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%	67
Charge conjugation (C) or Lepton Family number (LF) violating modes				
3γ	C	$< 3.1 \times 10^{-8}$	CL=90%	67
$\mu^+ e^-$	LF	$< 3.8 \times 10^{-10}$	CL=90%	26
$\mu^- e^+$	LF	$< 3.4 \times 10^{-9}$	CL=90%	26
$\mu^+ e^- + \mu^- e^+$	LF	$< 1.72 \times 10^{-8}$	CL=90%	26

η

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

Mass $m = 547.75 \pm 0.12$ MeV [f] (S = 2.6)
Full width $\Gamma = 1.29 \pm 0.07$ keV [g]

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 ± 0.07 (S = 1.3)

Dalitz plot parameter

$\pi^0\pi^0\pi^0$ $\alpha = -0.031 \pm 0.004$ (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		[g]	(39.43 ± 0.26) %	S=1.2	274
$3\pi^0$			(32.51 ± 0.29) %	S=1.2	179
$\pi^0 2\gamma$			$(7.2 \pm 1.4) \times 10^{-4}$		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	174
$\pi^+\pi^-\gamma$			(4.68 ± 0.11) %	S=1.2	236
$e^+e^-\gamma$			$(6.0 \pm 0.8) \times 10^{-3}$	S=1.4	274
$\mu^+\mu^-\gamma$			$(3.1 \pm 0.4) \times 10^{-4}$		253
e^+e^-			$< 7.7 \times 10^{-5}$	CL=90%	274
$\mu^+\mu^-$			$(5.8 \pm 0.8) \times 10^{-6}$		253
$e^+e^-e^+e^-$			$< 6.9 \times 10^{-5}$	CL=90%	274
$\pi^+\pi^-e^+e^-$			$(4.0 {}^{+14.0}_{-2.7}) \times 10^{-4}$	S=5.8	235
$\pi^+\pi^-2\gamma$			$< 2.0 \times 10^{-3}$		236
$\pi^+\pi^-\pi^0\gamma$			$< 5 \times 10^{-4}$	CL=90%	174
$\pi^0\mu^+\mu^-\gamma$			$< 3 \times 10^{-6}$	CL=90%	210
Charge conjugation (C), Parity (P), Charge conjugation $\times$ Parity (CP), or Lepton Family number (LF) violating modes					
$\pi^+\pi^-$	P,CP		$< 3.3 \times 10^{-4}$	CL=90%	236
$\pi^0\pi^0$	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%	40
$\pi^0e^+e^-$	C	[h]	$< 4 \times 10^{-5}$	CL=90%	257
$\pi^0\mu^+\mu^-$	C	[h]	$< 5 \times 10^{-6}$	CL=90%	210
$\mu^+e^- + \mu^-e^+$	LF		$< 6 \times 10^{-6}$	CL=90%	264

$f_0(600)$ [i] or σ

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

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

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

$\rho(770)$ [j]

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

Mass $m = 775.8 \pm 0.5$ MeV
Full width $\Gamma = 150.3 \pm 1.6$ MeV
$\Gamma_{ee} = 7.02 \pm 0.11$ keV

$\rho(770)$ DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\pi\pi$		~ 100 %		364
$\rho(770)^\pm$ decays				
$\pi^\pm\gamma$		$(4.5 \pm 0.5) \times 10^{-4}$	S=2.2	375
$\pi^\pm\eta$		$< 6 \times 10^{-3}$	CL=84%	153
$\pi^\pm\pi^+\pi^-\pi^0$		$< 2.0 \times 10^{-3}$	CL=84%	254
$\rho(770)^0$ decays				
$\pi^+\pi^-\gamma$		$(9.9 \pm 1.6) \times 10^{-3}$		362
$\pi^0\gamma$		$(6.0 \pm 1.3) \times 10^{-4}$	S=1.1	376
$\eta\gamma$		$(3.0 \pm 0.4) \times 10^{-4}$	S=1.4	195
$\pi^0\pi^0\gamma$		$(4.5 \pm 0.8) \times 10^{-5}$		364
$\mu^+\mu^-$	[k]	$(4.55 \pm 0.28) \times 10^{-5}$		373
e^+e^-	[k]	$(4.67 \pm 0.09) \times 10^{-5}$		388
$\pi^+\pi^-\pi^0$		$(1.01^{+0.54}_{-0.36} \pm 0.34) \times 10^{-4}$		323
$\pi^+\pi^-\pi^+\pi^-$		$(1.8 \pm 0.9) \times 10^{-5}$		251
$\pi^+\pi^-\pi^0\pi^0$		$< 4 \times 10^{-5}$	CL=90%	257

$\omega(782)$

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

Mass $m = 782.59 \pm 0.11$ MeV (S = 1.7)
Full width $\Gamma = 8.49 \pm 0.08$ MeV
$\Gamma_{ee} = 0.60 \pm 0.02$ keV

$\omega(782)$ DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\pi^+\pi^-\pi^0$		$(89.1 \pm 0.7)\%$	S=1.1	327
$\pi^0\gamma$		$(8.92^{+0.28}_{-0.24})\%$	S=1.1	380
$\pi^+\pi^-$		$(1.70 \pm 0.27)\%$	S=1.4	366
neutrals (excluding $\pi^0\gamma$)		$(1.4\ ^{+7.0}_{-0.9}) \times 10^{-3}$		–
$\eta\gamma$		$(4.9 \pm 0.5) \times 10^{-4}$		200
$\pi^0 e^+ e^-$		$(5.9 \pm 1.9) \times 10^{-4}$		380
$\pi^0 \mu^+ \mu^-$		$(9.6 \pm 2.3) \times 10^{-5}$		349
$e^+ e^-$		$(7.14 \pm 0.13) \times 10^{-5}$	S=1.1	391
$\pi^+\pi^-\pi^0\pi^0$		$< 2\ \%$	CL=90%	262
$\pi^+\pi^-\gamma$		$< 3.6 \times 10^{-3}$	CL=95%	366
$\pi^+\pi^-\pi^+\pi^-$		$< 1 \times 10^{-3}$	CL=90%	256
$\pi^0\pi^0\gamma$		$(6.7 \pm 1.1) \times 10^{-5}$		367
$\eta\pi^0\gamma$		$< 3.3 \times 10^{-5}$	CL=90%	162
$\mu^+\mu^-$		$(9.0 \pm 3.1) \times 10^{-5}$		377
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%	330

$\eta'(958)$

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

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)
$\pi^+\pi^-\eta$	$(44.3 \pm 1.5)\%$	S=1.2	232
$\rho^0\gamma$ (including non-resonant $\pi^+\pi^-\gamma$)	$(29.5 \pm 1.0)\%$	S=1.2	165
$\pi^0\pi^0\eta$	$(20.9 \pm 1.2)\%$	S=1.2	239
$\omega\gamma$	$(3.03 \pm 0.31)\%$		159
$\gamma\gamma$	$(2.12 \pm 0.14)\%$	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%	428

$\pi^0 \rho^0$			$<$ 4	%	CL=90%	110
$\pi^+ \pi^+ \pi^- \pi^-$			$<$ 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%	211
$\pi^+ \pi^- e^+ e^-$			$<$ 6	$\times 10^{-3}$	CL=90%	458
$\gamma e^+ e^-$			$<$ 9	$\times 10^{-4}$	CL=90%	479
$\pi^0 \gamma \gamma$			$<$ 8	$\times 10^{-4}$	CL=90%	469
$4\pi^0$			$<$ 5	$\times 10^{-4}$	CL=90%	380
$e^+ e^-$			$<$ 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*	[h]	$<$ 1.4	$\times 10^{-3}$	CL=90%	469
$\eta e^+ e^-$	*C*	[h]	$<$ 2.4	$\times 10^{-3}$	CL=90%	322
3γ	*C*		$<$ 1.0	$\times 10^{-4}$	CL=90%	479
$\mu^+ \mu^- \pi^0$	*C*	[h]	$<$ 6.0	$\times 10^{-5}$	CL=90%	445
$\mu^+ \mu^- \eta$	*C*	[h]	$<$ 1.5	$\times 10^{-5}$	CL=90%	273
$e \mu$	*LF*		$<$ 4.7	$\times 10^{-4}$	CL=90%	473

$f_0(980)$ [l]

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

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	471
$K \overline{K}$	seen	†
$\gamma \gamma$	seen	490

$a_0(980)$ [l]

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

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	322
$K \overline{K}$	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^-	(49.1 ± 0.6) %	S=1.2	127
$K^0_L K^0_S$	(34.0 ± 0.5) %	S=1.1	110
$\rho\pi + \pi^+\pi^-\pi^0$	(15.4 ± 0.5) %	S=1.3	–
$\eta\gamma$	(1.295 ± 0.025) %	S=1.1	363
$\pi^0\gamma$	$(1.23 \pm 0.10) \times 10^{-3}$		501
e^+e^-	$(2.98 \pm 0.04) \times 10^{-4}$	S=1.1	510
$\mu^+\mu^-$	$(2.85 \pm 0.19) \times 10^{-4}$		499
ηe^+e^-	$(1.15 \pm 0.10) \times 10^{-4}$		363
$\pi^+\pi^-$	$(7.3 \pm 1.3) \times 10^{-5}$		490
$\omega\pi^0$	$(5.2 ^{+1.3}_{-1.1}) \times 10^{-5}$		172
$\omega\gamma$	< 5 %	CL=84%	209
$\rho\gamma$	$< 1.2 \times 10^{-5}$	CL=90%	215
$\pi^+\pi^-\gamma$	$(4.1 \pm 1.3) \times 10^{-5}$		490
$f_0(980)\gamma$	$(4.40 \pm 0.21) \times 10^{-4}$		39
$\pi^0\pi^0\gamma$	$(1.09 \pm 0.06) \times 10^{-4}$		492
$\pi^+\pi^-\pi^+\pi^-$	$(3.9 ^{+2.8}_{-2.2}) \times 10^{-6}$		410
$\pi^+\pi^+\pi^-\pi^-\pi^0$	$< 4.6 \times 10^{-6}$	CL=90%	342
$\pi^0 e^+e^-$	$(1.12 \pm 0.28) \times 10^{-5}$		501
$\pi^0\eta\gamma$	$(8.3 \pm 0.5) \times 10^{-5}$		346
$a_0(980)\gamma$	$(7.6 \pm 0.6) \times 10^{-5}$		34
$\eta'(958)\gamma$	$(6.2 \pm 0.7) \times 10^{-5}$	S=1.1	60
$\eta\pi^0\pi^0\gamma$	$< 2 \times 10^{-5}$	CL=90%	293
$\mu^+\mu^-\gamma$	$(1.4 \pm 0.5) \times 10^{-5}$		499
$\rho\gamma\gamma$	$< 5 \times 10^{-4}$	CL=90%	215
$\eta\pi^+\pi^-$	$< 1.8 \times 10^{-5}$	CL=90%	288
$\eta\mu^+\mu^-$	$< 9.4 \times 10^{-6}$	CL=90%	321

$h_1(1170)$

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

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	307

$b_1(1235)$

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

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 = 0.277 ± 0.027]			
$\pi^\pm\gamma$	$(1.6 \pm 0.4) \times 10^{-3}$		607
$\eta\rho$	seen		†
$\pi^+\pi^+\pi^-\pi^0$	< 50 %	84%	535
$(K\overline{K})^\pm\pi^0$	< 8 %	90%	248
$K^0_S K^0_L \pi^\pm$	< 6 %	90%	235
$K^0_S K^0_S \pi^\pm$	< 2 %	90%	235
$\phi\pi$	< 1.5 %	84%	147

$a_1(1260)$ [m]

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

Mass $m = 1230 \pm 40$ MeV [n]
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	353
$(\rho\pi)_{D-\text{wave}}$	seen	353
$(\rho(1450)\pi)_{S-\text{wave}}$	seen	†
$(\rho(1450)\pi)_{D-\text{wave}}$	seen	†
$\sigma\pi$	seen	–
$f_0(980)\pi$	not seen	189
$f_0(1370)\pi$	seen	–
$f_2(1270)\pi$	seen	†
$K\overline{K}^*(892)+$ c.c.	seen	†
$\pi\gamma$	seen	608

$f_2(1270)$

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

Mass $m = 1275.4 \pm 1.2$ MeV
Full width $\Gamma = 185.1^{+3.5}_{-2.6}$ MeV (S = 1.5)

$f_2(1270)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\pi\pi$	$(84.8^{+2.5}_{-1.3})$ %	S=1.3	623
$\pi^+\pi^-2\pi^0$	$(7.1^{+1.5}_{-2.7})$ %	S=1.3	563

$K\overline{K}$	(4.6 ± 0.4) %	S=2.7	404
$2\pi^+ 2\pi^-$	(2.8 ± 0.4) %	S=1.2	559
$\eta\eta$	$(4.5 \pm 1.0) \times 10^{-3}$	S=2.4	327
$4\pi^0$	$(3.0 \pm 1.0) \times 10^{-3}$		565
$\gamma\gamma$	$(1.41 \pm 0.13) \times 10^{-5}$		638
$\eta\pi\pi$	$< 8 \times 10^{-3}$	CL=95%	478
$K^0 K^- \pi^+ +$ c.c.	$< 3.4 \times 10^{-3}$	CL=95%	293
$e^+ e^-$	$< 6 \times 10^{-10}$	CL=90%	638

$f_1(1285)$

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

Mass $m = 1281.8 \pm 0.6$ MeV (S = 1.6)
Full width $\Gamma = 24.1 \pm 1.1$ MeV (S = 1.3)

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	568
$\pi^0\pi^0\pi^+\pi^-$	$(22.0^{+1.4}_{-1.2})$ %	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	336
$\rho^0\rho^0$	seen		†
$4\pi^0$	$< 7 \times 10^{-4}$	CL=90%	568
$\eta\pi\pi$	(52 ± 16) %		482
$a_0(980)\pi$ [ignoring $a_0(980) \rightarrow K\overline{K}$]	(36 ± 7) %		234
$\eta\pi\pi$ [excluding $a_0(980)\pi$]	(16 ± 7) %		482
$K\overline{K}\pi$	(9.0 ± 0.4) %	S=1.1	308
$K\overline{K}^*(892)$	not seen		†
$\gamma\rho^0$	(5.5 ± 1.3) %	S=2.8	406
$\phi\gamma$	$(7.4 \pm 2.6) \times 10^{-4}$		236

$\eta(1295)$

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

Mass $m = 1294 \pm 4$ MeV (S = 1.6)
Full width $\Gamma = 55 \pm 5$ MeV

$\eta(1295)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\eta\pi^+\pi^-$	seen	487
$a_0(980)\pi$	seen	244
$\eta\pi^0\pi^0$	seen	490
$\eta(\pi\pi)_{S\text{-wave}}$	seen	–

$\pi(1300)$

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

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

$\pi(1300)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\rho\pi$	seen	404
$\pi(\pi\pi)_{S\text{-wave}}$	seen	–

$a_2(1320)$

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

Mass $m = 1318.3 \pm 0.6$ MeV (S = 1.2)
Full width $\Gamma = 107 \pm 5$ MeV [n]

$a_2(1320)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\rho\pi$	(70.1 ± 2.7) %	S=1.2	416
$\eta\pi$	(14.5 ± 1.2) %		535
$\omega\pi\pi$	(10.6 ± 3.2) %	S=1.3	366
$K\overline{K}$	(4.9 ± 0.8) %		437
$\eta'(958)\pi$	$(5.3 \pm 0.9) \times 10^{-3}$		288
$\pi^\pm\gamma$	$(2.68 \pm 0.31) \times 10^{-3}$		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

$f_0(1370)$ [l]

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

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	–
$\pi(1300)\pi$	seen	–
$a_1(1260)\pi$	seen	–
$\eta\eta$	seen	–
$K\overline{K}$	seen	–
$\gamma\gamma$	seen	–
$e^+ e^-$	not seen	–

$\pi_1(1400)$ [o]

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

Mass $m = 1376 \pm 17$ MeV
Full width $\Gamma = 300 \pm 40$ MeV

$\pi_1(1400)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\eta\pi^0$	seen	570
$\eta\pi^-$	seen	569

$\eta(1405)$ [p] was $\eta(1440)$

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

Mass $m = 1410.3 \pm 2.6$ MeV [n] (S = 2.2)
Full width $\Gamma = 51 \pm 4$ MeV [n] (S = 2.2)

$\eta(1405)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\overline{K}\pi$	seen	425
$\eta\pi\pi$	seen	563
$a_0(980)\pi$	seen	342

$\eta(\pi\pi)_{S\text{-wave}}$	seen	–
$f_0(980)\eta$	seen	†
4π	seen	639
$K^*(892)K$	seen	127

$f_1(1420)$ [q]

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

Mass $m = 1426.3 \pm 0.9$ MeV (S = 1.1)
Full width $\Gamma = 54.9 \pm 2.6$ MeV

f_1(1420) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\overline{K}\pi$	dominant	438
$K\overline{K}^*(892)+$ c.c.	dominant	163
$\eta\pi\pi$	possibly seen	573
$\phi\gamma$	seen	349

$\omega(1420)$ [r]

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

Mass m (1400–1450) MeV
Full width Γ (180–250) MeV

ω(1420) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\rho\pi$	dominant	488
$\omega\pi\pi$	seen	–
$b_1(1235)\pi$	seen	–
e^+e^-	seen	–

$a_0(1450)$ [l]

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

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	627
$\pi\eta'(958)$	seen	410
$K\overline{K}$	seen	547
$\omega\pi\pi$	seen	484

$\rho(1450)$ [s]

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

Mass $m = 1465 \pm 25$ MeV [n]
Full width $\Gamma = 400 \pm 60$ MeV [n]

$\rho(1450)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\pi\pi$	seen		720
4π	seen		669
$\omega\pi$	<2.0 %	95%	512
e^+e^-	seen		732
$\eta\rho$	<4 %		310
$a_2(1320)\pi$	not seen		55
$\phi\pi$	<1 %		360
$K\overline{K}$	$<1.6 \times 10^{-3}$	95%	541
$\eta\gamma$	possibly seen		630

$\eta(1475)$ [p]
was $\eta(1440)$

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

Mass $m = 1476 \pm 4$ MeV (S = 1.4)
Full width $\Gamma = 87 \pm 9$ MeV (S = 1.6)

$\eta(1475)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\overline{K}\pi$	dominant	477
$K\overline{K}^*(892)+$ c.c.	seen	245
$a_0(980)\pi$	seen	393
$\gamma\gamma$	seen	738

$f_0(1500)$ [o]

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

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)	Scale factor	p (MeV/c)
$\eta\eta'(958)$	(1.9 ± 0.8) %	1.7	34
$\eta\eta$	(5.1 ± 0.9) %	1.4	518
4π	(49.5 ± 3.3) %	1.2	692
$4\pi^0$	seen		692
$2\pi^+2\pi^-$	seen		688

$\pi\pi$	(34.9 ± 2.3) %	1.2	741
$\quad\pi^+\pi^-$	seen		741
$\quad 2\pi^0$	seen		741
$K\overline{K}$	$(\ 8.6\pm1.0)$ %	1.1	569
$\gamma\gamma$	not seen		754

$f_2'(1525)$

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

Mass $m = 1525 \pm 5$ MeV [n]
Full width $\Gamma = 73^{+6}_{-5}$ MeV [n]

$f_2'(1525)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\overline{K}$	$(88.8\ \pm3.1\ )$ %	581
$\eta\eta$	$(10.3\ \pm3.1\ )$ %	530
$\pi\pi$	$(\ 8.2\ \pm1.5\ )\times10^{-3}$	750
$\gamma\gamma$	$(\ 1.11\pm0.14)\times10^{-6}$	763

$\pi_1(1600)$ [o]

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

Mass $m = 1596^{+25}_{-14}$ MeV
Full width $\Gamma = 312^{+64}_{-24}$ MeV (S = 1.1)

$\pi_1(1600)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\pi\pi\pi$	seen	769
$\quad\rho^0\pi^-$	seen	600
$\quad f_2(1270)\pi^-$	not seen	259
$\eta'(958)\pi^-$	seen	497

$\eta_2(1645)$

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

Mass $m = 1617 \pm 5$ MeV
Full width $\Gamma = 181 \pm 11$ MeV

$\eta_2(1645)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$a_2(1320)\pi$	seen	242
$K\overline{K}\pi$	seen	580
$\quad K^*\overline{K}$	seen	404
$\eta\pi^+\pi^-$	seen	685
$a_0(980)\pi$	seen	496
$f_2(1270)\eta$	not seen	†

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

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

Mass $m = 1670 \pm 30$ MeV
Full width $\Gamma = 315 \pm 35$ MeV

$\omega(1650)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\rho\pi$	seen	646
$\omega\pi\pi$	seen	617
$\omega\eta$	seen	500
e^+e^-	seen	835

$\omega_3(1670)$

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

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

$\omega_3(1670)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\rho\pi$	seen	645
$\omega\pi\pi$	seen	615
$b_1(1235)\pi$	possibly seen	361

$\pi_2(1670)$

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

Mass $m = 1672.4 \pm 3.2$ MeV [n] (S = 1.4)
Full width $\Gamma = 259 \pm 9$ MeV [n] (S = 1.3)

$\pi_2(1670)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
3π	(95.8 ± 1.4) %		809
$f_2(1270)\pi$	(56.2 ± 3.2) %		329
$\rho\pi$	(31 ± 4) %		648
$\sigma\pi$	(10.9 ± 3.4) %		–
$(\pi\pi)_{S\text{-wave}}$	(8.7 ± 3.4) %		–
$K\overline{K}^*(892)+$ c.c.	(4.2 ± 1.4) %		455
$\omega\rho$	(2.7 ± 1.1) %		303
$\rho(1450)\pi$	$< 3.6 \times 10^{-3}$	97.7%	148
$b_1(1235)\pi$	$< 1.9 \times 10^{-3}$	97.7%	366

$\phi(1680)$

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

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

$\phi(1680)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\overline{K}^*(892)+$ c.c.	dominant	462
$K^0_S K\pi$	seen	621
$K\overline{K}$	seen	680
e^+e^-	seen	840
$\omega\pi\pi$	not seen	623

$\rho_3(1690)$

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

Mass $m = 1688.8 \pm 2.1$ MeV [n]
Full width $\Gamma = 161 \pm 10$ MeV [n] (S = 1.5)

$\rho_3(1690)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor	p (MeV/c)
4π	(71.1 ± 1.9) %		790
$\pi^{\pm}\pi^+\pi^-\pi^0$	(67 ± 22) %		787
$\omega\pi$	(16 ± 6) %		655
$\pi\pi$	(23.6 ± 1.3) %		834
$K\overline{K}\pi$	(3.8 ± 1.2) %		629
$K\overline{K}$	(1.58 ± 0.26) %	1.2	685
$\eta\pi^+\pi^-$	seen		727
$\rho(770)\eta$	seen		520
$\pi\pi\rho$	seen		633
Excluding 2ρ and $a_2(1320)\pi$.			
$a_2(1320)\pi$	seen		307
$\rho\rho$	seen		333

$\rho(1700)$ [s]

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

Mass $m = 1720 \pm 20$ MeV [n] ($\eta\rho^0$ and $\pi^+\pi^-$ modes)
Full width $\Gamma = 250 \pm 100$ MeV [n] ($\eta\rho^0$ and $\pi^+\pi^-$ modes)

$\rho(1700)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$2(\pi^+\pi^-)$	large	803
$\rho\pi\pi$	dominant	653
$\rho^0\pi^+\pi^-$	large	650

$\rho^{\pm}\pi^{\mp}\pi^{0}$	large	651
$a_1(1260)\pi$	seen	404
$h_1(1170)\pi$	seen	447
$\pi(1300)\pi$	seen	349
$\rho\rho$	seen	371
$\pi^+\pi^-$	seen	849
$\pi\pi$	seen	849
$K\overline{K}^*(892)+$ c.c.	seen	496
$\eta\rho$	seen	544
$a_2(1320)\pi$	not seen	334
$K\overline{K}$	seen	704
e^+e^-	seen	860
$\pi^0\omega$	seen	674

$f_0(1710)$ [u]

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

Mass $m = 1714 \pm 5$ MeV
Full width $\Gamma = 140 \pm 10$ MeV (S = 1.2)

$f_0(1710)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\overline{K}$	seen	701
$\eta\eta$	seen	659
$\pi\pi$	seen	846

$\pi(1800)$

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

Mass $m = 1812 \pm 14$ MeV (S = 2.3)
Full width $\Gamma = 207 \pm 13$ MeV

$\pi(1800)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\pi^+\pi^-\pi^-$	seen	879
$f_0(600)\pi^-$	seen	–
$f_0(980)\pi^-$	seen	631
$f_0(1370)\pi^-$	seen	–
$f_0(1500)\pi^-$	not seen	248
$\rho\pi^-$	not seen	732
$\eta\eta\pi^-$	seen	661
$a_0(980)\eta$	seen	469
$f_0(1500)\pi^-$	seen	248

$\eta\eta'(958)\pi^-$	seen	376
$K_0^*(1430)K^-$	seen	†
$K^*(892)K^-$	not seen	570

$\phi_3(1850)$

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

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

$f_2(1950)$

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

Mass $m = 1945 \pm 13$ MeV (S = 1.6)
Full width $\Gamma = 475 \pm 19$ MeV

$f_2(1950)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K^*(892)\overline{K}^*(892)$	seen	389
$\pi^+\pi^-$	seen	963
4π	seen	925
$\eta\eta$	seen	804
$K\overline{K}$	seen	838
$\gamma\gamma$	seen	973

