LIGHT UNFLAVORED MESONS ($S = C = B = 0$)

For $I = 1$ (π, b, ρ, a): $u\overline{d}$, $(u\overline{u} - d\overline{d})/\sqrt{2}$, $d\overline{u}$;
for $I = 0$ (η, η', h, h', ω, ϕ, f, f'): $c_1(u\overline{u} + d\overline{d}) + c_2(s\overline{s})$

$\pi^{\pm}$

$I^G(J^P) = 1^-(0^-)$

Mass $m = 139.57018 \pm 0.00035$ MeV (S = 1.2)
Mean life $\tau = (2.6033 \pm 0.0005) \times 10^{-8}$ s (S = 1.2)
$c\tau = 7.8045$ m

$\pi^{\pm} \rightarrow \ell^{\pm}\nu\gamma$ form factors [a]

$F_V = 0.017 \pm 0.008$
$F_A = 0.0116 \pm 0.0016$ (S = 1.3)
$R = 0.059^{+0.009}_{-0.008}$

π^- modes are charge conjugates of the modes below.

For decay limits to particles which are not established, see the appropriate Search setions (Massive Neutrino Peak Search Test, A^0 (axion), and Other Light Boson (X^0) Searches, etc.).

π^+ DECAY MODES			Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\mu^+\nu_\mu$		[b]	(99.98770 ± 0.00004) %		30
$\mu^+\nu_\mu\gamma$		[c]	$(2.00 \pm 0.25) \times 10^{-4}$		30
$e^+\nu_e$		[b]	$(1.230 \pm 0.004) \times 10^{-4}$		70
$e^+\nu_e\gamma$		[c]	$(1.61 \pm 0.23) \times 10^{-7}$		70
$e^+\nu_e\pi^0$			$(1.025 \pm 0.034) \times 10^{-8}$		4
$e^+\nu_e e^+ e^-$			$(3.2 \pm 0.5) \times 10^{-9}$		70
$e^+\nu_e\nu\overline{\nu}$			$< 5 \times 10^{-6}$	90%	70
Lepton Family number (*LF*) or Lepton number (*L*) violating modes					
$\mu^+\overline{\nu}_e$	L	[d]	$< 1.5 \times 10^{-3}$	90%	30
$\mu^+\nu_e$	LF	[d]	$< 8.0 \times 10^{-3}$	90%	30
$\mu^- e^+ e^+ \nu$	LF		$< 1.6 \times 10^{-6}$	90%	30

π^0

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

Mass $m = 134.9766 \pm 0.0006$ MeV (S = 1.1)
$m_{\pi^\pm} - m_{\pi^0} = 4.5936 \pm 0.0005$ MeV
Mean life $\tau = (8.4 \pm 0.6) \times 10^{-17}$ s (S = 3.0)
$c\tau = 25.1$ nm

For decay limits to particles which are not established, see the appropriate Search setions (A^0 (axion), and Other Light Boson (X^0) Searches, etc.).

π^0 DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
2γ		(98.798 ± 0.032) %	S=1.1	67
$e^+e^-\gamma$		(1.198 ± 0.032) %	S=1.1	67
γ positronium		$(1.82 \pm 0.29) \times 10^{-9}$		67
$e^+e^+e^-e^-$		$(3.14 \pm 0.30) \times 10^{-5}$		67
e^+e^-		$(6.2 \pm 0.5) \times 10^{-8}$		67
4γ		$< 2 \times 10^{-8}$	CL=90%	67
$\nu\overline{\nu}$	[e]	$< 8.3 \times 10^{-7}$	CL=90%	67
$\nu_e\overline{\nu}_e$		$< 1.7 \times 10^{-6}$	CL=90%	67
$\nu_\mu\overline{\nu}_\mu$		$< 3.1 \times 10^{-6}$	CL=90%	67
$\nu_\tau\overline{\nu}_\tau$		$< 2.1 \times 10^{-6}$	CL=90%	67
$\gamma\nu\overline{\nu}$		$< 6 \times 10^{-4}$	CL=90%	–
Charge conjugation (C) or Lepton Family number (LF) violating modes				
3γ	C	$< 3.1 \times 10^{-8}$	CL=90%	67
μ^+e^-	LF	$< 3.8 \times 10^{-10}$	CL=90%	26
μ^-e^+	LF	$< 3.4 \times 10^{-9}$	CL=90%	–
$\mu^+e^- + \mu^-e^+$	LF	$< 1.72 \times 10^{-8}$	CL=90%	26

η

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

Mass $m = 547.30 \pm 0.12$ MeV
Full width $\Gamma = 1.18 \pm 0.11$ keV [f] (S = 1.8)

C-nonconserving decay parameters

$\pi^+\pi^-\pi^0$ Left-right asymmetry $= (0.09 \pm 0.17) \times 10^{-2}$
$\pi^+\pi^-\pi^0$ Sextant asymmetry $= (0.18 \pm 0.16) \times 10^{-2}$
$\pi^+\pi^-\pi^0$ Quadrant asymmetry $= (-0.17 \pm 0.17) \times 10^{-2}$
$\pi^+\pi^-\gamma$ Left-right asymmetry $= (0.9 \pm 0.4) \times 10^{-2}$
$\pi^+\pi^-\gamma$ β (D-wave) $= -0.02 \pm 0.07$ (S = 1.3)

Dalitz plot parameter

$\pi^0 \pi^0 \pi^0$ $\quad \alpha = -0.031 \pm 0.004 \quad$ (S = 1.1)

η DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Neutral modes				
neutral modes		(72.0 ± 0.5) %	S=1.3	–
2γ	[f]	(39.43 ± 0.26) %	S=1.2	274
$3\pi^0$		(32.51 ± 0.29) %	S=1.2	178
$\pi^0 2\gamma$		$(7.2 \pm 1.4) \times 10^{-4}$		257
other neutral modes		< 2.8 %	CL=90%	–
Charged modes				
charged modes		(28.0 ± 0.5) %	S=1.3	–
$\pi^+ \pi^- \pi^0$		(22.6 ± 0.4) %	S=1.3	173
$\pi^+ \pi^- \gamma$		(4.68 ± 0.11) %	S=1.2	235
$e^+ e^- \gamma$		$(6.0 \pm 0.8) \times 10^{-3}$	S=1.4	274
$\mu^+ \mu^- \gamma$		$(3.1 \pm 0.4) \times 10^{-4}$		252
$e^+ e^-$		$< 7.7 \times 10^{-5}$	CL=90%	274
$\mu^+ \mu^-$		$(5.8 \pm 0.8) \times 10^{-6}$		252
$e^+ e^- e^+ e^-$		$< 6.9 \times 10^{-5}$	CL=90%	274
$\pi^+ \pi^- e^+ e^-$		$(4.0 {}^{+14.0}_{-2.7}) \times 10^{-4}$	S=5.8	235
$\pi^+ \pi^- 2\gamma$		$< 2.0 \times 10^{-3}$		235
$\pi^+ \pi^- \pi^0 \gamma$		$< 5 \times 10^{-4}$	CL=90%	173
$\pi^0 \mu^+ \mu^- \gamma$		$< 3 \times 10^{-6}$	CL=90%	210
Charge conjugation (C), Parity (P), Charge conjugation × Parity (CP), or Lepton Family number (LF) violating modes				
$\pi^+ \pi^-$	P,CP	$< 3.3 \times 10^{-4}$	CL=90%	235
$\pi^0 \pi^0$	P,CP	$< 4.3 \times 10^{-4}$	CL=90%	238
3γ	C	$< 5 \times 10^{-4}$	CL=95%	274
$4\pi^0$	P,CP	$< 6.9 \times 10^{-7}$	CL=90%	39
$\pi^0 e^+ e^-$	C [g]	$< 4 \times 10^{-5}$	CL=90%	257
$\pi^0 \mu^+ \mu^-$	C [g]	$< 5 \times 10^{-6}$	CL=90%	210
$\mu^+ e^- + \mu^- e^+$	LF	$< 6 \times 10^{-6}$	CL=90%	263

$f_0(600)$ [h] or σ

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

Mass $m = (400\text{–}1200)$ MeV
Full width $\Gamma = (600\text{–}1000)$ MeV

$f_0(600)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\pi\pi$	dominant	–
$\gamma\gamma$	seen	–

$\rho(770)$ [i]

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

Mass $m = 771.1 \pm 0.9$ MeV (S = 2.6)
Full width $\Gamma = 149.2 \pm 0.7$ MeV (S = 1.1)
$\Gamma_{ee} = 6.85 \pm 0.11$ keV

$\rho(770)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\pi\pi$	~ 100 %		358
$\rho(770)^{\pm}$ decays			
$\pi^{\pm}\gamma$	$(4.5 \pm 0.5) \times 10^{-4}$	S=2.2	372
$\pi^{\pm}\eta$	$< 6 \times 10^{-3}$	CL=84%	146
$\pi^{\pm}\pi^+\pi^-\pi^0$	$< 2.0 \times 10^{-3}$	CL=84%	249
$\rho(770)^0$ decays			
$\pi^+\pi^-\gamma$	$(9.9 \pm 1.6) \times 10^{-3}$		358
$\pi^0\gamma$	$(7.9 \pm 2.0) \times 10^{-4}$		372
$\eta\gamma$	$(3.8 \pm 0.7) \times 10^{-4}$		189
$\pi^0\pi^0\gamma$	$(4.8 {}^{+3.4}_{-1.9}) \times 10^{-5}$		–
$\mu^+\mu^-$	[j] $(4.60 \pm 0.28) \times 10^{-5}$		369
e^+e^-	[j] $(4.54 \pm 0.10) \times 10^{-5}$	S=1.1	384
$\pi^+\pi^-\pi^0$	$< 1.2 \times 10^{-4}$	CL=90%	319
$\pi^+\pi^-\pi^+\pi^-$	$(1.8 \pm 0.9) \times 10^{-5}$		246
$\pi^+\pi^-\pi^0\pi^0$	$< 4 \times 10^{-5}$	CL=90%	252

$\omega(782)$

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

Mass $m = 782.57 \pm 0.12$ MeV (S = 1.8)
Full width $\Gamma = 8.44 \pm 0.09$ MeV
$\Gamma_{ee} = 0.60 \pm 0.02$ keV

$\omega(782)$ DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\pi^+\pi^-\pi^0$		(89.1 ± 0.7) %	S=1.1	327
$\pi^0\gamma$		(8.7 ± 0.4) %		379
$\pi^+\pi^-$		(1.70 ± 0.28) %	S=1.5	365
neutrals (excluding $\pi^0\gamma$)		$(4.1 {}^{+8.2}_{-2.8}) \times 10^{-3}$		–
$\eta\gamma$		$(6.5 \pm 1.1) \times 10^{-4}$		199
$\pi^0 e^+ e^-$		$(5.9 \pm 1.9) \times 10^{-4}$		379
$\pi^0\mu^+\mu^-$		$(9.6 \pm 2.3) \times 10^{-5}$		349
e^+e^-		$(6.95 \pm 0.15) \times 10^{-5}$	S=1.1	391
$\pi^+\pi^-\pi^0\pi^0$		< 2 %	CL=90%	261
$\pi^+\pi^-\gamma$		$< 3.6 \times 10^{-3}$	CL=95%	365
$\pi^+\pi^-\pi^+\pi^-$		$< 1 \times 10^{-3}$	CL=90%	256
$\pi^0\pi^0\gamma$		$(7.8 \pm 3.4) \times 10^{-5}$		367
$\mu^+\mu^-$		$(9.0 \pm 3.1) \times 10^{-5}$		376
3γ		$< 1.9 \times 10^{-4}$	CL=95%	391
Charge conjugation (C) violating modes				
$\eta\pi^0$	C	$< 1 \times 10^{-3}$	CL=90%	162
$3\pi^0$	C	$< 3 \times 10^{-4}$	CL=90%	329

$\eta'(958)$

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

Mass $m = 957.78 \pm 0.14$ MeV
Full width $\Gamma = 0.202 \pm 0.016$ MeV (S = 1.3)

$\eta'(958)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\pi^+\pi^-\eta$	(44.3 ± 1.5) %	S=1.2	232
$\rho^0\gamma$ (including non-resonant $\pi^+\pi^-\gamma$)	(29.5 ± 1.0) %	S=1.2	169
$\pi^0\pi^0\eta$	(20.9 ± 1.2) %	S=1.2	239
$\omega\gamma$	(3.03 ± 0.31) %		160
$\gamma\gamma$	(2.12 ± 0.14) %	S=1.3	479
$3\pi^0$	$(1.56 \pm 0.26) \times 10^{-3}$		430
$\mu^+\mu^-\gamma$	$(1.04 \pm 0.26) \times 10^{-4}$		467
$\pi^+\pi^-\pi^0$	< 5 %	CL=90%	427
$\pi^0\rho^0$	< 4 %	CL=90%	118

$\pi^+\pi^+\pi^-\pi^-$			$<$ 1	%	CL=90%	372
$\pi^+\pi^+\pi^-\pi^-$ neutrals			$<$ 1	%	CL=95%	–
$\pi^+\pi^+\pi^-\pi^-\pi^0$			$<$ 1	%	CL=90%	298
6π			$<$ 1	%	CL=90%	189
$\pi^+\pi^-e^+e^-$			$<$ 6	$\times 10^{-3}$	CL=90%	458
γe^+e^-			$<$ 9	$\times 10^{-4}$	CL=90%	–
$\pi^0\gamma\gamma$			$<$ 8	$\times 10^{-4}$	CL=90%	469
$4\pi^0$			$<$ 5	$\times 10^{-4}$	CL=90%	379
e^+e^-			$<$ 2.1	$\times 10^{-7}$	CL=90%	479

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

$\pi^+\pi^-$	*P,CP*		$<$ 2	%	CL=90%	458
$\pi^0\pi^0$	*P,CP*		$<$ 9	$\times 10^{-4}$	CL=90%	459
$\pi^0 e^+e^-$	*C*	[g]	$<$ 1.4	$\times 10^{-3}$	CL=90%	469
ηe^+e^-	*C*	[g]	$<$ 2.4	$\times 10^{-3}$	CL=90%	322
3γ	*C*		$<$ 1.0	$\times 10^{-4}$	CL=90%	479
$\mu^+\mu^-\pi^0$	*C*	[g]	$<$ 6.0	$\times 10^{-5}$	CL=90%	445
$\mu^+\mu^-\eta$	*C*	[g]	$<$ 1.5	$\times 10^{-5}$	CL=90%	274
$e\mu$	*LF*		$<$ 4.7	$\times 10^{-4}$	CL=90%	–

$f_0(980)$ [k]

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

Mass $m = 980 \pm 10$ MeV
Full width $\Gamma = 40$ to 100 MeV

f_0(980) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\pi\pi$	dominant	470
$K\overline{K}$	seen	–

$a_0(980)$ [k]

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

Mass $m = 984.7 \pm 1.2$ MeV (S = 1.5)
Full width $\Gamma = 50$ to 100 MeV

a_0(980) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\eta\pi$	dominant	321
$K\overline{K}$	seen	–
$\gamma\gamma$	seen	492

$\phi(1020)$

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

Mass $m = 1019.456 \pm 0.020$ MeV (S = 1.1)
Full width $\Gamma = 4.26 \pm 0.05$ MeV (S = 1.7)

$\phi(1020)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
K^+K^-	$(49.2 \ {}^{+0.6}_{-0.7})$ %	S=1.2	127
$K^0_L K^0_S$	(33.7 ± 0.5) %	S=1.2	110
$\rho\pi + \pi^+\pi^-\pi^0$	(15.5 ± 0.5) %	S=1.3	–
$\eta\gamma$	(1.299 ± 0.026) %	S=1.2	363
$\pi^0\gamma$	$(1.24 \pm 0.10) \times 10^{-3}$		501
e^+e^-	$(2.96 \pm 0.04) \times 10^{-4}$	S=1.2	510
$\mu^+\mu^-$	$(2.87 \ {}^{+0.18}_{-0.22}) \times 10^{-4}$		499
ηe^+e^-	$(1.15 \pm 0.10) \times 10^{-4}$		363
$\pi^+\pi^-$	$(7.3 \pm 1.3) \times 10^{-5}$		490
$\omega\pi^0$	$(5.2 \ {}^{+1.3}_{-1.1}) \times 10^{-5}$		–
$\omega\gamma$	< 5 %	CL=84%	210
$\rho\gamma$	$< 1.2 \times 10^{-5}$	CL=90%	219
$\pi^+\pi^-\gamma$	$(4.1 \pm 1.3) \times 10^{-5}$		490
$f_0(980)\gamma$	$(3.3 \ {}^{+0.8}_{-0.5}) \times 10^{-4}$		39
$\pi^0\pi^0\gamma$	$(1.08 \pm 0.19) \times 10^{-4}$		492
$\pi^+\pi^-\pi^+\pi^-$	$(4.0 \ {}^{+2.8}_{-2.2}) \times 10^{-6}$		410
$\pi^+\pi^+\pi^-\pi^-\pi^0$	$< 4.6 \times 10^{-6}$	CL=90%	341
$\pi^0 e^+e^-$	$(1.2 \pm 0.4) \times 10^{-5}$		501
$\pi^0\eta\gamma$	$(8.9 \pm 1.4) \times 10^{-5}$		346
$a_0(980)\gamma$	$(8.8 \pm 1.7) \times 10^{-4}$		36
$\eta'(958)\gamma$	$(6.7 \ {}^{+1.5}_{-1.4}) \times 10^{-5}$		–
$\eta\pi^0\pi^0\gamma$	$< 2 \times 10^{-5}$	CL=90%	–
$\mu^+\mu^-\gamma$	$(1.4 \pm 0.5) \times 10^{-5}$		–
$\rho\gamma\gamma$	$< 5 \times 10^{-4}$	CL=90%	–
$\eta\pi^+\pi^-$	$< 1.8 \times 10^{-5}$	CL=90%	–
$\eta\mu^+\mu^-$	$< 9.4 \times 10^{-6}$	CL=90%	–

$h_1(1170)$

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

Mass $m = 1170 \pm 20$ MeV
Full width $\Gamma = 360 \pm 40$ MeV

h_1(1170) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\rho\pi$	seen	310

$b_1(1235)$

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

Mass $m = 1229.5 \pm 3.2$ MeV (S = 1.6)
Full width $\Gamma = 142 \pm 9$ MeV (S = 1.2)

b_1(1235) DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\omega\pi$	dominant		348
[D/S amplitude ratio = 0.29 ± 0.04]			
$\pi^\pm\gamma$	$(1.6\pm0.4) \times 10^{-3}$		608
$\eta\rho$	seen		–
$\pi^+\pi^+\pi^-\pi^0$	< 50 %	84%	536
$(K\overline{K})^\pm\pi^0$	< 8 %	90%	248
$K^0_S K^0_L \pi^\pm$	< 6 %	90%	238
$K^0_S K^0_S \pi^\pm$	< 2 %	90%	238
$\phi\pi$	< 1.5 %	84%	146

$a_1(1260)$ [l]

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

Mass $m = 1230 \pm 40$ MeV [m]
Full width $\Gamma = 250$ to 600 MeV

a_1(1260) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$(\rho\pi)_{S-\text{wave}}$	seen	–
$(\rho\pi)_{D-\text{wave}}$	seen	–
$(\rho(1450)\pi)_{S-\text{wave}}$	seen	–
$(\rho(1450)\pi)_{D-\text{wave}}$	seen	–
$\sigma\pi$	seen	–
$f_0(980)\pi$	not seen	–
$f_0(1370)\pi$	seen	–
$f_2(1270)\pi$	seen	–
$K\overline{K}^*(892)$+c.c.	seen	–
$\pi\gamma$	seen	607

$f_2(1270)$

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

Mass $m = 1275.4 \pm 1.2$ MeV
Full width $\Gamma = 185.1^{+3.4}_{-2.6}$ MeV (S = 1.5)

$f_2(1270)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\pi\pi$	$(84.7\ ^{+2.4}_{-1.3})$ %	S=1.3	622
$\pi^+\pi^-2\pi^0$	$(7.1\ ^{+1.5}_{-2.6})$ %	S=1.3	562
$K\overline{K}$	(4.6 ± 0.5) %	S=2.8	403
$2\pi^+2\pi^-$	(2.8 ± 0.4) %	S=1.2	559
$\eta\eta$	$(4.5 \pm 1.0) \times 10^{-3}$	S=2.4	327
$4\pi^0$	$(3.0 \pm 1.0) \times 10^{-3}$		564
$\gamma\gamma$	$(1.41 \pm 0.13) \times 10^{-5}$		637
$\eta\pi\pi$	$< 8 \times 10^{-3}$	CL=95%	475
$K^0K^-\pi^+$ + c.c.	$< 3.4 \times 10^{-3}$	CL=95%	293
e^+e^-	$< 6 \times 10^{-10}$	CL=90%	637

$f_1(1285)$

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

Mass $m = 1281.9 \pm 0.6$ MeV (S = 1.6)
Full width $\Gamma = 24.0 \pm 1.2$ MeV (S = 1.4)

$f_1(1285)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
4π	$(33.1^{+\ 2.1}_{-\ 1.8})$ %	S=1.3	563
$\pi^0\pi^0\pi^+\pi^-$	$(22.0^{+\ 1.4}_{-\ 1.2})$ %	S=1.3	566
$2\pi^+2\pi^-$	$(11.0^{+\ 0.7}_{-\ 0.6})$ %	S=1.3	563
$\rho^0\pi^+\pi^-$	$(11.0^{+\ 0.7}_{-\ 0.6})$ %	S=1.3	340
$\rho^0\rho^0$	seen		–
$4\pi^0$	$< 7 \times 10^{-4}$	CL=90%	568
$\eta\pi\pi$	(52 ± 16) %		479
$a_0(980)\pi$ [ignoring $a_0(980) \to K\overline{K}$]	(36 ± 7) %		234
$\eta\pi\pi$ [excluding $a_0(980)\pi$]	(16 ± 7) %		–
$K\overline{K}\pi$	(9.0 ± 0.4) %	S=1.1	308
$K\overline{K}^*(892)$	not seen		–
$\gamma\rho^0$	(5.5 ± 1.3) %	S=2.8	410
$\phi\gamma$	$(7.4 \pm 2.6) \times 10^{-4}$		236

$\eta(1295)$

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

Mass $m = 1293 \pm 5$ MeV (S = 1.9)
Full width $\Gamma = 55 \pm 5$ MeV

$\eta(1295)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\eta\pi^+\pi^-$	seen	488
$a_0(980)\pi$	seen	245
$\eta\pi^0\pi^0$	seen	–
$\eta(\pi\pi)_{S\text{-wave}}$	seen	–

$\pi(1300)$

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

Mass $m = 1300 \pm 100$ MeV [m]
Full width $\Gamma = 200$ to 600 MeV

$\pi(1300)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\rho\pi$	seen	406

$a_2(1320)$

$I^G(J^{PC}) = 1^-(2^{++})$

Mass $m = 1318.0 \pm 0.6$ MeV (S = 1.1)
Full width $\Gamma = 107 \pm 5$ MeV [m]

$a_2(1320)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\rho\pi$	(70.1 ± 2.7) %	S=1.2	419
$\eta\pi$	(14.5 ± 1.2) %		535
$\omega\pi\pi$	(10.6 ± 3.2) %	S=1.3	362
$K\overline{K}$	(4.9 ± 0.8) %		437
$\eta'(958)\pi$	$(5.3 \pm 0.9) \times 10^{-3}$		287
$\pi^\pm\gamma$	$(2.68 \pm 0.31) \times 10^{-3}$		652
$\gamma\gamma$	$(9.4 \pm 0.7) \times 10^{-6}$		659
$\pi^+\pi^-\pi^-$	< 8 %	CL=90%	621
e^+e^-	$< 6 \times 10^{-9}$	CL=90%	659

$f_0(1370)$ [k]

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

Mass $m = 1200$ to 1500 MeV
Full width $\Gamma = 200$ to 500 MeV

$f_0(1370)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\pi\pi$	seen	–
4π	seen	–
$4\pi^0$	seen	–
$2\pi^+ 2\pi^-$	seen	–
$\pi^+\pi^- 2\pi^0$	seen	–
$\rho\rho$	dominant	–
$2(\pi\pi)_{S\text{-wave}}$	seen	–
$\eta\eta$	seen	–
$K\overline{K}$	seen	–
$\gamma\gamma$	seen	–
e^+e^-	not seen	–

$f_1(1420)$ [n]

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

Mass $m = 1426.3 \pm 1.1$ MeV (S = 1.3)
Full width $\Gamma = 55.5 \pm 2.9$ MeV

$f_1(1420)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\overline{K}\pi$	dominant	439
$K\overline{K}^*(892)+$ c.c.	dominant	155
$\eta\pi\pi$	possibly seen	571
$\phi\gamma$	seen	–

$\omega(1420)$ [o]

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

Mass $m = 1419 \pm 31$ MeV
Full width $\Gamma = 174 \pm 60$ MeV

$\omega(1420)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\rho\pi$	dominant	488
$\omega\pi\pi$	possibly seen	–
$b_1(1235)\pi$	seen	–

$\eta(1440)$ [p]

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

Mass m = 1400 - 1470 MeV [m]
Full width Γ = 50 - 80 MeV [m]

$\eta(1440)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\overline{K}\pi$	seen	–
$K\overline{K}^*(892)+$ c.c.	seen	–
$\eta\pi\pi$	seen	–
$a_0(980)\pi$	seen	–
$\eta(\pi\pi)_{S\text{-wave}}$	seen	–
$f_0(980)\eta$	seen	–
4π	seen	–

$a_0(1450)$

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

Mass $m = 1474 \pm 19$ MeV
Full width $\Gamma = 265 \pm 13$ MeV

$a_0(1450)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\pi\eta$	seen	613
$\pi\eta'(958)$	seen	392
$K\overline{K}$	seen	530

$\rho(1450)$ [q]

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

Mass $m = 1465 \pm 25$ MeV [m]
Full width $\Gamma = 310 \pm 60$ MeV [m]

$\rho(1450)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\pi\pi$	seen		719
4π	seen		665
$\omega\pi$	<2.0 %	95%	512
e^+e^-	seen		732
$\eta\rho$	<4 %		317
$a_2(1320)\pi$	not seen		–
$\phi\pi$	<1 %		358
$K\overline{K}$	$<1.6 \times 10^{-3}$	95%	541
$\eta\gamma$	possibly seen		–

$f_0(1500)$ [r]

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

Mass $m = 1507 \pm 5$ MeV (S = 1.2)
Full width $\Gamma = 109 \pm 7$ MeV

$f_0(1500)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\eta\eta'(958)$	seen	–
$\eta\eta$	seen	513
4π	seen	–
$4\pi^0$	seen	690
$2\pi^+ 2\pi^-$	seen	686
$\pi\pi$	seen	–
$\pi^+\pi^-$	seen	737
$2\pi^0$	seen	738
$K\overline{K}$	seen	563
$\gamma\gamma$	not seen	–

$f'_2(1525)$

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

Mass $m = 1525 \pm 5$ MeV [m]
Full width $\Gamma = 76 \pm 10$ MeV [m]

$f'_2(1525)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\overline{K}$	(88.8 ± 3.1) %	581
$\eta\eta$	(10.3 ± 3.1) %	531
$\pi\pi$	$(8.2 \pm 1.5) \times 10^{-3}$	750
$\gamma\gamma$	$(1.23 \pm 0.17) \times 10^{-6}$	763

$\omega(1650)$ [s]
was $\omega(1600)$

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

Mass $m = 1649 \pm 24$ MeV (S = 2.3)
Full width $\Gamma = 220 \pm 35$ MeV (S = 1.6)

$\omega(1650)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\rho\pi$	seen	637
$\omega\pi\pi$	seen	601
$\omega\eta$	seen	–
e^+e^-	seen	824

$\omega_3(1670)$

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

Mass $m = 1667 \pm 4$ MeV
Full width $\Gamma = 168 \pm 10$ MeV [m]

$\omega_3(1670)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\rho\pi$	seen	647
$\omega\pi\pi$	seen	614
$b_1(1235)\pi$	possibly seen	359

$\pi_2(1670)$

$I^G(J^{PC}) = 1^-(2^{-+})$

Mass $m = 1670 \pm 20$ MeV [m]
Full width $\Gamma = 259 \pm 10$ MeV [m] (S = 1.4)

$\pi_2(1670)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
3π	(95.8 ± 1.4) %		806
$f_2(1270)\pi$	(56.2 ± 3.2) %		325
$\rho\pi$	(31 ± 4) %		649
$\sigma\pi$	(13 ± 6) %		–
$f_0(1370)\pi$	(8.7 ± 3.4) %		–
$K\overline{K}^*(892)+$ c.c.	(4.2 ± 1.4) %		453
$\omega\rho$	(2.7 ± 1.1) %		–
$\rho(1450)\pi$	$< 3.6 \times 10^{-3}$	97.7%	–
$b_1(1235)\pi$	$< 1.9 \times 10^{-3}$	97.7%	–

$\phi(1680)$

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

Mass $m = 1680 \pm 20$ MeV [m]
Full width $\Gamma = 150 \pm 50$ MeV [m]

$\phi(1680)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\overline{K}^*(892)+$ c.c.	dominant	463
$K^0_S K\pi$	seen	620
$K\overline{K}$	seen	681
e^+e^-	seen	840
$\omega\pi\pi$	not seen	622

$\rho_3(1690)$

$I^G(J^{PC}) = 1^+(3^{--})$

Mass $m = 1691 \pm 5$ MeV [m]
Full width $\Gamma = 161 \pm 10$ MeV [m] (S = 1.5)

$\rho_3(1690)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor	p (MeV/c)
4π	(71.1 ± 1.9) %		788
$\pi^{\pm}\pi^+\pi^-\pi^0$	(67 ±22) %		788
$\omega\pi$	(16 ± 6) %		656
$\pi\pi$	(23.6 ± 1.3) %		834
$K\overline{K}\pi$	(3.8 ± 1.2) %		628
$K\overline{K}$	(1.58± 0.26) %	1.2	686
$\eta\pi^+\pi^-$	seen		728
$\rho(770)\eta$	seen		–

$\rho(1700)$ [q]

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

Mass $m = 1700 \pm 20$ MeV [m] ($\eta\rho^0$ and $\pi^+\pi^-$ modes)
Full width $\Gamma = 240 \pm 60$ MeV [m] ($\eta\rho^0$ and $\pi^+\pi^-$ modes)

$\rho(1700)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$2(\pi^+\pi^-)$	large	792
$\rho\pi\pi$	dominant	640
$\rho^0\pi^+\pi^-$	large	640
$\rho^{\pm}\pi^{\mp}\pi^0$	large	642
$\pi^+\pi^-$	seen	838
$\pi\pi$	seen	839
$K\overline{K}^*(892)+$ c.c.	seen	479
$\eta\rho$	seen	533
$a_2(1320)\pi$	not seen	–
$K\overline{K}$	seen	692
e^+e^-	seen	850
$\pi^0\omega$	seen	662

