

c \bar{c} MESONS

$\eta_c(1S)$

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

Mass $m = 2983.6 \pm 0.7$ MeV (S = 1.3)

Full width $\Gamma = 32.2 \pm 0.9$ MeV

$\eta_c(1S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	ρ (MeV/c)
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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) %		1277
$K^*(892)\bar{K}^*(892)$	(7.0 \pm 1.3) $\times 10^{-3}$		1196
$K^{*0}\bar{K}^{*0}\pi^+\pi^-$	(1.1 \pm 0.5) %		1073
$\phi K^+ K^-$	(2.9 \pm 1.4) $\times 10^{-3}$		1104
$\phi\phi$	(1.76 \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%	1309
$f_2(1270)\eta$	< 1.1 %	90%	1145
$\omega\omega$	< 3.1 $\times 10^{-3}$	90%	1270
$\omega\phi$	< 1.7 $\times 10^{-3}$	90%	1185
$f_2(1270)f_2(1270)$	(9.8 \pm 2.5) $\times 10^{-3}$		774
$f_2(1270)f'_2(1525)$	(9.7 \pm 3.2) $\times 10^{-3}$		513

Decays into stable hadrons

$K\bar{K}\pi$	(7.3 \pm 0.5) %		1381
$\eta\pi^+\pi^-$	(1.7 \pm 0.5) %		1428
$\eta 2(\pi^+\pi^-)$	(4.4 \pm 1.3) %		1385
$K^+K^-\pi^+\pi^-$	(6.9 \pm 1.1) $\times 10^{-3}$		1345
$K^+K^-\pi^+\pi^-\pi^0$	(3.5 \pm 0.6) %		1304
$K^0 K^- \pi^+ \pi^- \pi^+ + \text{c.c.}$	(5.6 \pm 1.5) %		-
$K^+K^- 2(\pi^+\pi^-)$	(7.5 \pm 2.4) $\times 10^{-3}$		1253
$2(K^+K^-)$	(1.47 \pm 0.31) $\times 10^{-3}$		1055
$\pi^+\pi^-\pi^0\pi^0$	(4.7 \pm 1.0) %		1460
$2(\pi^+\pi^-)$	(9.7 \pm 1.2) $\times 10^{-3}$		1459
$2(\pi^+\pi^-\pi^0)$	(17.4 \pm 3.3) %		1409
$3(\pi^+\pi^-)$	(1.8 \pm 0.4) %		1407
$p\bar{p}$	(1.52 \pm 0.16) $\times 10^{-3}$		1160

$p\bar{p}\pi^0$	$(3.6 \pm 1.3) \times 10^{-3}$	1101
$\Lambda\bar{\Lambda}$	$(1.09 \pm 0.24) \times 10^{-3}$	990
$\Sigma^+\bar{\Sigma}^-$	$(2.1 \pm 0.6) \times 10^{-3}$	901
$\Xi^-\bar{\Xi}^+$	$(8.9 \pm 2.7) \times 10^{-4}$	692
$K\bar{K}\eta$	$(10 \pm 5) \times 10^{-3}$	1265
$\pi^+\pi^-\rho\bar{\rho}$	$(5.3 \pm 1.8) \times 10^{-3}$	1027

Radiative decays

$\gamma\gamma$	$(1.57 \pm 0.12) \times 10^{-4}$	1492
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Charge conjugation (C), Parity (P), Lepton family number (LF) violating modes

$\pi^+\pi^-$	$P, CP < 1.1$	$\times 10^{-4}$	90%	1485
$\pi^0\pi^0$	$P, CP < 3.5$	$\times 10^{-5}$	90%	1486
K^+K^-	$P, CP < 6$	$\times 10^{-4}$	90%	1408
$K_S^0 K_S^0$	$P, CP < 3.1$	$\times 10^{-4}$	90%	1406

J/ψ(1S)

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

Mass $m = 3096.916 \pm 0.011$ 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)	p
hadrons	$(87.7 \pm 0.5) \%$		—
virtual $\gamma \rightarrow$ hadrons	$(13.50 \pm 0.30) \%$		—
ggg	$(64.1 \pm 1.0) \%$		—
γgg	$(8.8 \pm 1.1) \%$		—
e^+e^-	$(5.971 \pm 0.032) \%$		1548
$e^+e^-\gamma$	[a] $(8.8 \pm 1.4) \times 10^{-3}$		1548
$\mu^+\mu^-$	$(5.961 \pm 0.033) \%$		1545

Decays involving hadronic resonances

$\rho\pi$	$(1.69 \pm 0.15) \%$	S=2.4	1448
$\rho^0\pi^0$	$(5.6 \pm 0.7) \times 10^{-3}$		1448
$a_2(1320)\rho$	$(1.09 \pm 0.22) \%$		1123
$\omega\pi^+\pi^+\pi^-\pi^-$	$(8.5 \pm 3.4) \times 10^{-3}$		1392
$\omega\pi^+\pi^-\pi^0$	$(4.0 \pm 0.7) \times 10^{-3}$		1418
$\omega\pi^+\pi^-$	$(8.6 \pm 0.7) \times 10^{-3}$	S=1.1	1435
$\omega f_2(1270)$	$(4.3 \pm 0.6) \times 10^{-3}$		1142
$K^*(892)^0 \bar{K}^*(892)^0$	$(2.3 \pm 0.7) \times 10^{-4}$		1266
$K^*(892)^\pm K^*(892)^\mp$	$(1.00 \pm 0.22 \pm 0.40) \times 10^{-3}$		1266
$K^*(892)^\pm K^*(800)^\mp$	$(1.1 \pm 1.0 \pm 0.6) \times 10^{-3}$		—

$\eta K^*(892)^0 \bar{K}^*(892)^0$		$(1.15 \pm 0.26) \times 10^{-3}$	1003
$K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.}$		$(6.0 \pm 0.6) \times 10^{-3}$	1012
$K^*(892)^0 \bar{K}_2^*(1770)^0 + \text{c.c.} \rightarrow$ $K^*(892)^0 K^- \pi^+ + \text{c.c.}$		$(6.9 \pm 0.9) \times 10^{-4}$	—
$\omega K^*(892) \bar{K} + \text{c.c.}$		$(6.1 \pm 0.9) \times 10^{-3}$	1097
$K^+ K^*(892)^- + \text{c.c.}$		$(5.12 \pm 0.30) \times 10^{-3}$	1373
$K^+ K^*(892)^- + \text{c.c.} \rightarrow$ $K^+ K^- \pi^0$		$(1.97 \pm 0.20) \times 10^{-3}$	—
$K^+ K^*(892)^- + \text{c.c.} \rightarrow$ $K^0 K^\pm \pi^\mp + \text{c.c.}$		$(3.0 \pm 0.4) \times 10^{-3}$	—
$K^0 \bar{K}^*(892)^0 + \text{c.c.}$		$(4.39 \pm 0.31) \times 10^{-3}$	1373
$K^0 \bar{K}^*(892)^0 + \text{c.c.} \rightarrow$ $K^0 K^\pm \pi^\mp + \text{c.c.}$		$(3.2 \pm 0.4) \times 10^{-3}$	—
$K_1(1400)^\pm K^\mp$		$(3.8 \pm 1.4) \times 10^{-3}$	1170
$\bar{K}^*(892)^0 K^+ \pi^- + \text{c.c.}$	seen		1343
$\omega \pi^0 \pi^0$		$(3.4 \pm 0.8) \times 10^{-3}$	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
$\phi K \bar{K}$		$(1.83 \pm 0.24) \times 10^{-3}$	S=1.5 1179
$\phi f_0(1710) \rightarrow \phi K \bar{K}$		$(3.6 \pm 0.6) \times 10^{-4}$	875
$\phi f_2(1270)$		$(7.2 \pm 1.3) \times 10^{-4}$	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]	$(1.10 \pm 0.12) \times 10^{-3}$	697
$\phi f_2'(1525)$		$(8 \pm 4) \times 10^{-4}$	S=2.7 871
$\phi \pi^+ \pi^-$		$(9.4 \pm 0.9) \times 10^{-4}$	S=1.2 1365
$\phi \pi^0 \pi^0$		$(5.6 \pm 1.6) \times 10^{-4}$	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
$\Xi^0 \Xi^0$		$(1.20 \pm 0.24) \times 10^{-3}$	818
$\Xi(1530)^- \Xi^+$		$(5.9 \pm 1.5) \times 10^{-4}$	600
$\rho K^- \bar{\Sigma}(1385)^0$		$(5.1 \pm 3.2) \times 10^{-4}$	646
$\omega \pi^0$		$(4.5 \pm 0.5) \times 10^{-4}$	S=1.4 1446
$\phi \eta'(958)$		$(4.0 \pm 0.7) \times 10^{-4}$	S=2.1 1192
$\phi f_0(980)$		$(3.2 \pm 0.9) \times 10^{-4}$	S=1.9 1178
$\phi f_0(980) \rightarrow \phi \pi^+ \pi^-$		$(1.8 \pm 0.4) \times 10^{-4}$	—