$f_2(2010)$

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

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 $m = 2010 \pm 12$ MeV
Full width $\Gamma = 353 \pm 40$ MeV

$a_4(2040)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\overline{K}$	seen	875
$\pi^+\pi^-\pi^0$	seen	981
$\rho\pi$	seen	849
$f_2(1270)\pi$	seen	590
$\eta\pi^0$	seen	925
$\eta'(958)\pi$	seen	769

$f_4(2050)$

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

Mass $m = 2034 \pm 11$ MeV (S = 1.6)
Full width $\Gamma = 222 \pm 19$ MeV (S = 1.8)

$f_4(2050)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\omega\omega$	not seen	650
$\pi\pi$	(17.0 ± 1.5) %	1008
$K\overline{K}$	$(6.8^{+3.4}_{-1.8}) \times 10^{-3}$	889
$\eta\eta$	$(2.1\pm0.8) \times 10^{-3}$	857
$4\pi^0$	< 1.2 %	972
$a_2(1320)\pi$	seen	579

$f_2(2300)$

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

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
$K\overline{K}$	seen	1037
$\gamma\gamma$	seen	1149

$f_2(2340)$

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

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 ($S = \pm 1$, $C = B = 0$)

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

$K^\pm$

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

Mass $m = 493.677 \pm 0.016$ MeV [v] (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 [w]

(See Particle Listings for quadratic coefficients)

$K^+ \to \pi^+\pi^+\pi^- = -0.2154 \pm 0.0035$ (S = 1.4)
$K^- \to \pi^-\pi^-\pi^+ = -0.217 \pm 0.007$ (S = 2.5)
$K^\pm \to \pi^\pm\pi^0\pi^0 = 0.638 \pm 0.020$ (S = 2.5)

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

Assuming μ-e universality

$\lambda_+(K^+_{\mu 3}) = \lambda_+(K^+_{e3}) = (2.78 \pm 0.07) \times 10^{-2}$ (S = 1.5)
$\lambda_0(K^+_{\mu 3}) = (1.77 \pm 0.16) \times 10^{-2}$ (S = 1.5)

Not assuming μ-e universality

$\lambda_+(K^+_{e3}) = (2.77 \pm 0.05) \times 10^{-2}$

$\lambda_+(K^+_{\mu 3}) = (2.84 \pm 0.27) \times 10^{-2}$ (S = 1.8)

$\lambda_0(K^+_{\mu 3}) = (1.74 \pm 0.22) \times 10^{-2}$ (S = 1.8)

K^+_{e3} $\left|f_S/f_+\right| = (-0.3^{+0.8}_{-0.7}) \times 10^{-2}$

K^+_{e3} $\left|f_T/f_+\right| = (-1.2 \pm 2.3) \times 10^{-2}$

$K^+_{\mu 3}$ $\left|f_S/f_+\right| = (0.2 \pm 0.6) \times 10^{-2}$

$K^+_{\mu 3}$ $\left|f_T/f_+\right| = (-0.1 \pm 0.7) \times 10^{-2}$

$K^+ \rightarrow e^+ \nu_e \gamma$ $\left|F_A + F_V\right| = 0.148 \pm 0.010$

$K^+ \rightarrow \mu^+ \nu_\mu \gamma$ $\left|F_A + F_V\right| = 0.165 \pm 0.013$

$K^+ \rightarrow e^+ \nu_e \gamma$ $\left|F_A - F_V\right| < 0.49$

$K^+ \rightarrow \mu^+ \nu_\mu \gamma$ $\left|F_A - F_V\right| = -0.24$ to 0.04, CL = 90%

Charge Radius

$\langle r \rangle = 0.560 \pm 0.031$ fm

***CP* violation parameters**

$\Delta(K^\pm_{\pi\mu\mu}) = -0.02 \pm 0.12$

***T* violation parameters**

$K^+ \rightarrow \pi^0 \mu^+ \nu_\mu$ $P_T = (-4 \pm 5) \times 10^{-3}$

$K^+ \rightarrow \mu^+ \nu_\mu \gamma$ $P_T = (-0.6 \pm 1.9) \times 10^{-2}$

$K^+ \rightarrow \pi^0 \mu^+ \nu_\mu$ $\mathrm{Im}(\xi) = -0.014 \pm 0.014$

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

$\mu^+ \nu_\mu \gamma$		[y,z]	$(5.50 \pm 0.28) \times 10^{-3}$		236
$\pi^0 e^+ \nu_e \gamma$		[y,z]	$(2.65 \pm 0.20) \times 10^{-4}$		228
$\pi^0 e^+ \nu_e \gamma$(SD)		[aa]	$< 5.3 \times 10^{-5}$	CL=90%	228
$\pi^0 \mu^+ \nu_\mu \gamma$		[y,z]	$< 6.1 \times 10^{-5}$	CL=90%	215
$\pi^0 \pi^0 e^+ \nu_e \gamma$			$< 5 \times 10^{-6}$	CL=90%	206

Hadronic modes with photons

$\pi^+ \pi^0 \gamma$		[y,z]	$(2.75 \pm 0.15) \times 10^{-4}$		205
$\pi^+ \pi^0 \gamma$(DE)		[z,bb]	$(4.4 \pm 0.8) \times 10^{-6}$		205
$\pi^+ \pi^0 \pi^0 \gamma$		[y,z]	$(7.4 ^{+5.5}_{-2.9}) \times 10^{-6}$		133
$\pi^+ \pi^+ \pi^- \gamma$		[y,z]	$(1.04 \pm 0.31) \times 10^{-4}$		125
$\pi^+ \gamma \gamma$		[z]	$(1.10 \pm 0.32) \times 10^{-6}$		227
$\pi^+ 3\gamma$		[z]	$< 1.0 \times 10^{-4}$	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
$e^+ \nu_e e^+ e^-$			$(2.48 \pm 0.20) \times 10^{-8}$		247
$\mu^+ \nu_\mu e^+ e^-$			$(7.06 \pm 0.31) \times 10^{-8}$		236
$e^+ \nu_e \mu^+ \mu^-$			$< 5 \times 10^{-7}$	CL=90%	223
$\mu^+ \nu_\mu \mu^+ \mu^-$			$< 4.1 \times 10^{-7}$	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*		$(8.1 \pm 1.4) \times 10^{-8}$	S=2.7	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%	205
$\mu^- \nu e^+ e^+$	*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
$\pi^+ \gamma$		[cc] $<$ 3.6	$\times 10^{-7}$	CL=90%	227

K^0

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

50% K_S, 50% K_L

Mass $m = 497.648 \pm 0.022$ MeV

$m_{K^0} - m_{K^\pm} = 3.972 \pm 0.027$ MeV (S = 1.2)

Mean Square Charge Radius

$\langle r^2 \rangle = -0.076 \pm 0.018$ fm^2 (S = 1.1)

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

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

CPT-violation parameters [x]

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

Im $\delta = (0.02 \pm 0.05) \times 10^{-3}$

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

$(\Gamma_{K^0} - \Gamma_{\overline{K}^0})/m_{\text{average}} = (8 \pm 8) \times 10^{-18}$

K^0_S

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

Mean life $\tau = (0.8953 \pm 0.0006) \times 10^{-10}$ s (S = 1.4) Assuming CPT

Mean life $\tau = (0.8958 \pm 0.0006) \times 10^{-10}$ s (S = 1.2) Not assuming CPT

$c\tau = 2.6842$ cm Assuming CPT

CP-violation parameters [ee]

$\text{Im}(\eta_{+-0}) = -0.002 \pm 0.009$

$\text{Im}(\eta_{000}) = -0.05 \pm 0.13$

CP asymmetry A in $\pi^+ \pi^- e^+ e^- = (-1 \pm 4)\%$

K^0_S DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
Hadronic modes			
$\pi^0 \pi^0$	(31.05 ± 0.14) %	S=1.1	209
$\pi^+ \pi^-$	(68.95 ± 0.14) %	S=1.1	206
$\pi^+ \pi^- \pi^0$	$(3.2\ ^{+1.2}_{-1.0}) \times 10^{-7}$		133

Modes with photons or $\ell\overline{\ell}$ pairs

$\pi^+\pi^-\gamma$		[y,ff]	$(1.79\pm0.05)\times10^{-3}$		206
$\pi^+\pi^-e^+e^-$			$(4.69\pm0.30)\times10^{-5}$		206
$\pi^0\gamma\gamma$		[ff]	$(4.9\ \pm1.8\ )\times10^{-8}$		231
$\gamma\gamma$			$(2.80\pm0.07)\times10^{-6}$		249

Semileptonic modes

$\pi^\pm e^\mp\nu_e$		[gg]	$(6.9\ \pm0.4\ )\times10^{-4}$		229

CP violating (*CP*) and $\Delta S = 1$ weak neutral current (*S1*) modes

$3\pi^0$	*CP*		$<1.4\qquad\times10^{-5}$	CL=90%	139
$\mu^+\mu^-$	*S1*		$<3.2\qquad\times10^{-7}$	CL=90%	225
e^+e^-	*S1*		$<1.4\qquad\times10^{-7}$	CL=90%	249
$\pi^0e^+e^-$	*S1*	[ff]	$(3.0\ {}^{+1.5}_{-1.2})\times10^{-9}$		231

K^0_L

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

$m_{K_L} - m_{K_S}$

$= (0.5292 \pm 0.0010)\times10^{10}\ \hbar\ \mathrm{s}^{-1}$ (S = 1.2) Assuming *CPT*

$= (3.483 \pm 0.006)\times10^{-12}$ MeV Assuming *CPT*

$= (0.5290 \pm 0.0016)\times10^{10}\ \hbar\ \mathrm{s}^{-1}$ (S = 1.2) Not assuming *CPT*

Mean life $\tau = (5.18 \pm 0.04)\times10^{-8}$ s (S = 1.1)

$c\tau = 15.51$ m

Slope parameter *g* [w]

(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 [x]

Assuming μ-e universality

$\lambda_+(K^0_{\mu3}) = \lambda_+(K^0_{e3}) = 0.0300 \pm 0.0020$ (S = 2.0)

$\lambda_0(K^0_{\mu3}) = 0.030 \pm 0.005$ (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%

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

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

$K_L \rightarrow \mu^+ \mu^- \gamma$: $\alpha_{K^*} = -0.158 \pm 0.027$

$K_L \rightarrow e^+ e^- e^+ e^-$: $\alpha^{\mathrm{eff}}_{K^*} = -0.14 \pm 0.22$

$K_L \rightarrow \pi^+ \pi^- e^+ e^-$: $a_1/a_2 = -0.734 \pm 0.022\ \mathrm{GeV}^2$

$K_L \rightarrow \pi^0 2\gamma$: $a_V = -0.54 \pm 0.12$ (S = 2.8)

***CP*-violation parameters** [ee]

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

$\left|\eta_{00}\right| = (2.276 \pm 0.014) \times 10^{-3}$

$\left|\eta_{+-}\right| = (2.288 \pm 0.014) \times 10^{-3}$

$\left|\epsilon\right| = (2.284 \pm 0.014) \times 10^{-3}$

$\left|\eta_{00}/\eta_{+-}\right| = 0.9950 \pm 0.0008$ [hh] (S = 1.6)

$\mathrm{Re}(\epsilon'/\epsilon) = (1.67 \pm 0.26) \times 10^{-3}$ [hh] (S = 1.6)

Assuming *CPT*

$\phi_{+-} = (43.52 \pm 0.06)^\circ$ (S = 1.3)

$\phi_{00} = (43.50 \pm 0.06)^\circ$ (S = 1.3)

$\phi_\epsilon = \phi_{\mathrm{SW}} = (43.51 \pm 0.05)^\circ$ (S = 1.2)

Not assuming CPT

$\phi_{+-} = (43.4 \pm 0.7)^\circ$ (S = 1.3)

$\phi_{00} = (43.7 \pm 0.8)^\circ$ (S = 1.2)

$\phi_{\epsilon} = (43.5 \pm 0.7)^\circ$ (S = 1.3)

CP asymmetry A in $K^0_L \to \pi^+\pi^- e^+ e^-$ = (13.8 ± 2.2)%

β_{CP} from $K^0_L \to e^+ e^- e^+ e^-$ = −0.23 ± 0.09

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

j for $K^0_L \to \pi^+\pi^-\pi^0$ = 0.0012 ± 0.0008

f for $K^0_L \to \pi^+\pi^-\pi^0$ = 0.004 ± 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%

T-violation parameters

$\mathrm{Im}(\xi)$ in $K^0_{\mu 3} = -0.007 \pm 0.026$

CPT invariance tests

$\phi_{00} - \phi_{+-} = (0.2 \pm 0.4)^\circ$

$\mathrm{Re}(\frac{2}{3}\eta_{+-} + \frac{1}{3}\eta_{00}) - \frac{\delta_L}{2} = (-3 \pm 35) \times 10^{-6}$

$\Delta S = -\Delta Q$ 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		
$\pi^\pm e^\mp \nu_e$	[gg]	(38.81 ±0.27) %	S=1.1	229
Called K^0_{e3}.				
$\pi^\pm \mu^\mp \nu_\mu$	[gg]	(27.19 ±0.25) %	S=1.1	216
Called $K^0_{\mu 3}$.				
$(\pi\mu \mathrm{atom})\nu$		(1.06 ±0.11) $\times 10^{-7}$		188
$\pi^0\pi^\pm e^\mp \nu$	[gg]	(5.18 ±0.29) $\times 10^{-5}$		207
Hadronic modes, including Charge conjugation×Parity Violating (*CPV*) modes				
$3\pi^0$		(21.05 ±0.23) %	S=1.1	139
$\pi^+\pi^-\pi^0$		(12.59 ±0.19) %	S=1.6	133
$\pi^+\pi^-$	*CPV*	(2.090±0.025) $\times 10^{-3}$	S=1.1	206
$\pi^0\pi^0$	*CPV*	(9.32 ±0.12) $\times 10^{-4}$	S=1.1	209

Semileptonic modes with photons

$\pi^{\pm} e^{\mp} \nu_e \gamma$	[y,gg,ii]	$(3.53 \pm 0.06) \times 10^{-3}$		229
$\pi^{\pm} \mu^{\mp} \nu_\mu \gamma$		$(5.7 {}^{+0.6}_{-0.7}) \times 10^{-4}$		216

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

$\pi^0 \pi^0 \gamma$		$< 5.6 \times 10^{-6}$		209
$\pi^+ \pi^- \gamma$	[y,ii]	$(4.39 \pm 0.12) \times 10^{-5}$	S=1.8	206
$\pi^0 2\gamma$	[ii]	$(1.41 \pm 0.12) \times 10^{-6}$	S=2.8	231
$\pi^0 \gamma e^+ e^-$		$(2.3 \pm 0.4) \times 10^{-8}$		231

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

2γ		$(5.90 \pm 0.07) \times 10^{-4}$	S=1.1	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
$e^+ e^- \gamma\gamma$	[ii]	$(5.95 \pm 0.33) \times 10^{-7}$		249
$\mu^+ \mu^- \gamma\gamma$	[ii]	$(1.0 {}^{+0.8}_{-0.6}) \times 10^{-8}$		225

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

$\mu^+ \mu^-$	*S1*		$(7.27 \pm 0.14) \times 10^{-9}$		225
$e^+ e^-$	*S1*		$(9 {}^{+6}_{-4}) \times 10^{-12}$		249
$\pi^+ \pi^- e^+ e^-$	*S1*	[ii]	$(3.11 \pm 0.19) \times 10^{-7}$		206
$\pi^0 \pi^0 e^+ e^-$	*S1*		$< 6.6 \times 10^{-9}$	CL=90%	209
$\mu^+ \mu^- e^+ e^-$	*S1*		$(2.69 \pm 0.27) \times 10^{-9}$		225
$e^+ e^- e^+ e^-$	*S1*		$(3.75 \pm 0.27) \times 10^{-8}$		249
$\pi^0 \mu^+ \mu^-$	*CP,S1*	[jj]	$< 3.8 \times 10^{-10}$	CL=90%	177
$\pi^0 e^+ e^-$	*CP,S1*	[jj]	$< 5.1 \times 10^{-10}$	CL=90%	231
$\pi^0 \nu \overline{\nu}$	*CP,S1*	[kk]	$< 5.9 \times 10^{-7}$	CL=90%	231
$e^{\pm} \mu^{\mp}$	*LF*	[gg]	$< 4.7 \times 10^{-12}$	CL=90%	238
$e^{\pm} e^{\pm} \mu^{\mp} \mu^{\mp}$	*LF*	[gg]	$< 4.12 \times 10^{-11}$	CL=90%	225
$\pi^0 \mu^{\pm} e^{\mp}$	*LF*	[gg]	$< 6.2 \times 10^{-9}$	CL=90%	217

$K^*(892)$

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

$K^*(892)^{\pm}$ 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)
$K\pi$	$\sim$ 100 %		289
$K^0\gamma$	$(2.30\pm0.20)\times10^{-3}$		307
$K^{\pm}\gamma$	$(9.9\pm0.9)\times10^{-4}$		309
$K\pi\pi$	$< 7 \times10^{-4}$	95%	223

$K_1(1270)$

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

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

$K_1(1270)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$K\rho$	(42 ± 6) %	43
$K_0^*(1430)\pi$	(28 ± 4) %	†
$K^*(892)\pi$	(16 ± 5) %	302
$K\omega$	(11.0 ± 2.0) %	†
$K f_0(1370)$	(3.0 ± 2.0) %	–
γK^0	seen	539

$K_1(1400)$

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

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) %	402
$K\rho$	(3.0 ± 3.0) %	292
$K f_0(1370)$	(2.0 ± 2.0) %	–
$K\omega$	(1.0 ± 1.0) %	284
$K_0^*(1430)\pi$	not seen	†
γK^0	seen	613

$K^*(1410)$

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

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%	410
$K\pi$	(6.6±1.3) %		612
$K\rho$	< 7 %	95%	305
γK^0	seen		619

$K_0^*(1430)$ [ll]

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

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) %	611

$K_2^*(1430)$

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

$K_2^*(1430)^\pm$ 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) %		619
$K^*(892)\pi$	(24.7±1.5) %		419
$K^*(892)\pi\pi$	(13.4±2.2) %		372
$K\rho$	(8.7±0.8) %	S=1.2	318
$K\omega$	(2.9±0.8) %		311
$K^+\gamma$	$(2.4\pm0.5) \times 10^{-3}$	S=1.1	627
$K\eta$	$(1.5^{+3.4}_{-1.0}) \times 10^{-3}$	S=1.3	486
$K\omega\pi$	$< 7.2 \times 10^{-4}$	CL=95%	100
$K^0\gamma$	$< 9 \times 10^{-4}$	CL=90%	626

$K^*(1680)$

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

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) %	781
$K\rho$	$(31.4^{+4.7}_{-2.1})$ %	570
$K^*(892)\pi$	$(29.9^{+2.2}_{-4.7})$ %	618

$K_2(1770)$ [mm]

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

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)
$K\pi\pi$		794
$K_2^*(1430)\pi$	dominant	288
$K^*(892)\pi$	seen	654
$K f_2(1270)$	seen	53
$K\phi$	seen	441
$K\omega$	seen	607

$K_3^*(1780)$

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

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) %		613
$K^*(892)\pi$	(20 ± 5) %		656
$K\pi$	(18.8 ± 1.0) %		813
$K\eta$	(30 ± 13) %		719
$K_2^*(1430)\pi$	< 16 %	95%	291

$K_2(1820)$ [nn]

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

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	327
$K^*(892)\pi$	seen	681
$K f_2(1270)$	seen	185
$K\omega$	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 ± 5) %	802
$K^*(892)\pi\pi\pi$	(7 ± 5) %	768
$\rho K\pi$	(5.7 ± 3.2) %	741
$\omega K\pi$	(5.0 ± 3.0) %	738
$\phi K\pi$	(2.8 ± 1.4) %	594
$\phi K^*(892)$	(1.4 ± 0.7) %	363

CHARMED MESONS ($C = \pm1$)

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

$D^\pm$

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

Mass $m = 1869.4 \pm 0.5$ MeV (S = 1.1)
Mean life $\tau = (1040 \pm 7) \times 10^{-15}$ s
$c\tau = 311.8$ μm

c-quark decays

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

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

$r_v = 1.62 \pm 0.08$ (S = 1.5)
$r_2 = 0.83 \pm 0.05$
$r_3 = 0.0 \pm 0.4$
$\Gamma_L/\Gamma_T = 1.13 \pm 0.08$
$\Gamma_+/\Gamma_- = 0.22 \pm 0.06$ (S = 1.6)

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		(27.5 ± 2.4) %		–
$\overline{K}^0$ anything + K^0 anything		(61 ± 8) %		–
K^+ anything		(5.5 ± 1.6) %		–
η anything	[pp]	< 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
$\overline{K}^0 \ell^+ \nu_\ell$	[qq]	(6.8 ± 0.8) %		868
$\overline{K}^0 e^+ \nu_e$		(6.7 ± 0.9) %		868
$\overline{K}^0 \mu^+ \nu_\mu$		$(7.0 ^{+3.0}_{-2.0})$ %		865
$K^- \pi^+ e^+ \nu_e$		$(4.5 ^{+1.0}_{-0.8})$ %	S=1.1	863
$\overline{K}^*(892)^0 e^+ \nu_e$ $\times$ B($\overline{K}^*(892)^0 \to K^- \pi^+$)		(3.7 ± 0.5) %		722
$K^- \pi^+ e^+ \nu_e$ nonresonant		$< 7 \times 10^{-3}$	CL=90%	863
$K^- \pi^+ \mu^+ \nu_\mu$		(4.00 ± 0.32) %		851
$\overline{K}^*(892)^0 \mu^+ \nu_\mu$ $\times$ B($\overline{K}^*(892)^0 \to K^- \pi^+$)		(3.7 ± 0.3) %		717

$K^- \pi^+ \mu^+ \nu_\mu$ nonresonant		$(3.3 \pm 1.3) \times 10^{-3}$		851
$(\overline{K}^*(892)\pi)^0 e^+ \nu_e$		< 1.2 %	CL=90%	712
$(\overline{K}\pi\pi)^0 e^+ \nu_e$ non-$\overline{K}^*(892)$		$< 9 \times 10^{-3}$	CL=90%	846
$K^- \pi^+ \pi^0 \mu^+ \nu_\mu$		$< 1.7 \times 10^{-3}$	CL=90%	825
$\pi^0 \ell^+ \nu_\ell$	[rr]	$(3.1 \pm 1.5) \times 10^{-3}$		930

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

$\overline{K}^*(892)^0 \ell^+ \nu_\ell$	[qq]	(5.73 ± 0.35) %		722
$\quad\overline{K}^*(892)^0 e^+ \nu_e$		(5.5 ± 0.7) %	S=1.4	722
$\quad\overline{K}^*(892)^0 \mu^+ \nu_\mu$		(5.5 ± 0.4) %		717
$\overline{K}_1(1270)^0 \mu^+ \nu_\mu$		< 4 %	CL=95%	493
$\overline{K}_2^*(1430)^0 \mu^+ \nu_\mu$		< 1.0 %	CL=95%	380
$\rho^0 e^+ \nu_e$		$(2.5 \pm 1.0) \times 10^{-3}$		774
$\rho^0 \mu^+ \nu_\mu$		$(3.4 \pm 0.8) \times 10^{-3}$		769
$\phi e^+ \nu_e$		< 2.09 %	CL=90%	657
$\phi \mu^+ \nu_\mu$		< 3.72 %	CL=90%	651
$\eta \ell^+ \nu_\ell$		$< 5 \times 10^{-3}$	CL=90%	854
$\eta'(958) \mu^+ \nu_\mu$		< 1.1 %	CL=90%	684

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

$\overline{K}^0 \pi^+$		(2.82 ± 0.19) %		862
$K^- \pi^+ \pi^+$	[ss]	(9.2 ± 0.6) %		845
$\quad\overline{K}^*(892)^0 \pi^+ \times B(\overline{K}^*(892)^0 \to K^- \pi^+)$		(1.30 ± 0.13) %		714
$\quad\overline{K}_0^*(1430)^0 \pi^+ \times B(\overline{K}_0^*(1430)^0 \to K^- \pi^+)$		(2.3 ± 0.3) %		382
$\quad\overline{K}^*(1680)^0 \pi^+ \times B(\overline{K}^*(1680)^0 \to K^- \pi^+)$		$(3.8 \pm 0.8) \times 10^{-3}$		58
$\quad K^- \pi^+ \pi^+$ nonresonant		(8.8 ± 0.9) %		845
$\overline{K}^0 \pi^+ \pi^0$	[ss]	(9.7 ± 3.0) %	S=1.1	845
$\quad\overline{K}^0 \rho^+$		(6.6 ± 2.5) %		677
$\quad\overline{K}^*(892)^0 \pi^+ \times B(\overline{K}^*(892)^0 \to \overline{K}^0 \pi^0)$		$(6.5 \pm 0.6) \times 10^{-3}$		714
$\quad\overline{K}^0 \pi^+ \pi^0$ nonresonant		(1.3 ± 1.1) %		845
$K^- \pi^+ \pi^+ \pi^0$	[ss]	(6.5 ± 1.1) %		816
$\quad\overline{K}^*(892)^0 \rho^+$ total $\times B(\overline{K}^*(892)^0 \to K^- \pi^+)$		(1.4 ± 0.9) %		422
$\quad\overline{K}_1(1400)^0 \pi^+ \times B(\overline{K}_1(1400)^0 \to K^- \pi^+ \pi^0)$		(2.2 ± 0.6) %		390
$\quad K^- \rho^+ \pi^+$ total		(3.1 ± 1.1) %		612
$\qquad K^- \rho^+ \pi^+$ 3-body		(1.1 ± 0.4) %		612
$\quad\overline{K}^*(892)^0 \pi^+ \pi^0$ total $\times B(\overline{K}^*(892)^0 \to K^- \pi^+)$		(4.5 ± 0.9) %		690

