

c \bar{c} MESONS

$\eta_c(1S)$

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

Mass $m = 2981.0 \pm 1.1$ MeV (S = 1.7)

Full width $\Gamma = 29.7 \pm 1.0$ MeV

$\eta_c(1S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	ρ (MeV/c)
--------------------------	--------------------------------	------------------	-------------------

Decays involving hadronic resonances

$\eta'(958)\pi\pi$	(4.1 \pm 1.7) %		1322
$\rho\rho$	(1.8 \pm 0.5) %		1273
$K^*(892)^0 K^- \pi^+ + \text{c.c.}$	(2.0 \pm 0.7) %		1276
$K^*(892)\bar{K}^*(892)$	(6.8 \pm 1.3) $\times 10^{-3}$		1194
$K^{*0}\bar{K}^{*0}\pi^+\pi^-$	(1.1 \pm 0.5) %		1071
$\phi K^+ K^-$	(2.9 \pm 1.4) $\times 10^{-3}$		1102
$\phi\phi$	(1.94 \pm 0.30) $\times 10^{-3}$		1087
$\phi 2(\pi^+\pi^-)$	< 3.5 $\times 10^{-3}$	90%	1249
$a_0(980)\pi$	< 2 %	90%	1326
$a_2(1320)\pi$	< 2 %	90%	1194
$K^*(892)\bar{K} + \text{c.c.}$	< 1.28 %	90%	1308
$f_2(1270)\eta$	< 1.1 %	90%	1144
$\omega\omega$	< 3.1 $\times 10^{-3}$	90%	1268
$\omega\phi$	< 1.7 $\times 10^{-3}$	90%	1184
$f_2(1270)f_2(1270)$	(9.7 \pm 2.5) $\times 10^{-3}$		772
$f_2(1270)f'_2(1525)$	(9.3 \pm 3.1) $\times 10^{-3}$		509

Decays into stable hadrons

$K\bar{K}\pi$	(7.2 \pm 0.6) %		1379
$\eta\pi^+\pi^-$	(4.9 \pm 1.8) %		1426
$K^+ K^- \pi^+ \pi^-$	(6.1 \pm 1.2) $\times 10^{-3}$		1343
$K^+ K^- \pi^+ \pi^- \pi^0$	(3.4 \pm 0.6) %		1303
$K^+ K^- 2(\pi^+ \pi^-)$	(7.1 \pm 2.9) $\times 10^{-3}$		1252
$2(K^+ K^-)$	(1.34 \pm 0.32) $\times 10^{-3}$		1054
$2(\pi^+ \pi^-)$	(8.6 \pm 1.3) $\times 10^{-3}$		1458
$3(\pi^+ \pi^-)$	(1.5 \pm 0.5) %		1405
$p\bar{p}$	(1.41 \pm 0.17) $\times 10^{-3}$		1158
$\Lambda\bar{\Lambda}$	(9.4 \pm 3.2) $\times 10^{-4}$		988
$K\bar{K}\eta$	< 3.1 %	90%	1264
$\pi^+ \pi^- p\bar{p}$	< 1.2 %	90%	1025

Radiative decays

$\gamma\gamma$	(1.78 \pm 0.16) $\times 10^{-4}$		1490
----------------	------------------------------------	--	------

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

$\pi^+ \pi^-$	$P, CP < 1.1$	$\times 10^{-4}$	90%	1484
$\pi^0 \pi^0$	$P, CP < 3.5$	$\times 10^{-5}$	90%	1484
$K^+ K^-$	$P, CP < 6$	$\times 10^{-4}$	90%	1406
$K_S^0 K_S^0$	$P, CP < 3.1$	$\times 10^{-4}$	90%	1405

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 ± 0.5) %		—
virtual $\gamma \rightarrow$ hadrons	(13.50 ± 0.30) %		—
$g g g$	(64.1 ± 1.0) %		—
$\gamma g g$	(8.8 ± 1.1) %		—
$e^+ e^-$	(5.94 ± 0.06) %		1548
$e^+ e^- \gamma$	[a] (8.8 ± 1.4) $\times 10^{-3}$		1548
$\mu^+ \mu^-$	(5.93 ± 0.06) %		1545

Decays involving hadronic resonances

$\rho \pi$	(1.69 ± 0.15) %	S=2.4	1448
$\rho^0 \pi^0$	(5.6 ± 0.7) $\times 10^{-3}$		1448
$a_2(1320) \rho$	(1.09 ± 0.22) %		1123
$\omega \pi^+ \pi^+ \pi^- \pi^-$	(8.5 ± 3.4) $\times 10^{-3}$		1392
$\omega \pi^+ \pi^- \pi^0$	(4.0 ± 0.7) $\times 10^{-3}$		1418
$\omega \pi^+ \pi^-$	(8.6 ± 0.7) $\times 10^{-3}$	S=1.1	1435
$\omega f_2(1270)$	(4.3 ± 0.6) $\times 10^{-3}$		1142
$K^*(892)^0 \bar{K}^*(892)^0$	(2.3 ± 0.7) $\times 10^{-4}$		1266
$K^*(892)^\pm \bar{K}^*(892)^\mp$	(1.00 $^{+0.22}_{-0.40}$) $\times 10^{-3}$		1266
$K^*(892)^\pm \bar{K}^*(800)^\mp$	(1.1 $^{+1.0}_{-0.6}$) $\times 10^{-3}$		—
$\eta K^*(892)^0 \bar{K}^*(892)^0$	(1.15 ± 0.26) $\times 10^{-3}$		1003
$K^*(892)^0 \bar{K}_2^*(1430)^0 + c.c.$	(6.0 ± 0.6) $\times 10^{-3}$		1012
$K^*(892)^0 \bar{K}_2^*(1770)^0 + c.c. \rightarrow$	(6.9 ± 0.9) $\times 10^{-4}$		—
$K^*(892)^0 K^- \pi^+ + c.c.$			
$\omega K^*(892) \bar{K} + c.c.$	(6.1 ± 0.9) $\times 10^{-3}$		1097
$K^+ \bar{K}^*(892)^- + c.c.$	(5.12 ± 0.30) $\times 10^{-3}$		1373
$K^+ \bar{K}^*(892)^- + c.c. \rightarrow$	(1.97 ± 0.20) $\times 10^{-3}$		—
$K^+ K^- \pi^0$			
$K^+ \bar{K}^*(892)^- + c.c. \rightarrow$	(3.0 ± 0.4) $\times 10^{-3}$		—
$K^0 K^\pm \pi^\mp$			

$K^0 \bar{K}^*(892)^0 + \text{c.c.}$		$(4.39 \pm 0.31) \times 10^{-3}$		1373
$K^0 \bar{K}^*(892)^0 + \text{c.c.} \rightarrow$		$(3.2 \pm 0.4) \times 10^{-3}$		—
$K^0 K^\pm \pi^\mp$				
$K_1(1400)^\pm K^\mp$		$(3.8 \pm 1.4) \times 10^{-3}$		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]	$(1.03 \pm 0.13) \times 10^{-3}$		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
$\phi f_0(980) \rightarrow \phi \pi^+ \pi^-$		$(1.8 \pm 0.4) \times 10^{-4}$		—
$\phi f_0(980) \rightarrow \phi \pi^0 \pi^0$		$(1.7 \pm 0.7) \times 10^{-4}$		—
$\eta \phi f_0(980) \rightarrow \eta \phi \pi^+ \pi^-$		$(3.2 \pm 1.0) \times 10^{-4}$		—
$\phi a_0(980)^0 \rightarrow \phi \eta \pi^0$		$(5 \pm 4) \times 10^{-6}$		—
$\Xi(1530)^0 \Xi^0$		$(3.2 \pm 1.4) \times 10^{-4}$		608
$\Sigma(1385)^- \bar{\Sigma}^+ (\text{or c.c.})$	[b]	$(3.1 \pm 0.5) \times 10^{-4}$		855
$\phi f_1(1285)$		$(2.6 \pm 0.5) \times 10^{-4}$	S=1.1	1032
$\eta \pi^+ \pi^-$		$(4.0 \pm 1.7) \times 10^{-4}$		1487
$\rho \eta$		$(1.93 \pm 0.23) \times 10^{-4}$		1396
$\omega \eta'(958)$		$(1.82 \pm 0.21) \times 10^{-4}$		1279
$\omega f_0(980)$		$(1.4 \pm 0.5) \times 10^{-4}$		1267

