

$c\bar{c}$ 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 $\Gamma = 32.0 \pm 0.7$ MeV

$\eta_c(1S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (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) %		1278
$K^*(892)\bar{K}^*(892)$	(7.0 \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
$\phi\phi$	(1.77 \pm 0.19) $\times 10^{-3}$		1089
$\phi 2(\pi^+ \pi^-)$	< 4 $\times 10^{-3}$	90%	1251
$a_0(980)\pi$	< 2 %	90%	1327
$a_2(1320)\pi$	< 2 %	90%	1197
$K^*(892)\bar{K} + \text{c.c.}$	< 1.28 %	90%	1310
$f_2(1270)\eta$	< 1.1 %	90%	1145
$\omega\omega$	(2.9 \pm 0.8) $\times 10^{-3}$		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
$f_2(1270)f_2'(1525)$	(9.7 \pm 3.2) $\times 10^{-3}$		524
$f_0(980)\eta$	seen		1264
$f_0(1500)\eta$	seen		1025
$f_0(2200)\eta$	seen		498
$a_0(980)\pi$	seen		1327
$a_0(1320)\pi$	seen		-
$a_0(1450)\pi$	seen		1123
$a_0(1950)\pi$	seen		860
$K_0^*(1430)\bar{K}$	seen		-
$K_2^*(1430)\bar{K}$	seen		-
$K_0^*(1950)\bar{K}$	seen		-

Decays into stable hadrons

$K\bar{K}\pi$	(7.3 \pm 0.4) %	1381
$K\bar{K}\eta$	(1.36 \pm 0.15) %	1265
$\eta\pi^+\pi^-$	(1.7 \pm 0.5) %	1428

$\eta 2(\pi^+ \pi^-)$	(4.4 ± 1.3) %		1386
$K^+ K^- \pi^+ \pi^-$	(6.9 ± 1.0) × 10 ⁻³		1345
$K^+ K^- \pi^+ \pi^- \pi^0$	(3.5 ± 0.6) %		1304
$K^0 K^- \pi^+ \pi^- \pi^+ + c.c.$	(5.6 ± 1.5) %		—
$K^+ K^- 2(\pi^+ \pi^-)$	(7.5 ± 2.4) × 10 ⁻³		1254
$2(K^+ K^-)$	(1.46 ± 0.30) × 10 ⁻³		1056
$\pi^+ \pi^- \pi^0$	< 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
$2(\pi^+ \pi^- \pi^0)$	(16.1 ± 2.0) %		1409
$3(\pi^+ \pi^-)$	(1.8 ± 0.4) %		1407
$p\bar{p}$	(1.45 ± 0.14) × 10 ⁻³		1160
$p\bar{p}\pi^0$	(3.6 ± 1.3) × 10 ⁻³		1101
$\Lambda\bar{\Lambda}$	(1.07 ± 0.24) × 10 ⁻³		991
$K^+ \bar{p} \Lambda + c.c.$	(2.6 ± 0.4) × 10 ⁻³		772
$\bar{\Lambda}(1520) \Lambda + c.c.$	(3.1 ± 1.4) × 10 ⁻³		694
$\Sigma^+ \bar{\Sigma}^-$	(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

$\gamma\gamma$	(1.58 ± 0.11) × 10 ⁻⁴		1492
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**Charge conjugation (C), Parity (P),
Lepton family number (LF) violating modes**

$\pi^+ \pi^-$	$P, CP < 1.1$	× 10 ⁻⁴	90%	1485
$\pi^0 \pi^0$	$P, CP < 4$	× 10 ⁻⁵	90%	1486
$K^+ K^-$	$P, CP < 6$	× 10 ⁻⁴	90%	1408
$K_S^0 K_S^0$	$P, CP < 3.1$	× 10 ⁻⁴	90%	1407

J/ψ(1S)

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

Mass $m = 3096.900 \pm 0.006$ MeV
 Full width $\Gamma = 92.9 \pm 2.8$ keV (S = 1.1)
 $\Gamma_{ee} = 5.53 \pm 0.10$ keV
 $\Gamma_{ee} < 5.4$ eV, CL = 90%

J/ψ(1S) DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level (MeV/c)	p
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		—
$\rho(1450)^0\pi^0 \rightarrow K^+K^-\pi^0$	(2.7 ± 0.6) × 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) %		1124
$\omega\pi^+\pi^+\pi^-\pi^-$	(8.5 ± 3.4) × 10 ⁻³		1392
$\omega\pi^+\pi^-\pi^0$	(4.0 ± 0.7) × 10 ⁻³		1418
$\omega\pi^+\pi^-$	(7.2 ± 1.0) × 10 ⁻³		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		—
$K_S^0 K^*(892)^0 \rightarrow \gamma K_S^0 K_S^0$	(6.3 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ $\begin{smallmatrix} 0.6 \\ 0.5 \end{smallmatrix}$) × 10 ⁻⁶		—
$K_2^*(1430)^+ K^- + \text{c.c.} \rightarrow$ $K^+ K^- \pi^0$	(2.69 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ $\begin{smallmatrix} 0.25 \\ 0.19 \end{smallmatrix}$) × 10 ⁻⁴		—
$K_2^*(1980)^+ K^- + \text{c.c.} \rightarrow$ $K^+ K^- \pi^0$	(1.10 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ $\begin{smallmatrix} 0.60 \\ 0.14 \end{smallmatrix}$) × 10 ⁻⁵		—
$K_4^*(2045)^+ K^- + \text{c.c.} \rightarrow$ $K^+ K^- \pi^0$	(6.2 $\begin{smallmatrix} + \\ - \end{smallmatrix}$ $\begin{smallmatrix} 2.9 \\ 1.6 \end{smallmatrix}$) × 10 ⁻⁶		—
$\eta K^*(892)^0\bar{K}^*(892)^0$	(1.15 ± 0.26) × 10 ⁻³		1003
$\eta' K^{*\pm} K^\mp$	(1.48 ± 0.13) × 10 ⁻³		—
$\eta' K^{*0}\bar{K}^0 + \text{c.c.}$	(1.66 ± 0.21) × 10 ⁻³		1000
$\eta' h_1(1415) \rightarrow \eta' K^*\bar{K} + \text{c.c.}$	(2.16 ± 0.31) × 10 ⁻⁴		—
$\eta' h_1(1415) \rightarrow \eta' K^{*\pm} K^\mp$	(1.51 ± 0.23) × 10 ⁻⁴		—
$K^*(1410)\bar{K} + \text{c.c.} \rightarrow$ $K^\pm K^\mp \pi^0$	(7 ± 4) × 10 ⁻⁵		—
$K^*(1410)\bar{K} + \text{c.c.} \rightarrow$ $K_S^0 K^\pm \pi^\mp$	(8 ± 6) × 10 ⁻⁵		—
$K_2^*(1430)\bar{K} + \text{c.c.} \rightarrow$ $K^\pm K^\mp \pi^0$	(1.0 ± 0.5) × 10 ⁻⁴		—

