$c\overline{c}$ MESONS

$\eta_c(1S)$

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

Mass $m = 2983.7 \pm 0.7$ MeV (S = 1.4)
Full width $\Gamma = 32.0 \pm 0.9$ MeV

$\eta_c(1S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
Decays involving hadronic resonances			
$\eta'(958)\pi\pi$	(4.1 ±1.7) %		1323
$\rho\rho$	(1.8 ±0.5) %		1275
$K^*(892)^0 K^-\pi^+$ + c.c.	(2.0 ±0.7) %		1277
$K^*(892)\overline{K}^*(892)$	(7.1 ±1.3) $\times 10^{-3}$		1196
$K^{*0}\overline{K}^{*0}\pi^+\pi^-$	(1.1 ±0.5) %		1073
$\phi K^+ K^-$	(2.9 ±1.4) $\times 10^{-3}$		1104
$\phi\phi$	(1.76±0.20) $\times 10^{-3}$		1089
$\phi 2(\pi^+\pi^-)$	< 3.5 $\times 10^{-3}$	90%	1251
$a_0(980)\pi$	< 2 %	90%	1327
$a_2(1320)\pi$	< 2 %	90%	1196
$K^*(892)\overline{K}$ + c.c.	< 1.28 %	90%	1309
$f_2(1270)\eta$	< 1.1 %	90%	1145
$\omega\omega$	< 3.1 $\times 10^{-3}$	90%	1270
$\omega\phi$	< 1.7 $\times 10^{-3}$	90%	1185
$f_2(1270) f_2(1270)$	(9.8 ±2.5) $\times 10^{-3}$		774
$f_2(1270) f_2'(1525)$	(9.7 ±3.2) $\times 10^{-3}$		513
Decays into stable hadrons			
$K\overline{K}\pi$	(7.3 ±0.5) %		1381
$\eta\pi^+\pi^-$	(1.7 ±0.5) %		1428
$\eta 2(\pi^+\pi^-)$	(4.4 ±1.3) %		1386
$K^+K^-\pi^+\pi^-$	(6.9 ±1.1) $\times 10^{-3}$		1345
$K^+K^-\pi^+\pi^-\pi^0$	(3.5 ±0.6) %		1304
$K^0K^-\pi^+\pi^-\pi^+$ +c.c.	(5.6 ±1.5) %		–
$K^+K^-2(\pi^+\pi^-)$	(7.5 ±2.4) $\times 10^{-3}$		1254
$2(K^+K^-)$	(1.47±0.31) $\times 10^{-3}$		1055
$\pi^+\pi^-\pi^0\pi^0$	(4.7 ±1.0) %		1460
$2(\pi^+\pi^-)$	(9.7 ±1.2) $\times 10^{-3}$		1459
$2(\pi^+\pi^-\pi^0)$	(17.4 ±3.3) %		1409
$3(\pi^+\pi^-)$	(1.7 ±0.4) %		1407
$p\overline{p}$	(1.51±0.16) $\times 10^{-3}$		1160

$p\overline{p}\pi^0$	$(3.6 \pm 1.3) \times 10^{-3}$		1101
$\Lambda\overline{\Lambda}$	$(1.09 \pm 0.24) \times 10^{-3}$		990
$K\overline{K}\eta$	$(10 \pm 5) \times 10^{-3}$		1265
$\pi^+\pi^- p\overline{p}$	$(5.3 \pm 1.8) \times 10^{-3}$		1027

Radiative decays

$\gamma\gamma$	$(1.57 \pm 0.12) \times 10^{-4}$		1492

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

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

$J/\psi(1S)$

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

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

$J/\psi(1S)$ DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
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^-		(5.94 ± 0.06) %		1548
$e^+e^-\gamma$	[a]	$(8.8 \pm 1.4) \times 10^{-3}$		1548
$\mu^+\mu^-$		(5.93 ± 0.06) %		1545

Decays involving hadronic resonances

$\rho\pi$	(1.69 ± 0.15) %	S=2.4	1448
$\rho^0\pi^0$	$(5.6 \pm 0.7) \times 10^{-3}$		1448
$a_2(1320)\rho$	(1.09 ± 0.22) %		1123
$\omega\pi^+\pi^+\pi^-\pi^-$	$(8.5 \pm 3.4) \times 10^{-3}$		1392
$\omega\pi^+\pi^-\pi^0$	$(4.0 \pm 0.7) \times 10^{-3}$		1418
$\omega\pi^+\pi^-$	$(8.6 \pm 0.7) \times 10^{-3}$	S=1.1	1435
$\omega f_2(1270)$	$(4.3 \pm 0.6) \times 10^{-3}$		1142
$K^*(892)^0\overline{K}^*(892)^0$	$(2.3 \pm 0.7) \times 10^{-4}$		1266
$K^*(892)^\pm\overline{K}^*(892)^\mp$	$(1.00 \,^{+0.22}_{-0.40}) \times 10^{-3}$		1266
$K^*(892)^\pm\overline{K}^*(800)^\mp$	$(1.1 \,^{+1.0}_{-0.6}) \times 10^{-3}$		–
$\eta K^*(892)^0\overline{K}^*(892)^0$	$(1.15 \pm 0.26) \times 10^{-3}$		1003
$K^*(892)^0\overline{K}^*_2(1430)^0 +$ c.c.	$(6.0 \pm 0.6) \times 10^{-3}$		1012

$K^*(892)^0\overline{K}_2(1770)^0$ + c.c. → $K^*(892)^0K^-\pi^+$ + c.c.		(6.9 ±0.9) × 10^{-4}		–
$\omega K^*(892)\overline{K}$ + c.c.		(6.1 ±0.9) × 10^{-3}		1097
$K^+\overline{K}^*(892)^-$ + c.c.		(5.12 ±0.30) × 10^{-3}		1373
$K^+\overline{K}^*(892)^-$ + c.c. → $K^+K^-\pi^0$		(1.97 ±0.20) × 10^{-3}		–
$K^+\overline{K}^*(892)^-$ + c.c. → $K^0K^\pm\pi^\mp$		(3.0 ±0.4) × 10^{-3}		–
$K^0\overline{K}^*(892)^0$ + c.c.		(4.39 ±0.31) × 10^{-3}		1373
$K^0\overline{K}^*(892)^0$ + c.c. → $K^0K^\pm\pi^\mp$		(3.2 ±0.4) × 10^{-3}		–
$K_1(1400)^\pm K^\mp$		(3.8 ±1.4) × 10^{-3}		1170
$\overline{K}^*(892)^0K^+\pi^-$ + c.c.		seen		1343
$\omega\pi^0\pi^0$		(3.4 ±0.8) × 10^{-3}		1436
$b_1(1235)^\pm\pi^\mp$	[b]	(3.0 ±0.5) × 10^{-3}		1300
$\omega K^\pm K^0_S\pi^\mp$	[b]	(3.4 ±0.5) × 10^{-3}		1210
$b_1(1235)^0\pi^0$		(2.3 ±0.6) × 10^{-3}		1300
$\eta K^\pm K^0_S\pi^\mp$	[b]	(2.2 ±0.4) × 10^{-3}		1278
$\phi K^*(892)\overline{K}$ + c.c.		(2.18 ±0.23) × 10^{-3}		969
$\omega K\overline{K}$		(1.70 ±0.32) × 10^{-3}		1268
$\omega f_0(1710) \to \omega K\overline{K}$		(4.8 ±1.1) × 10^{-4}		878
$\phi 2(\pi^+\pi^-)$		(1.66 ±0.23) × 10^{-3}		1318
$\Delta(1232)^{++}\overline{p}\pi^-$		(1.6 ±0.5) × 10^{-3}		1030
$\omega\eta$		(1.74 ±0.20) × 10^{-3}	S=1.6	1394
$\phi K\overline{K}$		(1.83 ±0.24) × 10^{-3}	S=1.5	1179
$\phi f_0(1710) \to \phi K\overline{K}$		(3.6 ±0.6) × 10^{-4}		875
$\phi f_2(1270)$		(7.2 ±1.3) × 10^{-4}		1036
$\Delta(1232)^{++}\overline{\Delta}(1232)^{--}$		(1.10 ±0.29) × 10^{-3}		938
$\Sigma(1385)^-\overline{\Sigma}(1385)^+$ (or c.c.)	[b]	(1.10 ±0.12) × 10^{-3}		697
$\phi f'_2(1525)$		(8 ±4) × 10^{-4}	S=2.7	871
$\phi\pi^+\pi^-$		(9.4 ±0.9) × 10^{-4}	S=1.2	1365
$\phi\pi^0\pi^0$		(5.6 ±1.6) × 10^{-4}		1366
$\phi K^\pm K^0_S\pi^\mp$	[b]	(7.2 ±0.8) × 10^{-4}		1114
$\omega f_1(1420)$		(6.8 ±2.4) × 10^{-4}		1062
$\phi\eta$		(7.5 ±0.8) × 10^{-4}	S=1.5	1320
$\Xi^0\overline{\Xi}^0$		(1.20 ±0.24) × 10^{-3}		818
$\Xi(1530)^-\overline{\Xi}^+$		(5.9 ±1.5) × 10^{-4}		600
$pK^-\overline{\Sigma}(1385)^0$		(5.1 ±3.2) × 10^{-4}		646
$\omega\pi^0$		(4.5 ±0.5) × 10^{-4}	S=1.4	1446
$\phi\eta'(958)$		(4.0 ±0.7) × 10^{-4}	S=2.1	1192
$\phi f_0(980)$		(3.2 ±0.9) × 10^{-4}	S=1.9	1178
$\phi f_0(980) \to \phi\pi^+\pi^-$		(1.8 ±0.4) × 10^{-4}		–
$\phi f_0(980) \to \phi\pi^0\pi^0$		(1.7 ±0.7) × 10^{-4}		–
$\eta\phi f_0(980) \to \eta\phi\pi^+\pi^-$		(3.2 ±1.0) × 10^{-4}		–

