$c\overline{c}$ MESONS

$\eta_c(1S)$

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

Mass $m = 2979.6 \pm 1.2$ MeV (S = 1.7)
Full width $\Gamma = 17.3^{+2.7}_{-2.5}$ MeV (S = 1.1)

$\eta_c(1S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
Decays involving hadronic resonances			
$\eta'(958)\pi\pi$	(4.1 ±1.7) %		1321
$\rho\rho$	(2.6 ±0.9) %		1272
$K^*(892)^0 K^-\pi^+$ + c.c.	(2.0 ±0.7) %		1275
$K^*(892)\overline{K}^*(892)$	(8.5 ±3.1) $\times 10^{-3}$		1194
$\phi K^+ K^-$	(2.9 ±1.4) $\times 10^{-3}$		1101
$\phi\phi$	(2.6 ±0.9) $\times 10^{-3}$		1086
$a_0(980)\pi$	< 2 %	90%	1323
$a_2(1320)\pi$	< 2 %	90%	1194
$K^*(892)\overline{K}$ + c.c.	< 1.28 %	90%	1307
$f_2(1270)\eta$	< 1.1 %	90%	1143
$\omega\omega$	< 3.1 $\times 10^{-3}$	90%	1268
Decays into stable hadrons			
$K\overline{K}\pi$	(5.7 ±1.6) %		1379
$\eta\pi\pi$	(4.9 ±1.8) %		1426
$\pi^+\pi^- K^+ K^-$	(1.5 ±0.6) %		1343
$2(K^+ K^-)$	(1.5 ±0.7) $\times 10^{-3}$		1053
$2(\pi^+\pi^-)$	(1.20±0.30) %		1457
$p\overline{p}$	(1.3 ±0.4) $\times 10^{-3}$		1157
$K\overline{K}\eta$	< 3.1 %	90%	1263
$\pi^+\pi^- p\overline{p}$	< 1.2 %	90%	1024
$\Lambda\overline{\Lambda}$	< 2 $\times 10^{-3}$	90%	987
Radiative decays			
$\gamma\gamma$	(4.3 ±1.5) $\times 10^{-4}$		1490