$\overline{K}^*(892)^0 \pi^+ \pi^0$ 3-body $\times$ B($\overline{K}^*(892)^0 \to K^- \pi^+$)		(2.9 ± 0.9) %		690
$K^*(892)^- \pi^+ \pi^+$ 3-body $\times$ B($K^*(892)^- \to K^- \pi^0$)		(7 ± 3) $\times 10^{-3}$		688
$K^- \pi^+ \pi^+ \pi^0$ nonresonant	[tt]	(1.2 ± 0.6) %		816
$\overline{K}^0 \pi^+ \pi^+ \pi^-$	[ss]	(7.1 ± 1.0) %		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($\overline{K}_1(1400)^0 \to \overline{K}^0 \pi^+ \pi^-$)		(2.2 ± 0.6) %		390
$K^*(892)^- \pi^+ \pi^+$ 3-body $\times$ B($K^*(892)^- \to \overline{K}^0 \pi^-$)		(1.4 ± 0.6) %		688
$\overline{K}^0 \rho^0 \pi^+$ total		(4.3 ± 0.9) %		610
$\overline{K}^0 \rho^0 \pi^+$ 3-body		(5 ± 5) $\times 10^{-3}$		610
$\overline{K}^0 \pi^+ \pi^+ \pi^-$ nonresonant		(9 ± 4) $\times 10^{-3}$		814
$K^- 3\pi^+ \pi^-$	[ss]	(6.2 ± 0.8) $\times 10^{-3}$	S=1.3	772
$\overline{K}^*(892)^0 \pi^+ \pi^+ \pi^-$ $\times$ B($\overline{K}^*(892)^0 \to K^- \pi^+$)		(2.1 ± 0.8) $\times 10^{-3}$		645
$\overline{K}^*(892)^0 \rho^0 \pi^+$ $\times$ B($\overline{K}^*(892)^0 \to K^- \pi^+$)		(2.0 ± 0.5) $\times 10^{-3}$		239
$\overline{K}^*(892)^0 \pi^+ \pi^+ \pi^-$ no-ρ $\times$ B($\overline{K}^*(892)^0 \to K^- \pi^+$)		(2.9 ± 1.1) $\times 10^{-3}$		645
$K^- \rho^0 \pi^+ \pi^+$		(1.94 ± 0.35) $\times 10^{-3}$	S=1.1	524
$K^- 3\pi^+ \pi^-$ nonresonant		(4.3 ± 3.2) $\times 10^{-4}$		772
$\overline{K}^0 \overline{K}^0 K^+$		(1.8 ± 0.8) %		545
$K^+ K^- \overline{K}^0 \pi^+$		(5.5 ± 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) %		677
$\overline{K}^0 a_1(1260)^+$		(8.2 ± 1.7) %		328
$\overline{K}^0 a_2(1320)^+$		< 3 $\times 10^{-3}$	CL=90%	199
$\overline{K}^*(892)^0 \pi^+$		(1.95 ± 0.19) %		714
$\overline{K}^*(892)^0 \rho^+$ total	[tt]	(2.1 ± 1.4) %		422
$\overline{K}^*(892)^0 \rho^+$ S-wave	[tt]	(1.7 ± 1.6) %		422
$\overline{K}^*(892)^0 \rho^+$ P-wave		< 1 $\times 10^{-3}$	CL=90%	422
$\overline{K}^*(892)^0 \rho^+$ D-wave		(10 ± 7) $\times 10^{-3}$		422
$\overline{K}^*(892)^0 \rho^+$ D-wave longitudinal		< 7 $\times 10^{-3}$	CL=90%	422
$\overline{K}_1(1270)^0 \pi^+$		< 7 $\times 10^{-3}$	CL=90%	487
$\overline{K}_1(1400)^0 \pi^+$		(5.0 ± 1.3) %		390
$\overline{K}_0^*(1430)^0 \pi^+$		(3.8 ± 0.4) %		382
$\overline{K}^*(1680)^0 \pi^+$		(1.47 ± 0.31) %		58
$\overline{K}^*(892)^0 \pi^+ \pi^0$ total		(6.8 ± 1.4) %		690

$\overline{K}^*(892)^0 \pi^+ \pi^0$ 3-body	[tt]	(4.3 ± 1.4) %		690
$K^*(892)^- \pi^+ \pi^+$ total		—		688
$K^*(892)^- \pi^+ \pi^+$ 3-body		(2.1 ± 0.9) %		688
$K^- \rho^+ \pi^+$ total		(3.1 ± 1.1) %		612
$K^- \rho^+ \pi^+$ 3-body		(1.1 ± 0.4) %		612
$\overline{K}^0 \rho^0 \pi^+$ total		(4.3 ± 0.9) %	CL=90%	610
$\overline{K}^0 \rho^0 \pi^+$ 3-body		$(5 \pm 5) \times 10^{-3}$		610
$\overline{K}^*(892)^0 \pi^+ \pi^+ \pi^-$		$(3.2 \pm 1.2) \times 10^{-3}$	S=2.0	645
$\overline{K}^*(892)^0 \rho^0 \pi^+$		$(3.0 \pm 0.7) \times 10^{-3}$	S=1.3	239
$\overline{K}^*(892)^0 \pi^+ \pi^+ \pi^-$ no-ρ		$(4.4 \pm 1.7) \times 10^{-3}$		645
$K^- \rho^0 \pi^+ \pi^+$		$(1.94 \pm 0.35) \times 10^{-3}$		524
$\overline{K}^*(892)^0 a_1(1260)^+$		$(9.1 \pm 1.9) \times 10^{-3}$		†

Pionic modes

$\pi^+ \pi^0$		$(2.6 \pm 0.7) \times 10^{-3}$		925
$\pi^+ \pi^+ \pi^-$		$(3.1 \pm 0.4) \times 10^{-3}$		908
$\sigma \pi^+$		$(2.2 \pm 0.5) \times 10^{-3}$		–
$\rho^0 \pi^+$		$(1.05 \pm 0.18) \times 10^{-3}$		766
$f_0(980) \pi^+ \times \mathrm{B}(f_0 \to \pi^+ \pi^-)$	[uu]	$(1.9 \pm 0.5) \times 10^{-4}$		669
$f_2(1270) \pi^+ \times \mathrm{B}(f_2 \to \pi^+ \pi^-)$		$(6.1 \pm 1.1) \times 10^{-4}$		485
$\pi^+ \pi^+ \pi^-$ nonresonant		$(2.4 \pm 2.1) \times 10^{-4}$		908
$\pi^+ \pi^+ \pi^- \pi^0$		—		883
$\eta \pi^+ \times \mathrm{B}(\eta \to \pi^+ \pi^- \pi^0)$		$(6.8 \pm 1.4) \times 10^{-4}$		848
$\omega \pi^+ \times \mathrm{B}(\omega \to \pi^+ \pi^- \pi^0)$		$< 6 \times 10^{-3}$	CL=90%	763
$3\pi^+ 2\pi^-$		$(1.82 \pm 0.25) \times 10^{-3}$	S=1.2	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
$\rho^0 \pi^+$		$(1.05 \pm 0.18) \times 10^{-3}$		766
$\omega \pi^+$		$< 7 \times 10^{-3}$	CL=90%	763
$\eta \rho^+$		$< 7 \times 10^{-3}$	CL=90%	655
$\eta'(958) \pi^+$		$(5.1 \pm 1.0) \times 10^{-3}$		680
$\eta'(958) \rho^+$		$< 5 \times 10^{-3}$	CL=90%	348
$f_2(1270) \pi^+$		$(1.08 \pm 0.20) \times 10^{-3}$		485

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

$K^+ \overline{K}^0$		$(5.9 \pm 0.6) \times 10^{-3}$	S=1.2	792
$K^+ K^- \pi^+$	[ss]	$(8.9 \pm 0.8) \times 10^{-3}$		744
$\phi \pi^+ \times \mathrm{B}(\phi \to K^+ K^-)$		$(3.1 \pm 0.3) \times 10^{-3}$		647
$K^+ \overline{K}^*(892)^0 \times \mathrm{B}(\overline{K}^{*0} \to K^- \pi^+)$		$(2.9 \pm 0.4) \times 10^{-3}$		613
$K^+ K^- \pi^+$ nonresonant		$(4.6 \pm 0.9) \times 10^{-3}$		744

$K^0 \overline{K}^0 \pi^+$		—			741
$K^*(892)^+ \overline{K}^0$ $\times$ B($K^{*+} \rightarrow K^0 \pi^+$)		(2.1 ± 0.9) %			611
$K^+ K^- \pi^+ \pi^0$		—			682
$\phi \pi^+ \pi^0$ $\times$ B($\phi \rightarrow K^+ K^-$)		(1.1 ± 0.5) %			619
$\phi \rho^+$ $\times$ B($\phi \rightarrow K^+ K^-$)		< 7	$\times 10^{-3}$	CL=90%	258
$K^+ K^- \pi^+ \pi^0$ non-ϕ		($1.5^{+0.7}_{-0.6}$) %			682
$K^+ \overline{K}^0 \pi^+ \pi^-$		(4.0 ± 0.7)	$\times 10^{-3}$		678
$K^0 K^- \pi^+ \pi^+$		(5.5 ± 0.8)	$\times 10^{-3}$		678
$K^*(892)^+ \overline{K}^*(892)^0$ $\times$ B^2($K^*(892)^+ \rightarrow K^0 \pi^+$)		(1.2 ± 0.5) %			280
$K^0 K^- \pi^+ \pi^+$ (non-$K^{*+} \overline{K}^{*0}$)		< 7.9	$\times 10^{-3}$	CL=90%	678
$K^+ K^- \pi^+ \pi^+ \pi^-$		(2.5 ± 1.3)	$\times 10^{-4}$		600

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

$\phi \pi^+$		(6.2 ± 0.6)	$\times 10^{-3}$		647
$\phi \pi^+ \pi^0$		(2.3 ± 1.0) %			619
$\phi \rho^+$		< 1.5	%	CL=90%	258
$K^+ \overline{K}^*(892)^0$		(4.3 ± 0.6)	$\times 10^{-3}$		613
$K^*(892)^+ \overline{K}^0$		(3.1 ± 1.4) %			611
$K^*(892)^+ \overline{K}^*(892)^0$		(2.6 ± 1.1) %			280

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*		(7.0 ± 1.5)	$\times 10^{-4}$		845
$K^+ \rho^0$	*DC*		(2.6 ± 1.2)	$\times 10^{-4}$		678
$K^*(892)^0 \pi^+$	*DC*	[*vv*]	(3.7 ± 1.7)	$\times 10^{-4}$		714
$K^+ \pi^+ \pi^-$ nonresonant	*DC*		(2.5 ± 1.2)	$\times 10^{-4}$		845
$K^+ K^+ K^-$	*DC*		(8.7 ± 2.1)	$\times 10^{-5}$		550
ϕK^+	*DC*	[*vv*]	< 1.3	$\times 10^{-4}$	CL=90%	527
$\pi^+ e^+ e^-$	*C1*		< 5.2	$\times 10^{-5}$	CL=90%	929
$\pi^+ \mu^+ \mu^-$	*C1*		< 8.8	$\times 10^{-6}$	CL=90%	917
$\rho^+ \mu^+ \mu^-$	*C1*		< 5.6	$\times 10^{-4}$	CL=90%	757
$K^+ e^+ e^-$		[*ww*]	< 2.0	$\times 10^{-4}$	CL=90%	870
$K^+ \mu^+ \mu^-$		[*ww*]	< 9.2	$\times 10^{-6}$	CL=90%	856
$\pi^+ e^\pm \mu^\mp$	*LF*	[*gg*]	< 3.4	$\times 10^{-5}$	CL=90%	926
$K^+ e^\pm \mu^\mp$	*LF*	[*gg*]	< 6.8	$\times 10^{-5}$	CL=90%	866
$\pi^- e^+ e^+$	*L*		< 9.6	$\times 10^{-5}$	CL=90%	929
$\pi^- \mu^+ \mu^+$	*L*		< 4.8	$\times 10^{-6}$	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%	757

$K^- e^+ e^+$	L	$<$ 1.2	$\times 10^{-4}$	CL=90%	870
$K^- \mu^+ \mu^+$	L	$<$ 1.3	$\times 10^{-5}$	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 $m = 1864.6 \pm 0.5$ MeV (S = 1.1)

$m_{D^\pm} - m_{D^0} = 4.78 \pm 0.10$ MeV (S = 1.1)

Mean life $\tau = (410.3 \pm 1.5) \times 10^{-15}$ s

$c\tau = 123.0\ \mu$m

$\left|m_{D_1^0} - m_{D_2^0}\right| < 7 \times 10^{10}\ \hbar\ \text{s}^{-1}$, CL = 95% [xx]

$(\Gamma_{D_1^0} - \Gamma_{D_2^0})/\Gamma = 2y = 0.016 \pm 0.010$

$\Gamma(K^+ \ell^- \overline{\nu}_\ell \text{ (via } \overline{D}^0))/\Gamma(K^- \ell^+ \nu_\ell) < 0.005$, 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

$A_{CP}(K^+ K^-) = 0.005 \pm 0.016$

$A_{CP}(K_S^0 K_S^0) = -0.23 \pm 0.19$

$A_{CP}(\pi^+ \pi^-) = 0.021 \pm 0.026$

$A_{CP}(\pi^0 \pi^0) = 0.00 \pm 0.05$

$A_{CP}(K_S^0 \phi) = -0.03 \pm 0.09$

$A_{CP}(K_S^0 \pi^0) = 0.001 \pm 0.013$

$A_{CP}(K^\pm \pi^\mp) = 0.08 \pm 0.09$

$A_{CP}(K^\mp \pi^\pm \pi^0) = -0.03 \pm 0.09$

$A_{CP}(K^\pm \pi^\mp \pi^0) = 0.09^{+0.25}_{-0.22}$

CPT-violation decay-rate asymmetry

$A_{CPT}(K^\mp \pi^\pm) = 0.008 \pm 0.008$

$\overline{D}^0$ 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	[yy]	(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	[pp]	$<$ 13 %	CL=90%	–
ϕ anything		(1.7 ± 0.8) %		–

Semileptonic modes

$K^- \ell^+ \nu_\ell$	[qq]	(3.43± 0.14) %		S=1.2	867
$K^- e^+ \nu_e$		(3.58± 0.18) %		S=1.1	867
$K^- \mu^+ \nu_\mu$		(3.19± 0.17) %			864
$K^- \pi^0 e^+ \nu_e$		(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
$\overline{K}^*(892)^- e^+ \nu_e$ × B($K^*(892)^- \to \overline{K}^0 \pi^-$)		(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%	692
$\pi^- e^+ \nu_e$		(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.

$K^*(892)^- e^+ \nu_e$		(2.15± 0.35) %			719

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

$K^- \pi^+$		(3.80± 0.09) %			861
$\overline{K}^0 \pi^0$		(2.30± 0.22) %			860
$\overline{K}^0 \pi^+ \pi^-$	[ss]	(5.97± 0.35) %		S=1.1	842
$\overline{K}^0 \rho^0$		(1.55 $^{+0.12}_{-0.16}$) %			673
$\overline{K}^0 \omega$ × B($\omega \to \pi^+ \pi^-$)		(3.9 ± 0.9)	$\times 10^{-4}$		670
$\overline{K}^0 f_0(980)$ × B($f_0(980) \to \pi^+ \pi^-$)		(2.8 $^{+0.6}_{-0.4}$)	$\times 10^{-3}$		549
$\overline{K}^0 f_2(1270)$ × B($f_2(1270) \to \pi^+ \pi^-$)		(2.6 $^{+2.3}_{-1.4}$)	$\times 10^{-4}$		262
$\overline{K}^0 f_0(1370)$ × B($f_0(1370) \to \pi^+ \pi^-$)		(5.1 $^{+1.2}_{-1.3}$)	$\times 10^{-3}$		–
$K^*(892)^- \pi^+$ × B($K^*(892)^- \to \overline{K}^0 \pi^-$)		(3.9 ± 0.3) %			711
$K_0^*(1430)^- \pi^+$ × B($K_0^*(1430)^- \to \overline{K}^0 \pi^-$)		(6.1 $^{+1.2}_{-0.8}$)	$\times 10^{-3}$		378
$K_2^*(1430)^- \pi^+$ × B($K_2^*(1430)^- \to \overline{K}^0 \pi^-$)		(1.0 $^{+0.7}_{-0.4}$)	$\times 10^{-3}$		367
$K^*(1680)^- \pi^+$ × B($K^*(1680)^- \to \overline{K}^0 \pi^-$)		(2.1 $^{+1.0}_{-0.9}$)	$\times 10^{-3}$		46
$K^*(892)^+ \pi^-$ × B($K^*(892)^+ \to K^0 \pi^+$)		(2.0 $^{+2.6}_{-0.9}$)	$\times 10^{-4}$		711
$\overline{K}^0 \pi^+ \pi^-$ nonresonant		(5.4 $^{+12.0}_{-3.4}$)	$\times 10^{-4}$		842

$K^- \pi^+ \pi^0$	[ss]	(13.0 ± 0.8) %	S=1.3	844
$K^- \rho^+$		(10.1 ± 0.8) %		675
$K^- \rho(1700)^+ \times B(\rho(1700)^+ \to \pi^+ \pi^0)$		$(7.4 \pm 1.6) \times 10^{-3}$		†
$K^*(892)^- \pi^+ \times B(K^*(892)^- \to K^- \pi^0)$		(1.97 ± 0.13) %		711
$\overline{K}^*(892)^0 \pi^0 \times B(\overline{K}^*(892)^0 \to K^- \pi^+)$		(1.87 ± 0.27) %		711
$K_0^*(1430)^- \pi^+ \times B(K_0^*(1430)^- \to K^- \pi^0)$		$(3.0 {}^{+0.6}_{-0.4}) \times 10^{-3}$		378
$\overline{K}_0^*(1430)^0 \pi^0 \times B(\overline{K}_0^*(1430)^0 \to K^- \pi^+)$		$(5.3 {}^{+4.2}_{-1.4}) \times 10^{-3}$		379
$K^*(1680)^- \pi^+ \times B(K^*(1680)^- \to K^- \pi^0)$		$(1.1 \pm 0.5) \times 10^{-3}$		46
$K^- \pi^+ \pi^0$ nonresonant		$(1.04 {}^{+0.50}_{-0.19})$ %		844
$\overline{K}^0 \pi^0 \pi^0$		—		843
$\overline{K}^*(892)^0 \pi^0 \times B(\overline{K}^*(892)^0 \to \overline{K}^0 \pi^0)$		$(9.3 \pm 1.3) \times 10^{-3}$		711
$\overline{K}^0 \pi^0 \pi^0$ nonresonant		$(8.5 \pm 2.2) \times 10^{-3}$		843
$K^- \pi^+ \pi^+ \pi^-$	[ss]	(7.46 ± 0.31) %		812
$K^- \pi^+ \rho^0$ total		(6.2 ± 0.4) %		609
$K^- \pi^+ \rho^0$ 3-body		$(4.7 \pm 2.1) \times 10^{-3}$		609
$\overline{K}^*(892)^0 \rho^0 \times B(\overline{K}^*(892)^0 \to K^- \pi^+)$		$(9.7 \pm 2.1) \times 10^{-3}$		416
$K^- a_1(1260)^+ \times B(a_1(1260)^+ \to \pi^+ \pi^+ \pi^-)$		(3.6 ± 0.6) %		327
$\overline{K}^*(892)^0 \pi^+ \pi^-$ total $\times B(\overline{K}^*(892)^0 \to K^- \pi^+)$		(1.5 ± 0.4) %		685
$\overline{K}^*(892)^0 \pi^+ \pi^-$ 3-body $\times B(\overline{K}^*(892)^0 \to K^- \pi^+)$		$(9.5 \pm 2.1) \times 10^{-3}$		685
$K_1(1270)^- \pi^+ \times B(K_1(1270)^- \to K^- \pi^+ \pi^-)$	[tt]	$(2.9 \pm 0.3) \times 10^{-3}$		484
$K^- \pi^+ \pi^+ \pi^-$ nonresonant		(1.74 ± 0.25) %		812
$\overline{K}^0 \pi^+ \pi^- \pi^0$	[ss]	(10.9 ± 1.3) %		812
$\overline{K}^0 \eta \times B(\eta \to \pi^+ \pi^- \pi^0)$		$(1.74 \pm 0.25) \times 10^{-3}$		772
$\overline{K}^0 \omega \times B(\omega \to \pi^+ \pi^- \pi^0)$		(2.1 ± 0.4) %		670
$K^*(892)^- \rho^+ \times B(K^*(892)^- \to \overline{K}^0 \pi^-)$		(4.4 ± 1.7) %		416
$\overline{K}^*(892)^0 \rho^0 \times B(\overline{K}^*(892)^0 \to \overline{K}^0 \pi^0)$		$(4.8 \pm 1.1) \times 10^{-3}$		416
$K_1(1270)^- \pi^+ \times B(K_1(1270)^- \to \overline{K}^0 \pi^- \pi^0)$	[tt]	$(4.5 \pm 1.2) \times 10^{-3}$		484

$\overline{K}^*(892)^0 \pi^+ \pi^-$ 3-body $\times$ B($\overline{K}^*(892)^0 \to \overline{K}^0 \pi^0$)	(4.7 ± 1.0) $\times 10^{-3}$		685
$\overline{K}^0 \pi^+ \pi^- \pi^0$ nonresonant	(2.3 ± 2.3) %		812
$K^- \pi^+ \pi^+ \pi^- \pi^0$	(4.0 ± 0.4) %		771
$\overline{K}^*(892)^0 \pi^+ \pi^- \pi^0$ $\times$ B($\overline{K}^*(892)^0 \to K^- \pi^+$)	(1.2 ± 0.6) %		643
$\overline{K}^*(892)^0 \eta$ $\times$ B($\overline{K}^*(892)^0 \to K^- \pi^+$) $\times$ B($\eta \to \pi^+ \pi^- \pi^0$)	(2.7 ± 0.6) $\times 10^{-3}$		582
$K^- \pi^+ \omega \times$ B($\omega \to \pi^+ \pi^- \pi^0$)	(2.7 ± 0.5) %		605
$\overline{K}^*(892)^0 \omega$ $\times$ B($\overline{K}^*(892)^0 \to K^- \pi^+$) $\times$ B($\omega \to \pi^+ \pi^- \pi^0$)	(6.5 ± 2.4) $\times 10^{-3}$		410
$\overline{K}^0 \pi^+ \pi^+ \pi^- \pi^-$	(6.4 ± 1.8) $\times 10^{-3}$		768
$\overline{K}^0 K^+ K^-$	(1.03 ± 0.10) %		544
$\overline{K}^0 \phi \times$ B($\phi \to K^+ K^-$)	(4.7 ± 0.6) $\times 10^{-3}$		520
$\overline{K}^0 K^+ K^-$ non-ϕ	(5.6 ± 0.9) $\times 10^{-3}$		544
$K^0_S K^0_S K^0_S$	(9.2 ± 1.6) $\times 10^{-4}$		538
$K^+ K^- K^- \pi^+$	(2.04 ± 0.30) $\times 10^{-4}$		434
$K^+ K^- \overline{K}^*(892)^0$ $\times$ B($\overline{K}^*(892)^0 \to K^- \pi^+$)	(4.1 ± 1.7) $\times 10^{-5}$		†
$K^- \pi^+ \phi \times$ B($\phi \to K^+ K^-$)	(3.8 ± 1.6) $\times 10^{-5}$		422
$\phi \overline{K}^*(892)^0$ $\times$ B($\phi \to K^+ K^-$) $\times$ B($\overline{K}^*(892)^0 \to K^- \pi^+$)	(1.0 ± 0.2) $\times 10^{-4}$		†
$K^+ K^- K^- \pi^+$ nonresonant	(3.1 ± 1.4) $\times 10^{-5}$		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.)