$\rho\eta'(958)$	$(1.05 \pm 0.18) \times 10^{-4}$		1281
$a_2(1320)^\pm \pi^\mp$	$[b] < 4.3$	$\times 10^{-3}$	CL=90% 1263
$K\bar{K}_2^*(1430)+$ c.c.	< 4.0	$\times 10^{-3}$	CL=90% 1159
$K_1(1270)^\pm K^\mp$	< 3.0	$\times 10^{-3}$	CL=90% 1231
$K_2^*(1430)^0 \bar{K}_2^*(1430)^0$	< 2.9	$\times 10^{-3}$	CL=90% 604
$\phi\pi^0$	< 6.4	$\times 10^{-6}$	CL=90% 1377
$\phi\eta(1405) \rightarrow \phi\eta\pi\pi$	< 2.5	$\times 10^{-4}$	CL=90% 946
$\omega f_2'(1525)$	< 2.2	$\times 10^{-4}$	CL=90% 1003
$\eta\phi(2170) \rightarrow$ $\eta K^*(892)^0 \bar{K}^*(892)^0$	< 2.52	$\times 10^{-4}$	CL=90% -
$\Sigma(1385)^0 \bar{\Lambda}$	< 2	$\times 10^{-4}$	CL=90% 912
$\Delta(1232)^+ \bar{p}$	< 1	$\times 10^{-4}$	CL=90% 1100
$\Theta(1540) \bar{\Theta}(1540) \rightarrow$ $K_S^0 p K^- \bar{n} +$ 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% -
$\Sigma^0 \bar{\Lambda}$	< 9	$\times 10^{-5}$	CL=90% 1032

Decays into stable hadrons

$2(\pi^+ \pi^-) \pi^0$	$(4.1 \pm 0.5) \%$	S=2.4	1496
$3(\pi^+ \pi^-) \pi^0$	$(2.9 \pm 0.6) \%$		1433
$\pi^+ \pi^- \pi^0$	$(2.07 \pm 0.12) \%$	S=1.6	1533
$\pi^+ \pi^- \pi^0 K^+ K^-$	$(1.79 \pm 0.29) \%$	S=2.2	1368
$4(\pi^+ \pi^-) \pi^0$	$(9.0 \pm 3.0) \times 10^{-3}$		1345
$\pi^+ \pi^- K^+ K^-$	$(6.6 \pm 0.5) \times 10^{-3}$		1407
$\pi^+ \pi^- K^+ K^- \eta$	$(1.84 \pm 0.28) \times 10^{-3}$		1221
$\pi^0 \pi^0 K^+ K^-$	$(2.45 \pm 0.31) \times 10^{-3}$		1410
$K\bar{K}\pi$	$(6.1 \pm 1.0) \times 10^{-3}$		1442
$2(\pi^+ \pi^-)$	$(3.55 \pm 0.23) \times 10^{-3}$		1517
$3(\pi^+ \pi^-)$	$(4.3 \pm 0.4) \times 10^{-3}$		1466
$2(\pi^+ \pi^- \pi^0)$	$(1.62 \pm 0.21) \%$		1468
$2(\pi^+ \pi^-) \eta$	$(2.29 \pm 0.24) \times 10^{-3}$		1446
$3(\pi^+ \pi^-) \eta$	$(7.2 \pm 1.5) \times 10^{-4}$		1379
$\rho\bar{p}$	$(2.17 \pm 0.07) \times 10^{-3}$		1232
$\rho\bar{p}\pi^0$	$(1.19 \pm 0.08) \times 10^{-3}$	S=1.1	1176
$\rho\bar{p}\pi^+ \pi^-$	$(6.0 \pm 0.5) \times 10^{-3}$	S=1.3	1107
$\rho\bar{p}\pi^+ \pi^- \pi^0$	$[c] (2.3 \pm 0.9) \times 10^{-3}$	S=1.9	1033
$\rho\bar{p}\eta$	$(2.00 \pm 0.12) \times 10^{-3}$		948
$\rho\bar{p}\rho$	< 3.1	$\times 10^{-4}$	CL=90% 774
$\rho\bar{p}\omega$	$(1.10 \pm 0.15) \times 10^{-3}$	S=1.3	768
$\rho\bar{p}\eta'(958)$	$(2.1 \pm 0.4) \times 10^{-4}$		596
$\rho\bar{p}\phi$	$(4.5 \pm 1.5) \times 10^{-5}$		527

$n\bar{n}$		$(2.2 \pm 0.4) \times 10^{-3}$		1231
$n\bar{n}\pi^+\pi^-$		$(4 \pm 4) \times 10^{-3}$		1106
$\Sigma^+\bar{\Sigma}^-$		$(1.50 \pm 0.24) \times 10^{-3}$		992
$\Sigma^0\bar{\Sigma}^0$		$(1.29 \pm 0.09) \times 10^{-3}$		988
$2(\pi^+\pi^-)K^+K^-$		$(4.7 \pm 0.7) \times 10^{-3}$	S=1.3	1320
$p\bar{n}\pi^-$		$(2.12 \pm 0.09) \times 10^{-3}$		1174
$nN(1440)$		seen		978
$nN(1520)$		seen		924
$nN(1535)$		seen		914
$\Xi^-\bar{\Xi}^+$		$(8.5 \pm 1.6) \times 10^{-4}$	S=1.5	807
$\Lambda\bar{\Lambda}$		$(1.61 \pm 0.15) \times 10^{-3}$	S=1.9	1074
$\Lambda\bar{\Sigma}^-\pi^+$ (or c.c.)	[b]	$(8.3 \pm 0.7) \times 10^{-4}$	S=1.2	950
$pK^-\bar{\Lambda}$		$(8.9 \pm 1.6) \times 10^{-4}$		876
$2(K^+K^-)$		$(7.6 \pm 0.9) \times 10^{-4}$		1131
$pK^-\bar{\Sigma}^0$		$(2.9 \pm 0.8) \times 10^{-4}$		819
K^+K^-		$(2.37 \pm 0.31) \times 10^{-4}$		1468
$K_S^0 K_L^0$		$(1.46 \pm 0.26) \times 10^{-4}$	S=2.7	1466
$\Lambda\bar{\Lambda}\eta$		$(2.6 \pm 0.7) \times 10^{-4}$		672
$\Lambda\bar{\Lambda}\pi^0$		$< 6.4 \times 10^{-5}$	CL=90%	998
$\bar{\Lambda}nK_S^0 + \text{c.c.}$		$(6.5 \pm 1.1) \times 10^{-4}$		872
$\pi^+\pi^-$		$(1.47 \pm 0.23) \times 10^{-4}$		1542
$\Lambda\bar{\Sigma} + \text{c.c.}$		$< 1.5 \times 10^{-4}$	CL=90%	1034
$K_S^0 K_S^0$		$< 1 \times 10^{-6}$	CL=95%	1466