$J/\psi(1S)$

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

Mass $m = 3096.916 \pm 0.011$ MeV
Full width $\Gamma = 91.0 \pm 3.2$ keV
$\Gamma_{ee} = 5.40 \pm 0.15 \pm 0.07$ 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		(17.0 ±2.0) %		–
$e^+ e^-$		(5.93±0.10) %		1548
$\mu^+ \mu^-$		(5.88±0.10) %		1545
Decays involving hadronic resonances				
$\rho\pi$		(1.27±0.09) %		1448
$\rho^0\pi^0$		(4.2 ±0.5) $\times 10^{-3}$		1448
$a_2(1320)\rho$		(1.09±0.22) %		1123
$\omega\pi^+\pi^+\pi^-\pi^-$		(8.5 ±3.4) $\times 10^{-3}$		1392
$\omega\pi^+\pi^-$		(7.2 ±1.0) $\times 10^{-3}$		1435
$\omega f_2(1270)$		(4.3 ±0.6) $\times 10^{-3}$		1142
$K^*(892)^0 \overline{K}{}^*_2(1430)^0$ + c.c.		(6.7 ±2.6) $\times 10^{-3}$		1012
$\omega K^*(892)\overline{K}$ + c.c.		(5.3 ±2.0) $\times 10^{-3}$		1097
$K^+ \overline{K}{}^*(892)^-$ + c.c.		(5.0 ±0.4) $\times 10^{-3}$		1373
$K^0 \overline{K}{}^*(892)^0$ + c.c.		(4.2 ±0.4) $\times 10^{-3}$		1373
$K_1(1400)^\pm K^\mp$		(3.8 ±1.4) $\times 10^{-3}$		1171
$\omega\pi^0\pi^0$		(3.4 ±0.8) $\times 10^{-3}$		1436
$b_1(1235)^\pm\pi^\mp$	[a]	(3.0 ±0.5) $\times 10^{-3}$		1300
$\omega K^\pm K^0_S \pi^\mp$	[a]	(2.9 ±0.7) $\times 10^{-3}$		1210
$b_1(1235)^0\pi^0$		(2.3 ±0.6) $\times 10^{-3}$		1300
$\phi K^*(892)\overline{K}$ + c.c.		(2.04±0.28) $\times 10^{-3}$		969
$\omega K \overline{K}$		(1.9 ±0.4) $\times 10^{-3}$		1268
$\omega f_0(1710) \rightarrow \omega K \overline{K}$		(4.8 ±1.1) $\times 10^{-4}$		878
$\phi 2(\pi^+\pi^-)$		(1.60±0.32) $\times 10^{-3}$		1318
$\Delta(1232)^{++}\overline{p}\pi^-$		(1.6 ±0.5) $\times 10^{-3}$		1030
$\omega\eta$		(1.58±0.16) $\times 10^{-3}$		1394
$\phi K \overline{K}$		(1.54±0.21) $\times 10^{-3}$		1179
$\phi f_0(1710) \rightarrow \phi K \overline{K}$		(3.6 ±0.6) $\times 10^{-4}$		875
$p\overline{p}\omega$		(1.30±0.25) $\times 10^{-3}$	S=1.3	768
$\Delta(1232)^{++}\overline{\Delta}(1232)^{--}$		(1.10±0.29) $\times 10^{-3}$		938
$\Sigma(1385)^-\overline{\Sigma}(1385)^+$ (or c.c.)	[a]	(1.03±0.13) $\times 10^{-3}$		697
$p\overline{p}\eta'(958)$		(9 ±4) $\times 10^{-4}$	S=1.7	596
$\phi f'_2(1525)$		(8 ±4) $\times 10^{-4}$	S=2.7	871
$\phi\pi^+\pi^-$		(8.0 ±1.2) $\times 10^{-4}$		1365
$\phi K^\pm K^0_S \pi^\mp$	[a]	(7.2 ±0.9) $\times 10^{-4}$		1114

$\omega f_1(1420)$		(6.8 ±2.4) × 10^{-4}			1062
$\phi\eta$		(6.5 ±0.7) × 10^{-4}			1320
$\Xi(1530)^-\overline{\Xi}^+$		(5.9 ±1.5) × 10^{-4}			601
$pK^-\overline{\Sigma}(1385)^0$		(5.1 ±3.2) × 10^{-4}			646
$\omega\pi^0$		(4.2 ±0.6) × 10^{-4}		S=1.4	1446
$\phi\eta'(958)$		(3.3 ±0.4) × 10^{-4}			1192
$\phi f_0(980)$		(3.2 ±0.9) × 10^{-4}		S=1.9	1182
$\Xi(1530)^0\overline{\Xi}^0$		(3.2 ±1.4) × 10^{-4}			608
$\Sigma(1385)^-\overline{\Sigma}^+$ (or c.c.)	[a]	(3.1 ±0.5) × 10^{-4}			855
$\phi f_1(1285)$		(2.6 ±0.5) × 10^{-4}		S=1.1	1032
$\rho\eta$		(1.93±0.23) × 10^{-4}			1396
$\omega\eta'(958)$		(1.67±0.25) × 10^{-4}			1279
$\omega f_0(980)$		(1.4 ±0.5) × 10^{-4}			1271
$\rho\eta'(958)$		(1.05±0.18) × 10^{-4}			1281
$p\overline{p}\phi$		(4.5 ±1.5) × 10^{-5}			527
$a_2(1320)^\pm\pi^\mp$	[a]	< 4.3	× 10^{-3}	CL=90%	1263
$K\overline{K}_2^*(1430)$+ c.c.		< 4.0	× 10^{-3}	CL=90%	1159
$K_1(1270)^\pm K^\mp$		< 3.0	× 10^{-3}	CL=90%	1231
$K_2^*(1430)^0\overline{K}_2^*(1430)^0$		< 2.9	× 10^{-3}	CL=90%	604
$K^*(892)^0\overline{K}^*(892)^0$		< 5	× 10^{-4}	CL=90%	1266
$\phi f_2(1270)$		< 3.7	× 10^{-4}	CL=90%	1036
$p\overline{p}\rho$		< 3.1	× 10^{-4}	CL=90%	774
$\phi\eta(1405) \rightarrow \phi\eta\pi\pi$		< 2.5	× 10^{-4}	CL=90%	946
$\omega f_2'(1525)$		< 2.2	× 10^{-4}	CL=90%	1003
$\Sigma(1385)^0\overline{\Lambda}$		< 2	× 10^{-4}	CL=90%	912
$\Delta(1232)^+\overline{p}$		< 1	× 10^{-4}	CL=90%	1100
$\Sigma^0\overline{\Lambda}$		< 9	× 10^{-5}	CL=90%	1032
$\phi\pi^0$		< 6.8	× 10^{-6}	CL=90%	1377