$\phi f_0(980) \rightarrow \phi \pi^0 \pi^0$	(1.7 ±0.7) × 10 ⁻⁴			—
$\eta \phi f_0(980) \rightarrow \eta \phi \pi^+ \pi^-$	(3.2 ±1.0) × 10 ⁻⁴			—
$\phi a_0(980)^0 \rightarrow \phi \eta \pi^0$	(5 ±4) × 10 ⁻⁶			—
$\Xi(1530)^0 \Xi^0$	(3.2 ±1.4) × 10 ⁻⁴			608
$\Sigma(1385)^- \bar{\Sigma}^+$ (or c.c.)	[b] (3.1 ±0.5) × 10 ⁻⁴			855
$\phi f_1(1285)$	(2.6 ±0.5) × 10 ⁻⁴		S=1.1	1032
$\eta \pi^+ \pi^-$	(4.0 ±1.7) × 10 ⁻⁴			1487
$\rho \eta$	(1.93 ±0.23) × 10 ⁻⁴			1396
$\omega \eta'(958)$	(1.82 ±0.21) × 10 ⁻⁴			1279
$\omega f_0(980)$	(1.4 ±0.5) × 10 ⁻⁴			1267
$\rho \eta'(958)$	(1.05 ±0.18) × 10 ⁻⁴			1281
$a_2(1320)^\pm \pi^\mp$	[b] < 4.3	× 10 ⁻³	CL=90%	1263
$K \bar{K}_2^*(1430)^+ \text{ c.c.}$	< 4.0	× 10 ⁻³	CL=90%	1159
$K_1(1270)^\pm K^\mp$	< 3.0	× 10 ⁻³	CL=90%	1231
$K_2^*(1430)^0 \bar{K}_2^*(1430)^0$	< 2.9	× 10 ⁻³	CL=90%	604
$\phi \pi^0$	< 6.4	× 10 ⁻⁶	CL=90%	1377
$\phi \eta(1405) \rightarrow \phi \eta \pi \pi$	< 2.5	× 10 ⁻⁴	CL=90%	946
$\omega f_2'(1525)$	< 2.2	× 10 ⁻⁴	CL=90%	1003
$\omega X(1835) \rightarrow \omega p \bar{p}$	< 3.9	× 10 ⁻⁶	CL=95%	—
$\eta \phi(2170) \rightarrow$	< 2.52	× 10 ⁻⁴	CL=90%	—
$\eta K^*(892)^0 \bar{K}^*(892)^0$				
$\Sigma(1385)^0 \bar{\Lambda} + \text{ c.c.}$	< 8.2	× 10 ⁻⁶	CL=90%	912
$\Delta(1232)^+ \bar{p}$	< 1	× 10 ⁻⁴	CL=90%	1100
$\Lambda(1520) \bar{\Lambda} + \text{ c.c.} \rightarrow \gamma \Lambda \bar{\Lambda}$	< 4.1	× 10 ⁻⁶	CL=90%	—
$\Theta(1540) \bar{\Theta}(1540) \rightarrow$	< 1.1	× 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	× 10 ⁻⁵	CL=90%	—
$\Theta(1540) K_S^0 \bar{p} \rightarrow K_S^0 \bar{p} K^+ n$	< 1.6	× 10 ⁻⁵	CL=90%	—
$\bar{\Theta}(1540) K^+ n \rightarrow K_S^0 \bar{p} K^+ n$	< 5.6	× 10 ⁻⁵	CL=90%	—
$\bar{\Theta}(1540) K_S^0 p \rightarrow K_S^0 p K^- \bar{n}$	< 1.1	× 10 ⁻⁵	CL=90%	—
$\Sigma^0 \bar{\Lambda}$	< 9	× 10 ⁻⁵	CL=90%	1032

Decays into stable hadrons

$2(\pi^+ \pi^-) \pi^0$	(4.1 ±0.5) %	S=2.4	1496
$3(\pi^+ \pi^-) \pi^0$	(2.9 ±0.6) %		1433
$\pi^+ \pi^- \pi^0$	(2.11 ±0.07) %	S=1.5	1533
$\pi^+ \pi^- \pi^0 K^+ K^-$	(1.79 ±0.29) %	S=2.2	1368
$4(\pi^+ \pi^-) \pi^0$	(9.0 ±3.0) × 10 ⁻³		1345
$\pi^+ \pi^- K^+ K^-$	(6.6 ±0.5) × 10 ⁻³		1407
$\pi^+ \pi^- K^+ K^- \eta$	(1.84 ±0.28) × 10 ⁻³		1221
$\pi^0 \pi^0 K^+ K^-$	(2.45 ±0.31) × 10 ⁻³		1410
$K \bar{K} \pi$	(6.1 ±1.0) × 10 ⁻³		1442
$2(\pi^+ \pi^-)$	(3.57 ±0.30) × 10 ⁻³		1517
$3(\pi^+ \pi^-)$	(4.3 ±0.4) × 10 ⁻³		1466

$2(\pi^+\pi^-\pi^0)$	(1.62 ±0.21) %		1468
$2(\pi^+\pi^-\eta)$	(2.29 ±0.24) × 10 ⁻³		1446
$3(\pi^+\pi^-\eta)$	(7.2 ±1.5) × 10 ⁻⁴		1379
$\rho\bar{\rho}$	(2.120±0.029) × 10 ⁻³		1232
$\rho\bar{\rho}\pi^0$	(1.19 ±0.08) × 10 ⁻³	S=1.1	1176
$\rho\bar{\rho}\pi^+\pi^-$	(6.0 ±0.5) × 10 ⁻³	S=1.3	1107
$\rho\bar{\rho}\pi^+\pi^-\pi^0$	[c] (2.3 ±0.9) × 10 ⁻³	S=1.9	1033
$\rho\bar{\rho}\eta$	(2.00 ±0.12) × 10 ⁻³		948
$\rho\bar{\rho}\rho$	< 3.1 × 10 ⁻⁴	CL=90%	774
$\rho\bar{\rho}\omega$	(9.8 ±1.0) × 10 ⁻⁴	S=1.3	768
$\rho\bar{\rho}\eta'(958)$	(2.1 ±0.4) × 10 ⁻⁴		596
$\rho\bar{\rho}\phi$	(4.5 ±1.5) × 10 ⁻⁵		527
$n\bar{n}$	(2.09 ±0.16) × 10 ⁻³		1231
$n\bar{n}\pi^+\pi^-$	(4 ±4) × 10 ⁻³		1106
$\Sigma^+\bar{\Sigma}^-$	(1.50 ±0.24) × 10 ⁻³		992
$\Sigma^0\bar{\Sigma}^0$	(1.29 ±0.09) × 10 ⁻³		988
$2(\pi^+\pi^-)K^+K^-$	(4.7 ±0.7) × 10 ⁻³	S=1.3	1320
$\rho\bar{n}\pi^-$	(2.12 ±0.09) × 10 ⁻³		1174
$nN(1440)$	seen		984
$nN(1520)$	seen		928
$nN(1535)$	seen		914
$\Xi^-\bar{\Xi}^+$	(8.6 ±1.1) × 10 ⁻⁴	S=1.2	807
$\Lambda\bar{\Lambda}$	(1.61 ±0.15) × 10 ⁻³	S=1.9	1074
$\Lambda\bar{\Sigma}^-\pi^+$ (or c.c.)	[b] (8.3 ±0.7) × 10 ⁻⁴	S=1.2	950
$\rho K^-\bar{\Lambda}$	(8.9 ±1.6) × 10 ⁻⁴		876
$2(K^+K^-)$	(7.6 ±0.9) × 10 ⁻⁴		1131
$\rho K^-\bar{\Sigma}^0$	(2.9 ±0.8) × 10 ⁻⁴		819
K^+K^-	(2.70 ±0.17) × 10 ⁻⁴		1468
$K_S^0 K_L^0$	(2.1 ±0.4) × 10 ⁻⁴	S=3.2	1466
$\Lambda\bar{\Lambda}\pi^+\pi^-$	(4.3 ±1.0) × 10 ⁻³		903
$\Lambda\bar{\Lambda}\eta$	(1.62 ±0.17) × 10 ⁻⁴		672
$\Lambda\bar{\Lambda}\pi^0$	(3.8 ±0.4) × 10 ⁻⁵		998
$\bar{\Lambda}nK_S^0 + \text{c.c.}$	(6.5 ±1.1) × 10 ⁻⁴		872
$\pi^+\pi^-$	(1.47 ±0.14) × 10 ⁻⁴		1542
$\Lambda\bar{\Sigma} + \text{c.c.}$	(2.83 ±0.23) × 10 ⁻⁵		1034
$K_S^0 K_S^0$	< 1 × 10 ⁻⁶	CL=95%	1466