Radiative decays

3γ		$(1.2 \pm 0.4) \times 10^{-5}$		1548
4γ		$< 9 \times 10^{-6}$	CL=90%	1548
5γ		$< 1.5 \times 10^{-5}$	CL=90%	1548
$\gamma\eta_c(1S)$		$(1.7 \pm 0.4) \%$	S=1.6	114
$\gamma\eta_c(1S) \rightarrow 3\gamma$		$(1.2 \begin{smallmatrix} +2.7 \\ -1.1 \end{smallmatrix}) \times 10^{-6}$		—
$\gamma\pi^+\pi^-2\pi^0$		$(8.3 \pm 3.1) \times 10^{-3}$		1518
$\gamma\eta\pi\pi$		$(6.1 \pm 1.0) \times 10^{-3}$		1487
$\gamma\eta_2(1870) \rightarrow \gamma\eta\pi^+\pi^-$		$(6.2 \pm 2.4) \times 10^{-4}$		—
$\gamma\eta(1405/1475) \rightarrow \gamma K\bar{K}\pi$	[d]	$(2.8 \pm 0.6) \times 10^{-3}$	S=1.6	1223
$\gamma\eta(1405/1475) \rightarrow \gamma\gamma\rho^0$		$(7.8 \pm 2.0) \times 10^{-5}$	S=1.8	1223
$\gamma\eta(1405/1475) \rightarrow \gamma\eta\pi^+\pi^-$		$(3.0 \pm 0.5) \times 10^{-4}$		—
$\gamma\eta(1405/1475) \rightarrow \gamma\gamma\phi$		$< 8.2 \times 10^{-5}$	CL=95%	—
$\gamma\rho\rho$		$(4.5 \pm 0.8) \times 10^{-3}$		1340
$\gamma\rho\omega$		$< 5.4 \times 10^{-4}$	CL=90%	1338
$\gamma\rho\phi$		$< 8.8 \times 10^{-5}$	CL=90%	1258
$\gamma\eta'(958)$		$(5.16 \pm 0.15) \times 10^{-3}$	S=1.1	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
$\gamma f_0(1710) \rightarrow \gamma K \bar{K}$	$(8.5 \begin{smallmatrix} +1.2 \\ -0.9 \end{smallmatrix}) \times 10^{-4}$	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
$\gamma f_1(1510) \rightarrow \gamma \eta \pi^+ \pi^-$	$(4.5 \pm 1.2) \times 10^{-4}$		—
$\gamma f'_2(1525)$	$(4.5 \begin{smallmatrix} +0.7 \\ -0.4 \end{smallmatrix}) \times 10^{-4}$		1173
$\gamma f_2(1640) \rightarrow \gamma \omega \omega$	$(2.8 \pm 1.8) \times 10^{-4}$		—
$\gamma f_2(1910) \rightarrow \gamma \omega \omega$	$(2.0 \pm 1.4) \times 10^{-4}$		—
$\gamma f_2(1950) \rightarrow$	$(7.0 \pm 2.2) \times 10^{-4}$		—
$\gamma K^*(892) \bar{K}^*(892)$			
$\gamma K^*(892) \bar{K}^*(892)$	$(4.0 \pm 1.3) \times 10^{-3}$		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
$\gamma X(1835) \rightarrow \gamma \rho \bar{\rho}$	$(7.5 \begin{smallmatrix} +1.9 \\ -0.9 \end{smallmatrix}) \times 10^{-5}$		—
$\gamma (K \bar{K} \pi) [J^{PC} = 0^{-+}]$	$(7 \pm 4) \times 10^{-4}$	S=2.1	1442
$\gamma \pi^0$	$(3.49 \begin{smallmatrix} +0.33 \\ -0.30 \end{smallmatrix}) \times 10^{-5}$		1546
$\gamma \rho \bar{\rho} \pi^+ \pi^-$	$< 7.9 \times 10^{-4}$	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
$\gamma f_J(2220) \rightarrow \gamma \pi \pi$	$(8 \pm 4) \times 10^{-5}$		—
$\gamma f_J(2220) \rightarrow \gamma K \bar{K}$	$< 3.6 \times 10^{-5}$		—
$\gamma f_J(2220) \rightarrow \gamma \rho \bar{\rho}$	$(1.5 \pm 0.8) \times 10^{-5}$		—
$\gamma f_0(1500)$	$(1.01 \pm 0.32) \times 10^{-4}$		1183
$\gamma A \rightarrow \gamma$ invisible	$[e] < 6.3 \times 10^{-6}$	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
$\bar{D}^0 \bar{K}^0 + \text{c.c.}$	< 1.7	$\times 10^{-4}$	CL=90%	898
$D_s^- \pi^+ + \text{c.c.}$	< 1.3	$\times 10^{-4}$	CL=90%	915

**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	< 1.1	$\times 10^{-6}$	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%	–
-----------	-----	------------------	--------	---

$\chi_{c0}(1P)$

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

Mass $m = 3414.75 \pm 0.31$ MeV

Full width $\Gamma = 10.4 \pm 0.6$ MeV

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

Hadronic decays

$2(\pi^+ \pi^-)$	(2.26 ± 0.19) %		1679
$\rho^0 \pi^+ \pi^-$	(8.8 ± 2.8) $\times 10^{-3}$		1607
$f_0(980) f_0(980)$	(6.7 ± 2.1) $\times 10^{-4}$		1391
$\pi^+ \pi^- \pi^0 \pi^0$	(3.4 ± 0.4) %		1680
$\rho^+ \pi^- \pi^0 + \text{c.c.}$	(2.9 ± 0.4) %		1607
$4\pi^0$	(3.3 ± 0.4) $\times 10^{-3}$		1681
$\pi^+ \pi^- K^+ K^-$	(1.79 ± 0.15) %		1580
$K_0^*(1430)^0 \bar{K}_0^*(1430)^0 \rightarrow$ $\pi^+ \pi^- K^+ K^-$	(9.9 $\begin{smallmatrix} +4.0 \\ -2.9 \end{smallmatrix}$) $\times 10^{-4}$		–
$K_0^*(1430)^0 \bar{K}_2^*(1430)^0 + \text{c.c.} \rightarrow$ $\pi^+ \pi^- K^+ K^-$	(8.1 $\begin{smallmatrix} +2.0 \\ -2.4 \end{smallmatrix}$) $\times 10^{-4}$		–
$K_1(1270)^+ K^- + \text{c.c.} \rightarrow$ $\pi^+ \pi^- K^+ K^-$	(6.3 ± 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 $\begin{smallmatrix} +1.1 \\ -0.9 \end{smallmatrix}$) $\times 10^{-4}$		1391
$f_0(980) f_0(2200)$	(8.0 $\begin{smallmatrix} +2.0 \\ -2.5 \end{smallmatrix}$) $\times 10^{-4}$		584

$f_0(1370) f_0(1370)$	< 2.8	$\times 10^{-4}$	CL=90%	1019
$f_0(1370) f_0(1500)$	< 1.7	$\times 10^{-4}$	CL=90%	920
$f_0(1370) f_0(1710)$	$(6.8^{+4.0}_{-2.4})$	$\times 10^{-4}$		723
$f_0(1500) f_0(1370)$	< 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%	559
$K^+ K^- \pi^+ \pi^- \pi^0$	(1.13 ± 0.27)	%		1545
$K^+ K^- \pi^0 \pi^0$	(5.6 ± 0.9)	$\times 10^{-3}$		1582
$K^+ \pi^- K^0 \pi^0 + \text{c.c.}$	(2.52 ± 0.34)	%		1581
$\rho^+ K^- K^0 + \text{c.c.}$	(1.22 ± 0.21)	%		1458
$K^*(892)^- K^+ \pi^0 \rightarrow$ $K^+ \pi^- K^0 \pi^0 + \text{c.c.}$	(4.7 ± 1.2)	$\times 10^{-3}$		—
$K_S^0 K_S^0 \pi^+ \pi^-$	(5.8 ± 1.1)	$\times 10^{-3}$		1579
$K^+ K^- \eta \pi^0$	(3.0 ± 0.7)	$\times 10^{-3}$		1468
$3(\pi^+ \pi^-)$	(1.20 ± 0.18)	%		1633
$K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$	(7.3 ± 1.6)	$\times 10^{-3}$		1523
$K^*(892)^0 \bar{K}^*(892)^0$	(1.7 ± 0.6)	$\times 10^{-3}$		1456
$\pi \pi$	(8.5 ± 0.4)	$\times 10^{-3}$		1702
$\pi^0 \eta$	< 1.8	$\times 10^{-4}$		1661
$\pi^0 \eta'$	< 1.1	$\times 10^{-3}$		1570
$\eta \eta$	(3.03 ± 0.21)	$\times 10^{-3}$		1617
$\eta \eta'$	< 2.4	$\times 10^{-4}$	CL=90%	1521
$\eta' \eta'$	(2.02 ± 0.22)	$\times 10^{-3}$		1413
$\omega \omega$	(9.8 ± 1.1)	$\times 10^{-4}$		1517
$\omega \phi$	(1.19 ± 0.22)	$\times 10^{-4}$		1447
$K^+ K^-$	(6.06 ± 0.35)	$\times 10^{-3}$		1634
$K_S^0 K_S^0$	(3.14 ± 0.18)	$\times 10^{-3}$		1633
$\pi^+ \pi^- \eta$	< 2.0	$\times 10^{-4}$	CL=90%	1651
$\pi^+ \pi^- \eta'$	< 4	$\times 10^{-4}$	CL=90%	1560
$\bar{K}^0 K^+ \pi^- + \text{c.c.}$	< 1.0	$\times 10^{-4}$	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 ± 0.5)	$\times 10^{-3}$		1331
$K^+ K^- K^+ K^-$	(2.79 ± 0.29)	$\times 10^{-3}$		1333
$K^+ K^- \phi$	(9.8 ± 2.5)	$\times 10^{-4}$		1381
$\phi \phi$	(8.2 ± 0.8)	$\times 10^{-4}$		1370
$\rho \bar{\rho}$	(2.23 ± 0.13)	$\times 10^{-4}$		1426
$\rho \bar{\rho} \pi^0$	(7.0 ± 0.7)	$\times 10^{-4}$	S=1.2	1379
$\rho \bar{\rho} \eta$	(3.6 ± 0.4)	$\times 10^{-4}$		1187
$\rho \bar{\rho} \omega$	(5.3 ± 0.6)	$\times 10^{-4}$		1043
$\rho \bar{\rho} \phi$	(6.1 ± 1.5)	$\times 10^{-5}$		876
$\rho \bar{\rho} \pi^+ \pi^-$	(2.1 ± 0.7)	$\times 10^{-3}$	S=1.4	1320
$\rho \bar{\rho} \pi^0 \pi^0$	(1.05 ± 0.28)	$\times 10^{-3}$		1324
$\rho \bar{\rho} K^+ K^-$ (non-resonant)	(1.23 ± 0.27)	$\times 10^{-4}$		890