Decays into stable hadrons

$2(\pi^+\pi^-)\pi^0$		(3.37±0.26) %			1496
$3(\pi^+\pi^-)\pi^0$		(2.9 ±0.6) %			1433
$\pi^+\pi^-\pi^0$		(1.50±0.20) %			1533
$\pi^+\pi^-\pi^0 K^+K^-$		(1.20±0.30) %			1368
$4(\pi^+\pi^-)\pi^0$		(9.0 ±3.0) × 10^{-3}			1345
$\pi^+\pi^- K^+K^-$		(7.2 ±2.3) × 10^{-3}			1407
$K\overline{K}\pi$		(6.1 ±1.0) × 10^{-3}			1442
$p\overline{p}\pi^+\pi^-$		(6.0 ±0.5) × 10^{-3}		S=1.3	1107
$2(\pi^+\pi^-)$		(4.0 ±1.0) × 10^{-3}			1517
$3(\pi^+\pi^-)$		(4.0 ±2.0) × 10^{-3}			1466
$n\overline{n}\pi^+\pi^-$		(4 ±4) × 10^{-3}			1106
$\Sigma^0\overline{\Sigma}^0$		(1.27±0.17) × 10^{-3}			988
$2(\pi^+\pi^-)K^+K^-$		(3.1 ±1.3) × 10^{-3}			1320
$p\overline{p}\pi^+\pi^-\pi^0$	[b]	(2.3 ±0.9) × 10^{-3}		S=1.9	1033

$p\overline{p}$		$(\ 2.12\pm0.10)\times10^{-3}$		1232
$p\overline{p}\eta$		$(\ 2.09\pm0.18)\times10^{-3}$		948
$p\overline{n}\pi^-$		$(\ 2.00\pm0.10)\times10^{-3}$		1174
$n\overline{n}$		$(\ 2.2\ \pm0.4\ )\times10^{-3}$		1231
$\Xi\overline{\Xi}$		$(\ 1.8\ \pm0.4\ )\times10^{-3}$	S=1.8	818
$\Lambda\overline{\Lambda}$		$(\ 1.30\pm0.12)\times10^{-3}$	S=1.1	1074
$p\overline{p}\pi^0$		$(\ 1.09\pm0.09)\times10^{-3}$		1176
$\Lambda\overline{\Sigma}^-\pi^+$ (or c.c.)	[a]	$(\ 1.06\pm0.12)\times10^{-3}$		950
$pK^-\overline{\Lambda}$		$(\ 8.9\ \pm1.6\ )\times10^{-4}$		876
$2(K^+K^-)$		$(\ 9.2\ \pm3.3\ )\times10^{-4}$	S=1.3	1131
$pK^-\overline{\Sigma}^0$		$(\ 2.9\ \pm0.8\ )\times10^{-4}$		819
K^+K^-		$(\ 2.37\pm0.31)\times10^{-4}$		1468
$K^0_SK^0_L$		$(\ 1.46\pm0.26)\times10^{-4}$	S=2.7	1466
$\Lambda\overline{\Lambda}\pi^0$		$(\ 2.2\ \pm0.6\ )\times10^{-4}$		998
$\pi^+\pi^-$		$(\ 1.47\pm0.23)\times10^{-4}$		1542
$\Lambda\overline{\Sigma}+$ c.c.		$<\ 1.5\ \times10^{-4}$	CL=90%	1034
$K^0_SK^0_S$		$<\ 5.2\ \times10^{-6}$	CL=90%	1466