Radiative decays

3γ	(1.16 ±0.22) × 10 ⁻⁵		1548
4γ	< 9 × 10 ⁻⁶	CL=90%	1548
5γ	< 1.5 × 10 ⁻⁵	CL=90%	1548
$\gamma\eta_c(1S)$	(1.7 ±0.4) %	S=1.6	111
$\gamma\eta_c(1S) \rightarrow 3\gamma$	(3.8 ^{+1.3} _{-1.0}) × 10 ⁻⁶	S=1.1	—
$\gamma\pi^+\pi^-2\pi^0$	(8.3 ±3.1) × 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
$\gamma\eta'(958)$	$(5.15 \pm 0.16) \times 10^{-3}$	S=1.2	1400
$\gamma 2\pi^+ 2\pi^-$	$(2.8 \pm 0.5) \times 10^{-3}$	S=1.9	1517
$\gamma f_2(1270) f_2(1270)$	$(9.5 \pm 1.7) \times 10^{-4}$		879
$\gamma f_2(1270) f_2(1270)$ (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
$\gamma f_2(1270)$	$(1.43 \pm 0.11) \times 10^{-3}$		1286
$\gamma f_0(1710) \rightarrow \gamma K\bar{K}$	$(8.5 \pm 1.2 \pm 0.9) \times 10^{-4}$	S=1.2	1075
$\gamma f_0(1710) \rightarrow \gamma\pi\pi$	$(4.0 \pm 1.0) \times 10^{-4}$		—
$\gamma f_0(1710) \rightarrow \gamma\omega\omega$	$(3.1 \pm 1.0) \times 10^{-4}$		—
$\gamma\eta$	$(1.104 \pm 0.034) \times 10^{-3}$		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
$\gamma f_1(1510) \rightarrow \gamma\eta\pi^+\pi^-$	$(4.5 \pm 1.2) \times 10^{-4}$		—
$\gamma f_2'(1525)$	$(4.5 \pm 0.7 \pm 0.4) \times 10^{-4}$		1173
$\gamma f_2(1640) \rightarrow \gamma\omega\omega$	$(2.8 \pm 1.8) \times 10^{-4}$		—
$\gamma f_2(1910) \rightarrow \gamma\omega\omega$	$(2.0 \pm 1.4) \times 10^{-4}$		—
$\gamma f_0(1800) \rightarrow \gamma\omega\phi$	$(2.5 \pm 0.6) \times 10^{-4}$		—
$\gamma f_2(1950) \rightarrow$	$(7.0 \pm 2.2) \times 10^{-4}$		—
$\gamma K^*(892)\bar{K}^*(892)$			
$\gamma K^*(892)\bar{K}^*(892)$	$(4.0 \pm 1.3) \times 10^{-3}$		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
$\gamma\eta(2225)$	$(3.3 \pm 0.5) \times 10^{-4}$		749
$\gamma\eta(1760) \rightarrow \gamma\rho^0\rho^0$	$(1.3 \pm 0.9) \times 10^{-4}$		1048
$\gamma\eta(1760) \rightarrow \gamma\omega\omega$	$(1.98 \pm 0.33) \times 10^{-3}$		—
$\gamma X(1835) \rightarrow \gamma\pi^+\pi^-\eta'$	$(2.6 \pm 0.4) \times 10^{-4}$		1006
$\gamma X(1835) \rightarrow \gamma\rho\bar{\rho}$	$(7.7 \pm 1.5 \pm 0.9) \times 10^{-5}$		—
$\gamma X(1840) \rightarrow \gamma 3(\pi^+\pi^-)$	$(2.4 \pm 0.7 \pm 0.8) \times 10^{-5}$		—
$\gamma(K\bar{K}\pi) [J^{PC} = 0^{-+}]$	$(7 \pm 4) \times 10^{-4}$	S=2.1	1442

$\gamma\pi^0$	$(3.49^{+0.33}_{-0.30}) \times 10^{-5}$			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
$\gamma f_J(2220)$	> 2.50	$\times 10^{-3}$	CL=99.9%	745
$\gamma f_J(2220) \rightarrow \gamma\pi\pi$	$(8 \pm 4) \times 10^{-5}$			—
$\gamma f_J(2220) \rightarrow \gamma K\bar{K}$	< 3.6	$\times 10^{-5}$		—
$\gamma f_J(2220) \rightarrow \gamma p\bar{p}$	$(1.5 \pm 0.8) \times 10^{-5}$			—
$\gamma f_0(1500)$	$(1.01 \pm 0.32) \times 10^{-4}$			1183
$\gamma A \rightarrow \gamma \text{invisible}$	[e] < 6.3	$\times 10^{-6}$	CL=90%	—
$\gamma A^0 \rightarrow \gamma\mu^+\mu^-$	[f] < 2.1	$\times 10^{-5}$	CL=90%	—

Weak decays

$D^- e^+ \nu_e + \text{c.c.}$	< 1.2	$\times 10^{-5}$	CL=90%	984
$\bar{D}^0 e^+ e^- + \text{c.c.}$	< 1.1	$\times 10^{-5}$	CL=90%	987
$D_s^- e^+ \nu_e + \text{c.c.}$	< 3.6	$\times 10^{-5}$	CL=90%	923
$D^- \pi^+ + \text{c.c.}$	< 7.5	$\times 10^{-5}$	CL=90%	977
$\bar{D}^0 K^0 + \text{c.c.}$	< 1.7	$\times 10^{-4}$	CL=90%	898
$D_s^- \pi^+ + \text{c.c.}$	< 1.3	$\times 10^{-4}$	CL=90%	916

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

$\gamma\gamma$	C	< 5	$\times 10^{-6}$	CL=90%	1548
$e^\pm \mu^\mp$	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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$\chi_{c0}(1P)$

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

Mass $m = 3414.75 \pm 0.31$ MeV

Full width $\Gamma = 10.5 \pm 0.6$ MeV

$\chi_{c0}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
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Hadronic decays

$2(\pi^+\pi^-)$	$(2.24 \pm 0.18) \%$		1679
$\rho^0\pi^+\pi^-$	$(8.7 \pm 2.8) \times 10^{-3}$		1607
$f_0(980)f_0(980)$	$(6.5 \pm 2.1) \times 10^{-4}$		1391
$\pi^+\pi^-\pi^0\pi^0$	$(3.3 \pm 0.4) \%$		1680
$\rho^+\pi^-\pi^0 + \text{c.c.}$	$(2.8 \pm 0.4) \%$		1607
$4\pi^0$	$(3.2 \pm 0.4) \times 10^{-3}$		1681
$\pi^+\pi^-K^+K^-$	$(1.75 \pm 0.14) \%$		1580