$p\bar{p}K_S^0 K_S^0$	$< 8.8 \times 10^{-4}$	CL=90%	884
$p\bar{n}\pi^-$	$(1.14 \pm 0.31) \times 10^{-3}$		1376
$\Lambda\bar{\Lambda}$	$(3.3 \pm 0.4) \times 10^{-4}$		1292
$\Lambda\bar{\Lambda}\pi^+\pi^-$	$< 4.0 \times 10^{-3}$	CL=90%	1153
$K^+\bar{p}\Lambda + \text{c.c.}$	$(1.02 \pm 0.19) \times 10^{-3}$		1132
$K^+ p \Lambda(1520) + \text{c.c.}$	$(3.0 \pm 0.8) \times 10^{-4}$		858
$\Lambda(1520)\bar{\Lambda}(1520)$	$(3.2 \pm 1.2) \times 10^{-4}$		779
$\Sigma^0\bar{\Sigma}^0$	$(4.2 \pm 0.7) \times 10^{-4}$		1222
$\Sigma^+\bar{\Sigma}^-$	$(3.1 \pm 0.7) \times 10^{-4}$		1225
$\Xi^0\bar{\Xi}^0$	$(3.2 \pm 0.8) \times 10^{-4}$		1089
$\Xi^-\bar{\Xi}^+$	$(4.9 \pm 0.7) \times 10^{-4}$		1081

Radiative decays

$\gamma J/\psi(1S)$	$(1.17 \pm 0.08) \%$		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
$\gamma\gamma$	$(2.23 \pm 0.17) \times 10^{-4}$		1707

$\chi_{c1}(1P)$

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

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

Full width $\Gamma = 0.86 \pm 0.05$ 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
$\pi^+\pi^-\pi^0\pi^0$	$(1.26 \pm 0.17) \%$		1729
$\rho^+\pi^-\pi^0 + \text{c.c.}$	$(1.53 \pm 0.26) \%$		1658
$\rho^0\pi^+\pi^-$	$(3.9 \pm 3.5) \times 10^{-3}$		1657
$4\pi^0$	$(5.7 \pm 0.8) \times 10^{-4}$		1729
$\pi^+\pi^-K^+K^-$	$(4.5 \pm 1.0) \times 10^{-3}$		1632
$K^+K^-\pi^0\pi^0$	$(1.18 \pm 0.29) \times 10^{-3}$		1634
$K^+\pi^-K^0\pi^0 + \text{c.c.}$	$(9.0 \pm 1.5) \times 10^{-3}$		1632
$\rho^+K^-K^0 + \text{c.c.}$	$(5.3 \pm 1.3) \times 10^{-3}$		1514
$K^*(892)^0 K^0\pi^0 \rightarrow$ $K^+\pi^-K^0\pi^0 + \text{c.c.}$	$(2.5 \pm 0.7) \times 10^{-3}$		—
$K^+K^-\eta\pi^0$	$(1.2 \pm 0.4) \times 10^{-3}$		1523
$\pi^+\pi^-K_S^0 K_S^0$	$(7.2 \pm 3.1) \times 10^{-4}$		1630
$K^+K^-\eta$	$(3.3 \pm 1.0) \times 10^{-4}$		1566
$K^0 K^+\pi^- + \text{c.c.}$	$(7.3 \pm 0.6) \times 10^{-3}$		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
$K_J^*(1430)^0 \bar{K}^0 + \text{c.c.} \rightarrow$	$< 8 \times 10^{-4}$	CL=90%	–
$K_S^0 K^+ \pi^- + \text{c.c.}$			
$K_J^*(1430)^+ K^- + \text{c.c.} \rightarrow$	$< 2.3 \times 10^{-3}$	CL=90%	–
$K_S^0 K^+ \pi^- + \text{c.c.}$			
$K^+ K^- \pi^0$	$(1.91 \pm 0.26) \times 10^{-3}$		1662
$\eta \pi^+ \pi^-$	$(5.0 \pm 0.5) \times 10^{-3}$		1701
$a_0(980)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-$	$(1.9 \pm 0.7) \times 10^{-3}$		–
$f_2(1270) \eta$	$(2.8 \pm 0.8) \times 10^{-3}$		1468
$\pi^+ \pi^- \eta'$	$(2.4 \pm 0.5) \times 10^{-3}$		1612
$\pi^0 f_0(980) \rightarrow \pi^0 \pi^+ \pi^-$	$< 6 \times 10^{-6}$	CL=90%	–
$K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$	$(3.2 \pm 2.1) \times 10^{-3}$		1577
$K^*(892)^0 \bar{K}^*(892)^0$	$(1.5 \pm 0.4) \times 10^{-3}$		1512
$K^+ K^- K_S^0 K_S^0$	$< 5 \times 10^{-4}$	CL=90%	1390
$K^+ K^- K^+ K^-$	$(5.6 \pm 1.2) \times 10^{-4}$		1393
$K^+ K^- \phi$	$(4.3 \pm 1.6) \times 10^{-4}$		1440
$\omega \omega$	$(6.0 \pm 0.7) \times 10^{-4}$		1571
$\omega \phi$	$(2.2 \pm 0.6) \times 10^{-5}$		1503
$\phi \phi$	$(4.4 \pm 0.6) \times 10^{-4}$		1429
$\rho \bar{\rho}$	$(7.3 \pm 0.4) \times 10^{-5}$		1484
$\rho \bar{\rho} \pi^0$	$(1.64 \pm 0.20) \times 10^{-4}$		1438
$\rho \bar{\rho} \eta$	$(1.53 \pm 0.26) \times 10^{-4}$		1254
$\rho \bar{\rho} \omega$	$(2.24 \pm 0.33) \times 10^{-4}$		1117
$\rho \bar{\rho} \phi$	$< 1.8 \times 10^{-5}$	CL=90%	962
$\rho \bar{\rho} \pi^+ \pi^-$	$(5.0 \pm 1.9) \times 10^{-4}$		1381
$\rho \bar{\rho} K^+ K^- (\text{non-resonant})$	$(1.34 \pm 0.24) \times 10^{-4}$		974
$\rho \bar{\rho} K_S^0 K_S^0$	$< 4.5 \times 10^{-4}$	CL=90%	968
$\Lambda \bar{\Lambda}$	$(1.18 \pm 0.19) \times 10^{-4}$		1355
$\Lambda \bar{\Lambda} \pi^+ \pi^-$	$< 1.5 \times 10^{-3}$	CL=90%	1223
$K^+ \bar{p} \Lambda$	$(3.2 \pm 1.0) \times 10^{-4}$		1203
$K^+ \rho \Lambda(1520) + \text{c.c.}$	$(1.8 \pm 0.5) \times 10^{-4}$		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
$\Xi^0 \bar{\Xi}^0$	$< 6 \times 10^{-5}$	CL=90%	1163
$\Xi^- \bar{\Xi}^+$	$(8.4 \pm 2.3) \times 10^{-5}$		1155
$\pi^+ \pi^- + K^+ K^-$	$< 2.1 \times 10^{-3}$		–
$K_S^0 K_S^0$	$< 6 \times 10^{-5}$	CL=90%	1683