$K_2^*(1430)\bar{K} + \text{c.c.} \rightarrow$	$(4.0 \pm 1.0) \times 10^{-4}$		—
$K_S^0 K^\pm \pi^\mp$			
$K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.}$	$(4.66 \pm 0.31) \times 10^{-3}$		1011
$K^*(892)^+ K_2^*(1430)^- + \text{c.c.}$	$(3.4 \pm 2.9) \times 10^{-3}$		1011
$K^*(892)^+ K_2^*(1430)^- + \text{c.c.} \rightarrow$	$(4 \pm 4) \times 10^{-4}$		—
$K^*(892)^+ K_S^0 \pi^- + \text{c.c.}$			
$K^*(892)^0 \bar{K}_2(1770)^0 + \text{c.c.} \rightarrow$	$(6.9 \pm 0.9) \times 10^{-4}$		—
$K^*(892)^0 K^- \pi^+ + \text{c.c.}$			
$\omega K^*(892)\bar{K} + \text{c.c.}$	$(6.1 \pm 0.9) \times 10^{-3}$		1097
$\bar{K} K^*(892) + \text{c.c.} \rightarrow$	$(5.0 \pm 0.5) \times 10^{-3}$		—
$K_S^0 K^\pm \pi^\mp$			
$K^+ K^*(892)^- + \text{c.c.}$	$(6.0 \pm_{-1.0}^{0.8}) \times 10^{-3}$	S=2.9	1373
$K^+ K^*(892)^- + \text{c.c.} \rightarrow$	$(2.69 \pm_{-0.20}^{0.13}) \times 10^{-3}$		—
$K^+ K^- \pi^0$			
$K^+ K^*(892)^- + \text{c.c.} \rightarrow$	$(3.0 \pm 0.4) \times 10^{-3}$		—
$K^0 K^\pm \pi^\mp + \text{c.c.}$			
$K^0 \bar{K}^*(892)^0 + \text{c.c.}$	$(4.2 \pm 0.4) \times 10^{-3}$		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
$\bar{K}^*(892)^0 K^+ \pi^- + \text{c.c.}$	$(7.7 \pm 1.6) \times 10^{-3}$		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
$\omega \pi^0 \eta$	$(3.4 \pm 1.7) \times 10^{-4}$		1363
$b_1(1235)^\pm \pi^\mp$	[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
$\omega K \bar{K}$	$(1.9 \pm 0.4) \times 10^{-3}$		1268
$\omega f_0(1710) \rightarrow \omega K \bar{K}$	$(4.8 \pm 1.1) \times 10^{-4}$		878
$\phi 2(\pi^+ \pi^-)$	$(1.60 \pm 0.32) \times 10^{-3}$		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
$\omega \eta' \pi^+ \pi^-$	$(1.12 \pm 0.13) \times 10^{-3}$		1173
$\phi K \bar{K}$	$(1.77 \pm 0.16) \times 10^{-3}$	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
$K^+ K^- f'_2(1525)$	$(1.05 \pm 0.35) \times 10^{-3}$		897
$\phi f'_2(1525)$	$(8 \pm 4) \times 10^{-4}$	S=2.7	877
$\phi \pi^+ \pi^-$	$(9.4 \pm 1.5) \times 10^{-4}$	S=1.7	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
$\phi \eta$	$(7.4 \pm 0.8) \times 10^{-4}$	S=1.5	1320
$\Xi^0 \Xi^0$	$(1.17 \pm 0.04) \times 10^{-3}$		818
$\Xi(1530)^- \Xi^+ + \text{c.c.}$	$(3.18 \pm 0.08) \times 10^{-4}$		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
$\omega \pi^0 \rightarrow \pi^+ \pi^- \pi^0$	$(1.7 \pm 0.8) \times 10^{-5}$		–
$\phi \eta'(958)$	$(4.6 \pm 0.5) \times 10^{-4}$	S=2.2	1192
$\phi f_0(980)$	$(3.2 \pm 0.9) \times 10^{-4}$	S=1.9	1178
$\phi f_0(980) \rightarrow \phi \pi^+ \pi^-$	$(2.59 \pm 0.34) \times 10^{-4}$		–
$\phi f_0(980) \rightarrow \phi \pi^0 \pi^0$	$(1.8 \pm 0.5) \times 10^{-4}$		–
$\phi \eta \eta'$	$(2.32 \pm 0.17) \times 10^{-4}$		885
$\phi \pi^0 f_0(980) \rightarrow \phi \pi^0 \pi^+ \pi^-$	$(4.5 \pm 1.0) \times 10^{-6}$		–
$\phi \pi^0 f_0(980) \rightarrow \phi \pi^0 \rho^0 \pi^0$	$(1.7 \pm 0.6) \times 10^{-6}$		1045
$\eta \phi f_0(980) \rightarrow \eta \phi \pi^+ \pi^-$	$(3.2 \pm 1.0) \times 10^{-4}$		–
$\phi a_0(980)^0 \rightarrow \phi \eta \pi^0$	$(4.4 \pm 1.4) \times 10^{-6}$		–
$\Xi(1530)^0 \Xi^0$	$(3.2 \pm 1.4) \times 10^{-4}$		608
$\Sigma(1385)^- \bar{\Sigma}^+ (\text{or c.c.})$	[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
$\phi \pi^0 f_0(980) \rightarrow$			
$\phi \pi^0 \pi^0 \pi^0$			
$\eta \pi^+ \pi^-$	$(3.8 \pm 0.7) \times 10^{-4}$		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%	1264
$K \bar{K}_2^*(1430)^+ \text{c.c.}$	$< 4.0 \times 10^{-3}$	CL=90%	1158
$K_1(1270)^\pm K^\mp$	$< 3.0 \times 10^{-3}$	CL=90%	1240
$K_1(1270) K_S^0 \rightarrow \gamma K_S^0 K_S^0$	$(8.5 \pm 2.5) \times 10^{-7}$		–
$K_S^0 \pi^- K_2^*(1430)^+ + \text{c.c.}$	$(3.6 \pm 1.8) \times 10^{-3}$		1116
$K_2^*(1430)^0 \bar{K}_2^*(1430)^0$	$< 2.9 \times 10^{-3}$	CL=90%	601
$\phi \pi^0$	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%	1007
$\omega X(1835) \rightarrow \omega p \bar{p}$	< 3.9	$\times 10^{-6}$	CL=95%	—
$\omega X(1835), X \rightarrow \eta' \pi^+ \pi^-$	< 6.2	$\times 10^{-5}$		—
$\phi X(1835) \rightarrow \phi p \bar{p}$	< 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%	—
$\eta \phi(2170) \rightarrow \eta \phi f_0(980) \rightarrow$ $\eta \phi \pi^+ \pi^-$	(1.2 ± 0.4)	$\times 10^{-4}$		628
$\eta \phi(2170) \rightarrow$ $\eta K^*(892)^0 \bar{K}^*(892)^0$	< 2.52	$\times 10^{-4}$	CL=90%	—
$\Sigma(1385)^0 \bar{\Lambda} + \text{c.c.}$	< 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%	—
$\bar{\Lambda}(1520) \Lambda + \text{c.c.}$	< 1.80	$\times 10^{-3}$	CL=90%	807
$\Theta(1540) \bar{\Theta}(1540) \rightarrow$ $K_S^0 p K^- \bar{n} + \text{c.c.}$	< 1.1	$\times 10^{-5}$	CL=90%	—
$\Theta(1540) K^- \bar{n} \rightarrow K_S^0 p K^- \bar{n}$	< 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%	—

Decays into stable hadrons

$2(\pi^+ \pi^-) \pi^0$	$(3.73 \pm 0.32) \%$	S=1.4	1496
$3(\pi^+ \pi^-) \pi^0$	$(2.9 \pm 0.6) \%$		1433
$\pi^+ \pi^- \pi^0$	$(2.10 \pm 0.08) \%$	S=1.6	1533
$\pi^+ \pi^- \pi^0 \pi^0 \pi^0$	$(2.71 \pm 0.29) \%$		1497
$\rho^\pm \pi^\mp \pi^0 \pi^0$	$(1.41 \pm 0.22) \%$		1421
$\rho^+ \rho^- \pi^0$	$(6.0 \pm 1.1) \times 10^{-3}$		1298
$\pi^+ \pi^- \pi^0 K^+ K^-$	$(1.20 \pm 0.30) \%$		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
$\pi^+ \pi^- K^+ K^- \eta$	$(4.7 \pm 0.7) \times 10^{-3}$		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
$K^+ K^- \pi^0$	$(2.88 \pm 0.12) \times 10^{-3}$		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
$K^*(892)^0 \bar{K}^0 + \text{c.c.} \rightarrow$ $K_S^0 K_L^0 \pi^0$	$(1.21 \pm 0.18) \times 10^{-3}$		—