Radiative decays

$\gamma\eta_c(1S)$		$(\ 1.3\ \pm0.4\ )\ \%$		115
$\gamma\pi^+\pi^-2\pi^0$		$(\ 8.3\ \pm3.1\ )\times10^{-3}$		1518
$\gamma\eta\pi\pi$		$(\ 6.1\ \pm1.0\ )\times10^{-3}$		1487
$\gamma\eta(1405/1475)\rightarrow\ \gamma K\overline{K}\pi$	[c]	$(\ 2.8\ \pm0.6\ )\times10^{-3}$	S=1.6	1223
$\gamma\eta(1405/1475)\rightarrow\ \gamma\gamma\rho^0$		$(\ 6.4\ \pm1.4\ )\times10^{-5}$		1223
$\gamma\eta(1405/1475)\rightarrow\ \gamma\eta\pi^+\pi^-$		$(\ 3.0\ \pm0.5\ )\times10^{-4}$		–
$\gamma\rho\rho$		$(\ 4.5\ \pm0.8\ )\times10^{-3}$		1340
$\gamma\eta_2(1870)\rightarrow\ \gamma\pi^+\pi^-$		$(\ 6.2\ \pm2.4\ )\times10^{-4}$		–
$\gamma\eta'(958)$		$(\ 4.31\pm0.30)\times10^{-3}$		1400
$\gamma2\pi^+2\pi^-$		$(\ 2.8\ \pm0.5\ )\times10^{-3}$	S=1.9	1517
$\gamma K^+K^-\pi^+\pi^-$		$(\ 2.1\ \pm0.6\ )\times10^{-3}$		1407
$\gamma f_4(2050)$		$(\ 2.7\ \pm0.7\ )\times10^{-3}$		880
$\gamma\omega\omega$		$(\ 1.59\pm0.33)\times10^{-3}$		1336
$\gamma\eta(1405/1475)\rightarrow\ \gamma\rho^0\rho^0$		$(\ 1.7\ \pm0.4\ )\times10^{-3}$	S=1.3	1223
$\gamma f_2(1270)$		$(\ 1.38\pm0.14)\times10^{-3}$		1286
$\gamma f_0(1710)\rightarrow\ \gamma K\overline{K}$		$(\ 8.5\ ^{+1.2}_{-0.9}\ )\times10^{-4}$	S=1.2	1075
$\gamma\eta$		$(\ 8.6\ \pm0.8\ )\times10^{-4}$		1500
$\gamma f_1(1420)\rightarrow\ \gamma K\overline{K}\pi$		$(\ 7.9\ \pm1.3\ )\times10^{-4}$		1220
$\gamma f_1(1285)$		$(\ 6.1\ \pm0.8\ )\times10^{-4}$		1283
$\gamma f_1(1510)\rightarrow\ \gamma\eta\pi^+\pi^-$		$(\ 4.5\ \pm1.2\ )\times10^{-4}$		–
$\gamma f_2'(1525)$		$(\ 4.5\ ^{+0.7}_{-0.4}\ )\times10^{-4}$		1173
$\gamma f_2(1950)\rightarrow$ $\gamma K^*(892)\overline{K}^*(892)$		$(\ 7.0\ \pm2.2\ )\times10^{-4}$		–
$\gamma K^*(892)\overline{K}^*(892)$		$(\ 4.0\ \pm1.3\ )\times10^{-3}$		1266

