times 10^{-5}$		—
$\gamma X(1840) \rightarrow \gamma 3(\pi^+\pi^-)$	$(2.4 \pm_{-0.8}^{+0.7}) \times 10^{-5}$		—

$\gamma(K\bar{K}\pi) [J^{PC} = 0^{-+}]$	$(7 \pm 4) \times 10^{-4}$	S=2.1	1442
$\gamma\pi^0$	$(3.49 \pm_{-0.30}^{+0.33}) \times 10^{-5}$		1546
$\gamma p\bar{p}\pi^+\pi^-$	$< 7.9 \times 10^{-4}$	CL=90%	1107
$\gamma\Lambda\bar{\Lambda}$	$< 1.3 \times 10^{-4}$	CL=90%	1074
$\gamma f_0(2100) \rightarrow \gamma\eta\eta$	$(1.13 \pm_{-0.30}^{+0.60}) \times 10^{-4}$		—
$\gamma f_0(2100) \rightarrow \gamma\pi\pi$	$(6.2 \pm 1.0) \times 10^{-4}$		—
$\gamma f_0(2200) \rightarrow \gamma K\bar{K}$	$(5.9 \pm 1.3) \times 10^{-4}$		—
$\gamma f_J(2220) \rightarrow \gamma\pi\pi$	$< 3.9 \times 10^{-5}$	CL=90%	—
$\gamma f_J(2220) \rightarrow \gamma K\bar{K}$	$< 4.1 \times 10^{-5}$	CL=90%	—
$\gamma f_J(2220) \rightarrow \gamma p\bar{p}$	$(1.5 \pm 0.8) \times 10^{-5}$		—
$\gamma f_2(2340) \rightarrow \gamma\eta\eta$	$(5.6 \pm_{-2.2}^{+2.4}) \times 10^{-5}$		—
$\gamma f_0(1500) \rightarrow \gamma\pi\pi$	$(1.09 \pm 0.24) \times 10^{-4}$		1183
$\gamma f_0(1500) \rightarrow \gamma\eta\eta$	$(1.7 \pm_{-1.4}^{+0.6}) \times 10^{-5}$		—
$\gamma A \rightarrow \gamma \text{invisible}$	[e] $< 6.3 \times 10^{-6}$	CL=90%	—
$\gamma A^0 \rightarrow \gamma\mu^+\mu^-$	[f] $< 5 \times 10^{-6}$	CL=90%	—

Dalitz decays

$\pi^0 e^+ e^-$	$(7.6 \pm 1.4) \times 10^{-7}$		1546
$\eta e^+ e^-$	$(1.16 \pm 0.09) \times 10^{-5}$		1500
$\eta'(958) e^+ e^-$	$(5.81 \pm 0.35) \times 10^{-5}$		1400

Weak decays

$D^- e^+ \nu_e + \text{c.c.}$	$< 1.2 \times 10^{-5}$	CL=90%	984
$\bar{D}^0 e^+ e^- + \text{c.c.}$	$< 8.5 \times 10^{-8}$	CL=90%	987
$D_s^- e^+ \nu_e + \text{c.c.}$	$< 1.3 \times 10^{-6}$	CL=90%	923
$D_s^{*-} e^+ \nu_e + \text{c.c.}$	$< 1.8 \times 10^{-6}$	CL=90%	828
$D^- \pi^+ + \text{c.c.}$	$< 7.5 \times 10^{-5}$	CL=90%	977
$\bar{D}^0 \bar{K}^0 + \text{c.c.}$	$< 1.7 \times 10^{-4}$	CL=90%	898
$\bar{D}^0 \bar{K}^{*0} + \text{c.c.}$	$< 2.5 \times 10^{-6}$	CL=90%	670
$D_s^- \pi^+ + \text{c.c.}$	$< 1.3 \times 10^{-4}$	CL=90%	915
$D_s^- \rho^+ + \text{c.c.}$	$< 1.3 \times 10^{-5}$	CL=90%	663

Charge conjugation (C), Parity (P), Lepton Family number (LF) violating modes

$\gamma\gamma$	C	$< 2.7 \times 10^{-7}$	CL=90%	1548
$\gamma\phi$	C	$< 1.4 \times 10^{-6}$	CL=90%	1381
$e^\pm \mu^\mp$	LF	$< 1.6 \times 10^{-7}$	CL=90%	1547
$e^\pm \tau^\mp$	LF	$< 8.3 \times 10^{-6}$	CL=90%	1039
$\mu^\pm \tau^\mp$	LF	$< 2.0 \times 10^{-6}$	CL=90%	1035

Other decays

invisible	$< 7 \times 10^{-4}$	CL=90%	—
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$\chi_{c0}(1P)$

$$J^{PC} = 0^+(0^{++})$$

Mass $m = 3414.71 \pm 0.30$ MeVFull width $\Gamma = 10.8 \pm 0.6$ MeV

$\chi_{c0}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	ρ (MeV/c)
Hadronic decays			
$2(\pi^+\pi^-)$	$(2.34 \pm 0.18) \%$		1679
$\rho^0\pi^+\pi^-$	$(9.1 \pm 2.9) \times 10^{-3}$		1607
$f_0(980)f_0(980)$	$(6.6 \pm 2.1) \times 10^{-4}$		1391
$\pi^+\pi^-\pi^0\pi^0$	$(3.3 \pm 0.4) \%$		1680
$\rho^+\pi^-\pi^0 + \text{c.c.}$	$(2.9 \pm 0.4) \%$		1607
$4\pi^0$	$(3.3 \pm 0.4) \times 10^{-3}$		1681
$\pi^+\pi^-K^+K^-$	$(1.81 \pm 0.14) \%$		1580
$K_0^*(1430)^0\bar{K}_0^*(1430)^0 \rightarrow$ $\pi^+\pi^-K^+K^-$	$(9.8 \begin{smallmatrix} +4.0 \\ -2.8 \end{smallmatrix}) \times 10^{-4}$		—
$K_0^*(1430)^0\bar{K}_2^*(1430)^0 + \text{c.c.} \rightarrow$ $\pi^+\pi^-K^+K^-$	$(8.0 \begin{smallmatrix} +2.0 \\ -2.4 \end{smallmatrix}) \times 10^{-4}$		—
$K_1(1270)^+K^- + \text{c.c.} \rightarrow$ $\pi^+\pi^-K^+K^-$	$(6.3 \pm 1.9) \times 10^{-3}$		—
$K_1(1400)^+K^- + \text{c.c.} \rightarrow$ $\pi^+\pi^-K^+K^-$	$< 2.7 \times 10^{-3}$	CL=90%	—
$f_0(980)f_0(980)$	$(1.6 \begin{smallmatrix} +1.0 \\ -0.9 \end{smallmatrix}) \times 10^{-4}$		1391
$f_0(980)f_0(2200)$	$(7.9 \begin{smallmatrix} +2.0 \\ -2.5 \end{smallmatrix}) \times 10^{-4}$		584
$f_0(1370)f_0(1370)$	$< 2.7 \times 10^{-4}$	CL=90%	1019
$f_0(1370)f_0(1500)$	$< 1.7 \times 10^{-4}$	CL=90%	921
$f_0(1370)f_0(1710)$	$(6.7 \begin{smallmatrix} +3.5 \\ -2.3 \end{smallmatrix}) \times 10^{-4}$		720
$f_0(1500)f_0(1370)$	$< 1.3 \times 10^{-4}$	CL=90%	921
$f_0(1500)f_0(1500)$	$< 5 \times 10^{-5}$	CL=90%	807
$f_0(1500)f_0(1710)$	$< 7 \times 10^{-5}$	CL=90%	557
$K^+K^-\pi^+\pi^-\pi^0$	$(8.6 \pm 0.9) \times 10^{-3}$		1545
$K_S^0K^\pm\pi^\mp\pi^+\pi^-$	$(4.2 \pm 0.4) \times 10^{-3}$		1543
$K^+K^-\pi^0\pi^0$	$(5.6 \pm 0.9) \times 10^{-3}$		1582
$K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$	$(2.49 \pm 0.33) \%$		1581
$\rho^+K^-K^0 + \text{c.c.}$	$(1.21 \pm 0.21) \%$		1458
$K^*(892)^-K^+\pi^0 \rightarrow$ $K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$	$(4.6 \pm 1.2) \times 10^{-3}$		—
$K_S^0K_S^0\pi^+\pi^-$	$(5.7 \pm 1.1) \times 10^{-3}$		1579
$K^+K^-\eta\pi^0$	$(3.0 \pm 0.7) \times 10^{-3}$		1468
$3(\pi^+\pi^-)$	$(1.20 \pm 0.18) \%$		1633
$K^+\bar{K}^*(892)^0\pi^- + \text{c.c.}$	$(7.5 \pm 1.6) \times 10^{-3}$		1523

$K^*(892)^0 \bar{K}^*(892)^0$	$(1.7 \pm 0.6) \times 10^{-3}$		1456
$\pi\pi$	$(8.51 \pm 0.33) \times 10^{-3}$		1702
$\pi^0\eta$	$< 1.8 \times 10^{-4}$		1661
$\pi^0\eta'$	$< 1.1 \times 10^{-3}$		1570
$\pi^0\eta_c$	$< 1.6 \times 10^{-3}$	CL=90%	383
$\eta\eta$	$(3.01 \pm 0.19) \times 10^{-3}$		1617
$\eta\eta'$	$(9.1 \pm 1.1) \times 10^{-5}$		1521
$\eta'\eta'$	$(2.17 \pm 0.12) \times 10^{-3}$		1413
$\omega\omega$	$(9.7 \pm 1.1) \times 10^{-4}$		1517
$\omega\phi$	$(1.18 \pm 0.22) \times 10^{-4}$		1447
$\omega K^+ K^-$	$(1.94 \pm 0.21) \times 10^{-3}$		1457
$K^+ K^-$	$(6.05 \pm 0.31) \times 10^{-3}$		1634
$K_S^0 K_S^0$	$(3.16 \pm 0.17) \times 10^{-3}$		1633
$\pi^+ \pi^- \eta$	$< 2.0 \times 10^{-4}$	CL=90%	1651
$\pi^+ \pi^- \eta'$	$< 4 \times 10^{-4}$	CL=90%	1560
$\bar{K}^0 K^+ \pi^- + \text{c.c.}$	$< 9 \times 10^{-5}$	CL=90%	1610
$K^+ K^- \pi^0$	$< 6 \times 10^{-5}$	CL=90%	1611
$K^+ K^- \eta$	$< 2.3 \times 10^{-4}$	CL=90%	1512
$K^+ K^- K_S^0 K_S^0$	$(1.4 \pm 0.5) \times 10^{-3}$		1331
$K^+ K^- K^+ K^-$	$(2.82 \pm 0.29) \times 10^{-3}$		1333
$K^+ K^- \phi$	$(9.7 \pm 2.5) \times 10^{-4}$		1381
$\bar{K}^0 K^+ \pi^- \phi + \text{c.c.}$	$(3.7 \pm 0.6) \times 10^{-3}$		1326
$K^+ K^- \pi^0 \phi$	$(1.90 \pm 0.35) \times 10^{-3}$		1329
$\phi\pi^+ \pi^- \pi^0$	$(1.18 \pm 0.15) \times 10^{-3}$		1525
$\phi\phi$	$(8.0 \pm 0.7) \times 10^{-4}$		1370
$p\bar{p}$	$(2.21 \pm 0.08) \times 10^{-4}$		1426
$p\bar{p}\pi^0$	$(7.0 \pm 0.7) \times 10^{-4}$	S=1.3	1379
$p\bar{p}\eta$	$(3.5 \pm 0.4) \times 10^{-4}$		1187
$p\bar{p}\omega$	$(5.2 \pm 0.6) \times 10^{-4}$		1043
$p\bar{p}\phi$	$(6.0 \pm 1.4) \times 10^{-5}$		876
$p\bar{p}\pi^+ \pi^-$	$(2.1 \pm 0.7) \times 10^{-3}$	S=1.4	1320
$p\bar{p}\pi^0 \pi^0$	$(1.04 \pm 0.28) \times 10^{-3}$		1324
$p\bar{p}K^+ K^-$ (non-resonant)	$(1.22 \pm 0.26) \times 10^{-4}$		890
$p\bar{p}K_S^0 K_S^0$	$< 8.8 \times 10^{-4}$	CL=90%	884
$p\bar{n}\pi^-$	$(1.27 \pm 0.11) \times 10^{-3}$		1376
$\bar{p}n\pi^+$	$(1.37 \pm 0.12) \times 10^{-3}$		1376
$p\bar{n}\pi^- \pi^0$	$(2.34 \pm 0.21) \times 10^{-3}$		1321
$\bar{p}n\pi^+ \pi^0$	$(2.21 \pm 0.18) \times 10^{-3}$		1321
$\Lambda\bar{\Lambda}$	$(3.27 \pm 0.24) \times 10^{-4}$		1292
$\Lambda\bar{\Lambda}\pi^+ \pi^-$	$(1.18 \pm 0.13) \times 10^{-3}$		1153
$\Lambda\bar{\Lambda}\pi^+ \pi^-$ (non-resonant)	$< 5 \times 10^{-4}$	CL=90%	1153
$\Sigma(1385)^+ \bar{\Lambda}\pi^- + \text{c.c.}$	$< 5 \times 10^{-4}$	CL=90%	1083
$\Sigma(1385)^- \bar{\Lambda}\pi^+ + \text{c.c.}$	$< 5 \times 10^{-4}$	CL=90%	1083
$K^+ \bar{p}\Lambda + \text{c.c.}$	$(1.25 \pm 0.12) \times 10^{-3}$	S=1.3	1132