$\phi a_0(980)^0 \rightarrow \phi\eta\pi^0$		(5	± 4)	$\times 10^{-6}$		–
$\Xi(1530)^0\overline{\Xi}{}^0$		(3.2	± 1.4)	$\times 10^{-4}$		608
$\Sigma(1385)^-\overline{\Sigma}{}^+$ (or c.c.)	[b]	(3.1	± 0.5)	$\times 10^{-4}$		855
$\phi f_1(1285)$		(2.6	± 0.5)	$\times 10^{-4}$	S=1.1	1032
$\eta\pi^+\pi^-$		(4.0	± 1.7)	$\times 10^{-4}$		1487
$\rho\eta$		(1.93	± 0.23)	$\times 10^{-4}$		1396
$\omega\eta'(958)$		(1.82	± 0.21)	$\times 10^{-4}$		1279
$\omega f_0(980)$		(1.4	± 0.5)	$\times 10^{-4}$		1267
$\rho\eta'(958)$		(1.05	± 0.18)	$\times 10^{-4}$		1281
$a_2(1320)^\pm\pi^\mp$	[b]	$<$ 4.3		$\times 10^{-3}$	CL=90%	1263
$K\overline{K}{}^*_2(1430)+$ c.c.		$<$ 4.0		$\times 10^{-3}$	CL=90%	1159
$K_1(1270)^\pm K^\mp$		$<$ 3.0		$\times 10^{-3}$	CL=90%	1231
$K^*_2(1430)^0\overline{K}{}^*_2(1430)^0$		$<$ 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
$\eta\phi(2170) \rightarrow$ $\eta K^*(892)^0\overline{K}{}^*(892)^0$		$<$ 2.52		$\times 10^{-4}$	CL=90%	–
$\Sigma(1385)^0\overline{\Lambda}+$ c.c.		$<$ 8.2		$\times 10^{-6}$	CL=90%	912
$\Delta(1232)^+\overline{p}$		$<$ 1		$\times 10^{-4}$	CL=90%	1100
$\Lambda(1520)\overline{\Lambda}+$ c.c. $\rightarrow \gamma\Lambda\overline{\Lambda}$		$<$ 4.1		$\times 10^{-6}$	CL=90%	–
$\Theta(1540)\overline{\Theta}(1540) \rightarrow$ $K^0_S p K^-\overline{n}+$ c.c.		$<$ 1.1		$\times 10^{-5}$	CL=90%	–
$\Theta(1540)K^-\overline{n} \rightarrow K^0_S p K^-\overline{n}$		$<$ 2.1		$\times 10^{-5}$	CL=90%	–
$\Theta(1540)K^0_S\overline{p} \rightarrow K^0_S\overline{p}K^+ n$		$<$ 1.6		$\times 10^{-5}$	CL=90%	–
$\overline{\Theta}(1540)K^+ n \rightarrow K^0_S\overline{p}K^+ n$		$<$ 5.6		$\times 10^{-5}$	CL=90%	–
$\overline{\Theta}(1540)K^0_S p \rightarrow K^0_S p K^-\overline{n}$		$<$ 1.1		$\times 10^{-5}$	CL=90%	–
$\Sigma^0\overline{\Lambda}$		$<$ 9		$\times 10^{-5}$	CL=90%	1032

Decays into stable hadrons

$2(\pi^+\pi^-)\pi^0$		(4.1	± 0.5)	%	S=2.4	1496
$3(\pi^+\pi^-)\pi^0$		(2.9	± 0.6)	%		1433
$\pi^+\pi^-\pi^0$		(2.11	± 0.07)	%	S=1.5	1533
$\pi^+\pi^-\pi^0 K^+K^-$		(1.79	± 0.29)	%	S=2.2	1368
$4(\pi^+\pi^-)\pi^0$		(9.0	± 3.0)	$\times 10^{-3}$		1345
$\pi^+\pi^- K^+K^-$		(6.6	± 0.5)	$\times 10^{-3}$		1407
$\pi^+\pi^- K^+K^-\eta$		(1.84	± 0.28)	$\times 10^{-3}$		1221
$\pi^0\pi^0 K^+K^-$		(2.45	± 0.31)	$\times 10^{-3}$		1410
$K\overline{K}\pi$		(6.1	± 1.0)	$\times 10^{-3}$		1442
$2(\pi^+\pi^-)$		(3.57	± 0.30)	$\times 10^{-3}$		1517
$3(\pi^+\pi^-)$		(4.3	± 0.4)	$\times 10^{-3}$		1466
$2(\pi^+\pi^-\pi^0)$		(1.62	± 0.21)	%		1468
$2(\pi^+\pi^-)\eta$		(2.29	± 0.24)	$\times 10^{-3}$		1446
$3(\pi^+\pi^-)\eta$		(7.2	± 1.5)	$\times 10^{-4}$		1379

$p\overline{p}$		$(\ 2.120 \pm 0.029) \times 10^{-3}$		1232
$p\overline{p}\pi^0$		$(\ 1.19 \pm 0.08\ ) \times 10^{-3}$	S=1.1	1176
$p\overline{p}\pi^+\pi^-$		$(\ 6.0 \pm 0.5\ ) \times 10^{-3}$	S=1.3	1107
$p\overline{p}\pi^+\pi^-\pi^0$	[c]	$(\ 2.3 \pm 0.9\ ) \times 10^{-3}$	S=1.9	1033
$p\overline{p}\eta$		$(\ 2.00 \pm 0.12\ ) \times 10^{-3}$		948
$p\overline{p}\rho$		$< 3.1 \times 10^{-4}$	CL=90%	774
$p\overline{p}\omega$		$(\ 1.10 \pm 0.15\ ) \times 10^{-3}$	S=1.3	768
$p\overline{p}\eta'(958)$		$(\ 2.1 \pm 0.4\ ) \times 10^{-4}$		596
$p\overline{p}\phi$		$(\ 4.5 \pm 1.5\ ) \times 10^{-5}$		527
$n\overline{n}$		$(\ 2.09 \pm 0.16\ ) \times 10^{-3}$		1231
$n\overline{n}\pi^+\pi^-$		$(\ 4 \pm 4\ ) \times 10^{-3}$		1106
$\Sigma^+\overline{\Sigma}^-$		$(\ 1.50 \pm 0.24\ ) \times 10^{-3}$		992
$\Sigma^0\overline{\Sigma}^0$		$(\ 1.29 \pm 0.09\ ) \times 10^{-3}$		988
$2(\pi^+\pi^-)K^+K^-$		$(\ 4.7 \pm 0.7\ ) \times 10^{-3}$	S=1.3	1320
$p\overline{n}\pi^-$		$(\ 2.12 \pm 0.09\ ) \times 10^{-3}$		1174
$nN(1440)$		seen		978
$nN(1520)$		seen		924
$nN(1535)$		seen		914
$\Xi^-\overline{\Xi}^+$		$(\ 8.6 \pm 1.1\ ) \times 10^{-4}$	S=1.2	807
$\Lambda\overline{\Lambda}$		$(\ 1.61 \pm 0.15\ ) \times 10^{-3}$	S=1.9	1074
$\Lambda\overline{\Sigma}^-\pi^+$ (or c.c.)	[b]	$(\ 8.3 \pm 0.7\ ) \times 10^{-4}$	S=1.2	950
$pK^-\overline{\Lambda}$		$(\ 8.9 \pm 1.6\ ) \times 10^{-4}$		876
$2(K^+K^-)$		$(\ 7.6 \pm 0.9\ ) \times 10^{-4}$		1131
$pK^-\overline{\Sigma}^0$		$(\ 2.9 \pm 0.8\ ) \times 10^{-4}$		819
K^+K^-		$(\ 2.70 \pm 0.17\ ) \times 10^{-4}$		1468
$K^0_S K^0_L$		$(\ 2.1 \pm 0.4\ ) \times 10^{-4}$	S=3.2	1466
$\Lambda\overline{\Lambda}\pi^+\pi^-$		$(\ 4.3 \pm 1.0\ ) \times 10^{-3}$		903
$\Lambda\overline{\Lambda}\eta$		$(\ 1.62 \pm 0.17\ ) \times 10^{-4}$		672
$\Lambda\overline{\Lambda}\pi^0$		$(\ 3.8 \pm 0.4\ ) \times 10^{-5}$		998
$\overline{\Lambda}nK^0_S$ + c.c.		$(\ 6.5 \pm 1.1\ ) \times 10^{-4}$		872
$\pi^+\pi^-$		$(\ 1.47 \pm 0.14\ ) \times 10^{-4}$		1542
$\Lambda\overline{\Sigma}$ + c.c.		$(\ 2.83 \pm 0.23\ ) \times 10^{-3}$		1034
$K^0_S K^0_S$		$< 1 \times 10^{-6}$	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
$\gamma\eta_c(1S)$		$(\ 1.7 \pm 0.4\ )\ \%$	S=1.6	111
$\gamma\eta_c(1S) \rightarrow\ 3\gamma$		$(\ 3.8\ ^{+1.3}_{-1.0}\ ) \times 10^{-6}$	S=1.1	–
$\gamma\pi^+\pi^-2\pi^0$		$(\ 8.3 \pm 3.1\ ) \times 10^{-3}$		1518
$\gamma\eta\pi\pi$		$(\ 6.1 \pm 1.0\ ) \times 10^{-3}$		1487
$\gamma\eta_2(1870) \rightarrow\ \gamma\eta\pi^+\pi^-$		$(\ 6.2 \pm 2.4\ ) \times 10^{-4}$		–
$\gamma\eta(1405/1475) \rightarrow\ \gamma K\overline{K}\pi$	[d]	$(\ 2.8 \pm 0.6\ ) \times 10^{-3}$	S=1.6	1223

