CHARMED, STRANGE MESONS ($C = S = \pm 1$)

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

$D_s^\pm$

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

Mass $m = 1968.49 \pm 0.34$ MeV (S = 1.3)
$m_{D_s^\pm} - m_{D^\pm} = 98.87 \pm 0.30$ MeV (S = 1.4)
Mean life $\tau = (500 \pm 7) \times 10^{-15}$ s (S = 1.3)
$c\tau = 149.9$ μm

CP-violating decay-rate asymmetries

$A_{CP}(K^\pm K_S^0) = 0.049 \pm 0.023$
$A_{CP}(K^+ K^- \pi^\pm) = 0.003 \pm 0.014$
$A_{CP}(K^+ K^- \pi^\pm \pi^0) = -0.06 \pm 0.04$
$A_{CP}(K_S^0 K^\mp 2\pi^\pm) = -0.01 \pm 0.04$
$A_{CP}(\pi^+ \pi^- \pi^\pm) = 0.02 \pm 0.05$
$A_{CP}(\pi^\pm \eta) = -0.08 \pm 0.05$
$A_{CP}(\pi^\pm \eta') = -0.06 \pm 0.04$
$A_{CP}(K^\pm \pi^0) = 0.02 \pm 0.29$
$A_{CP}(K_S^0 \pi^\pm) = 0.27 \pm 0.11$
$A_{CP}(K^\pm \pi^+ \pi^-) = 0.11 \pm 0.07$
$A_{CP}(K^\pm \eta) = -0.20 \pm 0.18$
$A_{CP}(K^\pm \eta'(958)) = -0.2 \pm 0.4$

T-violating decay-rate asymmetry

$A_T(K_S^0 K^\pm \pi^+ \pi^-) = -0.04 \pm 0.07$ [a]

D_s^+ form factors

$r_2 = 1.32 \pm 0.24$ (S = 1.2)
$r_v = 1.72 \pm 0.21$
$\Gamma_L/\Gamma_T = 0.72 \pm 0.18$

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)	Confidence level	p (MeV/c)
Inclusive modes				
K^- anything		(13 $^{+14}_{-12}$) %		–
$\overline{K}^0$ anything + K^0 anything		(39 $\pm$28) %		–
K^+ anything		(20 $^{+18}_{-14}$) %		–
(non-K $\overline{K}$) anything		(64 $\pm$17) %		–
η anything	[b]	(24 $\pm$ 4) %		–
η' anything		(8.7 $\pm$ 2.1) %		–
ϕ anything		(16.1 $\pm$ 1.6) %		–
e^+ anything		(8 $^{+6}_{-5}$) %		–
Leptonic and semileptonic modes				
$e^+\nu_e$		$<$ 1.3 $\times 10^{-4}$	90%	984
$\mu^+\nu_\mu$		(6.2 $\pm$ 0.6) $\times 10^{-3}$		981
$\tau^+\nu_\tau$		(6.6 $\pm$ 0.6) %		182
$\phi\ell^+\nu_\ell$	[c]	(2.36$\pm$ 0.26) %		720
$\eta\ell^+\nu_\ell$ + $\eta'(958)\ell^+\nu_\ell$	[c]	(3.9 $\pm$ 0.7) %		–
$\eta\ell^+\nu_\ell$	[c]	(2.9 $\pm$ 0.6) %		908
$\eta'(958)\ell^+\nu_\ell$	[c]	(1.02$\pm$ 0.33) %		751
Hadronic modes with a $K\overline{K}$ pair				
$K^+K^0_S$		(1.49$\pm$ 0.09) %		850
$K^+K^-\pi^+$	[d]	(5.50$\pm$ 0.28) %		805
$\phi\pi^+$	[e,f]	(4.38$\pm$ 0.35) %		712
$\phi\pi^+$, $\phi\to K^+K^-$	[e]	(2.18$\pm$ 0.33) %		712
$K^+\overline{K}^*(892)^0$, $\overline{K}^{*0}\to K^-\pi^+$		(2.6 $\pm$ 0.4) %		416
$f_0(980)\pi^+$, $f_0\to K^+K^-$		(6.0 $\pm$ 2.4) $\times 10^{-3}$		732
$K^+\overline{K}^*_0(1430)^0$, $\overline{K}^*_0\to K^-\pi^+$		(5.1 $\pm$ 2.5) $\times 10^{-3}$		218
$K^0\overline{K}^0\pi^+$		—		802
$K^*(892)^+\overline{K}^0$	[f]	(5.3 $\pm$ 1.2) %		683
$K^+K^-\pi^+\pi^0$		(5.6 $\pm$ 0.5) %		748
$\phi\rho^+$, $\phi\to K^+K^-$		(4.0 $^{+1.1}_{-1.2}$) %		400
$\phi\pi^+\pi^0$ 3-body, $\phi\to K^+K^-$		$<$ 1.5 %	90%	686
$K^+K^-\pi^+\pi^0$ non-ϕ		$<$ 11 %	90%	748