$K_2^*(1430)^0 \bar{K}^0 + \text{c.c.} \rightarrow K_S^0 K_L^0 \pi^0$	(4.3 ± 1.3) × 10 ⁻⁴		—
$K_S^0 K_L^0 \eta$	(1.44 ± 0.34) × 10 ⁻³		1328
$2(\pi^+ \pi^-)$	(3.57 ± 0.30) × 10 ⁻³		1517
$3(\pi^+ \pi^-)$	(4.3 ± 0.4) × 10 ⁻³		1466
$2(\pi^+ \pi^- \pi^0)$	(1.61 ± 0.21) %		1468
$2(\pi^+ \pi^-) \eta$	(2.26 ± 0.28) × 10 ⁻³		1446
$3(\pi^+ \pi^-) \eta$	(7.2 ± 1.5) × 10 ⁻⁴		1379
$\pi^+ \pi^- \pi^0 \pi^0 \eta$	(2.3 ± 0.5) × 10 ⁻³		1448
$\rho^\pm \pi^\mp \pi^0 \eta$	(1.9 ± 0.8) × 10 ⁻³		1326
$p \bar{p}$	(2.121 ± 0.029) × 10 ⁻³		1232
$p \bar{p} \pi^0$	(1.19 ± 0.08) × 10 ⁻³	S=1.1	1176
$p \bar{p} \pi^+ \pi^-$	(6.0 ± 0.5) × 10 ⁻³	S=1.3	1107
$p \bar{p} \pi^+ \pi^- \pi^0$	[c] (2.3 ± 0.9) × 10 ⁻³	S=1.9	1033
$p \bar{p} \eta$	(2.00 ± 0.12) × 10 ⁻³		948
$p \bar{p} \rho$	< 3.1 × 10 ⁻⁴	CL=90%	774
$p \bar{p} \omega$	(9.8 ± 1.0) × 10 ⁻⁴	S=1.3	768
$p \bar{p} \eta'(958)$	(1.29 ± 0.14) × 10 ⁻⁴	S=2.0	596
$p \bar{p} a_0(980) \rightarrow p \bar{p} \pi^0 \eta$	(6.8 ± 1.8) × 10 ⁻⁵		—
$p \bar{p} \phi$	(5.19 ± 0.33) × 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
$\Sigma^0 \bar{\Sigma}^0$	(1.172 ± 0.032) × 10 ⁻³	S=1.4	988
$2(\pi^+ \pi^-) K^+ K^-$	(3.1 ± 1.3) × 10 ⁻³		1320
$p \bar{n} \pi^-$	(2.12 ± 0.09) × 10 ⁻³		1174
$n N(1440)$	seen		978
$n N(1520)$	seen		928
$n N(1535)$	seen		917
$\Xi^- \bar{\Xi}^+$	(9.7 ± 0.8) × 10 ⁻⁴	S=1.4	807
$\Lambda \bar{\Lambda}$	(1.89 ± 0.09) × 10 ⁻³	S=2.8	1074
$\Lambda \bar{\Sigma}^- \pi^+ (\text{or c.c.})$	[b] (8.3 ± 0.7) × 10 ⁻⁴	S=1.2	950
$p K^- \bar{\Lambda} + \text{c.c.}$	(8.7 ± 1.1) × 10 ⁻⁴		876
$2(K^+ K^-)$	(7.2 ± 0.8) × 10 ⁻⁴		1131
$p K^- \bar{\Sigma}^0$	(2.9 ± 0.8) × 10 ⁻⁴		819
$K^+ K^-$	(2.86 ± 0.21) × 10 ⁻⁴		1468
$K_S^0 K_L^0$	(1.95 ± 0.11) × 10 ⁻⁴	S=2.4	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
$\bar{\Lambda} n K_S^0 + \text{c.c.}$	(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
$K_S^0 K_S^0$	< 1.4 × 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%	–
$\gamma K_S^0 K_S^0$	$(8.1 \pm 0.4) \times 10^{-4}$		1466
$\gamma\eta_c(1S)$	$(1.7 \pm 0.4) \%$	S=1.5	111
$\gamma\eta_c(1S) \rightarrow 3\gamma$	$(3.8 \begin{smallmatrix} + 1.3 \\ - 1.0 \end{smallmatrix}) \times 10^{-6}$	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%	–
$\gamma\eta(1405) \rightarrow \gamma\gamma\gamma$	$< 2.63 \times 10^{-6}$	CL=90%	–
$\gamma\eta(1475) \rightarrow \gamma\gamma\gamma$	$< 1.86 \times 10^{-6}$	CL=90%	–
$\gamma\rho\rho$	$(4.5 \pm 0.8) \times 10^{-3}$		1340
$\gamma\rho\omega$	$< 5.4 \times 10^{-4}$	CL=90%	1338
$\gamma\rho\phi$	$< 8.8 \times 10^{-5}$	CL=90%	1258
$\gamma\eta'(958)$	$(5.25 \pm 0.07) \times 10^{-3}$	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
$\gamma f_2(1270) \rightarrow \gamma K_S^0 K_S^0$	$(2.58 \begin{smallmatrix} + 0.60 \\ - 0.22 \end{smallmatrix}) \times 10^{-5}$		–
$\gamma f_0(1370) \rightarrow \gamma K\bar{K}$	$(4.2 \pm 1.5) \times 10^{-4}$		–
$\gamma f_0(1370) \rightarrow \gamma K_S^0 K_S^0$	$(1.1 \pm 0.4) \times 10^{-5}$		–
$\gamma f_0(1500) \rightarrow \gamma K_S^0 K_S^0$	$(1.59 \begin{smallmatrix} + 0.24 \\ - 0.60 \end{smallmatrix}) \times 10^{-5}$		–
$\gamma f_0(1710) \rightarrow \gamma K\bar{K}$	$(9.5 \begin{smallmatrix} + 1.0 \\ - 0.5 \end{smallmatrix}) \times 10^{-4}$	S=1.5	1075
$\gamma f_0(1710) \rightarrow \gamma\pi\pi$	$(3.8 \pm 0.5) \times 10^{-4}$		–
$\gamma f_0(1710) \rightarrow \gamma\omega\omega$	$(3.1 \pm 1.0) \times 10^{-4}$		–
$\gamma f_0(1710) \rightarrow \gamma\eta\eta$	$(2.4 \begin{smallmatrix} + 1.2 \\ - 0.7 \end{smallmatrix}) \times 10^{-4}$		–

$\gamma\eta$	$(1.108 \pm 0.027) \times 10^{-3}$		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	1177
$\gamma f'_2(1525) \rightarrow \gamma K_S^0 K_S^0$	$(8.0 \pm_{-0.5}^{+0.7}) \times 10^{-5}$		—
$\gamma f'_2(1525) \rightarrow \gamma \eta \eta$	$(3.4 \pm 1.4) \times 10^{-5}$		—
$\gamma f_2(1640) \rightarrow \gamma \omega \omega$	$(2.8 \pm 1.8) \times 10^{-4}$		—
$\gamma f_2(1910) \rightarrow \gamma \omega \omega$	$(2.0 \pm 1.4) \times 10^{-4}$		—
$\gamma f_0(1750) \rightarrow \gamma K_S^0 K_S^0$	$(1.11 \pm_{-0.33}^{+0.20}) \times 10^{-5}$		—
$\gamma f_0(1800) \rightarrow \gamma \omega \phi$	$(2.5 \pm 0.6) \times 10^{-4}$		—
$\gamma f_2(1810) \rightarrow \gamma \eta \eta$	$(5.4 \pm_{-2.4}^{+3.5}) \times 10^{-5}$		—
$\gamma f_2(1950) \rightarrow$ $\gamma K^*(892) \bar{K}^*(892)$	$(7.0 \pm 2.2) \times 10^{-4}$		—
$\gamma K^*(892) \bar{K}^*(892)$	$(4.0 \pm 1.3) \times 10^{-3}$		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
$\gamma \eta(1760) \rightarrow \gamma \omega \omega$	$(1.98 \pm 0.33) \times 10^{-3}$		—
$\gamma \eta(1760) \rightarrow \gamma \gamma \gamma$	$< 4.80 \times 10^{-6}$	CL=90%	—
$\gamma X(1835) \rightarrow \gamma \pi^+ \pi^- \eta'$	$(2.77 \pm_{-0.40}^{+0.34}) \times 10^{-4}$	S=1.1	1006
$\gamma X(1835) \rightarrow \gamma \rho \bar{\rho}$	$(7.7 \pm_{-0.9}^{+1.5}) \times 10^{-5}$		—
$\gamma X(1835) \rightarrow \gamma K_S^0 K_S^0 \eta$	$(3.3 \pm_{-1.3}^{+2.0}) \times 10^{-5}$		—
$\gamma X(1835) \rightarrow \gamma \gamma \gamma$	$< 3.56 \times 10^{-6}$	CL=90%	—
$\gamma X(1840) \rightarrow \gamma 3(\pi^+ \pi^-)$	$(2.4 \pm_{-0.8}^{+0.7}) \times 10^{-5}$		—
$\gamma(K \bar{K} \pi) [J^{PC} = 0^{-+}]$ $\gamma \pi^0$	$(7 \pm 4) \times 10^{-4}$	S=2.1	1442
$\gamma \rho \bar{\rho} \pi^+ \pi^-$	$(3.56 \pm 0.17) \times 10^{-5}$		1546
$\gamma \Lambda \bar{\Lambda}$	$< 7.9 \times 10^{-4}$	CL=90%	1107
	$< 1.3 \times 10^{-4}$	CL=90%	1074
$\gamma f_0(2100) \rightarrow \gamma \eta \eta$	$(1.13 \pm_{-0.30}^{+0.60}) \times 10^{-4}$		—
$\gamma f_0(2100) \rightarrow \gamma \pi \pi$	$(6.2 \pm 1.0) \times 10^{-4}$		—
$\gamma f_0(2200) \rightarrow \gamma K \bar{K}$	$(5.9 \pm 1.3) \times 10^{-4}$		—
$\gamma f_0(2200) \rightarrow \gamma K_S^0 K_S^0$	$(2.72 \pm_{-0.50}^{+0.19}) \times 10^{-4}$		—
$\gamma f_J(2220) \rightarrow \gamma \pi \pi$	$< 3.9 \times 10^{-5}$	CL=90%	—
$\gamma f_J(2220) \rightarrow \gamma K \bar{K}$	$< 4.1 \times 10^{-5}$	CL=90%	—
$\gamma f_J(2220) \rightarrow \gamma \rho \bar{\rho}$	$(1.5 \pm 0.8) \times 10^{-5}$		—