$\gamma\eta(1405/1475) \rightarrow \gamma\gamma\rho^0$	(7.8	± 2.0)	$\times 10^{-5}$	S=1.8	1223
$\gamma\eta(1405/1475) \rightarrow \gamma\eta\pi^+\pi^-$	(3.0	± 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	± 0.8)	$\times 10^{-3}$		1340
$\gamma\rho\omega$	$<$ 5.4		$\times 10^{-4}$	CL=90%	1338
$\gamma\rho\phi$	$<$ 8.8		$\times 10^{-5}$	CL=90%	1258
$\gamma\eta'(958)$	(5.15	± 0.16)	$\times 10^{-3}$	S=1.2	1400
$\gamma 2\pi^+ 2\pi^-$	(2.8	± 0.5)	$\times 10^{-3}$	S=1.9	1517
$\gamma f_2(1270) f_2(1270)$	(9.5	± 1.7)	$\times 10^{-4}$		879
$\gamma f_2(1270) f_2(1270)$(non resonant)	(8.2	± 1.9)	$\times 10^{-4}$		–
$\gamma K^+ K^- \pi^+ \pi^-$	(2.1	± 0.6)	$\times 10^{-3}$		1407
$\gamma f_4(2050)$	(2.7	± 0.7)	$\times 10^{-3}$		891
$\gamma\omega\omega$	(1.61	± 0.33)	$\times 10^{-3}$		1336
$\gamma\eta(1405/1475) \rightarrow \gamma\rho^0\rho^0$	(1.7	± 0.4)	$\times 10^{-3}$	S=1.3	1223
$\gamma f_2(1270)$	(1.43	± 0.11)	$\times 10^{-3}$		1286
$\gamma f_0(1710) \rightarrow \gamma K\overline{K}$	(8.5	$^{+1.2}_{-0.9}$)	$\times 10^{-4}$	S=1.2	1075
$\gamma f_0(1710) \rightarrow \gamma\pi\pi$	(4.0	± 1.0)	$\times 10^{-4}$		–
$\gamma f_0(1710) \rightarrow \gamma\omega\omega$	(3.1	± 1.0)	$\times 10^{-4}$		–
$\gamma\eta$	(1.104	± 0.034)	$\times 10^{-3}$		1500
$\gamma f_1(1420) \rightarrow \gamma K\overline{K}\pi$	(7.9	± 1.3)	$\times 10^{-4}$		1220
$\gamma f_1(1285)$	(6.1	± 0.8)	$\times 10^{-4}$		1283
$\gamma f_1(1510) \rightarrow \gamma\eta\pi^+\pi^-$	(4.5	± 1.2)	$\times 10^{-4}$		–
$\gamma f_2'(1525)$	(4.5	$^{+0.7}_{-0.4}$)	$\times 10^{-4}$		1173
$\gamma f_2(1640) \rightarrow \gamma\omega\omega$	(2.8	± 1.8)	$\times 10^{-4}$		–
$\gamma f_2(1910) \rightarrow \gamma\omega\omega$	(2.0	± 1.4)	$\times 10^{-4}$		–
$\gamma f_0(1800) \rightarrow \gamma\omega\phi$	(2.5	± 0.6)	$\times 10^{-4}$		–
$\gamma f_2(1950) \rightarrow \gamma K^*(892)\overline{K}^*(892)$	(7.0	± 2.2)	$\times 10^{-4}$		–
$\gamma K^*(892)\overline{K}^*(892)$	(4.0	± 1.3)	$\times 10^{-3}$		1266
$\gamma\phi\phi$	(4.0	± 1.2)	$\times 10^{-4}$	S=2.1	1166
$\gamma p\overline{p}$	(3.8	± 1.0)	$\times 10^{-4}$		1232
$\gamma\eta(2225)$	(3.3	± 0.5)	$\times 10^{-4}$		749
$\gamma\eta(1760) \rightarrow \gamma\rho^0\rho^0$	(1.3	± 0.9)	$\times 10^{-4}$		1048
$\gamma\eta(1760) \rightarrow \gamma\omega\omega$	(1.98	± 0.33)	$\times 10^{-3}$		–
$\gamma X(1835) \rightarrow \gamma\pi^+\pi^-\eta'$	(2.6	± 0.4)	$\times 10^{-4}$		1006
$\gamma X(1835) \rightarrow \gamma p\overline{p}$	(7.7	$^{+1.5}_{-0.9}$)	$\times 10^{-5}$		–
$\gamma(K\overline{K}\pi)$ [$J^{PC} = 0^{-+}$]	(7	± 4)	$\times 10^{-4}$	S=2.1	1442
$\gamma\pi^0$	(3.49	$^{+0.33}_{-0.30}$)	$\times 10^{-5}$		1546
$\gamma p\overline{p}\pi^+\pi^-$	$<$ 7.9		$\times 10^{-4}$	CL=90%	1107
$\gamma\Lambda\overline{\Lambda}$	$<$ 1.3		$\times 10^{-4}$	CL=90%	1074

$\gamma f_J(2220)$		$>$	2.50	$\times 10^{-3}$	CL=99.9%	745
$\gamma f_J(2220) \to \gamma\pi\pi$		(	8 ± 4)	$\times 10^{-5}$		–
$\gamma f_J(2220) \to \gamma K\overline{K}$		$<$	3.6	$\times 10^{-5}$		–
$\gamma f_J(2220) \to \gamma p\overline{p}$		(	1.5 ± 0.8)	$\times 10^{-5}$		–
$\gamma f_0(1500)$		(	1.01 ± 0.32)	$\times 10^{-4}$		1183
$\gamma A \to \gamma$invisible	[e]	$<$	6.3	$\times 10^{-6}$	CL=90%	–
$\gamma A^0 \to \gamma\mu^+\mu^-$	[f]	$<$	2.1	$\times 10^{-5}$	CL=90%	–

Weak decays

$D^- e^+ \nu_e +$ c.c.		$<$	1.2	$\times 10^{-5}$	CL=90%	984
$\overline{D}^0 e^+ e^- +$ c.c.		$<$	1.1	$\times 10^{-5}$	CL=90%	987
$D_s^- e^+ \nu_e +$ c.c.		$<$	3.6	$\times 10^{-5}$	CL=90%	923
$D^- \pi^+ +$ c.c.		$<$	7.5	$\times 10^{-5}$	CL=90%	977
$\overline{D}^0 \overline{K}^0 +$ c.c.		$<$	1.7	$\times 10^{-4}$	CL=90%	898
$D_s^- \pi^+ +$ 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 $\Gamma = 10.3 \pm 0.6$ MeV

$\chi_{c0}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Hadronic decays			
$2(\pi^+\pi^-)$	(2.25$\pm$0.19) %		1679
$\rho^0\pi^+\pi^-$	(8.8 ± 2.8) $\times 10^{-3}$		1607
$f_0(980) f_0(980)$	(6.6 ± 2.1) $\times 10^{-4}$		1391
$\pi^+\pi^-\pi^0\pi^0$	(3.3 ± 0.4) %		1680
$\rho^+\pi^-\pi^0 +$ c.c.	(2.8 ± 0.4) %		1607
$4\pi^0$	(3.3 ± 0.4) $\times 10^{-3}$		1681
$\pi^+\pi^- K^+ K^-$	(1.77$\pm$0.15) %		1580
$K_0^*(1430)^0 \overline{K}_0^*(1430)^0 \to \pi^+\pi^- K^+ K^-$	(9.8 $^{+4.0}_{-2.8}$) $\times 10^{-4}$		–
$K_0^*(1430)^0 \overline{K}_2^*(1430)^0 +$ c.c. $\to \pi^+\pi^- K^+ K^-$	(8.0 $^{+2.0}_{-2.4}$) $\times 10^{-4}$		–

$K_1(1270)^+ K^-$ + c.c. → $\pi^+\pi^- K^+ K^-$	$(6.2 \pm 1.9) \times 10^{-3}$		–
$K_1(1400)^+ K^-$ + c.c. → $\pi^+\pi^- K^+ K^-$	$< 2.7 \times 10^{-3}$	CL=90%	–
$f_0(980) f_0(980)$	$(1.6\ ^{+1.0}_{-0.9}) \times 10^{-4}$		1391
$f_0(980) f_0(2200)$	$(7.9\ ^{+2.0}_{-2.5}) \times 10^{-4}$		584
$f_0(1370) f_0(1370)$	$< 2.7 \times 10^{-4}$	CL=90%	1019
$f_0(1370) f_0(1500)$	$< 1.7 \times 10^{-4}$	CL=90%	920
$f_0(1370) f_0(1710)$	$(6.7\ ^{+3.5}_{-2.3}) \times 10^{-4}$		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
$K^+ K^- \pi^+ \pi^- \pi^0$	(1.12 ± 0.27) %		1545
$K^+ K^- \pi^0 \pi^0$	$(5.5 \pm 0.9) \times 10^{-3}$		1582
$K^+ \pi^- K^0 \pi^0$ + c.c.	(2.47 ± 0.33) %		1581
$\rho^+ K^- K^0$ + c.c.	(1.20 ± 0.21) %		1458
$K^*(892)^- K^+ \pi^0$ → $K^+ \pi^- K^0 \pi^0$ + c.c.	$(4.6 \pm 1.2) \times 10^{-3}$		–
$K^0_S K^0_S \pi^+ \pi^-$	$(5.7 \pm 1.1) \times 10^{-3}$		1579
$K^+ K^- \eta \pi^0$	$(3.0 \pm 0.7) \times 10^{-3}$		1468
$3(\pi^+ \pi^-)$	(1.20 ± 0.18) %		1633
$K^+ \overline{K}^*(892)^0 \pi^-$ + c.c.	$(7.3 \pm 1.6) \times 10^{-3}$		1523
$K^*(892)^0 \overline{K}^*(892)^0$	$(1.7 \pm 0.6) \times 10^{-3}$		1456
$\pi\pi$	$(8.5 \pm 0.4) \times 10^{-3}$		1702
$\pi^0 \eta$	$< 1.9 \times 10^{-4}$		1661
$\pi^0 \eta'$	$< 1.2 \times 10^{-3}$		1570
$\eta\eta$	$(3.01 \pm 0.20) \times 10^{-3}$		1617
$\eta\eta'$	$< 2.3 \times 10^{-4}$	CL=90%	1521
$\eta'\eta'$	$(1.99 \pm 0.22) \times 10^{-3}$		1413
$\omega\omega$	$(9.6 \pm 1.1) \times 10^{-4}$		1517
$\omega\phi$	$(1.17 \pm 0.22) \times 10^{-4}$		1447
$K^+ K^-$	$(5.98 \pm 0.34) \times 10^{-3}$		1634
$K^0_S K^0_S$	$(3.10 \pm 0.18) \times 10^{-3}$		1633
$\pi^+ \pi^- \eta$	$< 2.0 \times 10^{-4}$	CL=90%	1651
$\pi^+ \pi^- \eta'$	$< 4 \times 10^{-4}$	CL=90%	1560
$\overline{K}^0 K^+ \pi^-$ + c.c.	$< 9 \times 10^{-5}$	CL=90%	1610
$K^+ K^- \pi^0$	$< 6 \times 10^{-5}$	CL=90%	1611
$K^+ K^- \eta$	$< 2.2 \times 10^{-4}$	CL=90%	1512
$K^+ K^- K^0_S K^0_S$	$(1.4 \pm 0.5) \times 10^{-3}$		1331
$K^+ K^- K^+ K^-$	$(2.77 \pm 0.29) \times 10^{-3}$		1333
$K^+ K^- \phi$	$(9.6 \pm 2.5) \times 10^{-4}$		1381
$\phi\phi$	$(7.9 \pm 0.8) \times 10^{-4}$		1370
$p\overline{p}$	$(2.13 \pm 0.12) \times 10^{-4}$		1426