$\overline{K}^0 \eta$	(7.7 ± 1.1) $\times 10^{-3}$		772
$\overline{K}^0 \rho^0$	($1.55^{+0.12}_{-0.16}$) %		673
$K^- \rho^+$	(10.1 ± 0.8) %	S=1.2	675
$\overline{K}^0 \omega$	(2.3 ± 0.4) %		670
$\overline{K}^0 \eta'(958)$	(1.88 ± 0.28) %		565
$\overline{K}^0 \phi$	(9.4 ± 1.1) $\times 10^{-3}$		520
$K^- a_1(1260)^+$	(7.2 ± 1.1) %		327
$\overline{K}^0 a_1(1260)^0$	< 1.9 %	CL=90%	323
$\overline{K}^0 f_2(1270)$	($4.7^{+4.1}_{-2.4}$) $\times 10^{-4}$		262
$K^- a_2(1320)^+$	< 2 $\times 10^{-3}$	CL=90%	197
$K^*(892)^- \pi^+$	(5.9 ± 0.4) %	S=1.1	711
$\overline{K}^*(892)^0 \pi^0$	(2.8 ± 0.4) %	S=1.1	711

$\overline{K}^*(892)^0 \pi^+ \pi^-$ total		(2.2 ± 0.5) %		685
$\overline{K}^*(892)^0 \pi^+ \pi^-$ 3-body		(1.42± 0.31) %		685
$K^- \pi^+ \rho^0$ total		(6.2 ± 0.4) %		609
$K^- \pi^+ \rho^0$ 3-body		(4.7 ± 2.1) $\times 10^{-3}$		609
$\overline{K}^*(892)^0 \rho^0$		(1.45± 0.32) %		416
$\overline{K}^*(892)^0 \rho^0$ transverse		(1.5 ± 0.5) %		416
$\overline{K}^*(892)^0 \rho^0$ S-wave		(2.8 ± 0.6) %		416
$\overline{K}^*(892)^0 \rho^0$ S-wave long.		< 3 $\times 10^{-3}$	CL=90%	416
$\overline{K}^*(892)^0 \rho^0$ P-wave		< 3 $\times 10^{-3}$	CL=90%	416
$\overline{K}^*(892)^0 \rho^0$ D-wave		(1.9 ± 0.6) %		416
$K^*(892)^- \rho^+$		(6.6 ± 2.6) %		416
$K^*(892)^- \rho^+$ longitudinal		(3.2 ± 1.3) %		416
$K^*(892)^- \rho^+$ transverse		(3.4 ± 2.0) %		416
$K^*(892)^- \rho^+$ P-wave		< 1.5 %	CL=90%	416
$K_1(1270)^- \pi^+$	[tt]	(1.14± 0.31) %		484
$K_1(1400)^- \pi^+$		< 1.2 %	CL=90%	386
$\overline{K}_1(1400)^0 \pi^0$		< 3.7 %	CL=90%	387
$K_0^*(1430)^- \pi^+$		(9.8 $^{+2.0}_{-1.3}$) $\times 10^{-3}$		378
$\overline{K}_0^*(1430)^0 \pi^0$		(8.6 $^{+6.8}_{-2.3}$) $\times 10^{-3}$		379
$K_2^*(1430)^- \pi^+$		(2.0 $^{+1.3}_{-0.7}$) $\times 10^{-3}$		367
$\overline{K}_2^*(1430)^0 \pi^0$		< 3.3 $\times 10^{-3}$	CL=90%	368
$K^*(1680)^- \pi^+$		(8.2 $^{+3.9}_{-3.5}$) $\times 10^{-3}$	S=1.2	46
$\overline{K}^*(892)^0 \pi^+ \pi^- \pi^0$		(1.8 ± 0.9) %		643
$\overline{K}^*(892)^0 \eta$		(1.8 ± 0.4) %		582
$K^- \pi^+ \omega$		(3.0 ± 0.6) %		605
$\overline{K}^*(892)^0 \omega$		(1.1 ± 0.4) %		410
$K^- \pi^+ \eta'(958)$		(6.9 ± 1.8) $\times 10^{-3}$		479
$\overline{K}^*(892)^0 \eta'(958)$		< 1.0 $\times 10^{-3}$	CL=90%	119
$K^- \pi^+ \phi$		(7.6 ± 3.1) $\times 10^{-5}$		422
$K^+ K^- \overline{K}^*(892)^0$		(6.1 ± 2.5) $\times 10^{-5}$		†
$\phi \overline{K}^*(892)^0$		(3.0 ± 0.6) $\times 10^{-4}$		†

Pionic modes

$\pi^+ \pi^-$		(1.38± 0.05) $\times 10^{-3}$		922
$\pi^0 \pi^0$		(8.4 ± 2.2) $\times 10^{-4}$		922
$\pi^+ \pi^- \pi^0$		(1.1 ± 0.4) %		907
$\pi^+ \pi^+ \pi^- \pi^-$		(7.3 ± 0.5) $\times 10^{-3}$		880

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

$K^+ K^-$		$(3.89^{+0.12}_{-0.15}) \times 10^{-3}$	S=1.2	791
$K^0 \overline{K}^0$		$(7.1 \pm 1.9) \times 10^{-4}$	S=1.2	788
$K^0 K^- \pi^+$		$(6.9 \pm 1.0) \times 10^{-3}$		739
$\quad \overline{K}^*(892)^0 K^0 \times B(\overline{K}^{*0} \to K^- \pi^+)$		$< 1.1 \times 10^{-3}$	CL=90%	608
$\quad K^*(892)^+ K^- \times B(K^{*+} \to K^0 \pi^+)$		$(2.5 \pm 0.5) \times 10^{-3}$		610
$\quad K^0 K^- \pi^+$ nonresonant		$(2.3 \pm 2.3) \times 10^{-3}$		739
$\overline{K}^0 K^+ \pi^-$		$(5.3 \pm 1.0) \times 10^{-3}$		739
$\quad K^*(892)^0 \overline{K}^0 \times B(K^{*0} \to K^+ \pi^-)$		$< 6 \times 10^{-4}$	CL=90%	608
$\quad K^*(892)^- K^+ \times B(K^{*-} \to \overline{K}^0 \pi^-)$		$(1.3 \pm 0.7) \times 10^{-3}$		610
$\quad \overline{K}^0 K^+ \pi^-$ nonresonant		$(3.8^{+2.3}_{-1.9}) \times 10^{-3}$		739
$K^+ K^- \pi^0$		$(1.24 \pm 0.35) \times 10^{-3}$		743
$K^0_S K^0_S \pi^0$		$< 5.9 \times 10^{-4}$		740
$K^+ K^- \pi^+ \pi^-$	[zz]	$(2.49 \pm 0.23) \times 10^{-3}$		677
$\quad \phi \pi^+ \pi^- \times B(\phi \to K^+ K^-)$		$(5.3 \pm 1.4) \times 10^{-4}$		614
$\quad\quad \phi \rho^0 \times B(\phi \to K^+ K^-)$		$(2.9 \pm 1.5) \times 10^{-4}$		250
$\quad K^+ K^- \rho^0$ 3-body		$(9.0 \pm 2.3) \times 10^{-4}$		301
$\quad K^*(892)^0 K^- \pi^+ +$ c.c. $\times B(K^{*0} \to K^+ \pi^-)$	[aaa]	$< 5 \times 10^{-4}$		531
$\quad K^*(892)^0 \overline{K}^*(892)^0 \times B^2(K^{*0} \to K^+ \pi^-)$		$(6 \pm 2) \times 10^{-4}$		272
$\quad K^+ K^- \pi^+ \pi^-$ nonresonant		$< 8 \times 10^{-4}$	CL=90%	677
$K^0 \overline{K}^0 \pi^+ \pi^-$		$(7.5 \pm 2.9) \times 10^{-3}$		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%	608
$K^*(892)^+ K^-$		$(3.8 \pm 0.8) \times 10^{-3}$		610
$K^*(892)^0 \overline{K}^0$		$< 9 \times 10^{-4}$	CL=90%	608
$K^*(892)^- K^+$		$(2.0 \pm 1.1) \times 10^{-3}$		610
$\phi \pi^0$		$(7.5 \pm 0.5) \times 10^{-4}$		645
$\phi \eta$		$(1.4 \pm 0.5) \times 10^{-4}$		489
$\phi \omega$		$< 2.1 \times 10^{-3}$	CL=90%	238
$\phi \pi^+ \pi^-$		$(1.06 \pm 0.28) \times 10^{-3}$		614
$\quad \phi \rho^0$		$(5.7 \pm 3.0) \times 10^{-4}$		250
$\quad \phi \pi^+ \pi^-$ 3-body		$(7 \pm 5) \times 10^{-4}$		614
$K^*(892)^0 K^- \pi^+ +$ c.c.	[aaa]	$< 7 \times 10^{-4}$	CL=90%	531
$\quad K^*(892)^0 \overline{K}^*(892)^0$		$(1.4 \pm 0.5) \times 10^{-3}$		272

Radiative modes

$\rho^0\gamma$		$<\ 2.4$	$\times 10^{-4}$	CL=90%	771
$\omega\gamma$		$<\ 2.4$	$\times 10^{-4}$	CL=90%	768
$\phi\gamma$		$(\ 2.5\ ^{+\ 0.7}_{-\ 0.6}\ )$	$\times 10^{-5}$		654
$\overline{K}^*(892)^0\gamma$		$<\ 7.6$	$\times 10^{-4}$	CL=90%	719

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*	$(\ 1.38\pm\ 0.11)$	$\times 10^{-4}$		861
$K^+\pi^-$ (via $\overline{D}^0$)	*C2M*	$<\ 1.6$	$\times 10^{-5}$	CL=95%	861
$K^*(892)^+\pi^-$		$(\ 3.0\ ^{+\ 3.8}_{-\ 1.3}\ )$	$\times 10^{-4}$		711
$K^+\pi^-\pi^0$		$(\ 5.6\ \pm\ 1.7\ )$	$\times 10^{-4}$		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%	–
$\gamma\gamma$	*C1*	$<\ 2.8$	$\times 10^{-5}$	CL=90%	932
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%	771
$\pi^+\pi^-\mu^+\mu^-$	*C1*	$<\ 3.0$	$\times 10^{-5}$	CL=90%	894
$\rho^0\mu^+\mu^-$	*C1*	$<\ 2.2$	$\times 10^{-5}$	CL=90%	754
ωe^+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%	791
ϕe^+e^-	*C1*	$<\ 5.2$	$\times 10^{-5}$	CL=90%	654
$K^-K^+\mu^+\mu^-$	*C1*	$<\ 3.3$	$\times 10^{-5}$	CL=90%	710
$\phi\mu^+\mu^-$	*C1*	$<\ 3.1$	$\times 10^{-5}$	CL=90%	631
$\overline{K}^0 e^+e^-$	[ww]	$<\ 1.1$	$\times 10^{-4}$	CL=90%	866
$\overline{K}^0\mu^+\mu^-$	[ww]	$<\ 2.6$	$\times 10^{-4}$	CL=90%	852
$K^-\pi^+e^+e^-$	*C1*	$<\ 3.85$	$\times 10^{-4}$	CL=90%	861
$\overline{K}^*(892)^0 e^+e^-$	[ww]	$<\ 4.7$	$\times 10^{-5}$	CL=90%	719
$K^-\pi^+\mu^+\mu^-$	*C1*	$<\ 3.59$	$\times 10^{-4}$	CL=90%	829

$\overline{K}^*(892)^0 \mu^+ \mu^-$		[ww]	<	2.4	$\times 10^{-5}$	CL=90%	700
$\pi^+ \pi^- \pi^0 \mu^+ \mu^-$	C1		<	8.1	$\times 10^{-4}$	CL=90%	863
$\mu^\pm e^\mp$	LF	[gg]	<	8.1	$\times 10^{-6}$	CL=90%	929
$\pi^0 e^\pm \mu^\mp$	LF	[gg]	<	8.6	$\times 10^{-5}$	CL=90%	924
$\eta e^\pm \mu^\mp$	LF	[gg]	<	1.0	$\times 10^{-4}$	CL=90%	848
$\pi^+ \pi^- e^\pm \mu^\mp$	LF	[gg]	<	1.5	$\times 10^{-5}$	CL=90%	911
$\rho^0 e^\pm \mu^\mp$	LF	[gg]	<	4.9	$\times 10^{-5}$	CL=90%	767
$\omega e^\pm \mu^\mp$	LF	[gg]	<	1.2	$\times 10^{-4}$	CL=90%	764
$K^- K^+ e^\pm \mu^\mp$	LF	[gg]	<	1.8	$\times 10^{-4}$	CL=90%	754
$\phi e^\pm \mu^\mp$	LF	[gg]	<	3.4	$\times 10^{-5}$	CL=90%	648
$\overline{K}^0 e^\pm \mu^\mp$	LF	[gg]	<	1.0	$\times 10^{-4}$	CL=90%	862
$K^- \pi^+ e^\pm \mu^\mp$	LF	[gg]	<	5.53	$\times 10^{-4}$	CL=90%	848
$\overline{K}^*(892)^0 e^\pm \mu^\mp$	LF	[gg]	<	8.3	$\times 10^{-5}$	CL=90%	714
$\pi^- \pi^- e^+ e^+ +$ 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%	791
$K^- K^- \mu^+ \mu^+ +$ c.c.	L		<	9.4	$\times 10^{-5}$	CL=90%	710
$\pi^- \pi^- e^+ \mu^+ +$ 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
$D^+ \gamma$	$(\ 1.6 \pm 0.4)$ %	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.

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	504
$D^*(2010)^+ \pi^-$	seen	387

$D_2^*(2460)^{\pm}$

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

$J^P = 2^+$ assignment strongly favored.

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	507
$D^{*0}\pi^+$	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 $m = 1968.3 \pm 0.5$ MeV (S = 1.2)
$m_{D_s^{\pm}} - m_{D^{\pm}} = 98.87 \pm 0.31$ MeV (S = 1.4)
Mean life $\tau = (490 \pm 9) \times 10^{-15}$ s (S = 1.1)
$c\tau = 147.0$ μm

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				
$\mu^+ \nu_\mu$		$(5.0 \pm 1.9) \times 10^{-3}$	S=1.3	981
$\tau^+ \nu_\tau$		(6.4 ± 1.5) %		182
$\phi \ell^+ \nu_\ell$	[*bbb*]	(2.0 ± 0.5) %		720
$\eta \ell^+ \nu_\ell + \eta'(958) \ell^+ \nu_\ell$	[*bbb*]	(3.4 ± 1.0) %		–
$\eta \ell^+ \nu_\ell$	[*bbb*]	(2.5 ± 0.7) %		908
$\eta'(958) \ell^+ \nu_\ell$	[*bbb*]	$(8.9 \pm 3.3) \times 10^{-3}$		751
Hadronic modes with a $K\overline{K}$ pair (including from a ϕ)				
$K^+ \overline{K}^0$		(3.6 ± 1.1) %		850
$K^+ K^- \pi^+$	[*ss*]	(4.4 ± 1.2) %		805
$\phi \pi^+$	[*ccc*]	(3.6 ± 0.9) %		712
$K^+ \overline{K}^*(892)^0$	[*ccc*]	(3.3 ± 0.9) %		685
$f_0(980) \pi^+ \times B(f_0 \to K^+ K^-)$	[*ddd*]	$(4.9 \pm 2.3) \times 10^{-3}$		732
$K^+ \overline{K}^*_0(1430)^0$	[*ccc*]	$(7 \pm 4) \times 10^{-3}$		218
$K^+ K^- \pi^+$ nonresonant		$(9 \pm 4) \times 10^{-3}$		805
$K^0 \overline{K}^0 \pi^+$		—		802
$K^*(892)^+ \overline{K}^0$	[*ccc*]	(4.3 ± 1.4) %		683
$K^+ K^- \pi^+ \pi^0$		—		748
$\phi \pi^+ \pi^0$	[*ccc*]	(9 ± 5) %		686
$\phi \rho^+$	[*ccc*]	(6.7 ± 2.3) %		400
$\phi \pi^+ \pi^0$ 3-body	[*ccc*]	< 2.6 %	CL=90%	686
$K^+ K^- \pi^+ \pi^0$ non-ϕ		< 9 %	CL=90%	748
$K^+ \overline{K}^0 \pi^+ \pi^-$		(2.5 ± 0.9) %		744
$K^0 K^- \pi^+ \pi^+$		(4.3 ± 1.5) %		744
$K^*(892)^+ \overline{K}^*(892)^0$	[*ccc*]	(5.8 ± 2.5) %		416
$K^0 K^- \pi^+ \pi^+$ (non-$K^{*+} \overline{K}^{*0}$)		< 2.9 %	CL=90%	744
$K^+ K^- \pi^+ \pi^+ \pi^-$		$(7.1 \pm 2.2) \times 10^{-3}$		673
$\phi \pi^+ \pi^+ \pi^-$	[*ccc*]	$(9.7 \pm 2.6) \times 10^{-3}$		640
$K^+ K^- \rho^0 \pi^+$ non-ϕ		$< 2.1 \times 10^{-4}$	CL=90%	248
$\phi \rho^0 \pi^+$	[*ccc*]	(1.06 ± 0.35) %		180
$\phi a_1(1260)^+$	[*ccc*]	(2.5 ± 0.8) %		†
$K^+ K^- \pi^+ \pi^+ \pi^-$ nonresonant		$(7 \pm 6) \times 10^{-4}$		673
Hadronic modes without K's				
$\pi^+ \pi^+ \pi^-$		(1.01 ± 0.28) %	S=1.1	959
$\rho^0 \pi^+$		$< 7 \times 10^{-4}$	CL=90%	824
$f_0(980) \pi^+ \times B(f_0 \to \pi^+ \pi^-)$	[*uu*]	$(5.7 \pm 1.7) \times 10^{-3}$		732
$f_2(1270) \pi^+$	[*ccc*]	$(3.5 \pm 1.2) \times 10^{-3}$		559
$f_0(1370) \pi^+ \times B(f_0 \to \pi^+ \pi^-)$	[*uu*]	$(3.3 \pm 1.2) \times 10^{-3}$		493
$\rho(1450)^0 \pi^+ \times B(\rho^0 \to \pi^+ \pi^-)$	[*uu*]	$(4.4 \pm 2.5) \times 10^{-4}$		421

$\pi^+\pi^+\pi^-$ nonresonant			$(5\ {}^{+22}_{-\ 5})\times10^{-5}$		959
$\pi^+\pi^+\pi^-\pi^0$			<12 %	CL=90%	935
$\eta\pi^+$		[ccc]	(1.7 ± 0.5) %		902
$\omega\pi^+$		[ccc]	$(2.8\pm1.1)\times10^{-3}$		822
$3\pi^+2\pi^-$			$(6.5\pm1.8)\times10^{-3}$		899
$\pi^+\pi^+\pi^-\pi^0\pi^0$			—		902
$\eta\rho^+$		[ccc]	(10.8 ± 3.1) %		723
$\eta\pi^+\pi^0$ 3-body		[ccc]	<4 %	CL=90%	885
$3\pi^+2\pi^-\pi^0$			(4.9 ± 3.2) %		856
$\eta'(958)\pi^+$		[ccc]	(3.9 ± 1.0) %		743
$3\pi^+2\pi^-2\pi^0$			—		803
$\eta'(958)\rho^+$		[ccc]	(10.1 ± 2.8) %		464
$\eta'(958)\pi^+\pi^0$ 3-body		[ccc]	<1.4 %	CL=90%	720

Modes with one or three K's

$K^0\pi^+$			$<8\times10^{-3}$	CL=90%	916
$K^+\pi^+\pi^-$			(1.0 ± 0.4) %		900
$K^+\rho^0$			$<2.9\times10^{-3}$	CL=90%	744
$K^*(892)^0\pi^+$		[ccc]	$(6.5\pm2.8)\times10^{-3}$		775
$K^+K^+K^-$			$(4.0\pm1.7)\times10^{-4}$		627
ϕK^+		[ccc]	$<5\times10^{-4}$	CL=90%	607

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

$\pi^+e^+e^-$		[ww]	$<2.7\times10^{-4}$	CL=90%	979
$\pi^+\mu^+\mu^-$		[ww]	$<2.6\times10^{-5}$	CL=90%	968
$K^+e^+e^-$	C1		$<1.6\times10^{-3}$	CL=90%	922
$K^+\mu^+\mu^-$	C1		$<3.6\times10^{-5}$	CL=90%	909
$K^*(892)^+\mu^+\mu^-$	C1		$<1.4\times10^{-3}$	CL=90%	765
$\pi^+e^\pm\mu^\mp$	LF	[gg]	$<6.1\times10^{-4}$	CL=90%	976
$K^+e^\pm\mu^\mp$	LF	[gg]	$<6.3\times10^{-4}$	CL=90%	919
$\pi^-e^+e^+$	L		$<6.9\times10^{-4}$	CL=90%	979
$\pi^-\mu^+\mu^+$	L		$<2.9\times10^{-5}$	CL=90%	968
$\pi^-e^+\mu^+$	L		$<7.3\times10^{-4}$	CL=90%	976
$K^-e^+e^+$	L		$<6.3\times10^{-4}$	CL=90%	922
$K^-\mu^+\mu^+$	L		$<1.3\times10^{-5}$	CL=90%	909
$K^-e^+\mu^+$	L		$<6.8\times10^{-4}$	CL=90%	919
$K^*(892)^-\mu^+\mu^+$	L		$<1.4\times10^{-3}$	CL=90%	765

$D_s^{*\pm}$

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

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

Mass $m = 2112.1 \pm 0.7$ 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

$D_{sJ}^*(2317)^\pm$

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

J^P is natural, low mass consistent with 0^+.

Mass $m = 2317.4 \pm 0.9$ MeV (S = 1.1)

$m_{D_{sJ}^*(2317)^\pm} - m_{D_s^\pm} = 349.2 \pm 0.7$ MeV

Full width $\Gamma < 4.6$ MeV, CL = 90%

$D_{sJ}(2460)^\pm$

$I(J^P) = 0(1^+)$

Mass $m = 2459.3 \pm 1.3$ MeV (S = 1.3)

$m_{D_{sJ}^*(2460)^\pm} - m_{D_s^{*\pm}} = 347.2 \pm 1.2$ MeV (S = 1.3)

$m_{D_{sJ}^*(2460)^\pm} - m_{D_s^\pm} = 491.0 \pm 1.2$ MeV (S = 1.3)

Full width $\Gamma < 5.5$ MeV, CL = 90%

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

$I(J^P) = 0(1^+)$
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	168

$D^+ K^0$	not seen	382
$D^0 K^+$	not seen	392
$D_s^{*+} \gamma$	possibly seen	388

$D_{s2}(2573)^{\pm}$

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

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

$D_{s2}(2573)^-$ modes are charge conjugates of the modes below.

$D_{s2}(2573)^+$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D^0 K^+$	seen	435
$D^*(2007)^0 K^+$	not seen	244

BOTTOM MESONS ($B = \pm 1$)

$B^+ = u\overline{b}$, $B^0 = d\overline{b}$, $\overline{B}^0 = \overline{d}\,b$, $B^- = \overline{u}\,b$, 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

$B^{\pm}$

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

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

Mass $m_{B^{\pm}} = 5279.0 \pm 0.5$ MeV
Mean life $\tau_{B^{\pm}} = (1.671 \pm 0.018) \times 10^{-12}$ s
$c\tau = 501$ μm

CP violation

$A_{CP}(B^+ \to J/\psi(1S)K^+) = -0.007 \pm 0.019$
$A_{CP}(B^+ \to J/\psi(1S)\pi^+) = -0.01 \pm 0.13$
$A_{CP}(B^+ \to \psi(2S)K^+) = -0.037 \pm 0.025$
$A_{CP}(B^+ \to \overline{D}^0 K^+) = 0.04 \pm 0.07$
$A_{CP}(B^+ \to D_{CP(+1)} K^+) = 0.06 \pm 0.19$
$A_{CP}(B^+ \to D_{CP(-1)} K^+) = -0.19 \pm 0.18$
$A_{CP}(B^+ \to \pi^+ \pi^0) = 0.05 \pm 0.15$
$A_{CP}(B^+ \to K^+ \pi^0) = -0.10 \pm 0.08$
$A_{CP}(B^+ \to K^0_S \pi^+) = 0.03 \pm 0.08$ (S = 1.1)
$A_{CP}(B^+ \to \pi^+ \pi^- \pi^+) = -0.39 \pm 0.35$
$A_{CP}(B^+ \to \rho^+ \rho^0) = -0.09 \pm 0.16$
$A_{CP}(B^+ \to K^+ \pi^- \pi^+) = 0.01 \pm 0.08$
$A_{CP}(B^+ \to K^+ K^- K^+) = 0.02 \pm 0.08$
$A_{CP}(B^+ \to K^+ \eta') = 0.009 \pm 0.035$
$A_{CP}(B^+ \to \omega \pi^+) = -0.21 \pm 0.19$
$A_{CP}(B^+ \to \omega K^+) = -0.21 \pm 0.28$
$A_{CP}(B^+ \to \phi K^+) = 0.03 \pm 0.07$
$A_{CP}(B^+ \to \phi K^*(892)^+) = 0.09 \pm 0.15$
$A_{CP}(B^+ \to \rho^0 K^*(892)^+) = 0.20 \pm 0.31$

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.

For inclusive branching fractions, *e.g.*, $B \to D^\pm$ anything, the values usually are multiplicities, not branching fractions. They can be greater than one.