$f_0(1710)$ [t]

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

Mass $m = 1713 \pm 6$ MeV
Full width $\Gamma = 125 \pm 10$ MeV

$f_0(1710)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\overline{K}$	seen	690
$\eta\eta$	seen	648
$\pi\pi$	seen	837

$\pi(1800)$

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

Mass $m = 1801 \pm 13$ MeV (S = 1.9)
Full width $\Gamma = 210 \pm 15$ MeV

$\pi(1800)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\pi^+\pi^-\pi^-$	seen	–
$f_0(980)\pi^-$	seen	623
$f_0(1370)\pi^-$	seen	–
$\rho\pi^-$	not seen	728
$\eta\eta\pi^-$	seen	–
$a_0(980)\eta$	seen	459
$f_0(1500)\pi^-$	seen	240
$\eta\eta'(958)\pi^-$	seen	–
$K_0^*(1430)K^-$	seen	–
$K^*(892)K^-$	not seen	560

$\phi_3(1850)$

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

Mass $m = 1854 \pm 7$ MeV
Full width $\Gamma = 87^{+28}_{-23}$ MeV (S = 1.2)

$\phi_3(1850)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\overline{K}$	seen	785
$K\overline{K}^*(892)+$ c.c.	seen	602

$f_2(2010)$

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

Mass $m = 2011^{+60}_{-80}$ MeV
Full width $\Gamma = 202 \pm 60$ MeV

$f_2(2010)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\phi\phi$	seen	–

$a_4(2040)$

$I^G(J^{PC}) = 1^-(4^{++})$

Mass $m = 2011 \pm 13$ MeV
Full width $\Gamma = 360 \pm 40$ MeV

$a_4(2040)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\overline{K}$	seen	892
$\pi^+\pi^-\pi^0$	seen	–
$\eta\pi^0$	seen	941
$\eta'(958)\pi$	seen	–

$f_4(2050)$

$I^G(J^{PC}) = 0^+(4^{++})$

Mass $m = 2025 \pm 8$ MeV (S = 1.7)
Full width $\Gamma = 194 \pm 13$ MeV (S = 2.2)

$f_4(2050)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\omega\omega$	not seen	658
$\pi\pi$	(17.0 ± 1.5) %	1012
$K\overline{K}$	$(6.8^{+3.4}_{-1.8}) \times 10^{-3}$	895
$\eta\eta$	$(2.1\pm0.8) \times 10^{-3}$	863
$4\pi^0$	$<$ 1.2 %	977
$a_2(1320)\pi$	seen	–

$f_2(2300)$

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

Mass $m = 2297 \pm 28$ MeV
Full width $\Gamma = 149 \pm 40$ MeV

$f_2(2300)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\phi\phi$	seen	529

$f_2(2340)$

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

Mass $m = 2339 \pm 60$ MeV
Full width $\Gamma = 319^{+80}_{-70}$ MeV

$f_2(2340)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\phi\phi$	seen	573

STRANGE MESONS
($S = \pm1$, $C = B = 0$)

$K^+ = u\bar{s}$, $K^0 = d\bar{s}$, $\overline{K}^0 = \overline{d}s$, $K^- = \overline{u}s$, similarly for K^*'s

$K^\pm$

$I(J^P) = \frac{1}{2}(0^-)$

Mass $m = 493.677 \pm 0.016$ MeV [u] (S = 2.8)
Mean life $\tau = (1.2384 \pm 0.0024) \times 10^{-8}$ s (S = 2.0)
$c\tau = 3.713$ m

Slope parameter g [v]

(See Particle Listings for quadratic coefficients)

$K^+ \rightarrow \pi^+\pi^+\pi^- = -0.2154 \pm 0.0035$ (S = 1.4)
$K^- \rightarrow \pi^-\pi^-\pi^+ = -0.217 \pm 0.007$ (S = 2.5)
$K^\pm \rightarrow \pi^\pm\pi^0\pi^0 = 0.652 \pm 0.031$ (S = 2.7)

$K^\pm$ decay form factors [a,w]

Assuming μ-e universality

$\lambda_+(K^+_{\mu3}) = \lambda_+(K^+_{e3}) = 0.0282 \pm 0.0027$ (S = 1.5)
$\lambda_0(K^+_{\mu3}) = 0.013 \pm 0.005$ (S = 1.5)

Not assuming μ-e universality

$\lambda_+(K^+_{e3}) = 0.0278 \pm 0.0019$
$\lambda_+(K^+_{\mu3}) = 0.033 \pm 0.010$ (S = 1.8)
$\lambda_0(K^+_{\mu3}) = 0.004 \pm 0.009$ (S = 1.8)

K^+_{e3} $|f_S/f_+| = 0.045 \pm 0.033$ (S = 1.8)
K^+_{e3} $|f_T/f_+| = 0.31 \pm 0.25$ (S = 2.4)
$K^+_{\mu3}$ $|f_T/f_+| = 0.02 \pm 0.12$
$K^+ \rightarrow e^+\nu_e\gamma$ $|F_A + F_V| = 0.148 \pm 0.010$
$K^+ \rightarrow \mu^+\nu_\mu\gamma$ $|F_A + F_V| = 0.165 \pm 0.013$
$K^+ \rightarrow e^+\nu_e\gamma$ $|F_A - F_V| < 0.49$
$K^+ \rightarrow \mu^+\nu_\mu\gamma$ $|F_A - F_V|$

K^- modes are charge conjugates of the modes below.

K^+ DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Leptonic and semileptonic modes				
$e^+\nu_e$		$(1.55 \pm 0.07) \times 10^{-5}$		247
$\mu^+\nu_\mu$		(63.43 ± 0.17) %	S=1.2	236
$\pi^0 e^+\nu_e$		(4.87 ± 0.06) %	S=1.2	228
Called K^+_{e3}.				
$\pi^0 \mu^+\nu_\mu$		(3.27 ± 0.06) %	S=1.2	215
Called $K^+_{\mu 3}$.				
$\pi^0\pi^0 e^+\nu_e$		$(2.1 \pm 0.4) \times 10^{-5}$		206
$\pi^+\pi^- e^+\nu_e$		$(4.08 \pm 0.09) \times 10^{-5}$		203
$\pi^+\pi^- \mu^+\nu_\mu$		$(1.4 \pm 0.9) \times 10^{-5}$		151
$\pi^0\pi^0\pi^0 e^+\nu_e$		$< 3.5 \times 10^{-6}$	CL=90%	135
Hadronic modes				
$\pi^+\pi^0$		(21.13 ± 0.14) %	S=1.1	205
$\pi^+\pi^0\pi^0$		(1.73 ± 0.04) %	S=1.2	133
$\pi^+\pi^+\pi^-$		(5.576 ± 0.031) %	S=1.1	125
Leptonic and semileptonic modes with photons				
$\mu^+\nu_\mu\gamma$	[x,y]	$(5.50 \pm 0.28) \times 10^{-3}$		236
$\pi^0 e^+\nu_e\gamma$	[x,y]	$(2.65 \pm 0.20) \times 10^{-4}$		228
$\pi^0 e^+\nu_e\gamma$(SD)	[z]	$< 5.3 \times 10^{-5}$	CL=90%	228
$\pi^0 \mu^+\nu_\mu\gamma$	[x,y]	$< 6.1 \times 10^{-5}$	CL=90%	215
$\pi^0\pi^0 e^+\nu_e\gamma$		$< 5 \times 10^{-6}$	CL=90%	206
Hadronic modes with photons				
$\pi^+\pi^0\gamma$	[x,y]	$(2.75 \pm 0.15) \times 10^{-4}$		205
$\pi^+\pi^0\gamma$(DE)	[y,aa]	$(4.7 \pm 0.9) \times 10^{-6}$		205
$\pi^+\pi^0\pi^0\gamma$	[x,y]	$(7.4 {}^{+5.5}_{-2.9}) \times 10^{-6}$		133
$\pi^+\pi^+\pi^-\gamma$	[x,y]	$(1.04 \pm 0.31) \times 10^{-4}$		125
$\pi^+\gamma\gamma$	[y]	$(1.10 \pm 0.32) \times 10^{-6}$		227
$\pi^+ 3\gamma$	[y]	$< 1.0 \times 10^{-4}$	CL=90%	227
Leptonic modes with $\ell\overline{\ell}$ pairs				
$e^+\nu_e\nu\overline{\nu}$		$< 6 \times 10^{-5}$	CL=90%	247
$\mu^+\nu_\mu\nu\overline{\nu}$		$< 6.0 \times 10^{-6}$	CL=90%	236
$e^+\nu_e e^+ e^-$		$(3.1 {}^{+3.1}_{-1.6}) \times 10^{-8}$		247
$\mu^+\nu_\mu e^+ e^-$		$(1.3 \pm 0.4) \times 10^{-7}$		236
$e^+\nu_e \mu^+\mu^-$		$< 5 \times 10^{-7}$	CL=90%	–
$\mu^+\nu_\mu \mu^+\mu^-$		$< 4.1 \times 10^{-7}$	CL=90%	185

Lepton Family number (LF), Lepton number (L), $\Delta S = \Delta Q$ (SQ) violating modes, or $\Delta S = 1$ weak neutral current ($S1$) modes

$\pi^+ \pi^+ e^- \overline{\nu}_e$	SQ		$<$ 1.2	$\times 10^{-8}$	CL=90%	203
$\pi^+ \pi^+ \mu^- \overline{\nu}_\mu$	SQ		$<$ 3.0	$\times 10^{-6}$	CL=95%	151
$\pi^+ e^+ e^-$	$S1$		(2.88 $\pm$0.13)	$\times 10^{-7}$		227
$\pi^+ \mu^+ \mu^-$	$S1$		(7.6 $\pm$2.1)	$\times 10^{-8}$	S=3.4	172
$\pi^+ \nu \overline{\nu}$	$S1$		(1.6 $^{+1.8}_{-0.8}$)	$\times 10^{-10}$		227
$\pi^+ \pi^0 \nu \overline{\nu}$	$S1$		$<$ 4.3	$\times 10^{-5}$	CL=90%	–
$\mu^- \nu e^+ e^+$	LF		$<$ 2.0	$\times 10^{-8}$	CL=90%	236
$\mu^+ \nu_e$	LF	[d]	$<$ 4	$\times 10^{-3}$	CL=90%	236
$\pi^+ \mu^+ e^-$	LF		$<$ 2.8	$\times 10^{-11}$	CL=90%	214
$\pi^+ \mu^- e^+$	LF		$<$ 5.2	$\times 10^{-10}$	CL=90%	214
$\pi^- \mu^+ e^+$	L		$<$ 5.0	$\times 10^{-10}$	CL=90%	214
$\pi^- e^+ e^+$	L		$<$ 6.4	$\times 10^{-10}$	CL=90%	227
$\pi^- \mu^+ \mu^+$	L	[d]	$<$ 3.0	$\times 10^{-9}$	CL=90%	172
$\mu^+ \overline{\nu}_e$	L	[d]	$<$ 3.3	$\times 10^{-3}$	CL=90%	236
$\pi^0 e^+ \overline{\nu}_e$	L		$<$ 3	$\times 10^{-3}$	CL=90%	228
$\pi^+ \gamma$		[bb]	$<$ 3.6	$\times 10^{-7}$	CL=90%	–

K^0

$I(J^P) = \frac{1}{2}(0^-)$

50% K_S, 50% K_L

Mass $m = 497.672 \pm 0.031$ MeV

$m_{K^0} - m_{K^\pm} = 3.995 \pm 0.034$ MeV (S = 1.1)

$\left| m_{K^0} - m_{\overline{K}^0} \right| / m_{\text{average}} < 10^{-18}$, CL = 90% [cc]

T-violation parameters in K^0-$\overline{K}^0$ mixing [w]

Asymmetry A_T in K^0-$\overline{K}^0$ mixing = $(6.6 \pm 1.6) \times 10^{-3}$

CPT-violation parameters in K^0-$\overline{K}^0$ mixing [w]

Re $\delta = (2.9 \pm 2.7) \times 10^{-4}$

Im $\delta = (-0.8 \pm 3.1) \times 10^{-3}$

K^0_S

$I(J^P) = \frac{1}{2}(0^-)$

Mean life $\tau = (0.8935 \pm 0.0008) \times 10^{-10}$ s Assuming *CPT*
Mean life $\tau = (0.8937 \pm 0.0012) \times 10^{-10}$ s Not assuming *CPT*
$c\tau = 2.6786$ cm Assuming *CPT*

CP-violation parameters [dd]

$\mathrm{Im}(\eta_{+-0}) = -0.002 \pm 0.009$
$\mathrm{Im}(\eta_{000}) = -0.05 \pm 0.13$

K^0_S DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Hadronic modes				
$\pi^0 \pi^0$		(31.40 ± 0.27) %	S=1.2	209
$\pi^+ \pi^-$		(68.60 ± 0.27) %	S=1.2	206
$\pi^+ \pi^- \pi^0$		$(3.2\ ^{+1.2}_{-1.0}) \times 10^{-7}$		133
Modes with photons or $\ell\overline{\ell}$ pairs				
$\pi^+ \pi^- \gamma$	[x,ee]	$(1.78 \pm 0.05) \times 10^{-3}$		206
$\pi^+ \pi^- e^+ e^-$		$(4.5 \pm 0.8) \times 10^{-5}$		–
$\gamma \gamma$		$(2.5 \pm 0.4) \times 10^{-6}$		249
Semileptonic modes				
$\pi^\pm e^\mp \nu_e$	[ff]	$(7.2 \pm 1.4) \times 10^{-4}$		229
***CP* violating (*CP*) and $\Delta S = 1$ weak neutral current (*S1*) modes**				
$3\pi^0$	*CP*	$< 1.4 \times 10^{-5}$	CL=90%	139
$\mu^+ \mu^-$	*S1*	$< 3.2 \times 10^{-7}$	CL=90%	225
$e^+ e^-$	*S1*	$< 1.4 \times 10^{-7}$	CL=90%	249
$\pi^0 e^+ e^-$	*S1*	$< 1.4 \times 10^{-7}$	CL=90%	231

K^0_L

$I(J^P) = \frac{1}{2}(0^-)$

$m_{K_L} - m_{K_S}$
$= (0.5303 \pm 0.0009) \times 10^{10}\ \hbar\ \mathrm{s}^{-1}$ Assuming *CPT*
$= (3.490 \pm 0.006) \times 10^{-12}$ MeV Assuming *CPT*
$= (0.5301 \pm 0.0016) \times 10^{10}\ \hbar\ \mathrm{s}^{-1}$ Not assuming *CPT*

Mean life $\tau = (5.17 \pm 0.04) \times 10^{-8}$ s (S = 1.1)
$c\tau = 15.51$ m

Slope parameter g [v]

(See Particle Listings for quadratic coefficients)

$K^0_L \to \pi^+ \pi^- \pi^0 = 0.678 \pm 0.008$ (S = 1.5)

K_L decay form factors [w]

Assuming μ-e universality

$\lambda_+(K^0_{\mu 3}) = \lambda_+(K^0_{e3}) = 0.0300 \pm 0.0020$ (S = 2.0)

$\lambda_0(K^0_{\mu 3}) = 0.030 \pm 0.005$ (S = 2.0)

Not assuming μ-e universality

$\lambda_+(K^0_{e3}) = 0.0291 \pm 0.0018$ (S = 1.5)

$\lambda_+(K^0_{\mu 3}) = 0.033 \pm 0.005$ (S = 2.3)

$\lambda_0(K^0_{\mu 3}) = 0.027 \pm 0.006$ (S = 2.3)

K^0_{e3} $\left|f_S/f_+\right| < 0.04$, CL = 68%

K^0_{e3} $\left|f_T/f_+\right| < 0.23$, CL = 68%

$K^0_{\mu 3}$ $\left|f_T/f_+\right| = 0.12 \pm 0.12$

$K_L \to e^+ e^- \gamma$: $\alpha_{K^*} = -0.33 \pm 0.05$

$\alpha_{K^*} = -0.158 \pm 0.027$

$\alpha^{\text{eff}}_{K^*} = -0.14 \pm 0.22$

$a_V = -0.72 \pm 0.07$

CP-violation parameters [dd]

$\delta_L = (0.327 \pm 0.012)\%$

$\left|\eta_{00}\right| = (2.274 \pm 0.017) \times 10^{-3}$

$\left|\eta_{+-}\right| = (2.286 \pm 0.017) \times 10^{-3}$

$\left|\eta_{00}/\eta_{+-}\right| = 0.9946 \pm 0.0013$ [gg] (S = 2.3)

$\text{Re}(\epsilon'/\epsilon) = (1.8 \pm 0.4) \times 10^{-3}$ [gg] (S = 2.3)

Assuming *CPT*

$\phi_{+-} = \phi_{00} = (43.51 \pm 0.06)^\circ$

Not assuming *CPT*

$\phi_{+-} = (43.4 \pm 0.7)^\circ$

$\phi_{00} = (43.2 \pm 1.0)^\circ$

$\phi_{00} - \phi_{+-} = (-0.1 \pm 0.8)^\circ$

CP asymmetry *A* in $K^0_L \to \pi^+\pi^- e^+ e^- = (13.6 \pm 2.8)\%$

β_{CP} from $K_L \to e^+ e^- e^+ e^- = -0.23 \pm 0.09$

γ_{CP} from $K^0_L \to e^+ e^- e^+ e^- = -0.09 \pm 0.09$

j for $K^0_L \to \pi^+\pi^-\pi^0 = 0.0011 \pm 0.0008$

f for $K^0_L \to \pi^+\pi^-\pi^0 = 0.004 \pm 0.006$

$|\eta_{+-\gamma}| = (2.35 \pm 0.07) \times 10^{-3}$

$\phi_{+-\gamma} = (44 \pm 4)^\circ$

$|\epsilon'_{+-\gamma}|/\epsilon < 0.3$, CL = 90%

$\Delta S = -\Delta Q$ in $K^0_{\ell 3}$ decay

Re $x = -0.002 \pm 0.006$

Im $x = 0.0012 \pm 0.0021$

K^0_L DECAY MODES			Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Semileptonic modes					
$\pi^\pm e^\mp \nu_e$		[*ff*]	(38.79 ± 0.27) %	S=1.1	229
Called K^0_{e3}.					
$\pi^\pm \mu^\mp \nu_\mu$		[*ff*]	(27.18 ± 0.25) %	S=1.1	216
Called $K^0_{\mu 3}$.					
$(\pi\mu \text{atom})\nu$			$(1.06 \pm 0.11) \times 10^{-7}$		188
$\pi^0\pi^\pm e^\mp \nu$		[*ff*]	$(5.18 \pm 0.29) \times 10^{-5}$		207
Hadronic modes, including Charge conjugation×Parity Violating (*CPV*) modes					
$3\pi^0$			(21.08 ± 0.27) %	S=1.1	139
$\pi^+\pi^-\pi^0$			(12.58 ± 0.19) %	S=1.7	133
$\pi^+\pi^-$	*CPV*		$(2.084 \pm 0.032) \times 10^{-3}$	S=1.1	206
$\pi^0\pi^0$	*CPV*		$(9.42 \pm 0.19) \times 10^{-4}$	S=1.1	209
Semileptonic modes with photons					
$\pi^\pm e^\mp \nu_e \gamma$		[*x,ff,hh*]	$(3.53 \pm 0.06) \times 10^{-3}$		229
$\pi^\pm \mu^\mp \nu_\mu \gamma$			$(5.7 {}^{+0.6}_{-0.7}) \times 10^{-4}$		–

Hadronic modes with photons or $\ell\overline{\ell}$ pairs

$\pi^0\pi^0\gamma$		$< 5.6 \times 10^{-6}$			209
$\pi^+\pi^-\gamma$	[x,hh]	$(4.38 \pm 0.13) \times 10^{-5}$	S=1.8		206
$\pi^0 2\gamma$	[hh]	$(1.68 \pm 0.10) \times 10^{-6}$			231
$\pi^0\gamma e^+e^-$		$(2.3 \pm 0.4) \times 10^{-8}$			–

Other modes with photons or $\ell\overline{\ell}$ pairs

2γ		$(5.96 \pm 0.15) \times 10^{-4}$		249
3γ		$< 2.4 \times 10^{-7}$	CL=90%	249
$e^+e^-\gamma$		$(10.0 \pm 0.5) \times 10^{-6}$	S=1.5	249
$\mu^+\mu^-\gamma$		$(3.59 \pm 0.11) \times 10^{-7}$	S=1.3	225
$e^+e^-\gamma\gamma$	[hh]	$(5.95 \pm 0.33) \times 10^{-7}$		249
$\mu^+\mu^-\gamma\gamma$	[hh]	$(1.0 ^{+0.8}_{-0.6}) \times 10^{-8}$		–

Charge conjugation × Parity (*CP*) or Lepton Family number (*LF*) violating modes, or $\Delta S = 1$ weak neutral current (*S1*) modes

$\mu^+\mu^-$	*S1*		$(7.25 \pm 0.16) \times 10^{-9}$		225
e^+e^-	*S1*		$(9 ^{+6}_{-4}) \times 10^{-12}$		249
$\pi^+\pi^-e^+e^-$	*S1*	[hh]	$(3.5 \pm 0.6) \times 10^{-7}$		206
$\mu^+\mu^-e^+e^-$	*S1*		$(2.6 \pm 0.4) \times 10^{-9}$		225
$e^+e^-e^+e^-$	*S1*		$(3.75 \pm 0.27) \times 10^{-8}$		249
$\pi^0\mu^+\mu^-$	*CP,S1*	[ii]	$< 3.8 \times 10^{-10}$	CL=90%	177
$\pi^0e^+e^-$	*CP,S1*	[ii]	$< 5.1 \times 10^{-10}$	CL=90%	231
$\pi^0\nu\overline{\nu}$	*CP,S1*	[jj]	$< 5.9 \times 10^{-7}$	CL=90%	231
$e^\pm\mu^\mp$	*LF*	[ff]	$< 4.7 \times 10^{-12}$	CL=90%	238
$e^\pm e^\pm\mu^\mp\mu^\mp$	*LF*	[ff]	$< 1.23 \times 10^{-10}$	CL=90%	–
$\pi^0\mu^\pm e^\mp$	*LF*	[ff]	$< 6.2 \times 10^{-9}$	CL=90%	–

$K^*(892)$

$I(J^P) = \frac{1}{2}(1^-)$

$K^*(892)^\pm$ mass $m = 891.66 \pm 0.26$ MeV
$K^*(892)^0$ mass $m = 896.10 \pm 0.27$ MeV (S = 1.4)
$K^*(892)^\pm$ full width $\Gamma = 50.8 \pm 0.9$ MeV
$K^*(892)^0$ full width $\Gamma = 50.7 \pm 0.6$ MeV (S = 1.1)

K^*(892) DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$K\pi$	~ 100 %		291
$K^0\gamma$	$(2.30 \pm 0.20) \times 10^{-3}$		310
$K^\pm\gamma$	$(9.9 \pm 0.9) \times 10^{-4}$		309
$K\pi\pi$	$< 7 \times 10^{-4}$	95%	224

$K_1(1270)$

$I(J^P) = \frac{1}{2}(1^+)$

Mass $m = 1273 \pm 7$ MeV [m]
Full width $\Gamma = 90 \pm 20$ MeV [m]

$K_1(1270)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\rho$	(42 ± 6) %	76
$K_0^*(1430)\pi$	(28 ± 4) %	–
$K^*(892)\pi$	(16 ± 5) %	301
$K\omega$	(11.0 ± 2.0) %	–
$K f_0(1370)$	(3.0 ± 2.0) %	–

$K_1(1400)$

$I(J^P) = \frac{1}{2}(1^+)$

Mass $m = 1402 \pm 7$ MeV
Full width $\Gamma = 174 \pm 13$ MeV (S = 1.6)

$K_1(1400)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K^*(892)\pi$	(94 ± 6) %	401
$K\rho$	(3.0 ± 3.0) %	298
$K f_0(1370)$	(2.0 ± 2.0) %	–
$K\omega$	(1.0 ± 1.0) %	285
$K_0^*(1430)\pi$	not seen	–

$K^*(1410)$

$I(J^P) = \frac{1}{2}(1^-)$

Mass $m = 1414 \pm 15$ MeV (S = 1.3)
Full width $\Gamma = 232 \pm 21$ MeV (S = 1.1)

$K^*(1410)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$K^*(892)\pi$	> 40 %	95%	408
$K\pi$	(6.6 ± 1.3) %		611
$K\rho$	< 7 %	95%	309

$K_0^*(1430)$ [kk]

$I(J^P) = \frac{1}{2}(0^+)$

Mass $m = 1412 \pm 6$ MeV
Full width $\Gamma = 294 \pm 23$ MeV

$K_0^*(1430)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\pi$	(93 ± 10) %	621

$K_2^*(1430)$

$I(J^P) = \frac{1}{2}(2^+)$

$K_2^*(1430)^\pm$ mass $m = 1425.6 \pm 1.5$ MeV (S = 1.1)
$K_2^*(1430)^0$ mass $m = 1432.4 \pm 1.3$ MeV
$K_2^*(1430)^\pm$ full width $\Gamma = 98.5 \pm 2.7$ MeV (S = 1.1)
$K_2^*(1430)^0$ full width $\Gamma = 109 \pm 5$ MeV (S = 1.9)

$K_2^*(1430)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$K\pi$	(49.9 ± 1.2) %		622
$K^*(892)\pi$	(24.7 ± 1.5) %		423
$K^*(892)\pi\pi$	(13.4 ± 2.2) %		375
$K\rho$	(8.7 ± 0.8) %	S=1.2	331
$K\omega$	(2.9 ± 0.8) %		319
$K^+\gamma$	$(2.4\pm0.5)\times10^{-3}$	S=1.1	627
$K\eta$	$(1.5^{+3.4}_{-1.0})\times10^{-3}$	S=1.3	492
$K\omega\pi$	$< 7.2 \times10^{-4}$	CL=95%	110
$K^0\gamma$	$< 9 \times10^{-4}$	CL=90%	631

$K^*(1680)$

$I(J^P) = \frac{1}{2}(1^-)$

Mass $m = 1717 \pm 27$ MeV (S = 1.4)
Full width $\Gamma = 322 \pm 110$ MeV (S = 4.2)

$K^*(1680)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\pi$	(38.7 ± 2.5) %	779
$K\rho$	$(31.4^{+4.7}_{-2.1})$ %	571
$K^*(892)\pi$	$(29.9^{+2.2}_{-4.7})$ %	615

$K_2(1770)$ [ll]

$I(J^P) = \frac{1}{2}(2^-)$

Mass $m = 1773 \pm 8$ MeV
Full width $\Gamma = 186 \pm 14$ MeV

$K_2(1770)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\pi\pi$		–
$K_2^*(1430)\pi$	dominant	287
$K^*(892)\pi$	seen	653
$K f_2(1270)$	seen	–
$K\phi$	seen	441
$K\omega$	seen	608

$K_3^*(1780)$

$I(J^P) = \frac{1}{2}(3^-)$

Mass $m = 1776 \pm 7$ MeV (S = 1.1)
Full width $\Gamma = 159 \pm 21$ MeV (S = 1.3)

$K_3^*(1780)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$K\rho$	(31 ± 9) %		612
$K^*(892)\pi$	(20 ± 5) %		651
$K\pi$	(18.8 ± 1.0) %		810
$K\eta$	(30 ± 13) %		715
$K_2^*(1430)\pi$	< 16 %	95%	284

$K_2(1820)$ [mm]

$I(J^P) = \frac{1}{2}(2^-)$

Mass $m = 1816 \pm 13$ MeV
Full width $\Gamma = 276 \pm 35$ MeV

$K_2(1820)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K_2^*(1430)\pi$	seen	325
$K^*(892)\pi$	seen	680
$K f_2(1270)$	seen	186
$K\omega$	seen	638

$K_4^*(2045)$

$I(J^P) = \frac{1}{2}(4^+)$

Mass $m = 2045 \pm 9$ MeV (S = 1.1)
Full width $\Gamma = 198 \pm 30$ MeV

$K_4^*(2045)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\pi$	(9.9 ± 1.2) %	958
$K^*(892)\pi\pi$	$(9\ \pm5\ )$ %	800
$K^*(892)\pi\pi\pi$	$(7\ \pm5\ )$ %	764
$\rho K\pi$	(5.7 ± 3.2) %	742
$\omega K\pi$	(5.0 ± 3.0) %	736
$\phi K\pi$	(2.8 ± 1.4) %	591
$\phi K^*(892)$	(1.4 ± 0.7) %	363

CHARMED MESONS
($C = \pm 1$)

$D^+ = c\overline{d}$, $D^0 = c\overline{u}$, $\overline{D}^0 = \overline{c}\,u$, $D^- = \overline{c}\,d$, similarly for D^*'s

$D^{\pm}$

$I(J^P) = \frac{1}{2}(0^-)$

Mass $m = 1869.3 \pm 0.5$ MeV (S = 1.1)
Mean life $\tau = (1051 \pm 13) \times 10^{-15}$ s
$c\tau = 315\ \mu$m

c-quark decays

$\Gamma(c \to \ \ell^+ \text{anything})/\Gamma(c \to \ \text{anything}) = 0.096 \pm 0.004$ [nn]
$\Gamma(c \to \ D^*(2010)^+ \text{anything})/\Gamma(c \to \ \text{anything}) = 0.255 \pm 0.017$

CP-violation decay-rate asymmetries

$A_{CP}(K^0_S \pi^{\pm}) = -0.016 \pm 0.017$
$A_{CP}(K^0_S K^{\pm}) = 0.07 \pm 0.06$
$A_{CP}(K^+ K^- \pi^{\pm}) = 0.002 \pm 0.011$
$A_{CP}(K^{\pm} K^{*0}) = -0.02 \pm 0.05$
$A_{CP}(\phi \pi^{\pm}) = -0.014 \pm 0.033$
$A_{CP}(\pi^+ \pi^- \pi^{\pm}) = -0.02 \pm 0.04$

$D^+ \to \ \overline{K}^*(892)^0 \ell^+ \nu_{\ell}$ form factors

$r_v = 1.82 \pm 0.09$
$r_2 = 0.78 \pm 0.07$
$r_3 = 0.0 \pm 0.4$
$\Gamma_L/\Gamma_T = 1.14 \pm 0.08$
$\Gamma_+/\Gamma_- = 0.21 \pm 0.04$ (S = 1.3)

D^- modes are charge conjugates of the modes below.