$p\overline{p}\pi^0$	$(6.9 \pm 0.7) \times 10^{-4}$	S=1.2	1379
$p\overline{p}\eta$	$(3.5 \pm 0.4) \times 10^{-4}$		1187
$p\overline{p}\omega$	$(5.2 \pm 0.6) \times 10^{-4}$		1043
$p\overline{p}\phi$	$(6.0 \pm 1.4) \times 10^{-5}$		876
$p\overline{p}\pi^+\pi^-$	$(2.1 \pm 0.7) \times 10^{-3}$	S=1.4	1320
$p\overline{p}\pi^0\pi^0$	$(1.03 \pm 0.28) \times 10^{-3}$		1324
$p\overline{p}K^+K^-$ (non-resonant)	$(1.21 \pm 0.26) \times 10^{-4}$		890
$p\overline{p}K^0_S K^0_S$	$< 8.8 \times 10^{-4}$	CL=90%	884
$p\overline{n}\pi^-$	$(1.12 \pm 0.31) \times 10^{-3}$		1376
$\Lambda\overline{\Lambda}$	$(3.3 \pm 0.4) \times 10^{-4}$		1292
$\Lambda\overline{\Lambda}\pi^+\pi^-$	$< 4.0 \times 10^{-3}$	CL=90%	1153
$K^+\overline{p}\Lambda$ + c.c.	$(1.24 \pm 0.12) \times 10^{-3}$	S=1.3	1132
$K^+ p\Lambda(1520)$ + c.c.	$(2.9 \pm 0.7) \times 10^{-4}$		858
$\Lambda(1520)\overline{\Lambda}(1520)$	$(3.1 \pm 1.2) \times 10^{-4}$		779
$\Sigma^0\overline{\Sigma}^0$	$(4.1 \pm 0.7) \times 10^{-4}$		1222
$\Sigma^+\overline{\Sigma}^-$	$(3.0 \pm 0.7) \times 10^{-4}$		1225
$\Xi^0\overline{\Xi}^0$	$(3.1 \pm 0.8) \times 10^{-4}$		1089
$\Xi^-\overline{\Xi}^+$	$(4.8 \pm 0.7) \times 10^{-4}$		1081

Radiative decays

$\gamma J/\psi(1S)$	(1.30 ± 0.07) %		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
$\gamma\gamma$	$(2.25 \pm 0.17) \times 10^{-4}$		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
$\pi^+\pi^-\pi^0\pi^0$	(1.25±0.17) %		1729
$\rho^+\pi^-\pi^0$ + c.c.	(1.53±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
$K^+K^-\pi^0\pi^0$	$(1.17 \pm 0.29) \times 10^{-3}$		1634
$K^+\pi^-K^0\pi^0$ + c.c.	$(9.0 \pm 1.4) \times 10^{-3}$		1632
$\rho^+K^-K^0$ + c.c.	$(5.3 \pm 1.3) \times 10^{-3}$		1514

$K^*(892)^0 K^0 \pi^0 \rightarrow K^+ \pi^- K^0 \pi^0$ + c.c.	$(\ 2.4\ \pm 0.7\ ) \times 10^{-3}$		–
$K^+ K^- \eta \pi^0$	$(\ 1.2\ \pm 0.4\ ) \times 10^{-3}$		1523
$\pi^+ \pi^- K^0_S K^0_S$	$(\ 7.2\ \pm 3.1\ ) \times 10^{-4}$		1630
$K^+ K^- \eta$	$(\ 3.3\ \pm 1.0\ ) \times 10^{-4}$		1566
$K^0 K^+ \pi^-$ + c.c.	$(\ 7.3\ \pm 0.6\ ) \times 10^{-3}$		1661
$K^*(892)^0 \overline{K}^0$ + c.c.	$(\ 1.0\ \pm 0.4\ ) \times 10^{-3}$		1602
$K^*(892)^+ K^-$ + c.c.	$(\ 1.5\ \pm 0.7\ ) \times 10^{-3}$		1602
$K^*_J(1430)^0 \overline{K}^0$ + c.c. $\rightarrow K^0_S K^+ \pi^-$ + c.c.	$< 8 \times 10^{-4}$	CL=90%	–
$K^*_J(1430)^+ K^-$ + c.c. $\rightarrow K^0_S K^+ \pi^-$ + c.c.	$< 2.3 \times 10^{-3}$	CL=90%	–
$K^+ K^- \pi^0$	$(\ 1.91 \pm 0.26) \times 10^{-3}$		1662
$\eta \pi^+ \pi^-$	$(\ 5.0\ \pm 0.5\ ) \times 10^{-3}$		1701
$a_0(980)^+ \pi^-$ + 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
$\pi^+ \pi^- \eta'$	$(\ 2.3\ \pm 0.5\ ) \times 10^{-3}$		1612
$\pi^0 f_0(980) \rightarrow \pi^0 \pi^+ \pi^-$	$< 6 \times 10^{-6}$	CL=90%	–
$K^+ \overline{K}^*(892)^0 \pi^-$ + c.c.	$(\ 3.2\ \pm 2.1\ ) \times 10^{-3}$		1577
$K^*(892)^0 \overline{K}^*(892)^0$	$(\ 1.5\ \pm 0.4\ ) \times 10^{-3}$		1512
$K^+ K^- K^0_S K^0_S$	$< 5 \times 10^{-4}$	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
$p \overline{p}$	$(\ 7.3\ \pm 0.4\ ) \times 10^{-5}$		1484
$p \overline{p} \pi^0$	$(\ 1.63 \pm 0.20) \times 10^{-4}$		1438
$p \overline{p} \eta$	$(\ 1.53 \pm 0.26) \times 10^{-4}$		1254
$p \overline{p} \omega$	$(\ 2.23 \pm 0.33) \times 10^{-4}$		1117
$p \overline{p} \phi$	$< 1.8 \times 10^{-5}$	CL=90%	962
$p \overline{p} \pi^+ \pi^-$	$(\ 5.0\ \pm 1.9\ ) \times 10^{-4}$		1381
$p \overline{p} K^+ K^-$ (non-resonant)	$(\ 1.34 \pm 0.24) \times 10^{-4}$		974
$p \overline{p} K^0_S K^0_S$	$< 4.5 \times 10^{-4}$	CL=90%	968
$\Lambda \overline{\Lambda}$	$(\ 1.18 \pm 0.19) \times 10^{-4}$		1355
$\Lambda \overline{\Lambda} \pi^+ \pi^-$	$< 1.5 \times 10^{-3}$	CL=90%	1223
$K^+ \overline{p} \Lambda$	$(\ 4.3\ \pm 0.4\ ) \times 10^{-4}$	S=1.1	1203
$K^+ p \Lambda(1520)$ + c.c.	$(\ 1.8\ \pm 0.5\ ) \times 10^{-4}$		950
$\Lambda(1520) \overline{\Lambda}(1520)$	$< 1.0 \times 10^{-4}$	CL=90%	879
$\Sigma^0 \overline{\Sigma}^0$	$< 4 \times 10^{-5}$	CL=90%	1288
$\Sigma^+ \overline{\Sigma}^-$	$< 6 \times 10^{-5}$	CL=90%	1291
$\Xi^0 \overline{\Xi}^0$	$< 6 \times 10^{-5}$	CL=90%	1163

$\Xi^-\overline{\Xi}^+$	(8.4 ±2.3)	$\times 10^{-5}$		1155
$\pi^+\pi^- + K^+K^-$	< 2.1	$\times 10^{-3}$		–
$K^0_S K^0_S$	< 6	$\times 10^{-5}$	CL=90%	1683

Radiative decays

$\gamma J/\psi(1S)$	(34.8 ±1.5)	%		389
$\gamma\rho^0$	(2.27±0.19)	$\times 10^{-4}$		1670
$\gamma\omega$	(7.1 ±0.9)	$\times 10^{-5}$		1668
$\gamma\phi$	(2.6 ±0.6)	$\times 10^{-5}$		1607

$h_c(1P)$

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

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

$h_c(1P)$ DECAY MODES	Fraction (Γ_i/Γ)		p (MeV/c)
$J/\psi(1S)\pi\pi$	not seen		312
$\eta_c(1S)\gamma$	(51 ±6)	%	500
$\pi^+\pi^-\pi^0$	< 2.2	$\times 10^{-3}$	1749
$2\pi^+2\pi^-\pi^0$	($2.2^{+0.8}_{-0.7}$)	%	1716
$3\pi^+3\pi^-\pi^0$	< 2.9	%	1661

$\chi_{c2}(1P)$

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

Mass $m = 3556.20 \pm 0.09$ MeV
Full width $\Gamma = 1.97 \pm 0.11$ MeV

$\chi_{c2}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)		Confidence level	p (MeV/c)
Hadronic decays				
$2(\pi^+\pi^-)$	(1.10±0.11)	%		1751
$\pi^+\pi^-\pi^0\pi^0$	(1.99±0.26)	%		1752
$\rho^+\pi^-\pi^0$ + c.c.	(2.4 ±0.4)	%		1682
$4\pi^0$	(1.21±0.17)	$\times 10^{-3}$		1752
$K^+K^-\pi^0\pi^0$	(2.2 ±0.4)	$\times 10^{-3}$		1658
$K^+\pi^-K^0\pi^0$ + c.c.	(1.50±0.22)	%		1657
$\rho^+K^-K^0$ + c.c.	(4.5 ±1.4)	$\times 10^{-3}$		1540
$K^*(892)^0K^+\pi^- \to K^+\pi^-K^0\pi^0$ + c.c.	(3.2 ±0.9)	$\times 10^{-3}$		–
$K^*(892)^0K^0\pi^0 \to K^+\pi^-K^0\pi^0$ + c.c.	(4.2 ±0.9)	$\times 10^{-3}$		–
$K^*(892)^-K^+\pi^0 \to K^+\pi^-K^0\pi^0$ + c.c.	(4.0 ±0.9)	$\times 10^{-3}$		–