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

Semileptonic and leptonic modes

$\ell^+ \nu_\ell$ anything	[rr]	(10.2 ± 0.9) %		–
$\overline{D}^0 \ell^+ \nu_\ell$	[rr]	(2.15 ± 0.22) %		2310
$\overline{D}^*(2007)^0 \ell^+ \nu_\ell$	[rr]	(6.5 ± 0.5) %		2258
$\overline{D}_1(2420)^0 \ell^+ \nu_\ell$		$(5.6 \pm 1.6) \times 10^{-3}$		2084
$\overline{D}_2^*(2460)^0 \ell^+ \nu_\ell$		$< 8 \times 10^{-3}$	CL=90%	2067
$\pi^0 e^+ \nu_e$		$(9.0 \pm 2.8) \times 10^{-5}$		2638
$\eta \ell^+ \nu_\ell$		$(8 \pm 4) \times 10^{-5}$		2611
$\omega \ell^+ \nu_\ell$	[rr]	$< 2.1 \times 10^{-4}$	CL=90%	2582
$\rho^0 \ell^+ \nu_\ell$	[rr]	$(1.34^{+0.32}_{-0.35}) \times 10^{-4}$		2583
$p \overline{p} e^+ \nu_e$		$< 5.2 \times 10^{-3}$	CL=90%	2467
$e^+ \nu_e$		$< 1.5 \times 10^{-5}$	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%	2640
$\mu^+ \nu_\mu \gamma$		$< 5.2 \times 10^{-5}$	CL=90%	2638

D, D^*, or D_s modes

$\overline{D}^0 \pi^+$	$(4.98 \pm 0.29) \times 10^{-3}$		2308
$\overline{D}^0 \rho^+$	(1.34 ± 0.18) %		2236
$\overline{D}^0 K^+$	$(3.7 \pm 0.6) \times 10^{-4}$	S=1.1	2280
$\overline{D}^0 K^*(892)^+$	$(6.1 \pm 2.3) \times 10^{-4}$		2213
$\overline{D}^0 K^+ \overline{K}^0$	$(5.5 \pm 1.6) \times 10^{-4}$		2189
$\overline{D}^0 K^+ \overline{K}^*(892)^0$	$(7.5 \pm 1.7) \times 10^{-4}$		2071
$\overline{D}^0 \pi^+ \pi^+ \pi^-$	(1.1 ± 0.4) %		2289
$\overline{D}^0 \pi^+ \pi^+ \pi^-$ nonresonant	$(5 \pm 4) \times 10^{-3}$		2289
$\overline{D}^0 \pi^+ \rho^0$	$(4.2 \pm 3.0) \times 10^{-3}$		2207
$\overline{D}^0 a_1(1260)^+$	$(5 \pm 4) \times 10^{-3}$		2123
$\overline{D}^0 \omega \pi^+$	$(4.1 \pm 0.9) \times 10^{-3}$		2206
$D^*(2010)^- \pi^+ \pi^+$	$(2.1 \pm 0.6) \times 10^{-3}$		2247
$D^- \pi^+ \pi^+$	$< 1.4 \times 10^{-3}$	CL=90%	2299
$\overline{D}^*(2007)^0 \pi^+$	$(4.6 \pm 0.4) \times 10^{-3}$		2256
$\overline{D}^*(2007)^0 \omega \pi^+$	$(4.5 \pm 1.2) \times 10^{-3}$		2149
$\overline{D}^*(2007)^0 \rho^+$	$(9.8 \pm 1.7) \times 10^{-3}$		2181
$\overline{D}^*(2007)^0 K^+$	$(3.6 \pm 1.0) \times 10^{-4}$		2227
$\overline{D}^*(2007)^0 K^*(892)^+$	$(7.2 \pm 3.4) \times 10^{-4}$		2156
$\overline{D}^*(2007)^0 K^+ \overline{K}^0$	$< 1.06 \times 10^{-3}$	CL=90%	2132
$\overline{D}^*(2007)^0 K^+ K^*(892)^0$	$(1.5 \pm 0.4) \times 10^{-3}$		2008
$\overline{D}^*(2007)^0 \pi^+ \pi^+ \pi^-$	$(9.4 \pm 2.6) \times 10^{-3}$		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) %		2219
$D^*(2010)^+ \pi^0$	$< 1.7 \times 10^{-4}$	CL=90%	2255
$\overline{D}^*(2010)^+ K^0$	$< 9.5 \times 10^{-5}$	CL=90%	2225
$D^*(2010)^- \pi^+ \pi^+ \pi^0$	(1.5 ± 0.7) %		2235

$D^*(2010)^- \pi^+ \pi^+ \pi^+ \pi^-$	$<$ 1 %		CL=90%	2217
$\overline{D}{}_1^*(2420)^0 \pi^+$	(1.5 $\pm$0.6) $\times 10^{-3}$		S=1.3	2081
$\overline{D}{}_1^*(2420)^0 \rho^+$	$<$ 1.4 $\times 10^{-3}$		CL=90%	1995
$\overline{D}{}_2^*(2460)^0 \pi^+$	$<$ 1.3 $\times 10^{-3}$		CL=90%	2064
$\overline{D}{}_2^*(2460)^0 \rho^+$	$<$ 4.7 $\times 10^{-3}$		CL=90%	1977
$\overline{D}{}^0 D_s^+$	(1.3 $\pm$0.4) %			1815
$\overline{D}{}^0 D_{sJ}(2317)^+$	seen			1605
$\overline{D}{}^0 D_{sJ}(2457)^+$	seen			–
$\overline{D}{}^0 D_{sJ}(2536)^+$	not seen			1447
$\overline{D}{}^*(2007)^0 D_{sJ}(2536)^+$	not seen			1338
$\overline{D}{}^0 D_{sJ}(2573)^+$	not seen			1417
$\overline{D}{}^*(2007)^0 D_{sJ}(2573)^+$	not seen			1306
$\overline{D}{}^0 D_s^{*+}$	(9 $\pm$4) $\times 10^{-3}$			1734
$\overline{D}{}^*(2007)^0 D_s^+$	(1.2 $\pm$0.5) %			1737
$\overline{D}{}^*(2007)^0 D_s^{*+}$	(2.7 $\pm$1.0) %			1651
$D_s^{(*)+} \overline{D}{}^{**0}$	(2.7 $\pm$1.2) %			–
$\overline{D}{}^*(2007)^0 D^*(2010)^+$	$<$ 1.1 %		CL=90%	1713
$\overline{D}{}^0 D^*(2010)^+ + \overline{D}{}^*(2007)^0 D^+$	$<$ 1.3 %		CL=90%	1792
$\overline{D}{}^0 D^+$	$<$ 6.7 $\times 10^{-3}$		CL=90%	1866
$\overline{D}{}^0 D^+ K^0$	$<$ 2.8 $\times 10^{-3}$		CL=90%	1571
$\overline{D}{}^*(2007)^0 D^+ K^0$	$<$ 6.1 $\times 10^{-3}$		CL=90%	1475
$\overline{D}{}^0 \overline{D}{}^*(2010)^+ K^0$	(5.2 $\pm$1.2) $\times 10^{-3}$			1476
$\overline{D}{}^*(2007)^0 D^*(2010)^+ K^0$	(7.8 $\pm$2.6) $\times 10^{-3}$			1362
$\overline{D}{}^0 D^0 K^+$	(1.9 $\pm$0.4) $\times 10^{-3}$			1577
$\overline{D}{}^*(2010)^0 D^0 K^+$	$<$ 3.8 $\times 10^{-3}$		CL=90%	–
$\overline{D}{}^0 D^*(2007)^0 K^+$	(4.7 $\pm$1.0) $\times 10^{-3}$			1481
$\overline{D}{}^*(2007)^0 D^*(2007)^0 K^+$	(5.3 $\pm$1.6) $\times 10^{-3}$			1368
$D^- D^+ K^+$	$<$ 4 $\times 10^{-4}$		CL=90%	1571
$D^- D^*(2010)^+ K^+$	$<$ 7 $\times 10^{-4}$		CL=90%	1475
$D^*(2010)^- D^+ K^+$	(1.5 $\pm$0.4) $\times 10^{-3}$			1475
$D^*(2010)^- D^*(2010)^+ K^+$	$<$ 1.8 $\times 10^{-3}$		CL=90%	1363
$(\overline{D}+\overline{D}{}^*)(D+D^*)K$	(3.5 $\pm$0.6) %			–
$D_s^+ \pi^0$	$<$ 2.0 $\times 10^{-4}$		CL=90%	2270
$D_s^{*+} \pi^0$	$<$ 3.3 $\times 10^{-4}$		CL=90%	2215
$D_s^+ \eta$	$<$ 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%	2172
$D_s^{*+} \overline{K}^*(892)^0$	$<$ 4	$\times 10^{-4}$	CL=90%	2112
$D_s^- \pi^+ K^+$	$<$ 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%	2138
$D_s^{*-} \pi^+ K^*(892)^+$	$<$ 8	$\times 10^{-3}$	CL=90%	2076

Charmonium modes

$\eta_c K^+$	(9.0 ± 2.7)	$\times 10^{-4}$		1754
$J/\psi(1S) K^+$	(1.00 ± 0.04)	$\times 10^{-3}$		1683
$J/\psi(1S) K^+ \pi^+ \pi^-$	(7.7 ± 2.0)	$\times 10^{-4}$		1612
$X(3872) K^+$	seen			–
$J/\psi(1S) K^*(892)^+$	(1.35 ± 0.10)	$\times 10^{-3}$		1571
$J/\psi(1S) K(1270)^+$	(1.8 ± 0.5)	$\times 10^{-3}$		1390
$J/\psi(1S) K(1400)^+$	$<$ 5	$\times 10^{-4}$	CL=90%	1308
$J/\psi(1S) \phi K^+$	(5.2 ± 1.7)	$\times 10^{-5}$	S=1.2	1227
$J/\psi(1S) \pi^+$	(4.0 ± 0.5)	$\times 10^{-5}$		1727
$J/\psi(1S) \rho^+$	$<$ 7.7	$\times 10^{-4}$	CL=90%	1611
$J/\psi(1S) a_1(1260)^+$	$<$ 1.2	$\times 10^{-3}$	CL=90%	1414
$J/\psi(1S) p \overline{\Lambda}$	$(1.2 {}^{+0.9}_{-0.6})$	$\times 10^{-5}$		567
$\psi(2S) K^+$	(6.8 ± 0.4)	$\times 10^{-4}$		1284
$\psi(2S) K^*(892)^+$	(9.2 ± 2.2)	$\times 10^{-4}$		1115
$\psi(2S) K^+ \pi^+ \pi^-$	(1.9 ± 1.2)	$\times 10^{-3}$		1178
$\chi_{c0}(1P) K^+$	$(6.0 {}^{+2.4}_{-2.1})$	$\times 10^{-4}$		1478
$\chi_{c1}(1P) K^+$	(6.8 ± 1.2)	$\times 10^{-4}$		1411
$\chi_{c1}(1P) K^*(892)^+$	$<$ 2.1	$\times 10^{-3}$	CL=90%	1265

K or *K** modes

$K^0 \pi^+$	(1.88 ± 0.21)	$\times 10^{-5}$		2614
$K^+ \pi^0$	(1.29 ± 0.12)	$\times 10^{-5}$		2615
$\eta' K^+$	(7.8 ± 0.5)	$\times 10^{-5}$		2528
$\eta' K^*(892)^+$	$<$ 3.5	$\times 10^{-5}$	CL=90%	2472
ηK^+	$<$ 6.9	$\times 10^{-6}$	CL=90%	2588
$\eta K^*(892)^+$	$(2.6 {}^{+1.0}_{-0.9})$	$\times 10^{-5}$		2534
ωK^+	$(9.2 {}^{+2.8}_{-2.5})$	$\times 10^{-6}$		2557
$\omega K^*(892)^+$	$<$ 8.7	$\times 10^{-5}$	CL=90%	2503

$K^*(892)^0\pi^+$	$(1.9\ ^{+0.6}_{-0.8}$	$) \times 10^{-5}$		2562
$K^*(892)^+\pi^0$	<3.1	$\times 10^{-5}$	CL=90%	2562
$K^+\pi^-\pi^+$	$(5.7\ \pm 0.4$	$) \times 10^{-5}$		2609
$K^+\pi^-\pi^+$ nonresonant	<2.8	$\times 10^{-5}$	CL=90%	2609
$K^+\rho^0$	<1.2	$\times 10^{-5}$	CL=90%	2558
$K_2^*(1430)^0\pi^+$	<6.8	$\times 10^{-4}$	CL=90%	2445
$K^-\pi^+\pi^+$	<1.8	$\times 10^{-6}$	CL=90%	2609
$K^-\pi^+\pi^+$ nonresonant	<5.6	$\times 10^{-5}$	CL=90%	2609
$K_1(1400)^0\pi^+$	<2.6	$\times 10^{-3}$	CL=90%	2451
$K^0\pi^+\pi^0$	<6.6	$\times 10^{-5}$	CL=90%	2609
$K^0\rho^+$	<4.8	$\times 10^{-5}$	CL=90%	2558
$K^*(892)^+\pi^+\pi^-$	<1.1	$\times 10^{-3}$	CL=90%	2556
$K^*(892)^+\rho^0$	$(1.1\ \pm 0.4$	$) \times 10^{-5}$		2504
$K^*(892)^+K^*(892)^0$	<7.1	$\times 10^{-5}$	CL=90%	2484
$K_1(1400)^+\rho^0$	<7.8	$\times 10^{-4}$	CL=90%	2387
$K_2^*(1430)^+\rho^0$	<1.5	$\times 10^{-3}$	CL=90%	2381
$K^+\overline{K}^0$	<2.0	$\times 10^{-6}$	CL=90%	2593
$\overline{K}^0K^+\pi^0$	<2.4	$\times 10^{-5}$	CL=90%	2578
$K^+K_S^0K_S^0$	$(1.34\pm 0.24$	$) \times 10^{-5}$		2521
$K_S^0K_S^0\pi^+$	<3.2	$\times 10^{-6}$	CL=90%	2577
$K^+K^-\pi^+$	<6.3	$\times 10^{-6}$	CL=90%	2578
$K^+K^-\pi^+$ nonresonant	<7.5	$\times 10^{-5}$	CL=90%	2578
$K^+K^+\pi^-$	<1.3	$\times 10^{-6}$	CL=90%	2578
$K^+K^+\pi^-$ nonresonant	<8.79	$\times 10^{-5}$	CL=90%	2578
$K^+K^*(892)^0$	<5.3	$\times 10^{-6}$	CL=90%	2540
$K^+K^-K^+$	$(3.08\pm 0.21$	$) \times 10^{-5}$		2522
$K^+\phi$	$(9.3\ \pm 1.0$	$) \times 10^{-6}$	S=1.3	2516
$K^+K^-K^+$ nonresonant	<3.8	$\times 10^{-5}$	CL=90%	2522
$K^*(892)^+K^+K^-$	<1.6	$\times 10^{-3}$	CL=90%	2466
$K^*(892)^+\phi$	$(9.6\ \pm 3.0$	$) \times 10^{-6}$	S=1.9	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
$K^+\phi\phi$	$(2.6\ ^{+1.1}_{-0.9}$	$) \times 10^{-6}$		2306
$K^*(892)^+\gamma$	$(3.8\ \pm 0.5$	$) \times 10^{-5}$		2564
$K_1(1270)^+\gamma$	<9.9	$\times 10^{-5}$	CL=90%	2486
$\phi K^+\gamma$	$(3.4\ \pm 1.0$	$) \times 10^{-6}$		2516
$K^+\pi^-\pi^+\gamma$	$(2.4\ ^{+0.6}_{-0.5}$	$) \times 10^{-5}$		2609
$K^*(892)^0\pi^+\gamma$	$(2.0\ ^{+0.7}_{-0.6}$	$) \times 10^{-5}$		2562
$K^+\rho^0\gamma$	<2.0	$\times 10^{-5}$	CL=90%	2558
$K^+\pi^-\pi^+\gamma$ nonresonant	<9.2	$\times 10^{-6}$	CL=90%	2609
$K_1(1400)^+\gamma$	<5.0	$\times 10^{-5}$	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

$\rho^+\gamma$	<2.1	$\times 10^{-6}$	CL=90%	2583
$\pi^+\pi^0$	$(5.6\ ^{+0.9}_{-1.1})$	$\times 10^{-6}$		2636
$\pi^+\pi^+\pi^-$	$(1.1\ \pm 0.4)$	$\times 10^{-5}$		2630
$\rho^0\pi^+$	$(8.6\ \pm 2.0)$	$\times 10^{-6}$		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%	2630
$\pi^+\pi^0\pi^0$	<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
$\rho^+\rho^0$	$(2.6\ \pm 0.6)$	$\times 10^{-5}$		2523
$a_1(1260)^+\pi^0$	<1.7	$\times 10^{-3}$	CL=90%	2494
$a_1(1260)^0\pi^+$	<9.0	$\times 10^{-4}$	CL=90%	2494
$\omega\pi^+$	$(6.4\ ^{+1.8}_{-1.6})$	$\times 10^{-6}$	S=1.3	2580
$\omega\rho^+$	<6.1	$\times 10^{-5}$	CL=90%	2522
$\eta\pi^+$	<5.7	$\times 10^{-6}$	CL=90%	2609
$\eta'\pi^+$	<7.0	$\times 10^{-6}$	CL=90%	2551
$\eta'\rho^+$	<3.3	$\times 10^{-5}$	CL=90%	2492
$\eta\rho^+$	<1.5	$\times 10^{-5}$	CL=90%	2553
$\phi\pi^+$	<4.1	$\times 10^{-7}$	CL=90%	2539
$\phi\rho^+$	<1.6	$\times 10^{-5}$		2480
$\pi^+\pi^+\pi^+\pi^-\pi^-$	<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%	2410
$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^0$	<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 $\pi^\pm$

$h^+\pi^0$	$(1.6\ ^{+0.7}_{-0.6})$	$\times 10^{-5}$		2636
ωh^+	$(1.38\ ^{+0.27}_{-0.24})$	$\times 10^{-5}$		2580
$h^+ X^0$(Familon)	<4.9	$\times 10^{-5}$	CL=90%	–

Baryon modes

$p\overline{p}\pi^+$		$<$	3.7	$\times 10^{-6}$	CL=90%	2439
$p\overline{p}\pi^+$ nonresonant		$<$	5.3	$\times 10^{-5}$	CL=90%	2439
$p\overline{p}\pi^+\pi^+\pi^-$		$<$	5.2	$\times 10^{-4}$	CL=90%	2369
$p\overline{p}K^+$			$(4.3\ {}^{+1.2}_{-1.0}) \times 10^{-6}$			2348
$p\overline{p}K^+$ nonresonant		$<$	8.9	$\times 10^{-5}$	CL=90%	2348
$p\overline{\Lambda}$		$<$	1.5	$\times 10^{-6}$	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
$D^+ p\overline{p}$		$<$	1.5	$\times 10^{-5}$	CL=90%	1860
$D^*(2010)^+ p\overline{p}$		$<$	1.5	$\times 10^{-5}$	CL=90%	1786
$\overline{\Lambda}_c^- p\pi^+$			$(2.1 \pm 0.7) \times 10^{-4}$			1981
$\overline{\Lambda}_c^- p\pi^+\pi^0$			$(1.8 \pm 0.6) \times 10^{-3}$			1936
$\overline{\Lambda}_c^- p\pi^+\pi^+\pi^-$			$(2.3 \pm 0.7) \times 10^{-3}$			1881
$\overline{\Lambda}_c^- p\pi^+\pi^+\pi^-\pi^0$		$<$	1.34	%	CL=90%	1823
$\overline{\Sigma}_c(2455)^0 p$		$<$	8	$\times 10^{-5}$	CL=90%	1939
$\overline{\Sigma}_c(2520)^0 p$		$<$	4.6	$\times 10^{-5}$	CL=90%	1905
$\overline{\Sigma}_c(2455)^0 p\pi^0$			$(4.4 \pm 1.8) \times 10^{-4}$			1897
$\overline{\Sigma}_c(2455)^0 p\pi^-\pi^+$			$(4.4 \pm 1.7) \times 10^{-4}$			1845
$\overline{\Sigma}_c(2455)^{--} p\pi^+\pi^+$			$(2.8 \pm 1.2) \times 10^{-4}$			1845
$\overline{\Lambda}_c(2593)^- / \overline{\Lambda}_c(2625)^- p\pi^+$		$<$	1.9	$\times 10^{-4}$	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*			$(6.3\ {}^{+1.9}_{-1.7}) \times 10^{-7}$			2616
$K^+ \mu^+ \mu^-$	*B1*			$(4.5\ {}^{+1.4}_{-1.2}) \times 10^{-7}$			2612
$K^+ \ell^+ \ell^-$	*B1*	[rr]		$(5.3 \pm 1.1) \times 10^{-7}$			2616
$K^+ \overline{\nu}\nu$	*B1*		$<$	2.4	$\times 10^{-4}$	CL=90%	2616
$K^*(892)^+ e^+ e^-$	*B1*		$<$	4.6	$\times 10^{-6}$	CL=90%	2564
$K^*(892)^+ \mu^+ \mu^-$	*B1*		$<$	2.2	$\times 10^{-6}$	CL=90%	2560
$K^*(892)^+ \ell^+ \ell$	*B1*	[rr]	$<$	2.2	$\times 10^{-6}$	CL=90%	2564
$\pi^+ e^+ \mu^-$	*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*		$<$	8	$\times 10^{-7}$	CL=90%	2615
$K^+ e^- \mu^+$	*LF*		$<$	6.4	$\times 10^{-3}$	CL=90%	2615
$K^*(892)^+ e^\pm \mu^\mp$	*LF*		$<$	7.9	$\times 10^{-6}$	CL=90%	2563
$\pi^- e^+ e^+$	*L*		$<$	1.6	$\times 10^{-6}$	CL=90%	2638
$\pi^- \mu^+ \mu^+$	*L*		$<$	1.4	$\times 10^{-6}$	CL=90%	2633

$\pi^- e^+ \mu^+$	L	$<$ 1.3	$\times 10^{-6}$	CL=90%	2637
$\rho^- e^+ e^+$	L	$<$ 2.6	$\times 10^{-6}$	CL=90%	2583
$\rho^- \mu^+ \mu^+$	L	$<$ 5.0	$\times 10^{-6}$	CL=90%	2578
$\rho^- e^+ \mu^+$	LF	$<$ 3.3	$\times 10^{-6}$	CL=90%	2581
$K^- e^+ e^+$	L	$<$ 1.0	$\times 10^{-6}$	CL=90%	2616
$K^- \mu^+ \mu^+$	L	$<$ 1.8	$\times 10^{-6}$	CL=90%	2612
$K^- e^+ \mu^+$	L	$<$ 2.0	$\times 10^{-6}$	CL=90%	2615
$K^*(892)^- e^+ e^+$	L	$<$ 2.8	$\times 10^{-6}$	CL=90%	2564
$K^*(892)^- \mu^+ \mu^+$	L	$<$ 8.3	$\times 10^{-6}$	CL=90%	2560
$K^*(892)^- e^+ \mu^+$	LF	$<$ 4.4	$\times 10^{-6}$	CL=90%	2563

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 $\tau_{B^0} = (1.536 \pm 0.014) \times 10^{-12}$ s

$c\tau = 460$ μm

$\tau_{B^+}/\tau_{B^0} = 1.086 \pm 0.017$ (direct measurements)

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

$\chi_d = 0.186 \pm 0.004$

$\Delta m_{B^0} = m_{B^0_H} - m_{B^0_L} = (0.502 \pm 0.007) \times 10^{12}\ \hbar\ \mathrm{s}^{-1}$

$= (3.304 \pm 0.046) \times 10^{-10}$ MeV

$x_d = \Delta m_{B^0}/\Gamma_{B^0} = 0.771 \pm 0.012$

CP violation parameters

$\mathrm{Re}(\epsilon_{B^0})/(1+|\epsilon_{B^0}|^2) = (0.5 \pm 3.1) \times 10^{-3}$
$A_{T/CP} = 0.005 \pm 0.018$
$A_{CP}\ (B^0 \to K^+ \pi^-) = -0.09 \pm 0.04$
$A_{CP}(B^0 \to \rho^+ \pi^-) = -0.18 \pm 0.09$
$A_{CP}(B^0 \to \rho^+ K^-) = 0.28 \pm 0.19$
$A_{CP}(B^0 \to K^*(892)^+ \pi^-) = 0.26 \pm 0.35$
$A_{CP}(B^0 \to K^*(892)^0 \phi) = 0.05 \pm 0.10$
$A_{CP}(B^0 \to D^*(2010)^+ D^-) = -0.03 \pm 0.12$
$C_{\pi\pi}\ (B^0 \to \pi^+ \pi^-) = -0.51 \pm 0.23 \quad (S = 1.2)$
$S_{\pi\pi}\ (B^0 \to \pi^+ \pi^-) = -0.5 \pm 0.6 \quad (S = 2.3)$
$C_{\rho\pi}\ (B^0 \to \rho^+ \pi^-) = 0.36 \pm 0.18$
$S_{\rho\pi}\ (B^0 \to \rho^+ \pi^-) = 0.19 \pm 0.24$
$C_{\eta'(958)K}\ (B^0 \to \eta'(958) K^0_S) = 0.04 \pm 0.13$
$S_{\eta'(958)K}\ (B^0 \to \eta'(958) K^0_S) = 0.27 \pm 0.21$
$C_{\phi K^0_S}\ (B^0 \to \phi K^0_S) = 0.15 \pm 0.30$
$S_{\phi K^0_S}\ (B^0 \to \phi K^0_S) = -1.0 \pm 0.5$
$C_{K^+ K^- K^0_S}\ (B^0 \to K^+ K^- K^0_S) = 0.17 \pm 0.16$
$S_{K^+ K^- K^0_S}\ (B^0 \to K^+ K^- K^0_S) = -0.51 \pm 0.26$
$C_{D^*(2010)^- D^+}\ (B^0 \to D^*(2010)^- D^+) = -0.2 \pm 0.4$
$S_{D^*(2010)^- D^+}\ (B^0 \to D^*(2010)^- D^+) = -0.2 \pm 0.7$
$C_{D^*(2010)^+ D^-}\ (B^0 \to D^*(2010)^+ D^-) = -0.5 \pm 0.4$
$S_{D^*(2010)^+ D^-}\ (B^0 \to D^*(2010)^+ D^-) = -0.8 \pm 0.8$
$C_{J/\psi(1S)\pi^0}\ (B^0 \to J/\psi(1S)\pi^0) = 0.4 \pm 0.4$
$S_{J/\psi(1S)\pi^0}\ (B^0 \to J/\psi(1S)\pi^0) = 0.1 \pm 0.5$
$\Delta C_{\rho\pi}\ (B^0 \to \rho^+ \pi^-) = 0.28 \pm 0.19$
$\Delta S_{\rho\pi}\ (B^0 \to \rho^+ \pi^-) = 0.15 \pm 0.25$
$|\lambda|\ (B^0 \to c\overline{c} K^0) = 0.949 \pm 0.045$
$|\lambda|\ (B^0 \to D^{*+} D^{*-}) = 0.75 \pm 0.19$
$\mathrm{Im}(\lambda)\ (B^0 \to D^{*+} D^{*-}) = 0.05 \pm 0.31$
$\sin(2\beta) = 0.731 \pm 0.056$

$\overline{B}^0$ 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.