D^+ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Inclusive modes			
e^+ anything	(17.2 ± 1.9) %		–
K^- anything	(24.2 ± 2.8) %	S=1.4	–
$\overline{K}^0$ anything + K^0 anything	(59 ± 7) %		–
K^+ anything	(5.8 ± 1.4) %		–
η anything	[oo] < 13 %	CL=90%	–
ϕ anything	< 1.8 %	CL=90%	–
ϕe^+ anything	< 1.6 %	CL=90%	–

Leptonic and semileptonic modes

$\mu^+ \nu_\mu$		$(8\ {}^{+17}_{-\ 5}) \times 10^{-4}$		932
$\overline{K}^0 \ell^+ \nu_\ell$	[pp]	(6.7 ± 0.8) %		–
$\quad \overline{K}^0 e^+ \nu_e$		(6.6 ± 0.9) %		868
$\quad \overline{K}^0 \mu^+ \nu_\mu$		$(7.0\ {}^{+3.0}_{-2.0})$ %		865
$K^- \pi^+ e^+ \nu_e$		$(4.1\ {}^{+0.9}_{-0.7})$ %		863
$\quad \overline{K}^*(892)^0 e^+ \nu_e$ $\times$ B($\overline{K}^{*0} \to K^- \pi^+$)		(3.2 ± 0.33) %		720
$\quad K^- \pi^+ e^+ \nu_e$ nonresonant		$< 7 \times 10^{-3}$	CL=90%	863
$K^- \pi^+ \mu^+ \nu_\mu$		(3.2 ± 0.4) %	S=1.1	851
$\quad \overline{K}^*(892)^0 \mu^+ \nu_\mu$ $\times$ B($\overline{K}^{*0} \to K^- \pi^+$)		(3.0 ± 0.4) %		715
$\quad K^- \pi^+ \mu^+ \nu_\mu$ nonresonant		$(2.7 \pm 1.1) \times 10^{-3}$		851
$(\overline{K}^*(892)\pi)^0 e^+ \nu_e$		< 1.2 %	CL=90%	714
$(\overline{K}\pi\pi)^0 e^+ \nu_e$ non-$\overline{K}^*(892)$		$< 9 \times 10^{-3}$	CL=90%	846
$K^- \pi^+ \pi^0 \mu^+ \nu_\mu$		$< 1.4 \times 10^{-3}$	CL=90%	825
$\pi^0 \ell^+ \nu_\ell$	[qq]	$(3.1 \pm 1.5) \times 10^{-3}$		930

Fractions of some of the following modes with resonances have already appeared above as submodes of particular charged-particle modes.

$\overline{K}^*(892)^0 \ell^+ \nu_\ell$	[pp]	(4.8 ± 0.4) %		–
$\quad \overline{K}^*(892)^0 e^+ \nu_e$		(4.8 ± 0.5) %		720
$\quad \overline{K}^*(892)^0 \mu^+ \nu_\mu$		(4.5 ± 0.6) %	S=1.1	715
$\overline{K}_1(1270)^0 \mu^+ \nu_\mu$		< 3.5 %	CL=95%	493
$\overline{K}_2^*(1430)^0 \mu^+ \nu_\mu$		$< 8 \times 10^{-3}$	CL=95%	374
$\rho^0 e^+ \nu_e$		$(2.2 \pm 0.8) \times 10^{-3}$		776
$\rho^0 \mu^+ \nu_\mu$		$(2.7 \pm 0.7) \times 10^{-3}$		772
$\phi e^+ \nu_e$		< 2.09 %	CL=90%	657
$\phi \mu^+ \nu_\mu$		< 3.72 %	CL=90%	651
$\eta \ell^+ \nu_\ell$		$< 5 \times 10^{-3}$	CL=90%	–
$\eta'(958) \mu^+ \nu_\mu$		$< 9 \times 10^{-3}$	CL=90%	684

Hadronic modes with a $\overline{K}$ or $\overline{K}K\overline{K}$

$\overline{K}^0 \pi^+$		(2.77 ± 0.18) %		862
$K^- \pi^+ \pi^+$	[rr]	(9.1 ± 0.6) %		845
$\quad \overline{K}^*(892)^0 \pi^+$ $\times$ B($\overline{K}^{*0} \to K^- \pi^+$)		(1.28 ± 0.13) %		712
$\quad \overline{K}_0^*(1430)^0 \pi^+$ $\times$ B($\overline{K}_0^*(1430)^0 \to K^- \pi^+$)		(2.3 ± 0.3) %		368
$\quad \overline{K}^*(1680)^0 \pi^+$ $\times$ B($\overline{K}^*(1680)^0 \to K^- \pi^+$)		$(3.7 \pm 0.8) \times 10^{-3}$		65
$\quad K^- \pi^+ \pi^+$ nonresonant		(8.6 ± 0.8) %		845

$\overline{K}^0 \pi^+ \pi^0$	[rr]	(9.7 ± 3.0) %	S=1.1	845
$\overline{K}^0 \rho^+$		(6.6 ± 2.5) %		680
$\overline{K}^*(892)^0 \pi^+$ $\times$ B($\overline{K}^{*0} \to \overline{K}^0 \pi^0$)		(6.4 ± 0.6) $\times 10^{-3}$		712
$\overline{K}^0 \pi^+ \pi^0$ nonresonant		(1.3 ± 1.1) %		845
$K^- \pi^+ \pi^+ \pi^0$	[rr]	(6.4 ± 1.1) %		816
$\overline{K}^*(892)^0 \rho^+$ total $\times$ B($\overline{K}^{*0} \to K^- \pi^+$)		(1.4 ± 0.9) %		423
$\overline{K}_1(1400)^0 \pi^+$ $\times$ B($\overline{K}_1(1400)^0 \to K^- \pi^+ \pi^0$)		(2.1 ± 0.5) %		390
$K^- \rho^+ \pi^+$ total		(3.1 ± 1.1) %		616
$K^- \rho^+ \pi^+$ 3-body		(1.1 ± 0.4) %		616
$\overline{K}^*(892)^0 \pi^+ \pi^0$ total $\times$ B($\overline{K}^{*0} \to K^- \pi^+$)		(4.5 ± 0.9) %		687
$\overline{K}^*(892)^0 \pi^+ \pi^0$ 3-body $\times$ B($\overline{K}^{*0} \to K^- \pi^+$)		(2.8 ± 0.9) %		687
$K^*(892)^- \pi^+ \pi^+$ 3-body $\times$ B($K^{*-} \to K^- \pi^0$)		(7 ± 3) $\times 10^{-3}$		688
$K^- \pi^+ \pi^+ \pi^0$ nonresonant	[ss]	(1.2 ± 0.6) %		816
$\overline{K}^0 \pi^+ \pi^+ \pi^-$	[rr]	(7.0 ± 0.9) %		814
$\overline{K}^0 a_1(1260)^+$ $\times$ B($a_1(1260)^+ \to \pi^+ \pi^+ \pi^-$)		(4.0 ± 0.9) %		328
$\overline{K}_1(1400)^0 \pi^+$ $\times$ B($\overline{K}_1(1400)^0 \to \overline{K}^0 \pi^+ \pi^-$)		(2.1 ± 0.5) %		390
$K^*(892)^- \pi^+ \pi^+$ 3-body $\times$ B($K^{*-} \to \overline{K}^0 \pi^-$)		(1.4 ± 0.6) %		688
$\overline{K}^0 \rho^0 \pi^+$ total		(4.2 ± 0.9) %		614
$\overline{K}^0 \rho^0 \pi^+$ 3-body		(5 ± 5) $\times 10^{-3}$		614
$\overline{K}^0 \pi^+ \pi^+ \pi^-$ nonresonant		(8 ± 4) $\times 10^{-3}$		814
$K^- \pi^+ \pi^+ \pi^+ \pi^-$	[rr]	(7.3 ± 1.0) $\times 10^{-3}$		772
$\overline{K}^*(892)^0 \pi^+ \pi^+ \pi^-$ $\times$ B($\overline{K}^{*0} \to K^- \pi^+$)		(5.5 ± 2.3) $\times 10^{-3}$		642
$\overline{K}^*(892)^0 \rho^0 \pi^+$ $\times$ B($\overline{K}^{*0} \to K^- \pi^+$)		($1.9 \ {}^{+1.1}_{-1.0}$) $\times 10^{-3}$		242
$\overline{K}^*(892)^0 \pi^+ \pi^+ \pi^-$ no-ρ $\times$ B($\overline{K}^{*0} \to K^- \pi^+$)		(2.9 ± 1.1) $\times 10^{-3}$		642
$K^- \rho^0 \pi^+ \pi^+$		(3.1 ± 1.0) $\times 10^{-3}$		529
$K^- \pi^+ \pi^+ \pi^+ \pi^-$ nonresonant		< 2.4 $\times 10^{-3}$	CL=90%	772
$\overline{K}^0 \overline{K}^0 K^+$		(1.8 ± 0.8) %		545
$K^+ K^- \overline{K}^0 \pi^+$		(5.4 ± 1.4) $\times 10^{-4}$		435

Fractions of some of the following modes with resonances have already appeared above as submodes of particular charged-particle modes.

$\overline{K}^0 \rho^+$		(6.6 ± 2.5) %			680
$\overline{K}^0 a_1(1260)^+$		(8.1 ± 1.7) %			328
$\overline{K}^0 a_2(1320)^+$		< 3	$\times 10^{-3}$	CL=90%	199
$\overline{K}^*(892)^0 \pi^+$		(1.92 ± 0.19) %			712
$\overline{K}^*(892)^0 \rho^+$ total	[*ss*]	(2.1 ± 1.4) %			423
$\overline{K}^*(892)^0 \rho^+$ *S*-wave	[*ss*]	(1.7 ± 1.6) %			423
$\overline{K}^*(892)^0 \rho^+$ *P*-wave		< 1	$\times 10^{-3}$	CL=90%	423
$\overline{K}^*(892)^0 \rho^+$ *D*-wave		(10 ± 7)	$\times 10^{-3}$		423
$\overline{K}^*(892)^0 \rho^+$ *D*-wave longitudinal		< 7	$\times 10^{-3}$	CL=90%	423
$\overline{K}_1(1270)^0 \pi^+$		< 7	$\times 10^{-3}$	CL=90%	487
$\overline{K}_1(1400)^0 \pi^+$		(4.9 ± 1.2) %			390
$\overline{K}^*_0(1430)^0 \pi^+$		(3.7 ± 0.4) %			368
$\overline{K}^*(1680)^0 \pi^+$		(1.45 ± 0.31) %			65
$\overline{K}^*(892)^0 \pi^+ \pi^0$ total		(6.7 ± 1.4) %			687
$\overline{K}^*(892)^0 \pi^+ \pi^0$ 3-body	[*ss*]	(4.2 ± 1.4) %			687
$K^*(892)^- \pi^+ \pi^+$ 3-body		(2.1 ± 0.9) %			688
$K^- \rho^+ \pi^+$ total		(3.1 ± 1.1) %			616
$K^- \rho^+ \pi^+$ 3-body		(1.1 ± 0.4) %			616
$\overline{K}^0 \rho^0 \pi^+$ total		(4.2 ± 0.9) %		CL=90%	614
$\overline{K}^0 \rho^0 \pi^+$ 3-body		(5 ± 5)	$\times 10^{-3}$		614
$\overline{K}^*(892)^0 \pi^+ \pi^+ \pi^-$		(8.2 ± 3.4)	$\times 10^{-3}$	S=1.7	642
$\overline{K}^*(892)^0 \rho^0 \pi^+$		$(2.9 {+1.7 \atop -1.5})$	$\times 10^{-3}$	S=1.8	242
$\overline{K}^*(892)^0 \pi^+ \pi^+ \pi^-$ no-ρ		(4.3 ± 1.7)	$\times 10^{-3}$		642
$K^- \rho^0 \pi^+ \pi^+$		(3.1 ± 1.0)	$\times 10^{-3}$		529

Pionic modes

$\pi^+ \pi^0$		(2.5 ± 0.7)	$\times 10^{-3}$		925
$\pi^+ \pi^+ \pi^-$		(3.1 ± 0.4)	$\times 10^{-3}$	S=1.5	908
$\sigma \pi^+$		(2.1 ± 0.5)	$\times 10^{-3}$		–
$\rho^0 \pi^+$		(1.04 ± 0.18)	$\times 10^{-3}$		769
$f_0(980) \pi^+ \times \mathrm{B}(f_0 \to \pi^+ \pi^-)$	[*tt*]	(1.9 ± 0.5)	$\times 10^{-4}$		669
$f_2(1270) \pi^+ \times \mathrm{B}(f_2 \to \pi^+ \pi^-)$		(6.0 ± 1.1)	$\times 10^{-4}$		485
$\pi^+ \pi^+ \pi^-$ nonresonant		(2.4 ± 2.1)	$\times 10^{-4}$		908
$\pi^+ \pi^+ \pi^- \pi^0$		—			882
$\eta \pi^+ \times \mathrm{B}(\eta \to \pi^+ \pi^- \pi^0)$		(6.9 ± 1.4)	$\times 10^{-4}$		848
$\omega \pi^+ \times \mathrm{B}(\omega \to \pi^+ \pi^- \pi^0)$		< 6	$\times 10^{-3}$	CL=90%	764
$\pi^+ \pi^+ \pi^+ \pi^- \pi^-$		(2.1 ± 0.4)	$\times 10^{-3}$		845

Fractions of some of the following modes with resonances have already appeared above as submodes of particular charged-particle modes.

$\eta\pi^+$		$(3.0 \pm 0.6) \times 10^{-3}$		848
$\rho^0\pi^+$		$(1.04 \pm 0.18) \times 10^{-3}$		769
$\omega\pi^+$		$< 7 \times 10^{-3}$	CL=90%	764
$\eta\rho^+$		$< 7 \times 10^{-3}$	CL=90%	658
$\eta'(958)\pi^+$		$(5.0 \pm 1.0) \times 10^{-3}$		680
$\eta'(958)\rho^+$		$< 5 \times 10^{-3}$	CL=90%	355
$f_2(1270)\pi^+$		$(1.06 \pm 0.20) \times 10^{-3}$		485

Hadronic modes with a $K\overline{K}$ pair

$K^+\overline{K}^0$		$(5.8 \pm 0.6) \times 10^{-3}$	S=1.2	792
$K^+K^-\pi^+$	[rr]	$(8.8 \pm 0.8) \times 10^{-3}$		744
$\phi\pi^+ \times B(\phi \to K^+K^-)$		$(3.0 \pm 0.3) \times 10^{-3}$		647
$K^+\overline{K}^*(892)^0 \times B(\overline{K}^{*0} \to K^-\pi^+)$		$(2.8 \pm 0.4) \times 10^{-3}$		610
$K^+K^-\pi^+$ nonresonant		$(4.5 \pm 0.9) \times 10^{-3}$		744
$K^0\overline{K}^0\pi^+$		—		741
$K^*(892)^+\overline{K}^0 \times B(K^{*+} \to K^0\pi^+)$		(2.1 ± 0.9) %		611
$K^+K^-\pi^+\pi^0$		—		682
$\phi\pi^+\pi^0 \times B(\phi \to K^+K^-)$		(1.1 ± 0.5) %		619
$\phi\rho^+ \times B(\phi \to K^+K^-)$		$< 7 \times 10^{-3}$	CL=90%	268
$K^+K^-\pi^+\pi^0$ non-ϕ		$(1.5 {}^{+0.7}_{-0.6})$ %		682
$K^+\overline{K}^0\pi^+\pi^-$		$(4.0 \pm 0.7) \times 10^{-3}$		678
$K^0K^-\pi^+\pi^+$		$(5.4 \pm 0.8) \times 10^{-3}$		678
$K^*(892)^+\overline{K}^*(892)^0 \times B^2(K^{*+} \to K^0\pi^+)$		(1.2 ± 0.5) %		273
$K^0K^-\pi^+\pi^+$ non-$K^{*+}\overline{K}^{*0}$		$< 7.9 \times 10^{-3}$	CL=90%	678
$K^+K^-\pi^+\pi^+\pi^-$		—		600
$\phi\pi^+\pi^+\pi^- \times B(\phi \to K^+K^-)$		$< 1 \times 10^{-3}$	CL=90%	565
$K^+K^-\pi^+\pi^+\pi^-$ nonresonant		< 3 %	CL=90%	600

Fractions of the following modes with resonances have already appeared above as submodes of particular charged-particle modes.

$\phi\pi^+$	$(6.1 \pm 0.6) \times 10^{-3}$		647
$\phi\pi^+\pi^0$	(2.3 ± 1.0) %		619
$\phi\rho^+$	< 1.4 %	CL=90%	268
$\phi\pi^+\pi^+\pi^-$	$< 2 \times 10^{-3}$	CL=90%	565
$K^+\overline{K}^*(892)^0$	$(4.2 \pm 0.5) \times 10^{-3}$		610
$K^*(892)^+\overline{K}^0$	(3.1 ± 1.4) %		611
$K^*(892)^+\overline{K}^*(892)^0$	(2.6 ± 1.1) %		273

Doubly Cabibbo suppressed (*DC*) modes,
$\Delta C = 1$ weak neutral current (*C1*) modes, or
Lepton Family number (*LF*) or Lepton number (*L*) violating modes

$K^+\pi^+\pi^-$	*DC*		$(6.8 \pm 1.5) \times 10^{-4}$		845
$K^+\rho^0$	*DC*		$(2.5 \pm 1.2) \times 10^{-4}$		681
$K^*(892)^0\pi^+$	*DC*		$(3.6 \pm 1.6) \times 10^{-4}$		712
$K^+\pi^+\pi^-$ nonresonant	*DC*		$(2.5 \pm 1.2) \times 10^{-4}$		845
$K^+K^+K^-$	*DC*		$< 1.4 \times 10^{-4}$	CL=90%	550
ϕK^+	*DC*		$< 1.3 \times 10^{-4}$	CL=90%	527
$\pi^+e^+e^-$	*C1*		$< 5.2 \times 10^{-5}$	CL=90%	929
$\pi^+\mu^+\mu^-$	*C1*		$< 1.5 \times 10^{-5}$	CL=90%	917
$\rho^+\mu^+\mu^-$	*C1*		$< 5.6 \times 10^{-4}$	CL=90%	759
$K^+e^+e^-$		[uu]	$< 2.0 \times 10^{-4}$	CL=90%	869
$K^+\mu^+\mu^-$		[uu]	$< 4.4 \times 10^{-5}$	CL=90%	856
$\pi^+e^\pm\mu^\mp$	*LF*	[ff]	$< 3.4 \times 10^{-5}$	CL=90%	926
$K^+e^\pm\mu^\mp$	*LF*	[ff]	$< 6.8 \times 10^{-5}$	CL=90%	866
$\pi^-e^+e^+$	*L*		$< 9.6 \times 10^{-5}$	CL=90%	929
$\pi^-\mu^+\mu^+$	*L*		$< 1.7 \times 10^{-5}$	CL=90%	917
$\pi^-e^+\mu^+$	*L*		$< 5.0 \times 10^{-5}$	CL=90%	926
$\rho^-\mu^+\mu^+$	*L*		$< 5.6 \times 10^{-4}$	CL=90%	759
$K^-e^+e^+$	*L*		$< 1.2 \times 10^{-4}$	CL=90%	869
$K^-\mu^+\mu^+$	*L*		$< 1.2 \times 10^{-4}$	CL=90%	856
$K^-e^+\mu^+$	*L*		$< 1.3 \times 10^{-4}$	CL=90%	866
$K^*(892)^-\mu^+\mu^+$	*L*		$< 8.5 \times 10^{-4}$	CL=90%	703

D^0

$I(J^P) = \frac{1}{2}(0^-)$

Mass $m = 1864.5 \pm 0.5$ MeV (S = 1.1)
$m_{D^\pm} - m_{D^0} = 4.78 \pm 0.10$ MeV (S = 1.1)
Mean life $\tau = (411.7 \pm 2.7) \times 10^{-15}$ s
$c\tau = 123.4\ \mu$m
$\left|m_{D_1^0} - m_{D_2^0}\right| < 7 \times 10^{10}\ \hbar\ \text{s}^{-1}$, CL = 95% [vv]
$(\Gamma_{D_1^0} - \Gamma_{D_2^0})/\Gamma = 2y = -0.003 \pm 0.022$ (S = 1.4)
$\Gamma(K^+\ell^-\overline{\nu}_\ell\ (\text{via}\ \overline{D}^0))/\Gamma(K^-\ell^+\nu_\ell) < 0.005$, CL = 90%
$\Gamma\big(K^+\pi^-(\text{via}\ \overline{D}^0)\big)/\Gamma\big(K^-\pi^+\big) < 4.1 \times 10^{-4}$, CL = 95%

CP-violation decay-rate asymmetries

$A_{CP}(K^+K^-) = 0.005 \pm 0.016$
$A_{CP}(K^0_S K^0_S) = -0.23 \pm 0.19$
$A_{CP}(\pi^+\pi^-) = 0.021 \pm 0.026$
$A_{CP}(\pi^0\pi^0) = 0.00 \pm 0.05$
$A_{CP}(K^0_S\phi) = -0.03 \pm 0.09$
$A_{CP}(K^0_S\pi^0) = 0.001 \pm 0.013$
$A_{CP}(K^\pm\pi^\mp) = 0.02 \pm 0.20$
$A_{CP}(K^\mp\pi^\pm\pi^0) = -0.03 \pm 0.09$
$A_{CP}(K^\pm\pi^\mp\pi^0) = 0.09^{+0.25}_{-0.22}$

$\overline{D}^0$ modes are charge conjugates of the modes below.

D^0 DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Inclusive modes				
e^+ anything	[ww]	(6.87±0.28) %		–
μ^+ anything		(6.5 ±0.8) %		–
K^- anything		(53 ±4) %	S=1.3	–
$\overline{K}^0$ anything + K^0 anything		(42 ±5) %		–
K^+ anything		($3.4\ ^{+0.6}_{-0.4}$) %		–
η anything	[oo]	< 13 %	CL=90%	–
ϕ anything		(1.7 ±0.8) %		–
Semileptonic modes				
$K^-\ell^+\nu_\ell$	[pp]	(3.43±0.15) %	S=1.2	867
$K^-e^+\nu_e$		(3.58±0.18) %	S=1.1	867
$K^-\mu^+\nu_\mu$		(3.19±0.17) %		863
$K^-\pi^0e^+\nu_e$		($1.1\ ^{+0.8}_{-0.6}$) %	S=1.6	861
$\overline{K}^0\pi^-e^+\nu_e$		(1.8 ±0.8) %	S=1.6	860
$\overline{K}^*(892)^-e^+\nu_e$ $\times$ B($K^{*-}\to\overline{K}^0\pi^-$)		(1.43±0.23) %		719
$K^-\pi^+\pi^-\mu^+\nu_\mu$		< 1.2 $\times 10^{-3}$	CL=90%	821
$(\overline{K}^*(892)\pi)^-\mu^+\nu_\mu$		< 1.4 $\times 10^{-3}$	CL=90%	693
$\pi^-e^+\nu_e$		(3.6 ±0.6) $\times 10^{-3}$		927

A fraction of the following resonance mode has already appeared above as a submode of a charged-particle mode.

$K^*(892)^-e^+\nu_e$		(2.14±0.35) %		719

Hadronic modes with a $\overline{K}$ or $\overline{K}K\overline{K}$

$K^-\pi^+$		$(3.80\pm0.09)\ \%$		861
$\overline{K}^0\pi^0$		$(2.28\pm0.22)\ \%$		860
$\overline{K}^0\pi^+\pi^-$	[rr]	$(5.92\pm0.35)\ \%$	S=1.1	842
$\overline{K}^0\rho^0$		$(1.47\pm0.29)\ \%$		676
$\overline{K}^0 f_0(980)$ $\times$ B($f_0 \to \pi^+\pi^-$)		$(3.2\ \pm0.9\ )\times10^{-3}$		549
$\overline{K}^0 f_2(1270)$ $\times$ B($f_2 \to \pi^+\pi^-$)		$(2.5\ \pm1.0\ )\times10^{-3}$		263
$\overline{K}^0 f_0(1370)$ $\times$ B($f_0 \to \pi^+\pi^-$)		$(4.7\ \pm1.4\ )\times10^{-3}$		–
$K^*(892)^-\pi^+$ $\times$ B($K^{*-} \to \overline{K}^0\pi^-$)		$(4.0\ \pm0.4\ )\ \%$		711
$K_0^*(1430)^-\pi^+$ $\times$ B($K_0^*(1430)^- \to \overline{K}^0\pi^-$)		$(7.3\ \pm1.6\ )\times10^{-3}$		364
$K^-\pi^+\pi^0$	[rr]	$(13.1\ \pm0.9\ )\ \%$	S=1.3	844
$K^-\rho^+$		$(10.2\ \pm0.9\ )\ \%$		678
$K^-\rho(1700)^+$ $\times$ B($\rho(1700)^+ \to \pi^+\pi^0$)		$(7.5\ \pm1.7\ )\times10^{-3}$		–
$K^*(892)^-\pi^+$ $\times$ B($K^{*-} \to K^-\pi^0$)		$(2.0\ \pm0.2\ )\ \%$		711
$\overline{K}^*(892)^0\pi^0$ $\times$ B($\overline{K}^{*0} \to K^-\pi^+$)		$(1.87\pm0.27)\ \%$		709
$K_0^*(1430)^-\pi^+$ $\times$ B($K_0^*(1430)^- \to K^-\pi^0$)		$(3.6\ \pm0.8\ )\times10^{-3}$		364
$\overline{K}_0^*(1430)^0\pi^0$ $\times$ B($\overline{K}_0^*(1430)^0 \to K^-\pi^+$)		$(5.3\ ^{+4.2}_{-1.4}\ )\times10^{-3}$		365
$K^*(1680)^-\pi^+$ $\times$ B($K^*(1680)^- \to K^-\pi^0$)		$(1.7\ \pm0.6\ )\times10^{-3}$		115
$K^-\pi^+\pi^0$ nonresonant		$(1.05^{+0.51}_{-0.19})\ \%$		844
$\overline{K}^0\pi^0\pi^0$		—		843
$\overline{K}^*(892)^0\pi^0$ $\times$ B($\overline{K}^{*0} \to \overline{K}^0\pi^0$)		$(9.3\ \pm1.3\ )\times10^{-3}$		709
$\overline{K}^0\pi^0\pi^0$ nonresonant		$(8.4\ \pm2.2\ )\times10^{-3}$		843
$K^-\pi^+\pi^+\pi^-$	[rr]	$(7.46\pm0.31)\ \%$		812
$K^-\pi^+\rho^0$ total		$(6.2\ \pm0.4\ )\ \%$		612
$K^-\pi^+\rho^0$ 3-body		$(4.7\ \pm2.1\ )\times10^{-3}$		612
$\overline{K}^*(892)^0\rho^0$ $\times$ B($\overline{K}^{*0} \to K^-\pi^+$)		$(9.7\ \pm2.1\ )\times10^{-3}$		418
$K^-a_1(1260)^+$ $\times$ B($a_1(1260)^+ \to \pi^+\pi^+\pi^-$)		$(3.6\ \pm0.6\ )\ \%$		327

$\overline{K}^*(892)^0 \pi^+ \pi^-$ total $\times$ B($\overline{K}^{*0} \to K^- \pi^+$)		(1.5 $\pm$0.4) %	683
$\overline{K}^*(892)^0 \pi^+ \pi^-$ 3-body $\times$ B($\overline{K}^{*0} \to K^- \pi^+$)		(9.5 $\pm$2.1) $\times 10^{-3}$	683
$K_1(1270)^- \pi^+$ $\times$ B($K_1(1270)^- \to K^- \pi^+ \pi^-$)	[ss]	(3.7 $\pm$1.0) $\times 10^{-3}$	483
$K^- \pi^+ \pi^+ \pi^-$ nonresonant		(1.74$\pm$0.25) %	812
$\overline{K}^0 \pi^+ \pi^- \pi^0$	[rr]	(10.8 $\pm$1.3) %	812
$\overline{K}^0 \eta \times$ B($\eta \to \pi^+ \pi^- \pi^0$)		(1.7 $\pm$0.3) $\times 10^{-3}$	772
$\overline{K}^0 \omega \times$ B($\omega \to \pi^+ \pi^- \pi^0$)		(2.2 $\pm$0.4) %	670
$K^*(892)^- \rho^+$ $\times$ B($K^{*-} \to \overline{K}^0 \pi^-$)		(4.3 $\pm$1.7) %	422
$\overline{K}^*(892)^0 \rho^0$ $\times$ B($\overline{K}^{*0} \to \overline{K}^0 \pi^0$)		(4.8 $\pm$1.1) $\times 10^{-3}$	418
$K_1(1270)^- \pi^+$ $\times$ B($K_1(1270)^- \to \overline{K}^0 \pi^- \pi^0$)	[ss]	(5.3 $\pm$1.5) $\times 10^{-3}$	483
$\overline{K}^*(892)^0 \pi^+ \pi^-$ 3-body $\times$ B($\overline{K}^{*0} \to \overline{K}^0 \pi^0$)		(4.7 $\pm$1.0) $\times 10^{-3}$	683
$\overline{K}^0 \pi^+ \pi^- \pi^0$ nonresonant		(2.3 $\pm$2.3) %	812
$K^- \pi^+ \pi^+ \pi^- \pi^0$		(4.0 $\pm$0.4) %	771
$\overline{K}^*(892)^0 \pi^+ \pi^- \pi^0$ $\times$ B($\overline{K}^{*0} \to K^- \pi^+$)		(1.2 $\pm$0.6) %	641
$\overline{K}^*(892)^0 \eta$ $\times$ B($\overline{K}^{*0} \to K^- \pi^+$) $\times$ B($\eta \to \pi^+ \pi^- \pi^0$)		(2.8 $\pm$0.6) $\times 10^{-3}$	580
$K^- \pi^+ \omega \times$ B($\omega \to \pi^+ \pi^- \pi^0$)		(2.7 $\pm$0.5) %	605
$\overline{K}^*(892)^0 \omega$ $\times$ B($\overline{K}^{*0} \to K^- \pi^+$) $\times$ B($\omega \to \pi^+ \pi^- \pi^0$)		(6.5 $\pm$2.4) $\times 10^{-3}$	406
$\overline{K}^0 \pi^+ \pi^+ \pi^- \pi^-$		(6.3 $\pm$1.8) $\times 10^{-3}$	768
$\overline{K}^0 K^+ K^-$		(1.02$\pm$0.10) %	544
$\overline{K}^0 \phi \times$ B($\phi \to K^+ K^-$)		(4.7 $\pm$0.6) $\times 10^{-3}$	520
$\overline{K}^0 K^+ K^-$ non-ϕ		(5.5 $\pm$0.9) $\times 10^{-3}$	544
$K^0_S K^0_S K^0_S$		(9.1 $\pm$1.6) $\times 10^{-4}$	538
$K^+ K^- K^- \pi^+$		(2.4 $\pm$0.7) $\times 10^{-4}$	434

Fractions of many of the following modes with resonances have already appeared above as submodes of particular charged-particle modes. (Modes for which there are only upper limits and $\overline{K}^*(892)\,\rho$ submodes only appear below.)