$K^+ \bar{p} \Lambda(1520) + \text{c.c.}$	$(2.9 \pm 0.7) \times 10^{-4}$		858
$\Lambda(1520) \bar{\Lambda}(1520)$	$(3.1 \pm 1.2) \times 10^{-4}$		779
$\Sigma^0 \bar{\Sigma}^0$	$(4.5 \pm 0.4) \times 10^{-4}$		1222
$\Sigma^+ \bar{\Sigma}^-$	$(4.0 \pm 0.7) \times 10^{-4}$	S=1.7	1225
$\Sigma(1385)^+ \bar{\Sigma}(1385)^-$	$(1.6 \pm 0.6) \times 10^{-4}$		1001
$\Sigma(1385)^- \bar{\Sigma}(1385)^+$	$(2.3 \pm 0.7) \times 10^{-4}$		1001
$K^- \Lambda \bar{\Xi}^+ + \text{c.c.}$	$(1.94 \pm 0.35) \times 10^{-4}$		873
$\Xi^0 \bar{\Xi}^0$	$(3.1 \pm 0.8) \times 10^{-4}$		1089
$\Xi^- \bar{\Xi}^+$	$(4.8 \pm 0.7) \times 10^{-4}$		1081
$\eta_c \pi^+ \pi^-$	$< 7 \times 10^{-4}$	CL=90%	307

Radiative decays

$\gamma J/\psi(1S)$	$(1.40 \pm 0.05) \%$		303
$\gamma \rho^0$	$< 9 \times 10^{-6}$	CL=90%	1619
$\gamma \omega$	$< 8 \times 10^{-6}$	CL=90%	1618
$\gamma \phi$	$< 6 \times 10^{-6}$	CL=90%	1555
$\gamma \gamma$	$(2.04 \pm 0.09) \times 10^{-4}$		1707
$e^+ e^- J/\psi(1S)$	$(1.54 \pm 0.33) \times 10^{-4}$		303

$\chi_{c1}(1P)$	$I^G(J^{PC}) = 0^+(1^{++})$
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Mass $m = 3510.67 \pm 0.05$ MeV (S = 1.2)

Full width $\Gamma = 0.84 \pm 0.04$ MeV

$\chi_{c1}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
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Hadronic decays

$3(\pi^+ \pi^-)$	$(5.8 \pm 1.4) \times 10^{-3}$	S=1.2	1683
$2(\pi^+ \pi^-)$	$(7.6 \pm 2.6) \times 10^{-3}$		1728
$\pi^+ \pi^- \pi^0 \pi^0$	$(1.19 \pm 0.15) \%$		1729
$\rho^+ \pi^- \pi^0 + \text{c.c.}$	$(1.45 \pm 0.24) \%$		1658
$\rho^0 \pi^+ \pi^-$	$(3.9 \pm 3.5) \times 10^{-3}$		1657
$4\pi^0$	$(5.4 \pm 0.8) \times 10^{-4}$		1729
$\pi^+ \pi^- K^+ K^-$	$(4.5 \pm 1.0) \times 10^{-3}$		1632
$K^+ K^- \pi^0 \pi^0$	$(1.12 \pm 0.27) \times 10^{-3}$		1634
$K^+ K^- \pi^+ \pi^- \pi^0$	$(1.15 \pm 0.13) \%$		1598
$K_S^0 K^\pm \pi^\mp \pi^+ \pi^-$	$(7.5 \pm 0.8) \times 10^{-3}$		1596
$K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.}$	$(8.6 \pm 1.4) \times 10^{-3}$		1632
$\rho^- K^+ \bar{K}^0 + \text{c.c.}$	$(5.0 \pm 1.2) \times 10^{-3}$		1514
$K^*(892)^0 \bar{K}^0 \pi^0 \rightarrow$ $K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.}$	$(2.3 \pm 0.6) \times 10^{-3}$		—
$K^+ K^- \eta \pi^0$	$(1.12 \pm 0.34) \times 10^{-3}$		1523
$\pi^+ \pi^- K_S^0 K_S^0$	$(6.9 \pm 2.9) \times 10^{-4}$		1630
$K^+ K^- \eta$	$(3.2 \pm 1.0) \times 10^{-4}$		1566

$\bar{K}^0 K^+ \pi^- + \text{c.c.}$	$(7.0 \pm 0.6) \times 10^{-3}$		1661
$K^*(892)^0 \bar{K}^0 + \text{c.c.}$	$(10 \pm 4) \times 10^{-4}$		1602
$K^*(892)^+ K^- + \text{c.c.}$	$(1.4 \pm 0.6) \times 10^{-3}$		1602
$K_J^*(1430)^0 \bar{K}^0 + \text{c.c.} \rightarrow$ $K_S^0 K^+ \pi^- + \text{c.c.}$	$< 8 \times 10^{-4}$	CL=90%	—
$K_J^*(1430)^+ K^- + \text{c.c.} \rightarrow$ $K_S^0 K^+ \pi^- + \text{c.c.}$	$< 2.1 \times 10^{-3}$	CL=90%	—
$K^+ K^- \pi^0$	$(1.81 \pm 0.24) \times 10^{-3}$		1662
$\eta \pi^+ \pi^-$	$(4.62 \pm 0.23) \times 10^{-3}$		1701
$a_0(980)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-$	$(3.2 \pm 0.4) \times 10^{-3}$	S=2.2	—
$a_2(1320)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-$	$(1.76 \pm 0.24) \times 10^{-4}$		—
$a_2(1700)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-$	$(4.6 \pm 0.7) \times 10^{-5}$		—
$f_2(1270) \eta \rightarrow \eta \pi^+ \pi^-$	$(3.5 \pm 0.6) \times 10^{-4}$		—
$f_4(2050) \eta \rightarrow \eta \pi^+ \pi^-$	$(2.5 \pm 0.9) \times 10^{-5}$		—
$\pi_1(1400)^+ \pi^- + \text{c.c.} \rightarrow$ $\eta \pi^+ \pi^-$	$< 5 \times 10^{-5}$	CL=90%	—
$\pi_1(1600)^+ \pi^- + \text{c.c.} \rightarrow$ $\eta \pi^+ \pi^-$	$< 1.5 \times 10^{-5}$	CL=90%	—
$\pi_1(2015)^+ \pi^- + \text{c.c.} \rightarrow$ $\eta \pi^+ \pi^-$	$< 8 \times 10^{-6}$	CL=90%	—
$f_2(1270) \eta$	$(6.7 \pm 1.1) \times 10^{-4}$		1467
$\pi^+ \pi^- \eta'$	$(2.2 \pm 0.4) \times 10^{-3}$		1612
$K^+ K^- \eta'(958)$	$(8.8 \pm 0.9) \times 10^{-4}$		1461
$K_0^*(1430)^+ K^- + \text{c.c.}$	$(6.4 \pm_{-2.8}^{+2.2}) \times 10^{-4}$		—
$f_0(980) \eta'(958)$	$(1.6 \pm_{-0.7}^{+1.4}) \times 10^{-4}$		1460
$f_0(1710) \eta'(958)$	$(7 \pm_{-5}^{+7}) \times 10^{-5}$		1106
$f_2'(1525) \eta'(958)$	$(9 \pm 6) \times 10^{-5}$		1225
$\pi^0 f_0(980) \rightarrow \pi^0 \pi^+ \pi^-$	$< 6 \times 10^{-6}$	CL=90%	—
$K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$	$(3.2 \pm 2.1) \times 10^{-3}$		1577
$K^*(892)^0 \bar{K}^*(892)^0$	$(1.4 \pm 0.4) \times 10^{-3}$		1512
$K^+ K^- K_S^0 K_S^0$	$< 4 \times 10^{-4}$	CL=90%	1390
$K^+ K^- K^+ K^-$	$(5.4 \pm 1.1) \times 10^{-4}$		1393
$K^+ K^- \phi$	$(4.1 \pm 1.5) \times 10^{-4}$		1440
$\bar{K}^0 K^+ \pi^- \phi + \text{c.c.}$	$(3.3 \pm 0.5) \times 10^{-3}$		1387
$K^+ K^- \pi^0 \phi$	$(1.62 \pm 0.30) \times 10^{-3}$		1390
$\phi \pi^+ \pi^- \pi^0$	$(7.5 \pm 1.0) \times 10^{-4}$		1578
$\omega \omega$	$(5.7 \pm 0.7) \times 10^{-4}$		1571
$\omega K^+ K^-$	$(7.8 \pm 0.9) \times 10^{-4}$		1513
$\omega \phi$	$(2.1 \pm 0.6) \times 10^{-5}$		1503
$\phi \phi$	$(4.2 \pm 0.5) \times 10^{-4}$		1429
$\rho \bar{\rho}$	$(7.60 \pm 0.34) \times 10^{-5}$		1484
$\rho \bar{\rho} \pi^0$	$(1.55 \pm 0.18) \times 10^{-4}$		1438