Radiative decays

$\gamma J/\psi(1S)$	(34.4 ± 1.5) %	389
$\gamma \rho^0$	(2.28 ± 0.19) × 10 ⁻⁴	1670
$\gamma \omega$	(7.1 ± 0.9) × 10 ⁻⁵	1668
$\gamma \phi$	(2.6 ± 0.6) × 10 ⁻⁵	1607

$h_c(1P)$

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

Mass $m = 3525.41 \pm 0.16$ MeV (S = 1.2)

Full width $\Gamma < 1$ MeV

$h_c(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$J/\psi(1S)\pi\pi$	not seen	312
$\eta_c(1S)\gamma$	(51 ± 6) %	502
$\pi^+\pi^-\pi^0$	< 2.2 × 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 $\Gamma = 1.98 \pm 0.11$ MeV

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

Hadronic decays

$2(\pi^+\pi^-)$	(1.10 ± 0.11) %	1751
$\pi^+\pi^-\pi^0\pi^0$	(2.00 ± 0.26) %	1752
$\rho^+\pi^-\pi^0 + \text{c.c.}$	(2.4 ± 0.4) %	1682
$4\pi^0$	(1.21 ± 0.17) × 10 ⁻³	1752
$K^+K^-\pi^0\pi^0$	(2.2 ± 0.5) × 10 ⁻³	1658
$K^+\pi^-K^0\pi^0 + \text{c.c.}$	(1.51 ± 0.22) %	1657
$\rho^+K^-K^0 + \text{c.c.}$	(4.5 ± 1.4) × 10 ⁻³	1540
$K^*(892)^0 K^+\pi^- \rightarrow$ $K^+\pi^-K^0\pi^0 + \text{c.c.}$	(3.2 ± 0.9) × 10 ⁻³	—
$K^*(892)^0 K^0\pi^0 \rightarrow$ $K^+\pi^-K^0\pi^0 + \text{c.c.}$	(4.2 ± 0.9) × 10 ⁻³	—
$K^*(892)^- K^+\pi^0 \rightarrow$ $K^+\pi^-K^0\pi^0 + \text{c.c.}$	(4.1 ± 0.9) × 10 ⁻³	—
$K^*(892)^+ K^0\pi^- \rightarrow$ $K^+\pi^-K^0\pi^0 + \text{c.c.}$	(3.2 ± 0.9) × 10 ⁻³	—
$K^+K^-\eta\pi^0$	(1.4 ± 0.5) × 10 ⁻³	1549

$K^+ K^- \pi^+ \pi^-$	$(9.1 \pm 1.1) \times 10^{-3}$		1656
$K^+ K^- \pi^+ \pi^- \pi^0$	$(1.3 \pm 0.4) \%$		1623
$K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$	$(2.3 \pm 1.2) \times 10^{-3}$		1602
$K^*(892)^0 \bar{K}^*(892)^0$	$(2.5 \pm 0.5) \times 10^{-3}$		1538
$3(\pi^+ \pi^-)$	$(8.6 \pm 1.8) \times 10^{-3}$		1707
$\phi\phi$	$(1.14 \pm 0.12) \times 10^{-3}$		1457
$\omega\omega$	$(9.2 \pm 1.1) \times 10^{-4}$		1597
$\pi\pi$	$(2.43 \pm 0.13) \times 10^{-3}$		1773
$\rho^0 \pi^+ \pi^-$	$(4.0 \pm 1.7) \times 10^{-3}$		1681
$\pi^+ \pi^- \eta$	$(5.2 \pm 1.4) \times 10^{-4}$		1724
$\pi^+ \pi^- \eta'$	$(5.5 \pm 2.0) \times 10^{-4}$		1636
$\eta\eta$	$(5.9 \pm 0.5) \times 10^{-4}$		1692
$K^+ K^-$	$(1.09 \pm 0.08) \times 10^{-3}$		1708
$K_S^0 K_S^0$	$(5.8 \pm 0.5) \times 10^{-4}$		1707
$\bar{K}^0 K^+ \pi^- + \text{c.c.}$	$(1.40 \pm 0.20) \times 10^{-3}$		1685
$K^+ K^- \pi^0$	$(3.3 \pm 0.8) \times 10^{-4}$		1686
$K^+ K^- \eta$	$< 3.5 \times 10^{-4}$	90%	1592
$\eta\eta'$	$< 6 \times 10^{-5}$	90%	1600
$\eta'\eta'$	$< 1.1 \times 10^{-4}$	90%	1498
$\pi^+ \pi^- K_S^0 K_S^0$	$(2.4 \pm 0.6) \times 10^{-3}$		1655
$K^+ K^- K_S^0 K_S^0$	$< 4 \times 10^{-4}$	90%	1418
$K^+ K^- K^+ K^-$	$(1.78 \pm 0.22) \times 10^{-3}$		1421
$K^+ K^- \phi$	$(1.55 \pm 0.33) \times 10^{-3}$		1468
$p\bar{p}$	$(7.2 \pm 0.4) \times 10^{-5}$		1510
$p\bar{p}\pi^0$	$(5.1 \pm 0.5) \times 10^{-4}$		1465
$p\bar{p}\eta$	$(1.90 \pm 0.28) \times 10^{-4}$		1285
$p\bar{p}\omega$	$(3.9 \pm 0.5) \times 10^{-4}$		1152
$p\bar{p}\phi$	$(3.0 \pm 1.0) \times 10^{-5}$		1002
$p\bar{p}\pi^+ \pi^-$	$(1.32 \pm 0.34) \times 10^{-3}$		1410
$p\bar{p}\pi^0 \pi^0$	$(8.6 \pm 2.6) \times 10^{-4}$		1414
$p\bar{p}K^+ K^-$ (non-resonant)	$(2.1 \pm 0.4) \times 10^{-4}$		1013
$p\bar{p}K_S^0 K_S^0$	$< 7.9 \times 10^{-4}$	90%	1007
$p\bar{p}\pi^-$	$(1.1 \pm 0.4) \times 10^{-3}$		1463
$\Lambda\bar{\Lambda}$	$(1.86 \pm 0.27) \times 10^{-4}$		1385
$\Lambda\bar{\Lambda}\pi^+ \pi^-$	$< 3.5 \times 10^{-3}$	90%	1255
$K^+ \bar{p}\Lambda + \text{c.c.}$	$(9.1 \pm 1.8) \times 10^{-4}$		1236
$K^+ p\Lambda(1520) + \text{c.c.}$	$(3.1 \pm 0.7) \times 10^{-4}$		992
$\Lambda(1520)\bar{\Lambda}(1520)$	$(5.1 \pm 1.6) \times 10^{-4}$		923
$\Sigma^0 \bar{\Sigma}^0$	$< 8 \times 10^{-5}$	90%	1319
$\Sigma^+ \bar{\Sigma}^-$	$< 7 \times 10^{-5}$	90%	1322
$\Xi^0 \bar{\Xi}^0$	$< 1.1 \times 10^{-4}$	90%	1197
$\Xi^- \bar{\Xi}^+$	$(1.55 \pm 0.35) \times 10^{-4}$		1189
$J/\psi(1S)\pi^+ \pi^- \pi^0$	$< 1.5 \%$	90%	185