$K^*(892)^+ K^0 \pi^-$ → $K^+ \pi^- K^0 \pi^0$ + 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 ±1.1) × 10^{-3}		1656
$K^+ K^- \pi^+ \pi^- \pi^0$	(1.3 ±0.4) %		1623
$K^+ \overline{K}^*(892)^0 \pi^-$ + c.c.	(2.3 ±1.2) × 10^{-3}		1602
$K^*(892)^0 \overline{K}^*(892)^0$	(2.5 ±0.5) × 10^{-3}		1538
$3(\pi^+ \pi^-)$	(8.6 ±1.8) × 10^{-3}		1707
$\phi\phi$	(1.16±0.10) × 10^{-3}		1457
$\omega\omega$	(9.2 ±1.1) × 10^{-4}		1597
$\pi\pi$	(2.42±0.13) × 10^{-3}		1773
$\rho^0 \pi^+ \pi^-$	(4.0 ±1.7) × 10^{-3}		1682
$\pi^+ \pi^- \eta$	(5.2 ±1.4) × 10^{-4}		1724
$\pi^+ \pi^- \eta'$	(5.4 ±2.0) × 10^{-4}		1636
$\eta\eta$	(5.9 ±0.5) × 10^{-4}		1692
$K^+ K^-$	(1.09±0.08) × 10^{-3}		1708
$K^0_S K^0_S$	(5.8 ±0.5) × 10^{-4}		1707
$\overline{K}^0 K^+ \pi^-$ + c.c.	(1.39±0.20) × 10^{-3}		1685
$K^+ K^- \pi^0$	(3.3 ±0.8) × 10^{-4}		1686
$K^+ K^- \eta$	< 3.5 × 10^{-4}	90%	1592
$\eta\eta'$	< 6 × 10^{-5}	90%	1600
$\eta'\eta'$	< 1.1 × 10^{-4}	90%	1498
$\pi^+ \pi^- K^0_S K^0_S$	(2.4 ±0.6) × 10^{-3}		1655
$K^+ K^- K^0_S K^0_S$	< 4 × 10^{-4}	90%	1418
$K^+ K^- K^+ K^-$	(1.78±0.22) × 10^{-3}		1421
$K^+ K^- \phi$	(1.54±0.32) × 10^{-3}		1468
$p\overline{p}$	(7.1 ±0.4) × 10^{-5}		1510
$p\overline{p}\pi^0$	(5.1 ±0.5) × 10^{-4}		1465
$p\overline{p}\eta$	(1.89±0.28) × 10^{-4}		1285
$p\overline{p}\omega$	(3.9 ±0.5) × 10^{-4}		1152
$p\overline{p}\phi$	(3.0 ±1.0) × 10^{-5}		1002
$p\overline{p}\pi^+ \pi^-$	(1.32±0.34) × 10^{-3}		1410
$p\overline{p}\pi^0 \pi^0$	(8.5 ±2.6) × 10^{-4}		1414
$p\overline{p}K^+ K^-$ (non-resonant)	(2.08±0.35) × 10^{-4}		1013
$p\overline{p}K^0_S K^0_S$	< 7.9 × 10^{-4}	90%	1007
$p\overline{n}\pi^-$	(1.1 ±0.4) × 10^{-3}		1463
$\Lambda\overline{\Lambda}$	(1.86±0.27) × 10^{-4}		1385
$\Lambda\overline{\Lambda}\pi^+ \pi^-$	< 3.5 × 10^{-3}	90%	1255
$K^+ \overline{p}\Lambda$ + c.c.	(8.4 ±0.6) × 10^{-4}		1236
$K^+ p\Lambda(1520)$ + c.c.	(3.1 ±0.7) × 10^{-4}		992
$\Lambda(1520)\overline{\Lambda}(1520)$	(5.0 ±1.6) × 10^{-4}		923
$\Sigma^0 \overline{\Sigma}^0$	< 8 × 10^{-5}	90%	1319
$\Sigma^+ \overline{\Sigma}^-$	< 7 × 10^{-5}	90%	1322
$\Xi^0 \overline{\Xi}^0$	< 1.1 × 10^{-4}	90%	1197

$\Xi^-\overline{\Xi}^+$	$(\ 1.55\pm0.35)\times10^{-4}$			1189
$J/\psi(1S)\pi^+\pi^-\pi^0$	$<\ 1.5$	%	90%	185
$\eta_c(1S)\pi^+\pi^-$	$<\ 2.3$	%	90%	459
Radiative decays				
$\gamma J/\psi(1S)$	$(19.8\ \pm0.8\ )$	%		430
$\gamma\rho^0$	$<\ 2.1$	$\times10^{-5}$	90%	1694
$\gamma\omega$	$<\ 6$	$\times10^{-6}$	90%	1692
$\gamma\phi$	$<\ 8$	$\times10^{-6}$	90%	1632
$\gamma\gamma$	$(\ 2.61\pm0.16)\times10^{-4}$			1778

$\eta_c(2S)$

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

Quantum numbers are quark model predictions.

Mass $m = 3639.4 \pm 1.3$ MeV (S = 1.2)
Full width $\Gamma = 11.3^{+3.2}_{-2.9}$ MeV

$\eta_c(2S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
hadrons	not seen		–
$K\overline{K}\pi$	$(\ 1.9\pm1.2)$ %		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
$K^{*0}\overline{K}^{*0}$	not seen		1586
$K^+K^-\pi^+\pi^-\pi^0$	$(\ 1.4\pm1.0)$ %		1668
$K^+K^-2\pi^+2\pi^-$	not seen		1628
$K^0_S K^-2\pi^+\pi^-$ + c.c.	seen		1667
$2K^+2K^-$	not seen		1471
$\phi\phi$	not seen		1507
$p\overline{p}$	$<\ 2.9\ \times10^{-4}$	90%	1559
$\gamma\gamma$	$(\ 1.9\pm1.3)\times10^{-4}$		1820
$\pi^+\pi^-\eta$	not seen		1767
$\pi^+\pi^-\eta'$	not seen		1681
$K^+K^-\eta$	not seen		1638
$\pi^+\pi^-\eta_c(1S)$	<25 %	90%	539

$\psi(2S)$

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

Mass $m = 3686.109^{+0.012}_{-0.014}$ MeV
Full width $\Gamma = 303 \pm 9$ keV
$\Gamma_{ee} = 2.37 \pm 0.04$ 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^-	(7.82 ±0.17) $\times 10^{-3}$		1843
$\mu^+\mu^-$	(7.8 ±0.9) $\times 10^{-3}$		1840
$\tau^+\tau^-$	(3.1 ±0.4) $\times 10^{-3}$		490
Decays into $J/\psi(1S)$ and anything			
$J/\psi(1S)$ anything	(60.3 ±0.7) %		–
$J/\psi(1S)$ neutrals	(24.9 ±0.4) %		–
$J/\psi(1S)\pi^+\pi^-$	(34.0 ±0.4) %		477
$J/\psi(1S)\pi^0\pi^0$	(17.93 ±0.33) %		481
$J/\psi(1S)\eta$	(3.33 ±0.05) %		199
$J/\psi(1S)\pi^0$	(1.268±0.032) $\times 10^{-3}$		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
$p\overline{p}$	(2.75 ±0.12) $\times 10^{-4}$		1586
$\Delta^{++}\overline{\Delta}^{--}$	(1.28 ±0.35) $\times 10^{-4}$		1371
$\Lambda\overline{\Lambda}\pi^0$	$<$ 2.9 $\times 10^{-6}$	CL=90%	1412
$\Lambda\overline{\Lambda}\eta$	(2.5 ±0.4) $\times 10^{-5}$		1197
$\Lambda\overline{p}K^+$	(1.00 ±0.14) $\times 10^{-4}$		1327
$\Lambda\overline{p}K^+\pi^+\pi^-$	(1.8 ±0.4) $\times 10^{-4}$		1167
$\Lambda\overline{\Lambda}\pi^+\pi^-$	(2.8 ±0.6) $\times 10^{-4}$		1346
$\Lambda\overline{\Lambda}$	(2.8 ±0.5) $\times 10^{-4}$	S=2.6	1467
$\Sigma^0\overline{p}K^+ +$ c.c.	(1.67 ±0.18) $\times 10^{-5}$		1291
$\Sigma^+\overline{\Sigma}^-$	(2.6 ±0.8) $\times 10^{-4}$		1408
$\Sigma^0\overline{\Sigma}^0$	(2.2 ±0.4) $\times 10^{-4}$	S=1.5	1405
$\Sigma(1385)^+\overline{\Sigma}(1385)^-$	(1.1 ±0.4) $\times 10^{-4}$		1218
$\Xi^-\overline{\Xi}^+$	(1.8 ±0.6) $\times 10^{-4}$	S=2.8	1284
$\Xi^0\overline{\Xi}^0$	(2.8 ±0.9) $\times 10^{-4}$		1292
$\Xi(1530)^0\overline{\Xi}(1530)^0$	$<$ 8.1 $\times 10^{-5}$	CL=90%	1025