$p\bar{p}\eta$	$(1.45 \pm 0.25) \times 10^{-4}$		1254
$p\bar{p}\omega$	$(2.12 \pm 0.31) \times 10^{-4}$		1117
$p\bar{p}\phi$	$< 1.7 \times 10^{-5}$	CL=90%	962
$p\bar{p}\pi^+\pi^-$	$(5.0 \pm 1.9) \times 10^{-4}$		1381
$p\bar{p}K^+K^-$ (non-resonant)	$(1.27 \pm 0.22) \times 10^{-4}$		974
$p\bar{p}K_S^0K_S^0$	$< 4.5 \times 10^{-4}$	CL=90%	968
$p\bar{p}\pi^-\pi^+$	$(3.8 \pm 0.5) \times 10^{-4}$		1435
$\bar{p}n\pi^+$	$(3.9 \pm 0.5) \times 10^{-4}$		1435
$p\bar{p}\pi^-\pi^0$	$(1.03 \pm 0.12) \times 10^{-3}$		1383
$\bar{p}n\pi^+\pi^0$	$(1.01 \pm 0.12) \times 10^{-3}$		1383
$\Lambda\bar{\Lambda}$	$(1.14 \pm 0.11) \times 10^{-4}$		1355
$\Lambda\bar{\Lambda}\pi^+\pi^-$	$(2.9 \pm 0.5) \times 10^{-4}$		1223
$\Lambda\bar{\Lambda}\pi^+\pi^-$ (non-resonant)	$(2.5 \pm 0.6) \times 10^{-4}$		1223
$\Sigma(1385)^+\bar{\Lambda}\pi^- + c.c.$	$< 1.3 \times 10^{-4}$	CL=90%	1157
$\Sigma(1385)^-\bar{\Lambda}\pi^+ + c.c.$	$< 1.3 \times 10^{-4}$	CL=90%	1157
$K^+\bar{p}\Lambda$	$(4.1 \pm 0.4) \times 10^{-4}$	S=1.2	1203
$K^+\bar{p}\Lambda(1520) + c.c.$	$(1.7 \pm 0.4) \times 10^{-4}$		950
$\Lambda(1520)\bar{\Lambda}(1520)$	$< 9 \times 10^{-5}$	CL=90%	879
$\Sigma^0\bar{\Sigma}^0$	$< 4 \times 10^{-5}$	CL=90%	1288
$\Sigma^+\bar{\Sigma}^-$	$< 6 \times 10^{-5}$	CL=90%	1291
$\Sigma(1385)^+\bar{\Sigma}(1385)^-$	$< 9 \times 10^{-5}$	CL=90%	1081
$\Sigma(1385)^-\bar{\Sigma}(1385)^+$	$< 5 \times 10^{-5}$	CL=90%	1081
$K^-\Lambda\bar{\Xi}^+ + c.c.$	$(1.35 \pm 0.24) \times 10^{-4}$		963
$\Xi^0\bar{\Xi}^0$	$< 6 \times 10^{-5}$	CL=90%	1163
$\Xi^-\bar{\Xi}^+$	$(8.0 \pm 2.1) \times 10^{-5}$		1155
$\pi^+\pi^- + K^+K^-$	$< 2.1 \times 10^{-3}$		—
$K_S^0K_S^0$	$< 6 \times 10^{-5}$	CL=90%	1683
$\eta_c\pi^+\pi^-$	$< 3.2 \times 10^{-3}$	CL=90%	413

Radiative decays

$\gamma J/\psi(1S)$	$(34.3 \pm 1.0) \%$		389
$\gamma\rho^0$	$(2.16 \pm 0.17) \times 10^{-4}$		1670
$\gamma\omega$	$(6.8 \pm 0.8) \times 10^{-5}$		1668
$\gamma\phi$	$(2.4 \pm 0.5) \times 10^{-5}$		1607
$\gamma\gamma$	$< 6.3 \times 10^{-6}$	CL=90%	1755
$e^+e^- J/\psi(1S)$	$(3.65 \pm 0.25) \times 10^{-3}$		389

$h_c(1P)$

$$I^G(J^{PC}) = ??(1^{+-})$$

Mass $m = 3525.38 \pm 0.11$ MeVFull width $\Gamma = 0.7 \pm 0.4$ MeV

$h_c(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (MeV/c)
$J/\psi(1S)\pi\pi$	not seen		312
$p\bar{p}$	$< 1.5 \times 10^{-4}$	90%	1492
$\pi^+\pi^-\pi^0$	$< 2.2 \times 10^{-3}$		1749
$2\pi^+2\pi^-\pi^0$	$(2.2^{+0.8}_{-0.7})\%$		1716
$3\pi^+3\pi^-\pi^0$	$< 2.9\%$		1661
Radiative decays			
$\gamma\eta$	$(4.7 \pm 2.1) \times 10^{-4}$		1720
$\gamma\eta'(958)$	$(1.5 \pm 0.4) \times 10^{-3}$		1633
$\gamma\eta_c(1S)$	$(51 \pm 6)\%$		500

 $\chi_{c2}(1P)$

$$I^G(J^{PC}) = 0^+(2^{++})$$

Mass $m = 3556.17 \pm 0.07$ MeVFull width $\Gamma = 1.97 \pm 0.09$ MeV

$\chi_{c2}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (MeV/c)
Hadronic decays			
$2(\pi^+\pi^-)$	$(1.02 \pm 0.09)\%$		1751
$\pi^+\pi^-\pi^0\pi^0$	$(1.83 \pm 0.23)\%$		1752
$\rho^+\pi^-\pi^0 + \text{c.c.}$	$(2.19 \pm 0.34)\%$		1682
$4\pi^0$	$(1.11 \pm 0.15) \times 10^{-3}$		1752
$K^+K^-\pi^0\pi^0$	$(2.1 \pm 0.4) \times 10^{-3}$		1658
$K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$	$(1.38 \pm 0.20)\%$		1657
$\rho^-K^+\bar{K}^0 + \text{c.c.}$	$(4.1 \pm 1.2) \times 10^{-3}$		1540
$K^*(892)^0K^-\pi^+ \rightarrow$ $K^-\pi^+K^0\pi^0 + \text{c.c.}$	$(2.9 \pm 0.8) \times 10^{-3}$		—
$K^*(892)^0\bar{K}^0\pi^0 \rightarrow$ $K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$	$(3.8 \pm 0.9) \times 10^{-3}$		—
$K^*(892)^-K^+\pi^0 \rightarrow$ $K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$	$(3.7 \pm 0.8) \times 10^{-3}$		—
$K^*(892)^+\bar{K}^0\pi^- \rightarrow$ $K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$	$(2.9 \pm 0.8) \times 10^{-3}$		—
$K^+K^-\eta\pi^0$	$(1.3 \pm 0.4) \times 10^{-3}$		1549
$K^+K^-\pi^+\pi^-$	$(8.4 \pm 0.9) \times 10^{-3}$		1656
$K^+K^-\pi^+\pi^-\pi^0$	$(1.17 \pm 0.13)\%$		1623

$K_S^0 K^\pm \pi^\mp \pi^+ \pi^-$	$(7.3 \pm 0.8) \times 10^{-3}$		1621
$K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$	$(2.1 \pm 1.1) \times 10^{-3}$		1602
$K^*(892)^0 \bar{K}^*(892)^0$	$(2.3 \pm 0.4) \times 10^{-3}$		1538
$3(\pi^+ \pi^-)$	$(8.6 \pm 1.8) \times 10^{-3}$		1707
$\phi\phi$	$(1.06 \pm 0.09) \times 10^{-3}$		1457
$\omega\omega$	$(8.4 \pm 1.0) \times 10^{-4}$		1597
$\omega K^+ K^-$	$(7.3 \pm 0.9) \times 10^{-4}$		1540
$\pi\pi$	$(2.23 \pm 0.09) \times 10^{-3}$		1773
$\rho^0 \pi^+ \pi^-$	$(3.7 \pm 1.6) \times 10^{-3}$		1682
$\pi^+ \pi^- \pi^0$ (non-resonant)	$(2.0 \pm 0.4) \times 10^{-5}$		1765
$\rho(770)^\pm \pi^\mp$	$(6 \pm 4) \times 10^{-6}$		–
$\pi^+ \pi^- \eta$	$(4.8 \pm 1.3) \times 10^{-4}$		1724
$\pi^+ \pi^- \eta'$	$(5.0 \pm 1.8) \times 10^{-4}$		1636
$\eta\eta$	$(5.4 \pm 0.4) \times 10^{-4}$		1692
$K^+ K^-$	$(1.01 \pm 0.06) \times 10^{-3}$		1708
$K_S^0 K_S^0$	$(5.2 \pm 0.4) \times 10^{-4}$		1707
$K^*(892)^\pm K^\mp$	$(1.44 \pm 0.21) \times 10^{-4}$		1627
$K^*(892)^0 \bar{K}^0 + \text{c.c.}$	$(1.24 \pm 0.27) \times 10^{-4}$		1627
$K_2^*(1430)^\pm K^\mp$	$(1.48 \pm 0.12) \times 10^{-3}$		–
$K_2^*(1430)^0 \bar{K}^0 + \text{c.c.}$	$(1.24 \pm 0.17) \times 10^{-3}$		1444
$K_3^*(1780)^\pm K^\mp$	$(5.2 \pm 0.8) \times 10^{-4}$		–
$K_3^*(1780)^0 \bar{K}^0 + \text{c.c.}$	$(5.6 \pm 2.1) \times 10^{-4}$		1276
$a_2(1320)^0 \pi^0$	$(1.29 \pm 0.34) \times 10^{-3}$		–
$a_2(1320)^\pm \pi^\mp$	$(1.8 \pm 0.6) \times 10^{-3}$		1530
$\bar{K}^0 K^+ \pi^- + \text{c.c.}$	$(1.28 \pm 0.18) \times 10^{-3}$		1685
$K^+ K^- \pi^0$	$(3.0 \pm 0.8) \times 10^{-4}$		1686
$K^+ K^- \eta$	$< 3.2 \times 10^{-4}$	90%	1592
$K^+ K^- \eta'(958)$	$(1.94 \pm 0.34) \times 10^{-4}$		1488
$\eta\eta'$	$(2.2 \pm 0.5) \times 10^{-5}$		1600
$\eta'\eta'$	$(4.6 \pm 0.6) \times 10^{-5}$		1498
$\pi^+ \pi^- K_S^0 K_S^0$	$(2.2 \pm 0.5) \times 10^{-3}$		1655
$K^+ K^- K_S^0 K_S^0$	$< 4 \times 10^{-4}$	90%	1418
$K^+ K^- K^+ K^-$	$(1.65 \pm 0.20) \times 10^{-3}$		1421
$K^+ K^- \phi$	$(1.42 \pm 0.29) \times 10^{-3}$		1468
$\bar{K}^0 K^+ \pi^- \phi + \text{c.c.}$	$(4.8 \pm 0.7) \times 10^{-3}$		1416
$K^+ K^- \pi^0 \phi$	$(2.7 \pm 0.5) \times 10^{-3}$		1419
$\phi \pi^+ \pi^- \pi^0$	$(9.3 \pm 1.2) \times 10^{-4}$		1603
$p\bar{p}$	$(7.33 \pm 0.33) \times 10^{-5}$		1510
$p\bar{p}\pi^0$	$(4.7 \pm 0.4) \times 10^{-4}$		1465
$p\bar{p}\eta$	$(1.74 \pm 0.25) \times 10^{-4}$		1285
$p\bar{p}\omega$	$(3.6 \pm 0.4) \times 10^{-4}$		1152
$p\bar{p}\phi$	$(2.8 \pm 0.9) \times 10^{-5}$		1002
$p\bar{p}\pi^+ \pi^-$	$(1.32 \pm 0.34) \times 10^{-3}$		1410

$p\bar{p}\pi^0\pi^0$	$(7.8 \pm 2.3) \times 10^{-4}$		1414
$p\bar{p}K^+K^-$ (non-resonant)	$(1.91 \pm 0.32) \times 10^{-4}$		1013
$p\bar{p}K_S^0K_S^0$	$< 7.9 \times 10^{-4}$	90%	1007
$p\bar{n}\pi^-$	$(8.5 \pm 0.9) \times 10^{-4}$		1463
$\bar{p}n\pi^+$	$(8.9 \pm 0.8) \times 10^{-4}$		1463
$p\bar{n}\pi^-\pi^0$	$(2.17 \pm 0.18) \times 10^{-3}$		1411
$\bar{p}n\pi^+\pi^0$	$(2.11 \pm 0.18) \times 10^{-3}$		1411
$\Lambda\bar{\Lambda}$	$(1.84 \pm 0.15) \times 10^{-4}$		1384
$\Lambda\bar{\Lambda}\pi^+\pi^-$	$(1.25 \pm 0.15) \times 10^{-3}$		1255
$\Lambda\bar{\Lambda}\pi^+\pi^-$ (non-resonant)	$(6.6 \pm 1.5) \times 10^{-4}$		1255
$\Sigma(1385)^+\bar{\Lambda}\pi^- + \text{c.c.}$	$< 4 \times 10^{-4}$	90%	1192
$\Sigma(1385)^-\bar{\Lambda}\pi^+ + \text{c.c.}$	$< 6 \times 10^{-4}$	90%	1192
$K^+\bar{p}\Lambda + \text{c.c.}$	$(7.8 \pm 0.5) \times 10^{-4}$		1236
$K^+\bar{p}\Lambda(1520) + \text{c.c.}$	$(2.8 \pm 0.7) \times 10^{-4}$		992
$\Lambda(1520)\bar{\Lambda}(1520)$	$(4.6 \pm 1.5) \times 10^{-4}$		923
$\Sigma^0\bar{\Sigma}^0$	$< 6 \times 10^{-5}$	90%	1319
$\Sigma^+\bar{\Sigma}^-$	$< 7 \times 10^{-5}$	90%	1322
$\Sigma(1385)^+\bar{\Sigma}(1385)^-$	$< 1.6 \times 10^{-4}$	90%	1118
$\Sigma(1385)^-\bar{\Sigma}(1385)^+$	$< 8 \times 10^{-5}$	90%	1118
$K^-\Lambda\bar{\Xi}^+ + \text{c.c.}$	$(1.76 \pm 0.32) \times 10^{-4}$		1004
$\Xi^0\bar{\Xi}^0$	$< 1.0 \times 10^{-4}$	90%	1197
$\Xi^-\bar{\Xi}^+$	$(1.42 \pm 0.32) \times 10^{-4}$		1189
$J/\psi(1S)\pi^+\pi^-\pi^0$	$< 1.5 \%$	90%	185
$\pi^0\eta_c$	$< 3.2 \times 10^{-3}$	90%	511
$\eta_c(1S)\pi^+\pi^-$	$< 5.4 \times 10^{-3}$	90%	459