$\gamma\phi\phi$	$(\ 4.0\ \pm1.2\ )\times10^{-4}$	S=2.1		1166
$\gamma p\overline{p}$	$(\ 3.8\ \pm1.0\ )\times10^{-4}$			1232
$\gamma\eta(2225)$	$(\ 2.9\ \pm0.6\ )\times10^{-4}$			752
$\gamma\eta(1760)\to\ \gamma\rho^0\rho^0$	$(\ 1.3\ \pm0.9\ )\times10^{-4}$			1048
$\gamma(K\overline{K}\pi)_{\ J^PC=0^{-+}}$	$(\ 7\ \ \pm4\ \ )\times10^{-4}$	S=2.1		1442
$\gamma\pi^0$	$(\ 3.9\ \pm1.3\ )\times10^{-5}$			1546
$\gamma p\overline{p}\pi^+\pi^-$	$<\ 7.9\ \times10^{-4}$	CL=90%		1107
$\gamma\gamma$	$<\ 5\ \times10^{-4}$	CL=90%		1548
$\gamma\Lambda\overline{\Lambda}$	$<\ 1.3\ \times10^{-4}$	CL=90%		1074
3γ	$<\ 5.5\ \times10^{-5}$	CL=90%		1548
$\gamma f_J(2220)$	$>\ 2.50\ \times10^{-3}$	CL=99.9%		745
$\gamma f_J(2220)\to\ \gamma\pi\pi$	$(\ 8\ \ \pm4\ \ )\times10^{-5}$			–
$\gamma f_J(2220)\to\ \gamma K\overline{K}$	$(\ 8.1\ \pm3.0\ )\times10^{-5}$			–
$\gamma f_J(2220)\to\ \gamma p\overline{p}$	$(\ 1.5\ \pm0.8\ )\times10^{-5}$			–
$\gamma f_0(1500)$	$>(\ 5.7\ \pm0.8\ )\times10^{-4}$			1182
γe^+e^-	$(\ 8.8\ \pm1.4\ )\times10^{-3}$			1548

Lepton Family number (*LF*) violating modes

$e^\pm\mu^\mp$	*LF*	$<\ 1.1\ \times10^{-6}$	CL=90%		1547

$\chi_{c0}(1P)$

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

Mass $m = 3415.19 \pm 0.34$ MeV
Full width $\Gamma = 10.1 \pm 0.8$ MeV

$\chi_{c0}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
Hadronic decays			
$2(\pi^+\pi^-)$	(2.58 ± 0.31) %		1679
$\pi^+\pi^-K^+K^-$	$(2.1\ \pm0.5\ )$ %		1581
$\rho^0\pi^+\pi^-$	$(1.6\ \pm0.5\ )$ %		1607
$3(\pi^+\pi^-)$	(1.27 ± 0.22) %		1633
$K^+\overline{K}^*(892)^0\pi^-$ + c.c.	$(1.2\ \pm0.4\ )$ %		1524
K^+K^-	$(6.0\ \pm0.9\ )\times10^{-3}$		1635
$\pi\pi$	$(7.4\ \pm0.8\ )\times10^{-3}$		1702
$\eta\eta$	$(2.1\ \pm1.1\ )\times10^{-3}$		1617
$K^+K^-K^+K^-$	$(2.3\ \pm0.5\ )\times10^{-3}$		1334
$K^0_SK^0_S$	$(2.1\ \pm0.6\ )\times10^{-3}$		1633
$\pi^+\pi^-p\overline{p}$	$(2.2\ \pm0.8\ )\times10^{-3}$		1320
$\phi\phi$	$(1.0\ \pm0.6\ )\times10^{-3}$		1370
$p\overline{p}$	$(2.24\pm0.27)\times10^{-4}$		1427
$\Lambda\overline{\Lambda}$	$(4.7\ \pm1.6\ )\times10^{-4}$		1293
$K^0_SK^+\pi^-$ + c.c.	$<\ 8\ \times10^{-4}$	90%	1610