For inclusive branching fractions, *e.g.*, $B \to D^{\pm}$ anything, the values usually are multiplicities, not branching fractions. They can be greater than one.

B^0 DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\ell^+ \nu_\ell$ anything	[*rr*]	(10.5 ± 0.8) %		–
$D^- \ell^+ \nu_\ell$	[*rr*]	(2.14 ± 0.20) %		2309
$D^*(2010)^- \ell^+ \nu_\ell$	[*rr*]	(5.44 ± 0.23) %		2257
$\rho^- \ell^+ \nu_\ell$	[*rr*]	$(2.6 \pm 0.7) \times 10^{-4}$		2583
$\pi^- \ell^+ \nu_\ell$	[*rr*]	$(1.33 \pm 0.22) \times 10^{-4}$		2638
Inclusive modes				
K^+ anything		(78 ± 8) %		–
D, D^*, or D_s modes				
$D^- \pi^+$		$(2.76 \pm 0.25) \times 10^{-3}$		2306
$D^- \rho^+$		$(7.7 \pm 1.3) \times 10^{-3}$		2235
$D^- K^*(892)^+$		$(3.7 \pm 1.8) \times 10^{-4}$		2211
$D^- \omega \pi^+$		$(2.8 \pm 0.6) \times 10^{-3}$		2204
$D^- K^+$		$(2.0 \pm 0.6) \times 10^{-4}$		2279
$D^- K^+ \overline{K}^0$		$< 3.1 \times 10^{-4}$	CL=90%	2188
$D^- K^+ \overline{K}^*(892)^0$		$(8.8 \pm 1.9) \times 10^{-4}$		2070
$\overline{D}^0 \pi^+ \pi^-$		$(8.0 \pm 1.6) \times 10^{-4}$		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
$D^- \pi^+ \rho^0$		$(1.1 \pm 1.0) \times 10^{-3}$		2206
$D^- a_1(1260)^+$		$(6.0 \pm 3.3) \times 10^{-3}$		2121
$D^*(2010)^- \pi^+ \pi^0$		(1.5 ± 0.5) %		2247
$D^*(2010)^- \rho^+$		$(6.8 \pm 0.9) \times 10^{-3}$		2180
$D^*(2010)^- K^+$		$(2.0 \pm 0.5) \times 10^{-4}$		2226
$D^*(2010)^- K^*(892)^+$		$(3.8 \pm 1.5) \times 10^{-4}$		2155
$D^*(2010)^- K^+ \overline{K}^0$		$< 4.7 \times 10^{-4}$	CL=90%	2131
$D^*(2010)^- K^+ \overline{K}^*(892)^0$		$(1.29 \pm 0.33) \times 10^{-3}$		2007
$D^*(2010)^- \pi^+ \pi^+ \pi^-$		$(7.6 \pm 1.8) \times 10^{-3}$	S=1.4	2235
$(D^*(2010)^- \pi^+ \pi^+ \pi^-)$ non-resonant		$(0.0 \pm 2.5) \times 10^{-3}$		2235
$D^*(2010)^- \pi^+ \rho^0$		$(5.7 \pm 3.2) \times 10^{-3}$		2150

$D^*(2010)^- a_1(1260)^+$	(1.30 ± 0.27) %		2061
$D^*(2010)^- \pi^+ \pi^+ \pi^- \pi^0$	(1.76 ± 0.27) %		2218
$D^*(2010)^+ \pi^+ \pi^- \pi^- \pi^0$	$(1.8\ \pm0.7\ )$ %		2218
$D^*(2010)^- p \overline{p} \pi^+$	$(6.5\ \pm1.6\ ) \times 10^{-4}$		1707
$D^*(2010)^- p \overline{n}$	$(1.5\ \pm0.4\ ) \times 10^{-3}$		1785
$\overline{D}^*(2010)^- \omega \pi^+$	$(2.9\ \pm0.5\ ) \times 10^{-3}$		2148
$\overline{D}_2^*(2460)^- \pi^+$	$< 2.2 \times 10^{-3}$	CL=90%	2064
$\overline{D}_2^*(2460)^- \rho^+$	$< 4.9 \times 10^{-3}$	CL=90%	1977
$D^- D^+$	$< 9.4 \times 10^{-4}$	CL=90%	1864
$D^- D_s^+$	$(8.0\ \pm3.0\ ) \times 10^{-3}$		1812
$D^*(2010)^- D_s^+$	(1.07 ± 0.29) %		1735
$D^- D_s^{*+}$	$(1.0\ \pm0.5\ )$ %		1732
$D^*(2010)^- D_s^{*+}$	$(1.9\ \pm0.5\ )$ %		1649
$D^- D_{sJ}(2317)^+$	seen		1602
$D^- D_{sJ}(2457)^+$	seen		–
$D^- D_{sJ}(2536)^+$	not seen		1444
$D^*(2010)^- D_{sJ}(2536)^+$	not seen		1336
$D^- D_{sJ}(2573)^+$	not seen		1414
$D^*(2010)^- D_{sJ}(2573)^+$	not seen		1303
$D_s^+ \pi^-$	$(2.7\ \pm1.0\ ) \times 10^{-5}$		2270
$D_s^{*+} \pi^-$	$< 4.1 \times 10^{-5}$	CL=90%	2215
$D_s^+ \rho^-$	$< 7 \times 10^{-4}$	CL=90%	2197
$D_s^{*+} \rho^-$	$< 8 \times 10^{-4}$	CL=90%	2138
$D_s^+ a_1(1260)^-$	$< 2.6 \times 10^{-3}$	CL=90%	2080
$D_s^{*+} a_1(1260)^-$	$< 2.2 \times 10^{-3}$	CL=90%	2015
$D_s^- K^+$	$(3.8\ \pm1.3\ ) \times 10^{-5}$		2242
$D_s^{*-} K^+$	$< 2.5 \times 10^{-5}$	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%	2138
$D_s^{*-} \pi^+ K^*(892)^0$	$< 2.0 \times 10^{-3}$	CL=90%	2076
$\overline{D}^0 K^0$	$(5.0\ \pm1.4\ ) \times 10^{-5}$		2280
$\overline{D}^0 K^*(892)^0$	$(4.8\ \pm1.2\ ) \times 10^{-5}$		2213
$\overline{D}^0 \pi^0$	$(2.91\pm0.28) \times 10^{-4}$		2308
$\overline{D}^0 \rho^0$	$(2.9\ \pm1.1\ ) \times 10^{-4}$		2237
$\overline{D}^0 \eta$	$(2.2\ \pm0.5\ ) \times 10^{-4}$	S=1.6	2274
$\overline{D}^0 \eta'$	$(1.7\ \pm0.4\ ) \times 10^{-4}$		2198
$\overline{D}^0 \omega$	$(2.5\ \pm0.6\ ) \times 10^{-4}$	S=1.5	2235
$D^0 K^*(892)^0$	$< 1.8 \times 10^{-5}$	CL=90%	2213
$\overline{D}^{*0} \gamma$	$< 5.0 \times 10^{-5}$	CL=90%	2258

$\overline{D}^*(2007)^0 \pi^0$	$(2.7 \pm 0.5) \times 10^{-4}$		2256
$\overline{D}^*(2007)^0 \rho^0$	$< 5.1 \times 10^{-4}$	CL=90%	2181
$\overline{D}^*(2007)^0 \eta$	$(2.6 \pm 0.6) \times 10^{-4}$		2220
$\overline{D}^*(2007)^0 \eta'$	$< 2.6 \times 10^{-4}$	CL=90%	2141
$\overline{D}^*(2007)^0 \pi^+ \pi^-$	$(6.2 \pm 2.2) \times 10^{-4}$		2248
$\overline{D}^*(2007)^0 K^0$	$< 6.6 \times 10^{-5}$	CL=90%	2227
$\overline{D}^*(2007)^0 K^*(892)^0$	$< 6.9 \times 10^{-5}$	CL=90%	2157
$D^*(2007)^0 K^*(892)^0$	$< 4.0 \times 10^{-5}$	CL=90%	2157
$D^*(2007)^0 \pi^+ \pi^+ \pi^- \pi^-$	$(3.0 \pm 0.9) \times 10^{-3}$		2219
$D^*(2010)^+ D^*(2010)^-$	$(8.7 \pm 1.8) \times 10^{-4}$		1711
$\overline{D}^*(2007)^0 \omega$	$(4.2 \pm 1.1) \times 10^{-4}$		2180
$D^*(2010)^+ D^-$	$< 6.3 \times 10^{-4}$	CL=90%	1790
$D^*(2010)^- D^+ + D^*(2010)^+ D^-$	$(9.3 \pm 1.5) \times 10^{-4}$		1790
$D^*(2007)^0 \overline{D}^*(2007)^0$	< 2.7 %	CL=90%	1715
$D^- D^0 K^+$	$(1.7 \pm 0.4) \times 10^{-3}$		1574
$D^- D^*(2007)^0 K^+$	$(4.6 \pm 1.0) \times 10^{-3}$		1478
$D^*(2010)^- D^0 K^+$	$(3.1 {}^{+0.6}_{-0.5}) \times 10^{-3}$		1479
$D^*(2010)^- D^*(2007)^0 K^+$	(1.18 ± 0.20) %		1366
$D^- D^+ K^0$	$< 1.7 \times 10^{-3}$	CL=90%	1568
$D^*(2010)^- D^+ K^0 + D^- D^*(2010)^+ K^0$	$(6.5 \pm 1.6) \times 10^{-3}$		1473
$D^*(2010)^- D^*(2010)^+ K^0$	$(8.8 \pm 1.9) \times 10^{-3}$		1360
$\overline{D}^0 D^0 K^0$	$< 1.4 \times 10^{-3}$	CL=90%	1575
$\overline{D}^0 D^*(2007)^0 K^0 + \overline{D}^*(2007)^0 D^0 K^0$	$< 3.7 \times 10^{-3}$	CL=90%	1478
$\overline{D}^*(2007)^0 D^*(2007)^0 K^0$	$< 6.6 \times 10^{-3}$	CL=90%	1365
$(\overline{D} + \overline{D}^*)(D + D^*) K$	(4.3 ± 0.7) %		–

Charmonium modes

$\eta_c K^0$	$(1.2 \pm 0.4) \times 10^{-3}$		1753
$\eta_c K^*(892)^0$	$(1.6 \pm 0.7) \times 10^{-3}$		1648
$J/\psi(1S) K^0$	$(8.5 \pm 0.5) \times 10^{-4}$		1683
$J/\psi(1S) K^+ \pi^-$	$(1.2 \pm 0.6) \times 10^{-3}$		1652
$J/\psi(1S) K^*(892)^0$	$(1.31 \pm 0.07) \times 10^{-3}$		1571
$J/\psi(1S) \phi K^0$	$(9.4 \pm 2.6) \times 10^{-5}$		1224
$J/\psi(1S) K(1270)^0$	$(1.3 \pm 0.5) \times 10^{-3}$		1390
$J/\psi(1S) \pi^0$	$(2.2 \pm 0.4) \times 10^{-5}$		1728
$J/\psi(1S) \eta$	$< 2.7 \times 10^{-5}$	CL=90%	1672
$J/\psi(1S) \pi^+ \pi^-$	$(4.6 \pm 0.9) \times 10^{-5}$		1716
$J/\psi(1S) \rho^0$	$(1.6 \pm 0.7) \times 10^{-5}$		1611
$J/\psi(1S) \omega$	$< 2.7 \times 10^{-4}$	CL=90%	1609
$J/\psi(1S) \phi$	$< 9.2 \times 10^{-6}$	CL=90%	1519

$J/\psi(1S)\eta'(958)$		$< 6.3 \times 10^{-5}$	CL=90%	1546
$J/\psi(1S)K^0\pi^+\pi^-$		$(1.0 \pm 0.4) \times 10^{-3}$		1611
$J/\psi(1S)K^0\rho^0$		$(5.4 \pm 3.0) \times 10^{-4}$		1390
$J/\psi(1S)K^*(892)^+\pi^-$		$(8 \pm 4) \times 10^{-4}$		1514
$J/\psi(1S)K^*(892)^0\pi^+\pi^-$		$(6.6 \pm 2.2) \times 10^{-4}$		1447
$J/\psi(1S)p\overline{p}$		$< 1.9 \times 10^{-6}$	CL=90%	862
$\psi(2S)K^0$		$(6.2 \pm 0.7) \times 10^{-4}$		1283
$\psi(2S)K^+\pi^-$		$< 1 \times 10^{-3}$	CL=90%	1238
$\psi(2S)K^*(892)^0$		$(8.0 \pm 1.3) \times 10^{-4}$		1116
$\chi_{c0}(1P)K^0$		$< 5.0 \times 10^{-4}$	CL=90%	1477
$\chi_{c1}(1P)K^0$		$(4.0 ^{+1.2}_{-1.0}) \times 10^{-4}$		1411
$\chi_{c1}(1P)K^*(892)^0$		$(4.1 \pm 1.5) \times 10^{-4}$		1265

K or K^* modes

$K^+\pi^-$		$(1.85 \pm 0.11) \times 10^{-5}$	S=1.2	2615
$K^0\pi^0$		$(9.5 ^{+2.1}_{-1.9}) \times 10^{-6}$		2614
$\eta' K^0$		$(6.3 \pm 0.7) \times 10^{-5}$	S=1.1	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%	2587
ωK^0		$< 1.3 \times 10^{-5}$	CL=90%	2557
$K^0_S X^0$ (Familon)		$< 5.3 \times 10^{-5}$	CL=90%	–
$\omega K^*(892)^0$		$< 2.3 \times 10^{-5}$	CL=90%	2503
$K^0\overline{K}^0$		$< 3.3 \times 10^{-6}$	CL=90%	2592
$K^0_S K^0_S K^0_S$		$(4.2 ^{+1.8}_{-1.5}) \times 10^{-6}$		2521
$K^+\pi^-\pi^0$		$< 4.0 \times 10^{-5}$	CL=90%	2609
$K^+\rho^-$		$(7.3 \pm 1.8) \times 10^{-6}$		2559
$K^0\pi^+\pi^-$		$(4.7 \pm 0.7) \times 10^{-5}$		2609
$K^0\rho^0$		$< 3.9 \times 10^{-5}$	CL=90%	2558
$K^0 f_0(980)$		$< 3.6 \times 10^{-4}$	CL=90%	2524
$K^*(892)^+\pi^-$		$(1.6 ^{+0.6}_{-0.5}) \times 10^{-5}$		2562
$K^*(892)^0\pi^0$		$< 3.6 \times 10^{-6}$	CL=90%	2563
$K^*_2(1430)^+\pi^-$		$< 1.8 \times 10^{-5}$	CL=90%	2445
$K^0K^-\pi^+$		$< 2.1 \times 10^{-5}$	CL=90%	2578
$K^+K^-\pi^0$		$< 1.9 \times 10^{-5}$	CL=90%	2579
$K^0K^+K^-$		$(2.8 \pm 0.5) \times 10^{-5}$		2522
$K^0\phi$		$(8.6 ^{+1.3}_{-1.1}) \times 10^{-6}$		2516
$K^-\pi^+\pi^+\pi^-$	[eee]	$< 2.3 \times 10^{-4}$	CL=90%	2600
$K^*(892)^0\pi^+\pi^-$		$< 1.4 \times 10^{-3}$	CL=90%	2557
$K^*(892)^0\rho^0$		$< 3.4 \times 10^{-5}$	CL=90%	2504

$K^*(892)^0 f_0(980)$		< 1.7	$\times 10^{-4}$	CL=90%	2468
$K_1(1400)^+ \pi^-$		< 1.1	$\times 10^{-3}$	CL=90%	2451
$K^- a_1(1260)^+$	[eee]	< 2.3	$\times 10^{-4}$	CL=90%	2471
$K^*(892)^0 K^+ K^-$		< 6.1	$\times 10^{-4}$	CL=90%	2466
$K^*(892)^0 \phi$		(1.07±0.11)	$\times 10^{-5}$		2460
$\overline{K}^*(892)^0 K^*(892)^0$		< 2.2	$\times 10^{-5}$	CL=90%	2485
$K^*(892)^0 K^*(892)^0$		< 3.7	$\times 10^{-5}$	CL=90%	2485
$K^*(892)^+ K^*(892)^-$		< 1.41	$\times 10^{-4}$	CL=90%	2485
$K_1(1400)^0 \rho^0$		< 3.0	$\times 10^{-3}$	CL=90%	2388
$K_1(1400)^0 \phi$		< 5.0	$\times 10^{-3}$	CL=90%	2339
$K_2^*(1430)^0 \rho^0$		< 1.1	$\times 10^{-3}$	CL=90%	2381
$K_2^*(1430)^0 \phi$		< 1.4	$\times 10^{-3}$	CL=90%	2333
$K^*(892)^0 \gamma$		(4.3 ±0.4)	$\times 10^{-5}$		2564
$K^0 \phi \gamma$		< 8.3	$\times 10^{-6}$	CL=90%	2516
$K^+ \pi^- \gamma$		(4.6 ±1.4)	$\times 10^{-6}$		2615
$K^*(1410) \gamma$		< 1.3	$\times 10^{-4}$	CL=90%	2450
$K^+ \pi^- \gamma$ nonresonant		< 2.6	$\times 10^{-6}$	CL=90%	2615
$K_1(1270)^0 \gamma$		< 7.0	$\times 10^{-3}$	CL=90%	2486
$K_1(1400)^0 \gamma$		< 4.3	$\times 10^{-3}$	CL=90%	2453
$K_2^*(1430)^0 \gamma$		(1.3 ±0.5)	$\times 10^{-5}$		2447
$K^*(1680)^0 \gamma$		< 2.0	$\times 10^{-3}$	CL=90%	2360
$K_3^*(1780)^0 \gamma$		< 1.0	%	CL=90%	2341
$K_4^*(2045)^0 \gamma$		< 4.3	$\times 10^{-3}$	CL=90%	2244

Light unflavored meson modes

$\rho^0 \gamma$	< 1.2	$\times 10^{-6}$	CL=90%	2583
$\omega \gamma$	< 1.0	$\times 10^{-6}$	CL=90%	2582
$\phi \gamma$	< 3.3	$\times 10^{-6}$	CL=90%	2541
$\pi^+ \pi^-$	(4.8 ±0.5)	$\times 10^{-6}$		2636
$\pi^0 \pi^0$	(1.9 ±0.5)	$\times 10^{-6}$		2636
$\eta \pi^0$	< 2.9	$\times 10^{-6}$	CL=90%	2610
$\eta \eta$	< 1.8	$\times 10^{-5}$	CL=90%	2582
$\eta' \pi^0$	< 5.7	$\times 10^{-6}$	CL=90%	2551
$\eta' \eta'$	< 4.7	$\times 10^{-5}$	CL=90%	2460
$\eta' \eta$	< 2.7	$\times 10^{-5}$	CL=90%	2522
$\eta' \rho^0$	< 1.2	$\times 10^{-5}$	CL=90%	2492
$\eta \rho^0$	< 1.0	$\times 10^{-5}$	CL=90%	2553
$\omega \eta$	< 1.2	$\times 10^{-5}$	CL=90%	2552
$\omega \eta'$	< 6.0	$\times 10^{-5}$	CL=90%	2491
$\omega \rho^0$	< 1.1	$\times 10^{-5}$	CL=90%	2522
$\omega \omega$	< 1.9	$\times 10^{-5}$	CL=90%	2521
$\phi \pi^0$	< 5	$\times 10^{-6}$	CL=90%	2539
$\phi \eta$	< 9	$\times 10^{-6}$	CL=90%	2511
$\phi \eta'$	< 3.1	$\times 10^{-5}$	CL=90%	2447

$\phi\,\rho^0$		$<\ 1.3$	$\times 10^{-5}$	CL=90%	2480
$\phi\,\omega$		$<\ 2.1$	$\times 10^{-5}$	CL=90%	2479
$\phi\,\phi$		$<\ 1.2$	$\times 10^{-5}$	CL=90%	2435
$\pi^+\pi^-\pi^0$		$<\ 7.2$	$\times 10^{-4}$	CL=90%	2631
$\quad\rho^0\pi^0$		$<\ 5.3$	$\times 10^{-6}$	CL=90%	2581
$\quad\rho^\mp\pi^\pm$	[gg]	$(\ 2.28\pm0.25)$	$\times 10^{-5}$		2581
$\pi^+\pi^-\pi^+\pi^-$		$<\ 2.3$	$\times 10^{-4}$	CL=90%	2621
$\quad\rho^0\rho^0$		$<\ 2.1$	$\times 10^{-6}$	CL=90%	2523
$\quad a_1(1260)^\mp\pi^\pm$	[gg]	$<\ 4.9$	$\times 10^{-4}$	CL=90%	2494
$\quad a_2(1320)^\mp\pi^\pm$	[gg]	$<\ 3.0$	$\times 10^{-4}$	CL=90%	2473
$\pi^+\pi^-\pi^0\pi^0$		$<\ 3.1$	$\times 10^{-3}$	CL=90%	2622
$\quad\rho^+\rho^-$		$<\ 2.2$	$\times 10^{-3}$	CL=90%	2523
$\quad a_1(1260)^0\pi^0$		$<\ 1.1$	$\times 10^{-3}$	CL=90%	2494
$\quad\omega\pi^0$		$<\ 3$	$\times 10^{-6}$	CL=90%	2580
$\pi^+\pi^+\pi^-\pi^-\pi^0$		$<\ 9.0$	$\times 10^{-3}$	CL=90%	2609
$\quad a_1(1260)^+\rho^-$		$<\ 3.4$	$\times 10^{-3}$	CL=90%	2433
$\quad a_1(1260)^0\rho^0$		$<\ 2.4$	$\times 10^{-3}$	CL=90%	2433
$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-$		$<\ 3.0$	$\times 10^{-3}$	CL=90%	2592
$\quad a_1(1260)^+a_1(1260)^-$		$<\ 2.8$	$\times 10^{-3}$	CL=90%	2336
$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-\pi^0$		$<\ 1.1$	%	CL=90%	2572

Baryon modes

$p\,\overline{p}$		$<\ 1.2$	$\times 10^{-6}$	CL=90%	2467
$p\,\overline{p}\,\pi^+\pi^-$		$<\ 2.5$	$\times 10^{-4}$	CL=90%	2406
$p\,\overline{p}\,K^0$		$<\ 7.2$	$\times 10^{-6}$	CL=90%	2347
$p\,\overline{\Lambda}\,\pi^-$		$(\ 4.0\ {}^{+1.1}_{-1.0}\ )$	$\times 10^{-6}$		2401
$p\,\overline{\Lambda}\,K^-$		$<\ 8.2$	$\times 10^{-7}$	CL=90%	2308
$p\,\overline{\Sigma}^0\,\pi^-$		$<\ 3.8$	$\times 10^{-6}$	CL=90%	2383
$\overline{\Lambda}\,\Lambda$		$<\ 1.0$	$\times 10^{-6}$	CL=90%	2392
$\Delta^0\,\overline{\Delta}^0$		$<\ 1.5$	$\times 10^{-3}$	CL=90%	2335
$\Delta^{++}\,\overline{\Delta}^{--}$		$<\ 1.1$	$\times 10^{-4}$	CL=90%	2335
$\overline{D}^0\,p\,\overline{p}$		$(\ 1.18\pm0.22)$	$\times 10^{-4}$		1862
$\overline{D}^*(2007)^0\,p\,\overline{p}$		$(\ 1.2\ \pm0.4\ )$	$\times 10^{-4}$		1788
$\overline{\Sigma}_c^{--}\,\Delta^{++}$		$<\ 1.0$	$\times 10^{-3}$	CL=90%	1840
$\overline{\Lambda}_c^-\,p\,\pi^+\pi^-$		$(\ 1.3\ \pm0.4\ )$	$\times 10^{-3}$		1934
$\overline{\Lambda}_c^-\,p$		$(\ 2.2\ \pm0.8\ )$	$\times 10^{-5}$		2021
$\overline{\Lambda}_c^-\,p\,\pi^0$		$<\ 5.9$	$\times 10^{-4}$	CL=90%	1982
$\overline{\Lambda}_c^-\,p\,\pi^+\pi^-\pi^0$		$<\ 5.07$	$\times 10^{-3}$	CL=90%	1883
$\overline{\Lambda}_c^-\,p\,\pi^+\pi^-\pi^+\pi^-$		$<\ 2.74$	$\times 10^{-3}$	CL=90%	1821
$\overline{\Sigma}_c(2520)^{--}\,p\,\pi^+$		$(\ 1.6\ \pm0.7\ )$	$\times 10^{-4}$		1861
$\overline{\Sigma}_c(2520)^0\,p\,\pi^-$		$<\ 1.21$	$\times 10^{-4}$	CL=90%	1861

$\overline{\Sigma}_c(2455)^0 p \pi^-$			$(10 \pm 8) \times 10^{-5}$	S=1.7	1896
$\overline{\Sigma}_c(2455)^{--} p \pi^+$			$(2.8 \pm 0.9) \times 10^{-4}$		1896
$\overline{\Lambda}_c(2593)^- / \overline{\Lambda}_c(2625)^- p$			$< 1.1 \times 10^{-4}$	CL=90%	–

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

$\gamma\gamma$	B1		$< 1.7 \times 10^{-6}$	CL=90%	2640
$e^+ e^-$	B1		$< 1.9 \times 10^{-7}$	CL=90%	2640
$\mu^+ \mu^-$	B1		$< 1.6 \times 10^{-7}$	CL=90%	2638
$K^0 e^+ e^-$	B1		$< 5.4 \times 10^{-7}$	CL=90%	2616
$K^0 \mu^+ \mu^-$	B1		$(5.6 ^{+2.9}_{-2.4}) \times 10^{-7}$		2612
$K^0 \ell^+ \ell^-$	B1	[rr]	$< 6.8 \times 10^{-7}$	CL=90%	2616
$K^*(892)^0 e^+ e^-$	B1		$< 2.4 \times 10^{-6}$	CL=90%	2564
$K^*(892)^0 \mu^+ \mu^-$	B1		$(1.3 \pm 0.4) \times 10^{-6}$		2560
$K^*(892)^0 \nu \overline{\nu}$	B1		$< 1.0 \times 10^{-3}$	CL=90%	2564
$K^*(892)^0 \ell^+ \ell^-$	B1	[rr]	$(1.17 \pm 0.30) \times 10^{-6}$		2564
$e^\pm \mu^\mp$	LF	[gg]	$< 1.7 \times 10^{-7}$	CL=90%	2639
$K^0 e^\pm \mu^\mp$	LF		$< 4.0 \times 10^{-6}$	CL=90%	2615
$K^*(892)^0 e^\pm \mu^\mp$	LF		$< 3.4 \times 10^{-6}$	CL=90%	2563
$e^\pm \tau^\mp$	LF	[gg]	$< 5.3 \times 10^{-4}$	CL=90%	2341
$\mu^\pm \tau^\mp$	LF	[gg]	$< 8.3 \times 10^{-4}$	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 $B(\Upsilon(4S) \to B\overline{B}) = 100\%$.