Radiative decays

$\gamma J/\psi(1S)$	$(19.0 \pm 0.5) \%$		430
$\gamma\rho^0$	$< 1.9 \times 10^{-5}$	90%	1694
$\gamma\omega$	$< 6 \times 10^{-6}$	90%	1692
$\gamma\phi$	$< 7 \times 10^{-6}$	90%	1632
$\gamma\gamma$	$(2.85 \pm 0.10) \times 10^{-4}$		1778
$e^+e^- J/\psi(1S)$	$(2.37 \pm 0.16) \times 10^{-3}$		430

$\eta_c(2S)$

$$I^G(J^{PC}) = 0^+(0^{-+})$$

Quantum numbers are quark model predictions.

$$\text{Mass } m = 3637.6 \pm 1.2 \text{ MeV} \quad (S = 1.2)$$

$$\text{Full width } \Gamma = 11.3_{-2.9}^{+3.2} \text{ MeV}$$

$\eta_c(2S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (MeV/c)
hadrons	not seen		—
$K\bar{K}\pi$	$(1.9 \pm 1.2) \%$		1729

$K\bar{K}\eta$	$(5 \pm 4) \times 10^{-3}$			1637
$2\pi^+2\pi^-$	not seen			1792
$\rho^0\rho^0$	not seen			1645
$3\pi^+3\pi^-$	not seen			1749
$K^+K^-\pi^+\pi^-$	not seen			1700
$K^{*0}\bar{K}^{*0}$	not seen			1585
$K^+K^-\pi^+\pi^-\pi^0$	$(1.4 \pm 1.0) \%$			1667
$K^+K^-\pi^+\pi^-$	not seen			1627
$K_S^0K^-\pi^+\pi^- + c.c.$	seen			1666
$2K^+2K^-$	not seen			1470
$\phi\phi$	not seen			1506
$p\bar{p}$	seen			1558
$\gamma\gamma$	$(1.9 \pm 1.3) \times 10^{-4}$			1819
$\gamma J/\psi(1S)$	$< 1.4 \%$	90%		500
$\pi^+\pi^-\eta$	not seen			1766
$\pi^+\pi^-\eta'$	not seen			1680
$\pi^+\pi^-\eta_c(1S)$	$< 25 \%$	90%		538

$\psi(2S)$

$$I^G(J^{PC}) = 0^-(1^{--})$$

Mass $m = 3686.097 \pm 0.025$ MeV (S = 2.6)

Full width $\Gamma = 294 \pm 8$ keV

$\Gamma_{ee} = 2.33 \pm 0.04$ keV

$\psi(2S)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
hadrons	$(97.85 \pm 0.13) \%$		—
virtual $\gamma \rightarrow$ hadrons	$(1.73 \pm 0.14) \%$	S=1.5	—
ggg	$(10.6 \pm 1.6) \%$		—
γgg	$(1.03 \pm 0.29) \%$		—
light hadrons	$(15.4 \pm 1.5) \%$		—
e^+e^-	$(7.93 \pm 0.17) \times 10^{-3}$		1843
$\mu^+\mu^-$	$(8.0 \pm 0.6) \times 10^{-3}$		1840
$\tau^+\tau^-$	$(3.1 \pm 0.4) \times 10^{-3}$		489

Decays into $J/\psi(1S)$ and anything

$J/\psi(1S)$ anything	$(61.4 \pm 0.6) \%$		—
$J/\psi(1S)$ neutrals	$(25.37 \pm 0.32) \%$		—
$J/\psi(1S)\pi^+\pi^-$	$(34.67 \pm 0.30) \%$		477
$J/\psi(1S)\pi^0\pi^0$	$(18.23 \pm 0.31) \%$		481
$J/\psi(1S)\eta$	$(3.37 \pm 0.05) \%$		199
$J/\psi(1S)\pi^0$	$(1.268 \pm 0.032) \times 10^{-3}$		528

Hadronic decays

$\pi^0 h_c(1P)$	$(8.6 \pm 1.3) \times 10^{-4}$		85
$3(\pi^+ \pi^-) \pi^0$	$(3.5 \pm 1.6) \times 10^{-3}$		1746
$2(\pi^+ \pi^-) \pi^0$	$(2.9 \pm 1.0) \times 10^{-3}$	S=4.7	1799
$\rho a_2(1320)$	$(2.6 \pm 0.9) \times 10^{-4}$		1500
$p \bar{p}$	$(2.88 \pm 0.10) \times 10^{-4}$		1586
$\Delta^{++} \bar{\Delta}^{--}$	$(1.28 \pm 0.35) \times 10^{-4}$		1371
$\Lambda \bar{\Lambda} \pi^0$	$< 2.9 \times 10^{-6}$	CL=90%	1412
$\Lambda \bar{\Lambda} \eta$	$(2.5 \pm 0.4) \times 10^{-5}$		1197
$\Lambda \bar{p} K^+$	$(1.00 \pm 0.14) \times 10^{-4}$		1327
$\Lambda \bar{p} K^+ \pi^+ \pi^-$	$(1.8 \pm 0.4) \times 10^{-4}$		1167
$\Lambda \bar{\Lambda} \pi^+ \pi^-$	$(2.8 \pm 0.6) \times 10^{-4}$		1346
$\Lambda \bar{\Lambda}$	$(3.81 \pm 0.13) \times 10^{-4}$	S=1.4	1467
$\Lambda \bar{\Sigma}^+ \pi^- + \text{c.c.}$	$(1.40 \pm 0.13) \times 10^{-4}$		1376
$\Lambda \bar{\Sigma}^- \pi^+ + \text{c.c.}$	$(1.54 \pm 0.14) \times 10^{-4}$		1379
$\Lambda \bar{\Sigma}^0$	$(1.23 \pm 0.24) \times 10^{-5}$		1437
$\Sigma^0 \bar{p} K^+ + \text{c.c.}$	$(1.67 \pm 0.18) \times 10^{-5}$		1291
$\Sigma^+ \bar{\Sigma}^-$	$(2.32 \pm 0.12) \times 10^{-4}$		1408
$\Sigma^0 \bar{\Sigma}^0$	$(2.35 \pm 0.09) \times 10^{-4}$	S=1.1	1405
$\Sigma(1385)^+ \bar{\Sigma}(1385)^-$	$(8.5 \pm 0.7) \times 10^{-5}$		1218
$\Sigma(1385)^- \bar{\Sigma}(1385)^+$	$(8.5 \pm 0.8) \times 10^{-5}$		1218
$\Sigma(1385)^0 \bar{\Sigma}(1385)^0$	$(6.9 \pm 0.7) \times 10^{-5}$		1218
$\Xi^- \bar{\Xi}^+$	$(2.87 \pm 0.11) \times 10^{-4}$	S=1.1	1284
$\Xi^0 \bar{\Xi}^0$	$(2.3 \pm 0.4) \times 10^{-4}$	S=4.2	1291
$\Xi(1530)^0 \bar{\Xi}(1530)^0$	$(5.2 \begin{smallmatrix} +3.2 \\ -1.2 \end{smallmatrix}) \times 10^{-5}$		1025
$K^- \Lambda \bar{\Xi}^+ + \text{c.c.}$	$(3.9 \pm 0.4) \times 10^{-5}$		1114
$\Xi(1690)^- \bar{\Xi}^+ \rightarrow K^- \Lambda \bar{\Xi}^+ +$	$(5.2 \pm 1.6) \times 10^{-6}$		—
$\Xi(1820)^- \bar{\Xi}^+ \rightarrow K^- \Lambda \bar{\Xi}^+ +$	$(1.20 \pm 0.32) \times 10^{-5}$		—
$K^- \Sigma^0 \bar{\Xi}^+ + \text{c.c.}$	$(3.7 \pm 0.4) \times 10^{-5}$		1060
$\Omega^- \bar{\Omega}^+$	$(5.2 \pm 0.4) \times 10^{-5}$		774
$\pi^0 p \bar{p}$	$(1.53 \pm 0.07) \times 10^{-4}$		1543
$N(940) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$	$(6.4 \begin{smallmatrix} +1.8 \\ -1.3 \end{smallmatrix}) \times 10^{-5}$		—
$N(1440) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$	$(7.3 \begin{smallmatrix} +1.7 \\ -1.5 \end{smallmatrix}) \times 10^{-5}$	S=2.5	—
$N(1520) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$	$(6.4 \begin{smallmatrix} +2.3 \\ -1.8 \end{smallmatrix}) \times 10^{-6}$		—
$N(1535) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$	$(2.5 \pm 1.0) \times 10^{-5}$		—
$N(1650) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$	$(3.8 \begin{smallmatrix} +1.4 \\ -1.7 \end{smallmatrix}) \times 10^{-5}$		—
$N(1720) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$	$(1.79 \begin{smallmatrix} +0.26 \\ -0.70 \end{smallmatrix}) \times 10^{-5}$		—
$N(2300) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$	$(2.6 \begin{smallmatrix} +1.2 \\ -0.7 \end{smallmatrix}) \times 10^{-5}$		—