Radiative decays

$\gamma J/\psi(1S)$	(19.5 ± 0.8) %		430
$\gamma \rho^0$	< 2.1	$\times 10^{-5}$	90% 1694
$\gamma \omega$	< 6	$\times 10^{-6}$	90% 1692
$\gamma \phi$	< 8	$\times 10^{-6}$	90% 1632
$\gamma \gamma$	(2.59 ± 0.16)	$\times 10^{-4}$	1778

$\eta_c(2S)$

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

Quantum numbers are quark model predictions.

$$\text{Mass } m = 3638.9 \pm 1.3 \text{ MeV}$$

$$\text{Full width } \Gamma = 10 \pm 4 \text{ MeV}$$

$\eta_c(2S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	ρ (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
$K_S^0 K^- 2\pi^+ \pi^- + \text{c.c.}$	not seen		1666
$2K^+ 2K^-$	not seen		1471
$\phi \phi$	not seen		1507
$\gamma \gamma$	< 5	$\times 10^{-4}$ 90%	1819
$\pi^+ \pi^- \eta$	not seen		1767
$\pi^+ \pi^- \eta'$	not seen		1681
$K^+ K^- \eta$	not seen		1638
$\pi^+ \pi^- \eta_c(1S)$	not seen		541

$\psi(2S)$

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

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

$$\text{Full width } \Gamma = 304 \pm 9 \text{ keV}$$

$$\Gamma_{ee} = 2.35 \pm 0.04 \text{ keV}$$

$\psi(2S)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	ρ (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) %		—
$e^+ e^-$	(7.73±0.17) $\times 10^{-3}$		1843
$\mu^+ \mu^-$	(7.7 ±0.8) $\times 10^{-3}$		1840
$\tau^+ \tau^-$	(3.0 ±0.4) $\times 10^{-3}$		490

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

$J/\psi(1S)$ anything	(59.5 ±0.8) %		—
$J/\psi(1S)$ neutrals	(24.6 ±0.4) %		—
$J/\psi(1S)\pi^+\pi^-$	(33.6 ±0.4) %		477
$J/\psi(1S)\pi^0\pi^0$	(17.75±0.34) %		481
$J/\psi(1S)\eta$	(3.28±0.07) %		199
$J/\psi(1S)\pi^0$	(1.30±0.10) $\times 10^{-3}$	S=1.4	528

Hadronic decays

$\pi^0 h_c(1P)$	(8.6 ±1.3) $\times 10^{-4}$		85
$3(\pi^+\pi^-)\pi^0$	(3.5 ±1.6) $\times 10^{-3}$		1746
$2(\pi^+\pi^-)\pi^0$	(2.9 ±1.0) $\times 10^{-3}$	S=4.6	1799
$\rho a_2(1320)$	(2.6 ±0.9) $\times 10^{-4}$		1500
$p\bar{p}$	(2.76±0.12) $\times 10^{-4}$		1586
$\Delta^{++}\bar{\Delta}^{--}$	(1.28±0.35) $\times 10^{-4}$		1371
$\Lambda\bar{\Lambda}\pi^0$	< 1.2 $\times 10^{-4}$	CL=90%	1412
$\Lambda\bar{\Lambda}\eta$	< 4.9 $\times 10^{-5}$	CL=90%	1197
$\Lambda\bar{p}K^+$	(1.00±0.14) $\times 10^{-4}$		1327
$\Lambda\bar{p}K^+\pi^+\pi^-$	(1.8 ±0.4) $\times 10^{-4}$		1167
$\Lambda\bar{\Lambda}\pi^+\pi^-$	(2.8 ±0.6) $\times 10^{-4}$		1346
$\Lambda\bar{\Lambda}$	(2.8 ±0.5) $\times 10^{-4}$	S=2.6	1467
$\Sigma^+\bar{\Sigma}^-$	(2.6 ±0.8) $\times 10^{-4}$		1408
$\Sigma^0\bar{\Sigma}^0$	(2.2 ±0.4) $\times 10^{-4}$	S=1.5	1405
$\Sigma(1385)^+\bar{\Sigma}(1385)^-$	(1.1 ±0.4) $\times 10^{-4}$		1218
$\Xi^-\bar{\Xi}^+$	(1.8 ±0.6) $\times 10^{-4}$	S=2.8	1284
$\Xi^0\bar{\Xi}^0$	(2.8 ±0.9) $\times 10^{-4}$		1292
$\Xi(1530)^0\bar{\Xi}(1530)^0$	< 8.1 $\times 10^{-5}$	CL=90%	1025
$\Omega^-\bar{\Omega}^+$	< 7.3 $\times 10^{-5}$	CL=90%	774
$\pi^0 p\bar{p}$	(1.50±0.08) $\times 10^{-4}$	S=1.1	1543
$N_1^*(1440)\bar{p} \rightarrow \pi^0 p\bar{p}$	(8.1 ±0.8) $\times 10^{-5}$		—
$\pi^0 f_0(2100) \rightarrow \pi^0 p\bar{p}$	(1.1 ±0.4) $\times 10^{-5}$		—
$\eta p\bar{p}$	(5.7 ±0.6) $\times 10^{-5}$		1373
$\eta f_0(2100) \rightarrow \eta p\bar{p}$	(1.2 ±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
$2(\pi^+ \pi^- \pi^0)$	$(4.8 \pm 1.5) \times 10^{-3}$		1776
$\eta \pi^+ \pi^-$	$< 1.6 \times 10^{-4}$	CL=90%	1791
$\eta \pi^+ \pi^- \pi^0$	$(9.5 \pm 1.7) \times 10^{-4}$		1778
$2(\pi^+ \pi^-) \eta$	$(1.2 \pm 0.6) \times 10^{-3}$		1758
$\eta' \pi^+ \pi^- \pi^0$	$(4.5 \pm 2.1) \times 10^{-4}$		1692
$\omega \pi^+ \pi^-$	$(7.3 \pm 1.2) \times 10^{-4}$	S=2.1	1748
$b_1^\pm \pi^\mp$	$(4.0 \pm 0.6) \times 10^{-4}$	S=1.1	1635
$b_1^0 \pi^0$	$(2.4 \pm 0.6) \times 10^{-4}$		—
$\omega f_2(1270)$	$(2.2 \pm 0.4) \times 10^{-4}$		1515
$\pi^+ \pi^- K^+ K^-$	$(7.5 \pm 0.9) \times 10^{-4}$	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
$\rho^0 p \bar{p}$	$(5.0 \pm 2.2) \times 10^{-5}$		1251
$K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$	$(6.7 \pm 2.5) \times 10^{-4}$		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
$\omega f_0(1710) \rightarrow \omega K^+ K^-$	$(5.9 \pm 2.2) \times 10^{-5}$		—
$K^*(892)^0 K^- \pi^+ \pi^0 + \text{c.c.}$	$(8.6 \pm 2.2) \times 10^{-4}$		—
$K^*(892)^+ K^- \pi^+ \pi^- + \text{c.c.}$	$(9.6 \pm 2.8) \times 10^{-4}$		—
$K^*(892)^+ K^- \rho^0 + \text{c.c.}$	$(7.3 \pm 2.6) \times 10^{-4}$		—
$K^*(892)^0 K^- \rho^+ + \text{c.c.}$	$(6.1 \pm 1.8) \times 10^{-4}$		—
$\eta K^+ K^-$	$< 1.3 \times 10^{-4}$	CL=90%	1664
$\omega K^+ K^-$	$(1.85 \pm 0.25) \times 10^{-4}$	S=1.1	1614
$3(\pi^+ \pi^-)$	$(3.5 \pm 2.0) \times 10^{-4}$	S=2.8	1774
$p \bar{p} \pi^+ \pi^- \pi^0$	$(7.3 \pm 0.7) \times 10^{-4}$		1435
$K^+ K^-$	$(6.3 \pm 0.7) \times 10^{-5}$		1776
$K_S^0 K_L^0$	$(5.4 \pm 0.5) \times 10^{-5}$		1775
$\pi^+ \pi^- \pi^0$	$(1.68 \pm 0.26) \times 10^{-4}$	S=1.4	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	—
$\pi^+ \pi^-$	$(8 \pm 5) \times 10^{-5}$		1838