$\overline{K}^0\,\eta$		$(\ 7.6\ \pm1.1\ )\times10^{-3}$		772
$\overline{K}^0\,\rho^0$		$(\ 1.47\pm0.29)$ %		676
$K^-\,\rho^+$		$(10.2\ \pm0.8\ )$ %	S=1.2	678
$\overline{K}^0\,\omega$		$(\ 2.2\ \pm0.4\ )$ %		670
$\overline{K}^0\,\eta'(958)$		$(\ 1.87\pm0.28)$ %		565
$\overline{K}^0\,\phi$		$(\ 9.4\ \pm1.1\ )\times10^{-3}$		520
$K^-\,a_1(1260)^+$		$(\ 7.2\ \pm1.1\ )$ %		327
$\overline{K}^0\,a_1(1260)^0$		$<\ 1.9$ %	CL=90%	322
$\overline{K}^0\,f_2(1270)$		$(\ 4.5\ \pm1.7\ )\times10^{-3}$		263
$K^-\,a_2(1320)^+$		$<\ 2\ \times10^{-3}$	CL=90%	197
$K^*(892)^-\,\pi^+$		$(\ 6.0\ \pm0.5\ )$ %	S=1.2	711
$\overline{K}^*(892)^0\,\pi^0$		$(\ 2.8\ \pm0.4\ )$ %	S=1.1	709
$\overline{K}^*(892)^0\,\pi^+\,\pi^-$ total		$(\ 2.2\ \pm0.5\ )$ %		683
$\quad\overline{K}^*(892)^0\,\pi^+\,\pi^-$ 3-body		$(\ 1.42\pm0.31)$ %		683
$K^-\,\pi^+\,\rho^0$ total		$(\ 6.2\ \pm0.4\ )$ %		612
$\quad K^-\,\pi^+\,\rho^0$ 3-body		$(\ 4.7\ \pm2.1\ )\times10^{-3}$		612
$\quad\overline{K}^*(892)^0\,\rho^0$		$(\ 1.45\pm0.32)$ %		418
$\qquad\overline{K}^*(892)^0\,\rho^0$ transverse		$(\ 1.5\ \pm0.5\ )$ %		418
$\qquad\overline{K}^*(892)^0\,\rho^0$ S-wave		$(\ 2.8\ \pm0.6\ )$ %		418
$\qquad\overline{K}^*(892)^0\,\rho^0$ S-wave long.		$<\ 3\ \times10^{-3}$	CL=90%	418
$\qquad\overline{K}^*(892)^0\,\rho^0$ P-wave		$<\ 3\ \times10^{-3}$	CL=90%	418
$\qquad\overline{K}^*(892)^0\,\rho^0$ D-wave		$(\ 1.9\ \pm0.6\ )$ %		418
$K^*(892)^-\,\rho^+$		$(\ 6.5\ \pm2.6\ )$ %		422
$\quad K^*(892)^-\,\rho^+$ longitudinal		$(\ 3.1\ \pm1.3\ )$ %		422
$\quad K^*(892)^-\,\rho^+$ transverse		$(\ 3.4\ \pm2.0\ )$ %		422
$\quad K^*(892)^-\,\rho^+$ P-wave		$<\ 1.5$ %	CL=90%	422
$K_1(1270)^-\,\pi^+$	[ss]	$(\ 1.13\pm0.31)$ %		483
$K_1(1400)^-\,\pi^+$		$<\ 1.2$ %	CL=90%	386
$\overline{K}_1(1400)^0\,\pi^0$		$<\ 3.7$ %	CL=90%	387
$K_0^*(1430)^-\,\pi^+$		$(\ 1.18\pm0.25)$ %		364
$\overline{K}_0^*(1430)^0\,\pi^0$		$(\ 8.6\ {}^{+6.8}_{-2.3}\ )\times10^{-3}$		–
$K_2^*(1430)^-\,\pi^+$		$<\ 9\ \times10^{-3}$	CL=90%	367
$\overline{K}_2^*(1430)^0\,\pi^0$		$<\ 3.4\ \times10^{-3}$	CL=90%	363
$K^*(1680)^-\,\pi^+$		$(\ 1.3\ \pm0.5\ )$ %		–
$\overline{K}^*(892)^0\,\pi^+\,\pi^-\,\pi^0$		$(\ 1.8\ \pm0.9\ )$ %		641
$\quad\overline{K}^*(892)^0\,\eta$		$(\ 1.8\ \pm0.4\ )$ %		580
$K^-\,\pi^+\,\omega$		$(\ 3.0\ \pm0.6\ )$ %		605

$\overline{K}^*(892)^0\omega$		(1.1 ± 0.4) %		406
$K^-\pi^+\eta'(958)$		$(6.9 \pm 1.8) \times 10^{-3}$		479
$\overline{K}^*(892)^0\eta'(958)$		$< 1.0 \times 10^{-3}$	CL=90%	99
$K^-\pi^+\phi$		$(3.3 \pm 1.7) \times 10^{-4}$		–
Pionic modes				
$\pi^+\pi^-$		$(1.43\pm0.07) \times 10^{-3}$		922
$\pi^0\pi^0$		$(8.4 \pm 2.2) \times 10^{-4}$		922
$\pi^+\pi^-\pi^0$		(1.1 ± 0.4) %		907
$\pi^+\pi^+\pi^-\pi^-$		$(7.3 \pm 0.5) \times 10^{-3}$		879
Hadronic modes with a $K\overline{K}$ pair				
K^+K^-		$(4.12\pm0.14) \times 10^{-3}$		791
$K^0\overline{K}^0$		$(7.1 \pm 1.9) \times 10^{-4}$	S=1.2	788
$K^0K^-\pi^+$		$(6.9 \pm 1.0) \times 10^{-3}$	S=1.1	739
$\overline{K}^*(892)^0K^0$ $\times$ B($\overline{K}^{*0} \to K^-\pi^+$)		$< 1.1 \times 10^{-3}$	CL=90%	605
$K^*(892)^+K^-$ $\times$ B($K^{*+} \to K^0\pi^+$)		$(2.5 \pm 0.5) \times 10^{-3}$		610
$K^0K^-\pi^+$ nonresonant		$(2.3 \pm 2.3) \times 10^{-3}$		739
$\overline{K}^0K^+\pi^-$		$(5.2 \pm 1.0) \times 10^{-3}$		739
$K^*(892)^0\overline{K}^0$ $\times$ B($K^{*0} \to K^+\pi^-$)		$< 6 \times 10^{-4}$	CL=90%	605
$K^*(892)^-K^+$ $\times$ B($K^{*-} \to \overline{K}^0\pi^-$)		$(1.3 \pm 0.7) \times 10^{-3}$		610
$\overline{K}^0K^+\pi^-$ nonresonant		$(3.8 {}^{+2.3}_{-1.9}) \times 10^{-3}$		739
$K^+K^-\pi^0$		$(1.24\pm0.35) \times 10^{-3}$		742
$K^0_SK^0_S\pi^0$		$< 5.9 \times 10^{-4}$		739
$K^+K^-\pi^+\pi^-$	[xx]	$(2.49\pm0.23) \times 10^{-3}$		676
$\phi\pi^+\pi^-$ $\times$ B($\phi \to K^+K^-$)		$(5.3 \pm 1.4) \times 10^{-4}$		614
$\phi\rho^0$ $\times$ B($\phi \to K^+K^-$)		$(2.9 \pm 1.5) \times 10^{-4}$		260
$K^+K^-\rho^0$ 3-body		$(9.0 \pm 2.3) \times 10^{-4}$		309
$K^*(892)^0K^-\pi^+$+c.c. $\times$ B($K^{*0} \to K^+\pi^-$)	[yy]	$< 5 \times 10^{-4}$		528
$K^*(892)^0\overline{K}^*(892)^0$ $\times$ B^2($K^{*0} \to K^+\pi^-$)		$(6 \pm 2) \times 10^{-4}$		257
$K^+K^-\pi^+\pi^-$ nonresonant		$< 8 \times 10^{-4}$	CL=90%	676
$K^0\overline{K}^0\pi^+\pi^-$		$(7.5 \pm 2.9) \times 10^{-3}$		673
$K^+K^-\pi^+\pi^-\pi^0$		$(3.1 \pm 2.0) \times 10^{-3}$		600

Fractions of most of the following modes with resonances have already appeared above as submodes of particular charged-particle modes.

$\overline{K}^*(892)^0 K^0$		$<$ 1.7	$\times 10^{-3}$	CL=90%	605
$K^*(892)^+ K^-$		(3.8 $\pm$0.8)	$\times 10^{-3}$		610
$K^*(892)^0 \overline{K}^0$		$<$ 9	$\times 10^{-4}$	CL=90%	605
$K^*(892)^- K^+$		(2.0 $\pm$1.1)	$\times 10^{-3}$		610
$\phi\pi^0$		$<$ 1.4	$\times 10^{-3}$	CL=90%	644
$\phi\eta$		$<$ 2.8	$\times 10^{-3}$	CL=90%	489
$\phi\omega$		$<$ 2.1	$\times 10^{-3}$	CL=90%	239
$\phi\pi^+\pi^-$		(1.07$\pm$0.28)	$\times 10^{-3}$		614
$\phi\rho^0$		(5.7 $\pm$3.0)	$\times 10^{-4}$		260
$\phi\pi^+\pi^-$ 3-body		(7 $\pm$5)	$\times 10^{-4}$		614
$K^*(892)^0 K^-\pi^+$ + c.c.	[yy]	$<$ 7	$\times 10^{-4}$	CL=90%	528
$K^*(892)^0 \overline{K}^*(892)^0$		(1.4 $\pm$0.5)	$\times 10^{-3}$		257

Radiative modes

$\rho^0\gamma$	$<$ 2.4	$\times 10^{-4}$	CL=90%	773
$\omega\gamma$	$<$ 2.4	$\times 10^{-4}$	CL=90%	768
$\phi\gamma$	$<$ 1.9	$\times 10^{-4}$	CL=90%	654
$\overline{K}^*(892)^0\gamma$	$<$ 7.6	$\times 10^{-4}$	CL=90%	717

Doubly Cabibbo suppressed (*DC*) modes, $\Delta C = 2$ forbidden via mixing (*C2M*) modes, $\Delta C = 1$ weak neutral current (*C1*) modes, Lepton Family number (*LF*) violating modes, or Lepton number (*L*) violating modes

$K^+\ell^-\overline{\nu}_\ell$(via $\overline{D}^0$)	*C2M*	$<$ 1.7	$\times 10^{-4}$	CL=90%	–
$K^+\pi^-$	*DC*	(1.48$\pm$0.21)	$\times 10^{-4}$		861
$K^+\pi^-$ (via $\overline{D}^0$)	*C2M*	$<$ 1.6	$\times 10^{-5}$	CL=95%	861
$K^+\pi^-\pi^0$		(5.6 $\pm$1.7)	$\times 10^{-4}$		844
$K^+\pi^-\pi^+\pi^-$	*DC*	(3.1 $\pm$1.0)	$\times 10^{-4}$		812
$K^+\pi^-\pi^+\pi^-$ (via $\overline{D}^0$)	*C2M*	$<$ 4	$\times 10^{-4}$	CL=90%	812
$K^+\pi^-$ or $K^+\pi^-\pi^+\pi^-$ (via $\overline{D}^0$)		$<$ 1.0	$\times 10^{-3}$	CL=90%	–
μ^- anything (via $\overline{D}^0$)	*C2M*	$<$ 4	$\times 10^{-4}$	CL=90%	–
e^+e^-	*C1*	$<$ 6.2	$\times 10^{-6}$	CL=90%	932
$\mu^+\mu^-$	*C1*	$<$ 4.1	$\times 10^{-6}$	CL=90%	926
$\pi^0 e^+e^-$	*C1*	$<$ 4.5	$\times 10^{-5}$	CL=90%	927
$\pi^0\mu^+\mu^-$	*C1*	$<$ 1.8	$\times 10^{-4}$	CL=90%	915
ηe^+e^-	*C1*	$<$ 1.1	$\times 10^{-4}$	CL=90%	852
$\eta\mu^+\mu^-$	*C1*	$<$ 5.3	$\times 10^{-4}$	CL=90%	838
$\pi^+\pi^- e^+e^-$	*C1*	$<$ 3.73	$\times 10^{-4}$	CL=90%	922
$\rho^0 e^+e^-$	*C1*	$<$ 1.0	$\times 10^{-4}$	CL=90%	773
$\pi^+\pi^-\mu^+\mu^-$	*C1*	$<$ 3.0	$\times 10^{-5}$	CL=90%	894
$\rho^0\mu^+\mu^-$	*C1*	$<$ 2.2	$\times 10^{-5}$	CL=90%	756

$\omega e^+ e^-$	*C1*		$<$ 1.8	$\times 10^{-4}$	CL=90%	768
$\omega \mu^+ \mu^-$	*C1*		$<$ 8.3	$\times 10^{-4}$	CL=90%	751
$K^- K^+ e^+ e^-$	*C1*		$<$ 3.15	$\times 10^{-4}$	CL=90%	790
$\phi e^+ e^-$	*C1*		$<$ 5.2	$\times 10^{-5}$	CL=90%	654
$K^- K^+ \mu^+ \mu^-$	*C1*		$<$ 3.3	$\times 10^{-5}$	CL=90%	709
$\phi \mu^+ \mu^-$	*C1*		$<$ 3.1	$\times 10^{-5}$	CL=90%	631
$\overline{K}^0 e^+ e^-$		[*uu*]	$<$ 1.1	$\times 10^{-4}$	CL=90%	866
$\overline{K}^0 \mu^+ \mu^-$		[*uu*]	$<$ 2.6	$\times 10^{-4}$	CL=90%	852
$K^- \pi^+ e^+ e^-$	*C1*		$<$ 3.85	$\times 10^{-4}$	CL=90%	861
$\overline{K}^*(892)^0 e^+ e^-$		[*uu*]	$<$ 4.7	$\times 10^{-5}$	CL=90%	717
$K^- \pi^+ \mu^+ \mu^-$	*C1*		$<$ 3.59	$\times 10^{-4}$	CL=90%	829
$\overline{K}^*(892)^0 \mu^+ \mu^-$		[*uu*]	$<$ 2.4	$\times 10^{-5}$	CL=90%	698
$\pi^+ \pi^- \pi^0 \mu^+ \mu^-$	*C1*		$<$ 8.1	$\times 10^{-4}$	CL=90%	863
$\mu^\pm e^\mp$	*LF*	[*ff*]	$<$ 8.1	$\times 10^{-6}$	CL=90%	929
$\pi^0 e^\pm \mu^\mp$	*LF*	[*ff*]	$<$ 8.6	$\times 10^{-5}$	CL=90%	924
$\eta e^\pm \mu^\mp$	*LF*	[*ff*]	$<$ 1.0	$\times 10^{-4}$	CL=90%	848
$\pi^+ \pi^- e^\pm \mu^\mp$	*LF*	[*ff*]	$<$ 1.5	$\times 10^{-5}$	CL=90%	911
$\rho^0 e^\pm \mu^\mp$	*LF*	[*ff*]	$<$ 4.9	$\times 10^{-5}$	CL=90%	769
$\omega e^\pm \mu^\mp$	*LF*	[*ff*]	$<$ 1.2	$\times 10^{-4}$	CL=90%	764
$K^- K^+ e^\pm \mu^\mp$	*LF*	[*ff*]	$<$ 1.8	$\times 10^{-4}$	CL=90%	754
$\phi e^\pm \mu^\mp$	*LF*	[*ff*]	$<$ 3.4	$\times 10^{-5}$	CL=90%	648
$\overline{K}^0 e^\pm \mu^\mp$	*LF*	[*ff*]	$<$ 1.0	$\times 10^{-4}$	CL=90%	862
$K^- \pi^+ e^\pm \mu^\mp$	*LF*	[*ff*]	$<$ 5.53	$\times 10^{-4}$	CL=90%	848
$\overline{K}^*(892)^0 e^\pm \mu^\mp$	*LF*	[*ff*]	$<$ 8.3	$\times 10^{-5}$	CL=90%	712
$\pi^- \pi^- e^+ e^+ +$ c.c.	*L*		$<$ 1.12	$\times 10^{-4}$	CL=90%	922
$\pi^- \pi^- \mu^+ \mu^+ +$ c.c.	*L*		$<$ 2.9	$\times 10^{-5}$	CL=90%	894
$K^- \pi^- e^+ e^+ +$ c.c.	*L*		$<$ 2.06	$\times 10^{-4}$	CL=90%	861
$K^- \pi^- \mu^+ \mu^+ +$ c.c.	*L*		$<$ 3.9	$\times 10^{-4}$	CL=90%	829
$K^- K^- e^+ e^+ +$ c.c.	*L*		$<$ 1.52	$\times 10^{-4}$	CL=90%	790
$K^- K^- \mu^+ \mu^+ +$ c.c.	*L*		$<$ 9.4	$\times 10^{-5}$	CL=90%	709
$\pi^- \pi^- e^+ \mu^+ +$ c.c.	*L*		$<$ 7.9	$\times 10^{-5}$	CL=90%	911
$K^- \pi^- e^+ \mu^+ +$ c.c.	*L*		$<$ 2.18	$\times 10^{-4}$	CL=90%	848
$K^- K^- e^+ \mu^+ +$ c.c.	*L*		$<$ 5.7	$\times 10^{-5}$	CL=90%	754

$D^*(2007)^0$

$I(J^P) = \frac{1}{2}(1^-)$
I, J, P need confirmation.

Mass $m = 2006.7 \pm 0.5$ MeV (S = 1.1)
$m_{D^{*0}} - m_{D^0} = 142.12 \pm 0.07$ MeV
Full width $\Gamma < 2.1$ MeV, CL = 90%

$\overline{D}^*(2007)^0$ modes are charge conjugates of modes below.

$D^*(2007)^0$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^0\pi^0$	(61.9 ± 2.9) %	43
$D^0\gamma$	(38.1 ± 2.9) %	137

$D^*(2010)^\pm$

$I(J^P) = \frac{1}{2}(1^-)$
I, J, P need confirmation.

Mass $m = 2010.0 \pm 0.5$ MeV (S = 1.1)
$m_{D^*(2010)^+} - m_{D^+} = 140.64 \pm 0.10$ MeV (S = 1.1)
$m_{D^*(2010)^+} - m_{D^0} = 145.421 \pm 0.010$ MeV (S = 1.1)
Full width $\Gamma = 96 \pm 22$ keV

$D^*(2010)^-$ modes are charge conjugates of the modes below.

$D^*(2010)^\pm$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^0\pi^+$	(67.7 ± 0.5) %	39
$D^+\pi^0$	(30.7 ± 0.5) %	38
$D^+\gamma$	$(\ 1.6\pm0.4)$ %	136

$D_1(2420)^0$

$I(J^P) = \frac{1}{2}(1^+)$
I, J, P need confirmation.

Mass $m = 2422.2 \pm 1.8$ MeV (S = 1.2)
Full width $\Gamma = 18.9^{+4.6}_{-3.5}$ MeV

$\overline{D}_1(2420)^0$ modes are charge conjugates of modes below.

$D_1(2420)^0$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^*(2010)^+\pi^-$	seen	355
$D^+\pi^-$	not seen	474

$D_2^*(2460)^0$

$I(J^P) = \frac{1}{2}(2^+)$

$J^P = 2^+$ assignment strongly favored (ALBRECHT 89B).

Mass $m = 2458.9 \pm 2.0$ MeV (S = 1.2)
Full width $\Gamma = 23 \pm 5$ MeV

$\overline{D}_2^*(2460)^0$ modes are charge conjugates of modes below.

$D_2^*(2460)^0$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^+\pi^-$	seen	503
$D^*(2010)^+\pi^-$	seen	387

$D_2^*(2460)^\pm$

$I(J^P) = \frac{1}{2}(2^+)$

$J^P = 2^+$ assignment strongly favored (ALBRECHT 89B).

Mass $m = 2459 \pm 4$ MeV (S = 1.7)
$m_{D_2^*(2460)^\pm} - m_{D_2^*(2460)^0} = 0.9 \pm 3.3$ MeV (S = 1.1)
Full width $\Gamma = 25^{+8}_{-7}$ MeV

$D_2^*(2460)^-$ modes are charge conjugates of modes below.

$D_2^*(2460)^\pm$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^0\pi^+$	seen	508
$D^{*0}\pi^+$	seen	390

CHARMED, STRANGE MESONS ($C = S = \pm1$)

$D_s^+ = c\overline{s}$, $D_s^- = \overline{c}s$, similarly for D_s^*'s

$D_s^\pm$ was $F^\pm$

$I(J^P) = 0(0^-)$

Mass $m = 1968.5 \pm 0.6$ MeV (S = 1.1)
$m_{D_s^\pm} - m_{D^\pm} = 99.2 \pm 0.5$ MeV (S = 1.1)
Mean life $\tau = (490 \pm 9) \times 10^{-15}$ s (S = 1.1)
$c\tau = 147.0\ \mu$m

D_s^+ form factors

$r_2 = 1.60 \pm 0.24$
$r_v = 1.92 \pm 0.32$
$\Gamma_L/\Gamma_T = 0.72 \pm 0.18$

Unless otherwise noted, the branching fractions for modes with a resonance in the final state include all the decay modes of the resonance. D_s^- modes are charge conjugates of the modes below.

D_s^+ DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Inclusive modes				
K^- anything		$(13 \,^{+14}_{-12})$ %		–
$\overline{K}^0$ anything + K^0 anything		(39 ± 28) %		–
K^+ anything		$(20 \,^{+18}_{-14})$ %		–
non-$K\overline{K}$ anything		(64 ± 17) %		–
e^+ anything		$(8 \,^{+6}_{-5})$ %		–
ϕ anything		$(18 \,^{+15}_{-10})$ %		–
Leptonic and semileptonic modes				
$\mu^+\nu_\mu$		$(5.1 \pm 1.9) \times 10^{-3}$	S=1.2	981
$\tau^+\nu_\tau$		(6.4 ± 1.5) %		182
$\phi\ell^+\nu_\ell$	[zz]	(2.0 ± 0.5) %		–
$\eta\ell^+\nu_\ell$ + $\eta'(958)\ell^+\nu_\ell$	[zz]	(3.5 ± 1.0) %		–
$\eta\ell^+\nu_\ell$	[zz]	(2.6 ± 0.7) %		–
$\eta'(958)\ell^+\nu_\ell$	[zz]	$(9.1 \pm 3.4) \times 10^{-3}$		–

Hadronic modes with a $K\overline{K}$ pair (including from a ϕ)

$K^+\overline{K}^0$		$(3.6 \pm 1.1)\%$		850
$K^+K^-\pi^+$	[rr]	$(4.4 \pm 1.2)\%$		805
$\phi\pi^+$	[aaa]	$(3.6 \pm 0.9)\%$		712
$K^+\overline{K}^*(892)^0$	[aaa]	$(3.3 \pm 0.9)\%$		682
$f_0(980)\pi^+$ $\times$ B($f_0 \to K^+K^-$)	[bbb]	$(4.9 \pm 2.3)\times 10^{-3}$		732
$K^+\overline{K}^*_0(1430)^0$	[aaa]	$(7 \pm 4)\times 10^{-3}$		186
$K^+K^-\pi^+$ nonresonant		$(9 \pm 4)\times 10^{-3}$		805
$K^0\overline{K}^0\pi^+$		—		802
$K^*(892)^+\overline{K}^0$	[aaa]	$(4.3 \pm 1.4)\%$		683
$K^+K^-\pi^+\pi^0$		—		748
$\phi\pi^+\pi^0$	[aaa]	$(9 \pm 5)\%$		687
$\phi\rho^+$	[aaa]	$(6.7 \pm 2.3)\%$		407
$\phi\pi^+\pi^0$ 3-body	[aaa]	< 2.6 %	CL=90%	687
$K^+K^-\pi^+\pi^0$ non-ϕ		< 9 %	CL=90%	748
$K^+\overline{K}^0\pi^+\pi^-$		$(2.5 \pm 0.9)\%$		744
$K^0K^-\pi^+\pi^+$		$(4.3 \pm 1.5)\%$		744
$K^*(892)^+\overline{K}^*(892)^0$	[aaa]	$(5.8 \pm 2.5)\%$		412
$K^0K^-\pi^+\pi^+$ non-$K^{*+}\overline{K}^{*0}$		< 2.9 %	CL=90%	744
$K^+K^-\pi^+\pi^+\pi^-$		$(8.4 \pm 3.3)\times 10^{-3}$		673
$\phi\pi^+\pi^+\pi^-$	[aaa]	$(1.18 \pm 0.35)\%$		640

Hadronic modes without K's

$\pi^+\pi^+\pi^-$		$(1.01 \pm 0.28)\%$	S=1.1	959
$\rho^0\pi^+$		$< 7 \times 10^{-4}$	CL=90%	827
$f_0(980)\pi^+$ $\times$ B($f_0 \to \pi^+\pi^-$)	[tt]	$(5.7 \pm 1.7)\times 10^{-3}$		732
$f_2(1270)\pi^+$	[aaa]	$(3.5 \pm 1.2)\times 10^{-3}$		559
$f_0(1370)\pi^+$ $\times$ B($f_0 \to \pi^+\pi^-$)	[tt]	$(3.3 \pm 1.2)\times 10^{-3}$		–
$\rho(1450)^0\pi^+$ $\times$ B($\rho^0 \to \pi^+\pi^-$)	[tt]	$(4.4 \pm 2.5)\times 10^{-4}$		–
$\pi^+\pi^+\pi^-$ nonresonant		$(5 \pm 22)\times 10^{-5}$		959
$\pi^+\pi^+\pi^-\pi^0$		< 12 %	CL=90%	935
$\eta\pi^+$	[aaa]	$(1.7 \pm 0.5)\%$		902
$\omega\pi^+$	[aaa]	$(2.8 \pm 1.1)\times 10^{-3}$		822
$\pi^+\pi^+\pi^+\pi^-\pi^-$		$(7.0 \pm 3.0)\times 10^{-3}$		899
$\pi^+\pi^+\pi^-\pi^0\pi^0$		—		902
$\eta\rho^+$	[aaa]	$(10.8 \pm 3.1)\%$		727

$\eta\pi^+\pi^0$ 3-body		[aaa]	< 4	%	CL=90%	886
$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^0$			(4.9 ± 3.2)	%		856
$\eta'(958)\pi^+$		[aaa]	(3.9 ± 1.0)	%		743
$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^0\pi^0$			—			803
$\eta'(958)\rho^+$		[aaa]	(10.1 ± 2.8)	%		470
$\eta'(958)\pi^+\pi^0$ 3-body		[aaa]	< 1.4	%	CL=90%	720

Modes with one or three K's

$K^0\pi^+$			< 8	$\times 10^{-3}$	CL=90%	916
$K^+\pi^+\pi^-$			(1.0 ± 0.4)	%		900
$K^+\rho^0$			< 2.9	$\times 10^{-3}$	CL=90%	747
$K^*(892)^0\pi^+$		[aaa]	(6.5 ± 2.8)	$\times 10^{-3}$		773
$K^+K^+K^-$			< 6	$\times 10^{-4}$	CL=90%	628
ϕK^+		[aaa]	< 5	$\times 10^{-4}$	CL=90%	607

$\Delta C = 1$ weak neutral current (*C1*) modes, Lepton family number (*LF*), or Lepton number (*L*) violating modes

$\pi^+e^+e^-$		[uu]	< 2.7	$\times 10^{-4}$	CL=90%	979
$\pi^+\mu^+\mu^-$		[uu]	< 1.4	$\times 10^{-4}$	CL=90%	968
$K^+e^+e^-$	C1		< 1.6	$\times 10^{-3}$	CL=90%	922
$K^+\mu^+\mu^-$	C1		< 1.4	$\times 10^{-4}$	CL=90%	909
$K^*(892)^+\mu^+\mu^-$	C1		< 1.4	$\times 10^{-3}$	CL=90%	765
$\pi^+e^\pm\mu^\mp$	LF	[ff]	< 6.1	$\times 10^{-4}$	CL=90%	976
$K^+e^\pm\mu^\mp$	LF	[ff]	< 6.3	$\times 10^{-4}$	CL=90%	919
$\pi^-e^+e^+$	L		< 6.9	$\times 10^{-4}$	CL=90%	979
$\pi^-\mu^+\mu^+$	L		< 8.2	$\times 10^{-5}$	CL=90%	968
$\pi^-e^+\mu^+$	L		< 7.3	$\times 10^{-4}$	CL=90%	976
$K^-e^+e^+$	L		< 6.3	$\times 10^{-4}$	CL=90%	922
$K^-\mu^+\mu^+$	L		< 1.8	$\times 10^{-4}$	CL=90%	909
$K^-e^+\mu^+$	L		< 6.8	$\times 10^{-4}$	CL=90%	919
$K^*(892)^-\mu^+\mu^+$	L		< 1.4	$\times 10^{-3}$	CL=90%	765

$D_s^{*\pm}$

$I(J^P) = 0(?^?)$

J^P is natural, width and decay modes consistent with 1^-.

Mass $m = 2112.4 \pm 0.7$ MeV (S = 1.1)
$m_{D_s^{*\pm}} - m_{D_s^\pm} = 143.8 \pm 0.4$ MeV
Full width $\Gamma < 1.9$ MeV, CL = 90%

D_s^{*-} modes are charge conjugates of the modes below.

D_s^{*+} DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D_s^+ \gamma$	(94.2±2.5) %	139
$D_s^+ \pi^0$	(5.8±2.5) %	48

$D_{s1}(2536)^\pm$

$I(J^P) = 0(1^+)$
J, P need confirmation.

Mass $m = 2535.35 \pm 0.34 \pm 0.5$ MeV
Full width $\Gamma < 2.3$ MeV, CL = 90%

$D_{s1}(2536)^-$ modes are charge conjugates of the modes below.

$D_{s1}(2536)^+$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^*(2010)^+ K^0$	seen	150
$D^*(2007)^0 K^+$	seen	169
$D^+ K^0$	not seen	382
$D^0 K^+$	not seen	392
$D_s^{*+} \gamma$	possibly seen	389

$D_{sJ}(2573)^\pm$

$I(J^P) = 0(?^?)$

J^P is natural, width and decay modes consistent with 2^+.

Mass $m = 2572.4 \pm 1.5$ MeV
Full width $\Gamma = 15^{+5}_{-4}$ MeV

$D_{sJ}(2573)^-$ modes are charge conjugates of the modes below.