$N(2570)\bar{p} + \text{c.c.} \rightarrow \pi^0 p\bar{p}$	$(2.13^{+0.40}_{-0.31}) \times 10^{-5}$	–
$\pi^0 f_0(2100) \rightarrow \pi^0 p\bar{p}$	$(1.1 \pm 0.4) \times 10^{-5}$	–
$\eta p\bar{p}$	$(6.0 \pm 0.4) \times 10^{-5}$	1373
$\eta f_0(2100) \rightarrow \eta p\bar{p}$	$(1.2 \pm 0.4) \times 10^{-5}$	–
$N(1535)\bar{p} \rightarrow \eta p\bar{p}$	$(4.4 \pm 0.7) \times 10^{-5}$	–
$\omega p\bar{p}$	$(6.9 \pm 2.1) \times 10^{-5}$	1247
$\phi p\bar{p}$	$< 2.4 \times 10^{-5}$	CL=90% 1109
$\pi^+ \pi^- p\bar{p}$	$(6.0 \pm 0.4) \times 10^{-4}$	1491
$p\bar{n}\pi^- \text{ or c.c.}$	$(2.48 \pm 0.17) \times 10^{-4}$	–
$p\bar{n}\pi^- \pi^0$	$(3.2 \pm 0.7) \times 10^{-4}$	1492
$2(\pi^+ \pi^- \pi^0)$	$(4.8 \pm 1.5) \times 10^{-3}$	1776
$\eta \pi^+ \pi^-$	$< 1.6 \times 10^{-4}$	CL=90% 1791
$\eta \pi^+ \pi^- \pi^0$	$(9.5 \pm 1.7) \times 10^{-4}$	1778
$2(\pi^+ \pi^-) \eta$	$(1.2 \pm 0.6) \times 10^{-3}$	1758
$\eta' \pi^+ \pi^- \pi^0$	$(4.5 \pm 2.1) \times 10^{-4}$	1692
$\omega \pi^+ \pi^-$	$(7.3 \pm 1.2) \times 10^{-4}$	S=2.1 1748
$b_1^\pm \pi^\mp$	$(4.0 \pm 0.6) \times 10^{-4}$	S=1.1 1635
$b_1^0 \pi^0$	$(2.4 \pm 0.6) \times 10^{-4}$	–
$\omega f_2(1270)$	$(2.2 \pm 0.4) \times 10^{-4}$	1515
$\pi^0 \pi^0 K^+ K^-$	$(2.6 \pm 1.3) \times 10^{-4}$	1728
$\pi^+ \pi^- K^+ K^-$	$(7.3 \pm 0.5) \times 10^{-4}$	1726
$\pi^0 \pi^0 K_S^0 K_L^0$	$(1.3 \pm 0.5) \times 10^{-3}$	1726
$\rho^0 K^+ K^-$	$(2.2 \pm 0.4) \times 10^{-4}$	1616
$K^*(892)^0 \bar{K}_2^*(1430)^0$	$(1.9 \pm 0.5) \times 10^{-4}$	1418
$K^+ K^- \pi^+ \pi^- \eta$	$(1.3 \pm 0.7) \times 10^{-3}$	1574
$K^+ K^- 2(\pi^+ \pi^-) \pi^0$	$(1.00 \pm 0.31) \times 10^{-3}$	1611
$K^+ K^- 2(\pi^+ \pi^-)$	$(1.9 \pm 0.9) \times 10^{-3}$	1654
$K_1(1270)^\pm K^\mp$	$(1.00 \pm 0.28) \times 10^{-3}$	1581
$K_S^0 K_S^0 \pi^+ \pi^-$	$(2.2 \pm 0.4) \times 10^{-4}$	1724
$\rho^0 p\bar{p}$	$(5.0 \pm 2.2) \times 10^{-5}$	1252
$K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$	$(6.7 \pm 2.5) \times 10^{-4}$	1674
$2(\pi^+ \pi^-)$	$(2.4 \pm 0.6) \times 10^{-4}$	S=2.2 1817
$\rho^0 \pi^+ \pi^-$	$(2.2 \pm 0.6) \times 10^{-4}$	S=1.4 1750
$K^+ K^- \pi^+ \pi^- \pi^0$	$(1.26 \pm 0.09) \times 10^{-3}$	1694
$\omega f_0(1710) \rightarrow \omega K^+ K^-$	$(5.9 \pm 2.2) \times 10^{-5}$	–
$K^*(892)^0 K^- \pi^+ \pi^0 + \text{c.c.}$	$(8.6 \pm 2.2) \times 10^{-4}$	–
$K^*(892)^+ K^- \pi^+ \pi^- + \text{c.c.}$	$(9.6 \pm 2.8) \times 10^{-4}$	–
$K^*(892)^+ K^- \rho^0 + \text{c.c.}$	$(7.3 \pm 2.6) \times 10^{-4}$	–
$K^*(892)^0 K^- \rho^+ + \text{c.c.}$	$(6.1 \pm 1.8) \times 10^{-4}$	–
$\eta K^+ K^-$, no $\eta \phi$	$(3.1 \pm 0.4) \times 10^{-5}$	1664
$\omega K^+ K^-$	$(1.62 \pm 0.11) \times 10^{-4}$	S=1.1 1614
$\omega K^*(892)^+ K^- + \text{c.c.}$	$(2.07 \pm 0.26) \times 10^{-4}$	1482
$\omega K_2^*(1430)^+ K^- + \text{c.c.}$	$(6.1 \pm 1.2) \times 10^{-5}$	1253

$\omega \bar{K}^*(892)^0 K^0$	$(1.68 \pm 0.30) \times 10^{-4}$		1481
$\omega \bar{K}_2^*(1430)^0 K^0$	$(5.8 \pm 2.2) \times 10^{-5}$		1251
$\omega X(1440) \rightarrow \omega K_S^0 K^- \pi^+ +$ c.c.	$(1.6 \pm 0.4) \times 10^{-5}$		—
$\omega X(1440) \rightarrow \omega K^+ K^- \pi^0$	$(1.09 \pm 0.26) \times 10^{-5}$		—
$\omega f_1(1285) \rightarrow \omega K_S^0 K^- \pi^+ +$ c.c.	$(3.0 \pm 1.0) \times 10^{-6}$		—
$\omega f_1(1285) \rightarrow \omega K^+ K^- \pi^0$	$(1.2 \pm 0.7) \times 10^{-6}$		—
$3(\pi^+ \pi^-)$	$(3.5 \pm 2.0) \times 10^{-4}$	S=2.8	1774
$p\bar{p}\pi^+ \pi^- \pi^0$	$(7.3 \pm 0.7) \times 10^{-4}$		1435
$K^+ K^-$	$(7.5 \pm 0.5) \times 10^{-5}$		1776
$K_S^0 K_L^0$	$(5.34 \pm 0.33) \times 10^{-5}$		1775
$\pi^+ \pi^- \pi^0$	$(2.01 \pm 0.17) \times 10^{-4}$	S=1.7	1830
$\rho(2150)\pi \rightarrow \pi^+ \pi^- \pi^0$	$(1.9 \begin{smallmatrix} +1.2 \\ -0.4 \end{smallmatrix}) \times 10^{-4}$		—
$\rho(770)\pi \rightarrow \pi^+ \pi^- \pi^0$	$(3.2 \pm 1.2) \times 10^{-5}$	S=1.8	—
$\pi^+ \pi^-$	$(7.8 \pm 2.6) \times 10^{-6}$		1838
$K_1(1400)^\pm K^\mp$	$< 3.1 \times 10^{-4}$	CL=90%	1532
$K_2^*(1430)^\pm K^\mp$	$(7.1 \begin{smallmatrix} +1.3 \\ -0.9 \end{smallmatrix}) \times 10^{-5}$		—
$K^+ K^- \pi^0$	$(4.07 \pm 0.31) \times 10^{-5}$		1754
$K_S^0 K_L^0 \pi^0$	$< 3.0 \times 10^{-4}$	CL=90%	1753
$K_S^0 K_L^0 \eta$	$(1.3 \pm 0.5) \times 10^{-3}$		1661
$K^+ K^*(892)^- + \text{c.c.}$	$(2.9 \pm 0.4) \times 10^{-5}$	S=1.2	1698
$K^*(892)^0 \bar{K}^0 + \text{c.c.}$	$(1.09 \pm 0.20) \times 10^{-4}$		1697
$\phi \pi^+ \pi^-$	$(1.18 \pm 0.26) \times 10^{-4}$	S=1.5	1690
$\phi f_0(980) \rightarrow \pi^+ \pi^-$	$(7.5 \pm 3.3) \times 10^{-5}$	S=1.6	—
$2(K^+ K^-)$	$(6.3 \pm 1.3) \times 10^{-5}$		1499
$\phi K^+ K^-$	$(7.0 \pm 1.6) \times 10^{-5}$		1546
$2(K^+ K^-) \pi^0$	$(1.10 \pm 0.28) \times 10^{-4}$		1440
$\phi \eta$	$(3.10 \pm 0.31) \times 10^{-5}$		1654
$\phi \eta'$	$(3.1 \pm 1.6) \times 10^{-5}$		1555
$\omega \eta'$	$(3.2 \begin{smallmatrix} +2.5 \\ -2.1 \end{smallmatrix}) \times 10^{-5}$		1623
$\omega \pi^0$	$(2.1 \pm 0.6) \times 10^{-5}$		1757
$\rho \eta'$	$(1.9 \begin{smallmatrix} +1.7 \\ -1.2 \end{smallmatrix}) \times 10^{-5}$		1625
$\rho \eta$	$(2.2 \pm 0.6) \times 10^{-5}$	S=1.1	1717
$\omega \eta$	$< 1.1 \times 10^{-5}$	CL=90%	1715
$\phi \pi^0$	$< 4 \times 10^{-7}$	CL=90%	1699
$\eta_c \pi^+ \pi^- \pi^0$	$< 1.0 \times 10^{-3}$	CL=90%	512
$p\bar{p}K^+ K^-$	$(2.7 \pm 0.7) \times 10^{-5}$		1118
$\bar{\Lambda} n K_S^0 + \text{c.c.}$	$(8.1 \pm 1.8) \times 10^{-5}$		1324
$\phi f_2'(1525)$	$(4.4 \pm 1.6) \times 10^{-5}$		1321
$\Theta(1540) \bar{\Theta}(1540) \rightarrow$ $K_S^0 p K^- \bar{n} + \text{c.c.}$	$< 8.8 \times 10^{-6}$	CL=90%	—

$\Theta(1540) K^- \bar{n} \rightarrow K_S^0 p K^- \bar{n}$	< 1.0	$\times 10^{-5}$	CL=90%	—
$\Theta(1540) K_S^0 \bar{p} \rightarrow K_S^0 \bar{p} K^+ n$	< 7.0	$\times 10^{-6}$	CL=90%	—
$\bar{\Theta}(1540) K^+ n \rightarrow K_S^0 \bar{p} K^+ n$	< 2.6	$\times 10^{-5}$	CL=90%	—
$\bar{\Theta}(1540) K_S^0 p \rightarrow K_S^0 p K^- \bar{n}$	< 6.0	$\times 10^{-6}$	CL=90%	—
$K_S^0 K_S^0$	< 4.6	$\times 10^{-6}$		1775

Radiative decays

$\gamma \chi_{c0}(1P)$	$(9.79 \pm 0.20) \%$			261
$\gamma \chi_{c1}(1P)$	$(9.75 \pm 0.24) \%$			171
$\gamma \chi_{c2}(1P)$	$(9.52 \pm 0.20) \%$			128
$\gamma \eta_c(1S)$	$(3.4 \pm 0.5) \times 10^{-3}$	S=1.3		635
$\gamma \eta_c(2S)$	$(7 \pm 5) \times 10^{-4}$			48
$\gamma \pi^0$	$(1.04 \pm 0.22) \times 10^{-6}$	S=1.4		1841
$\gamma \eta'(958)$	$(1.24 \pm 0.04) \times 10^{-4}$			1719
$\gamma f_2(1270)$	$(2.73^{+0.29}_{-0.25}) \times 10^{-4}$	S=1.8		1622
$\gamma f_0(1370) \rightarrow \gamma K \bar{K}$	$(3.1 \pm 1.7) \times 10^{-5}$			1588
$\gamma f_0(1500)$	$(9.2 \pm 1.9) \times 10^{-5}$			1536
$\gamma f_2'(1525)$	$(3.3 \pm 0.8) \times 10^{-5}$			1528
$\gamma f_0(1710) \rightarrow \gamma \pi \pi$	$(3.5 \pm 0.6) \times 10^{-5}$			—
$\gamma f_0(1710) \rightarrow \gamma K \bar{K}$	$(6.6 \pm 0.7) \times 10^{-5}$			—
$\gamma f_0(2100) \rightarrow \gamma \pi \pi$	$(4.8 \pm 1.0) \times 10^{-6}$			1244
$\gamma f_0(2200) \rightarrow \gamma K \bar{K}$	$(3.2 \pm 1.0) \times 10^{-6}$			1193
$\gamma f_J(2220) \rightarrow \gamma \pi \pi$	< 5.8	$\times 10^{-6}$	CL=90%	1168
$\gamma f_J(2220) \rightarrow \gamma K \bar{K}$	< 9.5	$\times 10^{-6}$	CL=90%	1168
$\gamma \gamma$	< 1.5	$\times 10^{-4}$	CL=90%	1843
$\gamma \eta$	$(9.2 \pm 1.8) \times 10^{-7}$			1802
$\gamma \eta \pi^+ \pi^-$	$(8.7 \pm 2.1) \times 10^{-4}$			1791
$\gamma \eta(1405) \rightarrow \gamma K \bar{K} \pi$	< 9	$\times 10^{-5}$	CL=90%	1569
$\gamma \eta(1405) \rightarrow \eta \pi^+ \pi^-$	$(3.6 \pm 2.5) \times 10^{-5}$			—
$\gamma \eta(1405) \rightarrow \gamma f_0(980) \pi^0 \rightarrow \gamma \pi^+ \pi^- \pi^0$	< 5.0	$\times 10^{-7}$	CL=90%	—
$\gamma \eta(1475) \rightarrow K \bar{K} \pi$	< 1.4	$\times 10^{-4}$	CL=90%	—
$\gamma \eta(1475) \rightarrow \eta \pi^+ \pi^-$	< 8.8	$\times 10^{-5}$	CL=90%	—
$\gamma 2(\pi^+ \pi^-)$	$(4.0 \pm 0.6) \times 10^{-4}$			1817
$\gamma K^{*0} K^+ \pi^- + c.c.$	$(3.7 \pm 0.9) \times 10^{-4}$			1674
$\gamma K^{*0} \bar{K}^{*0}$	$(2.4 \pm 0.7) \times 10^{-4}$			1613
$\gamma K_S^0 K^+ \pi^- + c.c.$	$(2.6 \pm 0.5) \times 10^{-4}$			1753
$\gamma K^+ K^- \pi^+ \pi^-$	$(1.9 \pm 0.5) \times 10^{-4}$			1726
$\gamma p \bar{p}$	$(3.9 \pm 0.5) \times 10^{-5}$	S=2.0		1586
$\gamma f_2(1950) \rightarrow \gamma p \bar{p}$	$(1.20 \pm 0.22) \times 10^{-5}$			—
$\gamma f_2(2150) \rightarrow \gamma p \bar{p}$	$(7.2 \pm 1.8) \times 10^{-6}$			—
$\gamma X(1835) \rightarrow \gamma p \bar{p}$	$(4.6^{+1.8}_{-4.0}) \times 10^{-6}$			—
$\gamma X \rightarrow \gamma p \bar{p}$	$[g] < 2$	$\times 10^{-6}$	CL=90%	—