$K_1(1400)^\pm K^\mp$	$< 3.1 \times 10^{-4}$	CL=90%	1532
$K^+ K^- \pi^0$	$< 2.96 \times 10^{-5}$	CL=90%	1754
$K^+ \bar{K}^*(892)^- + \text{c.c.}$	$(1.7^{+0.8}_{-0.7}) \times 10^{-5}$		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
$\phi f_0(980) \rightarrow \pi^+ \pi^-$	$(6.8 \pm 2.5) \times 10^{-5}$	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
$\phi \eta$	$(2.8^{+1.0}_{-0.8}) \times 10^{-5}$		1654
$\phi \eta'$	$(3.1 \pm 1.6) \times 10^{-5}$		1555
$\omega \eta'$	$(3.2^{+2.5}_{-2.1}) \times 10^{-5}$		1623
$\omega \pi^0$	$(2.1 \pm 0.6) \times 10^{-5}$		1757
$\rho \eta'$	$(1.9^{+1.7}_{-1.2}) \times 10^{-5}$		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
$\phi \pi^0$	$< 4 \times 10^{-6}$	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

$\gamma \chi_{c0}(1P)$	$(9.68 \pm 0.31) \%$		261
$\gamma \chi_{c1}(1P)$	$(9.2 \pm 0.4) \%$		171
$\gamma \chi_{c2}(1P)$	$(8.72 \pm 0.34) \%$		128
$\gamma \eta_c(1S)$	$(3.4 \pm 0.5) \times 10^{-3}$	S=1.3	638
$\gamma \eta_c(2S)$	$< 8 \times 10^{-4}$	CL=90%	47
$\gamma \pi^0$	$(1.6 \pm 0.4) \times 10^{-6}$		1841
$\gamma \eta'(958)$	$(1.23 \pm 0.06) \times 10^{-4}$		1719
$\gamma f_2(1270)$	$(2.1 \pm 0.4) \times 10^{-4}$		1623
$\gamma f_0(1710) \rightarrow \gamma \pi \pi$	$(3.0 \pm 1.3) \times 10^{-5}$		—
$\gamma f_0(1710) \rightarrow \gamma K \bar{K}$	$(6.0 \pm 1.6) \times 10^{-5}$		—
$\gamma \gamma$	$< 1.4 \times 10^{-4}$	CL=90%	1843
$\gamma \eta$	$(1.4 \pm 0.5) \times 10^{-6}$		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
$\gamma\eta(1405) \rightarrow \eta\pi^+\pi^-$	$(3.6 \pm 2.5) \times 10^{-5}$		—
$\gamma\eta(1475) \rightarrow K\bar{K}\pi$	$< 1.4 \times 10^{-4}$	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
$\gamma f_2(1950) \rightarrow \gamma\rho\bar{\rho}$	$(1.20 \pm 0.22) \times 10^{-5}$		—
$\gamma f_2(2150) \rightarrow \gamma\rho\bar{\rho}$	$(7.2 \pm 1.8) \times 10^{-6}$		—
$\gamma X(1835) \rightarrow \gamma\rho\bar{\rho}$	$< 1.6 \times 10^{-6}$	CL=90%	—
$\gamma X \rightarrow \gamma\rho\bar{\rho}$	$[f] < 2 \times 10^{-6}$	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

$\psi(3770)$

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

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	ρ (MeV/c)
$D\bar{D}$	$(93 \pm 8_{-9})\%$	S=2.0	285
$D^0\bar{D}^0$	$(52 \pm 5)\%$	S=2.0	285
D^+D^-	$(41 \pm 4)\%$	S=2.0	252
$J/\psi\pi^+\pi^-$	$(1.93 \pm 0.28) \times 10^{-3}$		560
$J/\psi\pi^0\pi^0$	$(8.0 \pm 3.0) \times 10^{-4}$		564
$J/\psi\eta$	$(9 \pm 4) \times 10^{-4}$		360
$J/\psi\pi^0$	$< 2.8 \times 10^{-4}$	CL=90%	603
e^+e^-	$(9.6 \pm 0.7) \times 10^{-6}$	S=1.3	1887

Decays to light hadrons

$b_1(1235)\pi$	< 1.4	$\times 10^{-5}$	CL=90%	1683
$\phi\eta'$	< 7	$\times 10^{-4}$	CL=90%	1607
$\omega\eta'$	< 4	$\times 10^{-4}$	CL=90%	1672
$\rho^0\eta'$	< 6	$\times 10^{-4}$	CL=90%	1674
$\phi\eta$	(3.1 ± 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
$\eta3\pi$	< 1.34	$\times 10^{-3}$	CL=90%	1824
$\eta2(\pi^+\pi^-)$	< 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
ωK^+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
$\rho \bar{\rho} \pi^0$	< 1.2	$\times 10^{-3}$		1595
$\rho \bar{\rho} \pi^+ \pi^-$	< 5.8	$\times 10^{-4}$	CL=90%	1544
$\Lambda \bar{\Lambda}$	< 1.2	$\times 10^{-4}$	CL=90%	1521
$\rho \bar{\rho} \pi^+ \pi^- \pi^0$	< 1.85	$\times 10^{-3}$	CL=90%	1490
$\omega \rho \bar{\rho}$	< 2.9	$\times 10^{-4}$	CL=90%	1309
$\Lambda \bar{\Lambda} \pi^0$	< 1.2	$\times 10^{-3}$	CL=90%	1469
$\rho \bar{\rho} 2(\pi^+ \pi^-)$	< 2.6	$\times 10^{-3}$	CL=90%	1425
$\eta \rho \bar{\rho}$	< 5.4	$\times 10^{-4}$	CL=90%	1430
$\eta \rho \bar{\rho} \pi^+ \pi^-$	< 3.3	$\times 10^{-3}$	CL=90%	1284
$\rho^0 \rho \bar{\rho}$	< 1.7	$\times 10^{-3}$	CL=90%	1313
$\rho \bar{\rho} K^+ K^-$	< 3.2	$\times 10^{-4}$	CL=90%	1185
$\eta \rho \bar{\rho} K^+ K^-$	< 6.9	$\times 10^{-3}$	CL=90%	736
$\pi^0 \rho \bar{\rho} K^+ K^-$	< 1.2	$\times 10^{-3}$	CL=90%	1093
$\phi \rho \bar{\rho}$	< 1.3	$\times 10^{-4}$	CL=90%	1178
$\Lambda \bar{\Lambda} \pi^+ \pi^-$	< 2.5	$\times 10^{-4}$	CL=90%	1405
$\Lambda \bar{\rho} K^+$	< 2.8	$\times 10^{-4}$	CL=90%	1387
$\Lambda \bar{\rho} K^+ \pi^+ \pi^-$	< 6.3	$\times 10^{-4}$	CL=90%	1234

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)

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

Quantum numbers not established.

$$\text{Mass } m = 3871.68 \pm 0.17 \text{ MeV}$$

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

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

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

X(3872) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\pi^+\pi^- J/\psi(1S)$	$>2.6\%$	650
$\omega J/\psi(1S)$	$>1.9\%$	†
$D^0\bar{D}^0\pi^0$	$>3.2 \times 10^{-3}$	116
$\bar{D}^{*0}D^0$	$>5 \times 10^{-3}$	†
$\gamma J/\psi$	$>6 \times 10^{-3}$	697
$\gamma\psi(2S)$	[g] $>3.0\%$	181

X(3915)

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

Observed in $\omega J/\psi$, thus $C = +$

$$\text{Mass } m = 3917.5 \pm 2.7 \text{ MeV}$$

$$\text{Full width } \Gamma = 27 \pm 10 \text{ MeV} \quad (S = 1.4)$$

X(3915) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\omega J/\psi$	seen	219
$\gamma\gamma$	seen	1959