For inclusive branching fractions, *e.g.*, $B \to D^\pm$ anything, the values usually are multiplicities, not branching fractions. They can be greater than one.

$\overline{B}$ 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

$B \rightarrow e^+ \nu_e$ anything	[fff]	(10.73 ± 0.28) %			–
$B \rightarrow \overline{p} e^+ \nu_e$ anything		< 5.9	$\times 10^{-4}$	CL=90%	–
$B \rightarrow \ell^+ \nu_\ell$ anything	[rr,fff]	(10.73 ± 0.28) %			–
$B \rightarrow D^- \ell^+ \nu_\ell$ anything	[rr]	(2.8 ± 0.9) %			–
$B \rightarrow \overline{D}^0 \ell^+ \nu_\ell$ anything	[rr]	(7.2 ± 1.5) %			–
$B \rightarrow \overline{D}^{**} \ell^+ \nu_\ell$	[rr,ggg]	(2.7 ± 0.7) %			–
$B \rightarrow \overline{D}_1(2420) \ell^+ \nu_\ell$ anything		(7.4 ± 1.6) $\times 10^{-3}$			–
$B \rightarrow D \pi \ell^+ \nu_\ell$ anything + $D^* \pi \ell^+ \nu_\ell$ anything		(2.6 ± 0.5) %		S=1.5	–
$B \rightarrow D \pi \ell^+ \nu_\ell$ anything		(1.5 ± 0.6) %			–
$B \rightarrow D^* \pi \ell^+ \nu_\ell$ anything		(1.9 ± 0.4) %			–
$B \rightarrow \overline{D}_2^*(2460) \ell^+ \nu_\ell$ anything		< 6.5	$\times 10^{-3}$	CL=95%	–
$B \rightarrow D^{*-} \pi^+ \ell^+ \nu_\ell$ anything		(1.00 ± 0.34) %			–
$B \rightarrow D_s^- \ell^+ \nu_\ell$ anything	[rr]	< 9	$\times 10^{-3}$	CL=90%	–
$B \rightarrow D_s^- \ell^+ \nu_\ell K^+$ anything	[rr]	< 6	$\times 10^{-3}$	CL=90%	–
$B \rightarrow D_s^- \ell^+ \nu_\ell K^0$ anything	[rr]	< 9	$\times 10^{-3}$	CL=90%	–
$B \rightarrow K^+ \ell^+ \nu_\ell$ anything	[rr]	(6.2 ± 0.6) %			–
$B \rightarrow K^- \ell^+ \nu_\ell$ anything	[rr]	(10 ± 4) $\times 10^{-3}$			–
$B \rightarrow K^0 / \overline{K}^0 \ell^+ \nu_\ell$ anything	[rr]	(4.5 ± 0.5) %			–

D, D^*, or D_s modes

$B \rightarrow D^\pm$ anything		(23.5 ± 1.9) %			–
$B \rightarrow D^0 / \overline{D}^0$ anything		(64.0 ± 3.0) %		S=1.1	–
$B \rightarrow D^*(2010)^\pm$ anything		(22.5 ± 1.5) %			–
$B \rightarrow D^*(2007)^0$ anything		(26.0 ± 2.7) %			–
$B \rightarrow D_s^\pm$ anything	[gg]	(10.5 ± 2.6) %			–
$B \rightarrow D_s^{*\pm}$ anything		(7.9 ± 2.2) %			–
$B \rightarrow D_s^{*\pm} \overline{D}^{(*)}$		(4.2 ± 1.2) %			–
$B \rightarrow \overline{D} D_{sJ}(2317)$		seen			1605
$B \rightarrow \overline{D} D_{sJ}(2457)$		seen			–
$B \rightarrow D^{(*)} \overline{D}^{(*)} K^0 + D^{(*)} \overline{D}^{(*)} K^\pm$	[gg,hhh]	(7.1 $^{+2.7}_{-1.7}$) %			–
$b \rightarrow c \overline{c} s$		(22 ± 4) %			–

$B \to D_s^{(*)} \overline{D}^{(*)}$	[gg,hhh]	(4.9 ± 1.2) %			–
$B \to D^* D^*(2010)^{\pm}$	[gg]	< 5.9	$\times 10^{-3}$	CL=90%	1711
$B \to D D^*(2010)^{\pm} + D^* D^{\pm}$	[gg]	< 5.5	$\times 10^{-3}$	CL=90%	–
$B \to D D^{\pm}$	[gg]	< 3.1	$\times 10^{-3}$	CL=90%	1866
$B \to D_s^{(*)\pm} \overline{D}^{(*)} X(n\pi^{\pm})$	[gg,hhh]	(9 $^{+5}_{-4}$) %			–
$B \to D^*(2010)\gamma$		< 1.1	$\times 10^{-3}$	CL=90%	2257
$B \to D_s^+ \pi^-$, $D_s^{*+} \pi^-$, $D_s^+ \rho^-$, $D_s^{*+} \rho^-$, $D_s^+ \pi^0$, $D_s^{*+} \pi^0$, $D_s^+ \eta$, $D_s^{*+} \eta$, $D_s^+ \rho^0$, $D_s^{*+} \rho^0$, $D_s^+ \omega$, $D_s^{*+} \omega$	[gg]	< 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		(1.094 ± 0.032) %		S=1.1	–
$B \to J/\psi(1S)$(direct) anything		(7.8 ± 0.4)	$\times 10^{-3}$	S=1.1	–
$B \to \psi(2S)$ anything		(3.07 ± 0.21)	$\times 10^{-3}$		–
$B \to \chi_{c1}(1P)$ anything		(3.86 ± 0.27)	$\times 10^{-3}$		–
$B \to \chi_{c1}(1P)$(direct) anything		(3.34 ± 0.28)	$\times 10^{-3}$		–
$B \to \chi_{c2}(1P)$ anything		(1.3 ± 0.4)	$\times 10^{-3}$	S=1.9	–
$B \to \chi_{c2}(1P)$(direct) anything		(1.65 ± 0.31)	$\times 10^{-3}$		–
$B \to \eta_c(1S)$ anything		< 9	$\times 10^{-3}$	CL=90%	–

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

$B \to K^{\pm}$ anything	[gg]	(78.9 ± 2.5) %			–
$B \to K^+$ anything		(66 ± 5) %			–
$B \to K^-$ anything		(13 ± 4) %			–
$B \to K^0/\overline{K}^0$ anything	[gg]	(64 ± 4) %			–
$B \to K^*(892)^{\pm}$ anything		(18 ± 6) %			–
$B \to K^*(892)^0/\overline{K}^*(892)^0$ anything	[gg]	(14.6 ± 2.6) %			–
$B \to K^*(892)\gamma$		(4.2 ± 0.6)	$\times 10^{-5}$		2564
$B \to K_1(1400)\gamma$		< 1.27	$\times 10^{-4}$	CL=90%	2453
$B \to K_2^*(1430)\gamma$		(1.7 $^{+0.6}_{-0.5}$)	$\times 10^{-5}$		2447
$B \to K_2(1770)\gamma$		< 1.2	$\times 10^{-3}$	CL=90%	2342
$B \to K_3^*(1780)\gamma$		< 3.0	$\times 10^{-3}$	CL=90%	2341
$B \to K_4^*(2045)\gamma$		< 1.0	$\times 10^{-3}$	CL=90%	2244

$B \to K\eta'(958)$		$(8.3 \pm 1.1) \times 10^{-5}$		2528
$B \to K^*(892)\eta'(958)$		$< 2.2 \times 10^{-5}$	CL=90%	2472
$B \to K\eta$		$< 5.2 \times 10^{-6}$	CL=90%	2588
$B \to K^*(892)\eta$		$(1.8 \pm 0.5) \times 10^{-5}$		2534
$B \to K\phi\phi$		$(2.3 \pm 0.9) \times 10^{-6}$		2306
$B \to \overline{b} \to \overline{s}\gamma$		$(3.3 \pm 0.4) \times 10^{-4}$		–
$B \to \overline{b} \to \overline{s}$gluon		< 6.8 %	CL=90%	–
$B \to \eta$anything		$< 4.4 \times 10^{-4}$	CL=90%	–
$B \to \eta'$anything		$(4.6 \pm 1.3) \times 10^{-4}$		–

Light unflavored meson modes

$B \to \rho\gamma$		$< 1.9 \times 10^{-6}$	CL=90%	2583
$B \to \pi^{\pm}$ anything	[gg,iii]	(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%	2460

Baryon modes

$B \to \Lambda_c^+ / \overline{\Lambda}_c^-$ 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%	2021
$B \to \overline{\Sigma}_c^{--}$ 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%	1939
$B \to \Xi_c^0$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	[gg]	(8.0 ± 0.4) %		–
$B \to p/\overline{p}$(direct) anything	[gg]	(5.5 ± 0.5) %		–
$B \to \Lambda/\overline{\Lambda}$anything	[gg]	(4.0 ± 0.5) %		–
$B \to \Xi^- / \overline{\Xi}^+$ anything	[gg]	$(2.7 \pm 0.6) \times 10^{-3}$		–
$B \to$ 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	[gg]	(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

$B \to s e^+ e^-$	*B1*		$(5.0 \pm 2.6) \times 10^{-6}$		–
$B \to s \mu^+ \mu^-$	*B1*		$(7.9 {}^{+3.0}_{-2.6}) \times 10^{-6}$		–
$B \to s \ell^+ \ell^-$	*B1*	[rr]	$(6.1 {}^{+2.0}_{-1.8}) \times 10^{-6}$		–
$B \to K e^+ e^-$	*B1*		$(4.8 {}^{+1.5}_{-1.3}) \times 10^{-7}$		2617
$B \to K^*(892) e^+ e^-$	*B1*		$(1.5 \pm 0.5) \times 10^{-6}$		2564
$B \to K \mu^+ \mu^-$	*B1*		$(4.8 \pm 1.2) \times 10^{-7}$		2612
$B \to K^*(892) \mu^+ \mu^-$	*B1*		$(1.17 {}^{+0.37}_{-0.33}) \times 10^{-6}$		2560
$B \to K \ell^+ \ell^-$	*B1*		$(5.4 \pm 0.8) \times 10^{-7}$		2617
$B \to K^*(892) \ell^+ \ell^-$	*B1*		$(1.05 \pm 0.20) \times 10^{-6}$		2564
$B \to e^\pm \mu^\mp s$	*LF*	[gg]	$< 2.2 \times 10^{-5}$	CL=90%	–
$B \to \pi e^\pm \mu^\mp$	*LF*		$< 1.6 \times 10^{-6}$	CL=90%	2637
$B \to \rho e^\pm \mu^\mp$	*LF*		$< 3.2 \times 10^{-6}$	CL=90%	2582
$B \to K e^\pm \mu^\mp$	*LF*		$< 1.6 \times 10^{-6}$	CL=90%	2616
$B \to K^*(892) e^\pm \mu^\mp$	*LF*		$< 6.2 \times 10^{-6}$	CL=90%	2563

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

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

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

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

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

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, $Sp\overline{p}S$) 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.*, $B \to D^\pm$ anything, the values usually are multiplicities, not branching fractions. They can be greater than one.

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 Heavy Flavor Averaging Group (HFAG) as described in the note "B^0-$\overline{B}^0$ Mixing" in the B^0 Particle Listings. Values assume

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

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, $B(\overline{b} \to B^0)$.

B^+		(39.7 ± 1.0) %		–
B^0		(39.7 ± 1.0) %		–
B^0_s		(10.7 ± 1.1) %		–
b-baryon		(9.9 ± 1.7) %		–
B_c		—		–

DECAY MODES

Semileptonic and leptonic modes

ν anything		(23.1 ± 1.5) %		–
$\ell^+ \nu_\ell$ anything	[rr]	(10.68 ± 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	[rr]	(2.3 ± 0.4) %	S=1.7	–
$D^- \pi^+ \ell^+ \nu_\ell$ 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	[rr]	(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	[rr]	(2.75 ± 0.19) %		–
$D^{*-} \pi^+ \ell^+ \nu_\ell$ anything		$(4.8 \pm 1.0) \times 10^{-3}$		–
$D^{*-} \pi^- \ell^+ \nu_\ell$ anything		$(6 \pm 7) \times 10^{-4}$		–
$D_j^- \ell^+ \nu_\ell$ anything	[rr,jjj]	seen		–
$D_2^*(2460)^- \ell^+ \nu_\ell$ anything		seen		–

charmless $\ell \overline{\nu}_\ell$	[rr]	$(1.7 \pm 0.5) \times 10^{-3}$		–
$\tau^+ \nu_\tau$ anything		(2.48 ± 0.26) %		–
$D^{*-} \tau \nu_\tau$ anything		$(9 \pm 4) \times 10^{-3}$		–
$\overline{c} \to \ell^- \overline{\nu}_\ell$ anything	[rr]	(8.0 ± 0.4) %		–
$c \to \ell^+ \nu$ anything		$(1.6 {}^{+0.4}_{-0.5})$ %		–

Charmed meson and baryon modes

$\overline{D}^0$ anything		(61.0 ± 3.2) %		–
$D^0 D_s^\pm$ anything	[gg]	$(9.1 {}^{+3.9}_{-2.8})$ %		–
$D^\mp D_s^\pm$ anything	[gg]	$(4.0 {}^{+2.3}_{-1.8})$ %		–
$\overline{D}^0 D^0$ anything	[gg]	$(5.1 {}^{+2.0}_{-1.8})$ %		–
$D^0 D^\pm$ anything	[gg]	$(2.7 {}^{+1.8}_{-1.6})$ %		–
$D^\pm D^\mp$ anything	[gg]	$< 9 \times 10^{-3}$	CL=90%	–
D^- anything		(23.1 ± 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	[gg]	$(3.3 {}^{+1.6}_{-1.3})$ %		–
$D^0 D^*(2010)^\pm$ anything	[gg]	$(3.0 {}^{+1.1}_{-0.9})$ %		–
$D^*(2010)^\pm D^\mp$ anything	[gg]	$(2.5 {}^{+1.2}_{-1.0})$ %		–
$D^*(2010)^\pm D^*(2010)^\mp$ anything	[gg]	(1.2 ± 0.4) %		–
$D_2^*(2460)^0$ anything		(4.7 ± 2.7) %		–
D_s^- anything		(18 ± 5) %		–
D_s^+ anything		(10.1 ± 3.1) %		–
Λ_c^+ anything		(9.7 ± 2.9) %		–
$\overline{c}/c$ anything	[iii]	(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	[iii]	(278 ± 60) %		–
ϕ anything		(2.82 ± 0.23) %		–

		Baryon modes		
$p/\overline{p}$anything		(13.1 ± 1.1) %		–
		Other modes		
charged anything	[iii]	(497 ± 7) %		–
hadron$^+$ hadron$^-$		($1.7 ^{+1.0}_{-0.7}$) $\times 10^{-5}$		–
charmless		(7 ±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^*

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

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	45

BOTTOM, STRANGE MESONS ($B = \pm1$, $S = \mp1$)

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

B^0_s

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

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

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

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

$c\tau = 438\ \mu$m

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

$\Delta m_{B_s^0} = m_{B_{sH}^0} - m_{B_{sL}^0} > 14.4 \times 10^{12}\ \hbar\ \mathrm{s}^{-1}$, CL = 95%

$> 94.8 \times 10^{-10}$ MeV, CL = 95%

$x_s = \Delta m_{B_s^0}/\Gamma_{B_s^0} > 20.6$, CL = 95%

$\chi_s > 0.49883$, CL = 95%

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

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

For inclusive branching fractions, *e.g.*, $B \rightarrow D^\pm$ anything, the values usually are multiplicities, not branching fractions. They can be greater than one.

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	[kkk]	(7.9 ± 2.4) %		–
$D_s^- \pi^+$		< 13 %		2322
$D_s^{(*)+} D_s^{(*)-}$		$(23\ ^{+21}_{-13})$ %		–
$J/\psi(1S)\phi$		(9.3 ± 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		1123
$\pi^+\pi^-$		< 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%	2570
$\phi\rho^0$		< 6.17 $\times 10^{-4}$	90%	2528
$\phi\phi$		< 1.183 $\times 10^{-3}$	90%	2484
$\pi^+ K^-$		< 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%	2551
$\overline{K}^*(892)^0 K^*(892)^0$		< 1.681 $\times 10^{-3}$	90%	2532
$\phi K^*(892)^0$		< 1.013 $\times 10^{-3}$	90%	2508
$p\overline{p}$		< 5.9 $\times 10^{-5}$	90%	2516
$\gamma\gamma$		< 1.48 $\times 10^{-4}$	90%	2685
$\phi\gamma$		< 1.2 $\times 10^{-4}$	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%	2683
$e^+ e^-$	$B1$		< 5.4	$\times 10^{-5}$	90%	2685
$e^\pm \mu^\mp$	LF	[gg]	< 6.1	$\times 10^{-6}$	90%	2684
$\phi(1020) \mu^+ \mu^-$	$B1$		< 4.7	$\times 10^{-5}$	90%	2584
$\phi \nu \overline{\nu}$	$B1$		< 5.4	$\times 10^{-3}$	90%	2588

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 $\times$ B($\overline{b} \to B_c$)	Fraction (Γ_i/Γ)		Confidence level	p (MeV/c)
The following quantities 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%	2448
$J/\psi(1S)\pi^+\pi^+\pi^-$	< 5.7	$\times 10^{-4}$	90%	2429
$J/\psi(1S)a_1(1260)$	< 1.2	$\times 10^{-3}$	90%	2255
$D^*(2010)^+\overline{D}^0$	< 6.2	$\times 10^{-3}$	90%	2546

$c\overline{c}$ MESONS

$\eta_c(1S)$

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

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

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

$J/\psi(1S)$

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

Mass $m = 3096.916 \pm 0.011$ MeV
Full width $\Gamma = 91.0 \pm 3.2$ keV
$\Gamma_{ee} = 5.40 \pm 0.15 \pm 0.07$ keV

$J/\psi(1S)$ DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
hadrons		(87.7 ± 0.5) %		–
virtual$\gamma \to$ 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) %		1448
$\rho^0 \pi^0$		$(4.2 \pm 0.5) \times 10^{-3}$		1448
$a_2(1320)\rho$		(1.09 ± 0.22) %		1123
$\omega \pi^+ \pi^+ \pi^- \pi^-$		$(8.5 \pm 3.4) \times 10^{-3}$		1392
$\omega \pi^+ \pi^-$		$(7.2 \pm 1.0) \times 10^{-3}$		1435
$\omega f_2(1270)$		$(4.3 \pm 0.6) \times 10^{-3}$		1142
$K^*(892)^0 \overline{K}^*_2(1430)^0 +$ c.c.		$(6.7 \pm 2.6) \times 10^{-3}$		1012
$\omega K^*(892) \overline{K} +$ c.c.		$(5.3 \pm 2.0) \times 10^{-3}$		1097
$K^+ \overline{K}^*(892)^- +$ c.c.		$(5.0 \pm 0.4) \times 10^{-3}$		1373
$K^0 \overline{K}^*(892)^0 +$ c.c.		$(4.2 \pm 0.4) \times 10^{-3}$		1373
$K_1(1400)^\pm K^\mp$		$(3.8 \pm 1.4) \times 10^{-3}$		1171
$\omega \pi^0 \pi^0$		$(3.4 \pm 0.8) \times 10^{-3}$		1436
$b_1(1235)^\pm \pi^\mp$	[gg]	$(3.0 \pm 0.5) \times 10^{-3}$		1300
$\omega K^\pm K^0_S \pi^\mp$	[gg]	$(2.9 \pm 0.7) \times 10^{-3}$		1210
$b_1(1235)^0 \pi^0$		$(2.3 \pm 0.6) \times 10^{-3}$		1300
$\phi K^*(892) \overline{K} +$ 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
$\phi K \overline{K}$		$(1.54 \pm 0.21) \times 10^{-3}$		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	768
$\Delta(1232)^{++} \overline{\Delta}(1232)^{--}$		$(1.10 \pm 0.29) \times 10^{-3}$		938
$\Sigma(1385)^- \overline{\Sigma}(1385)^+$ (or c.c.)	[gg]	$(1.03 \pm 0.13) \times 10^{-3}$		697
$p \overline{p} \eta'(958)$		$(9 \pm 4) \times 10^{-4}$	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
$\phi K^\pm K^0_S \pi^\mp$	[gg]	$(7.2 \pm 0.9) \times 10^{-4}$		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
$\Xi(1530)^- \overline{\Xi}^+$		$(5.9 \pm 1.5) \times 10^{-4}$			601
$p K^- \overline{\Sigma}(1385)^0$		$(5.1 \pm 3.2) \times 10^{-4}$			646
$\omega\pi^0$		$(4.2 \pm 0.6) \times 10^{-4}$		S=1.4	1446
$\phi\eta'(958)$		$(3.3 \pm 0.4) \times 10^{-4}$			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.)	[gg]	$(3.1 \pm 0.5) \times 10^{-4}$			855
$\phi f_1(1285)$		$(2.6 \pm 0.5) \times 10^{-4}$		S=1.1	1032
$\rho\eta$		$(1.93 \pm 0.23) \times 10^{-4}$			1396
$\omega\eta'(958)$		$(1.67 \pm 0.25) \times 10^{-4}$			1279
$\omega f_0(980)$		$(1.4 \pm 0.5) \times 10^{-4}$			1271
$\rho\eta'(958)$		$(1.05 \pm 0.18) \times 10^{-4}$			1281
$p\overline{p}\phi$		$(4.5 \pm 1.5) \times 10^{-5}$			527
$a_2(1320)^\pm \pi^\mp$	[gg]	$< 4.3 \times 10^{-3}$		CL=90%	1263
$K \overline{K}{}^*_2(1430) +$ c.c.		$< 4.0 \times 10^{-3}$		CL=90%	1159
$K_1(1270)^\pm K^\mp$		$< 3.0 \times 10^{-3}$		CL=90%	1231
$K^*_2(1430)^0 \overline{K}{}^*_2(1430)^0$		$< 2.9 \times 10^{-3}$		CL=90%	604
$K^*(892)^0 \overline{K}{}^*(892)^0$		$< 5 \times 10^{-4}$		CL=90%	1266
$\phi f_2(1270)$		$< 3.7 \times 10^{-4}$		CL=90%	1036
$p\overline{p}\rho$		$< 3.1 \times 10^{-4}$		CL=90%	774
$\phi\eta(1405) \to \phi\eta\pi\pi$		$< 2.5 \times 10^{-4}$		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%	912
$\Delta(1232)^+ \overline{p}$		$< 1 \times 10^{-4}$		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
$K\overline{K}\pi$		$(6.1 \pm 1.0) \times 10^{-3}$			1442
$p\overline{p}\pi^+\pi^-$		$(6.0 \pm 0.5) \times 10^{-3}$		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
$\Sigma^0 \overline{\Sigma}^0$		$(1.27 \pm 0.17) \times 10^{-3}$			988
$2(\pi^+\pi^-) K^+ K^-$		$(3.1 \pm 1.3) \times 10^{-3}$			1320
$p\overline{p}\pi^+\pi^-\pi^0$	[lll]	$(2.3 \pm 0.9) \times 10^{-3}$		S=1.9	1033