$\gamma f_0(2330) \rightarrow \gamma K_S^0 K_S^0$	$(4.9 \pm 0.7) \times 10^{-5}$	—
$\gamma f_2(2340) \rightarrow \gamma \eta \eta$	$(5.6 \begin{smallmatrix} + 2.4 \\ - 2.2 \end{smallmatrix}) \times 10^{-5}$	—
$\gamma f_2(2340) \rightarrow \gamma K_S^0 K_S^0$	$(5.5 \begin{smallmatrix} + 4.0 \\ - 1.5 \end{smallmatrix}) \times 10^{-5}$	—
$\gamma f_0(1500) \rightarrow \gamma \pi \pi$	$(1.09 \pm 0.24) \times 10^{-4}$	1183
$\gamma f_0(1500) \rightarrow \gamma \eta \eta$	$(1.7 \begin{smallmatrix} + 0.6 \\ - 1.4 \end{smallmatrix}) \times 10^{-5}$	—
$\gamma A \rightarrow \gamma \text{invisible}$	$[e] < 6.3 \times 10^{-6}$	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
$\eta e^+ e^-$	$(1.43 \pm 0.07) \times 10^{-5}$	1500
$\eta'(958) e^+ e^-$	$(6.59 \pm 0.18) \times 10^{-5}$	1400
$\eta U \rightarrow \eta e^+ e^-$	$< 9.11 \times 10^{-7}$	CL=90% —
$\eta'(958) U \rightarrow \eta'(958) e^+ e^-$	$< 2.0 \times 10^{-7}$	CL=90% —
$\phi e^+ e^-$	$< 1.2 \times 10^{-7}$	CL=90% 1381

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
$\bar{D}^0 K^0 + \text{c.c.}$	$< 1.7 \times 10^{-4}$	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
$\Lambda_c^+ e^- + \text{c.c.}$		$< 6.9 \times 10^{-8}$	CL=90% —

Other decays

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

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

Mass $m = 3414.71 \pm 0.30$ MeV

Full 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
$f_0(980)f_0(2200)$	$(7.9 \begin{smallmatrix} +2.0 \\ -2.5 \end{smallmatrix}) \times 10^{-4}$		586
$f_0(1370)f_0(1370)$	$< 2.7 \times 10^{-4}$	CL=90%	1019
$f_0(1370)f_0(1500)$	$< 1.7 \times 10^{-4}$	CL=90%	920
$f_0(1370)f_0(1710)$	$(6.7 \begin{smallmatrix} +3.5 \\ -2.3 \end{smallmatrix}) \times 10^{-4}$		740
$f_0(1500)f_0(1370)$	$< 1.3 \times 10^{-4}$	CL=90%	920
$f_0(1500)f_0(1500)$	$< 5 \times 10^{-5}$	CL=90%	804
$f_0(1500)f_0(1710)$	$< 7 \times 10^{-5}$	CL=90%	581
$K^+K^-\pi^+\pi^-\pi^0$	$(8.6 \pm 0.9) \times 10^{-3}$		1545
$K_S^0 K^\pm \pi^\mp \pi^+ \pi^-$	$(4.2 \pm 0.4) \times 10^{-3}$		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
$K^*(892)^-K^+\pi^0 \rightarrow$ $K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$	$(4.6 \pm 1.2) \times 10^{-3}$		—
$K_S^0 K_S^0 \pi^+ \pi^-$	$(5.7 \pm 1.1) \times 10^{-3}$		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
$\omega\phi$	$(1.41 \pm 0.13) \times 10^{-4}$		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
$K_S^0 K_S^0 K_S^0 K_S^0$	$(5.8 \pm 0.5) \times 10^{-4}$		1327
$K^+ K^- K^+ K^-$	$(2.82 \pm 0.29) \times 10^{-3}$		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
$\phi\phi\eta$	$(8.4 \pm 1.0) \times 10^{-4}$		1100
$p\bar{p}$	$(2.21 \pm 0.08) \times 10^{-4}$		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
$K^*(892)^+ \bar{p}\Lambda + \text{c.c.}$	$(4.8 \pm 0.9) \times 10^{-4}$		845
$K^+ \bar{p}\Lambda(1520) + \text{c.c.}$	$(2.9 \pm 0.7) \times 10^{-4}$		859
$\Lambda(1520)\bar{\Lambda}(1520)$	$(3.1 \pm 1.2) \times 10^{-4}$		780

$\Sigma^0 \bar{\Sigma}^0$	$(4.68 \pm 0.32) \times 10^{-4}$		1222
$\Sigma^+ \bar{p} K_S^0 + \text{c.c.}$	$(3.52 \pm 0.27) \times 10^{-4}$		1089
$\Sigma^+ \bar{\Sigma}^-$	$(4.6 \pm 0.8) \times 10^{-4}$	S=2.6	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
$e^+ e^- J/\psi(1S)$	$(1.33 \pm 0.29) \times 10^{-4}$		303
$\mu^+ \mu^- J/\psi(1S)$	$< 1.9 \times 10^{-5}$	CL=90%	226

$\chi_{c1}(1P)$

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

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	ρ (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
$f_0(1710) \eta'(958)$	$(7 \pm_5^+) \times 10^{-5}$		1118
$f_2'(1525) \eta'(958)$	$(9 \pm 6) \times 10^{-5}$		1229
$\pi^0 f_0(980) \rightarrow \pi^0 \pi^+ \pi^-$	$(3.5 \pm 0.9) \times 10^{-7}$		—
$K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$	$(3.2 \pm 2.1) \times 10^{-3}$		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
$K_S^0 K_S^0 K_S^0 K_S^0$	$(3.5 \pm 1.0) \times 10^{-5}$		1387
$K^+ K^- K^+ K^-$	$(5.4 \pm 1.1) \times 10^{-4}$		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
$\omega \phi$	$(2.7 \pm 0.4) \times 10^{-5}$		1503
$\phi \phi$	$(4.2 \pm 0.5) \times 10^{-4}$		1429
$\phi \phi \eta$	$(3.0 \pm 0.5) \times 10^{-4}$		1172