Radiative decays

$\gamma J/\psi(1S)$	(1.18±0.14) %	303
$\gamma\gamma$	(2.6 ±0.5) × 10^{-4}	1708

$\chi_{c1}(1P)$

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

Mass m = 3510.59 ± 0.10 MeV (S = 1.1)
Full width Γ = 0.91 ± 0.13 MeV

$\chi_{c1}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
Hadronic decays		
$3(\pi^+\pi^-)$	(6.2±1.6) × 10^{-3}	1683
$2(\pi^+\pi^-)$	(8.2±2.9) × 10^{-3}	1727
$\pi^+\pi^- K^+K^-$	(4.9±1.1) × 10^{-3}	1632
$\rho^0\pi^+\pi^-$	(3.9±3.5) × 10^{-3}	1657
$K^+\overline{K}^*(892)^0\pi^-$ + c.c.	(3.2±2.1) × 10^{-3}	1577
$K^0_S K^+\pi^-$ + c.c.	(2.5±0.7) × 10^{-3}	1660
$\pi^+\pi^- p\overline{p}$	(5.3±2.1) × 10^{-4}	1381
$K^+K^-K^+K^-$	(4.2±1.9) × 10^{-4}	1393
$p\overline{p}$	(7.2±1.3) × 10^{-5}	1483
$\Lambda\overline{\Lambda}$	(2.6±1.2) × 10^{-4}	1355
$\pi^+\pi^-$ + K^+K^-	< 2.1 × 10^{-3}	–
Radiative decays		
$\gamma J/\psi(1S)$	(31.6±3.3) %	389

$\chi_{c2}(1P)$

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

Mass m = 3556.26 ± 0.11 MeV
Full width Γ = 2.11 ± 0.16 MeV

$\chi_{c2}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
Hadronic decays			
$2(\pi^+\pi^-)$	(1.48±0.21) %		1751
$\pi^+\pi^- K^+K^-$	(1.24±0.33) %		1656
$3(\pi^+\pi^-)$	(1.07±0.24) %		1707
$\rho^0\pi^+\pi^-$	(7 ±4) × 10^{-3}		1681
$K^+\overline{K}^*(892)^0\pi^-$ + c.c.	(4.8 ±2.8) × 10^{-3}		1602
$\phi\phi$	(2.4 ±0.9) × 10^{-3}		1457
$\pi^+\pi^-$	(1.77±0.27) × 10^{-3}		1773
$\pi^0\pi^0$	(1.1 ±0.7) × 10^{-3}		1773

$\eta\eta$	< 1.5	$\times 10^{-3}$	90%	1692
$K^+K^-K^+K^-$	$(1.8 \pm 0.5) \times 10^{-3}$			1421
$\pi^+\pi^- p\overline{p}$	$(1.7 \pm 0.4) \times 10^{-3}$			1410
K^+K^-	$(9.4 \pm 2.1) \times 10^{-4}$			1708
$K^0_S K^0_S$	$(7.2 \pm 2.7) \times 10^{-4}$			1707
$p\overline{p}$	$(6.8 \pm 0.7) \times 10^{-5}$			1510
$\Lambda\overline{\Lambda}$	$(3.4 \pm 1.7) \times 10^{-4}$			1385
$J/\psi(1S)\pi^+\pi^-\pi^0$	< 1.5	%	90%	186
$K^0_S K^+\pi^- +$ c.c.	< 1.3	$\times 10^{-3}$	90%	1685

Radiative decays

$\gamma J/\psi(1S)$	(20.2 ± 1.7) %			430
$\gamma\gamma$	$(2.46 \pm 0.23) \times 10^{-4}$			1778

$\psi(2S)$

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

Mass $m = 3686.093 \pm 0.034$ MeV (S = 1.4)
Full width $\Gamma = 281 \pm 17$ keV
$\Gamma_{ee} = 2.12 \pm 0.12$ 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	(2.16 ± 0.35) %	S=2.1	–
e^+e^-	$(7.55 \pm 0.31) \times 10^{-3}$		1843
$\mu^+\mu^-$	$(7.3 \pm 0.8) \times 10^{-3}$		1840
$\tau^+\tau^-$	$(2.8 \pm 0.7) \times 10^{-3}$		489

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

$J/\psi(1S)$ anything	(57.6 ± 2.0) %			–
$J/\psi(1S)$ neutrals	(24.6 ± 1.2) %			–
$J/\psi(1S)\pi^+\pi^-$	(31.7 ± 1.1) %			477
$J/\psi(1S)\pi^0\pi^0$	(18.8 ± 1.2) %			481
$J/\psi(1S)\eta$	(3.16 ± 0.22) %			199
$J/\psi(1S)\pi^0$	$(9.6 \pm 2.1) \times 10^{-4}$			528