$D_{sJ}(2573)^+$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^0 K^+$	seen	436
$D^*(2007)^0 K^+$	not seen	245

BOTTOM MESONS
($B = \pm1$)

$B^+ = u\overline{b}$, $B^0 = d\overline{b}$, $\overline{B}^0 = \overline{d}\,b$, $B^- = \overline{u}\,b$, similarly for B^*'s

B-particle organization

Many measurements of B decays involve admixtures of B hadrons. Previously we arbitrarily included such admixtures in the $B^{\pm}$ section, but because of their importance we have created two new sections: "$B^{\pm}/B^0$ Admixture" for $\Upsilon(4S)$ results and "$B^{\pm}/B^0/B^0_s/b$-baryon Admixture" for results at higher energies. Most inclusive decay branching fractions and χ_b at high energy are found in the Admixture sections. B^0-$\overline{B}^0$ mixing data are found in the B^0 section, while B^0_s-$\overline{B}^0_s$ mixing data and B-$\overline{B}$ mixing data for a B^0/B^0_s admixture are found in the B^0_s section. CP-violation data are found in the $B^{\pm}$, B^0, and $B^{\pm}$ B^0 Admixture sections. b-baryons are found near the end of the Baryon section.

The organization of the B sections is now as follows, where bullets indicate particle sections and brackets indicate reviews.

- $B^{\pm}$
  mass, mean life, branching fractions CP violation
- B^0
  mass, mean life, branching fractions
  polarization in B^0 decay, B^0-$\overline{B}^0$ mixing, CP violation
- $B^{\pm}$ B^0 Admixtures
  branching fractions, CP violation
- $B^{\pm}/B^0/B^0_s/b$-baryon Admixtures
  mean life, production fractions, branching fractions
  χ_b at high energy, V_{cb} measurements
- B^*
  mass
- B^0_s
  mass, mean life, branching fractions
  polarization in B^0_s decay, B^0_s-$\overline{B}^0_s$ mixing
- $B^{\pm}_c$
  mass, mean life, branching fractions

At end of Baryon Listings:

- Λ_b
  mass, mean life, branching fractions
- b-baryon Admixture
  mean life, branching fractions

$B^{\pm}$

$I(J^P) = \frac{1}{2}(0^-)$

I, J, P need confirmation. Quantum numbers shown are quark-model predictions.

Mass $m_{B^{\pm}} = 5279.0 \pm 0.5$ MeV
Mean life $\tau_{B^{\pm}} = (1.674 \pm 0.018) \times 10^{-12}$ s
$c\tau = 502$ μm

CP violation

$A_{CP}(B^+ \to J/\psi(1S)K^+) = 0.008 \pm 0.025$
$A_{CP}(B^+ \to J/\psi(1S)\pi^+) = 0.01 \pm 0.22$
$A_{CP}(B^+ \to \psi(2S)K^+) = 0.02 \pm 0.09$
$A_{CP}(B^+ \to K^+\pi^0) = -0.10 \pm 0.12$
$A_{CP}(B^+ \to K^0_S\pi^+) = -0.05 \pm 0.14$
$A_{CP}(B^+ \to K^+\eta') = -0.02 \pm 0.07$
$A_{CP}(B^+ \to \omega\pi^+) = -0.21 \pm 0.19$
$A_{CP}(B^+ \to \phi K^+) = -0.05 \pm 0.20$
$A_{CP}(B^+ \to \phi K^*(892)^+) = -0.43^{+0.36}_{-0.31}$

B^- modes are charge conjugates of the modes below. Modes which do not identify the charge state of the B are listed in the $B^{\pm}/B^0$ ADMIXTURE section.

The branching fractions listed below assume 50% $B^0\overline{B}^0$ and 50% B^+B^- production at the $\Upsilon(4S)$. We have attempted to bring older measurements up to date by rescaling their assumed $\Upsilon(4S)$ production ratio to 50:50 and their assumed D, D_s, D^*, and ψ branching ratios to current values whenever this would affect our averages and best limits significantly.

Indentation is used to indicate a subchannel of a previous reaction. All resonant subchannels have been corrected for resonance branching fractions to the final state so the sum of the subchannel branching fractions can exceed that of the final state.

B^+ DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
		Semileptonic and leptonic modes		
$\ell^+\nu_\ell$ anything	[qq]	(10.2 ± 0.9) %		–
$\overline{D}^0\ell^+\nu_\ell$	[qq]	(2.15 ± 0.22) %		–
$\overline{D}^*(2007)^0\ell^+\nu_\ell$	[qq]	(5.3 ± 0.8) %		–
$\overline{D}_1(2420)^0\ell^+\nu_\ell$		$(5.6 \pm 1.6) \times 10^{-3}$		–
$\overline{D}^*_2(2460)^0\ell^+\nu_\ell$		$< 8 \times 10^{-3}$	CL=90%	–
$\pi^0 e^+\nu_e$		$(9.0 \pm 2.8) \times 10^{-5}$		2638

$\omega \ell^+ \nu_\ell$	[qq] $<$ 2.1	$\times 10^{-4}$	CL=90%	–
$\rho^0 \ell^+ \nu_\ell$	[qq] $(1.34^{+0.32}_{-0.35})$	$\times 10^{-4}$		–
$e^+ \nu_e$	$<$ 1.5	$\times 10^{-5}$	CL=90%	2640
$\mu^+ \nu_\mu$	$<$ 2.1	$\times 10^{-5}$	CL=90%	2638
$\tau^+ \nu_\tau$	$<$ 5.7	$\times 10^{-4}$	CL=90%	2340
$e^+ \nu_e \gamma$	$<$ 2.0	$\times 10^{-4}$	CL=90%	–
$\mu^+ \nu_\mu \gamma$	$<$ 5.2	$\times 10^{-5}$	CL=90%	–

***D*, *D**, or D_s modes**

$\overline{D}^0 \pi^+$	(5.3 ± 0.5)	$\times 10^{-3}$		2308
$\overline{D}^0 \rho^+$	(1.34 ± 0.18)	%		2237
$\overline{D}^0 K^+$	(3.7 ± 0.6)	$\times 10^{-4}$	S=1.1	–
$\overline{D}^0 K^*(892)^+$	(6.1 ± 2.3)	$\times 10^{-4}$		–
$\overline{D}^0 \pi^+ \pi^+ \pi^-$	(1.1 ± 0.4)	%		2289
$\overline{D}^0 \pi^+ \pi^+ \pi^-$ nonresonant	(5 ± 4)	$\times 10^{-3}$		2289
$\overline{D}^0 \pi^+ \rho^0$	(4.2 ± 3.0)	$\times 10^{-3}$		2208
$\overline{D}^0 a_1(1260)^+$	(5 ± 4)	$\times 10^{-3}$		2123
$\overline{D}^0 \omega \pi^+$	(4.1 ± 0.9)	$\times 10^{-3}$		–
$D^*(2010)^- \pi^+ \pi^+$	(2.1 ± 0.6)	$\times 10^{-3}$		2247
$D^- \pi^+ \pi^+$	$<$ 1.4	$\times 10^{-3}$	CL=90%	2299
$\overline{D}^*(2007)^0 \pi^+$	(4.6 ± 0.4)	$\times 10^{-3}$		2256
$\overline{D}^*(2007)^0 \omega \pi^+$	(4.5 ± 1.2)	$\times 10^{-3}$		–
$\overline{D}^*(2007)^0 \rho^+$	(1.55 ± 0.31)	%		2182
$\overline{D}^*(2007)^0 K^+$	(3.6 ± 1.0)	$\times 10^{-4}$		–
$\overline{D}^*(2007)^0 K^*(892)^+$	(7.2 ± 3.4)	$\times 10^{-4}$		–
$\overline{D}^*(2007)^0 \pi^+ \pi^+ \pi^-$	(9.4 ± 2.6)	$\times 10^{-3}$		2236
$\overline{D}^*(2007)^0 a_1(1260)^+$	(1.9 ± 0.5)	%		2062
$\overline{D}^*(2007)^0 \pi^- \pi^+ \pi^+ \pi^0$	(1.8 ± 0.4)	%		–
$D^*(2010)^+ \pi^0$	$<$ 1.7	$\times 10^{-4}$	CL=90%	2254
$\overline{D}^*(2010)^+ K^0$	$<$ 9.5	$\times 10^{-5}$	CL=90%	–
$D^*(2010)^- \pi^+ \pi^+ \pi^0$	(1.5 ± 0.7)	%		2235
$D^*(2010)^- \pi^+ \pi^+ \pi^+ \pi^-$	$<$ 1	%	CL=90%	2217
$\overline{D}_1^*(2420)^0 \pi^+$	(1.5 ± 0.6)	$\times 10^{-3}$	S=1.3	2081
$\overline{D}_1^*(2420)^0 \rho^+$	$<$ 1.4	$\times 10^{-3}$	CL=90%	1996
$\overline{D}_2^*(2460)^0 \pi^+$	$<$ 1.3	$\times 10^{-3}$	CL=90%	2064
$\overline{D}_2^*(2460)^0 \rho^+$	$<$ 4.7	$\times 10^{-3}$	CL=90%	1978
$\overline{D}^0 D_s^+$	(1.3 ± 0.4)	%		1815
$\overline{D}^0 D_s^{*+}$	(9 ± 4)	$\times 10^{-3}$		1734
$\overline{D}^*(2007)^0 D_s^+$	(1.2 ± 0.5)	%		1737
$\overline{D}^*(2007)^0 D_s^{*+}$	(2.7 ± 1.0)	%		1650
$D_s^{(*)+} \overline{D}^{**0}$	(2.7 ± 1.2)	%		–

$\overline{D}^*(2007)^0 D^*(2010)^+$	$<$	1.1	%	CL=90%	–
$\overline{D}^0 D^*(2010)^+ +$ $\overline{D}^*(2007)^0 D^+$	$<$	1.3	%	CL=90%	–
$\overline{D}^0 D^+$	$<$	6.7	$\times 10^{-3}$	CL=90%	–
$D_s^+ \pi^0$	$<$	2.0	$\times 10^{-4}$	CL=90%	2270
$D_s^{*+} \pi^0$	$<$	3.3	$\times 10^{-4}$	CL=90%	2214
$D_s^+ \eta$	$<$	5	$\times 10^{-4}$	CL=90%	2235
$D_s^{*+} \eta$	$<$	8	$\times 10^{-4}$	CL=90%	2178
$D_s^+ \rho^0$	$<$	4	$\times 10^{-4}$	CL=90%	2197
$D_s^{*+} \rho^0$	$<$	5	$\times 10^{-4}$	CL=90%	2138
$D_s^+ \omega$	$<$	5	$\times 10^{-4}$	CL=90%	2195
$D_s^{*+} \omega$	$<$	7	$\times 10^{-4}$	CL=90%	2136
$D_s^+ a_1(1260)^0$	$<$	2.2	$\times 10^{-3}$	CL=90%	2079
$D_s^{*+} a_1(1260)^0$	$<$	1.6	$\times 10^{-3}$	CL=90%	2014
$D_s^+ \phi$	$<$	3.2	$\times 10^{-4}$	CL=90%	2141
$D_s^{*+} \phi$	$<$	4	$\times 10^{-4}$	CL=90%	2079
$D_s^+ \overline{K}^0$	$<$	1.1	$\times 10^{-3}$	CL=90%	2241
$D_s^{*+} \overline{K}^0$	$<$	1.1	$\times 10^{-3}$	CL=90%	2184
$D_s^+ \overline{K}^*(892)^0$	$<$	5	$\times 10^{-4}$	CL=90%	2171
$D_s^{*+} \overline{K}^*(892)^0$	$<$	4	$\times 10^{-4}$	CL=90%	2110
$D_s^- \pi^+ K^+$	$<$	8	$\times 10^{-4}$	CL=90%	2222
$D_s^{*-} \pi^+ K^+$	$<$	1.2	$\times 10^{-3}$	CL=90%	2164
$D_s^- \pi^+ K^*(892)^+$	$<$	6	$\times 10^{-3}$	CL=90%	2137
$D_s^{*-} \pi^+ K^*(892)^+$	$<$	8	$\times 10^{-3}$	CL=90%	2076

Charmonium modes

$\eta_c K^+$		$(6.9\ ^{+3.4}_{-3.0})$	$\times 10^{-4}$		–
$J/\psi(1S) K^+$		(1.01 ± 0.05)	$\times 10^{-3}$		1683
$J/\psi(1S) K^+ \pi^+ \pi^-$		$(1.4\ \pm0.6\ )$	$\times 10^{-3}$		1612
$J/\psi(1S) K^*(892)^+$		(1.39 ± 0.13)	$\times 10^{-3}$		1571
$J/\psi(1S) K(1270)^+$		$(1.8\ \pm0.5\ )$	$\times 10^{-3}$		–
$J/\psi(1S) K(1400)^+$	$<$	5	$\times 10^{-4}$	CL=90%	–
$J/\psi(1S) \phi K^+$		$(8.8\ ^{+3.7}_{-3.3})$	$\times 10^{-5}$		–
$J/\psi(1S) \pi^+$		$(4.2\ \pm0.7\ )$	$\times 10^{-5}$		1727
$J/\psi(1S) \rho^+$	$<$	7.7	$\times 10^{-4}$	CL=90%	1613
$J/\psi(1S) a_1(1260)^+$	$<$	1.2	$\times 10^{-3}$	CL=90%	1414

$\psi(2S)K^+$	$(6.6 \pm 0.6) \times 10^{-4}$		1284
$\psi(2S)K^*(892)^+$	$(9.2 \pm 2.2) \times 10^{-4}$		1115
$\psi(2S)K^+\pi^+\pi^-$	$(1.9 \pm 1.2) \times 10^{-3}$		909
$\chi_{c0}(1P)K^+$	$(6.0\ ^{+2.4}_{-2.1}) \times 10^{-4}$		–
$\chi_{c1}(1P)K^+$	$(6.5 \pm 1.1) \times 10^{-4}$		1412
$\chi_{c1}(1P)K^*(892)^+$	$< 2.1 \times 10^{-3}$	CL=90%	1265

K or *K** modes

$K^0\pi^+$	$(1.73^{+0.27}_{-0.24}) \times 10^{-5}$		2614
$K^+\pi^0$	$(1.21 \pm 0.16) \times 10^{-5}$		2615
$\eta' K^+$	$(7.5 \pm 0.7) \times 10^{-5}$		2528
$\eta' K^*(892)^+$	$< 3.5 \times 10^{-5}$	CL=90%	2472
ηK^+	$< 6.9 \times 10^{-6}$	CL=90%	2587
$\eta K^*(892)^+$	$(2.6\ ^{+1.0}_{-0.9}) \times 10^{-5}$		2534
ωK^+	$< 4 \times 10^{-6}$	CL=90%	–
$\omega K^*(892)^+$	$< 8.7 \times 10^{-5}$	CL=90%	–
$K^*(892)^0\pi^+$	$(1.9\ ^{+0.6}_{-0.8}) \times 10^{-5}$		2561
$K^*(892)^+\pi^0$	$< 3.1 \times 10^{-5}$	CL=90%	2562
$K^+\pi^-\pi^+$	$(5.6 \pm 1.0) \times 10^{-5}$		–
$K^+\pi^-\pi^+$ nonresonant	$< 2.8 \times 10^{-5}$	CL=90%	2609
$K^+\rho^0$	$< 1.2 \times 10^{-5}$	CL=90%	2559
$K_2^*(1430)^0\pi^+$	$< 6.8 \times 10^{-4}$	CL=90%	2443
$K^-\pi^+\pi^+$	$< 7.0 \times 10^{-6}$	CL=90%	–
$K^-\pi^+\pi^+$ nonresonant	$< 5.6 \times 10^{-5}$	CL=90%	–
$K_1(1400)^0\pi^+$	$< 2.6 \times 10^{-3}$	CL=90%	2451
$K^0\rho^+$	$< 4.8 \times 10^{-5}$	CL=90%	2559
$K^*(892)^+\pi^+\pi^-$	$< 1.1 \times 10^{-3}$	CL=90%	2556
$K^*(892)^+\rho^0$	$< 7.4 \times 10^{-5}$	CL=90%	2504
$K^*(892)^+K^*(892)^0$	$< 7.1 \times 10^{-5}$	CL=90%	–
$K_1(1400)^+\rho^0$	$< 7.8 \times 10^{-4}$	CL=90%	2388
$K_2^*(1430)^+\rho^0$	$< 1.5 \times 10^{-3}$	CL=90%	2382
$K^+\overline{K}^0$	$< 2.4 \times 10^{-6}$	CL=90%	2592
$K^+K^-\pi^+$	$< 1.2 \times 10^{-6}$	CL=90%	–
$K^+K^-\pi^+$ nonresonant	$< 7.5 \times 10^{-5}$	CL=90%	–
$K^+K^+\pi^-$	$< 3.2 \times 10^{-5}$	CL=90%	–
$K^+K^+\pi^-$ nonresonant	$< 8.79 \times 10^{-5}$	CL=90%	–
$K^+K^*(892)^0$	$< 5.3 \times 10^{-6}$	CL=90%	–
$K^+K^-K^+$	$(3.5 \pm 0.6) \times 10^{-5}$		2522
$K^+\phi$	$(7.9\ ^{+2.0}_{-1.8}) \times 10^{-6}$	S=1.6	2516

$K^+ K^- K^+$ nonresonant	$<\ 3.8$	$\times 10^{-5}$	CL=90%	2516
$K^*(892)^+ K^+ K^-$	$<\ 1.6$	$\times 10^{-3}$	CL=90%	2466
$K^*(892)^+ \phi$	$(10\ {}^{+5}_{-4}) \times 10^{-6}$			2460
$K_1(1400)^+ \phi$	$<\ 1.1$	$\times 10^{-3}$	CL=90%	2339
$K_2^*(1430)^+ \phi$	$<\ 3.4$	$\times 10^{-3}$	CL=90%	2332
$K^*(892)^+ \gamma$	$(\ 3.8\ \pm 0.5\ ) \times 10^{-5}$			2564
$K_1(1270)^+ \gamma$	$<\ 7.3$	$\times 10^{-3}$	CL=90%	2486
$K_1(1400)^+ \gamma$	$<\ 2.2$	$\times 10^{-3}$	CL=90%	2453
$K_2^*(1430)^+ \gamma$	$<\ 1.4$	$\times 10^{-3}$	CL=90%	2447
$K^*(1680)^+ \gamma$	$<\ 1.9$	$\times 10^{-3}$	CL=90%	2360
$K_3^*(1780)^+ \gamma$	$<\ 5.5$	$\times 10^{-3}$	CL=90%	2341
$K_4^*(2045)^+ \gamma$	$<\ 9.9$	$\times 10^{-3}$	CL=90%	2243

Light unflavored meson modes

$\rho^+ \gamma$	$<\ 1.3$	$\times 10^{-5}$	CL=90%	–
$\pi^+ \pi^0$	$<\ 9.6$	$\times 10^{-6}$	CL=90%	2636
$\pi^+ \pi^+ \pi^-$	$<\ 1.3$	$\times 10^{-4}$	CL=90%	2630
$\rho^0 \pi^+$	$(\ 1.0\ \pm 0.4\ ) \times 10^{-5}$			2581
$\pi^+ f_0(980)$	$<\ 1.4$	$\times 10^{-4}$	CL=90%	2547
$\pi^+ f_2(1270)$	$<\ 2.4$	$\times 10^{-4}$	CL=90%	2483
$\pi^+ \pi^- \pi^+$ nonresonant	$<\ 4.1$	$\times 10^{-5}$	CL=90%	–
$\pi^+ \pi^0 \pi^0$	$<\ 8.9$	$\times 10^{-4}$	CL=90%	2631
$\rho^+ \pi^0$	$<\ 4.3$	$\times 10^{-5}$	CL=90%	2581
$\pi^+ \pi^- \pi^+ \pi^0$	$<\ 4.0$	$\times 10^{-3}$	CL=90%	2621
$\rho^+ \rho^0$	$<\ 1.0$	$\times 10^{-3}$	CL=90%	2524
$a_1(1260)^+ \pi^0$	$<\ 1.7$	$\times 10^{-3}$	CL=90%	2494
$a_1(1260)^0 \pi^+$	$<\ 9.0$	$\times 10^{-4}$	CL=90%	2494
$\omega \pi^+$	$(\ 8.1\ {}^{+2.3}_{-2.0}\ ) \times 10^{-6}$		S=1.2	2580
$\omega \rho^+$	$<\ 6.1$	$\times 10^{-5}$	CL=90%	–
$\eta \pi^+$	$<\ 5.7$	$\times 10^{-6}$	CL=90%	2609
$\eta' \pi^+$	$<\ 7.0$	$\times 10^{-6}$	CL=90%	2550
$\eta' \rho^+$	$<\ 3.3$	$\times 10^{-5}$	CL=90%	2493
$\eta \rho^+$	$<\ 1.5$	$\times 10^{-5}$	CL=90%	2554
$\phi \pi^+$	$<\ 1.4$	$\times 10^{-6}$	CL=90%	–
$\phi \rho^+$	$<\ 1.6$	$\times 10^{-5}$		–
$\pi^+ \pi^+ \pi^+ \pi^- \pi^-$	$<\ 8.6$	$\times 10^{-4}$	CL=90%	2608
$\rho^0 a_1(1260)^+$	$<\ 6.2$	$\times 10^{-4}$	CL=90%	2433
$\rho^0 a_2(1320)^+$	$<\ 7.2$	$\times 10^{-4}$	CL=90%	2411
$\pi^+ \pi^+ \pi^+ \pi^- \pi^- \pi^0$	$<\ 6.3$	$\times 10^{-3}$	CL=90%	2592
$a_1(1260)^+ a_1(1260)^0$	$<\ 1.3$	%	CL=90%	2335

Charged particle ($h^{\pm}$) modes

$h^{\pm} = K^{\pm}$ or $\pi^{\pm}$

$h^+ \pi^0$		(1.6 $^{+0.7}_{-0.6}$)	$\times 10^{-5}$		–
ωh^+		(1.4 $\pm$0.4)	$\times 10^{-5}$		–
$h^+ X^0$ (Familon)		< 4.9	$\times 10^{-5}$	CL=90%	–

Baryon modes

$p\overline{p}\pi^+$		< 1.6	$\times 10^{-4}$	CL=90%	2439
$p\overline{p}\pi^+$ nonresonant		< 5.3	$\times 10^{-5}$	CL=90%	–
$p\overline{p}\pi^+\pi^+\pi^-$		< 5.2	$\times 10^{-4}$	CL=90%	2369
$p\overline{p}K^+$ nonresonant		< 8.9	$\times 10^{-5}$	CL=90%	–
$p\overline{\Lambda}$		< 2.6	$\times 10^{-6}$	CL=90%	2430
$p\overline{\Lambda}\pi^+\pi^-$		< 2.0	$\times 10^{-4}$	CL=90%	2367
$\overline{\Delta}^0 p$		< 3.8	$\times 10^{-4}$	CL=90%	2402
$\Delta^{++}\overline{p}$		< 1.5	$\times 10^{-4}$	CL=90%	2402
$\Lambda_c^- p\pi^+$		(6.2 $\pm$2.7)	$\times 10^{-4}$		–
$\Lambda_c^- p\pi^+\pi^0$		< 3.12	$\times 10^{-3}$	CL=90%	–
$\Lambda_c^- p\pi^+\pi^+\pi^-$		< 1.46	$\times 10^{-3}$	CL=90%	–
$\Lambda_c^- p\pi^+\pi^+\pi^-\pi^0$		< 1.34	%	CL=90%	–

Lepton Family number (LF) or Lepton number (L) violating modes, or $\Delta B = 1$ weak neutral current ($B1$) modes

$\pi^+ e^+ e^-$	$B1$	< 3.9	$\times 10^{-3}$	CL=90%	2638
$\pi^+ \mu^+ \mu^-$	$B1$	< 9.1	$\times 10^{-3}$	CL=90%	2633
$K^+ e^+ e^-$	$B1$	< 1.4	$\times 10^{-6}$	CL=90%	2616
$K^+ \mu^+ \mu^-$	$B1$	(10 $^{+5}_{-4}$)	$\times 10^{-7}$		2612
$K^+ \overline{\nu}\nu$	$B1$	< 2.4	$\times 10^{-4}$	CL=90%	–
$K^*(892)^+ e^+ e^-$	$B1$	< 8.9	$\times 10^{-6}$	CL=90%	2564
$K^*(892)^+ \mu^+ \mu^-$	$B1$	< 3.9	$\times 10^{-6}$	CL=90%	2560
$\pi^+ e^+ \mu^-$	LF	< 6.4	$\times 10^{-3}$	CL=90%	2637
$\pi^+ e^- \mu^+$	LF	< 6.4	$\times 10^{-3}$	CL=90%	2637
$K^+ e^+ \mu^-$	LF	< 6.4	$\times 10^{-3}$	CL=90%	2615
$K^+ e^- \mu^+$	LF	< 6.4	$\times 10^{-3}$	CL=90%	2615
$\pi^- e^+ e^+$	L	< 3.9	$\times 10^{-3}$	CL=90%	2638
$\pi^- \mu^+ \mu^+$	L	< 9.1	$\times 10^{-3}$	CL=90%	2633
$\pi^- e^+ \mu^+$	L	< 6.4	$\times 10^{-3}$	CL=90%	2637
$K^- e^+ e^+$	L	< 3.9	$\times 10^{-3}$	CL=90%	2616
$K^- \mu^+ \mu^+$	L	< 9.1	$\times 10^{-3}$	CL=90%	2612
$K^- e^+ \mu^+$	L	< 6.4	$\times 10^{-3}$	CL=90%	2615

B^0

$I(J^P) = \frac{1}{2}(0^-)$

I, J, P need confirmation. Quantum numbers shown are quark-model predictions.

Mass $m_{B^0} = 5279.4 \pm 0.5$ MeV
$m_{B^0} - m_{B^\pm} = 0.33 \pm 0.28$ MeV (S = 1.1)
Mean life $\tau_{B^0} = (1.542 \pm 0.016) \times 10^{-12}$ s
$c\tau = 462$ μm
$\tau_{B^+}/\tau_{B^0} = 1.083 \pm 0.017$ (direct measurements)

B^0-$\overline{B}^0$ mixing parameters

$\chi_d = 0.181 \pm 0.004$
$\Delta m_{B^0} = m_{B^0_H} - m_{B^0_L} = (0.489 \pm 0.008) \times 10^{12}$ $\hbar$ s^{-1}
$x_d = \Delta m_{B^0}/\Gamma_{B^0} = 0.755 \pm 0.015$

CP violation parameters

$\mathrm{Re}(\epsilon_{B^0})/(1+|\epsilon_{B^0}|^2) = (0 \pm 4) \times 10^{-3}$
A_{CP} $(B^0 \to K^+\pi^-) = -0.09 \pm 0.06$
$A_{CP}(B^0 \to \phi K^*(892)^0) = 0.00 \pm 0.27$
$C_{\pi\pi}$ $(B^0 \to \pi^+\pi^-) = -0.2 \pm 0.5$
$S_{\pi\pi}$ $(B^0 \to \pi^+\pi^-) = 0.0 \pm 0.6$
$\sin(2\beta) = 0.79 \pm 0.14$ (S = 1.3)

$\overline{B}^0$ modes are charge conjugates of the modes below. Reactions indicate the weak decay vertex and do not include mixing. Modes which do not identify the charge state of the B are listed in the $B^{\pm}/B^0$ ADMIXTURE section.

The branching fractions listed below assume 50% $B^0\overline{B}^0$ and 50% B^+B^- production at the $\Upsilon(4S)$. We have attempted to bring older measurements up to date by rescaling their assumed $\Upsilon(4S)$ production ratio to 50:50 and their assumed D, D_s, D^*, and ψ branching ratios to current values whenever this would affect our averages and best limits significantly.

Indentation is used to indicate a subchannel of a previous reaction. All resonant subchannels have been corrected for resonance branching fractions to the final state so the sum of the subchannel branching fractions can exceed that of the final state.