$K_0^*(1430)^0 \bar{K}_0^*(1430)^0 \rightarrow \pi^+ \pi^- K^+ K^-$	$(9.6^{+3.5}_{-2.8}) \times 10^{-4}$	—
$K_0^*(1430)^0 \bar{K}_2^*(1430)^0 + \text{c.c.} \rightarrow \pi^+ \pi^- K^+ K^-$	$(7.8^{+1.9}_{-2.4}) \times 10^{-4}$	—
$K_1(1270)^+ K^- + \text{c.c.} \rightarrow \pi^+ \pi^- K^+ K^-$	$(6.1 \pm 1.9) \times 10^{-3}$	—
$K_1(1400)^+ K^- + \text{c.c.} \rightarrow \pi^+ \pi^- K^+ K^-$	$< 2.6 \times 10^{-3}$	CL=90% —
$f_0(980) f_0(980)$	$(1.6^{+1.0}_{-0.9}) \times 10^{-4}$	1391
$f_0(980) f_0(2200)$	$(7.8^{+2.0}_{-2.5}) \times 10^{-4}$	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% 920
$f_0(1370) f_0(1710)$	$(6.6^{+3.5}_{-2.3}) \times 10^{-4}$	721
$f_0(1500) f_0(1370)$	$< 1.3 \times 10^{-4}$	CL=90% 920
$f_0(1500) f_0(1500)$	$< 5 \times 10^{-5}$	CL=90% 805
$f_0(1500) f_0(1710)$	$< 7 \times 10^{-5}$	CL=90% 557
$K^+ K^- \pi^+ \pi^- \pi^0$	$(1.11 \pm 0.26) \%$	1545
$K^+ K^- \pi^0 \pi^0$	$(5.4 \pm 0.9) \times 10^{-3}$	1582
$K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.}$	$(2.44 \pm 0.33) \%$	1581
$\rho^+ K^- K^0 + \text{c.c.}$	$(1.18 \pm 0.21) \%$	1458
$K^*(892)^- K^+ \pi^0 \rightarrow K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.}$	$(4.5 \pm 1.1) \times 10^{-3}$	—
$K_S^0 K_S^0 \pi^+ \pi^-$	$(5.6 \pm 1.0) \times 10^{-3}$	1579
$K^+ K^- \eta \pi^0$	$(3.0 \pm 0.7) \times 10^{-3}$	1468
$3(\pi^+ \pi^-)$	$(1.20 \pm 0.18) \%$	1633
$K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$	$(7.2 \pm 1.6) \times 10^{-3}$	1523
$K^*(892)^0 \bar{K}^*(892)^0$	$(1.7 \pm 0.6) \times 10^{-3}$	1456
$\pi \pi$	$(8.33 \pm 0.35) \times 10^{-3}$	1702
$\pi^0 \eta$	$< 1.8 \times 10^{-4}$	1661
$\pi^0 \eta'$	$< 1.1 \times 10^{-3}$	1570
$\eta \eta$	$(2.95 \pm 0.19) \times 10^{-3}$	1617
$\eta \eta'$	$< 2.3 \times 10^{-4}$	CL=90% 1521
$\eta' \eta'$	$(1.96 \pm 0.21) \times 10^{-3}$	1413
$\omega \omega$	$(9.5 \pm 1.1) \times 10^{-4}$	1517
$\omega \phi$	$(1.16 \pm 0.21) \times 10^{-4}$	1447
$K^+ K^-$	$(5.91 \pm 0.32) \times 10^{-3}$	1634
$K_S^0 K_S^0$	$(3.10 \pm 0.18) \times 10^{-3}$	1633
$\pi^+ \pi^- \eta$	$< 1.9 \times 10^{-4}$	CL=90% 1651
$\pi^+ \pi^- \eta'$	$< 3.5 \times 10^{-4}$	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
$K^+ K^- \eta$	$< 2.2 \times 10^{-4}$	CL=90% 1512

$K^+ K^- K_S^0 K_S^0$	$(1.4 \pm 0.5) \times 10^{-3}$		1331
$K^+ K^- K^+ K^-$	$(2.75 \pm 0.28) \times 10^{-3}$		1333
$K^+ K^- \phi$	$(9.5 \pm 2.4) \times 10^{-4}$		1381
$\phi \phi$	$(7.7 \pm 0.7) \times 10^{-4}$		1370
$\rho \bar{\rho}$	$(2.25 \pm 0.09) \times 10^{-4}$		1426
$\rho \bar{\rho} \pi^0$	$(6.8 \pm 0.7) \times 10^{-4}$	S=1.3	1379
$\rho \bar{\rho} \eta$	$(3.5 \pm 0.4) \times 10^{-4}$		1187
$\rho \bar{\rho} \omega$	$(5.1 \pm 0.6) \times 10^{-4}$		1043
$\rho \bar{\rho} \phi$	$(5.9 \pm 1.4) \times 10^{-5}$		876
$\rho \bar{\rho} \pi^+ \pi^-$	$(2.1 \pm 0.7) \times 10^{-3}$	S=1.4	1320
$\rho \bar{\rho} \pi^0 \pi^0$	$(1.02 \pm 0.27) \times 10^{-3}$		1324
$\rho \bar{\rho} K^+ K^-$ (non-resonant)	$(1.19 \pm 0.26) \times 10^{-4}$		890
$\rho \bar{\rho} K_S^0 K_S^0$	$< 8.8 \times 10^{-4}$	CL=90%	884
$\rho \bar{n} \pi^-$	$(1.24 \pm 0.11) \times 10^{-3}$		1376
$\bar{\rho} n \pi^+$	$(1.34 \pm 0.12) \times 10^{-3}$		1376
$\rho \bar{n} \pi^- \pi^0$	$(2.29 \pm 0.21) \times 10^{-3}$		1321
$\bar{\rho} n \pi^+ \pi^0$	$(2.16 \pm 0.18) \times 10^{-3}$		1321
$\Lambda \bar{\Lambda}$	$(3.21 \pm 0.25) \times 10^{-4}$		1292
$\Lambda \bar{\Lambda} \pi^+ \pi^-$	$(1.15 \pm 0.13) \times 10^{-3}$		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
$K^+ \bar{\rho} \Lambda + \text{c.c.}$	$(1.22 \pm 0.12) \times 10^{-3}$	S=1.3	1132
$K^+ \bar{\rho} \Lambda(1520) + \text{c.c.}$	$(2.9 \pm 0.7) \times 10^{-4}$		858
$\Lambda(1520) \bar{\Lambda}(1520)$	$(3.1 \pm 1.2) \times 10^{-4}$		779
$\Sigma^0 \bar{\Sigma}^0$	$(4.4 \pm 0.4) \times 10^{-4}$		1222
$\Sigma^+ \bar{\Sigma}^-$	$(3.9 \pm 0.7) \times 10^{-4}$	S=1.7	1225
$\Sigma(1385)^+ \bar{\Sigma}(1385)^-$	$(1.6 \pm 0.6) \times 10^{-4}$		1001
$\Sigma(1385)^- \bar{\Sigma}(1385)^+$	$(2.3 \pm 0.6) \times 10^{-4}$		1001
$\Xi^0 \bar{\Xi}^0$	$(3.1 \pm 0.8) \times 10^{-4}$		1089
$\Xi^- \bar{\Xi}^+$	$(4.7 \pm 0.7) \times 10^{-4}$		1081

Radiative decays

$\gamma J/\psi(1S)$	$(1.27 \pm 0.06) \%$		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
$\gamma \gamma$	$(2.23 \pm 0.13) \times 10^{-4}$		1707

$\chi_{c1}(1P)$

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

Mass $m = 3510.66 \pm 0.07$ MeV (S = 1.5)

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)
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
$\pi^+\pi^-\pi^0\pi^0$	$(1.22 \pm 0.16) \%$		1729
$\rho^+\pi^-\pi^0 + \text{c.c.}$	$(1.48 \pm 0.25) \%$		1658
$\rho^0\pi^+\pi^-$	$(3.9 \pm 3.5) \times 10^{-3}$		1657
$4\pi^0$	$(5.5 \pm 0.8) \times 10^{-4}$		1729
$\pi^+\pi^-K^+K^-$	$(4.5 \pm 1.0) \times 10^{-3}$		1632
$K^+K^-\pi^0\pi^0$	$(1.14 \pm 0.28) \times 10^{-3}$		1634
$K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$	$(8.7 \pm 1.4) \times 10^{-3}$		1632
$\rho^-K^+\bar{K}^0 + \text{c.c.}$	$(5.1 \pm 1.2) \times 10^{-3}$		1514
$K^*(892)^0\bar{K}^0\pi^0 \rightarrow$ $K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$	$(2.4 \pm 0.7) \times 10^{-3}$		—
$K^+K^-\eta\pi^0$	$(1.14 \pm 0.35) \times 10^{-3}$		1523
$\pi^+\pi^-K_S^0K_S^0$	$(7.0 \pm 3.0) \times 10^{-4}$		1630
$K^+K^-\eta$	$(3.2 \pm 1.0) \times 10^{-4}$		1566
$\bar{K}^0K^+\pi^- + \text{c.c.}$	$(7.1 \pm 0.6) \times 10^{-3}$		1661
$K^*(892)^0\bar{K}^0 + \text{c.c.}$	$(1.0 \pm 0.4) \times 10^{-3}$		1602
$K^*(892)^+K^- + \text{c.c.}$	$(1.5 \pm 0.7) \times 10^{-3}$		1602
$K_J^*(1430)^0\bar{K}^0 + \text{c.c.} \rightarrow$ $K_S^0K^+\pi^- + \text{c.c.}$	$< 8 \times 10^{-4}$	CL=90%	—
$K_J^*(1430)^+K^- + \text{c.c.} \rightarrow$ $K_S^0K^+\pi^- + \text{c.c.}$	$< 2.2 \times 10^{-3}$	CL=90%	—
$K^+K^-\pi^0$	$(1.85 \pm 0.25) \times 10^{-3}$		1662
$\eta\pi^+\pi^-$	$(4.9 \pm 0.5) \times 10^{-3}$		1701
$a_0(980)^+\pi^- + \text{c.c.} \rightarrow \eta\pi^+\pi^-$	$(1.8 \pm 0.6) \times 10^{-3}$		—
$f_2(1270)\eta$	$(2.7 \pm 0.8) \times 10^{-3}$		1468
$\pi^+\pi^-\eta'$	$(2.3 \pm 0.5) \times 10^{-3}$		1612
$\pi^0f_0(980) \rightarrow \pi^0\pi^+\pi^-$	$< 6 \times 10^{-6}$	CL=90%	—
$K^+\bar{K}^*(892)^0\pi^- + \text{c.c.}$	$(3.2 \pm 2.1) \times 10^{-3}$		1577
$K^*(892)^0\bar{K}^*(892)^0$	$(1.5 \pm 0.4) \times 10^{-3}$		1512
$K^+K^-\bar{K}_S^0K_S^0$	$< 4 \times 10^{-4}$	CL=90%	1390
$K^+K^-\bar{K}^+K^-$	$(5.5 \pm 1.1) \times 10^{-4}$		1393
$K^+K^-\phi$	$(4.2 \pm 1.6) \times 10^{-4}$		1440
$\omega\omega$	$(5.8 \pm 0.7) \times 10^{-4}$		1571
$\omega\phi$	$(2.1 \pm 0.6) \times 10^{-5}$		1503
$\phi\phi$	$(4.2 \pm 0.5) \times 10^{-4}$		1429
$p\bar{p}$	$(7.72 \pm 0.35) \times 10^{-5}$		1484
$p\bar{p}\pi^0$	$(1.59 \pm 0.19) \times 10^{-4}$		1438
$p\bar{p}\eta$	$(1.48 \pm 0.25) \times 10^{-4}$		1254
$p\bar{p}\omega$	$(2.16 \pm 0.31) \times 10^{-4}$		1117