Hadronic decays

$3(\pi^+\pi^-)\pi^0$	$(3.5 \pm 1.6) \times 10^{-3}$			1746
$2(\pi^+\pi^-)\pi^0$	$(3.0 \pm 0.8) \times 10^{-3}$			1799
$\rho a_2(1320)$	< 2.3	$\times 10^{-4}$	CL=90%	1500
$\omega\pi^+\pi^-$	$(4.8 \pm 0.9) \times 10^{-4}$			1748
$b_1^\pm\pi^\mp$	$(3.2 \pm 0.8) \times 10^{-4}$			1635
$\omega f_2(1270)$	< 1.5	$\times 10^{-4}$	CL=90%	1515
$\pi^+\pi^- K^+K^-$	$(1.6 \pm 0.4) \times 10^{-3}$			1726
$K^*(892)\overline{K}^*_2(1430)^0$	< 1.2	$\times 10^{-4}$	CL=90%	1418

$K_1(1270)^{\pm} K^{\mp}$	$(\ 1.00 \pm 0.28) \times 10^{-3}$			1581
$\pi^+ \pi^- p \overline{p}$	$(\ 8.0 \ \pm 2.0\ ) \times 10^{-4}$			1491
$K^+ \overline{K}^*(892)^0 \pi^- +$ c.c.	$(\ 6.7 \ \pm 2.5\ ) \times 10^{-4}$			1674
$2(\pi^+ \pi^-)$	$(\ 4.5 \ \pm 1.0\ ) \times 10^{-4}$			1817
$\rho^0 \pi^+ \pi^-$	$(\ 4.2 \ \pm 1.5\ ) \times 10^{-4}$			1750
$\omega K^+ K^-$	$(\ 1.5 \ \pm 0.4\ ) \times 10^{-4}$			1614
$\omega p \overline{p}$	$(\ 8.0 \ \pm 3.2\ ) \times 10^{-5}$			1247
$\overline{p} p$	$(\ 2.07 \pm 0.31) \times 10^{-4}$			1586
$\Lambda \overline{\Lambda}$	$(\ 1.81 \pm 0.34) \times 10^{-4}$			1467
$3(\pi^+ \pi^-)$	$(\ 1.5 \ \pm 1.0\ ) \times 10^{-4}$			1774
$\overline{p} p \pi^0$	$(\ 1.4 \ \pm 0.5\ ) \times 10^{-4}$			1543
$\Delta^{++} \overline{\Delta}^{--}$	$(\ 1.28 \pm 0.35) \times 10^{-4}$			1371
$\Sigma^0 \overline{\Sigma}^0$	$(\ 1.2 \ \pm 0.6\ ) \times 10^{-4}$			1405
$\Sigma^{*+} \overline{\Sigma}^{*-}$	$(\ 1.1 \ \pm 0.4\ ) \times 10^{-4}$			1218
$K^+ K^-$	$(\ 1.0 \ \pm 0.7\ ) \times 10^{-4}$			1776
$K^0_S K^0_L$	$(\ 5.2 \ \pm 0.7\ ) \times 10^{-5}$			1775
$\pi^+ \pi^- \pi^0$	$(\ 8 \ \pm 5\ ) \times 10^{-5}$			1830
$\rho \pi$	$< 8.3 \times 10^{-5}$		CL=90%	1759
$\pi^+ \pi^-$	$(\ 8 \ \pm 5\ ) \times 10^{-5}$			1838
$\Xi^- \overline{\Xi}^+$	$(\ 9.4 \ \pm 3.1\ ) \times 10^{-5}$			1285
$K_1(1400)^{\pm} K^{\mp}$	$< 3.1 \times 10^{-4}$		CL=90%	1532
$\Xi^{*0} \overline{\Xi}^{*0}$	$< 8.1 \times 10^{-5}$		CL=90%	1025
$\Omega^- \overline{\Omega}^+$	$< 7.3 \times 10^{-5}$		CL=90%	774
$K^+ K^- \pi^0$	$< 2.96 \times 10^{-5}$		CL=90%	1754
$K^+ \overline{K}^*(892)^- +$ c.c.	$< 5.4 \times 10^{-5}$		CL=90%	1698
$\phi \pi^+ \pi^-$	$(\ 1.50 \pm 0.28) \times 10^{-4}$			1690
$\phi f_0(980) \rightarrow \pi^+ \pi^-$	$(\ 6.0 \ \pm 2.2\ ) \times 10^{-5}$			–
$\phi K^+ K^-$	$(\ 6.0 \ \pm 2.2\ ) \times 10^{-5}$			1546
$\phi p \overline{p}$	$< 2.6 \times 10^{-5}$		CL=90%	1109
$\phi f'_2(1525)$	$< 4.5 \times 10^{-5}$		CL=90%	1321