B^0 DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\ell^+\nu_\ell$ anything	[qq]	(10.5 ± 0.8) %		–
$D^-\ell^+\nu_\ell$	[qq]	(2.11 ± 0.17) %		–
$D^*(2010)^-\ell^+\nu_\ell$	[qq]	(4.60 ± 0.21) %		–
$\rho^-\ell^+\nu_\ell$	[qq]	$(2.6 {}^{+0.6}_{-0.7}) \times 10^{-4}$		–
$\pi^-\ell^+\nu_\ell$		$(1.8 \pm 0.6) \times 10^{-4}$		–
Inclusive modes				
K^+ anything		(78 ± 8) %		–
D, D^*, or D_s modes				
$D^-\pi^+$		$(3.0 \pm 0.4) \times 10^{-3}$		2306
$D^-\rho^+$		$(7.8 \pm 1.4) \times 10^{-3}$		2236
$D^-K^*(892)^+$		$(3.7 \pm 1.8) \times 10^{-4}$		–
$D^-\omega\pi^+$		$(2.8 \pm 0.6) \times 10^{-3}$		–
D^-K^+		$(2.0 \pm 0.6) \times 10^{-4}$		–
$\overline{D}^0\pi^+\pi^-$		$< 1.6 \times 10^{-3}$	CL=90%	2301
$D^*(2010)^-\pi^+$		$(2.76 \pm 0.21) \times 10^{-3}$		2255
$D^-\pi^+\pi^+\pi^-$		$(8.0 \pm 2.5) \times 10^{-3}$		2287
$(D^-\pi^+\pi^+\pi^-)$ nonresonant		$(3.9 \pm 1.9) \times 10^{-3}$		2287
$D^-\pi^+\rho^0$		$(1.1 \pm 1.0) \times 10^{-3}$		2207
$D^-a_1(1260)^+$		$(6.0 \pm 3.3) \times 10^{-3}$		2121
$D^*(2010)^-\pi^+\pi^0$		(1.5 ± 0.5) %		2248
$D^*(2010)^-\rho^+$		$(7.3 \pm 1.5) \times 10^{-3}$		2181
$D^*(2010)^-K^+$		$(2.0 \pm 0.5) \times 10^{-4}$		–
$D^*(2010)^-K^*(892)^+$		$(3.8 \pm 1.5) \times 10^{-4}$		–
$D^*(2010)^-\pi^+\pi^+\pi^-$		$(7.6 \pm 1.8) \times 10^{-3}$	S=1.4	2235
$(D^*(2010)^-\pi^+\pi^+\pi^-)$ non-resonant		$(0.0 \pm 2.5) \times 10^{-3}$		2235
$D^*(2010)^-\pi^+\rho^0$		$(5.7 \pm 3.2) \times 10^{-3}$		2151
$D^*(2010)^-a_1(1260)^+$		(1.30 ± 0.27) %		2061

$D^*(2010)^-\pi^+\pi^+\pi^-\pi^0$	(1.76±0.27) %			2218
$D^*(2010)^+\pi^+\pi^-\pi^-\pi^0$	(1.8 ±0.7) %			–
$D^*(2010)^- p\overline{p}\pi^+$	(6.5 ±1.6)	$\times 10^{-4}$		–
$D^*(2010)^- p\overline{n}$	(1.5 ±0.4)	$\times 10^{-3}$		–
$\overline{D}^*(2010)^-\omega\pi^+$	(2.9 ±0.5)	$\times 10^{-3}$		–
$\overline{D}_2^*(2460)^-\pi^+$	$<$ 2.2	$\times 10^{-3}$	CL=90%	2064
$\overline{D}_2^*(2460)^-\rho^+$	$<$ 4.9	$\times 10^{-3}$	CL=90%	1978
$D^- D^+$	$<$ 9.4	$\times 10^{-4}$	CL=90%	–
$D^- D_s^+$	(8.0 ±3.0)	$\times 10^{-3}$		1812
$D^*(2010)^- D_s^+$	(1.11±0.33) %			1735
$D^- D_s^{*+}$	(1.0 ±0.5) %			1732
$D^*(2010)^- D_s^{*+}$	(1.8 ±0.6) %			1649
$D_s^+\pi^-$	$<$ 2.8	$\times 10^{-4}$	CL=90%	2270
$D_s^{*+}\pi^-$	$<$ 5	$\times 10^{-4}$	CL=90%	2215
$D_s^+\rho^-$	$<$ 7	$\times 10^{-4}$	CL=90%	2198
$D_s^{*+}\rho^-$	$<$ 8	$\times 10^{-4}$	CL=90%	2139
$D_s^+ a_1(1260)^-$	$<$ 2.6	$\times 10^{-3}$	CL=90%	2079
$D_s^{*+} a_1(1260)^-$	$<$ 2.2	$\times 10^{-3}$	CL=90%	2015
$D_s^- K^+$	$<$ 2.4	$\times 10^{-4}$	CL=90%	2242
$D_s^{*-} K^+$	$<$ 1.7	$\times 10^{-4}$	CL=90%	2185
$D_s^- K^*(892)^+$	$<$ 9.9	$\times 10^{-4}$	CL=90%	2172
$D_s^{*-} K^*(892)^+$	$<$ 1.1	$\times 10^{-3}$	CL=90%	2112
$D_s^-\pi^+ K^0$	$<$ 5	$\times 10^{-3}$	CL=90%	2222
$D_s^{*-}\pi^+ K^0$	$<$ 3.1	$\times 10^{-3}$	CL=90%	2164
$D_s^-\pi^+ K^*(892)^0$	$<$ 4	$\times 10^{-3}$	CL=90%	2137
$D_s^{*-}\pi^+ K^*(892)^0$	$<$ 2.0	$\times 10^{-3}$	CL=90%	2075
$\overline{D}^0\pi^0$	(2.9 ±0.5)	$\times 10^{-4}$		2308
$\overline{D}^0\rho^0$	$<$ 3.9	$\times 10^{-4}$	CL=90%	2238
$\overline{D}^0\eta$	(1.4 $^{+0.6}_{-0.5}$)	$\times 10^{-4}$		2274
$\overline{D}^0\eta'$	$<$ 9.4	$\times 10^{-4}$	CL=90%	2198
$\overline{D}^0\omega$	(1.8 ±0.6)	$\times 10^{-4}$		2235
$\overline{D}^{*0}\gamma$	$<$ 5.0	$\times 10^{-5}$	CL=90%	–
$\overline{D}^*(2007)^0\pi^0$	(2.5 ±0.7)	$\times 10^{-4}$		2256
$\overline{D}^*(2007)^0\rho^0$	$<$ 5.6	$\times 10^{-4}$	CL=90%	2182
$\overline{D}^*(2007)^0\eta$	$<$ 2.6	$\times 10^{-4}$	CL=90%	2220
$\overline{D}^*(2007)^0\eta'$	$<$ 1.4	$\times 10^{-3}$	CL=90%	2141
$\overline{D}^*(2007)^0\omega$	$<$ 7.4	$\times 10^{-4}$	CL=90%	2180
$D^*(2007)^0\pi^+\pi^+\pi^-\pi^-$	(3.0 ±0.9)	$\times 10^{-3}$		–

$D^*(2010)^+ D^*(2010)^-$	$(9.9\ {}^{+4.4}_{-3.5}) \times 10^{-4}$			1711
$D^*(2010)^+ D^-$	< 6.3	$\times 10^{-4}$	CL=90%	1790
$D^{(*)0} \overline{D}^{(*)0}$	< 2.7	%	CL=90%	–

Charmonium modes

$\eta_c K^0$	$(1.1\ {}^{+0.6}_{-0.5}) \times 10^{-3}$			–
$J/\psi(1S) K^0$	$(8.7 \pm 0.5) \times 10^{-4}$			1683
$J/\psi(1S) K^+ \pi^-$	$(1.2 \pm 0.6) \times 10^{-3}$			1652
$J/\psi(1S) K^*(892)^0$	$(1.31 \pm 0.09) \times 10^{-3}$			1570
$J/\psi(1S) \phi K^0$	$(8.8\ {}^{+3.7}_{-3.3}) \times 10^{-5}$			–
$J/\psi(1S) K(1270)^0$	$(1.3 \pm 0.5) \times 10^{-3}$			–
$J/\psi(1S) \pi^0$	$(2.1 \pm 0.5) \times 10^{-5}$			1728
$J/\psi(1S) \eta$	< 1.2	$\times 10^{-3}$	CL=90%	1672
$J/\psi(1S) \rho^0$	< 2.5	$\times 10^{-4}$	CL=90%	1614
$J/\psi(1S) \omega$	< 2.7	$\times 10^{-4}$	CL=90%	1609
$J/\psi(1S) K^0 \pi^+ \pi^-$	$(1.0 \pm 0.4) \times 10^{-3}$			–
$J/\psi(1S) K^0 \rho^0$	$(5.4 \pm 3.0) \times 10^{-4}$			–
$J/\psi(1S) K^*(892)^+ \pi^-$	$(8 \pm 4) \times 10^{-4}$			–
$J/\psi(1S) K^*(892)^0 \pi^+ \pi^-$	$(6.6 \pm 2.2) \times 10^{-4}$			–
$\psi(2S) K^0$	$(5.7 \pm 1.0) \times 10^{-4}$			1283
$\psi(2S) K^+ \pi^-$	< 1	$\times 10^{-3}$	CL=90%	1238
$\psi(2S) K^*(892)^0$	$(8.0 \pm 1.3) \times 10^{-4}$			1113
$\chi_{c0}(1P) K^0$	< 5.0	$\times 10^{-4}$	CL=90%	–
$\chi_{c1}(1P) K^0$	$(4.0\ {}^{+1.2}_{-1.0}) \times 10^{-4}$			1411
$\chi_{c1}(1P) K^*(892)^0$	$(4.1 \pm 1.5) \times 10^{-4}$			1263

***K* or *K** modes**

$K^+ \pi^-$	$(1.74 \pm 0.15) \times 10^{-5}$			2615
$K^0 \pi^0$	$(1.07\ {}^{+0.27}_{-0.25}) \times 10^{-5}$			2614
$\eta' K^0$	$(5.8\ {}^{+1.4}_{-1.3}) \times 10^{-5}$		S=1.5	2528
$\eta' K^*(892)^0$	< 2.4	$\times 10^{-5}$	CL=90%	2472
$\eta K^*(892)^0$	$(1.4\ {}^{+0.6}_{-0.5}) \times 10^{-5}$			2534
ηK^0	< 9.3	$\times 10^{-6}$	CL=90%	2593
ωK^0	< 1.3	$\times 10^{-5}$	CL=90%	–
$K^0_S X^0$ (Familon)	< 5.3	$\times 10^{-5}$	CL=90%	–
$\omega K^*(892)^0$	< 2.3	$\times 10^{-5}$	CL=90%	–
$K^+ K^-$	< 1.9	$\times 10^{-6}$	CL=90%	2593
$K^0 \overline{K}^0$	< 1.7	$\times 10^{-5}$	CL=90%	2592
$K^+ \rho^-$	< 3.2	$\times 10^{-5}$	CL=90%	2559
$K^0 \rho^0$	< 3.9	$\times 10^{-5}$	CL=90%	2559
$K^0 f_0(980)$	< 3.6	$\times 10^{-4}$	CL=90%	2524

$K^*(892)^+\pi^-$		<7.2	$\times10^{-5}$	CL=90%	2562
$K^*(892)^0\pi^0$		<3.6	$\times10^{-6}$	CL=90%	2562
$K_2^*(1430)^+\pi^-$		<2.6	$\times10^{-3}$	CL=90%	2445
$K^0K^+K^-$		<1.3	$\times10^{-3}$	CL=90%	2522
$K^0\phi$		$(8.1\ ^{+3.2}_{-2.6})$	$\times10^{-6}$		2516
$K^-\pi^+\pi^+\pi^-$	[ccc]	<2.3	$\times10^{-4}$	CL=90%	2600
$K^*(892)^0\pi^+\pi^-$		<1.4	$\times10^{-3}$	CL=90%	2556
$K^*(892)^0\rho^0$		<3.4	$\times10^{-5}$	CL=90%	2504
$K^*(892)^0f_0(980)$		<1.7	$\times10^{-4}$	CL=90%	2467
$K_1(1400)^+\pi^-$		<1.1	$\times10^{-3}$	CL=90%	2451
$K^-a_1(1260)^+$	[ccc]	<2.3	$\times10^{-4}$	CL=90%	2471
$K^*(892)^0K^+K^-$		<6.1	$\times10^{-4}$	CL=90%	2466
$K^*(892)^0\phi$		$(9.5\ ^{+2.4}_{-2.0})$	$\times10^{-6}$		2459
$\overline{K}^*(892)^0K^*(892)^0$		<2.2	$\times10^{-5}$	CL=90%	–
$K^*(892)^0K^*(892)^0$		<3.7	$\times10^{-5}$	CL=90%	–
$K^*(892)^+K^*(892)^-$		<1.41	$\times10^{-4}$	CL=90%	–
$K_1(1400)^0\rho^0$		<3.0	$\times10^{-3}$	CL=90%	2388
$K_1(1400)^0\phi$		<5.0	$\times10^{-3}$	CL=90%	2340
$K_2^*(1430)^0\rho^0$		<1.1	$\times10^{-3}$	CL=90%	2380
$K_2^*(1430)^0\phi$		<1.4	$\times10^{-3}$	CL=90%	2331
$K^*(892)^0\gamma$		(4.3 ± 0.4)	$\times10^{-5}$		2564
$K_1(1270)^0\gamma$		<7.0	$\times10^{-3}$	CL=90%	2486
$K_1(1400)^0\gamma$		<4.3	$\times10^{-3}$	CL=90%	2454
$K_2^*(1430)^0\gamma$		<4.0	$\times10^{-4}$	CL=90%	2445
$K^*(1680)^0\gamma$		<2.0	$\times10^{-3}$	CL=90%	2360
$K_3^*(1780)^0\gamma$		<1.0	%	CL=90%	2341
$K_4^*(2045)^0\gamma$		<4.3	$\times10^{-3}$	CL=90%	2244
Light unflavored meson modes					
$\rho^0\gamma$		<1.7	$\times10^{-5}$	CL=90%	–
$\omega\gamma$		<9.2	$\times10^{-6}$	CL=90%	–
$\phi\gamma$		<3.3	$\times10^{-6}$	CL=90%	–
$\pi^+\pi^-$		(4.4 ± 0.9)	$\times10^{-6}$		2636
$\pi^0\pi^0$		<5.7	$\times10^{-6}$	CL=90%	2636
$\eta\pi^0$		<2.9	$\times10^{-6}$	CL=90%	2610
$\eta\eta$		<1.8	$\times10^{-5}$	CL=90%	2582
$\eta'\pi^0$		<5.7	$\times10^{-6}$	CL=90%	2551
$\eta'\eta'$		<4.7	$\times10^{-5}$	CL=90%	2460
$\eta'\eta$		<2.7	$\times10^{-5}$	CL=90%	2522
$\eta'\rho^0$		<1.2	$\times10^{-5}$	CL=90%	2493
$\eta\rho^0$		<1.0	$\times10^{-5}$	CL=90%	2554
$\omega\eta$		<1.2	$\times10^{-5}$	CL=90%	–
$\omega\eta'$		<6.0	$\times10^{-5}$	CL=90%	–

$\omega\rho^0$		<1.1	$\times 10^{-5}$	CL=90%	–
$\omega\omega$		<1.9	$\times 10^{-5}$	CL=90%	–
$\phi\pi^0$		<5	$\times 10^{-6}$	CL=90%	–
$\phi\eta$		<9	$\times 10^{-6}$	CL=90%	–
$\phi\eta'$		<3.1	$\times 10^{-5}$	CL=90%	–
$\phi\rho^0$		<1.3	$\times 10^{-5}$	CL=90%	–
$\phi\omega$		<2.1	$\times 10^{-5}$	CL=90%	–
$\phi\phi$		<1.2	$\times 10^{-5}$	CL=90%	2435
$\pi^+\pi^-\pi^0$		<7.2	$\times 10^{-4}$	CL=90%	2631
$\rho^0\pi^0$		<5.5	$\times 10^{-6}$	CL=90%	2581
$\rho^\mp\pi^\pm$	[ff]	(2.8 ± 0.9)	$\times 10^{-5}$		2581
$\pi^+\pi^-\pi^+\pi^-$		<2.3	$\times 10^{-4}$	CL=90%	2621
$\rho^0\rho^0$		<1.8	$\times 10^{-5}$	CL=90%	2525
$a_1(1260)^\mp\pi^\pm$	[ff]	<4.9	$\times 10^{-4}$	CL=90%	2494
$a_2(1320)^\mp\pi^\pm$	[ff]	<3.0	$\times 10^{-4}$	CL=90%	2473
$\pi^+\pi^-\pi^0\pi^0$		<3.1	$\times 10^{-3}$	CL=90%	2622
$\rho^+\rho^-$		<2.2	$\times 10^{-3}$	CL=90%	2525
$a_1(1260)^0\pi^0$		<1.1	$\times 10^{-3}$	CL=90%	2494
$\omega\pi^0$		<3	$\times 10^{-6}$	CL=90%	2580
$\pi^+\pi^+\pi^-\pi^-\pi^0$		<9.0	$\times 10^{-3}$	CL=90%	2609
$a_1(1260)^+\rho^-$		<3.4	$\times 10^{-3}$	CL=90%	2433
$a_1(1260)^0\rho^0$		<2.4	$\times 10^{-3}$	CL=90%	2433
$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-$		<3.0	$\times 10^{-3}$	CL=90%	2592
$a_1(1260)^+a_1(1260)^-$		<2.8	$\times 10^{-3}$	CL=90%	2336
$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-\pi^0$		<1.1	%	CL=90%	2572

Baryon modes

$p\overline{p}$	<7.0	$\times 10^{-6}$	CL=90%	2467
$p\overline{p}\pi^+\pi^-$	<2.5	$\times 10^{-4}$	CL=90%	2406
$p\overline{\Lambda}\pi^-$	<1.3	$\times 10^{-5}$	CL=90%	2401
$\overline{\Lambda}\Lambda$	<3.9	$\times 10^{-6}$	CL=90%	–
$\Delta^0\overline{\Delta}^0$	<1.5	$\times 10^{-3}$	CL=90%	2335
$\Delta^{++}\Delta^{--}$	<1.1	$\times 10^{-4}$	CL=90%	2335
$\overline{\Sigma}_c^{--}\Delta^{++}$	<1.0	$\times 10^{-3}$	CL=90%	1839
$\overline{\Lambda}_c^-p\pi^+\pi^-$	(1.3 ± 0.6)	$\times 10^{-3}$		–
$\overline{\Lambda}_c^-p$	<2.1	$\times 10^{-4}$	CL=90%	2021
$\overline{\Lambda}_c^-p\pi^0$	<5.9	$\times 10^{-4}$	CL=90%	–
$\overline{\Lambda}_c^-p\pi^+\pi^-\pi^0$	<5.07	$\times 10^{-3}$	CL=90%	–
$\overline{\Lambda}_c^-p\pi^+\pi^-\pi^+\pi^-$	<2.74	$\times 10^{-3}$	CL=90%	–

Lepton Family number (*LF*) violating modes, or $\Delta B = 1$ weak neutral current (*B1*) modes

$\gamma\gamma$			$<$ 1.7	$\times 10^{-6}$	CL=90%	2640
$e^+ e^-$	*B1*		$<$ 8.3	$\times 10^{-7}$	CL=90%	2640
$\mu^+ \mu^-$	*B1*		$<$ 6.1	$\times 10^{-7}$	CL=90%	2638
$K^0 e^+ e^-$	*B1*		$<$ 2.7	$\times 10^{-6}$	CL=90%	2616
$K^0 \mu^+ \mu^-$	*B1*		$<$ 3.3	$\times 10^{-6}$	CL=90%	2612
$K^*(892)^0 e^+ e^-$	*B1*		$<$ 6.4	$\times 10^{-6}$	CL=90%	2564
$K^*(892)^0 \mu^+ \mu^-$	*B1*		$<$ 4.2	$\times 10^{-6}$	CL=90%	2559
$K^*(892)^0 \nu\overline{\nu}$	*B1*		$<$ 1.0	$\times 10^{-3}$	CL=90%	2244
$e^\pm \mu^\mp$	*LF*	[*ff*]	$<$ 1.5	$\times 10^{-6}$	CL=90%	2639
$e^\pm \tau^\mp$	*LF*	[*ff*]	$<$ 5.3	$\times 10^{-4}$	CL=90%	2341
$\mu^\pm \tau^\mp$	*LF*	[*ff*]	$<$ 8.3	$\times 10^{-4}$	CL=90%	2339

$B^\pm/B^0$ ADMIXTURE

CP violation

$A_{CP}(B \to K^*(892)\gamma) = -0.01 \pm 0.07$
$A_{CP}(B \to s\gamma) = -0.08 \pm 0.11$

The branching fraction measurements are for an admixture of B mesons at the $\Upsilon(4S)$. The values quoted assume that $\mathrm{B}(\Upsilon(4S) \to B\overline{B}) = 100\%$.

For inclusive branching fractions, *e.g.*, $B \to D^\pm$ anything, the treatment of multiple D's in the final state must be defined. One possiblity would be to count the number of events with one-or-more D's and divide by the total number of B's. Another possibility would be to count the total number of D's and divide by the total number of B's, which is the definition of average multiplicity. The two definitions are identical when only one of the specified particles is allowed in the final state. Even though the "one-or-more" definition seems sensible, for practical reasons inclusive branching fractions are almost always measured using the multiplicity definition. For heavy final state particles, authors call their results inclusive branching fractions while for light particles some authors call their results multiplicities. In the B sections, we list all results as inclusive branching fractions, adopting a multiplicity definition. This means that inclusive branching fractions can exceed 100% and that inclusive partial widths can exceed total widths, just as inclusive cross sections can exceed total cross sections.

$\overline{B}$ modes are charge conjugates of the modes below. Reactions indicate the weak decay vertex and do not include mixing.

B DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)

Semileptonic and leptonic modes

$B \to e^+ \nu_e$ anything	[ddd]	(10.2 ± 0.4) %			–
$B \to \overline{p} e^+ \nu_e$ anything		< 1.6	$\times 10^{-3}$	CL=90%	–
$B \to \ell^+ \nu_\ell$ anything	[qq,ddd]	(10.38 ± 0.32) %			–
$B \to D^- \ell^+ \nu_\ell$ anything	[qq]	(2.7 ± 0.8) %			–
$B \to \overline{D}^0 \ell^+ \nu_\ell$ anything	[qq]	(7.0 ± 1.4) %			–
$B \to \overline{D}^{**} \ell^+ \nu_\ell$	[qq,eee]	(2.7 ± 0.7) %			–
$B \to \overline{D}_1(2420) \ell^+ \nu_\ell$ anything		(7.4 ± 1.6) $\times 10^{-3}$			–
$B \to D \pi \ell^+ \nu_\ell$ anything + $D^* \pi \ell^+ \nu_\ell$ anything		(2.6 ± 0.5) %		S=1.5	–
$B \to D \pi \ell^+ \nu_\ell$ anything		(1.5 ± 0.6) %			–
$B \to D^* \pi \ell^+ \nu_\ell$ anything		(1.9 ± 0.4) %			–
$B \to \overline{D}_2^*(2460) \ell^+ \nu_\ell$ anything		< 6.5	$\times 10^{-3}$	CL=95%	–
$B \to D^{*-} \pi^+ \ell^+ \nu_\ell$ anything		(1.00 ± 0.34) %			–
$B \to D_s^- \ell^+ \nu_\ell$ anything	[qq]	< 9	$\times 10^{-3}$	CL=90%	–
$B \to D_s^- \ell^+ \nu_\ell K^+$ anything	[qq]	< 6	$\times 10^{-3}$	CL=90%	–
$B \to D_s^- \ell^+ \nu_\ell K^0$ anything	[qq]	< 9	$\times 10^{-3}$	CL=90%	–
$B \to K^+ \ell^+ \nu_\ell$ anything	[qq]	(6.0 ± 0.6) %			–
$B \to K^- \ell^+ \nu_\ell$ anything	[qq]	(10 ± 4) $\times 10^{-3}$			–
$B \to K^0 / \overline{K}^0 \ell^+ \nu_\ell$ anything	[qq]	(4.4 ± 0.5) %			–

D, D^*, or D_s modes

$B \to D^\pm$ anything		(23.9 ± 1.9) %			–
$B \to D^0 / \overline{D}^0$ anything		(63.9 ± 3.0) %		S=1.1	–
$B \to D^*(2010)^\pm$ anything		(22.5 ± 1.5) %			–
$B \to D^*(2007)^0$ anything		(26.0 ± 2.7) %			–
$B \to D_s^\pm$ anything	[ff]	(10.5 ± 2.6) %			–
$B \to D_s^{*\pm}$ anything		(7.9 ± 2.2) %			–
$B \to D_s^{*\pm} \overline{D}^{(*)}$		(4.2 ± 1.2) %			–
$B \to D^{(*)} \overline{D}^{(*)} K^0$ + $D^{(*)} \overline{D}^{(*)} K^\pm$	[ff,fff]	($7.1^{+2.7}_{-1.7}$) %			–
$b \to c \overline{c} s$		(22 ± 4) %			–
$B \to D_s{}^{(*)} \overline{D}^{(*)}$	[ff,fff]	(4.9 ± 1.2) %			–
$B \to D^* D^*(2010)^\pm$	[ff]	< 5.9	$\times 10^{-3}$	CL=90%	–
$B \to D D^*(2010)^\pm$ + $D^* D^\pm$	[ff]	< 5.5	$\times 10^{-3}$	CL=90%	–

$B \to D D^{\pm}$	[ff]	< 3.1	$\times 10^{-3}$	CL=90%	–
$B \to D_s{}^{(*)\pm} \overline{D}^{(*)} X(n\pi^{\pm})$	[ff,fff]	$(9 \ {}^{+5}_{-4})$	%		–
$B \to D^*(2010)\gamma$		< 1.1	$\times 10^{-3}$	CL=90%	–
$B \to D_s^+\pi^-$, $D_s^{*+}\pi^-$, $D_s^+\rho^-$, $D_s^{*+}\rho^-$, $D_s^+\pi^0$, $D_s^{*+}\pi^0$, $D_s^+\eta$, $D_s^{*+}\eta$, $D_s^+\rho^0$, $D_s^{*+}\rho^0$, $D_s^+\omega$, $D_s^{*+}\omega$	[ff]	< 5	$\times 10^{-4}$	CL=90%	–
$B \to D_{s1}(2536)^+$ anything		< 9.5	$\times 10^{-3}$	CL=90%	–

Charmonium modes

$B \to J/\psi(1S)$ anything		(1.15 ± 0.06)	%		–
$B \to J/\psi(1S)$(direct) anything		(8.0 ± 0.8)	$\times 10^{-3}$		–
$B \to \psi(2S)$ anything		(3.5 ± 0.5)	$\times 10^{-3}$		–
$B \to \chi_{c1}(1P)$ anything		(3.6 ± 0.5)	$\times 10^{-3}$		–
$B \to \chi_{c1}(1P)$(direct) anything		(3.3 ± 0.5)	$\times 10^{-3}$		–
$B \to \chi_{c2}(1P)$ anything		(7 ± 4)	$\times 10^{-4}$		–
$B \to \eta_c(1S)$ anything		< 9	$\times 10^{-3}$	CL=90%	–

K or K^* modes

$B \to K^{\pm}$ anything	[ff]	(78.9 ± 2.5)	%		–
$B \to K^+$ anything		(66 ± 5)	%		–
$B \to K^-$ anything		(13 ± 4)	%		–
$B \to K^0/\overline{K}^0$ anything	[ff]	(64 ± 4)	%		–
$B \to K^*(892)^{\pm}$ anything		(18 ± 6)	%		–
$B \to K^*(892)^0/\overline{K}^*(892)^0$ anything	[ff]	(14.6 ± 2.6)	%		–
$B \to K^*(892)\gamma$		(4.2 ± 0.6)	$\times 10^{-5}$		–
$B \to K_1(1400)\gamma$		< 1.27	$\times 10^{-4}$	CL=90%	–
$B \to K_2^*(1430)\gamma$		$(1.7 \ {}^{+0.6}_{-0.5})$	$\times 10^{-5}$		–
$B \to K_2(1770)\gamma$		< 1.2	$\times 10^{-3}$	CL=90%	–
$B \to K_3^*(1780)\gamma$		< 3.0	$\times 10^{-3}$	CL=90%	–
$B \to K_4^*(2045)\gamma$		< 1.0	$\times 10^{-3}$	CL=90%	–
$B \to \eta'(958)K$		(8.3 ± 1.1)	$\times 10^{-5}$		–
$B \to \eta'(958)K^*(892)$		< 2.2	$\times 10^{-5}$	CL=90%	–
$B \to \eta K$		< 5.2	$\times 10^{-6}$	CL=90%	–
$B \to \eta K^*(892)$		(1.8 ± 0.5)	$\times 10^{-5}$		–
$B \to \overline{b} \to \overline{s}\gamma$		(3.3 ± 0.4)	$\times 10^{-4}$		–
$B \to \overline{b} \to \overline{s}$gluon		< 6.8	%	CL=90%	–
$B \to \eta$ anything		< 4.4	$\times 10^{-4}$	CL=90%	–
$B \to \eta'$ anything		$(6.2 \ {}^{+2.1}_{-2.6})$	$\times 10^{-4}$		–

Light unflavored meson modes

$B \to \rho\gamma$		$< 1.4 \times 10^{-5}$	CL=90%	–
$B \to \pi^{\pm}$ anything	[ff,ggg]	(358 ± 7) %		–
$B \to \pi^{0}$ anything		(235 ± 11) %		–
$B \to \eta$ anything		(17.6 ± 1.6) %		–
$B \to \rho^{0}$ anything		(21 ± 5) %		–
$B \to \omega$ anything		< 81 %	CL=90%	–
$B \to \phi$ anything		(3.5 ± 0.7) %	S=1.8	–
$B \to \phi K^{*}(892)$		$< 2.2 \times 10^{-5}$	CL=90%	–

Baryon modes

$B \to \Lambda_c^{\pm}$ anything		(6.4 ± 1.1) %		–
$B \to \overline{\Lambda}_c^{-} e^{+}$ anything		$< 3.2 \times 10^{-3}$	CL=90%	–
$B \to \overline{\Lambda}_c^{-} p$ anything		(3.6 ± 0.7) %		–
$B \to \overline{\Lambda}_c^{-} p e^{+} \nu_e$		$< 1.5 \times 10^{-3}$	CL=90%	–
$B \to \overline{\Sigma}_c^{--}$ anything		$(4.2 \pm 2.4) \times 10^{-3}$		–
$B \to \overline{\Sigma}_c^{-}$ anything		$< 9.6 \times 10^{-3}$	CL=90%	–
$B \to \overline{\Sigma}_c^{0}$ anything		$(4.6 \pm 2.4) \times 10^{-3}$		–
$B \to \overline{\Sigma}_c^{0} N (N = p$ or $n)$		$< 1.5 \times 10^{-3}$	CL=90%	–
$B \to \Xi_c^{0}$ anything $\times$ B($\Xi_c^{0} \to \Xi^{-}\pi^{+}$)		$(1.4 \pm 0.5) \times 10^{-4}$		–
$B \to \Xi_c^{+}$ anything $\times$ B($\Xi_c^{+} \to \Xi^{-}\pi^{+}\pi^{+}$)		$(4.5 {}^{+1.3}_{-1.2}) \times 10^{-4}$		–
$B \to p/\overline{p}$ anything	[ff]	(8.0 ± 0.4) %		–
$B \to p/\overline{p}$(direct) anything	[ff]	(5.5 ± 0.5) %		–
$B \to \Lambda/\overline{\Lambda}$ anything	[ff]	(4.0 ± 0.5) %		–
$B \to \Xi^{-}/\overline{\Xi}^{+}$ anything	[ff]	$(2.7 \pm 0.6) \times 10^{-3}$		–
$B \to$ baryons anything		(6.8 ± 0.6) %		–
$B \to p\overline{p}$ anything		(2.47 ± 0.23) %		–
$B \to \Lambda\overline{p}/\overline{\Lambda}p$ anything	[ff]	(2.5 ± 0.4) %		–
$B \to \Lambda\overline{\Lambda}$ anything		$< 5 \times 10^{-3}$	CL=90%	–

Lepton Family number (*LF*) violating modes or $\Delta B = 1$ weak neutral current (*B1*) modes

$B \to e^{+}e^{-}s$	*B1*	$< 5.7 \times 10^{-5}$	CL=90%	–
$B \to \mu^{+}\mu^{-}s$	*B1*	$< 5.8 \times 10^{-5}$	CL=90%	–
$B \to K e^{+}e^{-}$	*B1*	$< 1.3 \times 10^{-6}$	CL=90%	–
$B \to K^{*}(892) e^{+}e^{-}$	*B1*	$< 5.6 \times 10^{-6}$	CL=90%	–

$B \rightarrow K \mu^+ \mu^-$	*B1*		$(9.9 {}^{+4.2}_{-3.5}) \times 10^{-7}$		–
$B \rightarrow K^*(892) \mu^+ \mu^-$	*B1*		$< 3.1 \times 10^{-6}$	CL=90%	–
$B \rightarrow K \ell^+ \ell^-$	*B1*		$(7.5 {}^{+2.6}_{-2.2}) \times 10^{-7}$		–
$B \rightarrow K^*(892) \ell^+ \ell^-$	*B1*		$< 3.3 \times 10^{-6}$	CL=90%	–
$B \rightarrow e^\pm \mu^\mp s$	*LF*	[*ff*]	$< 2.2 \times 10^{-5}$	CL=90%	–

$B^\pm/B^0/B^0_s/b$-baryon ADMIXTURE

These measurements are for an admixture of bottom particles at high energy (LEP, Tevatron, S$p\overline{p}$S).

Mean life $\tau = (1.564 \pm 0.014) \times 10^{-12}$ s

Mean life $\tau = (1.72 \pm 0.10) \times 10^{-12}$ s Charged b-hadron admixture

Mean life $\tau = (1.58 \pm 0.14) \times 10^{-12}$ s Neutral b-hadron admixture

$\tau_{\text{charged } b-\text{hadron}}/\tau_{\text{neutral } b-\text{hadron}} = 1.09 \pm 0.13$

$|\Delta\tau_b|/\tau_{b,\overline{b}} = -0.001 \pm 0.014$

The branching fraction measurements are for an admixture of B mesons and baryons at energies above the $\Upsilon(4S)$. Only the highest energy results (LEP, Tevatron, S$p\overline{p}$S) are used in the branching fraction averages. In the following, we assume that the production fractions are the same at the LEP and at the Tevatron.