$p\bar{p}\phi$	$< 1.8 \times 10^{-5}$	CL=90%	962
$p\bar{p}\pi^+\pi^-$	$(5.0 \pm 1.9) \times 10^{-4}$		1381
$p\bar{p}K^+K^-$ (non-resonant)	$(1.30 \pm 0.23) \times 10^{-4}$		974
$p\bar{p}K_S^0K_S^0$	$< 4.5 \times 10^{-4}$	CL=90%	968
$p\bar{p}\pi^-\pi^-$	$(3.9 \pm 0.5) \times 10^{-4}$		1435
$\bar{p}n\pi^+$	$(4.0 \pm 0.5) \times 10^{-4}$		1435
$p\bar{n}\pi^-\pi^0$	$(1.05 \pm 0.12) \times 10^{-3}$		1383
$\bar{p}n\pi^+\pi^0$	$(1.03 \pm 0.12) \times 10^{-3}$		1383
$\Lambda\bar{\Lambda}$	$(1.16 \pm 0.12) \times 10^{-4}$		1355
$\Lambda\bar{\Lambda}\pi^+\pi^-$	$(3.0 \pm 0.5) \times 10^{-4}$		1223
$\Lambda\bar{\Lambda}\pi^+\pi^-$ (non-resonant)	$(2.5 \pm 0.6) \times 10^{-4}$		1223
$\Sigma(1385)^+\bar{\Lambda}\pi^- + \text{c.c.}$	$< 1.3 \times 10^{-4}$	CL=90%	1157
$\Sigma(1385)^-\bar{\Lambda}\pi^+ + \text{c.c.}$	$< 1.3 \times 10^{-4}$	CL=90%	1157
$K^+\bar{p}\Lambda$	$(4.2 \pm 0.4) \times 10^{-4}$	S=1.1	1203
$K^+\bar{p}\Lambda(1520) + \text{c.c.}$	$(1.7 \pm 0.5) \times 10^{-4}$		950
$\Lambda(1520)\bar{\Lambda}(1520)$	$< 1.0 \times 10^{-4}$	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
$\Sigma(1385)^+\bar{\Sigma}(1385)^-$	$< 1.0 \times 10^{-4}$	CL=90%	1081
$\Sigma(1385)^-\bar{\Sigma}(1385)^+$	$< 5 \times 10^{-5}$	CL=90%	1081
$\Xi^0\bar{\Xi}^0$	$< 6 \times 10^{-5}$	CL=90%	1163
$\Xi^-\bar{\Xi}^+$	$(8.2 \pm 2.2) \times 10^{-5}$		1155
$\pi^+\pi^- + K^+K^-$	$< 2.1 \times 10^{-3}$		—
$K_S^0K_S^0$	$< 6 \times 10^{-5}$	CL=90%	1683

Radiative decays

$\gamma J/\psi(1S)$	$(33.9 \pm 1.2) \%$	389
$\gamma\rho^0$	$(2.20 \pm 0.18) \times 10^{-4}$	1670
$\gamma\omega$	$(6.9 \pm 0.8) \times 10^{-5}$	1668
$\gamma\phi$	$(2.5 \pm 0.5) \times 10^{-5}$	1607

$h_c(1P)$

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

Mass $m = 3525.38 \pm 0.11$ MeV

Full 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
$\eta_c(1S)\gamma$	$(51 \pm 6) \%$		500

$\pi^+ \pi^- \pi^0$	$< 2.2 \times 10^{-3}$	1749
$2\pi^+ 2\pi^- \pi^0$	$(2.2^{+0.8}_{-0.7}) \%$	1716
$3\pi^+ 3\pi^- \pi^0$	$< 2.9 \%$	1661

$\chi_{c2}(1P)$

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

Mass $m = 3556.20 \pm 0.09$ MeV

Full width $\Gamma = 1.93 \pm 0.11$ MeV

$\chi_{c2}(1P)$ DECAY MODES Fraction (Γ_i/Γ) Confidence level (ρ (MeV/c))

Hadronic decays

$2(\pi^+ \pi^-)$	$(1.07 \pm 0.10) \%$	1751
$\pi^+ \pi^- \pi^0 \pi^0$	$(1.92 \pm 0.25) \%$	1752
$\rho^+ \pi^- \pi^0 + \text{c.c.}$	$(2.3 \pm 0.4) \%$	1682
$4\pi^0$	$(1.16 \pm 0.16) \times 10^{-3}$	1752
$K^+ K^- \pi^0 \pi^0$	$(2.2 \pm 0.4) \times 10^{-3}$	1658
$K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.}$	$(1.44 \pm 0.21) \%$	1657
$\rho^- K^+ \bar{K}^0 + \text{c.c.}$	$(4.3 \pm 1.3) \times 10^{-3}$	1540
$K^*(892)^0 K^- \pi^+ \rightarrow$ $K^- \pi^+ K^0 \pi^0 + \text{c.c.}$	$(3.1 \pm 0.8) \times 10^{-3}$	—
$K^*(892)^0 \bar{K}^0 \pi^0 \rightarrow$ $K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.}$	$(4.0 \pm 0.9) \times 10^{-3}$	—
$K^*(892)^- K^+ \pi^0 \rightarrow$ $K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.}$	$(3.9 \pm 0.9) \times 10^{-3}$	—
$K^*(892)^+ \bar{K}^0 \pi^- \rightarrow$ $K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.}$	$(3.1 \pm 0.8) \times 10^{-3}$	—
$K^+ K^- \eta \pi^0$	$(1.3 \pm 0.5) \times 10^{-3}$	1549
$K^+ K^- \pi^+ \pi^-$	$(8.8 \pm 1.0) \times 10^{-3}$	1656
$K^+ K^- \pi^+ \pi^- \pi^0$	$(1.23 \pm 0.34) \%$	1623
$K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$	$(2.2 \pm 1.1) \times 10^{-3}$	1602
$K^*(892)^0 \bar{K}^*(892)^0$	$(2.4 \pm 0.5) \times 10^{-3}$	1538
$3(\pi^+ \pi^-)$	$(8.6 \pm 1.8) \times 10^{-3}$	1707
$\phi \phi$	$(1.12 \pm 0.10) \times 10^{-3}$	1457
$\omega \omega$	$(8.8 \pm 1.1) \times 10^{-4}$	1597
$\pi \pi$	$(2.33 \pm 0.12) \times 10^{-3}$	1773
$\rho^0 \pi^+ \pi^-$	$(3.8 \pm 1.6) \times 10^{-3}$	1682
$\pi^+ \pi^- \eta$	$(5.0 \pm 1.3) \times 10^{-4}$	1724
$\pi^+ \pi^- \eta'$	$(5.2 \pm 1.9) \times 10^{-4}$	1636
$\eta \eta$	$(5.7 \pm 0.5) \times 10^{-4}$	1692
$K^+ K^-$	$(1.05 \pm 0.07) \times 10^{-3}$	1708
$K_S^0 K_S^0$	$(5.5 \pm 0.4) \times 10^{-4}$	1707
$\bar{K}^0 K^+ \pi^- + \text{c.c.}$	$(1.34 \pm 0.19) \times 10^{-3}$	1685