Radiative decays

$\gamma \chi_{c0}(1P)$	$(\ 8.6 \ \pm 0.7\ )$ %			261
$\gamma \chi_{c1}(1P)$	$(\ 8.4 \ \pm 0.8\ )$ %			171
$\gamma \chi_{c2}(1P)$	$(\ 6.4 \ \pm 0.6\ )$ %			128
$\gamma \eta_c(1S)$	$(\ 2.8 \ \pm 0.6\ ) \times 10^{-3}$			639
$\gamma \eta'(958)$	$(\ 1.5 \ \pm 0.4\ ) \times 10^{-4}$			1719
$\gamma f_2(1270)$	$(\ 2.1 \ \pm 0.4\ ) \times 10^{-4}$			1622
$\gamma f_0(1710) \rightarrow \gamma \pi \pi$	$(\ 3.0 \ \pm 1.3\ ) \times 10^{-5}$			–
$\gamma f_0(1710) \rightarrow \gamma K \overline{K}$	$(\ 6.0 \ \pm 1.6\ ) \times 10^{-5}$			–
$\gamma \gamma$	$< 1.5 \times 10^{-4}$		CL=90%	1843
$\gamma \eta$	$< 9 \times 10^{-5}$		CL=90%	1802
$\gamma \eta(1405) \rightarrow \gamma K \overline{K} \pi$	$< 1.2 \times 10^{-4}$		CL=90%	1569

$\psi(3770)$

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

Mass $m = 3770.0 \pm 2.4$ MeV (S = 1.8)
Full width $\Gamma = 23.6 \pm 2.7$ MeV (S = 1.1)
$\Gamma_{ee} = 0.26 \pm 0.04$ keV (S = 1.2)

$\psi(3770)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor	p (MeV/c)
$D\overline{D}$	dominant		276
e^+e^-	$(1.12\pm0.17)\times10^{-5}$	1.2	1885

$\psi(4040)$ [d]

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

Mass $m = 4040 \pm 10$ MeV
Full width $\Gamma = 52 \pm 10$ MeV
$\Gamma_{ee} = 0.75 \pm 0.15$ keV

$\psi(4040)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
e^+e^-	$(1.4\pm0.4)\times10^{-5}$	2020
$D^0\overline{D}^0$	seen	777
$D^*(2007)^0\overline{D}^0$ + c.c.	seen	577
$D^*(2007)^0\overline{D}^*(2007)^0$	seen	231

$\psi(4160)$ [d]

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

Mass $m = 4159 \pm 20$ MeV
Full width $\Gamma = 78 \pm 20$ MeV
$\Gamma_{ee} = 0.77 \pm 0.23$ keV

$\psi(4160)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
e^+e^-	$(10\pm4)\times10^{-6}$	2080

$\psi(4415)$ [d]

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

Mass $m = 4415 \pm 6$ MeV
Full width $\Gamma = 43 \pm 15$ MeV (S = 1.8)
$\Gamma_{ee} = 0.47 \pm 0.10$ keV

$\psi(4415)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
hadrons	dominant	–
e^+e^-	$(1.1\pm0.4)\times10^{-5}$	2207

NOTES

[*a*] The value is for the sum of the charge states or particle/antiparticle states indicated.

[*b*] Includes $p\overline{p}\pi^+\pi^-\gamma$ and excludes $p\overline{p}\eta$, $p\overline{p}\omega$, $p\overline{p}\eta'$.

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

[*d*] 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.