$\Omega^- \overline{\Omega}^+$	$<$	7.3		$\times 10^{-5}$	CL=90%	774
$\pi^0 p\overline{p}$	(	1.53	± 0.07)	$\times 10^{-4}$		1543
$N(940)\overline{p}+$ c.c. $\rightarrow$ $\pi^0 p\overline{p}$	(	6.4	$^{+1.8}_{-1.3}$)	$\times 10^{-5}$		–
$N(1440)\overline{p}+$ c.c. $\rightarrow$ $\pi^0 p\overline{p}$	(	7.3	$^{+1.7}_{-1.5}$)	$\times 10^{-5}$	S=2.5	–
$N(1520)\overline{p}+$ c.c. $\rightarrow$ $\pi^0 p\overline{p}$	(	6.4	$^{+2.3}_{-1.8}$)	$\times 10^{-6}$		–
$N(1535)\overline{p}+$ c.c. $\rightarrow$ $\pi^0 p\overline{p}$	(	2.5	± 1.0)	$\times 10^{-5}$		–
$N(1650)\overline{p}+$ c.c. $\rightarrow$ $\pi^0 p\overline{p}$	(	3.8	$^{+1.4}_{-1.7}$)	$\times 10^{-5}$		–
$N(1720)\overline{p}+$ c.c. $\rightarrow$ $\pi^0 p\overline{p}$	(	1.79	$^{+0.26}_{-0.70}$)	$\times 10^{-5}$		–
$N(2300)\overline{p}+$ c.c. $\rightarrow$ $\pi^0 p\overline{p}$	(	2.6	$^{+1.2}_{-0.7}$)	$\times 10^{-5}$		–
$N(2570)\overline{p}+$ c.c. $\rightarrow$ $\pi^0 p\overline{p}$	(	2.13	$^{+0.40}_{-0.31}$)	$\times 10^{-5}$		–
$\pi^0 f_0(2100) \rightarrow \pi^0 p\overline{p}$	(	1.1	± 0.4)	$\times 10^{-5}$		–
$\eta p\overline{p}$	(	5.7	± 0.6)	$\times 10^{-5}$		1373
$\eta f_0(2100) \rightarrow \eta p\overline{p}$	(	1.2	± 0.4)	$\times 10^{-5}$		–
$N(1535)\overline{p} \rightarrow \eta p\overline{p}$	(	4.4	± 0.7)	$\times 10^{-5}$		–
$\omega p\overline{p}$	(	6.9	± 2.1)	$\times 10^{-5}$		1247
$\phi p\overline{p}$	$<$	2.4		$\times 10^{-5}$	CL=90%	1109
$\pi^+\pi^- p\overline{p}$	(	6.0	± 0.4)	$\times 10^{-4}$		1491
$p\overline{n}\pi^-$ or c.c.	(	2.48	± 0.17)	$\times 10^{-4}$		–
$p\overline{n}\pi^-\pi^0$	(	3.2	± 0.7)	$\times 10^{-4}$		1492
$2(\pi^+\pi^-\pi^0)$	(	4.7	± 1.5)	$\times 10^{-3}$		1776
$\eta\pi^+\pi^-$	$<$	1.6		$\times 10^{-4}$	CL=90%	1791
$\eta\pi^+\pi^-\pi^0$	(	9.5	± 1.7)	$\times 10^{-4}$		1778
$2(\pi^+\pi^-)\eta$	(	1.2	± 0.6)	$\times 10^{-3}$		1758
$\eta'\pi^+\pi^-\pi^0$	(	4.5	± 2.1)	$\times 10^{-4}$		1692
$\omega\pi^+\pi^-$	(	7.3	± 1.2)	$\times 10^{-4}$	S=2.1	1748
$b_1^\pm\pi^\mp$	(	4.0	± 0.6)	$\times 10^{-4}$	S=1.1	1635
$b_1^0\pi^0$	(	2.4	± 0.6)	$\times 10^{-4}$		–
$\omega f_2(1270)$	(	2.2	± 0.4)	$\times 10^{-4}$		1515
$\pi^+\pi^- K^+ K^-$	(	7.5	± 0.9)	$\times 10^{-4}$	S=1.9	1726
$\rho^0 K^+ K^-$	(	2.2	± 0.4)	$\times 10^{-4}$		1616
$K^*(892)^0 \overline{K}_2^*(1430)^0$	(	1.9	± 0.5)	$\times 10^{-4}$		1418
$K^+ K^-\pi^+\pi^-\eta$	(	1.3	± 0.7)	$\times 10^{-3}$		1574
$K^+ K^- 2(\pi^+\pi^-)\pi^0$	(	1.00	± 0.31)	$\times 10^{-3}$		1611
$K^+ K^- 2(\pi^+\pi^-)$	(	1.9	± 0.9)	$\times 10^{-3}$		1654
$K_1(1270)^\pm K^\mp$	(	1.00	± 0.28)	$\times 10^{-3}$		1581
$K_S^0 K_S^0\pi^+\pi^-$	(	2.2	± 0.4)	$\times 10^{-4}$		1724
$\rho^0 p\overline{p}$	(	5.0	± 2.2)	$\times 10^{-5}$		1252
$K^+\overline{K}^*(892)^0\pi^-$ + c.c.	(	6.7	± 2.5)	$\times 10^{-4}$		1674
$2(\pi^+\pi^-)$	(	2.4	± 0.6)	$\times 10^{-4}$	S=2.2	1817
$\rho^0\pi^+\pi^-$	(	2.2	± 0.6)	$\times 10^{-4}$	S=1.4	1750

$K^+K^-\pi^+\pi^-\pi^0$	(1.26	± 0.09)	$\times 10^{-3}$		1694
$\omega f_0(1710) \rightarrow \omega K^+K^-$	(5.9	± 2.2)	$\times 10^{-5}$		–
$K^*(892)^0 K^-\pi^+\pi^0 +$ c.c.	(8.6	± 2.2)	$\times 10^{-4}$		–
$K^*(892)^+ K^-\pi^+\pi^- +$ c.c.	(9.6	± 2.8)	$\times 10^{-4}$		–
$K^*(892)^+ K^-\rho^0 +$ c.c.	(7.3	± 2.6)	$\times 10^{-4}$		–
$K^*(892)^0 K^-\rho^+ +$ c.c.	(6.1	± 1.8)	$\times 10^{-4}$		–
ηK^+K^-, no $\eta\phi$	(3.1	± 0.4)	$\times 10^{-5}$		1664
ωK^+K^-	(1.85	± 0.25)	$\times 10^{-4}$	S=1.1	1614
$3(\pi^+\pi^-)$	(3.5	± 2.0)	$\times 10^{-4}$	S=2.8	1774
$p\overline{p}\pi^+\pi^-\pi^0$	(7.3	± 0.7)	$\times 10^{-4}$		1435
K^+K^-	(7.1	± 0.5)	$\times 10^{-5}$	S=1.5	1776
$K^0_S K^0_L$	(5.34	± 0.33)	$\times 10^{-5}$		1775
$\pi^+\pi^-\pi^0$	(2.01	± 0.17)	$\times 10^{-4}$	S=1.7	1830
$\rho(2150)\pi \rightarrow \pi^+\pi^-\pi^0$	(1.9	$^{+1.2}_{-0.4}$)	$\times 10^{-4}$		–
$\rho(770)\pi \rightarrow \pi^+\pi^-\pi^0$	(3.2	± 1.2)	$\times 10^{-5}$	S=1.8	–
$\pi^+\pi^-$	(7.8	± 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	$^{+1.3}_{-0.9}$)	$\times 10^{-5}$		–
$K^+K^-\pi^0$	(4.07	± 0.31)	$\times 10^{-5}$		1754
$K^+K^*(892)^-$ + c.c.	(2.9	± 0.4)	$\times 10^{-5}$	S=1.2	1698
$K^*(892)^0\overline{K}^0$ + c.c.	(1.09	± 0.20)	$\times 10^{-4}$		1697
$\phi\pi^+\pi^-$	(1.17	± 0.29)	$\times 10^{-4}$	S=1.7	1690
$\phi f_0(980) \rightarrow \pi^+\pi^-$	(6.8	± 2.4)	$\times 10^{-5}$	S=1.1	–
$2(K^+K^-)$	(6.0	± 1.4)	$\times 10^{-5}$		1499
ϕK^+K^-	(7.0	± 1.6)	$\times 10^{-5}$		1546
$2(K^+K^-)\pi^0$	(1.10	± 0.28)	$\times 10^{-4}$		1440
$\phi\eta$	(3.10	± 0.31)	$\times 10^{-5}$		1654
$\phi\eta'$	(3.1	± 1.6)	$\times 10^{-5}$		1555
$\omega\eta'$	(3.2	$^{+2.5}_{-2.1}$)	$\times 10^{-5}$		1623
$\omega\pi^0$	(2.1	± 0.6)	$\times 10^{-5}$		1757
$\rho\eta'$	(1.9	$^{+1.7}_{-1.2}$)	$\times 10^{-5}$		1625
$\rho\eta$	(2.2	± 0.6)	$\times 10^{-5}$	S=1.1	1717
$\omega\eta$	$<$ 1.1		$\times 10^{-5}$	CL=90%	1715
$\phi\pi^0$	$<$ 4		$\times 10^{-7}$	CL=90%	1699
$\eta_c\pi^+\pi^-\pi^0$	$<$ 1.0		$\times 10^{-3}$	CL=90%	–
$p\overline{p}K^+K^-$	(2.7	± 0.7)	$\times 10^{-5}$		1118
$\overline{\Lambda}nK^0_S$ + c.c.	(8.1	± 1.8)	$\times 10^{-5}$		1324
$\phi f'_2(1525)$	(4.4	± 1.6)	$\times 10^{-5}$		1321
$\Theta(1540)\overline{\Theta}(1540) \rightarrow K^0_S pK^-\overline{n}$ + c.c.	$<$ 8.8		$\times 10^{-6}$	CL=90%	–
$\Theta(1540)K^-\overline{n} \rightarrow K^0_S pK^-\overline{n}$	$<$ 1.0		$\times 10^{-5}$	CL=90%	–

$\Theta(1540)\,K^0_S\,\overline{p} \rightarrow\ K^0_S\,\overline{p}\,K^+\,n$	$<$	7.0		$\times 10^{-6}$	CL=90%	–
$\overline{\Theta}(1540)\,K^+\,n \rightarrow\ K^0_S\,\overline{p}\,K^+\,n$	$<$	2.6		$\times 10^{-5}$	CL=90%	–
$\overline{\Theta}(1540)\,K^0_S\,p \rightarrow\ K^0_S\,p\,K^-\,\overline{n}$	$<$	6.0		$\times 10^{-6}$	CL=90%	–
$K^0_S\,K^0_S$	$<$	4.6		$\times 10^{-6}$		1775