$K^+ K^- \pi^0$	$(3.2 \pm 0.8) \times 10^{-4}$		1686
$K^+ K^- \eta$	$< 3.4 \times 10^{-4}$	90%	1592
$\eta \eta'$	$< 6 \times 10^{-5}$	90%	1600
$\eta' \eta'$	$< 1.0 \times 10^{-4}$	90%	1498
$\pi^+ \pi^- K_S^0 K_S^0$	$(2.3 \pm 0.6) \times 10^{-3}$		1655
$K^+ K^- K_S^0 K_S^0$	$< 4 \times 10^{-4}$	90%	1418
$K^+ K^- K^+ K^-$	$(1.73 \pm 0.21) \times 10^{-3}$		1421
$K^+ K^- \phi$	$(1.48 \pm 0.31) \times 10^{-3}$		1468
$p \bar{p}$	$(7.5 \pm 0.4) \times 10^{-5}$		1510
$p \bar{p} \pi^0$	$(4.9 \pm 0.4) \times 10^{-4}$		1465
$p \bar{p} \eta$	$(1.82 \pm 0.26) \times 10^{-4}$		1285
$p \bar{p} \omega$	$(3.8 \pm 0.5) \times 10^{-4}$		1152
$p \bar{p} \phi$	$(2.9 \pm 0.9) \times 10^{-5}$		1002
$p \bar{p} \pi^+ \pi^-$	$(1.32 \pm 0.34) \times 10^{-3}$		1410
$p \bar{p} \pi^0 \pi^0$	$(8.2 \pm 2.5) \times 10^{-4}$		1414
$p \bar{p} K^+ K^-$ (non-resonant)	$(2.00 \pm 0.34) \times 10^{-4}$		1013
$p \bar{p} K_S^0 K_S^0$	$< 7.9 \times 10^{-4}$	90%	1007
$p \bar{n} \pi^-$	$(8.9 \pm 1.0) \times 10^{-4}$		1463
$\bar{p} n \pi^+$	$(9.3 \pm 0.9) \times 10^{-4}$		1463
$p \bar{n} \pi^- \pi^0$	$(2.27 \pm 0.19) \times 10^{-3}$		1411
$\bar{p} n \pi^+ \pi^0$	$(2.21 \pm 0.20) \times 10^{-3}$		1411
$\Lambda \bar{\Lambda}$	$(1.92 \pm 0.16) \times 10^{-4}$		1385
$\Lambda \bar{\Lambda} \pi^+ \pi^-$	$(1.31 \pm 0.17) \times 10^{-3}$		1255
$\Lambda \bar{\Lambda} \pi^+ \pi^-$ (non-resonant)	$(6.9 \pm 1.6) \times 10^{-4}$		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
$K^+ \bar{p} \Lambda + \text{c.c.}$	$(8.1 \pm 0.6) \times 10^{-4}$		1236
$K^+ \bar{p} \Lambda(1520) + \text{c.c.}$	$(2.9 \pm 0.7) \times 10^{-4}$		992
$\Lambda(1520) \bar{\Lambda}(1520)$	$(4.8 \pm 1.5) \times 10^{-4}$		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
$\Xi^0 \bar{\Xi}^0$	$< 1.1 \times 10^{-4}$	90%	1197
$\Xi^- \bar{\Xi}^+$	$(1.48 \pm 0.33) \times 10^{-4}$		1189
$J/\psi(1S) \pi^+ \pi^- \pi^0$	$< 1.5 \%$	90%	185
$\eta_c(1S) \pi^+ \pi^-$	$< 2.2 \%$	90%	459

Radiative decays

$\gamma J/\psi(1S)$	$(19.2 \pm 0.7) \%$		430
$\gamma \rho^0$	$< 2.0 \times 10^{-5}$	90%	1694
$\gamma \omega$	$< 6 \times 10^{-6}$	90%	1692
$\gamma \phi$	$< 8 \times 10^{-6}$	90%	1632
$\gamma \gamma$	$(2.74 \pm 0.14) \times 10^{-4}$		1778

$\eta_c(2S)$

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

Quantum numbers are quark model predictions.

$$\text{Mass } m = 3639.4 \pm 1.3 \text{ MeV} \quad (S = 1.2)$$

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

$\eta_c(2S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
hadrons	not seen		—
$K \bar{K} \pi$	(1.9±1.2) %		1730
$2\pi^+ 2\pi^-$	not seen		1793
$\rho^0 \rho^0$	not seen		1646
$3\pi^+ 3\pi^-$	not seen		1750
$K^+ K^- \pi^+ \pi^-$	not seen		1701
$K^{*0} \bar{K}^{*0}$	not seen		1586
$K^+ K^- \pi^+ \pi^- \pi^0$	(1.4±1.0) %		1668
$K^+ K^- 2\pi^+ 2\pi^-$	not seen		1628
$K_S^0 K^- 2\pi^+ \pi^- + \text{c.c.}$	seen		1667
$2K^+ 2K^-$	not seen		1471
$\phi \phi$	not seen		1507
$p \bar{p}$	< 2.0 $\times 10^{-3}$	90%	1559
$\gamma \gamma$	(1.9±1.3) $\times 10^{-4}$		1820
$\pi^+ \pi^- \eta$	not seen		1767
$\pi^+ \pi^- \eta'$	not seen		1681
$K^+ K^- \eta$	not seen		1638
$\pi^+ \pi^- \eta_c(1S)$	< 25 %	90%	539

$\psi(2S)$

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

$$\text{Mass } m = 3686.109^{+0.012}_{-0.014} \text{ MeV}$$

$$\text{Full width } \Gamma = 299 \pm 8 \text{ keV}$$

$$\Gamma_{ee} = 2.36 \pm 0.04 \text{ keV}$$

$\psi(2S)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
hadrons	(97.85 ± 0.13) %		—
virtual $\gamma \rightarrow$ hadrons	(1.73 ± 0.14) %	S=1.5	—
$g g g$	(10.6 ± 1.6) %		—
$\gamma g g$	(1.03 ± 0.29) %		—
light hadrons	(15.4 ± 1.5) %		—
$e^+ e^-$	(7.89 ± 0.17) $\times 10^{-3}$		1843
$\mu^+ \mu^-$	(7.9 ± 0.9) $\times 10^{-3}$		1840
$\tau^+ \tau^-$	(3.1 ± 0.4) $\times 10^{-3}$		490

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

$J/\psi(1S)$ anything	(60.9 \pm 0.6) %	–
$J/\psi(1S)$ neutrals	(25.10 \pm 0.33) %	–
$J/\psi(1S)\pi^+\pi^-$	(34.45 \pm 0.30) %	477
$J/\psi(1S)\pi^0\pi^0$	(18.13 \pm 0.31) %	481
$J/\psi(1S)\eta$	(3.36 \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
$p\bar{p}$	(2.80 \pm 0.11) $\times 10^{-4}$	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
$\Lambda\bar{\Lambda}$	(2.8 \pm 0.5) $\times 10^{-4}$	S=2.6 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
$\Sigma^0\bar{p}K^+ + \text{c.c.}$	(1.67 \pm 0.18) $\times 10^{-5}$	1291
$\Sigma^+\bar{\Sigma}^-$	(2.6 \pm 0.8) $\times 10^{-4}$	1408
$\Sigma^0\bar{\Sigma}^0$	(2.2 \pm 0.4) $\times 10^{-4}$	S=1.5 1405
$\Sigma(1385)^+\bar{\Sigma}(1385)^-$	(1.1 \pm 0.4) $\times 10^{-4}$	1218
$\Xi^-\bar{\Xi}^+$	(1.8 \pm 0.6) $\times 10^{-4}$	S=2.8 1284
$\Xi^0\bar{\Xi}^0$	(2.8 \pm 0.9) $\times 10^{-4}$	1292
$\Xi(1530)^0\bar{\Xi}(1530)^0$	(5.2 $\begin{smallmatrix} +3.2 \\ -1.2 \end{smallmatrix}$) $\times 10^{-5}$	1025
$\Omega^-\bar{\Omega}^+$	< 7.3 $\times 10^{-5}$	CL=90% 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 $\begin{smallmatrix} +0.40 \\ -0.31 \end{smallmatrix}$) $\times 10^{-5}$	–

$\pi^0 f_0(2100) \rightarrow \pi^0 p \bar{p}$	$(1.1 \pm 0.4) \times 10^{-5}$	—
$\eta p \bar{p}$	$(6.0 \pm 0.4) \times 10^{-5}$	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
$p \bar{n} \pi^-$ 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
$2(\pi^+ \pi^- \pi^0)$	$(4.7 \pm 1.5) \times 10^{-3}$	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
$\pi^+ \pi^- K^+ K^-$	$(7.5 \pm 0.9) \times 10^{-4}$	S=1.9 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
$\omega K^+ K^-$	$(1.85 \pm 0.25) \times 10^{-4}$	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
$\omega X(1440) \rightarrow \omega K_S^0 K^- \pi^+ + \text{c.c.}$	$(1.6 \pm 0.4) \times 10^{-5}$	—