For inclusive branching fractions, *e.g.*, $B \rightarrow D^\pm$ anything, the treatment of multiple D's in the final state must be defined. One possiblity would be to count the number of events with one-or-more D's and divide by the total number of B's. Another possibility would be to count the total number of D's and divide by the total number of B's, which is the definition of average multiplicity. The two definitions are identical when only one of the specified particles is allowed in the final state. Even though the "one-or-more" definition seems sensible, for practical reasons inclusive branching fractions are almost always measured using the multiplicity definition. For heavy final state particles, authors call their results inclusive branching fractions while for light particles some authors call their results multiplicities. In the B sections, we list all results as inclusive branching fractions, adopting a multiplicity definition. This means that inclusive branching fractions can exceed 100% and that inclusive partial widths can exceed total widths, just as inclusive cross sections can exceed total cross sections.

The modes below are listed for a $\overline{b}$ initial state. b modes are their charge conjugates. Reactions indicate the weak decay vertex and do not include mixing.

$\overline{b}$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)

PRODUCTION FRACTIONS

The production fractions for weakly decaying b-hadrons at high energy have been calculated from the best values of mean lives, mixing parameters, and branching fractions in this edition by the LEP B Oscillation Working Group as described in the note "B^0-$\overline{B}^0$ Mixing" in the B^0 Particle Listings. Values assume

$$\mathrm{B}(\overline{b} \to B^+) = \mathrm{B}(\overline{b} \to B^0)$$
$$\mathrm{B}(\overline{b} \to B^+) + \mathrm{B}(\overline{b} \to B^0) + \mathrm{B}(\overline{b} \to B^0_s) + \mathrm{B}(b \to b\text{-baryon}) = 100\ \%.$$

The notation for production fractions varies in the literature (f_d, d_{B^0}, $f(b \to \overline{B}^0)$, $\mathrm{Br}(b \to \overline{B}^0)$). We use our own branching fraction notation here, $\mathrm{B}(\overline{b} \to B^0)$.

B^+		(38.8 ± 1.3) %		–
B^0		(38.8 ± 1.3) %		–
B^0_s		(10.6 ± 1.3) %		–
b-baryon		(11.8 ± 2.0) %		–
B_c		—		–

DECAY MODES

Semileptonic and leptonic modes

ν anything		(23.1 ± 1.5) %		–
$\ell^+ \nu_\ell$ anything	[qq]	(10.59 ± 0.22) %		–
$e^+ \nu_e$ anything		(10.86 ± 0.35) %		–
$\mu^+ \nu_\mu$ anything		$(10.95 {}^{+0.29}_{-0.25})$ %		–
$D^- \ell^+ \nu_\ell$ anything	[qq]	(2.31 ± 0.35) %	S=1.6	–
$D^- \pi^+ \ell^+ \nu_\ell$ anything		$(4.9 \pm 1.9) \times 10^{-3}$		–
$D^- \pi^- \ell^+ \nu_\ell$ anything		$(2.6 \pm 1.6) \times 10^{-3}$		–
$\overline{D}^0 \ell^+ \nu_\ell$ anything	[qq]	(6.90 ± 0.35) %		–
$\overline{D}^0 \pi^- \ell^+ \nu_\ell$ anything		(1.07 ± 0.27) %		–
$\overline{D}^0 \pi^+ \ell^+ \nu_\ell$ anything		$(2.3 \pm 1.6) \times 10^{-3}$		–
$D^{*-} \ell^+ \nu_\ell$ anything	[qq]	(2.75 ± 0.19) %		–
$D^{*-} \pi^+ \ell^+ \nu_\ell$ anything		$(4.8 \pm 1.0) \times 10^{-3}$		–
$D^{*-} \pi^- \ell^+ \nu_\ell$ anything		$(6 \pm 7) \times 10^{-4}$		–
$\overline{D}^0_j \ell^+ \nu_\ell$ anything	[qq,hhh]	seen		–
$D^-_j \ell^+ \nu_\ell$ anything	[qq,hhh]	seen		–
$\overline{D}^*_2(2460)^0 \ell^+ \nu_\ell$ anything		seen		–
$D^*_2(2460)^- \ell^+ \nu_\ell$ anything		seen		–
charmless $\ell \overline{\nu}_\ell$	[qq]	$(1.7 \pm 0.5) \times 10^{-3}$		–
$\tau^+ \nu_\tau$ anything		(2.48 ± 0.26) %		–
$D^{*-} \tau \nu_\tau$ anything		$(9 \pm 4) \times 10^{-3}$		–
$\overline{c} \to \ell^- \overline{\nu}_\ell$ anything	[qq]	(8.0 ± 0.4) %		–
$c \to \ell^+ \nu$ anything		$(1.6 {}^{+0.4}_{-0.5})$ %		–

Charmed meson and baryon modes

$\overline{D}^0$ anything		(60.9 ± 3.2) %		–
$D^0 D_s^{\pm}$ anything	[ff]	$(9.1 {+3.9 \atop -2.8})$ %		–
$D^{\mp} D_s^{\pm}$ anything	[ff]	$(4.0 {+2.3 \atop -1.8})$ %		–
$\overline{D}^0 D^0$ anything	[ff]	$(5.1 {+2.0 \atop -1.8})$ %		–
$D^0 D^{\pm}$ anything	[ff]	$(2.7 {+1.8 \atop -1.6})$ %		–
$D^{\pm} D^{\mp}$ anything	[ff]	$< 9 \times 10^{-3}$	CL=90%	–
D^- anything		(23.5 ± 2.2) %		–
$D^*(2010)^+$ anything		(17.3 ± 2.0) %		–
$D_1(2420)^0$ anything		(5.0 ± 1.5) %		–
$D^*(2010)^{\mp} D_s^{\pm}$ anything	[ff]	$(3.3 {+1.6 \atop -1.3})$ %		–
$D^0 D^*(2010)^{\pm}$ anything	[ff]	$(3.0 {+1.1 \atop -0.9})$ %		–
$D^*(2010)^{\pm} D^{\mp}$ anything	[ff]	$(2.5 {+1.2 \atop -1.0})$ %		–
$D^*(2010)^{\pm} D^*(2010)^{\mp}$ anything	[ff]	(1.2 ± 0.4) %		–
$D_2^*(2460)^0$ anything		(4.7 ± 2.7) %		–
$\overline{D}_s$ anything		(18 ± 5) %		–
Λ_c anything		(9.7 ± 2.9) %		–
$\overline{c}\,/\,c$ anything	[ggg]	(116.6 ± 3.3) %		–

Charmonium modes

$J/\psi(1S)$ anything		(1.16 ± 0.10) %		–
$\psi(2S)$ anything		$(4.8 \pm 2.4) \times 10^{-3}$		–
$\chi_{c1}(1P)$ anything		(1.5 ± 0.5) %		–

K or *K** modes

$\overline{s}\gamma$		$(3.1 \pm 1.1) \times 10^{-4}$		–
$\overline{s}\overline{\nu}\nu$		$< 6.4 \times 10^{-4}$	CL=90%	–
$K^{\pm}$ anything		(74 ± 6) %		–
K_S^0 anything		(29.0 ± 2.9) %		–

Pion modes

$\pi^{\pm}$ anything		(397 ± 21) %		–
π^0 anything	[ggg]	(278 ± 60) %		–
ϕ anything		(2.82 ± 0.23) %		–

Baryon modes

$p\,/\,\overline{p}$ anything		(13.1 ± 1.1) %		–

Other modes

charged anything	[ggg]	(497 ± 7) %		–
hadron$^+$ hadron$^-$		$(1.7 {+1.0 \atop -0.7}) \times 10^{-5}$		–
charmless		$(7 \pm 21) \times 10^{-3}$		–

Baryon modes

$\Lambda/\overline{\Lambda}$ anything		(5.9 ± 0.6) %		–
b-baryon anything		(10.2 ± 2.8) %		–

$\Delta B = 1$ weak neutral current ($B1$) modes

$\mu^+ \mu^-$ anything	*B1*	< 3.2	$\times 10^{-4}$ CL=90%	–

B^*

$$I(J^P) = \tfrac{1}{2}(1^-)$$

I, J, P need confirmation. Quantum numbers shown are quark-model predictions.

Mass $m_{B^*} = 5325.0 \pm 0.6$ MeV

$m_{B^*} - m_B = 45.78 \pm 0.35$ MeV

B^* DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$B\gamma$	dominant	46

BOTTOM, STRANGE MESONS
$(B = \pm 1, S = \mp 1)$

$B_s^0 = s\overline{b}$, $\overline{B}_s^0 = \overline{s}\,b$, similarly for B_s^*'s

B_s^0

$I(J^P) = 0(0^-)$

I, J, P need confirmation. Quantum numbers shown are quark-model predictions.

Mass $m_{B_s^0} = 5369.6 \pm 2.4$ MeV

Mean life $\tau = (1.461 \pm 0.057) \times 10^{-12}$ s

$c\tau = 438$ μm

B_s^0-$\overline{B}_s^0$ mixing parameters

$\Delta m_{B_s^0} = m_{B_{sH}^0} - m_{B_{sL}^0} > 13.1 \times 10^{12}\ \hbar\ \mathrm{s}^{-1}$, CL = 95%

$x_s = \Delta m_{B_s^0}/\Gamma_{B_s^0} > 19.0$, CL = 95%

$\chi_s > 0.49862$, CL = 95%

These branching fractions all scale with B($\overline{b} \to B_s^0$), the LEP B_s^0 production fraction. The first four were evaluated using B($\overline{b} \to B_s^0$) = (10.7 ± 1.4)% and the rest assume B($\overline{b} \to B_s^0$) = 12%.

The branching fraction B($B_s^0 \to D_s^- \ell^+ \nu_\ell$ anything) is not a pure measurement since the measured product branching fraction B($\overline{b} \to B_s^0$) $\times$ B($B_s^0 \to D_s^- \ell^+ \nu_\ell$ anything) was used to determine B($\overline{b} \to B_s^0$), as described in the note on "Production and Decay of b-Flavored Hadrons."

B_s^0 DECAY MODES		Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
D_s^- anything		(94 ± 30) %		–
$D_s^- \ell^+ \nu_\ell$ anything	[iii]	(7.9 ± 2.4) %		–
$D_s^- \pi^+$		< 13 %		2321
$D_s^{(*)+} D_s^{(*)-}$		$(23 {}^{+21}_{-13})$ %		–
$J/\psi(1S)\phi$		$(9.3 \pm 3.3) \times 10^{-4}$		1590
$J/\psi(1S)\pi^0$		$< 1.2 \times 10^{-3}$	90%	1788
$J/\psi(1S)\eta$		$< 3.8 \times 10^{-3}$	90%	1735
$\psi(2S)\phi$		seen		1122
$\pi^+\pi^-$		$< 1.7 \times 10^{-4}$	90%	2681
$\pi^0\pi^0$		$< 2.1 \times 10^{-4}$	90%	2681
$\eta\pi^0$		$< 1.0 \times 10^{-3}$	90%	2655

$\eta\eta$			< 1.5	$\times 10^{-3}$	90%	2628
$\rho^0\rho^0$			< 3.20	$\times 10^{-4}$	90%	–
$\phi\rho^0$			< 6.17	$\times 10^{-4}$	90%	–
$\phi\phi$			< 1.183	$\times 10^{-3}$	90%	–
$\pi^+ K^-$			< 2.1	$\times 10^{-4}$	90%	2660
$K^+ K^-$			< 5.9	$\times 10^{-5}$	90%	2639
$\overline{K}^*(892)^0 \rho^0$			< 7.67	$\times 10^{-4}$	90%	–
$\overline{K}^*(892)^0 K^*(892)^0$			< 1.681	$\times 10^{-3}$	90%	–
$\phi K^*(892)^0$			< 1.013	$\times 10^{-3}$	90%	–
$p\overline{p}$			< 5.9	$\times 10^{-5}$	90%	2515
$\gamma\gamma$			< 1.48	$\times 10^{-4}$	90%	2685
$\phi\gamma$			< 7	$\times 10^{-4}$	90%	2588

Lepton Family number (*LF*) violating modes or
$\Delta B = 1$ weak neutral current (*B1*) modes

$\mu^+\mu^-$	*B1*		< 2.0	$\times 10^{-6}$	90%	2682
$e^+ e^-$	*B1*		< 5.4	$\times 10^{-5}$	90%	2864
$e^\pm \mu^\mp$	*LF*	[ff]	< 6.1	$\times 10^{-6}$	90%	2864
$\phi\nu\overline{\nu}$	*B1*		< 5.4	$\times 10^{-3}$	90%	–

BOTTOM, CHARMED MESONS ($B = C = \pm 1$)

$B_c^+ = c\overline{b}$, $B_c^- = \overline{c}\,b$, similarly for B_c^*'s

$B_c^\pm$

$I(J^P) = 0(0^-)$
I, J, P need confirmation.

Quantum numbers shown are quark-model predicitions.

Mass $m = 6.4 \pm 0.4$ GeV
Mean life $\tau = (0.46^{+0.18}_{-0.16}) \times 10^{-12}$ s

B_c^- modes are charge conjugates of the modes below.

B_c^+ DECAY MODES × B($\overline{b} \to B_c$)	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
The following quanities are not pure branching ratios; rather the fraction $\Gamma_i/\Gamma \times$ B($\overline{b} \to B_c$).			
$J/\psi(1S)\ell^+\nu_\ell$ anything	$(5.2^{+2.4}_{-2.1}) \times 10^{-5}$		–
$J/\psi(1S)\pi^+$	$< 8.2 \times 10^{-5}$	90%	–
$J/\psi(1S)\pi^+\pi^+\pi^-$	$< 5.7 \times 10^{-4}$	90%	–
$J/\psi(1S)a_1(1260)$	$< 1.2 \times 10^{-3}$	90%	–
$D^*(2010)^+\overline{D}^0$	$< 6.2 \times 10^{-3}$	90%	–

$c\overline{c}$ MESONS

$\eta_c(1S)$

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

Mass $m = 2979.7 \pm 1.5$ MeV (S = 1.8)
Full width $\Gamma = 16.0^{+3.6}_{-3.2}$ MeV (S = 1.2)

$\eta_c(1S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
Decays involving hadronic resonances			
$\eta'(958)\pi\pi$	(4.1 ± 1.7) %		1319
$\rho\rho$	(2.6 ± 0.9) %		1275
$K^*(892)^0 K^- \pi^+$ + c.c.	(2.0 ± 0.7) %		1273
$K^*(892)\overline{K}^*(892)$	$(8.5 \pm 3.1) \times 10^{-3}$		1193
$\phi\phi$	$(7.1 \pm 2.8) \times 10^{-3}$		1086
$a_0(980)\pi$	< 2 %	90%	1323
$a_2(1320)\pi$	< 2 %	90%	1193
$K^*(892)\overline{K}$ + c.c.	< 1.28 %	90%	1307
$f_2(1270)\eta$	< 1.1 %	90%	1142
$\omega\omega$	$< 3.1 \times 10^{-3}$	90%	1268
Decays into stable hadrons			
$K\overline{K}\pi$	(5.5 ± 1.7) %		1378
$\eta\pi\pi$	(4.9 ± 1.8) %		1425
$\pi^+\pi^- K^+ K^-$	$(2.0\ ^{+0.7}_{-0.6})$ %		1342
$2(K^+K^-)$	(2.1 ± 1.2) %		1053
$2(\pi^+\pi^-)$	(1.2 ± 0.4) %		1457
$p\overline{p}$	$(1.2 \pm 0.4) \times 10^{-3}$		1157
$K\overline{K}\eta$	< 3.1 %	90%	1262
$\pi^+\pi^- p\overline{p}$	< 1.2 %	90%	1023
$\Lambda\overline{\Lambda}$	$< 2 \times 10^{-3}$	90%	987
Radiative decays			
$\gamma\gamma$	$(3.0 \pm 1.2) \times 10^{-4}$		1489

$J/\psi(1S)$

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

Mass $m = 3096.87 \pm 0.04$ MeV
Full width $\Gamma = 87 \pm 5$ keV
$\Gamma_{ee} = 5.26 \pm 0.37$ keV

$J/\psi(1S)$ DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
hadrons		(87.7 ± 0.5) %		–
virtual $\gamma \to$ 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) %		1449
$\rho^0\pi^0$		$(4.2 \pm 0.5) \times 10^{-3}$		1449
$a_2(1320)\rho$		(1.09 ± 0.22) %		1125
$\omega\pi^+\pi^+\pi^-\pi^-$		$(8.5 \pm 3.4) \times 10^{-3}$		1392
$\omega\pi^+\pi^-$		$(7.2 \pm 1.0) \times 10^{-3}$		1435
$\omega f_2(1270)$		$(4.3 \pm 0.6) \times 10^{-3}$		1143
$K^*(892)^0\overline{K}{}^*_2(1430)^0$ + c.c.		$(6.7 \pm 2.6) \times 10^{-3}$		1005
$\omega K^*(892)\overline{K}$ + c.c.		$(5.3 \pm 2.0) \times 10^{-3}$		1098
$K^+\overline{K}{}^*(892)^-$ + c.c.		$(5.0 \pm 0.4) \times 10^{-3}$		1373
$K^0\overline{K}{}^*(892)^0$ + c.c.		$(4.2 \pm 0.4) \times 10^{-3}$		1371
$K_1(1400)^\pm K^\mp$		$(3.8 \pm 1.4) \times 10^{-3}$		–
$\omega\pi^0\pi^0$		$(3.4 \pm 0.8) \times 10^{-3}$		1436
$b_1(1235)^\pm\pi^\mp$	[*ff*]	$(3.0 \pm 0.5) \times 10^{-3}$		1299
$\omega K^\pm K^0_S\pi^\mp$	[*ff*]	$(2.9 \pm 0.7) \times 10^{-3}$		1210
$b_1(1235)^0\pi^0$		$(2.3 \pm 0.6) \times 10^{-3}$		1299
$\phi K^*(892)\overline{K}$ + c.c.		$(2.04 \pm 0.28) \times 10^{-3}$		969
$\omega K\overline{K}$		$(1.9 \pm 0.4) \times 10^{-3}$		1268
$\omega f_0(1710) \to \omega K\overline{K}$		$(4.8 \pm 1.1) \times 10^{-4}$		878
$\phi 2(\pi^+\pi^-)$		$(1.60 \pm 0.32) \times 10^{-3}$		1318
$\Delta(1232)^{++}\overline{p}\pi^-$		$(1.6 \pm 0.5) \times 10^{-3}$		1030
$\omega\eta$		$(1.58 \pm 0.16) \times 10^{-3}$		1394
$\phi K\overline{K}$		$(1.48 \pm 0.22) \times 10^{-3}$		1179
$\phi f_0(1710) \to \phi K\overline{K}$		$(3.6 \pm 0.6) \times 10^{-4}$		875
$p\overline{p}\omega$		$(1.30 \pm 0.25) \times 10^{-3}$	S=1.3	769
$\Delta(1232)^{++}\overline{\Delta}(1232)^{--}$		$(1.10 \pm 0.29) \times 10^{-3}$		938
$\Sigma(1385)^-\overline{\Sigma}(1385)^+$ (or c.c.)	[*ff*]	$(1.03 \pm 0.13) \times 10^{-3}$		692
$p\overline{p}\eta'(958)$		$(9 \pm 4) \times 10^{-4}$	S=1.7	596
$\phi f'_2(1525)$		$(8 \pm 4) \times 10^{-4}$	S=2.7	871
$\phi\pi^+\pi^-$		$(8.0 \pm 1.2) \times 10^{-4}$		1365

$\phi K^{\pm} K^0_S \pi^{\mp}$	[ff]	$(7.2 \pm 0.9) \times 10^{-4}$		1114
$\omega f_1(1420)$		$(6.8 \pm 2.4) \times 10^{-4}$		1062
$\phi \eta$		$(6.5 \pm 0.7) \times 10^{-4}$		1320
$\Xi(1530)^- \overline{\Xi}^+$		$(5.9 \pm 1.5) \times 10^{-4}$		597
$p K^- \overline{\Sigma}(1385)^0$		$(5.1 \pm 3.2) \times 10^{-4}$		645
$\omega \pi^0$		$(4.2 \pm 0.6) \times 10^{-4}$	S=1.4	1447
$\phi \eta'(958)$		$(3.3 \pm 0.4) \times 10^{-4}$		1192
$\phi f_0(980)$		$(3.2 \pm 0.9) \times 10^{-4}$	S=1.9	1182
$\Xi(1530)^0 \overline{\Xi}^0$		$(3.2 \pm 1.4) \times 10^{-4}$		608
$\Sigma(1385)^- \overline{\Sigma}^+$ (or c.c.)	[ff]	$(3.1 \pm 0.5) \times 10^{-4}$		857
$\phi f_1(1285)$		$(2.6 \pm 0.5) \times 10^{-4}$	S=1.1	1032
$\rho \eta$		$(1.93 \pm 0.23) \times 10^{-4}$		1398
$\omega \eta'(958)$		$(1.67 \pm 0.25) \times 10^{-4}$		1279
$\omega f_0(980)$		$(1.4 \pm 0.5) \times 10^{-4}$		1271
$\rho \eta'(958)$		$(1.05 \pm 0.18) \times 10^{-4}$		1283
$p \overline{p} \phi$		$(4.5 \pm 1.5) \times 10^{-5}$		527
$a_2(1320)^{\pm} \pi^{\mp}$	[ff]	$< 4.3 \times 10^{-3}$	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%	–
$K^*_2(1430)^0 \overline{K}{}^*_2(1430)^0$		$< 2.9 \times 10^{-3}$	CL=90%	588
$K^*(892)^0 \overline{K}{}^*(892)^0$		$< 5 \times 10^{-4}$	CL=90%	1263
$\phi f_2(1270)$		$< 3.7 \times 10^{-4}$	CL=90%	1036
$p \overline{p} \rho$		$< 3.1 \times 10^{-4}$	CL=90%	779
$\phi \eta(1440) \to \phi \eta \pi \pi$		$< 2.5 \times 10^{-4}$	CL=90%	946
$\omega f'_2(1525)$		$< 2.2 \times 10^{-4}$	CL=90%	1003
$\Sigma(1385)^0 \overline{\Lambda}$		$< 2 \times 10^{-4}$	CL=90%	911
$\Delta(1232)^+ \overline{p}$		$< 1 \times 10^{-4}$	CL=90%	1100
$\Sigma^0 \overline{\Lambda}$		$< 9 \times 10^{-5}$	CL=90%	1032
$\phi \pi^0$		$< 6.8 \times 10^{-6}$	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
$4(\pi^+ \pi^-) \pi^0$		$(9.0 \pm 3.0) \times 10^{-3}$		1345
$\pi^+ \pi^- K^+ K^-$		$(7.2 \pm 2.3) \times 10^{-3}$		1407
$K \overline{K} \pi$		$(6.1 \pm 1.0) \times 10^{-3}$		1440
$p \overline{p} \pi^+ \pi^-$		$(6.0 \pm 0.5) \times 10^{-3}$	S=1.3	1107
$2(\pi^+ \pi^-)$		$(4.0 \pm 1.0) \times 10^{-3}$		1517
$3(\pi^+ \pi^-)$		$(4.0 \pm 2.0) \times 10^{-3}$		1466
$n \overline{n} \pi^+ \pi^-$		$(4 \pm 4) \times 10^{-3}$		1106
$\Sigma^0 \overline{\Sigma}^0$		$(1.27 \pm 0.17) \times 10^{-3}$		992
$2(\pi^+ \pi^-) K^+ K^-$		$(3.1 \pm 1.3) \times 10^{-3}$		1320

$p\overline{p}\pi^+\pi^-\pi^0$	[jjj]	$(2.3 \pm 0.9) \times 10^{-3}$	S=1.9	1033
$p\overline{p}$		$(2.12 \pm 0.10) \times 10^{-3}$		1232
$p\overline{p}\eta$		$(2.09 \pm 0.18) \times 10^{-3}$		948
$p\overline{n}\pi^-$		$(2.00 \pm 0.10) \times 10^{-3}$		1174
$n\overline{n}$		$(2.2 \pm 0.4) \times 10^{-3}$		1231
$\Xi\overline{\Xi}$		$(1.8 \pm 0.4) \times 10^{-3}$	S=1.8	818
$\Lambda\overline{\Lambda}$		$(1.30 \pm 0.12) \times 10^{-3}$	S=1.1	1074
$p\overline{p}\pi^0$		$(1.09 \pm 0.09) \times 10^{-3}$		1176
$\Lambda\overline{\Sigma}^-\pi^+$ (or c.c.)	[ff]	$(1.06 \pm 0.12) \times 10^{-3}$		945
$pK^-\overline{\Lambda}$		$(8.9 \pm 1.6) \times 10^{-4}$		876
$2(K^+K^-)$		$(7.0 \pm 3.0) \times 10^{-4}$		1131
$pK^-\overline{\Sigma}^0$		$(2.9 \pm 0.8) \times 10^{-4}$		820
K^+K^-		$(2.37 \pm 0.31) \times 10^{-4}$		1468
$\Lambda\overline{\Lambda}\pi^0$		$(2.2 \pm 0.6) \times 10^{-4}$		998
$\pi^+\pi^-$		$(1.47 \pm 0.23) \times 10^{-4}$		1542
$K^0_S K^0_L$		$(1.08 \pm 0.14) \times 10^{-4}$		1466
$\Lambda\overline{\Sigma}$ + c.c.		$< 1.5 \times 10^{-4}$	CL=90%	1032
$K^0_S K^0_S$		$< 5.2 \times 10^{-6}$	CL=90%	1466

Radiative decays

$\gamma\eta_c(1S)$		(1.3 ± 0.4) %		116
$\gamma\pi^+\pi^-2\pi^0$		$(8.3 \pm 3.1) \times 10^{-3}$		1518
$\gamma\eta\pi\pi$		$(6.1 \pm 1.0) \times 10^{-3}$		1487
$\gamma\eta(1440) \rightarrow \gamma K\overline{K}\pi$	[p]	$(9.7 \pm 1.7) \times 10^{-4}$		1223
$\gamma\eta(1440) \rightarrow \gamma\gamma\rho^0$		$(6.4 \pm 1.4) \times 10^{-5}$		1223
$\gamma\eta(1440) \rightarrow \gamma\eta\pi^+\pi^-$		$(3.0 \pm 0.5) \times 10^{-4}$		–
$\gamma\rho\rho$		$(4.5 \pm 0.8) \times 10^{-3}$		1343
$\gamma\eta_2(1870) \rightarrow \gamma\pi^+\pi^-$		$(6.2 \pm 2.4) \times 10^{-4}$		–
$\gamma\eta'(958)$		$(4.31 \pm 0.30) \times 10^{-3}$		1400
$\gamma 2\pi^+ 2\pi^-$		$(2.8 \pm 0.5) \times 10^{-3}$	S=1.9	1517
$\gamma K^+K^-\pi^+\pi^-$		$(2.1 \pm 0.6) \times 10^{-3}$		–
$\gamma f_4(2050)$		$(2.7 \pm 0.7) \times 10^{-3}$		874
$\gamma\omega\omega$		$(1.59 \pm 0.33) \times 10^{-3}$		1337
$\gamma\eta(1440) \rightarrow \gamma\rho^0\rho^0$		$(1.7 \pm 0.4) \times 10^{-3}$	S=1.3	1223
$\gamma f_2(1270)$		$(1.38 \pm 0.14) \times 10^{-3}$		1286
$\gamma f_0(1710) \rightarrow \gamma K\overline{K}$		$(8.5 {}^{+1.2}_{-0.9}) \times 10^{-4}$	S=1.2	1075
$\gamma\eta$		$(8.6 \pm 0.8) \times 10^{-4}$		1500
$\gamma f_1(1420) \rightarrow \gamma K\overline{K}\pi$		$(7.9 \pm 1.3) \times 10^{-4}$		1220
$\gamma f_1(1285)$		$(6.1 \pm 0.8) \times 10^{-4}$		1283
$\gamma f_1(1510) \rightarrow \gamma\eta\pi^+\pi^-$		$(4.5 \pm 1.2) \times 10^{-4}$		–
$\gamma f'_2(1525)$		$(4.7 {}^{+0.7}_{-0.5}) \times 10^{-4}$		1173

$\gamma f_2(1950) \rightarrow \gamma K^*(892)\overline{K}^*(892)$	$(7.0 \pm 2.2) \times 10^{-4}$		–
$\gamma K^*(892)\overline{K}^*(892)$	$(4.0 \pm 1.3) \times 10^{-3}$		–
$\gamma \phi \phi$	$(4.0 \pm 1.2) \times 10^{-4}$	S=2.1	1166
$\gamma p \overline{p}$	$(3.8 \pm 1.0) \times 10^{-4}$		1232
$\gamma \eta(2225)$	$(2.9 \pm 0.6) \times 10^{-4}$		834
$\gamma \eta(1760) \rightarrow \gamma \rho^0 \rho^0$	$(1.3 \pm 0.9) \times 10^{-4}$		1048
$\gamma (K \overline{K} \pi)_{J^{PC}=0-+}$	$(7 \pm 4) \times 10^{-4}$	S=2.1	–
$\gamma \pi^0$	$(3.9 \pm 1.3) \times 10^{-5}$		1546
$\gamma p \overline{p} \pi^+ \pi^-$	$< 7.9 \times 10^{-4}$	CL=90%	1107
$\gamma \gamma$	$< 5 \times 10^{-4}$	CL=90%	1548
$\gamma \Lambda \overline{\Lambda}$	$< 1.3 \times 10^{-4}$	CL=90%	1074
3γ	$< 5.5 \times 10^{-5}$	CL=90%	1548
$\gamma f_J(2220)$	$> 2.50 \times 10^{-3}$	CL=99.9%	–
$\gamma f_J(2220) \rightarrow \gamma \pi \pi$	$(8 \pm 4) \times 10^{-5}$		–
$\gamma f_J(2220) \rightarrow \gamma K \overline{K}$	$(8.1 \pm 3.0) \times 10^{-5}$		–
$\gamma f_J(2220) \rightarrow \gamma p \overline{p}$	$(1.5 \pm 0.8) \times 10^{-5}$		–
$\gamma f_0(1500)$	$<(5.7 \pm 0.8) \times 10^{-4}$		1184
$\gamma e^+ e^-$	$(8.8 \pm 1.4) \times 10^{-3}$		–