$\gamma\pi^+\pi^-\rho^-$	$(2.8 \pm 1.4) \times 10^{-5}$	1491
$\gamma 2(\pi^+\pi^-)K^+K^-$	$< 2.2 \times 10^{-4}$ CL=90%	1654
$\gamma 3(\pi^+\pi^-)$	$< 1.7 \times 10^{-4}$ CL=90%	1774
$\gamma K^+K^-K^+K^-$	$< 4 \times 10^{-5}$ CL=90%	1499
$\gamma\gamma J/\psi$	$(3.1^{+1.0}_{-1.2}) \times 10^{-4}$	542
$e^+e^-\chi_{c0}(1P)$	$(1.06 \pm 0.24) \times 10^{-3}$	261
$e^+e^-\chi_{c1}(1P)$	$(8.5 \pm 0.6) \times 10^{-4}$	171
$e^+e^-\chi_{c2}(1P)$	$(7.0 \pm 0.8) \times 10^{-4}$	128

Weak decays

$D^0 e^+ e^- + \text{c.c.}$	$< 1.4 \times 10^{-7}$ CL=90%	1371
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Other decays

invisible	< 1.6 % CL=90%	—
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$\psi(3770)$

$$J^G(J^PC) = 0^-(1^{--})$$

Mass $m = 3773.13 \pm 0.35$ MeV ($S = 1.1$)

Full width $\Gamma = 27.2 \pm 1.0$ MeV

$\Gamma_{ee} = 0.262 \pm 0.018$ keV ($S = 1.4$)

In addition to the dominant decay mode to $D\bar{D}$, $\psi(3770)$ was found to decay into the final states containing the J/ψ (BAI 05, ADAM 06). ADAMS 06 and HUANG 06A searched for various decay modes with light hadrons and found a statistically significant signal for the decay to $\phi\eta$ only (ADAMS 06).

$\psi(3770)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	ρ (MeV/c)
$D\bar{D}$	$(93^{+8}_{-9})\%$	S=2.0	286
$D^0\bar{D}^0$	$(52^{+4}_{-5})\%$	S=2.0	286
D^+D^-	$(41 \pm 4)\%$	S=2.0	252
$J/\psi\pi^+\pi^-$	$(1.93 \pm 0.28) \times 10^{-3}$		560
$J/\psi\pi^0\pi^0$	$(8.0 \pm 3.0) \times 10^{-4}$		564
$J/\psi\eta$	$(9 \pm 4) \times 10^{-4}$		360
$J/\psi\pi^0$	$< 2.8 \times 10^{-4}$	CL=90%	603
e^+e^-	$(9.6 \pm 0.7) \times 10^{-6}$	S=1.3	1887

Decays to light hadrons

$b_1(1235)\pi$	$< 1.4 \times 10^{-5}$	CL=90%	1683
$\phi\eta'$	$< 7 \times 10^{-4}$	CL=90%	1607
$\omega\eta'$	$< 4 \times 10^{-4}$	CL=90%	1672
$\rho^0\eta'$	$< 6 \times 10^{-4}$	CL=90%	1674
$\phi\eta$	$(3.1 \pm 0.7) \times 10^{-4}$		1703
$\omega\eta$	$< 1.4 \times 10^{-5}$	CL=90%	1762

$\rho^0 \eta$	< 5	$\times 10^{-4}$	CL=90%	1764
$\phi \pi^0$	< 3	$\times 10^{-5}$	CL=90%	1746
$\omega \pi^0$	< 6	$\times 10^{-4}$	CL=90%	1803
$\pi^+ \pi^- \pi^0$	< 5	$\times 10^{-6}$	CL=90%	1874
$\rho \pi$	< 5	$\times 10^{-6}$	CL=90%	1804
$K^*(892)^+ K^- + \text{c.c.}$	< 1.4	$\times 10^{-5}$	CL=90%	1745
$K^*(892)^0 \bar{K}^0 + \text{c.c.}$	< 1.2	$\times 10^{-3}$	CL=90%	1744
$K_S^0 K_L^0$	< 1.2	$\times 10^{-5}$	CL=90%	1820
$2(\pi^+ \pi^-)$	< 1.12	$\times 10^{-3}$	CL=90%	1861
$2(\pi^+ \pi^-) \pi^0$	< 1.06	$\times 10^{-3}$	CL=90%	1843
$2(\pi^+ \pi^- \pi^0)$	< 5.85	%	CL=90%	1821
$\omega \pi^+ \pi^-$	< 6.0	$\times 10^{-4}$	CL=90%	1794
$3(\pi^+ \pi^-)$	< 9.1	$\times 10^{-3}$	CL=90%	1819
$3(\pi^+ \pi^-) \pi^0$	< 1.37	%	CL=90%	1792
$3(\pi^+ \pi^-) 2\pi^0$	< 11.74	%	CL=90%	1760
$\eta \pi^+ \pi^-$	< 1.24	$\times 10^{-3}$	CL=90%	1836
$\pi^+ \pi^- 2\pi^0$	< 8.9	$\times 10^{-3}$	CL=90%	1862
$\rho^0 \pi^+ \pi^-$	< 6.9	$\times 10^{-3}$	CL=90%	1796
$\eta 3\pi$	< 1.34	$\times 10^{-3}$	CL=90%	1824
$\eta 2(\pi^+ \pi^-)$	< 2.43	%	CL=90%	1804
$\eta \rho^0 \pi^+ \pi^-$	< 1.45	%	CL=90%	1708
$\eta' 3\pi$	< 2.44	$\times 10^{-3}$	CL=90%	1740
$K^+ K^- \pi^+ \pi^-$	< 9.0	$\times 10^{-4}$	CL=90%	1772
$\phi \pi^+ \pi^-$	< 4.1	$\times 10^{-4}$	CL=90%	1737
$K^+ K^- 2\pi^0$	< 4.2	$\times 10^{-3}$	CL=90%	1774
$4(\pi^+ \pi^-)$	< 1.67	%	CL=90%	1757
$4(\pi^+ \pi^-) \pi^0$	< 3.06	%	CL=90%	1720
$\phi f_0(980)$	< 4.5	$\times 10^{-4}$	CL=90%	1597
$K^+ K^- \pi^+ \pi^- \pi^0$	< 2.36	$\times 10^{-3}$	CL=90%	1741
$K^+ K^- \rho^0 \pi^0$	< 8	$\times 10^{-4}$	CL=90%	1624
$K^+ K^- \rho^+ \pi^-$	< 1.46	%	CL=90%	1622
$\omega K^+ K^-$	< 3.4	$\times 10^{-4}$	CL=90%	1664
$\phi \pi^+ \pi^- \pi^0$	< 3.8	$\times 10^{-3}$	CL=90%	1722
$K^{*0} K^- \pi^+ \pi^0 + \text{c.c.}$	< 1.62	%	CL=90%	1693
$K^{*+} K^- \pi^+ \pi^- + \text{c.c.}$	< 3.23	%	CL=90%	1692
$K^+ K^- \pi^+ \pi^- 2\pi^0$	< 2.67	%	CL=90%	1705
$K^+ K^- 2(\pi^+ \pi^-)$	< 1.03	%	CL=90%	1702
$K^+ K^- 2(\pi^+ \pi^-) \pi^0$	< 3.60	%	CL=90%	1660
$\eta K^+ K^-$	< 4.1	$\times 10^{-4}$	CL=90%	1712
$\eta K^+ K^- \pi^+ \pi^-$	< 1.24	%	CL=90%	1624
$\rho^0 K^+ K^-$	< 5.0	$\times 10^{-3}$	CL=90%	1665
$2(K^+ K^-)$	< 6.0	$\times 10^{-4}$	CL=90%	1552
$\phi K^+ K^-$	< 7.5	$\times 10^{-4}$	CL=90%	1598
$2(K^+ K^-) \pi^0$	< 2.9	$\times 10^{-4}$	CL=90%	1493

$2(K^+K^-)\pi^+\pi^-$	< 3.2	$\times 10^{-3}$	CL=90%	1425
$K_S^0K^-\pi^+$	< 3.2	$\times 10^{-3}$	CL=90%	1799
$K_S^0K^-\pi^+\pi^0$	< 1.33	%	CL=90%	1773
$K_S^0K^-\rho^+$	< 6.6	$\times 10^{-3}$	CL=90%	1664
$K_S^0K^-\pi^+\pi^-$	< 8.7	$\times 10^{-3}$	CL=90%	1739
$K_S^0K^-\pi^+\rho^0$	< 1.6	%	CL=90%	1621
$K_S^0K^-\pi^+\eta$	< 1.3	%	CL=90%	1669
$K_S^0K^-\pi^+\pi^-\pi^0$	< 4.18	%	CL=90%	1703
$K_S^0K^-\pi^+\pi^-\eta$	< 4.8	%	CL=90%	1570
$K_S^0K^-\pi^+2(\pi^+\pi^-)$	< 1.22	%	CL=90%	1658
$K_S^0K^-\pi^+2\pi^0$	< 2.65	%	CL=90%	1742
$K_S^0K^-\pi^+K^+K^-\pi^+$	< 4.9	$\times 10^{-3}$	CL=90%	1490
$K_S^0K^-\pi^+K^+K^-\pi^+\pi^0$	< 3.0	%	CL=90%	1427
$K_S^0K^-\pi^+K^+K^-\pi^+\eta$	< 2.2	%	CL=90%	1214
$K^{*0}K^-\pi^+ + \text{c.c.}$	< 9.7	$\times 10^{-3}$	CL=90%	1722
$\rho\bar{\rho}\pi^0$	< 4	$\times 10^{-5}$	CL=90%	1595
$\rho\bar{\rho}\pi^+\pi^-$	< 5.8	$\times 10^{-4}$	CL=90%	1544
$\Lambda\bar{\Lambda}$	< 1.2	$\times 10^{-4}$	CL=90%	1521
$\rho\bar{\rho}\pi^+\pi^-\pi^0$	< 1.85	$\times 10^{-3}$	CL=90%	1490
$\omega\rho\bar{\rho}$	< 2.9	$\times 10^{-4}$	CL=90%	1309
$\Lambda\bar{\Lambda}\pi^0$	< 7	$\times 10^{-5}$	CL=90%	1468
$\rho\bar{\rho}2(\pi^+\pi^-)$	< 2.6	$\times 10^{-3}$	CL=90%	1425
$\eta\rho\bar{\rho}$	< 5.4	$\times 10^{-4}$	CL=90%	1430
$\eta\rho\bar{\rho}\pi^+\pi^-$	< 3.3	$\times 10^{-3}$	CL=90%	1284
$\rho^0\rho\bar{\rho}$	< 1.7	$\times 10^{-3}$	CL=90%	1313
$\rho\bar{\rho}K^+K^-$	< 3.2	$\times 10^{-4}$	CL=90%	1185
$\eta\rho\bar{\rho}K^+K^-$	< 6.9	$\times 10^{-3}$	CL=90%	736
$\pi^0\rho\bar{\rho}K^+K^-$	< 1.2	$\times 10^{-3}$	CL=90%	1093
$\phi\rho\bar{\rho}$	< 1.3	$\times 10^{-4}$	CL=90%	1178
$\Lambda\bar{\Lambda}\pi^+\pi^-$	< 2.5	$\times 10^{-4}$	CL=90%	1404
$\Lambda\bar{\rho}K^+$	< 2.8	$\times 10^{-4}$	CL=90%	1387
$\Lambda\bar{\rho}K^+\pi^+\pi^-$	< 6.3	$\times 10^{-4}$	CL=90%	1234
$\Lambda\bar{\Lambda}\eta$	< 1.9	$\times 10^{-4}$	CL=90%	1262
$\Sigma^+\bar{\Sigma}^-$	< 1.0	$\times 10^{-4}$	CL=90%	1464
$\Sigma^0\bar{\Sigma}^0$	< 4	$\times 10^{-5}$	CL=90%	1462
$\Xi^+\bar{\Xi}^-$	< 1.5	$\times 10^{-4}$	CL=90%	1346
$\Xi^0\bar{\Xi}^0$	< 1.4	$\times 10^{-4}$	CL=90%	1353