$\omega X(1440) \rightarrow \omega K^+ K^- \pi^0$	$(1.09 \pm 0.26) \times 10^{-5}$		—
$\omega f_1(1285) \rightarrow \omega K_S^0 K^- \pi^+ +$ 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
$K^+ K^-$	$(7.1 \pm 0.5) \times 10^{-5}$	S=1.5	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
$K^+ K^*(892)^- + \text{c.c.}$	$(2.9 \pm 0.4) \times 10^{-5}$	S=1.2	1698
$K^*(892)^0 \bar{K}^0 + \text{c.c.}$	$(1.09 \pm 0.20) \times 10^{-4}$		1697
$\phi \pi^+ \pi^-$	$(1.17 \pm 0.29) \times 10^{-4}$	S=1.7	1690
$\phi f_0(980) \rightarrow \pi^+ \pi^-$	$(6.8 \pm 2.4) \times 10^{-5}$	S=1.1	—
$2(K^+ K^-)$	$(6.0 \pm 1.4) \times 10^{-5}$		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%	—
$p\bar{p}K^+ K^-$	$(2.7 \pm 0.7) \times 10^{-5}$		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

$\gamma\chi_{c0}(1P)$	(9.99 ± 0.27) %	261
$\gamma\chi_{c1}(1P)$	(9.55 ± 0.31) %	171
$\gamma\chi_{c2}(1P)$	(9.11 ± 0.31) %	128
$\gamma\eta_c(1S)$	(3.4 ± 0.5) × 10 ⁻³ S=1.3	636
$\gamma\eta_c(2S)$	(7 ± 5) × 10 ⁻⁴	46
$\gamma\pi^0$	(1.6 ± 0.4) × 10 ⁻⁶	1841
$\gamma\eta'(958)$	(1.23 ± 0.06) × 10 ⁻⁴	1719
$\gamma f_2(1270)$	(2.1 ± 0.4) × 10 ⁻⁴	1623
$\gamma f_0(1710) \rightarrow \gamma\pi\pi$	(3.0 ± 1.3) × 10 ⁻⁵	—
$\gamma f_0(1710) \rightarrow \gamma K\bar{K}$	(6.0 ± 1.6) × 10 ⁻⁵	—
$\gamma\gamma$	< 1.4 × 10 ⁻⁴ CL=90%	1843
$\gamma\eta$	(1.4 ± 0.5) × 10 ⁻⁶	1802
$\gamma\eta\pi^+\pi^-$	(8.7 ± 2.1) × 10 ⁻⁴	1791
$\gamma\eta(1405) \rightarrow \gamma K\bar{K}\pi$	< 9 × 10 ⁻⁵ CL=90%	1569
$\gamma\eta(1405) \rightarrow \eta\pi^+\pi^-$	(3.6 ± 2.5) × 10 ⁻⁵	—
$\gamma\eta(1475) \rightarrow K\bar{K}\pi$	< 1.4 × 10 ⁻⁴ CL=90%	—
$\gamma\eta(1475) \rightarrow \eta\pi^+\pi^-$	< 8.8 × 10 ⁻⁵ CL=90%	—
$\gamma 2(\pi^+\pi^-)$	(4.0 ± 0.6) × 10 ⁻⁴	1817
$\gamma K^{*0}K^+\pi^- + c.c.$	(3.7 ± 0.9) × 10 ⁻⁴	1674
$\gamma K^{*0}\bar{K}^{*0}$	(2.4 ± 0.7) × 10 ⁻⁴	1613
$\gamma K_S^0K^+\pi^- + c.c.$	(2.6 ± 0.5) × 10 ⁻⁴	1753
$\gamma K^+K^-\pi^+\pi^-$	(1.9 ± 0.5) × 10 ⁻⁴	1726
$\gamma p\bar{p}$	(3.9 ± 0.5) × 10 ⁻⁵ S=2.0	1586
$\gamma f_2(1950) \rightarrow \gamma p\bar{p}$	(1.20 ± 0.22) × 10 ⁻⁵	—
$\gamma f_2(2150) \rightarrow \gamma p\bar{p}$	(7.2 ± 1.8) × 10 ⁻⁶	—
$\gamma X(1835) \rightarrow \gamma p\bar{p}$	(4.6 ^{+1.8} / _{-4.0}) × 10 ⁻⁶	—
$\gamma X \rightarrow \gamma p\bar{p}$	[g] < 2 × 10 ⁻⁶ CL=90%	—
$\gamma\pi^+\pi^-p\bar{p}$	(2.8 ± 1.4) × 10 ⁻⁵	1491
$\gamma 2(\pi^+\pi^-)K^+K^-$	< 2.2 × 10 ⁻⁴ CL=90%	1654
$\gamma 3(\pi^+\pi^-)$	< 1.7 × 10 ⁻⁴ CL=90%	1774
$\gamma K^+K^-K^+K^-$	< 4 × 10 ⁻⁵ CL=90%	1499
$\gamma\gamma J/\psi$	(3.1 ^{+1.0} / _{-1.2}) × 10 ⁻⁴	542

Other decays

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

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

Mass $m = 3773.15 \pm 0.33$ MeV

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	p (MeV/c)
$D\bar{D}$	(93 $\begin{smallmatrix} +8 \\ -9 \end{smallmatrix}$) %	S=2.0	286
$D^0\bar{D}^0$	(52 ± 5) %	S=2.0	286
D^+D^-	(41 ± 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 ± 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 $\times 10^{-3}$		1819
$3(\pi^+\pi^-)\pi^0$	< 1.37 %		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 %		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
$K_S^0 K^- \pi^+$	< 3.2	$\times 10^{-3}$	CL=90%	1799
$K_S^0 K^- \pi^+ \pi^0$	< 1.33	%	CL=90%	1773
$K_S^0 K^- \rho^+$	< 6.6	$\times 10^{-3}$	CL=90%	1664
$K_S^0 K^- 2\pi^+ \pi^-$	< 8.7	$\times 10^{-3}$	CL=90%	1739
$K_S^0 K^- \pi^+ \rho^0$	< 1.6	%	CL=90%	1621
$K_S^0 K^- \pi^+ \eta$	< 1.3	%	CL=90%	1669
$K_S^0 K^- 2\pi^+ \pi^- \pi^0$	< 4.18	%	CL=90%	1703
$K_S^0 K^- 2\pi^+ \pi^- \eta$	< 4.8	%	CL=90%	1570
$K_S^0 K^- \pi^+ 2(\pi^+ \pi^-)$	< 1.22	%	CL=90%	1658
$K_S^0 K^- \pi^+ 2\pi^0$	< 2.65	%	CL=90%	1742
$K_S^0 K^- K^+ K^- \pi^+$	< 4.9	$\times 10^{-3}$	CL=90%	1490
$K_S^0 K^- K^+ K^- \pi^+ \pi^0$	< 3.0	%	CL=90%	1427
$K_S^0 K^- K^+ K^- \pi^+ \eta$	< 2.2	%	CL=90%	1214
$K^{*0} K^- \pi^+ + \text{c.c.}$	< 9.7	$\times 10^{-3}$	CL=90%	1722
$p\bar{p}\pi^0$	< 1.2	$\times 10^{-3}$		1595
$p\bar{p}\pi^+ \pi^-$	< 5.8	$\times 10^{-4}$	CL=90%	1544
$\Lambda\bar{\Lambda}$	< 1.2	$\times 10^{-4}$	CL=90%	1521
$p\bar{p}\pi^+ \pi^- \pi^0$	< 1.85	$\times 10^{-3}$	CL=90%	1490
$\omega p\bar{p}$	< 2.9	$\times 10^{-4}$	CL=90%	1309

$\Lambda\bar{\Lambda}\pi^0$	< 7	$\times 10^{-5}$	CL=90%	1469
$p\bar{p}2(\pi^+\pi^-)$	< 2.6	$\times 10^{-3}$	CL=90%	1425
$\eta p\bar{p}$	< 5.4	$\times 10^{-4}$	CL=90%	1430
$\eta p\bar{p}\pi^+\pi^-$	< 3.3	$\times 10^{-3}$	CL=90%	1284
$\rho^0 p\bar{p}$	< 1.7	$\times 10^{-3}$	CL=90%	1313
$p\bar{p}K^+K^-$	< 3.2	$\times 10^{-4}$	CL=90%	1185
$\eta p\bar{p}K^+K^-$	< 6.9	$\times 10^{-3}$	CL=90%	736
$\pi^0 p\bar{p}K^+K^-$	< 1.2	$\times 10^{-3}$	CL=90%	1093
$\phi p\bar{p}$	< 1.3	$\times 10^{-4}$	CL=90%	1178
$\Lambda\bar{\Lambda}\pi^+\pi^-$	< 2.5	$\times 10^{-4}$	CL=90%	1405
$\Lambda\bar{p}K^+$	< 2.8	$\times 10^{-4}$	CL=90%	1387
$\Lambda\bar{p}K^+\pi^+\pi^-$	< 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%	—
$\Xi^0\bar{\Xi}^0$	< 1.4	$\times 10^{-4}$	CL=90%	1353