$p\bar{p}$	$(7.60 \pm 0.34) \times 10^{-5}$		1484
$p\bar{p}\pi^0$	$(1.55 \pm 0.18) \times 10^{-4}$		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
$p\bar{p}\pi^0\pi^0$	$< 5 \times 10^{-4}$	CL=90%	1385
$p\bar{p}K^+K^-$ (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
$p\bar{n}\pi^-$	$(3.8 \pm 0.5) \times 10^{-4}$		1435
$\bar{p}n\pi^+$	$(3.9 \pm 0.5) \times 10^{-4}$		1435
$p\bar{n}\pi^-\pi^0$	$(1.03 \pm 0.12) \times 10^{-3}$		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
$\Sigma(1385)^+\bar{\Lambda}\pi^- + \text{c.c.}$	$< 1.3 \times 10^{-4}$	CL=90%	1157
$\Sigma(1385)^-\bar{\Lambda}\pi^+ + \text{c.c.}$	$< 1.3 \times 10^{-4}$	CL=90%	1157
$K^+\bar{p}\Lambda + \text{c.c.}$	$(4.2 \pm 0.4) \times 10^{-4}$	S=1.2	1203
$K^*(892)^+\bar{p}\Lambda + \text{c.c.}$	$(4.9 \pm 0.7) \times 10^{-4}$		935
$K^+\bar{p}\Lambda(1520) + \text{c.c.}$	$(1.7 \pm 0.4) \times 10^{-4}$		951
$\Lambda(1520)\bar{\Lambda}(1520)$	$< 9 \times 10^{-5}$	CL=90%	880
$\Sigma^0\bar{\Sigma}^0$	$(4.2 \pm 0.6) \times 10^{-5}$		1288
$\Sigma^+\bar{p}K_S^0 + \text{c.c.}$	$(1.53 \pm 0.12) \times 10^{-4}$		1163
$\Sigma^+\bar{\Sigma}^-$	$(3.6 \pm 0.7) \times 10^{-5}$		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
$K^-\Lambda\bar{\Xi}^+ + \text{c.c.}$	$(1.35 \pm 0.24) \times 10^{-4}$		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
$e^+e^- J/\psi(1S)$	$(3.46 \pm 0.22) \times 10^{-3}$		389
$\mu^+\mu^- J/\psi(1S)$	$(2.33 \pm 0.29) \times 10^{-4}$		335

$h_c(1P)$

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

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
$J/\psi(1S)\pi^+\pi^-$	$< 2.3 \times 10^{-3}$	90%	305
$p\bar{p}$	$< 1.5 \times 10^{-4}$	90%	1492
$p\bar{p}\pi^+\pi^-$	$(2.9 \pm 0.6) \times 10^{-3}$		1390
$\pi^+\pi^-\pi^0$	$(1.6 \pm 0.5) \times 10^{-3}$		1749
$2\pi^+2\pi^-\pi^0$	$(8.1 \pm 1.8) \times 10^{-3}$		1716
$3\pi^+3\pi^-\pi^0$	$< 9 \times 10^{-3}$	90%	1661
$K^+K^-\pi^+\pi^-$	$< 6 \times 10^{-4}$	90%	1640
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 $m = 3556.17 \pm 0.07$ MeV

Full 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
$\phi \phi \eta$	$(5.3 \pm 0.6) \times 10^{-4}$		1206
$\omega \omega$	$(8.4 \pm 1.0) \times 10^{-4}$		1597
$\omega K^+ K^-$	$(7.3 \pm 0.9) \times 10^{-4}$		1540
$\omega \phi$	$(9.6 \pm 2.7) \times 10^{-6}$		1529
$\pi \pi$	$(2.23 \pm 0.09) \times 10^{-3}$		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
$K_2^*(1430)^\pm K^\mp$	$(1.48 \pm 0.12) \times 10^{-3}$		—
$K_2^*(1430)^0 \bar{K}^0 + \text{c.c.}$	$(1.24 \pm 0.17) \times 10^{-3}$		1443
$K_3^*(1780)^\pm K^\mp$	$(5.2 \pm 0.8) \times 10^{-4}$		—
$K_3^*(1780)^0 \bar{K}^0 + \text{c.c.}$	$(5.6 \pm 2.1) \times 10^{-4}$		1276
$a_2(1320)^0 \pi^0$	$(1.29 \pm 0.34) \times 10^{-3}$		—
$a_2(1320)^\pm \pi^\mp$	$(1.8 \pm 0.6) \times 10^{-3}$		1531
$\bar{K}^0 K^+ \pi^- + \text{c.c.}$	$(1.28 \pm 0.18) \times 10^{-3}$		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
$K_S^0 K_S^0 K_S^0 K_S^0$	$(1.13 \pm 0.18) \times 10^{-4}$		1415
$K^+ K^- K^+ K^-$	$(1.65 \pm 0.20) \times 10^{-3}$		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
$K^*(892)^+\bar{p}\Lambda + \text{c.c.}$	$(8.2 \pm 1.1) \times 10^{-4}$		976
$K^+\bar{p}\Lambda(1520) + \text{c.c.}$	$(2.8 \pm 0.7) \times 10^{-4}$		992
$\Lambda(1520)\bar{\Lambda}(1520)$	$(4.6 \pm 1.5) \times 10^{-4}$		924
$\Sigma^0\bar{\Sigma}^0$	$(3.7 \pm 0.6) \times 10^{-5}$		1319
$\Sigma^+\bar{p}K_S^0 + \text{c.c.}$	$(8.2 \pm 0.9) \times 10^{-5}$		1197
$\Sigma^+\bar{\Sigma}^-$	$(3.4 \pm 0.7) \times 10^{-5}$		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
$e^+e^- J/\psi(1S)$	$(2.15 \pm 0.14) \times 10^{-3}$		430
$\mu^+\mu^- J/\psi(1S)$	$(2.02 \pm 0.33) \times 10^{-4}$		381

$\eta_c(2S)$

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

Quantum numbers are quark model predictions.

$$\text{Mass } m = 3637.5 \pm 1.1 \text{ MeV} \quad (S = 1.2)$$

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

$\eta_c(2S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
hadrons	not seen		—
$K\bar{K}\pi$	(1.9±1.2) %		1729
$K\bar{K}\eta$	(5 ±4) × 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±1.0) %		1667
$K^+K^-2\pi^+2\pi^-$	not seen		1627
$K_S^0K^-2\pi^+\pi^- + \text{c.c.}$	seen		1666
$2K^+2K^-$	not seen		1470
$\phi\phi$	not seen		1506
$p\bar{p}$	seen		1558
$p\bar{p}\pi^+\pi^-$	seen		1461
$\gamma\gamma$	(1.9±1.3) × 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%	537

$\psi(2S)$

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

$$\text{Mass } m = 3686.10 \pm 0.06 \text{ MeV} \quad (S = 5.9)$$

$$\text{Full width } \Gamma = 294 \pm 8 \text{ keV}$$

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

$\psi(2S)$ 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	—
ggg	(10.6 ±1.6) %		—
γgg	(1.03 ±0.29) %		—

light hadrons	(15.4 ±1.5) %	—
$e^+ e^-$	(7.93 ±0.17) × 10 ⁻³	1843
$\mu^+ \mu^-$	(8.0 ±0.6) × 10 ⁻³	1840
$\tau^+ \tau^-$	(3.1 ±0.4) × 10 ⁻³	489

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

$J/\psi(1S)$ anything	(61.4 ±0.6) %	—
$J/\psi(1S)$ neutrals	(25.38 ±0.32) %	—
$J/\psi(1S) \pi^+ \pi^-$	(34.68 ±0.30) %	477
$J/\psi(1S) \pi^0 \pi^0$	(18.24 ±0.31) %	481
$J/\psi(1S) \eta$	(3.37 ±0.05) %	199
$J/\psi(1S) \pi^0$	(1.268 ±0.032) × 10 ⁻³	528