Radiative decays

$\gamma\chi_{c2}$	< 6.4	$\times 10^{-4}$	CL=90%	211
$\gamma\chi_{c1}$	(2.49 ± 0.23)	$\times 10^{-3}$		253
$\gamma\chi_{c0}$	(6.9 ± 0.6)	$\times 10^{-3}$		341
$\gamma\eta_c$	< 7	$\times 10^{-4}$	CL=90%	707

$\gamma\eta_c(2S)$	< 9	$\times 10^{-4}$	CL=90%	133
$\gamma\eta'$	< 1.8	$\times 10^{-4}$	CL=90%	1765
$\gamma\eta$	< 1.5	$\times 10^{-4}$	CL=90%	1847
$\gamma\pi^0$	< 2	$\times 10^{-4}$	CL=90%	1884

$\psi_2(3823)$

$$J^G(J^{PC}) = 0^-(2^{--})$$

I, J, P need confirmation.

Mass $m = 3822.2 \pm 1.2$ MeV
 Full width $\Gamma < 16$ MeV, CL = 90%

$\psi_2(3823)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\chi_{c1}\gamma$	seen	299
$\chi_{c2}\gamma$	not seen	257

$\chi_{c1}(3872)$

$$J^G(J^{PC}) = 0^+(1^{++})$$

Mass $m = 3871.69 \pm 0.17$ MeV
 $m_{\chi_{c1}(3872)} - m_{J/\psi} = 775 \pm 4$ MeV
 Full width $\Gamma < 1.2$ MeV, CL = 90%

$\chi_{c1}(3872)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\pi^+\pi^- J/\psi(1S)$	> 3.2 %	650
$\omega J/\psi(1S)$	> 2.3 %	†
$D^0\bar{D}^0\pi^0$	>40 %	117
$\bar{D}^{*0}D^0$	>30 %	3
$\gamma J/\psi$	> 7 $\times 10^{-3}$	697
$\gamma\psi(2S)$	> 4 %	181
$\pi^+\pi^-\eta_c(1S)$	not seen	746
$\pi^+\pi^-\chi_{c1}$	not seen	218
$p\bar{p}$	not seen	1693

$Z_c(3900)$

$$J^G(J^{PC}) = 1^+(1^{+-})$$

Mass $m = 3886.6 \pm 2.4$ MeV ($S = 1.6$)
 Full width $\Gamma = 28.2 \pm 2.6$ MeV

$Z_c(3900)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$J/\psi\pi$	seen	699
$h_c\pi^\pm$	not seen	318
$\eta_c\pi^+\pi^-$	not seen	758

$(D\bar{D}^*)^\pm$	seen	—
$D^0 D^{*-} + \text{c.c.}$	seen	150
$D^- D^{*0} + \text{c.c.}$	seen	140
$\omega\pi^\pm$	not seen	1862
$J/\psi\eta$	not seen	509
$D^+ D^{*-} + \text{c.c.}$	seen	—
$D^0 \bar{D}^{*0} + \text{c.c.}$	seen	—

X(3915)

$$I^G(J^{PC}) = 0^+(0 \text{ or } 2^{++})$$

Mass $m = 3918.4 \pm 1.9 \text{ MeV}$

Full width $\Gamma = 20 \pm 5 \text{ MeV}$ ($S = 1.1$)

X(3915) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\omega J/\psi$	seen	222
$\pi^+ \pi^- \eta_c(1S)$	not seen	785
$\eta_c \eta$	not seen	665
$\eta_c \pi^0$	not seen	814
$K\bar{K}$	not seen	1896
$\gamma\gamma$	seen	1959

$\chi_{c2}(3930)$

$$I^G(J^{PC}) = 0^+(2^{++})$$

Mass $m = 3927.2 \pm 2.6 \text{ MeV}$

Full width $\Gamma = 24 \pm 6 \text{ MeV}$

$\chi_{c2}(3930)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\gamma\gamma$	seen	1964
$D\bar{D}$	seen	615
$D^+ D^-$	seen	600
$D^0 \bar{D}^0$	seen	615
$\pi^+ \pi^- \eta_c(1S)$	not seen	792
$K\bar{K}$	not seen	1901

X(4020)

$$I^G(J^{PC}) = 1^+(?^{? -})$$

Mass $m = 4024.1 \pm 1.9 \text{ MeV}$

Full width $\Gamma = 13 \pm 5 \text{ MeV}$ ($S = 1.7$)

X(4020) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$h_c(1P)\pi$	seen	450
$D^*\bar{D}^*$	seen	85
$D\bar{D}^* + \text{c.c.}$	not seen	542
$\eta_c\pi^+\pi^-$	not seen	872
$J/\psi(1S)\pi^\pm$	not seen	811

$\psi(4040)$ [h]

$$J^{PC} = 0^-(1^{--})$$

Mass $m = 4039 \pm 1$ MeV

Full width $\Gamma = 80 \pm 10$ MeV

$\Gamma_{ee} = 0.86 \pm 0.07$ keV

$\Gamma_{ee} < 2.9$ eV, CL = 90%

$\Gamma_{ee} < 4.6$ eV, CL = 90%

Due to the complexity of the $c\bar{c}$ threshold region, in this listing, "seen" ("not seen") means that a cross section for the mode in question has been measured at effective \sqrt{s} near this particle's central mass value, more (less) than 2σ above zero, without regard to any peaking behavior in \sqrt{s} or absence thereof. See mode listing(s) for details and references.

$\psi(4040)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
e^+e^-	$(1.07 \pm 0.16) \times 10^{-5}$		2019
$D\bar{D}$	seen		775
$D^0\bar{D}^0$	seen		775
D^+D^-	seen		763
$D^*\bar{D} + \text{c.c.}$	seen		569
$D^*(2007)^0\bar{D}^0 + \text{c.c.}$	seen		575
$D^*(2010)^+D^- + \text{c.c.}$	seen		561
$D^*\bar{D}^*$	seen		193
$D^*(2007)^0\bar{D}^*(2007)^0$	seen		226
$D^*(2010)^+D^*(2010)^-$	seen		193
$D^0D^-\pi^+ + \text{c.c.}$ (excl. $D^*(2007)^0\bar{D}^0 + \text{c.c.}$, $D^*(2010)^+D^- + \text{c.c.}$)	not seen		—
$D\bar{D}^*\pi$ (excl. $D^*\bar{D}^*$)	not seen		—
$D^0\bar{D}^{*-}\pi^+ + \text{c.c.}$ (excl. $D^*(2010)^+D^*(2010)^-$)	seen		—
$D_s^+D_s^-$	seen		452
$J/\psi\pi^+\pi^-$	< 4	$\times 10^{-3}$ 90%	794
$J/\psi\pi^0\pi^0$	< 2	$\times 10^{-3}$ 90%	797

$J/\psi\eta$	$(5.2 \pm 0.7) \times 10^{-3}$		675
$J/\psi\pi^0$	< 2.8	$\times 10^{-4}$	90% 823
$J/\psi\pi^+\pi^-\pi^0$	< 2	$\times 10^{-3}$	90% 746
$\chi_{c1}\gamma$	< 3.4	$\times 10^{-3}$	90% 494
$\chi_{c2}\gamma$	< 5	$\times 10^{-3}$	90% 454
$\chi_{c1}\pi^+\pi^-\pi^0$	< 1.1	%	90% 306
$\chi_{c2}\pi^+\pi^-\pi^0$	< 3.2	%	90% 233
$h_c(1P)\pi^+\pi^-$	< 3	$\times 10^{-3}$	90% 403
$\phi\pi^+\pi^-$	< 3	$\times 10^{-3}$	90% 1880
$\Lambda\bar{\Lambda}\pi^+\pi^-$	< 2.9	$\times 10^{-4}$	90% 1578
$\Lambda\bar{\Lambda}\pi^0$	< 9	$\times 10^{-5}$	90% 1636
$\Lambda\bar{\Lambda}\eta$	< 3.0	$\times 10^{-4}$	90% 1452
$\Sigma^+\bar{\Sigma}^-$	< 1.3	$\times 10^{-4}$	90% 1632
$\Sigma^0\bar{\Sigma}^0$	< 7	$\times 10^{-5}$	90% 1630
$\Xi^+\bar{\Xi}^-$	< 1.6	$\times 10^{-4}$	90% 1527
$\Xi^0\bar{\Xi}^0$	< 1.8	$\times 10^{-4}$	90% 1533

$\chi_{c1}(4140)$

$$I^G(J^{PC}) = 0^+(1^{++})$$

Mass $m = 4146.8 \pm 2.4$ MeV ($S = 1.1$)

Full width $\Gamma = 22^{+8}_{-7}$ MeV ($S = 1.3$)

$\chi_{c1}(4140)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$J/\psi\phi$	seen	217
$\gamma\gamma$	not seen	2073

$\psi(4160)$ [h]

$$I^G(J^{PC}) = 0^-(1^{--})$$

Mass $m = 4191 \pm 5$ MeV

Full width $\Gamma = 70 \pm 10$ MeV

$\Gamma_{ee} = 0.48 \pm 0.22$ keV

$\Gamma_{ee} < 2.2$ eV, CL = 90%

Due to the complexity of the $c\bar{c}$ threshold region, in this listing, “seen” (“not seen”) means that a cross section for the mode in question has been measured at effective \sqrt{s} near this particle’s central mass value, more (less) than 2σ above zero, without regard to any peaking behavior in \sqrt{s} or absence thereof. See mode listing(s) for details and references.