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

Radiative decays

$\gamma\eta_c(1S)$		(1.3 ± 0.4) %		115
$\gamma\pi^+\pi^-2\pi^0$		$(8.3\pm3.1)\times10^{-3}$		1518
$\gamma\eta\pi\pi$		$(6.1\pm1.0)\times10^{-3}$		1487
$\gamma\eta(1405/1475)\to\gamma K\overline{K}\pi$	[p]	$(2.8\pm0.6)\times10^{-3}$	S=1.6	1223
$\gamma\eta(1405/1475)\to\gamma\gamma\rho^0$		$(6.4\pm1.4)\times10^{-5}$		1223
$\gamma\eta(1405/1475)\to\gamma\eta\pi^+\pi^-$		$(3.0\pm0.5)\times10^{-4}$		–
$\gamma\rho\rho$		$(4.5\pm0.8)\times10^{-3}$		1340
$\gamma\eta_2(1870)\to\gamma\pi^+\pi^-$		$(6.2\pm2.4)\times10^{-4}$		–
$\gamma\eta'(958)$		$(4.31\pm0.30)\times10^{-3}$		1400
$\gamma2\pi^+2\pi^-$		$(2.8\pm0.5)\times10^{-3}$	S=1.9	1517
$\gamma K^+K^-\pi^+\pi^-$		$(2.1\pm0.6)\times10^{-3}$		1407
$\gamma f_4(2050)$		$(2.7\pm0.7)\times10^{-3}$		880
$\gamma\omega\omega$		$(1.59\pm0.33)\times10^{-3}$		1336
$\gamma\eta(1405/1475)\to\gamma\rho^0\rho^0$		$(1.7\pm0.4)\times10^{-3}$	S=1.3	1223
$\gamma f_2(1270)$		$(1.38\pm0.14)\times10^{-3}$		1286
$\gamma f_0(1710)\to\gamma K\overline{K}$		$(8.5\ ^{+1.2}_{-0.9})\times10^{-4}$	S=1.2	1075
$\gamma\eta$		$(8.6\pm0.8)\times10^{-4}$		1500
$\gamma f_1(1420)\to\gamma K\overline{K}\pi$		$(7.9\pm1.3)\times10^{-4}$		1220
$\gamma f_1(1285)$		$(6.1\pm0.8)\times10^{-4}$		1283
$\gamma f_1(1510)\to\gamma\eta\pi^+\pi^-$		$(4.5\pm1.2)\times10^{-4}$		–
$\gamma f'_2(1525)$		$(4.5\ ^{+0.7}_{-0.4})\times10^{-4}$		1173
$\gamma f_2(1950)\to\gamma K^*(892)\overline{K}^*(892)$		$(7.0\pm2.2)\times10^{-4}$		–
$\gamma K^*(892)\overline{K}^*(892)$		$(4.0\pm1.3)\times10^{-3}$		1266

$\gamma\phi\phi$		$(4.0 \pm 1.2) \times 10^{-4}$	S=2.1	1166
$\gamma p\overline{p}$		$(3.8 \pm 1.0) \times 10^{-4}$		1232
$\gamma\eta(2225)$		$(2.9 \pm 0.6) \times 10^{-4}$		752
$\gamma\eta(1760) \to \gamma\rho^0\rho^0$		$(1.3 \pm 0.9) \times 10^{-4}$		1048
$\gamma(K\overline{K}\pi)_{J^{PC}=0-+}$		$(7 \pm 4) \times 10^{-4}$	S=2.1	1442
$\gamma\pi^0$		$(3.9 \pm 1.3) \times 10^{-5}$		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%	745
$\gamma f_J(2220) \to \gamma\pi\pi$		$(8 \pm 4) \times 10^{-5}$		–
$\gamma f_J(2220) \to \gamma K\overline{K}$		$(8.1 \pm 3.0) \times 10^{-5}$		–
$\gamma f_J(2220) \to \gamma p\overline{p}$		$(1.5 \pm 0.8) \times 10^{-5}$		–
$\gamma f_0(1500)$		$>(5.7 \pm 0.8) \times 10^{-4}$		1182
γe^+e^-		$(8.8 \pm 1.4) \times 10^{-3}$		1548

Lepton Family number (*LF*) violating modes

$e^\pm\mu^\mp$	*LF*	$< 1.1 \times 10^{-6}$	CL=90%	1547

$\chi_{c0}(1P)$

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

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

$\chi_{c0}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
Hadronic decays			
$2(\pi^+\pi^-)$	(2.58 ± 0.31) %		1679
$\pi^+\pi^-K^+K^-$	(2.1 ± 0.5) %		1581
$\rho^0\pi^+\pi^-$	(1.6 ± 0.5) %		1607
$3(\pi^+\pi^-)$	(1.27 ± 0.22) %		1633
$K^+\overline{K}^*(892)^0\pi^-$ + c.c.	(1.2 ± 0.4) %		1524
K^+K^-	$(6.0 \pm 0.9) \times 10^{-3}$		1635
$\pi\pi$	$(7.4 \pm 0.8) \times 10^{-3}$		1702
$\eta\eta$	$(2.1 \pm 1.1) \times 10^{-3}$		1617
$K^+K^-K^+K^-$	$(2.3 \pm 0.5) \times 10^{-3}$		1334
$K^0_SK^0_S$	$(2.1 \pm 0.6) \times 10^{-3}$		1633
$\pi^+\pi^-p\overline{p}$	$(2.2 \pm 0.8) \times 10^{-3}$		1320
$\phi\phi$	$(1.0 \pm 0.6) \times 10^{-3}$		1370
$p\overline{p}$	$(2.24 \pm 0.27) \times 10^{-4}$		1427
$\Lambda\overline{\Lambda}$	$(4.7 \pm 1.6) \times 10^{-4}$		1293
$K^0_SK^+\pi^-$ + c.c.	$< 8 \times 10^{-4}$	90%	1610

Radiative decays

$\gamma J/\psi(1S)$	(1.18 ± 0.14) %	303
$\gamma\gamma$	$(2.6\ \pm0.5\ )\times10^{-4}$	1708

$\chi_{c1}(1P)$

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

Mass $m = 3510.59 \pm 0.10$ MeV (S = 1.1)
Full width $\Gamma = 0.91 \pm 0.13$ MeV

$\chi_{c1}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
Hadronic decays		
$3(\pi^+\pi^-)$	$(\ 6.2\pm1.6)\times10^{-3}$	1683
$2(\pi^+\pi^-)$	$(\ 8.2\pm2.9)\times10^{-3}$	1727
$\pi^+\pi^-K^+K^-$	$(\ 4.9\pm1.1)\times10^{-3}$	1632
$\rho^0\pi^+\pi^-$	$(\ 3.9\pm3.5)\times10^{-3}$	1657
$K^+\overline{K}^*(892)^0\pi^-$ + c.c.	$(\ 3.2\pm2.1)\times10^{-3}$	1577
$K^0_S K^+\pi^-$ + c.c.	$(\ 2.5\pm0.7)\times10^{-3}$	1660
$\pi^+\pi^-p\overline{p}$	$(\ 5.3\pm2.1)\times10^{-4}$	1381
$K^+K^-K^+K^-$	$(\ 4.2\pm1.9)\times10^{-4}$	1393
$p\overline{p}$	$(\ 7.2\pm1.3)\times10^{-5}$	1483
$\Lambda\overline{\Lambda}$	$(\ 2.6\pm1.2)\times10^{-4}$	1355
$\pi^+\pi^-\ +\ K^+K^-$	$<\ 2.1\ \times10^{-3}$	–
Radiative decays		
$\gamma J/\psi(1S)$	(31.6 ± 3.3) %	389

$\chi_{c2}(1P)$

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

Mass $m = 3556.26 \pm 0.11$ MeV
Full width $\Gamma = 2.11 \pm 0.16$ MeV

$\chi_{c2}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
Hadronic decays			
$2(\pi^+\pi^-)$	$(\ 1.48\pm0.21)$ %		1751
$\pi^+\pi^-K^+K^-$	$(\ 1.24\pm0.33)$ %		1656
$3(\pi^+\pi^-)$	$(\ 1.07\pm0.24)$ %		1707
$\rho^0\pi^+\pi^-$	$(\ 7\ \ \pm4\ \ )\times10^{-3}$		1681
$K^+\overline{K}^*(892)^0\pi^-$ + c.c.	$(\ 4.8\ \pm2.8\ )\times10^{-3}$		1602
$\phi\phi$	$(\ 2.4\ \pm0.9\ )\times10^{-3}$		1457
$\pi^+\pi^-$	$(\ 1.77\pm0.27)\times10^{-3}$		1773
$\pi^0\pi^0$	$(\ 1.1\ \pm0.7\ )\times10^{-3}$		1773

$\eta\eta$	$< 1.5 \times 10^{-3}$	90%	1692
$K^+ K^- K^+ K^-$	$(1.8 \pm 0.5) \times 10^{-3}$		1421
$\pi^+ \pi^- p \overline{p}$	$(1.7 \pm 0.4) \times 10^{-3}$		1410
$K^+ K^-$	$(9.4 \pm 2.1) \times 10^{-4}$		1708
$K^0_S K^0_S$	$(7.2 \pm 2.7) \times 10^{-4}$		1707
$p \overline{p}$	$(6.8 \pm 0.7) \times 10^{-5}$		1510
$\Lambda \overline{\Lambda}$	$(3.4 \pm 1.7) \times 10^{-4}$		1385
$J/\psi(1S) \pi^+ \pi^- \pi^0$	< 1.5 %	90%	186
$K^0_S K^+ \pi^- +$ c.c.	$< 1.3 \times 10^{-3}$	90%	1685
Radiative decays			
$\gamma J/\psi(1S)$	(20.2 ± 1.7) %		430
$\gamma\gamma$	$(2.46 \pm 0.23) \times 10^{-4}$		1778

$\psi(2S)$

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

Mass $m = 3686.093 \pm 0.034$ MeV (S = 1.4)
Full width $\Gamma = 281 \pm 17$ keV
$\Gamma_{ee} = 2.12 \pm 0.12$ keV

$\psi(2S)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
hadrons	(97.85 ± 0.13) %		–
virtual$\gamma \to$ hadrons	(2.16 ± 0.35) %	S=2.1	–
$e^+ e^-$	$(7.55 \pm 0.31) \times 10^{-3}$		1843
$\mu^+ \mu^-$	$(7.3 \pm 0.8) \times 10^{-3}$		1840
$\tau^+ \tau^-$	$(2.8 \pm 0.7) \times 10^{-3}$		489
Decays into $J/\psi(1S)$ and anything			
$J/\psi(1S)$anything	(57.6 ± 2.0) %		–
$J/\psi(1S)$neutrals	(24.6 ± 1.2) %		–
$J/\psi(1S) \pi^+ \pi^-$	(31.7 ± 1.1) %		477
$J/\psi(1S) \pi^0 \pi^0$	(18.8 ± 1.2) %		481
$J/\psi(1S) \eta$	(3.16 ± 0.22) %		199
$J/\psi(1S) \pi^0$	$(9.6 \pm 2.1) \times 10^{-4}$		528
Hadronic decays			
$3(\pi^+ \pi^-) \pi^0$	$(3.5 \pm 1.6) \times 10^{-3}$		1746
$2(\pi^+ \pi^-) \pi^0$	$(3.0 \pm 0.8) \times 10^{-3}$		1799
$\rho a_2(1320)$	$< 2.3 \times 10^{-4}$	CL=90%	1500
$\omega \pi^+ \pi^-$	$(4.8 \pm 0.9) \times 10^{-4}$		1748
$b_1^{\pm} \pi^{\mp}$	$(3.2 \pm 0.8) \times 10^{-4}$		1635
$\omega f_2(1270)$	$< 1.5 \times 10^{-4}$	CL=90%	1515
$\pi^+ \pi^- K^+ K^-$	$(1.6 \pm 0.4) \times 10^{-3}$		1726
$K^*(892) \overline{K}{}^*_2(1430)^0$	$< 1.2 \times 10^{-4}$	CL=90%	1418

$K_1(1270)^\pm K^\mp$	$(1.00\pm0.28)\times10^{-3}$		1581
$\pi^+\pi^- p\overline{p}$	$(8.0\ \pm2.0\ )\times10^{-4}$		1491
$K^+\overline{K}^*(892)^0\pi^- +$ c.c.	$(6.7\ \pm2.5\ )\times10^{-4}$		1674
$2(\pi^+\pi^-)$	$(4.5\ \pm1.0\ )\times10^{-4}$		1817
$\quad\rho^0\pi^+\pi^-$	$(4.2\ \pm1.5\ )\times10^{-4}$		1750
$\omega K^+ K^-$	$(1.5\ \pm0.4\ )\times10^{-4}$		1614
$\omega p\overline{p}$	$(8.0\ \pm3.2\ )\times10^{-5}$		1247
$\overline{p}p$	$(2.07\pm0.31)\times10^{-4}$		1586
$\Lambda\overline{\Lambda}$	$(1.81\pm0.34)\times10^{-4}$		1467
$3(\pi^+\pi^-)$	$(1.5\ \pm1.0\ )\times10^{-4}$		1774
$\overline{p}p\pi^0$	$(1.4\ \pm0.5\ )\times10^{-4}$		1543
$\Delta^{++}\overline{\Delta}^{--}$	$(1.28\pm0.35)\times10^{-4}$		1371
$\Sigma^0\overline{\Sigma}^0$	$(1.2\ \pm0.6\ )\times10^{-4}$		1405
$\Sigma^{*+}\overline{\Sigma}^{*-}$	$(1.1\ \pm0.4\ )\times10^{-4}$		1218
K^+K^-	$(1.0\ \pm0.7\ )\times10^{-4}$		1776
$K^0_S K^0_L$	$(5.2\ \pm0.7\ )\times10^{-5}$		1775
$\pi^+\pi^-\pi^0$	$(8\ \ \pm5\ \ )\times10^{-5}$		1830
$\quad\rho\pi$	$<8.3\times10^{-5}$	CL=90%	1759
$\pi^+\pi^-$	$(8\ \ \pm5\ \ )\times10^{-5}$		1838
$\Xi^-\overline{\Xi}^+$	$(9.4\ \pm3.1\ )\times10^{-5}$		1285
$K_1(1400)^\pm K^\mp$	$<3.1\times10^{-4}$	CL=90%	1532
$\Xi^{*0}\overline{\Xi}^{*0}$	$<8.1\times10^{-5}$	CL=90%	1025
$\Omega^-\overline{\Omega}^+$	$<7.3\times10^{-5}$	CL=90%	774
$K^+K^-\pi^0$	$<2.96\times10^{-5}$	CL=90%	1754
$\quad K^+\overline{K}^*(892)^- +$ c.c.	$<5.4\times10^{-5}$	CL=90%	1698
$\phi\pi^+\pi^-$	$(1.50\pm0.28)\times10^{-4}$		1690
$\quad\phi f_0(980)\to\ \pi^+\pi^-$	$(6.0\ \pm2.2\ )\times10^{-5}$		–
ϕK^+K^-	$(6.0\ \pm2.2\ )\times10^{-5}$		1546
$\phi p\overline{p}$	$<2.6\times10^{-5}$	CL=90%	1109
$\phi f'_2(1525)$	$<4.5\times10^{-5}$	CL=90%	1321

Radiative decays

$\gamma\chi_{c0}(1P)$	$(8.6\ \pm0.7\ )$ %		261
$\gamma\chi_{c1}(1P)$	$(8.4\ \pm0.8\ )$ %		171
$\gamma\chi_{c2}(1P)$	$(6.4\ \pm0.6\ )$ %		128
$\gamma\eta_c(1S)$	$(2.8\ \pm0.6\ )\times10^{-3}$		639
$\gamma\eta'(958)$	$(1.5\ \pm0.4\ )\times10^{-4}$		1719
$\gamma f_2(1270)$	$(2.1\ \pm0.4\ )\times10^{-4}$		1622
$\gamma f_0(1710)\to\ \gamma\pi\pi$	$(3.0\ \pm1.3\ )\times10^{-5}$		–
$\gamma f_0(1710)\to\ \gamma K\overline{K}$	$(6.0\ \pm1.6\ )\times10^{-5}$		–
$\gamma\gamma$	$<1.5\times10^{-4}$	CL=90%	1843
$\gamma\eta$	$<9\times10^{-5}$	CL=90%	1802
$\gamma\eta(1405)\to\ \gamma K\overline{K}\pi$	$<1.2\times10^{-4}$	CL=90%	1569

$\psi(3770)$

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

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

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

$\psi(4040)$ [mmm]

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

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

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

$\psi(4160)$ [mmm]

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

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

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

$\psi(4415)$ [mmm]

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

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

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

$b\overline{b}$ MESONS

$\Upsilon(1S)$

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

Mass $m = 9460.30 \pm 0.26$ MeV (S = 3.3)
Full width $\Gamma = 53.0 \pm 1.5$ keV
$\Gamma_{ee} = 1.314 \pm 0.029$ 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			
$\eta'(958)$anything	$(2.8\ \pm0.4\ )$ %		–
$J/\psi(1S)$anything	$(1.1\ \pm0.4\ )\times10^{-3}$		4223
$\rho\pi$	$<2\ \times10^{-4}$	90%	4697
$\pi^+\pi^-$	$<5\ \times10^{-4}$	90%	4728
K^+K^-	$<5\ \times10^{-4}$	90%	4704
$p\overline{p}$	$<5\ \times10^{-4}$	90%	4636
$\pi^0\pi^+\pi^-$	$<1.84\ \times10^{-5}$	90%	4725
Radiative decays			
$\gamma\pi^+\pi^-$	$(6.3\ \pm1.8\ )\times10^{-5}$		4728
$\gamma\pi^0\pi^0$	$(1.7\ \pm0.7\ )\times10^{-5}$		4728
$\gamma 2h^+2h^-$	$(7.0\ \pm1.5\ )\times10^{-4}$		4720
$\gamma 3h^+3h^-$	$(5.4\ \pm2.0\ )\times10^{-4}$		4703
$\gamma 4h^+4h^-$	$(7.4\ \pm3.5\ )\times10^{-4}$		4679
$\gamma\pi^+\pi^-K^+K^-$	$(2.9\ \pm0.9\ )\times10^{-4}$		4686
$\gamma 2\pi^+2\pi^-$	$(2.5\ \pm0.9\ )\times10^{-4}$		4720
$\gamma 3\pi^+3\pi^-$	$(2.5\ \pm1.2\ )\times10^{-4}$		4703
$\gamma 2\pi^+2\pi^-K^+K^-$	$(2.4\ \pm1.2\ )\times10^{-4}$		4658
$\gamma\pi^+\pi^-p\overline{p}$	$(1.5\ \pm0.6\ )\times10^{-4}$		4604
$\gamma 2\pi^+2\pi^-p\overline{p}$	$(4\ \pm6\ )\times10^{-5}$		4563
$\gamma 2K^+2K^-$	$(2.0\ \pm2.0\ )\times10^{-5}$		4601
$\gamma\eta'(958)$	$<1.6\ \times10^{-5}$	90%	4682
$\gamma\eta$	$<2.1\ \times10^{-5}$	90%	4714
$\gamma f'_2(1525)$	$<1.4\ \times10^{-4}$	90%	4607
$\gamma f_2(1270)$	$(8\ \pm4\ )\times10^{-5}$		4644
$\gamma\eta(1405)$	$<8.2\ \times10^{-5}$	90%	4625
$\gamma f_0(1710) \to \gamma K\overline{K}$	$<2.6\ \times10^{-4}$	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
$\gamma f_J(2220) \to \gamma \pi^+ \pi^-$	< 1.2	$\times 10^{-5}$	90%	–
$\gamma f_J(2220) \to \gamma p \overline{p}$	< 1.6	$\times 10^{-5}$	90%	–
$\gamma \eta(2225) \to \gamma \phi \phi$	< 3	$\times 10^{-3}$	90%	4469
γX (X = pseudoscalar with $m < 7.2$ GeV)	< 3	$\times 10^{-5}$	90%	–
$\gamma X \overline{X}$ ($X\overline{X}$ = vectors with $m < 3.1$ GeV)	< 1	$\times 10^{-3}$	90%	–

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

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

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

$I^G(J^{PC}) = 0^+(1^{++})$
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) %	423

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

$I^G(J^{PC}) = 0^+(2^{++})$
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) %	442

$\Upsilon(2S)$

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

Mass $m = 10.02326 \pm 0.00031$ GeV
Full width $\Gamma = 43 \pm 6$ keV
$\Gamma_{ee} = 0.576 \pm 0.024$ 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^-	(1.34 ± 0.20) %		5012
$\Upsilon(1S)\pi^0$	$< 1.1 \times 10^{-3}$	90%	531
$\Upsilon(1S)\eta$	$< 2 \times 10^{-3}$	90%	126
$J/\psi(1S)$anything	$< 6 \times 10^{-3}$	90%	4533
Radiative decays			
$\gamma\chi_{b1}(1P)$	(6.8 ± 0.7) %		130
$\gamma\chi_{b2}(1P)$	(7.0 ± 0.6) %		110
$\gamma\chi_{b0}(1P)$	(3.8 ± 0.6) %		162
$\gamma f_0(1710)$	$< 5.9 \times 10^{-4}$	90%	4865
$\gamma f'_2(1525)$	$< 5.3 \times 10^{-4}$	90%	4896
$\gamma f_2(1270)$	$< 2.41 \times 10^{-4}$	90%	4930

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

$I^G(J^{PC}) = 0^+(0^{++})$
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) %	207
$\gamma\,\Upsilon(1S)$	$(9 \pm 6) \times 10^{-3}$	743

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

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

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

$I^G(J^{PC}) = 0^+(2^{++})$
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
$\gamma\, \Upsilon(1S)$	$(\ 7.1 \pm 1.0)$ %	776

$\Upsilon(3S)$

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

Mass $m = 10.3552 \pm 0.0005$ GeV
Full width $\Gamma = 26.3 \pm 3.4$ keV

$\Upsilon(3S)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\Upsilon(2S)$anything	(10.6 ± 0.8) %		296
$\Upsilon(2S)\pi^+\pi^-$	$(\ 2.8 \pm 0.6)$ %	S=2.2	177
$\Upsilon(2S)\pi^0\pi^0$	$(\ 2.00 \pm 0.32)$ %		190
$\Upsilon(2S)\gamma\gamma$	$(\ 5.0 \pm 0.7)$ %		327
$\Upsilon(1S)\pi^+\pi^-$	$(\ 4.48 \pm 0.21)$ %		813
$\Upsilon(1S)\pi^0\pi^0$	$(\ 2.06 \pm 0.28)$ %		816
$\Upsilon(1S)\eta$	$< 2.2 \times 10^{-3}$	CL=90%	677
$\mu^+\mu^-$	$(\ 1.81 \pm 0.17)$ %		5177
e^+e^-	seen		5178
Radiative decays			
$\gamma\,\chi_{b2}(2P)$	(11.4 ± 0.8) %	S=1.3	86
$\gamma\,\chi_{b1}(2P)$	(11.3 ± 0.6) %		100
$\gamma\,\chi_{b0}(2P)$	$(\ 5.4 \pm 0.6)$ %	S=1.1	122

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

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

Mass $m = 10.5800 \pm 0.0035$ GeV
Full width $\Gamma = 20 \pm 4$ MeV
$\Gamma_{ee} = 0.248 \pm 0.031$ keV (S = 1.3)

$\Upsilon(4S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$B\overline{B}$	> 96 %	95%	335
non-$B\overline{B}$	< 4 %	95%	–
e^+e^-	$(\ 2.8 \pm 0.7) \times 10^{-5}$		5290

$J/\psi(1S)$anything	$<$ 1.9	$\times 10^{-4}$	95%	–
D^{*+}anything + c.c.	$<$ 7.4	%	90%	5099
ϕanything	$<$ 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%	1027
$\Upsilon(2S)\pi^+\pi^-$	$<$ 3.9	$\times 10^{-4}$	90%	469

Υ(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

Υ(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^-	$(1.6\pm0.5) \times 10^{-6}$	5510

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*] Due to a new measurement in the average, this is 0.45 MeV larger than the mass we gave in our 2002 edition, 547.30 ± 0.12 MeV.

[*g*] Due to removing an old measurement from the average, this is 0.11 keV larger than the width we gave in our 2002 edition, 1.18 ± 0.11 keV. See the $\Gamma(2\gamma)$ data block in the Data Listings.

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

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

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

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

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

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

[*n*] 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.

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

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

[*q*] See the "Note on the $f_1(1420)$" in the $\eta(1405)$ Particle Listings.

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

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

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

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

[*v*] See the note in the $K^{\pm}$ Particle Listings.

[*w*] 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):

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

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

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

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

[*aa*] Structure-dependent part.

[*bb*] Direct-emission branching fraction.

[*cc*] Violates angular-momentum conservation.

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

[*ee*] 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^0_L Decay" in the Particle Listings):

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

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

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

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

$$\mathrm{Im}(\eta_{000})^2 = \frac{\Gamma(K^0_S \rightarrow \pi^0\pi^0\pi^0)}{\Gamma(K^0_L \rightarrow \pi^0\pi^0\pi^0)} .$$

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

[*ff*] See the K^0_S Particle Listings for the energy limits used in this measurement.

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

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

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

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

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

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

[*mm*] 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 .

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

[*oo*] 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.

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

[*qq*] 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^+.

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

[*ss*] 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.

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

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

[*vv*] Unseen decay modes of the resonance are included.

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

[*xx*] 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.

[*yy*] 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.

[*zz*] 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.

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

[*bbb*] 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*.

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

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

[*eee*] B^0 and B_s^0 contributions not separated. Limit is on weighted average of the two decay rates.

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

[*ggg*] D^{**} stands for the sum of the $D(1\,^1P_1)$, $D(1\,^3P_0)$, $D(1\,^3P_1)$, $D(1\,^3P_2)$, $D(2\,^1S_0)$, and $D(2\,^1S_1)$ resonances.

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

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

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

[*kkk*] Not a pure measurement. See note at head of B_s^0 Decay Modes.

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

[*mmm*] 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.

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