Hadronic decays

$\pi^0 h_c(1P)$	(8.6 ±1.3) × 10 ⁻⁴	85
$3(\pi^+ \pi^-) \pi^0$	(3.5 ±1.6) × 10 ⁻³	1746
$2(\pi^+ \pi^-) \pi^0$	(2.9 ±1.0) × 10 ⁻³	S=4.7 1799
$\rho a_2(1320)$	(2.6 ±0.9) × 10 ⁻⁴	1501
$\pi^+ \pi^- \pi^0 \pi^0 \pi^0$	(5.3 ±0.9) × 10 ⁻³	1800
$\rho^\pm \pi^\mp \pi^0 \pi^0$	< 2.7 × 10 ⁻³	CL=90% 1737
$p \bar{p}$	(2.94 ±0.08) × 10 ⁻⁴	1586
$n \bar{n}$	(3.06 ±0.15) × 10 ⁻⁴	1586
$\Delta^{++} \bar{\Delta}^{--}$	(1.28 ±0.35) × 10 ⁻⁴	1371
$\Lambda \bar{\Lambda} \pi^0$	< 2.9 × 10 ⁻⁶	CL=90% 1412
$\Lambda \bar{\Lambda} \eta$	(2.5 ±0.4) × 10 ⁻⁵	1197
$\Lambda \bar{p} K^+$	(1.00 ±0.14) × 10 ⁻⁴	1327
$K^*(892)^+ \bar{p} \Lambda + \text{c.c.}$	(6.3 ±0.7) × 10 ⁻⁵	1087
$\Lambda \bar{p} K^+ \pi^+ \pi^-$	(1.8 ±0.4) × 10 ⁻⁴	1167
$\Lambda \bar{\Lambda} \pi^+ \pi^-$	(2.8 ±0.6) × 10 ⁻⁴	1346
$\Lambda \bar{\Lambda}$	(3.81 ±0.13) × 10 ⁻⁴	S=1.4 1467
$\Lambda \bar{\Sigma}^+ \pi^- + \text{c.c.}$	(1.40 ±0.13) × 10 ⁻⁴	1376
$\Lambda \bar{\Sigma}^- \pi^+ + \text{c.c.}$	(1.54 ±0.14) × 10 ⁻⁴	1379
$\Lambda \bar{\Sigma}^0$	(1.23 ±0.24) × 10 ⁻⁵	1437
$\Sigma^0 \bar{p} K^+ + \text{c.c.}$	(1.67 ±0.18) × 10 ⁻⁵	1291
$\Sigma^+ \bar{\Sigma}^-$	(2.32 ±0.12) × 10 ⁻⁴	1408
$\Sigma^0 \bar{\Sigma}^0$	(2.35 ±0.09) × 10 ⁻⁴	S=1.1 1405
$\Sigma(1385)^+ \bar{\Sigma}(1385)^-$	(8.5 ±0.7) × 10 ⁻⁵	1218
$\Sigma(1385)^- \bar{\Sigma}(1385)^+$	(8.5 ±0.8) × 10 ⁻⁵	1218
$\Sigma(1385)^0 \bar{\Sigma}(1385)^0$	(6.9 ±0.7) × 10 ⁻⁵	1218
$\Xi^- \bar{\Xi}^+$	(2.87 ±0.11) × 10 ⁻⁴	S=1.1 1284
$\Xi^0 \bar{\Xi}^0$	(2.3 ±0.4) × 10 ⁻⁴	S=4.2 1291
$\Xi(1530)^0 \bar{\Xi}(1530)^0$	(5.2 ^{+3.2} _{-1.2}) × 10 ⁻⁵	1025
$K^- \Lambda \bar{\Xi}^+ + \text{c.c.}$	(3.9 ±0.4) × 10 ⁻⁵	1114
$\Xi(1530)^- \bar{\Xi}(1530)^+$	(1.15 ±0.07) × 10 ⁻⁴	1025

$\Xi(1530)^-\Xi^+$	$(7.0 \pm 1.2) \times 10^{-6}$	1165
$\Xi(1690)^-\Xi^+ \rightarrow K^- \Lambda \Xi^+ +$	$(5.2 \pm 1.6) \times 10^{-6}$	—
$\Xi(1820)^-\Xi^+ \rightarrow K^- \Lambda \Xi^+ +$	$(1.20 \pm 0.32) \times 10^{-5}$	—
$K^- \Sigma^0 \Xi^+ + \text{c.c.}$	$(3.7 \pm 0.4) \times 10^{-5}$	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 —
$N(1520) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$	$(6.4 \begin{smallmatrix} +2.3 \\ -1.8 \end{smallmatrix}) \times 10^{-6}$	—
$N(1535) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$	$(2.5 \pm 1.0) \times 10^{-5}$	—
$N(1650) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$	$(3.8 \begin{smallmatrix} +1.4 \\ -1.7 \end{smallmatrix}) \times 10^{-5}$	—
$N(1720) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$	$(1.79 \begin{smallmatrix} +0.26 \\ -0.70 \end{smallmatrix}) \times 10^{-5}$	—
$N(2300) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$	$(2.6 \begin{smallmatrix} +1.2 \\ -0.7 \end{smallmatrix}) \times 10^{-5}$	—
$N(2570) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$	$(2.13 \begin{smallmatrix} +0.40 \\ -0.31 \end{smallmatrix}) \times 10^{-5}$	—
$\pi^0 f_0(2100) \rightarrow \pi^0 p \bar{p}$	$(1.1 \pm 0.4) \times 10^{-5}$	—
$\eta p \bar{p}$	$(6.0 \pm 0.4) \times 10^{-5}$	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
$\eta' p \bar{p}$	$(1.10 \pm 0.13) \times 10^{-5}$	1141
$\phi p \bar{p}$	$(6.1 \pm 0.6) \times 10^{-6}$	1109
$\phi X(1835) \rightarrow \phi p \bar{p}$	$< 1.82 \times 10^{-7}$	CL=90% —
$\pi^+ \pi^- p \bar{p}$	$(6.0 \pm 0.4) \times 10^{-4}$	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
$2(\pi^+ \pi^- \pi^0)$	$(4.8 \pm 1.5) \times 10^{-3}$	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
$\pi^+ \pi^- \pi^0 \pi^0 \eta$	$< 4 \times 10^{-4}$	CL=90% 1760
$\eta' \pi^+ \pi^- \pi^0$	$(4.5 \pm 2.1) \times 10^{-4}$	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
$\omega \pi^0 \pi^0$	$(1.11 \pm 0.35) \times 10^{-3}$	1749
$\pi^0 \pi^0 K^+ K^-$	$(2.6 \pm 1.3) \times 10^{-4}$	1728
$\pi^+ \pi^- K^+ K^-$	$(7.3 \pm 0.5) \times 10^{-4}$	1726

$\pi^0 \pi^0 K_S^0 K_L^0$	$(1.3 \pm 0.6) \times 10^{-3}$		1726
$\rho^0 K^+ K^-$	$(2.2 \pm 0.4) \times 10^{-4}$		1616
$K^*(892)^0 \bar{K}_2^*(1430)^0$	$(1.9 \pm 0.5) \times 10^{-4}$		1417
$K^+ K^- \pi^+ \pi^- \eta$	$(1.3 \pm 0.7) \times 10^{-3}$		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
$K_1(1270)^\pm K^\mp$	$(1.00 \pm 0.28) \times 10^{-3}$		1588
$K_S^0 K_L^0 \pi^+ \pi^-$	$(2.2 \pm 0.4) \times 10^{-4}$		1724
$\rho^0 \rho \bar{\rho}$	$(5.0 \pm 2.2) \times 10^{-5}$		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
$\omega K_2^*(1430)^+ K^- + \text{c.c.}$	$(6.1 \pm 1.2) \times 10^{-5}$		1252
$\omega \bar{K}^*(892)^0 K^0$	$(1.68 \pm 0.30) \times 10^{-4}$		1481
$\omega \bar{K}_2^*(1430)^0 K^0$	$(5.8 \pm 2.2) \times 10^{-5}$		1250
$\omega X(1440) \rightarrow \omega K_S^0 K^- \pi^+ + \text{c.c.}$	$(1.6 \pm 0.4) \times 10^{-5}$		—
$\omega X(1440) \rightarrow \omega K^+ K^- \pi^0$	$(1.09 \pm 0.26) \times 10^{-5}$		—
$\omega f_1(1285) \rightarrow \omega K_S^0 K^- \pi^+ + \text{c.c.}$	$(3.0 \pm 1.0) \times 10^{-6}$		—
$\omega f_1(1285) \rightarrow \omega K^+ K^- \pi^0$	$(1.2 \pm 0.7) \times 10^{-6}$		—
$3(\pi^+ \pi^-)$	$(3.5 \pm 2.0) \times 10^{-4}$	S=2.8	1774
$\rho \bar{\rho} \pi^+ \pi^- \pi^0$	$(7.3 \pm 0.7) \times 10^{-4}$		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
$\eta \phi(2170), \phi(2170) \rightarrow$ $\phi f_0(980), f_0 \rightarrow \pi^+ \pi^-$	$< 2.2 \times 10^{-6}$	CL=90%	—
$\phi \eta'$	$(1.54 \pm 0.20) \times 10^{-5}$		1555
$\phi f_1(1285)$	$(3.0 \pm 1.3) \times 10^{-5}$		1436
$\phi \eta(1405) \rightarrow \phi \pi^+ \pi^- \eta$	$(8.5 \pm 1.7) \times 10^{-6}$		—
$\omega \eta'$	$(3.2 \begin{smallmatrix} +2.5 \\ -2.1 \end{smallmatrix}) \times 10^{-5}$		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
$\bar{p} \bar{p} K^+ K^-$	$(2.7 \pm 0.7) \times 10^{-5}$		1118
$\bar{\Lambda} n K_S^0 + \text{c.c.}$	$(8.1 \pm 1.8) \times 10^{-5}$		1324
$\phi f_2'(1525)$	$(4.4 \pm 1.6) \times 10^{-5}$		1325
$\Theta(1540) \bar{\Theta}(1540) \rightarrow$ $K_S^0 p K^- \bar{n} + \text{c.c.}$	$< 8.8 \times 10^{-6}$	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
$\Lambda_c^+ \bar{p} e^+ e^- + \text{c.c.}$	$< 1.7 \times 10^{-6}$	CL=90%	830