Radiative decays

$\gamma\,\chi_{c0}(1P)$	(	9.84	± 0.31)	%		261
$\gamma\,\chi_{c1}(1P)$	(	9.3	± 0.4)	%		171
$\gamma\,\chi_{c2}(1P)$	(	8.76	± 0.34)	%		128
$\gamma\,\eta_c(1S)$	(	3.4	± 0.5)	$\times 10^{-3}$	S=1.3	636
$\gamma\,\eta_c(2S)$	(	7	± 5)	$\times 10^{-4}$		46
$\gamma\,\pi^0$	(	1.6	± 0.4)	$\times 10^{-6}$		1841
$\gamma\,\eta'(958)$	(	1.23	± 0.06)	$\times 10^{-4}$		1719
$\gamma\,f_2(1270)$	(	2.1	± 0.4)	$\times 10^{-4}$		1623
$\quad\gamma\,f_0(1710) \rightarrow\ \gamma\,\pi\,\pi$	(	3.0	± 1.3)	$\times 10^{-5}$		–
$\quad\gamma\,f_0(1710) \rightarrow\ \gamma\,K\,\overline{K}$	(	6.0	± 1.6)	$\times 10^{-5}$		–
$\gamma\,\gamma$	$<$	1.4		$\times 10^{-4}$	CL=90%	1843
$\gamma\,\eta$	(	1.4	± 0.5)	$\times 10^{-6}$		1802
$\gamma\,\eta\,\pi^+\,\pi^-$	(	8.7	± 2.1)	$\times 10^{-4}$		1791
$\quad\gamma\,\eta(1405) \rightarrow\ \gamma\,K\,\overline{K}\,\pi$	$<$	9		$\times 10^{-5}$	CL=90%	1569
$\quad\gamma\,\eta(1405) \rightarrow\ \eta\,\pi^+\,\pi^-$	(	3.6	± 2.5)	$\times 10^{-5}$		–
$\quad\gamma\,\eta(1475) \rightarrow\ K\,\overline{K}\,\pi$	$<$	1.4		$\times 10^{-4}$	CL=90%	–
$\quad\gamma\,\eta(1475) \rightarrow\ \eta\,\pi^+\,\pi^-$	$<$	8.8		$\times 10^{-5}$	CL=90%	–
$\gamma\,2(\pi^+\,\pi^-)$	(	4.0	± 0.6)	$\times 10^{-4}$		1817
$\gamma\,K^{*0}\,K^+\,\pi^- +$ c.c.	(	3.7	± 0.9)	$\times 10^{-4}$		1674
$\gamma\,K^{*0}\,\overline{K}^{*0}$	(	2.4	± 0.7)	$\times 10^{-4}$		1613
$\gamma\,K^0_S\,K^+\,\pi^- +$ c.c.	(	2.6	± 0.5)	$\times 10^{-4}$		1753
$\gamma\,K^+\,K^-\,\pi^+\,\pi^-$	(	1.9	± 0.5)	$\times 10^{-4}$		1726
$\gamma\,p\,\overline{p}$	(	3.9	± 0.5)	$\times 10^{-5}$	S=2.0	1586
$\quad\gamma\,f_2(1950) \rightarrow\ \gamma\,p\,\overline{p}$	(	1.20	± 0.22)	$\times 10^{-5}$		–
$\quad\gamma\,f_2(2150) \rightarrow\ \gamma\,p\,\overline{p}$	(	7.2	± 1.8)	$\times 10^{-6}$		–
$\quad\gamma\,X(1835) \rightarrow\ \gamma\,p\,\overline{p}$	(	4.6	$^{+1.8}_{-4.0}$)	$\times 10^{-6}$		–
$\quad\gamma\,X \rightarrow\ \gamma\,p\,\overline{p}$	[g] $<$	2		$\times 10^{-6}$	CL=90%	–
$\gamma\,\pi^+\,\pi^-\,p\,\overline{p}$	(	2.8	± 1.4)	$\times 10^{-5}$		1491
$\gamma\,2(\pi^+\,\pi^-)\,K^+\,K^-$	$<$	2.2		$\times 10^{-4}$	CL=90%	1654
$\gamma\,3(\pi^+\,\pi^-)$	$<$	1.7		$\times 10^{-4}$	CL=90%	1774
$\gamma\,K^+\,K^-\,K^+\,K^-$	$<$	4		$\times 10^{-5}$	CL=90%	1499
$\gamma\,\gamma\,J/\psi$	(	3.1	$^{+1.0}_{-1.2}$)	$\times 10^{-4}$		542

$\psi(3770)$

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

Mass $m = 3773.15 \pm 0.33$ MeV
Full width $\Gamma = 27.2 \pm 1.0$ MeV
$\Gamma_{ee} = 0.262 \pm 0.018$ keV (S = 1.4)

In addition to the dominant decay mode to $D\overline{D}$, $\psi(3770)$ 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)
$D\overline{D}$	$(93\ ^{+8}_{-9})\%$	S=2.0	285
$D^0\overline{D}^0$	$(52\ \pm 5)\%$	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
$\phi\eta$	$(3.1 \pm 0.7) \times 10^{-4}$		1703
$\omega\eta$	$< 1.4 \times 10^{-5}$	CL=90%	1762
$\rho^0\eta$	$< 5 \times 10^{-4}$	CL=90%	1764
$\phi\pi^0$	$< 3 \times 10^{-5}$	CL=90%	1746
$\omega\pi^0$	$< 6 \times 10^{-4}$	CL=90%	1803
$\pi^+\pi^-\pi^0$	$< 5 \times 10^{-6}$	CL=90%	1874
$\rho\pi$	$< 5 \times 10^{-6}$	CL=90%	1804
$K^*(892)^+K^- +$ c.c.	$< 1.4 \times 10^{-5}$	CL=90%	1745
$K^*(892)^0\overline{K}^0 +$ c.c.	$< 1.2 \times 10^{-3}$	CL=90%	1744
$K^0_S K^0_L$	$< 1.2 \times 10^{-5}$	CL=90%	1820
$2(\pi^+\pi^-)$	$< 1.12 \times 10^{-3}$	CL=90%	1861
$2(\pi^+\pi^-)\pi^0$	$< 1.06 \times 10^{-3}$	CL=90%	1843
$2(\pi^+\pi^-\pi^0)$	$< 5.85\ \%$	CL=90%	1821
$\omega\pi^+\pi^-$	$< 6.0 \times 10^{-4}$	CL=90%	1794
$3(\pi^+\pi^-)$	$< 9.1 \times 10^{-3}$		1819
$3(\pi^+\pi^-)\pi^0$	$< 1.37\ \%$		1792
$3(\pi^+\pi^-)2\pi^0$	$< 11.74\ \%$	CL=90%	1760

$\eta\pi^+\pi^-$	$<$	1.24	$\times 10^{-3}$	CL=90%	1836
$\pi^+\pi^- 2\pi^0$	$<$	8.9	$\times 10^{-3}$	CL=90%	1862
$\rho^0\pi^+\pi^-$	$<$	6.9	$\times 10^{-3}$	CL=90%	1796
$\eta 3\pi$	$<$	1.34	$\times 10^{-3}$	CL=90%	1824
$\eta 2(\pi^+\pi^-)$	$<$	2.43	%		1804
$\eta\rho^0\pi^+\pi^-$	$<$	1.45	%	CL=90%	1708
$\eta' 3\pi$	$<$	2.44	$\times 10^{-3}$	CL=90%	1740
$K^+K^-\pi^+\pi^-$	$<$	9.0	$\times 10^{-4}$	CL=90%	1772
$\phi\pi^+\pi^-$	$<$	4.1	$\times 10^{-4}$	CL=90%	1737
$K^+K^- 2\pi^0$	$<$	4.2	$\times 10^{-3}$	CL=90%	1774
$4(\pi^+\pi^-)$	$<$	1.67	%	CL=90%	1757
$4(\pi^+\pi^-)\pi^0$	$<$	3.06	%	CL=90%	1720
$\phi f_0(980)$	$<$	4.5	$\times 10^{-4}$	CL=90%	1597
$K^+K^-\pi^+\pi^-\pi^0$	$<$	2.36	$\times 10^{-3}$	CL=90%	1741
$K^+K^-\rho^0\pi^0$	$<$	8	$\times 10^{-4}$	CL=90%	1624
$K^+K^-\rho^+\pi^-$	$<$	1.46	%	CL=90%	1622
ωK^+K^-	$<$	3.4	$\times 10^{-4}$	CL=90%	1664
$\phi\pi^+\pi^-\pi^0$	$<$	3.8	$\times 10^{-3}$	CL=90%	1722
$K^{*0}K^-\pi^+\pi^0 +$ c.c.	$<$	1.62	%	CL=90%	1693
$K^{*+}K^-\pi^+\pi^- +$ 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
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%	1665
$2(K^+K^-)$	$<$	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%	1493
$2(K^+K^-)\pi^+\pi^-$	$<$	3.2	$\times 10^{-3}$	CL=90%	1425
$K^0_S K^-\pi^+$	$<$	3.2	$\times 10^{-3}$	CL=90%	1799
$K^0_S K^-\pi^+\pi^0$	$<$	1.33	%	CL=90%	1773
$K^0_S K^-\rho^+$	$<$	6.6	$\times 10^{-3}$	CL=90%	1664
$K^0_S K^- 2\pi^+\pi^-$	$<$	8.7	$\times 10^{-3}$	CL=90%	1739
$K^0_S K^-\pi^+\rho^0$	$<$	1.6	%	CL=90%	1621
$K^0_S K^-\pi^+\eta$	$<$	1.3	%	CL=90%	1669
$K^0_S K^- 2\pi^+\pi^-\pi^0$	$<$	4.18	%	CL=90%	1703
$K^0_S K^- 2\pi^+\pi^-\eta$	$<$	4.8	%	CL=90%	1570
$K^0_S K^-\pi^+ 2(\pi^+\pi^-)$	$<$	1.22	%	CL=90%	1658
$K^0_S K^-\pi^+ 2\pi^0$	$<$	2.65	%	CL=90%	1742
$K^0_S K^- K^+ K^-\pi^+$	$<$	4.9	$\times 10^{-3}$	CL=90%	1490
$K^0_S K^- K^+ K^-\pi^+\pi^0$	$<$	3.0	%	CL=90%	1427
$K^0_S K^- K^+ K^-\pi^+\eta$	$<$	2.2	%	CL=90%	1214