$\chi_{c0}(1P)$

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

Mass $m = 3415.1 \pm 0.8$ MeV
Full width $\Gamma = 16.2 \pm 2.3$ MeV

$\chi_{c0}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Hadronic decays			
$2(\pi^+ \pi^-)$	(2.44 ± 0.33) %		1679
$\pi^+ \pi^- K^+ K^-$	(1.8 ± 0.6) %	S=1.9	1580
$\rho^0 \pi^+ \pi^-$	(1.6 ± 0.5) %		1608
$3(\pi^+ \pi^-)$	(1.24 ± 0.22) %		1633
$K^+ \overline{K}^*(892)^0 \pi^- +$ c.c.	(1.2 ± 0.4) %		1522
$K^+ K^-$	$(5.9 \pm 0.9) \times 10^{-3}$		1635
$\pi^+ \pi^-$	$(5.0 \pm 0.7) \times 10^{-3}$		1702
$K^+ K^- K^+ K^-$	$(2.1 \pm 0.5) \times 10^{-3}$		–
$K^0_S K^0_S$	$(2.0 \pm 0.6) \times 10^{-3}$		–
$\pi^+ \pi^- p \overline{p}$	$(1.8 \pm 0.9) \times 10^{-3}$	S=1.6	1320
$\phi \phi$	$(9 \pm 5) \times 10^{-4}$		–
$p \overline{p}$	$(2.2 \pm 0.5) \times 10^{-4}$		1427
$K^0_S K^+ \pi^- +$ c.c.	$< 7.1 \times 10^{-4}$	CL=90%	–

	Radiative decays	
$\gamma J/\psi(1S)$	(1.02 ± 0.17) %	303
$\gamma\gamma$	$(1.9 \pm0.4) \times 10^{-4}$	1708

$\chi_{c1}(1P)$

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

Mass $m = 3510.51 \pm 0.12$ MeV

Full width $\Gamma = 0.92 \pm 0.13$ MeV

$\chi_{c1}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor	p (MeV/c)
	Hadronic decays		
$3(\pi^+\pi^-)$	$(6.3\pm1.4) \times 10^{-3}$		1683
$2(\pi^+\pi^-)$	$(5.6\pm2.6) \times 10^{-3}$	2.2	1727
$\pi^+\pi^- K^+ K^-$	$(4.9\pm1.2) \times 10^{-3}$	1.1	1632
$\rho^0\pi^+\pi^-$	$(3.9\pm3.5) \times 10^{-3}$		1659
$K^+\overline{K}^*(892)^0\pi^-$ + c.c.	$(3.2\pm2.1) \times 10^{-3}$		1576
$K^0_S K^+\pi^-$	$(2.5\pm0.8) \times 10^{-3}$		–
$\pi^+\pi^- p\overline{p}$	$(5.4\pm2.1) \times 10^{-4}$		1381
$K^+K^-K^+K^-$	$(4.2\pm1.9) \times 10^{-4}$		–
$p\overline{p}$	$(7.2\pm1.3) \times 10^{-5}$		1483
$\pi^+\pi^- + K^+K^-$	$< 2.1 \times 10^{-3}$		–
	Radiative decays		
$\gamma J/\psi(1S)$	(31.6 ± 3.2) %		389

$\chi_{c2}(1P)$

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

Mass $m = 3556.18 \pm 0.13$ MeV

Full width $\Gamma = 2.08 \pm 0.17$ MeV

$\chi_{c2}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
	Hadronic decays		
$2(\pi^+\pi^-)$	(1.41 ± 0.20) %		1751
$\pi^+\pi^- K^+ K^-$	$(10 \pm4) \times 10^{-3}$	S=2.0	1656
$3(\pi^+\pi^-)$	$(9.2 \pm2.2) \times 10^{-3}$		1707
$\rho^0\pi^+\pi^-$	$(7 \pm4) \times 10^{-3}$		1683
$K^+\overline{K}^*(892)^0\pi^-$ + c.c.	$(4.8 \pm2.8) \times 10^{-3}$		1601
$\phi\phi$	$(2.0 \pm0.8) \times 10^{-3}$		–
$\pi^+\pi^-$	$(1.52\pm0.25) \times 10^{-3}$		1773

$K^+ K^- K^+ K^-$	$(1.5 \pm 0.4) \times 10^{-3}$		–
$\pi^+ \pi^- p \overline{p}$	$(1.4 \pm 0.6) \times 10^{-3}$	S=1.5	1410
$K^+ K^-$	$(8.1 \pm 1.9) \times 10^{-4}$		1708
$K^0_S K^0_S$	$(6.1 \pm 2.3) \times 10^{-4}$		–
$p \overline{p}$	$(7.4 \pm 1.0) \times 10^{-5}$		1510
$J/\psi(1S) \pi^+ \pi^- \pi^0$	< 1.5 %	CL=90%	185
$K^0_S K^+ \pi^- +$ c.c.	$< 1.06 \times 10^{-3}$	CL=90%	–

Radiative decays

$\gamma J/\psi(1S)$	(18.7 ± 2.0) %		430
$\gamma \gamma$	$(2.19 \pm 0.32) \times 10^{-4}$		1778

$\psi(2S)$

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

Mass $m = 3685.96 \pm 0.09$ MeV
Full width $\Gamma = 300 \pm 25$ keV
$\Gamma_{ee} = 2.19 \pm 0.15$ keV

$\psi(2S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
hadrons	(98.10 ± 0.30) %		–
virtual $\gamma \rightarrow$ hadrons	(2.9 ± 0.4) %		–
$e^+ e^-$	$(7.3 \pm 0.4) \times 10^{-3}$		1843
$\mu^+ \mu^-$	$(7.0 \pm 0.9) \times 10^{-3}$		1840
$\tau^+ \tau^-$	$(2.7 \pm 0.7) \times 10^{-3}$		–
Decays into $J/\psi(1S)$ and anything			
$J/\psi(1S)$ anything	(55.7 ± 2.6) %		–
$J/\psi(1S)$ neutrals	(23.9 ± 1.2) %		–
$J/\psi(1S) \pi^+ \pi^-$	(30.5 ± 1.6) %		477
$J/\psi(1S) \pi^0 \pi^0$	(18.2 ± 1.2) %		481
$J/\psi(1S) \eta$	(3.13 ± 0.21) %		200
$J/\psi(1S) \pi^0$	$(9.6 \pm 2.1) \times 10^{-4}$		527
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
$\omega f_2(1270)$	$< 1.7 \times 10^{-4}$	90%	–
$\rho a_2(1320)$	$< 2.3 \times 10^{-4}$	90%	–
$\pi^+ \pi^- K^+ K^-$	$(1.6 \pm 0.4) \times 10^{-3}$		1726
$K^*(892) \overline{K}^*_2(1430)^0$	$< 1.2 \times 10^{-4}$	90%	–
$K_1(1270)^{\pm} K^{\mp}$	$(1.00 \pm 0.28) \times 10^{-3}$		–
$\pi^+ \pi^- p \overline{p}$	$(8.0 \pm 2.0) \times 10^{-4}$		1491
$K^+ \overline{K}^*(892)^0 \pi^- +$ c.c.	$(6.7 \pm 2.5) \times 10^{-4}$		1673
$b_1^{\pm} \pi^{\mp}$	$(5.2 \pm 1.3) \times 10^{-4}$		–

$2(\pi^+\pi^-)$	$(4.5 \pm 1.0) \times 10^{-4}$		1817
$\quad\rho^0\pi^+\pi^-$	$(4.2 \pm 1.5) \times 10^{-4}$		1751
$\overline{p}p$	$(2.07\pm0.31) \times 10^{-4}$		1586
$\Lambda\overline{\Lambda}$	$(1.81\pm0.34) \times 10^{-4}$		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
$\Delta^{++}\overline{\Delta}^{--}$	$(1.28\pm0.35) \times 10^{-4}$		–
$\Sigma^0\overline{\Sigma}^0$	$(1.2 \pm 0.6) \times 10^{-4}$		–
$\Sigma^{*+}\overline{\Sigma}^{*-}$	$(1.1 \pm 0.4) \times 10^{-4}$		–
K^+K^-	$(1.0 \pm 0.7) \times 10^{-4}$		1776
$\pi^+\pi^-\pi^0$	$(8 \pm 5) \times 10^{-5}$		1830
$\quad\rho\pi$	$< 8.3 \times 10^{-5}$	90%	1760
$\pi^+\pi^-$	$(8 \pm 5) \times 10^{-5}$		1838
$\Xi^-\overline{\Xi}^+$	$(9.4 \pm 3.1) \times 10^{-5}$		1285
$K_1(1400)^\pm K^\mp$	$< 3.1 \times 10^{-4}$	90%	–
$\Xi^{*0}\overline{\Xi}^{*0}$	$< 8.1 \times 10^{-5}$	90%	–
$\Omega^-\overline{\Omega}^+$	$< 7.3 \times 10^{-5}$	90%	–
$K^+K^-\pi^0$	$< 2.96 \times 10^{-5}$	90%	1754
$\quad K^+\overline{K}^*(892)^- +$ c.c.	$< 5.4 \times 10^{-5}$	90%	1698
$\phi f_2'(1525)$	$< 4.5 \times 10^{-5}$	90%	–
Radiative decays			
$\gamma\chi_{c0}(1P)$	(8.7 ± 0.8) %		261
$\gamma\chi_{c1}(1P)$	(8.4 ± 0.7) %		171
$\gamma\chi_{c2}(1P)$	(6.8 ± 0.6) %		127
$\gamma\eta_c(1S)$	$(2.8 \pm 0.6) \times 10^{-3}$		639
$\gamma\eta'(958)$	$(1.5 \pm 0.4) \times 10^{-4}$		1719
$\gamma\gamma$	$< 1.4 \times 10^{-4}$	90%	1843
$\gamma\eta$	$< 9 \times 10^{-5}$	90%	1802
$\gamma\eta(1440) \to \gamma K\overline{K}\pi$	$< 1.2 \times 10^{-4}$	90%	1569

$\psi(3770)$

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

Mass $m = 3769.9 \pm 2.5$ 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		242
e^+e^-	$(1.12\pm0.17) \times 10^{-5}$	1.2	1885

$\psi(4040)$ [kkk]

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

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^-	$(1.4\pm0.4) \times 10^{-5}$	2020
$D^0\overline{D}^0$	seen	777
$D^*(2007)^0\overline{D}^0$ + c.c.	seen	578
$D^*(2007)^0\overline{D}^*(2007)^0$	seen	232

$\psi(4160)$ [kkk]

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

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^-	$(10\pm4) \times 10^{-6}$	2079

$\psi(4415)$ [kkk]

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

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^-	$(1.1\pm0.4) \times 10^{-5}$	2207

$b\overline{b}$ MESONS

$\Upsilon(1S)$

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

Mass $m = 9460.30 \pm 0.26$ MeV (S = 3.3)
Full width $\Gamma = 52.5 \pm 1.8$ keV
$\Gamma_{ee} = 1.32 \pm 0.05$ keV

$\Upsilon(1S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\tau^+\tau^-$	$(2.67^{+0.14}_{-0.16})$ %		4384
e^+e^-	(2.38 ± 0.11) %		4730
$\mu^+\mu^-$	(2.48 ± 0.06) %		4729
Hadronic decays			
$J/\psi(1S)$anything	$(1.1 \pm0.4) \times 10^{-3}$		4223
$\rho\pi$	$< 2 \times 10^{-4}$	90%	4698
$\pi^+\pi^-$	$< 5 \times 10^{-4}$	90%	4728
K^+K^-	$< 5 \times 10^{-4}$	90%	4704
$p\overline{p}$	$< 5 \times 10^{-4}$	90%	4636
$\pi^0\pi^+\pi^-$	$< 1.84 \times 10^{-5}$	90%	–
Radiative decays			
$\gamma\pi^+\pi^-$	$(6.3 \pm1.8) \times 10^{-5}$		–
$\gamma\pi^0\pi^0$	$(1.7 \pm0.7) \times 10^{-5}$		–
$\gamma 2h^+2h^-$	$(7.0 \pm1.5) \times 10^{-4}$		4720
$\gamma 3h^+3h^-$	$(5.4 \pm2.0) \times 10^{-4}$		4703
$\gamma 4h^+4h^-$	$(7.4 \pm3.5) \times 10^{-4}$		4679
$\gamma\pi^+\pi^-K^+K^-$	$(2.9 \pm0.9) \times 10^{-4}$		4686
$\gamma 2\pi^+2\pi^-$	$(2.5 \pm0.9) \times 10^{-4}$		4720
$\gamma 3\pi^+3\pi^-$	$(2.5 \pm1.2) \times 10^{-4}$		4703
$\gamma 2\pi^+2\pi^-K^+K^-$	$(2.4 \pm1.2) \times 10^{-4}$		4658
$\gamma\pi^+\pi^-p\overline{p}$	$(1.5 \pm0.6) \times 10^{-4}$		4604
$\gamma 2\pi^+2\pi^-p\overline{p}$	$(4 \pm6) \times 10^{-5}$		4563
$\gamma 2K^+2K^-$	$(2.0 \pm2.0) \times 10^{-5}$		4601
$\gamma\eta'(958)$	$< 1.6 \times 10^{-5}$	90%	4682
$\gamma\eta$	$< 3.5 \times 10^{-4}$	90%	4714
$\gamma f'_2(1525)$	$< 1.4 \times 10^{-4}$	90%	4607

$\gamma f_2(1270)$	$(8 \pm 4) \times 10^{-5}$		4644
$\gamma \eta(1440)$	$< 8.2 \times 10^{-5}$	90%	4624
$\gamma f_0(1710) \to \gamma K\overline{K}$	$< 2.6 \times 10^{-4}$	90%	4576
$\gamma f_0(2200) \to \gamma K^+ K^-$	$< 2 \times 10^{-4}$	90%	4475
$\gamma f_J(2220) \to \gamma K^+ K^-$	$< 1.5 \times 10^{-5}$	90%	4469
$\gamma \eta(2225) \to \gamma \phi\phi$	$< 3 \times 10^{-3}$	90%	4469
γX	$< 3 \times 10^{-5}$	90%	–
X = pseudoscalar with $m<$ 7.2 GeV)			
$\gamma X\overline{X}$	$< 1 \times 10^{-3}$	90%	–
$X\overline{X}$ = vectors with $m<$ 3.1 GeV)			

$\chi_{b0}(1P)$ [lll]

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

Mass $m = 9859.9 \pm 1.0$ MeV

$\chi_{b0}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\gamma \Upsilon(1S)$	<6 %	90%	391

$\chi_{b1}(1P)$ [lll]

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

Mass $m = 9892.7 \pm 0.6$ MeV (S = 1.1)

$\chi_{b1}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\gamma \Upsilon(1S)$	(35 ± 8) %	422

$\chi_{b2}(1P)$ [lll]

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

Mass $m = 9912.6 \pm 0.5$ MeV (S = 1.1)

$\chi_{b2}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\gamma \Upsilon(1S)$	(22 ± 4) %	443

$\Upsilon(2S)$

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

Mass $m = 10.02326 \pm 0.00031$ GeV
Full width $\Gamma = 44 \pm 7$ keV
$\Gamma_{ee} = 0.520 \pm 0.032$ keV

$\Upsilon(2S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\Upsilon(1S)\pi^+\pi^-$	(18.8 ± 0.6) %		475
$\Upsilon(1S)\pi^0\pi^0$	(9.0 ± 0.8) %		480
$\tau^+\tau^-$	(1.7 ± 1.6) %		4686
$\mu^+\mu^-$	(1.31 ± 0.21) %		5011
e^+e^-	(1.18 ± 0.20) %		5012
$\Upsilon(1S)\pi^0$	$< 1.1 \times 10^{-3}$	90%	531
$\Upsilon(1S)\eta$	$< 2 \times 10^{-3}$	90%	127
$J/\psi(1S)$anything	$< 6 \times 10^{-3}$	90%	4533
Radiative decays			
$\gamma\chi_{b1}(1P)$	(6.8 ± 0.7) %		131
$\gamma\chi_{b2}(1P)$	(7.0 ± 0.6) %		110
$\gamma\chi_{b0}(1P)$	(3.8 ± 0.6) %		162
$\gamma f_0(1710)$	$< 5.9 \times 10^{-4}$	90%	4866
$\gamma f'_2(1525)$	$< 5.3 \times 10^{-4}$	90%	4896
$\gamma f_2(1270)$	$< 2.41 \times 10^{-4}$	90%	4931

$\chi_{b0}(2P)$ [lll]

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

Mass $m = 10.2321 \pm 0.0006$ GeV

$\chi_{b0}(2P)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\gamma\,\Upsilon(2S)$	(4.6 ± 2.1) %	210
$\gamma\,\Upsilon(1S)$	$(9 \pm 6) \times 10^{-3}$	746

$\chi_{b1}(2P)$ [lll]

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

Mass $m = 10.2552 \pm 0.0005$ GeV
$m_{\chi_{b1}(2P)} - m_{\chi_{b0}(2P)} = 23.5 \pm 1.0$ MeV

$\chi_{b1}(2P)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor	p (MeV/c)
$\gamma\,\Upsilon(2S)$	(21 ± 4) %	1.5	229
$\gamma\,\Upsilon(1S)$	(8.5 ± 1.3) %	1.3	764

$\chi_{b2}(2P)$ [lll]

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

J needs confirmation.

Mass $m = 10.2685 \pm 0.0004$ GeV

$m_{\chi_{b2}(2P)} - m_{\chi_{b1}(2P)} = 13.5 \pm 0.6$ MeV

$\chi_{b2}(2P)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\gamma\, \Upsilon(2S)$	(16.2±2.4) %	242
$\gamma\, \Upsilon(1S)$	(7.1±1.0) %	776

$\Upsilon(3S)$

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

Mass $m = 10.3552 \pm 0.0005$ GeV

Full width $\Gamma = 26.3 \pm 3.5$ keV

$\Upsilon(3S)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\Upsilon(2S)$ anything	(10.6 ±0.8) %		296
$\Upsilon(2S)\pi^+\pi^-$	(2.8 ±0.6) %	S=2.2	177
$\Upsilon(2S)\pi^0\pi^0$	(2.00±0.32) %		190
$\Upsilon(2S)\gamma\gamma$	(5.0 ±0.7) %		327
$\Upsilon(1S)\pi^+\pi^-$	(4.48±0.21) %		814
$\Upsilon(1S)\pi^0\pi^0$	(2.06±0.28) %		816
$\Upsilon(1S)\eta$	$<$ 2.2 $\times 10^{-3}$	CL=90%	–
$\mu^+\mu^-$	(1.81±0.17) %		5177
e^+e^-	seen		5177
Radiative decays			
$\gamma\,\chi_{b2}(2P)$	(11.4 ±0.8) %	S=1.3	87
$\gamma\,\chi_{b1}(2P)$	(11.3 ±0.6) %		100
$\gamma\,\chi_{b0}(2P)$	(5.4 ±0.6) %	S=1.1	123

$\Upsilon(4S)$ or $\Upsilon(10580)$

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

Mass $m = 10.5800 \pm 0.0035$ GeV

Full width $\Gamma = 14 \pm 5$ MeV (S = 1.7)

$\Gamma_{ee} = 0.248 \pm 0.031$ keV (S = 1.3)

$\Upsilon(4S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$B\overline{B}$	$>$ 96 %	95%	–
non-$B\overline{B}$	$<$ 4 %	95%	–
e^+e^-	(2.8±0.7) $\times 10^{-5}$		5290
$J/\psi(1S)$ anything	$<$ 1.9 $\times 10^{-4}$	95%	–

D^{*+} anything + c.c.	< 7.4	%	90%	5099
ϕ anything	< 2.3	$\times 10^{-3}$	90%	5240
$\Upsilon(1S)$ anything	< 4	$\times 10^{-3}$	90%	1053
$\Upsilon(1S)\pi^+\pi^-$	< 1.2	$\times 10^{-4}$	90%	–
$\Upsilon(2S)\pi^+\pi^-$	< 3.9	$\times 10^{-4}$	90%	–

$\Upsilon(10860)$

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

Mass $m = 10.865 \pm 0.008$ GeV (S = 1.1)
Full width $\Gamma = 110 \pm 13$ MeV
$\Gamma_{ee} = 0.31 \pm 0.07$ keV (S = 1.3)

Υ(10860) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
e^+e^-	$(2.8\pm0.7) \times 10^{-6}$	5432

$\Upsilon(11020)$

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

Mass $m = 11.019 \pm 0.008$ GeV
Full width $\Gamma = 79 \pm 16$ MeV
$\Gamma_{ee} = 0.130 \pm 0.030$ keV

Υ(11020) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
e^+e^-	$(1.6\pm0.5) \times 10^{-6}$	5509

NOTES

[*a*] See the "Note on $\pi^\pm \to \ell^\pm \nu \gamma$ and $K^\pm \to \ell^\pm \nu \gamma$ Form Factors" in the $\pi^\pm$ Particle Listings for definitions and details.

[*b*] Measurements of $\Gamma(e^+ \nu_e)/\Gamma(\mu^+ \nu_\mu)$ always include decays with γ's, and measurements of $\Gamma(e^+ \nu_e \gamma)$ and $\Gamma(\mu^+ \nu_\mu \gamma)$ never include low-energy γ's. Therefore, since no clean separation is possible, we consider the modes with γ's to be subreactions of the modes without them, and let $[\Gamma(e^+ \nu_e) + \Gamma(\mu^+ \nu_\mu)]/\Gamma_{\text{total}} = 100\%$.

[*c*] See the $\pi^\pm$ Particle Listings for the energy limits used in this measurement; low-energy γ's are not included.

[*d*] Derived from an analysis of neutrino-oscillation experiments.

[*e*] Astrophysical and cosmological arguments give limits of order 10^{-13}; see the π^0 Particle Listings.

[*f*] See the "Note on the Decay Width $\Gamma(\eta \to \gamma\gamma)$" in our 1994 edition, Phys. Rev. **D50**, 1 August 1994, Part I, p. 1451.

[*g*] *C* parity forbids this to occur as a single-photon process.

[*h*] See the "Note on scalar mesons" in the $f_0(1370)$ Particle Listings . The interpretation of this entry as a particle is controversial.

[*i*] See the "Note on $\rho(770)$" in the $\rho(770)$ Particle Listings .

[*j*] The $e^+ e^-$ branching fraction is from $e^+ e^- \to \pi^+ \pi^-$ experiments only. The $\omega\rho$ interference is then due to $\omega\rho$ mixing only, and is expected to be small. If $e\mu$ universality holds, $\Gamma(\rho^0 \to \mu^+ \mu^-) = \Gamma(\rho^0 \to e^+ e^-) \times 0.99785$.

[*k*] See the "Note on scalar mesons" in the $f_0(1370)$ Particle Listings .

[*l*] See the "Note on $a_1(1260)$" in the $a_1(1260)$ Particle Listings .

[*m*] This is only an educated guess; the error given is larger than the error on the average of the published values. See the Particle Listings for details.

[*n*] See the "Note on the $f_1(1420)$" in the $\eta(1440)$ Particle Listings.

[*o*] See also the $\omega(1650)$ Particle Listings.

[*p*] See the "Note on the $\eta(1440)$" in the $\eta(1440)$ Particle Listings.

[*q*] See the "Note on the $\rho(1450)$ and the $\rho(1700)$" in the $\rho(1700)$ Particle Listings.

[*r*] See the "Note on non-$q\overline{q}$ mesons" in the Particle Listings (see the index for the page number).

[*s*] See also the $\omega(1420)$ Particle Listings.

[*t*] See the "Note on $f_0(1710)$" in the $f_0(1710)$ Particle Listings .

[*u*] See the note in the $K^\pm$ Particle Listings.

[*v*] The definition of the slope parameter g of the $K \rightarrow 3\pi$ Dalitz plot is as follows (see also "Note on Dalitz Plot Parameters for $K \rightarrow 3\pi$ Decays" in the $K^{\pm}$ Particle Listings):

$$\left|M\right|^2 = 1 + g(s_3 - s_0)/m_{\pi^+}^2 + \cdots .$$

[*w*] For more details and definitions of parameters see the Particle Listings.

[*x*] Most of this radiative mode, the low-momentum γ part, is also included in the parent mode listed without γ's.

[*y*] See the $K^{\pm}$ Particle Listings for the energy limits used in this measurement.

[*z*] Structure-dependent part.

[*aa*] Direct-emission branching fraction.

[*bb*] Violates angular-momentum conservation.

[*cc*] Derived from measured values of ϕ_{+-}, ϕ_{00}, $\left|\eta\right|$, $\left|m_{K_L^0} - m_{K_S^0}\right|$, and $\tau_{K_S^0}$, as described in the introduction to "Tests of Conservation Laws."

[*dd*] The *CP*-violation parameters are defined as follows (see also "Note on *CP* Violation in $K_S \rightarrow 3\pi$" and "Note on *CP* Violation in K_L^0 Decay" in the Particle Listings):

$$\eta_{+-} = \left|\eta_{+-}\right| e^{i\phi_{+-}} = \frac{A(K_L^0 \rightarrow \pi^+\pi^-)}{A(K_S^0 \rightarrow \pi^+\pi^-)} = \epsilon + \epsilon'$$

$$\eta_{00} = \left|\eta_{00}\right| e^{i\phi_{00}} = \frac{A(K_L^0 \rightarrow \pi^0\pi^0)}{A(K_S^0 \rightarrow \pi^0\pi^0)} = \epsilon - 2\epsilon'$$

$$\delta = \frac{\Gamma(K_L^0 \rightarrow \pi^-\ell^+\nu) - \Gamma(K_L^0 \rightarrow \pi^+\ell^-\nu)}{\Gamma(K_L^0 \rightarrow \pi^-\ell^+\nu) + \Gamma(K_L^0 \rightarrow \pi^+\ell^-\nu)} ,$$

$$\mathrm{Im}(\eta_{+-0})^2 = \frac{\Gamma(K_S^0 \rightarrow \pi^+\pi^-\pi^0)^{CP\ \text{viol.}}}{\Gamma(K_L^0 \rightarrow \pi^+\pi^-\pi^0)} ,$$

$$\mathrm{Im}(\eta_{000})^2 = \frac{\Gamma(K_S^0 \rightarrow \pi^0\pi^0\pi^0)}{\Gamma(K_L^0 \rightarrow \pi^0\pi^0\pi^0)} .$$

where for the last two relations *CPT* is assumed valid, *i.e.*, $\mathrm{Re}(\eta_{+-0}) \simeq 0$ and $\mathrm{Re}(\eta_{000}) \simeq 0$.

[*ee*] See the K_S^0 Particle Listings for the energy limits used in this measurement.

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

[*gg*] $\mathrm{Re}(\epsilon'/\epsilon) = \epsilon'/\epsilon$ to a very good approximation provided the phases satisfy *CPT* invariance.

[*hh*] See the K_L^0 Particle Listings for the energy limits used in this measurement.

[*ii*] Allowed by higher-order electroweak interactions.

[*jj*] Violates CP in leading order. Test of direct CP violation since the indirect CP-violating and CP-conserving contributions are expected to be suppressed.

[*kk*] See the "Note on $f_0(1370)$" in the $f_0(1370)$ Particle Listings and in the 1994 edition.

[*ll*] See the note in the $L(1770)$ Particle Listings in Reviews of Modern Physics **56** No. 2 Pt. II (1984), p. S200. See also the "Note on $K_2(1770)$ and the $K_2(1820)$" in the $K_2(1770)$ Particle Listings .

[*mm*] See the "Note on $K_2(1770)$ and the $K_2(1820)$" in the $K_2(1770)$ Particle Listings .

[*nn*] This result applies to $Z^0 \rightarrow c\overline{c}$ decays only. Here ℓ^+ is an average (not a sum) of e^+ and μ^+ decays.

[*oo*] This is a weighted average of $D^\pm$ (44%) and D^0 (56%) branching fractions. See "$D^+ \text{and} D^0 \rightarrow$ (η anything) / (total D^+ and D^0)" under "D^+ Branching Ratios" in the Particle Listings.

[*pp*] This value averages the e^+ and μ^+ branching fractions, after making a small phase-space adjustment to the μ^+ fraction to be able to use it as an e^+ fraction; hence our ℓ^+ here is really an e^+.

[*qq*] An ℓ indicates an e or a μ mode, not a sum over these modes.

[*rr*] The branching fraction for this mode may differ from the sum of the submodes that contribute to it, due to interference effects. See the relevant papers in the Particle Listings.

[*ss*] The two experiments measuring this fraction are in serious disagreement. See the Particle Listings.

[*tt*] This value includes only $\pi^+\pi^-$ decays of the intermediate resonance, because branching fractions of this resonance are not known.

[*uu*] This mode is not a useful test for a ΔC=1 weak neutral current because both quarks must change flavor in this decay.

[*vv*] This D_1^0-D_2^0 limit is inferred from the D^0-$\overline{D}^0$ mixing ratio $\Gamma(K^+\pi^-$ (via $\overline{D}^0$)) / $\Gamma(K^-\pi^+)$ near the end of the D^0 Listings.

[*ww*] The exclusive e^+ modes $K^- e^+ \nu_e$, $K^- \pi^0 e^+ \nu_e$, $\overline{K}^0 \pi^- e^+ \nu_e$ and $\pi^- e^+ \nu_e$ are constrained to equal this (well-measured) inclusive fraction.

[*xx*] The experiments on the division of this charge mode amongst its submodes disagree, and the submode branching fractions here add up to considerably more than the charged-mode fraction.

[*yy*] However, these upper limits are in serious disagreement with values obtained in another experiment.

[*zz*] For now, we average together measurements of the $X e^{+} \nu_{e}$ and $X \mu^{+} \nu_{\mu}$ branching fractions. This is the *average*, not the *sum*.

[*aaa*] This branching fraction includes all the decay modes of the final-state resonance.

[*bbb*] This value includes only $K^{+} K^{-}$ decays of the intermediate resonance, because branching fractions of this resonance are not known.

[*ccc*] B^{0} and B_{s}^{0} contributions not separated. Limit is on weighted average of the two decay rates.

[*ddd*] These values are model dependent. See 'Note on Semileptonic Decays' in the B^{+} Particle Listings.

[*eee*] D^{**} stands for the sum of the $D(1\,^{1}P_{1})$, $D(1\,^{3}P_{0})$, $D(1\,^{3}P_{1})$, $D(1\,^{3}P_{2})$, $D(2\,^{1}S_{0})$, and $D(2\,^{1}S_{1})$ resonances.

[*fff*] $D^{(*)}\overline{D}^{(*)}$ stands for the sum of $D^{*}\overline{D}^{*}$, $D^{*}\overline{D}$, $D\overline{D}^{*}$, and $D\overline{D}$.

[*ggg*] Inclusive branching fractions have a multiplicity definition and can be greater than 100%.

[*hhh*] D_{j} represents an unresolved mixture of pseudoscalar and tensor D^{**} (P-wave) states.

[*iii*] Not a pure measurement. See note at head of B_{s}^{0} Decay Modes.

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

[*kkk*] 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.

[*lll*] Spectroscopic labeling for these states is theoretical, pending experimental information.