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
$\gamma f_2(1270)$	$(2.73 \begin{smallmatrix} +0.29 \\ -0.25 \end{smallmatrix}) \times 10^{-4}$	S=1.8	1622
$\gamma f_0(1370) \rightarrow \gamma K \bar{K}$	$(3.1 \pm 1.7) \times 10^{-5}$		1588

$\gamma f_0(1500)$	$(9.3 \pm 1.9) \times 10^{-5}$		1535
$\gamma f'_2(1525)$	$(3.3 \pm 0.8) \times 10^{-5}$		1531
$\gamma f_0(1710) \rightarrow \gamma \pi \pi$	$(3.5 \pm 0.6) \times 10^{-5}$		—
$\gamma f_0(1710) \rightarrow \gamma K \bar{K}$	$(6.6 \pm 0.7) \times 10^{-5}$		—
$\gamma f_0(2100) \rightarrow \gamma \pi \pi$	$(4.8 \pm 1.0) \times 10^{-6}$		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
$\gamma K^{*0} K^+ \pi^- + \text{c.c.}$	$(3.7 \pm 0.9) \times 10^{-4}$		1674
$\gamma K^{*0} \bar{K}^{*0}$	$(2.4 \pm 0.7) \times 10^{-4}$		1613
$\gamma K_S^0 K^+ \pi^- + \text{c.c.}$	$(2.6 \pm 0.5) \times 10^{-4}$		1753
$\gamma K^+ K^- \pi^+ \pi^-$	$(1.9 \pm 0.5) \times 10^{-4}$		1726
$\gamma \rho \bar{\rho}$	$(3.9 \pm 0.5) \times 10^{-5}$	S=2.0	1586
$\gamma f_2(1950) \rightarrow \gamma \rho \bar{\rho}$	$(1.20 \pm 0.22) \times 10^{-5}$		—
$\gamma f_2(2150) \rightarrow \gamma \rho \bar{\rho}$	$(7.2 \pm 1.8) \times 10^{-6}$		—
$\gamma X(1835) \rightarrow \gamma \rho \bar{\rho}$	$(4.6 \begin{smallmatrix} +1.8 \\ -4.0 \end{smallmatrix}) \times 10^{-6}$		—
$\gamma X \rightarrow \gamma \rho \bar{\rho}$	[g] < 2	$\times 10^{-6}$ CL=90%	—
$\gamma \pi^+ \pi^- \rho \bar{\rho}$	$(2.8 \pm 1.4) \times 10^{-5}$		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
$\gamma \gamma J/\psi$	$(3.1 \begin{smallmatrix} +1.0 \\ -1.2 \end{smallmatrix}) \times 10^{-4}$		542
$e^+ e^- \eta'$	$(1.90 \pm 0.26) \times 10^{-6}$		1719
$e^+ e^- \chi_{c0}(1P)$	$(1.06 \pm 0.24) \times 10^{-3}$		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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$\psi(3770)$

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

$$\text{Mass } m = 3773.7 \pm 0.4 \text{ MeV} \quad (S = 1.4)$$

$$\text{Full width } \Gamma = 27.2 \pm 1.0 \text{ MeV}$$

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

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 $\frac{+8}{-9}$) %	S=2.0	287
$D^0\bar{D}^0$	(52 $\frac{+4}{-5}$) %	S=2.0	287
D^+D^-	(41 ± 4) %	S=2.0	254
$J/\psi\pi^+\pi^-$	(1.93 \pm 0.28) $\times 10^{-3}$		561
$J/\psi\pi^0\pi^0$	(8.0 \pm 3.0) $\times 10^{-4}$		565
$J/\psi\eta$	(9 ± 4) $\times 10^{-4}$		361
$J/\psi\pi^0$	< 2.8 $\times 10^{-4}$	CL=90%	604
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%	1684
$\phi\eta'$	< 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%	1805
$K^*(892)^+K^- + \text{c.c.}$	< 1.4 $\times 10^{-5}$	CL=90%	1745
$K^*(892)^0\bar{K}^0 + \text{c.c.}$	< 1.2 $\times 10^{-3}$	CL=90%	1745
$K_S^0 K_L^0$	< 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%	1844
$2(\pi^+\pi^-\pi^0)$	< 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%	1820
$3(\pi^+\pi^-)\pi^0$	< 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
$\eta3\pi$	< 1.34	$\times 10^{-3}$	CL=90%	1824
$\eta2(\pi^+\pi^-)$	< 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%	1741
$K^+K^-\pi^+\pi^-$	< 9.0	$\times 10^{-4}$	CL=90%	1773
$\phi\pi^+\pi^-$	< 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%	1623
ωK^+K^-	< 3.4	$\times 10^{-4}$	CL=90%	1664
$\phi\pi^+\pi^-\pi^0$	< 3.8	$\times 10^{-3}$	CL=90%	1723
$K^{*0}K^-\pi^+\pi^0 + \text{c.c.}$	< 1.62	%	CL=90%	1694
$K^{*+}K^-\pi^+\pi^- + \text{c.c.}$	< 3.23	%	CL=90%	1693
$K^+K^-\pi^+\pi^-2\pi^0$	< 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%	1661
ηK^+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%	1666
$2(K^+K^-)$	< 6.0	$\times 10^{-4}$	CL=90%	1552
ϕK^+K^-	< 7.5	$\times 10^{-4}$	CL=90%	1598
$2(K^+K^-)\pi^0$	< 2.9	$\times 10^{-4}$	CL=90%	1494
$2(K^+K^-)\pi^+\pi^-$	< 3.2	$\times 10^{-3}$	CL=90%	1426
$K_S^0 K^-\pi^+$	< 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%	1665
$K_S^0 K^-\pi^+\pi^-$	< 8.7	$\times 10^{-3}$	CL=90%	1740
$K_S^0 K^-\pi^+\rho^0$	< 1.6	%	CL=90%	1621
$K_S^0 K^-\pi^+\eta$	< 1.3	%	CL=90%	1670
$K_S^0 K^-\pi^+\pi^-\pi^0$	< 4.18	%	CL=90%	1703
$K_S^0 K^-\pi^+\pi^-\eta$	< 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
$K_S^0 K^-\pi^+K^+K^-\pi^+$	< 4.9	$\times 10^{-3}$	CL=90%	1491
$K_S^0 K^-\pi^+K^+K^-\pi^+\pi^0$	< 3.0	%	CL=90%	1427
$K_S^0 K^-\pi^+K^+K^-\pi^+\eta$	< 2.2	%	CL=90%	1214