Radiative decays

$\gamma\chi_{c2}$	< 9	$\times 10^{-4}$	CL=90%	211
$\gamma\chi_{c1}$	(2.9 \pm 0.6)	$\times 10^{-3}$		253
$\gamma\chi_{c0}$	(7.3 \pm 0.9)	$\times 10^{-3}$		341
$\gamma\eta'$	< 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

X(3872)

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

Mass $m = 3871.69 \pm 0.17$ MeV

$m_{X(3872)} - m_{J/\psi} = 775 \pm 4$ MeV

$m_{X(3872)} - m_{\psi(2S)}$

Full width $\Gamma < 1.2$ MeV, CL = 90%

X(3872) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\pi^+\pi^- J/\psi(1S)$	> 2.6 %	650
$\omega J/\psi(1S)$	> 1.9 %	†
$D^0\bar{D}^0\pi^0$	>32 %	117
$\bar{D}^{*0}D^0$	>24 %	†
$\gamma J/\psi$	> 6 $\times 10^{-3}$	697
$\gamma\psi(2S)$	[h] > 3.0 %	181
$\pi^+\pi^-\eta_c(1S)$	not seen	746
$p\bar{p}$	not seen	1693

X(3900)[±]

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

Mass $m = 3888.7 \pm 3.4$ MeV (S = 1.3)Full width $\Gamma = 35 \pm 7$ MeV

X(3900)[±] DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$J/\psi \pi^\pm$	seen	700
$h_c \pi^\pm$	not seen	—
$(D\bar{D}^*)^\pm$	seen	—

 **$\chi_{c0}(2P)$
was X(3915)**

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

Mass $m = 3918.4 \pm 1.9$ MeVFull width $\Gamma = 20 \pm 5$ MeV (S = 1.1)

$\chi_{c0}(2P)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\omega J/\psi$	seen	222
$\pi^+ \pi^- \eta_c(1S)$	not seen	785
$K\bar{K}$	not seen	—
$\gamma\gamma$	seen	1959

 $\chi_{c2}(2P)$

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

Mass $m = 3927.2 \pm 2.6$ MeVFull width $\Gamma = 24 \pm 6$ MeV

$\chi_{c2}(2P)$ 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

 $\psi(4040)$ [1]

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

Mass $m = 4039 \pm 1$ MeVFull width $\Gamma = 80 \pm 10$ MeV $\Gamma_{ee} = 0.86 \pm 0.07$ keV

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		764
$D^*\bar{D} + \text{c.c.}$	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		225
$D^*(2010)^+D^*(2010)^-$	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
$\chi_{c1}\gamma$	< 1.1	%	494
$\chi_{c2}\gamma$	< 1.7	%	454
$\chi_{c1}\pi^+\pi^-\pi^0$	< 1.1	%	306
$\chi_{c2}\pi^+\pi^-\pi^0$	< 3.2	%	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%	—
$\Xi^0\bar{\Xi}^0$	$< 1.8 \times 10^{-4}$	90%	1533

$\psi(4160)$ ^[i]

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

Mass $m = 4191 \pm 5$ MeVFull width $\Gamma = 70 \pm 10$ MeV $\Gamma_{ee} = 0.48 \pm 0.22$ keV

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		603
$D^*(2010)^+ D^*(2010)^-$	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		720
$D_s^{*+} D_s^- + \text{c.c.}$	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%	821
$J/\psi \pi^0$	$< 1 \times 10^{-3}$	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
$\chi_{c1} \gamma$	$< 7 \times 10^{-3}$	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

X(4260)

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

Mass $m = 4251 \pm 9$ MeV (S = 1.6)

Full width $\Gamma = 120 \pm 12$ MeV (S = 1.1)

X(4260) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$J/\psi\pi^+\pi^-$	seen	967
$J/\psi f_0(980), f_0(980) \rightarrow \pi^+\pi^-$	seen	—
$X(3900)^\pm\pi^\mp, X^\pm \rightarrow J/\psi\pi^\pm$	seen	—
$J/\psi\pi^0\pi^0$	seen	969
$J/\psi K^+K^-$	seen	512
$X(3872)\gamma$	seen	363
$J/\psi\eta$	not seen	876
$J/\psi\pi^0$	not seen	991
$J/\psi\eta'$	not seen	552
$J/\psi\pi^+\pi^-\pi^0$	not seen	930
$J/\psi\eta\eta$	not seen	311
$\psi(2S)\pi^+\pi^-$	not seen	459
$\psi(2S)\eta$	not seen	129
$\chi_{c0}\omega$	not seen	265
$\chi_{c1}\gamma$	not seen	676
$\chi_{c2}\gamma$	not seen	638
$\chi_{c1}\pi^+\pi^-\pi^0$	not seen	560
$\chi_{c2}\pi^+\pi^-\pi^0$	not seen	512
$h_c(1P)\pi^+\pi^-$	not seen	613
$\phi\pi^+\pi^-$	not seen	1993
$\phi f_0(980) \rightarrow \phi\pi^+\pi^-$	not seen	—
$D\bar{D}$	not seen	1020
$D^0\bar{D}^0$	not seen	1020
D^+D^-	not seen	1011
$D^*\bar{D} + c.c.$	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	691
$D^*(2007)^0\bar{D}^*(2007)^0$	not seen	700

$D^*(2010)^+ D^*(2010)^-$	not seen	691
$D^0 D^- \pi^+ + \text{c.c.}$ (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. $D^* \bar{D}^*$)	not seen	723
$D^0 D^{*-} \pi^+ + \text{c.c.}$ (excl. $D^*(2010)^+ D^*(2010)^-$)	not seen	—
$D^0 D^*(2010)^- \pi^+ + \text{c.c.}$	not seen	716
$D^* \bar{D}^* \pi$	not seen	449
$D_s^+ D_s^-$	not seen	803
$D_s^{*+} D_s^- + \text{c.c.}$	not seen	615
$D_s^{*+} D_s^{*-}$	not seen	239
$p \bar{p}$	not seen	1907
$K_S^0 K^\pm \pi^\mp$	not seen	2048
$K^+ K^- \pi^0$	not seen	2049

X(4360)

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

X(4360) MASS = 4361 ± 13 MeV

X(4360) WIDTH = 74 ± 18 MeV

X(4360) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\psi(2S) \pi^+ \pi^-$	seen	567

$\psi(4415)$ ^[i]

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

Mass $m = 4421 \pm 4$ MeV

Full width $\Gamma = 62 \pm 20$ MeV

$\Gamma_{ee} = 0.58 \pm 0.07$ keV

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)
$D \bar{D}$	not seen		1187
$D^0 \bar{D}^0$	seen		1187
$D^+ D^-$	seen		1179
$D^* \bar{D} + \text{c.c.}$	not seen		1063
$D^*(2007)^0 \bar{D}^0 + \text{c.c.}$	seen		1066

$D^*(2010)^+ D^- + \text{c.c.}$	seen			1059
$D^* \bar{D}^*$	not seen			919
$D^*(2007)^0 \bar{D}^*(2007)^0 + \text{c.c.}$	seen			927
$D^*(2010)^+ D^*(2010)^- + \text{c.c.}$	seen			919
$D^0 D^- \pi^+ (\text{excl. } D^*(2007)^0 \bar{D}^0 + \text{c.c., } D^*(2010)^+ D^- + \text{c.c.})$	< 2.3	%	90%	—
$D \bar{D}_2^*(2460) \rightarrow D^0 D^- \pi^+ + \text{c.c.}$	(10 ± 4)	%		—
$D^0 D^{*-} \pi^+ + \text{c.c.}$	< 11	%	90%	926
$D_s^+ D_s^-$	not seen			1006
$D_s^{*+} D_s^- + \text{c.c.}$	seen			—
$D_s^{*+} D_s^{*-}$	not seen			652
$J/\psi \eta$	< 6	$\times 10^{-3}$	90%	1022
$e^+ e^-$	(9.4 ± 3.2)	$\times 10^{-6}$		2210

X(4660)

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

X(4660) MASS = 4664 ± 12 MeV

X(4660) WIDTH = 48 ± 15 MeV

X(4660) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\psi(2S) \pi^+ \pi^-$	seen	838

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] BHARDWAJ 11 does not observe this decay and presents a stronger 90% CL limit than this value. See measurements listings for details.

[i] 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.