$\psi(4160)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
e^+e^-	$(6.9 \pm 3.3) \times 10^{-6}$		2096
$\mu^+\mu^-$	seen		2093
$D\bar{D}$	seen		956

$D^0 \bar{D}^0$	seen			956
$D^+ D^-$	seen			947
$D^* \bar{D}^+ + \text{c.c.}$	seen			798
$D^*(2007)^0 \bar{D}^0 + \text{c.c.}$	seen			802
$D^*(2010)^+ D^- + \text{c.c.}$	seen			792
$D^* \bar{D}^*$	seen			592
$D^*(2007)^0 \bar{D}^*(2007)^0$	seen			604
$D^*(2010)^+ D^*(2010)^-$	seen			592
$D^0 D^- \pi^+ + \text{c.c.}$ (excl. $D^*(2007)^0 \bar{D}^0 + \text{c.c.},$ $D^*(2010)^+ D^- + \text{c.c.}$)	not seen			—
$D \bar{D}^* \pi + \text{c.c.}$ (excl. $D^* \bar{D}^*$)	seen			—
$D^0 D^{*-} \pi^+ + \text{c.c.}$ (excl. $D^*(2010)^+ D^*(2010)^-$)	not seen			—
$D_s^+ D_s^-$	not seen			719
$D_s^{*+} D_s^- + \text{c.c.}$	seen			385
$J/\psi \pi^+ \pi^-$	< 3	$\times 10^{-3}$	90%	919
$J/\psi \pi^0 \pi^0$	< 3	$\times 10^{-3}$	90%	922
$J/\psi K^+ K^-$	< 2	$\times 10^{-3}$	90%	407
$J/\psi \eta$	< 8	$\times 10^{-3}$	90%	822
$J/\psi \pi^0$	< 1	$\times 10^{-3}$	90%	944
$J/\psi \eta'$	< 5	$\times 10^{-3}$	90%	457
$J/\psi \pi^+ \pi^- \pi^0$	< 1	$\times 10^{-3}$	90%	879
$\psi(2S) \pi^+ \pi^-$	< 4	$\times 10^{-3}$	90%	396
$\chi_{c1} \gamma$	< 5	$\times 10^{-3}$	90%	625
$\chi_{c2} \gamma$	< 1.3	%	90%	587
$\chi_{c1} \pi^+ \pi^- \pi^0$	< 2	$\times 10^{-3}$	90%	496
$\chi_{c2} \pi^+ \pi^- \pi^0$	< 8	$\times 10^{-3}$	90%	445
$h_c(1P) \pi^+ \pi^-$	< 5	$\times 10^{-3}$	90%	556
$h_c(1P) \pi^0 \pi^0$	< 2	$\times 10^{-3}$	90%	560
$h_c(1P) \eta$	< 2	$\times 10^{-3}$	90%	348
$h_c(1P) \pi^0$	< 4	$\times 10^{-4}$	90%	600
$\phi \pi^+ \pi^-$	< 2	$\times 10^{-3}$	90%	1961
$\gamma \chi_{c1}(3872) \rightarrow \gamma J/\psi \pi^+ \pi^-$	< 6.8	$\times 10^{-5}$	90%	—
$\gamma X(3915) \rightarrow \gamma J/\psi \pi^+ \pi^-$	< 1.36	$\times 10^{-4}$	90%	—
$\gamma X(3930) \rightarrow \gamma J/\psi \pi^+ \pi^-$	< 1.18	$\times 10^{-4}$	90%	—
$\gamma X(3940) \rightarrow \gamma J/\psi \pi^+ \pi^-$	< 1.47	$\times 10^{-4}$	90%	—
$\gamma \chi_{c1}(3872) \rightarrow \gamma \gamma J/\psi$	< 1.05	$\times 10^{-4}$	90%	—
$\gamma X(3915) \rightarrow \gamma \gamma J/\psi$	< 1.26	$\times 10^{-4}$	90%	—
$\gamma X(3930) \rightarrow \gamma \gamma J/\psi$	< 8.8	$\times 10^{-5}$	90%	—
$\gamma X(3940) \rightarrow \gamma \gamma J/\psi$	< 1.79	$\times 10^{-4}$	90%	—

$\psi(4260)$

$$J^G(J^{PC}) = 0^-(1^{--})$$

Mass $m = 4230 \pm 8$ MeV ($S = 2.9$)Full width $\Gamma = 55 \pm 19$ MeV ($S = 4.4$)

$\psi(4260)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$J/\psi \pi^+ \pi^-$	seen	950
$J/\psi f_0(980), f_0(980) \rightarrow \pi^+ \pi^-$	seen	—
$Z_c(3900)^\pm \pi^\mp, Z_c^\pm \rightarrow J/\psi \pi^\pm$	seen	—
$J/\psi \pi^0 \pi^0$	seen	952
$J/\psi K^+ K^-$	seen	477
$J/\psi K_S^0 K_S^0$	not seen	465
$J/\psi \eta$	not seen	857
$J/\psi \pi^0$	not seen	974
$J/\psi \eta'$	not seen	520
$J/\psi \pi^+ \pi^- \pi^0$	not seen	912
$J/\psi \eta \pi^0$	not seen	780
$J/\psi \eta \eta$	not seen	247
$\psi(2S) \pi^+ \pi^-$	not seen	437
$\psi(2S) \eta$	not seen	†
$\chi_{c0} \omega$	not seen	205
$\chi_{c1} \pi^+ \pi^- \pi^0$	not seen	537
$\chi_{c2} \pi^+ \pi^- \pi^0$	not seen	489
$h_c(1P) \pi^+ \pi^-$	not seen	593
$\phi \pi^+ \pi^-$	not seen	1982
$\phi f_0(980) \rightarrow \phi \pi^+ \pi^-$	not seen	—
$D \bar{D}$	not seen	998
$D^0 \bar{D}^0$	not seen	998
$D^+ D^-$	not seen	989
$D^* \bar{D}^* + c.c.$	not seen	887
$D^*(2007)^0 \bar{D}^0 + c.c.$	not seen	—
$D^*(2010)^+ D^- + c.c.$	not seen	—
$D^* \bar{D}^*$	not seen	657
$D^*(2007)^0 \bar{D}^*(2007)^0$	not seen	668
$D^*(2010)^+ D^*(2010)^-$	not seen	657
$D^0 D^- \pi^+ + c.c.$ (excl. $D^*(2007)^0 \bar{D}^{*0} + c.c.,$ $D^*(2010)^+ D^- + c.c.)$	not seen	—
$D \bar{D}^* \pi + c.c.$ (excl. $D^* \bar{D}^*$)	not seen	723
$D^0 D^{*-} \pi^+ + c.c.$ (excl. $D^*(2010)^+ D^*(2010)^-$)	not seen	—
$D^0 D^*(2010)^- \pi^+ + c.c.$	not seen	716

$D^* \bar{D}^* \pi$	not seen	395
$D_s^+ D_s^-$	not seen	774
$D_s^{*+} D_s^- + c.c.$	not seen	615
$D_s^{*+} D_s^{*-}$	not seen	109
$p \bar{p}$	not seen	1896
$p \bar{p} \pi^0$	not seen	1860
$K_S^0 K^\pm \pi^\mp$	not seen	2037
$K^+ K^- \pi^0$	not seen	2038

Radiative decays

$\eta_c(1S) \gamma$	possibly seen	1063
$\chi_{c1} \gamma$	not seen	658
$\chi_{c2} \gamma$	not seen	620
$\chi_{c1}(3872) \gamma$	seen	343

$\chi_{c1}(4274)$

$$I^G(J^{PC}) = 0^+(1^{++})$$

Mass $m = 4274^{+8}_{-6}$ MeV
 Full width $\Gamma = 49 \pm 12$ MeV

$\chi_{c1}(4274)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$J/\psi \phi$	seen	503

$\psi(4360)$

$$I^G(J^{PC}) = 0^-(1^{--})$$

I needs confirmation.

$\psi(4360)$ MASS = 4368 ± 13 MeV ($S = 3.7$)
 $\psi(4360)$ WIDTH = 96 ± 7 MeV
 $\Gamma_{ee} < 0.57$ eV, CL = 90%
 $\Gamma_{ee} < 1.9$ eV, CL = 90%

$\psi(4360)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\psi(2S) \pi^+ \pi^-$	seen	573
$\psi_2(3823) \pi^+ \pi^-$	possibly seen	440

$\psi(4415)$ ^[h]

$$I^G(J^{PC}) = 0^-(1^{--})$$

Mass $m = 4421 \pm 4$ MeV
 Full width $\Gamma = 62 \pm 20$ MeV
 $\Gamma_{ee} = 0.58 \pm 0.07$ keV
 $\Gamma_{ee} < 3.6$ eV, CL = 90%
 $\Gamma_{ee} < 0.47$ eV, CL = 90%
 $\Gamma_{ee} < 2.3$ eV, CL = 90%

Due to the complexity of the $c\bar{c}$ threshold region, in this listing, “seen” (“not seen”) means that a cross section for the mode in question has been measured at effective \sqrt{s} near this particle’s central mass value, more (less) than 2σ above zero, without regard to any peaking behavior in \sqrt{s} or absence thereof. See mode listing(s) for details and references.

$\psi(4415)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$D\bar{D}$	seen		1187
$D^0\bar{D}^0$	seen		1187
D^+D^-	seen		1179
$D^*\bar{D} + \text{c.c.}$	seen		1063
$D^*(2007)^0\bar{D}^0 + \text{c.c.}$	seen		1067
$D^*(2010)^+D^- + \text{c.c.}$	seen		1059
$D^*\bar{D}^*$	seen		919
$D^*(2007)^0\bar{D}^*(2007)^0 + \text{c.c.}$	seen		927
$D^*(2010)^+D^*(2010)^- + \text{c.c.}$	seen		919
$D^0D^-\pi^+$ (excl. $D^*(2007)^0\bar{D}^0$ +c.c., $D^*(2010)^+D^- + \text{c.c.}$)	< 2.3 %	90%	–
$D\bar{D}_2^*(2460) \rightarrow D^0D^-\pi^+ + \text{c.c.}$	(10 ± 4) %		–
$D^0D^*\pi^+ + \text{c.c.}$	< 11 %	90%	926
$D_s^+D_s^-$	not seen		1006
$\omega\chi_{c2}$	possibly seen		330
$D_s^{*+}D_s^- + \text{c.c.}$	seen		–
$D_s^{*+}D_s^{*-}$	not seen		652
$\psi_2(3823)\pi^+\pi^-$	possibly seen		494
$J/\psi\eta$	< 6 × 10 ⁻³	90%	1022
$\chi_{c1}\gamma$	< 8 × 10 ⁻⁴	90%	817
$\chi_{c2}\gamma$	< 4 × 10 ⁻³	90%	780
e^+e^-	(9.4 ± 3.2) × 10 ⁻⁶		2210

$Z_c(4430)$

$$I^G(J^{PC}) = 1^+(1^{+-})$$

I, G, C need confirmation.

Quantum numbers not established.

$$\text{Mass } m = 4478^{+15}_{-18} \text{ MeV}$$

$$\text{Full width } \Gamma = 181 \pm 31 \text{ MeV}$$

$Z_c(4430)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\pi^+\psi(2S)$	seen	711
π^+J/ψ	seen	1162

$\psi(4660)$

$$I^G(J^{PC}) = 0^-(1^{--})$$

 I needs confirmation.

$$\psi(4660) \text{ MASS} = 4643 \pm 9 \text{ MeV} \quad (S = 1.2)$$

$$\psi(4660) \text{ WIDTH} = 72 \pm 11 \text{ MeV}$$

$$\Gamma_{ee} < 0.45 \text{ eV, CL} = 90\%$$

$$\Gamma_{ee} < 2.1 \text{ eV, CL} = 90\%$$

$\psi(4660)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\psi(2S)\pi^+\pi^-$	seen	820

NOTES

- [a] For $E_\gamma > 100$ MeV.
- [b] The value is for the sum of the charge states or particle/antiparticle states indicated.
- [c] Includes $p\bar{p}\pi^+\pi^-\gamma$ and excludes $p\bar{p}\eta$, $p\bar{p}\omega$, $p\bar{p}\eta'$.
- [d] See the "Note on the $\eta(1405)$ " in the $\eta(1405)$ Particle Listings.
- [e] For a narrow state A with mass less than 960 MeV.
- [f] For a narrow scalar or pseudoscalar A^0 with mass 0.21–3.0 GeV.
- [g] For a narrow resonance in the range $2.2 < M(X) < 2.8$ GeV.
- [h] J^{PC} known by production in e^+e^- via single photon annihilation. I^G is not known; interpretation of this state as a single resonance is unclear because of the expectation of substantial threshold effects in this energy region.