$K^{*0} K^- \pi^+ + \text{c.c.}$	< 9.7	$\times 10^{-3}$	CL=90%	1722
$p\bar{p}\pi^0$	< 4	$\times 10^{-5}$	CL=90%	1595
$p\bar{p}\pi^+\pi^-$	< 5.8	$\times 10^{-4}$	CL=90%	1544
$\Lambda\bar{\Lambda}$	< 1.2	$\times 10^{-4}$	CL=90%	1522
$p\bar{p}\pi^+\pi^-\pi^0$	< 1.85	$\times 10^{-3}$	CL=90%	1490
$\omega p\bar{p}$	< 2.9	$\times 10^{-4}$	CL=90%	1310
$\Lambda\bar{\Lambda}\pi^0$	< 7	$\times 10^{-5}$	CL=90%	1469
$p\bar{p}2(\pi^+\pi^-)$	< 2.6	$\times 10^{-3}$	CL=90%	1426
$\eta p\bar{p}$	< 5.4	$\times 10^{-4}$	CL=90%	1431
$\eta p\bar{p}\pi^+\pi^-$	< 3.3	$\times 10^{-3}$	CL=90%	1284
$\rho^0 p\bar{p}$	< 1.7	$\times 10^{-3}$	CL=90%	1314
$p\bar{p}K^+K^-$	< 3.2	$\times 10^{-4}$	CL=90%	1186
$\eta p\bar{p}K^+K^-$	< 6.9	$\times 10^{-3}$	CL=90%	737
$\pi^0 p\bar{p}K^+K^-$	< 1.2	$\times 10^{-3}$	CL=90%	1094
$\phi p\bar{p}$	< 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%	1263
$\Sigma^+\bar{\Sigma}^-$	< 1.0	$\times 10^{-4}$	CL=90%	1465
$\Sigma^0\bar{\Sigma}^0$	< 4	$\times 10^{-5}$	CL=90%	1462
$\Xi^+\bar{\Xi}^-$	< 1.5	$\times 10^{-4}$	CL=90%	1347
$\Xi^0\bar{\Xi}^0$	< 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)	$\times 10^{-3}$		254
$\gamma\chi_{c0}$	(6.9 ± 0.6)	$\times 10^{-3}$		342
$\gamma\eta_c$	< 7	$\times 10^{-4}$	CL=90%	707
$\gamma\eta_c(2S)$	< 9	$\times 10^{-4}$	CL=90%	134
$\gamma\eta'$	< 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

$\psi_2(3823)$

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

I, J, P need confirmation.

was $\psi(3823)$, $X(3823)$

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

$\psi_3(3842)$

$$I^G(J^{PC}) = 0^-(3^{--})$$

J, P need confirmation.

Mass $m = 3842.71 \pm 0.20$ MeVFull width $\Gamma = 2.8 \pm 0.6$ MeV

$\psi_3(3842)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^+ D^-$	seen	443
$D^0 \bar{D}^0$	seen	463

 $\chi_{c1}(3872)$

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

also known as $X(3872)$ Mass $m = 3871.69 \pm 0.17$ MeV $m_{\chi_{c1}(3872)} - m_{J/\psi} = 775 \pm 4$ MeVFull 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 %	4
$\pi^0 \chi_{c1}$	> 2.8 %	319
$\gamma J/\psi$	> 7×10^{-3}	697
$\gamma \psi(2S)$	> 4 %	181
$\pi^+ \pi^- \eta_c(1S)$	not seen	745
$\pi^+ \pi^- \chi_{c1}$	not seen	218
$p \bar{p}$	not seen	1693

 $Z_c(3900)$

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

was $X(3900)$ Mass $m = 3888.4 \pm 2.5$ MeV ($S = 1.7$)Full width $\Gamma = 28.3 \pm 2.5$ MeV

$Z_c(3900)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$J/\psi \pi$	seen	700
$h_c \pi^\pm$	not seen	319
$\eta_c \pi^+ \pi^-$	not seen	760
$(D \bar{D}^*)^\pm$	seen	—
$D^0 D^{*-} + \text{c.c.}$	seen	160

$D^- D^{*0} + \text{c.c.}$	seen	152
$\omega \pi^\pm$	not seen	1863
$J/\psi \eta$	not seen	511
$D^+ D^{*-} + \text{c.c.}$	seen	—
$D^0 \bar{D}^{*0} + \text{c.c.}$	seen	—

X(3915)

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

was $\chi_{c0}(3915)$

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 $m = 3922.2 \pm 1.0 \text{ MeV}$ ($S = 1.6$)

Full width $\Gamma = 35.3 \pm 2.8 \text{ MeV}$ ($S = 1.4$)

$\chi_{c2}(3930)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\gamma \gamma$	seen	1961
$D \bar{D}$	seen	607
$D^+ D^-$	seen	592
$D^0 \bar{D}^0$	seen	607
$\pi^+ \pi^- \eta_c(1S)$	not seen	788
$K \bar{K}$	not seen	1898

X(4020) $^\pm$

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

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

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

X(4020)$^\pm$ 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*]

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

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	ρ (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
$D^0 D^- \pi^+ + \text{c.c.}$ (excl. $D^*(2007)^0 \bar{D}^0 + \text{c.c.}$, $D^*(2010)^+ D^- + \text{c.c.}$)	not seen		—
$D \bar{D}^* \pi$ (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 ± 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

$\chi_{c1}(4140)$

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

was $X(4140)$

$$\text{Mass } m = 4146.8 \pm 2.4 \text{ MeV} \quad (S = 1.1)$$

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

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

$\psi(4160)$ ^[h]

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

$$\text{Mass } m = 4191 \pm 5 \text{ MeV}$$

$$\text{Full width } \Gamma = 70 \pm 10 \text{ MeV}$$

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

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			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%	—

$\psi(4230)$

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

also known as $Y(4230)$; was $X(4230)$

See also $\psi(4260)$ entry in Particle Listings.

Mass $m = 4220 \pm 15$ MeV

Full width $\Gamma = 20$ to 100 MeV

$\psi(4230)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\omega \chi_{c0}$	seen	171
$\pi^+ \pi^- h_c$	seen	583
$\pi^+ \pi^- J/\psi$	seen	942
$\pi^+ \pi^- \psi(2S)$	seen	426
$\pi^+ D^0 D^{*-} + \text{c.c.}$	seen	650
$\gamma \chi_{c1}(3872)$	seen	334

 $\chi_{c1}(4274)$

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

was $X(4274)$

$$\text{Mass } m = 4274_{-6}^{+8} \text{ MeV}$$

$$\text{Full width } \Gamma = 49 \pm 12 \text{ MeV}$$

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

 $\psi(4360)$

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

also known as $Y(4360)$; was $X(4360)$

$$\psi(4360) \text{ MASS} = 4368 \pm 13 \text{ MeV} \quad (S = 3.7)$$

$$\psi(4360) \text{ WIDTH} = 96 \pm 7 \text{ MeV}$$

$\psi(4360)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\psi(2S) \pi^+ \pi^-$	seen	573
$\psi_2(3823) \pi^+ \pi^-$	possibly seen	440
$D_1(2420) \bar{D} + \text{c.c.}$	possibly seen	419

 $\psi(4415)$ ^[h]

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

$$\text{Mass } m = 4421 \pm 4 \text{ MeV}$$

$$\text{Full width } \Gamma = 62 \pm 20 \text{ MeV}$$

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

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)
$D\bar{D}$	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., $D^*(2010)^+D^-$ +c.c.)	< 2.3 %	90%	—
$D\bar{D}_2^*(2460) \rightarrow D^0D^-\pi^+$ +c.c.	(10 \pm 4) %		—
$D^0D^{*-}\pi^+$ +c.c.	< 11 %	90%	926
$D_1(2420)\bar{D} + \text{c.c.}$	possibly seen		538
$D_s^+D_s^-$	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
$\psi(3770)\pi^+\pi^-$	possibly seen		541
$J/\psi\eta$	< 6 $\times 10^{-3}$	90%	1022
$\chi_{c1}\gamma$	< 8 $\times 10^{-4}$	90%	817
$\chi_{c2}\gamma$	< 4 $\times 10^{-3}$	90%	780
e^+e^-	(9.4 \pm 3.2) $\times 10^{-6}$		2210

Z_c(4430)

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

G, C need confirmation.

was $X(4430)^\pm$

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

$\psi(4660)$

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

also known as $Y(4660)$; was $X(4660)$

$$\psi(4660) \text{ MASS} = 4633 \pm 7 \text{ MeV} \quad (S = 1.4)$$

$$\psi(4660) \text{ WIDTH} = 64 \pm 9 \text{ MeV}$$

$\psi(4660)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$e^+ e^-$	not seen	2316
$\psi(2S)\pi^+\pi^-$	seen	812
$J/\psi\eta$	not seen	1194
$D^0 D^{*-}\pi^+$	not seen	1156
$\chi_{c1}\gamma$	not seen	986
$\chi_{c2}\gamma$	not seen	952
$\Lambda_c^+ \Lambda_c^-$	seen	371
$D_s^+ D_{s1}(2536)^-$	seen	539

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.