$K^{*0}K^-\pi^+$ + c.c.	<	9.7	$\times 10^{-3}$	CL=90%	1722
$p\overline{p}\pi^0$	<	1.2	$\times 10^{-3}$		1595
$p\overline{p}\pi^+\pi^-$	<	5.8	$\times 10^{-4}$	CL=90%	1544
$\Lambda\overline{\Lambda}$	<	1.2	$\times 10^{-4}$	CL=90%	1521
$p\overline{p}\pi^+\pi^-\pi^0$	<	1.85	$\times 10^{-3}$	CL=90%	1490
$\omega p\overline{p}$	<	2.9	$\times 10^{-4}$	CL=90%	1309
$\Lambda\overline{\Lambda}\pi^0$	<	1.2	$\times 10^{-3}$	CL=90%	1469
$p\overline{p}2(\pi^+\pi^-)$	<	2.6	$\times 10^{-3}$	CL=90%	1425
$\eta p\overline{p}$	<	5.4	$\times 10^{-4}$	CL=90%	1430
$\eta p\overline{p}\pi^+\pi^-$	<	3.3	$\times 10^{-3}$	CL=90%	1284
$\rho^0 p\overline{p}$	<	1.7	$\times 10^{-3}$	CL=90%	1313
$p\overline{p}K^+K^-$	<	3.2	$\times 10^{-4}$	CL=90%	1185
$\eta p\overline{p}K^+K^-$	<	6.9	$\times 10^{-3}$	CL=90%	736
$\pi^0 p\overline{p}K^+K^-$	<	1.2	$\times 10^{-3}$	CL=90%	1093
$\phi p\overline{p}$	<	1.3	$\times 10^{-4}$	CL=90%	1178
$\Lambda\overline{\Lambda}\pi^+\pi^-$	<	2.5	$\times 10^{-4}$	CL=90%	1405
$\Lambda\overline{p}K^+$	<	2.8	$\times 10^{-4}$	CL=90%	1387
$\Lambda\overline{p}K^+\pi^+\pi^-$	<	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 ±0.6)	$\times 10^{-3}$		253
$\gamma\chi_{c0}$	(	7.3 ±0.9)	$\times 10^{-3}$		341
$\gamma\eta'$	<	1.8	$\times 10^{-4}$	CL=90%	1765
$\gamma\eta$	<	1.5	$\times 10^{-4}$	CL=90%	1847
$\gamma\pi^0$	<	2	$\times 10^{-4}$	CL=90%	1884

X(3872)

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

Mass $m = 3871.68 \pm 0.17$ MeV
$m_{X(3872)} - m_{J/\psi} = 775 \pm 4$ MeV
$m_{X(3872)} - m_{\psi(2S)}$
Full width $\Gamma < 1.2$ MeV, CL = 90%

X(3872) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\pi^+\pi^- J/\psi(1S)$	> 2.6 %	650
$\omega J/\psi(1S)$	> 1.9 %	†
$D^0\overline{D}^0\pi^0$	>32 %	116
$\overline{D}^{*0}D^0$	>24 %	†
$\gamma J/\psi$	> 6 $\times 10^{-3}$	697
$\gamma\psi(2S)$	[h] > 3.0 %	181
$\pi^+\pi^-\eta_c(1S)$	not seen	746

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

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

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

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

$\chi_{c2}(2P)$

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

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

$\chi_{c2}(2P)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\gamma\gamma$	seen	1964
$D\overline{D}$	seen	615
D^+D^-	seen	600
$D^0\overline{D}^0$	seen	615
$\pi^+\pi^-\eta_c(1S)$	not seen	792

$\psi(4040)$ [i]

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

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 $c\overline{c}$ 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^-	$(1.07\pm0.16)\times10^{-5}$		2019
$D\overline{D}$	seen		775
$D^0\overline{D}^0$	seen		775
D^+D^-	seen		763
$D^*\overline{D}$ + c.c.	seen		569
$D^*(2007)^0\overline{D}^0$ + c.c.	seen		575

$D^*(2010)^+ D^-$ + c.c.	seen			561
$D^* \overline{D}^*$	seen			193
$D^*(2007)^0 \overline{D}^*(2007)^0$	seen			224
$D^*(2010)^+ D^*(2010)^-$	seen			193
$D^0 D^- \pi^+$ +c.c. (excl. $D^*(2007)^0 \overline{D}^0$ +c.c., $D^*(2010)^+ D^-$ +c.c.)	not seen			–
$D \overline{D}^* \pi$ (excl. $D^* \overline{D}^*$)	not seen			–
$D^0 \overline{D}^{*-} \pi^+$ +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
$J/\psi \eta$	(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
$\chi_{c1} \gamma$	< 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

$\psi(4160)$ [i]

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

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 $c\overline{c}$ 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
$D \overline{D}$	seen		913
$D^0 \overline{D}^0$	seen		913
$D^+ D^-$	seen		904
$D^* \overline{D}$ + c.c.	seen		746
$D^*(2007)^0 \overline{D}^0$ + c.c.	seen		751
$D^*(2010)^+ D^-$ + c.c.	seen		740
$D^* \overline{D}^*$	seen		520

$D^*(2007)^0\overline{D}^*(2007)^0$	seen			533
$D^*(2010)^+D^*(2010)^-$	seen			520
$D^0D^-\pi^+$+c.c. (excl. $D^*(2007)^0\overline{D}^0$ +c.c., $D^*(2010)^+D^-$ +c.c.)	not seen			–
$D\overline{D}^*\pi$+c.c. (excl. $D^*\overline{D}^*$)	seen			–
$D^0D^{*-}\pi^+$+c.c. (excl. $D^*(2010)^+D^*(2010)^-$)	not seen			–
$D_s^+D_s^-$	not seen			661
$D_s^{*+}D_s^-$+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 $m = 4250 \pm 9$ MeV (S = 1.6)
Full width $\Gamma = 108 \pm 12$ MeV

$X(4260)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$J/\psi\pi^+\pi^-$	seen	966
$J/\psi f_0(980)$, $f_0(980) \to \pi^+\pi^-$	seen	–
$J/\psi\pi^0\pi^0$	seen	968
$J/\psi K^+K^-$	seen	510
$J/\psi\eta$	not seen	874
$J/\psi\pi^0$	not seen	990
$J/\psi\eta'$	not seen	550
$J/\psi\pi^+\pi^-\pi^0$	not seen	929
$J/\psi\eta\eta$	not seen	307

$\psi(2S)\pi^+\pi^-$	not seen	457
$\psi(2S)\eta$	not seen	124
$\chi_{c0}\omega$	not seen	262
$\chi_{c1}\gamma$	not seen	675
$\chi_{c2}\gamma$	not seen	637
$\chi_{c1}\pi^+\pi^-\pi^0$	not seen	558
$\chi_{c2}\pi^+\pi^-\pi^0$	not seen	510
$h_c(1P)\pi^+\pi^-$	not seen	611
$\phi\pi^+\pi^-$	not seen	1992
$\phi f_0(980) \rightarrow \phi\pi^+\pi^-$	not seen	–
$D\overline{D}$	not seen	1019
$D^0\overline{D}^0$	not seen	1019
D^+D^-	not seen	1010
$D^*\overline{D}$ +c.c.	not seen	887
$D^*(2007)^0\overline{D}^0$ +c.c.	not seen	–
$D^*(2010)^+D^-$ +c.c.	not seen	–
$D^*\overline{D}^*$	not seen	689
$D^*(2007)^0\overline{D}^*(2007)^0$	not seen	698
$D^*(2010)^+D^*(2010)^-$	not seen	689
$D^0D^-\pi^+$ +c.c. (excl. $D^*(2007)^0\overline{D}^{*0}$ +c.c., $D^*(2010)^+D^-$ +c.c.)	not seen	–
$D\overline{D}^*\pi$ +c.c. (excl. $D^*\overline{D}^*$)	not seen	723
$D^0D^{*-}\pi^+$ +c.c. (excl. $D^*(2010)^+D^*(2010)^-$)	not seen	–
$D^0D^*(2010)^-\pi^+$ +c.c.	not seen	716
$D^*\overline{D}^*\pi$	not seen	445
$D_s^+D_s^-$	not seen	800
$D_s^{*+}D_s^-$ +c.c.	not seen	615
$D_s^{*+}D_s^{*-}$	not seen	231
$p\overline{p}$	not seen	1907
$K_S^0K^\pm\pi^\mp$	not seen	2047
$K^+K^-\pi^0$	not seen	2049

X(4360)

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

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

$\psi(4415)$ [i]

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

Mass $m = 4421 \pm 4$ MeV
Full width $\Gamma = 62 \pm 20$ MeV
$\Gamma_{ee} = 0.58 \pm 0.07$ keV

Due to the complexity of the $c\overline{c}$ 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)
$D\overline{D}$	not seen		1187
$D^0\overline{D}^0$	seen		1187
D^+D^-	seen		1179
$D^*\overline{D}$ + c.c.	not seen		1063
$D^*(2007)^0\overline{D}^0$ + c.c.	seen		1066
$D^*(2010)^+D^-$ + c.c.	seen		1059
$D^*\overline{D}^*$	not seen		919
$D^*(2007)^0\overline{D}^*(2007)^0$ + c.c.	seen		926
$D^*(2010)^+D^*(2010)^-$ + c.c.	seen		919
$D^0D^-\pi^+$ (excl. $D^*(2007)^0\overline{D}^0$ +c.c., $D^*(2010)^+D^-$ +c.c.	< 2.3 %	90%	–
$D\overline{D}_2^*(2460) \to D^0D^-\pi^+$+c.c.	(10 ±4) %		–
$D^0D^{*-}\pi^+$+c.c.	< 11 %	90%	926
$D_s^+D_s^-$	not seen		1006
$D_s^{*+}D_s^-$+c.c.	seen		–
$D_s^{*+}D_s^{*-}$	not seen		651
e^+e^-	$(9.4\pm3.2)\times10^{-6}$		2210

$X(4660)$

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

$X(4660)$ MASS $= 4664 \pm 12$ MeV
$X(4660)$ WIDTH $= 48 \pm 15$ 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 $p\overline{p}\pi^+\pi^-\gamma$ and excludes $p\overline{p}\eta$, $p\overline{p}\omega$, $p\overline{p}\eta'$.

[*d*] See the "Note on the $\eta(1405)$" in the $\eta(1405)$ Particle Listings.

[*e*] For a narrow state A with mass less than 960 MeV.

[*f*] For a narrow scalar or pseudoscalar A^0 with mass 0.21–3.0 GeV.

[*g*] For a narrow resonance in the range $2.2 < M(X) < 2.8$ GeV.

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

[*i*] J^{PC} known by production in e^+e^- via single photon annihilation. I^G is not known; interpretation of this state as a single resonance is unclear because of the expectation of substantial threshold effects in this energy region.