$\chi_{c2}(2P)$

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

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

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

$\chi_{c2}(2P)$ 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

$\psi(4040)$ [h]

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

Mass $m = 4039 \pm 1$ MeV

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

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

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

$\psi(4040)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
e^+e^-	$(1.07 \pm 0.16) \times 10^{-5}$		2019
$D\bar{D}$	seen		775
$D^0\bar{D}^0$	seen		775
D^+D^-	seen		763
$D^*\bar{D} + c.c.$	seen		569
$D^*(2007)^0\bar{D}^0 + c.c.$	seen		575
$D^*(2010)^+D^- + c.c.$	seen		561
$D^*\bar{D}^*$	seen		193
$D^*(2007)^0\bar{D}^*(2007)^0$	seen		224
$D^*(2010)^+D^*(2010)^-$	seen		193
$D^0D^-\pi^+ + c.c.$ (excl. $D^*(2007)^0\bar{D}^0 + c.c.$, $D^*(2010)^+D^- + c.c.$)	not seen		—
$D\bar{D}^*\pi$ (excl. $D^*\bar{D}^*$)	not seen		—
$D^0\bar{D}^{*-}\pi^+ + c.c.$ (excl. $D^*(2010)^+D^*(2010)^-$)	seen		—
$D_s^+D_s^-$	seen		451
$J/\psi\pi^+\pi^-$	< 4	$\times 10^{-3}$	90% 794
$J/\psi\pi^0\pi^0$	< 2	$\times 10^{-3}$	90% 797
$J/\psi\eta$	< 7	$\times 10^{-3}$	90% 675
$J/\psi\pi^0$	< 2	$\times 10^{-3}$	90% 823
$J/\psi\pi^+\pi^-\pi^0$	< 2	$\times 10^{-3}$	90% 746

$\chi_{c1}\gamma$	< 1.1	%	90%	494
$\chi_{c2}\gamma$	< 1.7	%	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

$\psi(4160)$ [*h*]

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

Mass $m = 4153 \pm 3$ MeV

Full width $\Gamma = 103 \pm 8$ MeV

$\Gamma_{ee} = 0.83 \pm 0.07$ 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.

$\psi(4160)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
e^+e^-	$(8.1 \pm 0.9) \times 10^{-6}$		2076
$D\bar{D}$	seen		913
$D^0\bar{D}^0$	seen		913
D^+D^-	seen		904
$D^*\bar{D} + \text{c.c.}$	seen		746
$D^*(2007)^0\bar{D}^0 + \text{c.c.}$	seen		751
$D^*(2010)^+D^- + \text{c.c.}$	seen		740
$D^*\bar{D}^*$	seen		520
$D^*(2007)^0\bar{D}^*(2007)^0$	seen		533
$D^*(2010)^+D^*(2010)^-$	seen		520
$D^0D^-\pi^+ + \text{c.c. (excl. } D^*(2007)^0\bar{D}^0 + \text{c.c., } D^*(2010)^+D^- + \text{c.c.)}$	not seen		—
$D\bar{D}^*\pi + \text{c.c. (excl. } D^*\bar{D}^*)$	seen		—
$D^0D^*\pi^+ + \text{c.c. (excl. } D^*(2010)^+D^*(2010)^-)$	not seen		—
$D_s^+D_s^-$	not seen		661
$D_s^{*+}D_s^- + \text{c.c.}$	seen		385
$J/\psi\pi^+\pi^-$	< 3	$\times 10^{-3}$	90% 888
$J/\psi\pi^0\pi^0$	< 3	$\times 10^{-3}$	90% 891
$J/\psi K^+K^-$	< 2	$\times 10^{-3}$	90% 324
$J/\psi\eta$	< 8	$\times 10^{-3}$	90% 786
$J/\psi\pi^0$	< 1	$\times 10^{-3}$	90% 914

$J/\psi\eta'$	< 5	$\times 10^{-3}$	90%	385
$J/\psi\pi^+\pi^-\pi^0$	< 1	$\times 10^{-3}$	90%	847
$\psi(2S)\pi^+\pi^-$	< 4	$\times 10^{-3}$	90%	353
$\chi_{c1}\gamma$	< 7	$\times 10^{-3}$	90%	593
$\chi_{c2}\gamma$	< 1.3	%	90%	554
$\chi_{c1}\pi^+\pi^-\pi^0$	< 2	$\times 10^{-3}$	90%	452
$\chi_{c2}\pi^+\pi^-\pi^0$	< 8	$\times 10^{-3}$	90%	398
$h_c(1P)\pi^+\pi^-$	< 5	$\times 10^{-3}$	90%	519
$h_c(1P)\pi^0\pi^0$	< 2	$\times 10^{-3}$	90%	523
$h_c(1P)\eta$	< 2	$\times 10^{-3}$	90%	282
$h_c(1P)\pi^0$	< 4	$\times 10^{-4}$	90%	567
$\phi\pi^+\pi^-$	< 2	$\times 10^{-3}$	90%	1941

X(4260)

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

Mass $m = 4263_{-9}^{+8}$ MeV (S = 1.1)

Full width $\Gamma = 95 \pm 14$ MeV

X(4260) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$J/\psi\pi^+\pi^-$	seen	976
$J/\psi\pi^0\pi^0$	seen	978
$J/\psi K^+K^-$	seen	530
$J/\psi\eta$	not seen	886
$J/\psi\pi^0$	not seen	999
$J/\psi\eta'$	not seen	569
$J/\psi\pi^+\pi^-\pi^0$	not seen	939
$J/\psi\eta\eta$	not seen	339
$\psi(2S)\pi^+\pi^-$	not seen	470
$\psi(2S)\eta$	not seen	167
$\chi_{c0}\omega$	not seen	292
$\chi_{c1}\gamma$	not seen	686
$\chi_{c2}\gamma$	not seen	648
$\chi_{c1}\pi^+\pi^-\pi^0$	not seen	571
$\chi_{c2}\pi^+\pi^-\pi^0$	not seen	524
$h_c(1P)\pi^+\pi^-$	not seen	623
$\phi\pi^+\pi^-$	not seen	1999
$\phi f_0(980) \rightarrow \phi\pi^+\pi^-$	not seen	—
$D\bar{D}$	not seen	1032
$D^0\bar{D}^0$	not seen	1032
D^+D^-	not seen	1023
$D^*\bar{D} + c.c.$	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	708
$D^*(2007)^0 \bar{D}^*(2007)^0$	not seen	717
$D^*(2010)^+ D^*(2010)^-$	not seen	708
$D^0 D^- \pi^+ +c.c.$ (excl. $D^*(2007)^0 \bar{D}^{*0} +c.c.$, $D^*(2010)^+ D^- +c.c.$)	not seen	—
$D \bar{D}^* \pi +c.c.$ (excl. $D^* \bar{D}^*$)	not seen	723
$D^0 D^{*-} \pi^+ +c.c.$ (excl. $D^*(2010)^+ D^*(2010)^-$)	not seen	—
$D^0 D^*(2010)^- \pi^+ +c.c.$	not seen	716
$D^* \bar{D}^* \pi$	not seen	474
$D_s^+ D_s^-$	not seen	817
$D_s^{*+} D_s^- +c.c.$	not seen	615
$D_s^{*+} D_s^{*-}$	not seen	284
$p \bar{p}$	not seen	1914
$K_S^0 K^\pm \pi^\mp$	not seen	2054
$K^+ K^- \pi^0$	not seen	2055

X(4360)

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

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

$\psi(4415)$ [h]

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

Mass $m = 4421 \pm 4$ MeV

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

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

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.

X(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			926
$D^*(2010)^+ D^*(2010)^- + \text{c.c.}$	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			651
$e^+ e^-$	(9.4 ± 3.2)	$\times 10^{-6}$		2210

X(4660)

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

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 resonance in the range $2.2 < M(X) < 2.8$ GeV.
- [g] BHARDWAJ 11 does not observe this decay and presents a stronger 90% CL limit than this value. See measurements listings for details.
- [h] J^{PC} known by production in $e^+ e^-$ via single photon annihilation. J^{PC} 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.