$K^0_S K^- \pi^+ \pi^+$		(1.64± 0.12) %		744
$K^*(892)^+ \overline{K}^*(892)^0$	[f]	(7.0 ± 2.5) %		417
$K^0 K^- 2\pi^+$ (non-$K^{*+} \overline{K}^{*0}$)		< 3.5 %	90%	744
$K^+ K^0_S \pi^+ \pi^-$		(9.6 ± 1.3) × 10^{-3}		744
$K^+ K^- \pi^+ \pi^+ \pi^-$		(8.8 ± 1.6) × 10^{-3}		673
$\phi \pi^+ \pi^+ \pi^-$, $\phi \to K^+ K^-$		(5.9 ± 1.1) × 10^{-3}		640
$K^+ K^- \rho^0 \pi^+$ non-ϕ		< 2.6 × 10^{-4}	90%	249
$\phi \rho^0 \pi^+$, $\phi \to K^+ K^-$		(6.6 ± 1.3) × 10^{-3}		181
$\phi a_1(1260)^+$, $\phi \to K^+ K^-$, $a_1^+ \to \rho^0 \pi^+$		(7.5 ± 1.3) × 10^{-3}		†
$K^+ K^- \pi^+ \pi^+ \pi^-$ nonresonant		(9 ± 7) × 10^{-4}		673
$K^0_S K^0_S \pi^+ \pi^+ \pi^-$		(8.4 ± 3.5) × 10^{-4}		669

Hadronic modes without K's

$\pi^+ \pi^0$		< 6 × 10^{-4}	90%	975
$\pi^+ \pi^+ \pi^-$		(1.11± 0.08) %		959
$\rho^0 \pi^+$		not seen		825
$\pi^+ (\pi^+ \pi^-)_{S-\text{wave}}$	[g]	(9.7 ± 1.1) × 10^{-3}		959
$f_2(1270)\pi^+$, $f_2 \to \pi^+ \pi^-$		(1.1 ± 0.6) × 10^{-3}		559
$\rho(1450)^0 \pi^+$, $\rho^0 \to \pi^+ \pi^-$		(7 ± 6) × 10^{-4}		421
$\pi^+ \pi^+ \pi^- \pi^0$		< 14 %	90%	935
$\eta \pi^+$	[f]	(1.58± 0.21) %		902
$\omega \pi^+$	[f]	(2.5 ± 0.9) × 10^{-3}		822
$3\pi^+ 2\pi^-$		(8.0 ± 0.9) × 10^{-3}		899
$\pi^+ \pi^+ \pi^- \pi^0 \pi^0$		—		902
$\eta \rho^+$	[f]	(13.0 ± 2.2) %		724
$\eta \pi^+ \pi^0$ 3-body	[f]	< 5 %	90%	886
$3\pi^+ 2\pi^- \pi^0$		(4.9 ± 3.2) %		856
$\eta'(958)\pi^+$	[f]	(3.8 ± 0.4) %		743
$3\pi^+ 2\pi^- 2\pi^0$		—		803
$\eta'(958)\rho^+$	[f]	(12.2 ± 2.0) %		465
$\eta'(958)\pi^+ \pi^0$ 3-body	[f]	< 1.8 %	90%	720

Modes with one or three K's

$K^+ \pi^0$		(8.2 ± 2.2) × 10^{-4}		917
$K^0_S \pi^+$		(1.25± 0.15) × 10^{-3}		916
$K^+ \eta$		(1.41± 0.31) × 10^{-3}		835
$K^+ \eta'(958)$		(1.6 ± 0.5) × 10^{-3}		646
$K^+ \pi^+ \pi^-$		(6.9 ± 0.5) × 10^{-3}		900
$K^+ \rho^0$		(2.7 ± 0.5) × 10^{-3}		745
$K^+ \rho(1450)^0$, $\rho^0 \to \pi^+ \pi^-$		(7.4 ± 2.6) × 10^{-4}		–
$K^*(892)^0 \pi^+$, $K^{*0} \to K^+ \pi^-$		(1.50± 0.26) × 10^{-3}		775
$K^*(1410)^0 \pi^+$, $K^{*0} \to K^+ \pi^-$		(1.30± 0.31) × 10^{-3}		–

$K^*(1430)^0\pi^+$, $K^{*0}\to K^+\pi^-$		(5 ± 4) × 10^{-4}			–
$K^+\pi^+\pi^-$ nonresonant		(1.1 ± 0.4) × 10^{-3}			900
$K^0_S\pi^+\pi^+\pi^-$		(3.0 ± 1.1) × 10^{-3}			870
$K^+K^+K^-$		(4.9 ± 1.7) × 10^{-4}			628
ϕK^+, $\phi\to K^+K^-$		< 2.8 × 10^{-4}		90%	607

Doubly Cabibbo-suppressed modes

$K^+K^+\pi^-$		(2.9 ± 1.1) × 10^{-4}			805

Baryon-antibaryon mode

$p\overline{n}$		(1.3 ± 0.4) × 10^{-3}			295

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

$\pi^+e^+e^-$		[*h*] < 2.7	× 10^{-4}	90%	979
$\pi^+\mu^+\mu^-$		[*h*] < 2.6	× 10^{-5}	90%	968
$K^+e^+e^-$	*C1*	< 1.6	× 10^{-3}	90%	922
$K^+\mu^+\mu^-$	*C1*	< 3.6	× 10^{-5}	90%	909
$K^*(892)^+\mu^+\mu^-$	*C1*	< 1.4	× 10^{-3}	90%	765
$\pi^+e^\pm\mu^\mp$	*LF*	[*i*] < 6.1	× 10^{-4}	90%	976
$K^+e^\pm\mu^\mp$	*LF*	[*i*] < 6.3	× 10^{-4}	90%	919
$\pi^-e^+e^+$	*L*	< 6.9	× 10^{-4}	90%	979
$\pi^-\mu^+\mu^+$	*L*	< 2.9	× 10^{-5}	90%	968
$\pi^-e^+\mu^+$	*L*	< 7.3	× 10^{-4}	90%	976
$K^-e^+e^+$	*L*	< 6.3	× 10^{-4}	90%	922
$K^-\mu^+\mu^+$	*L*	< 1.3	× 10^{-5}	90%	909
$K^-e^+\mu^+$	*L*	< 6.8	× 10^{-4}	90%	919
$K^*(892)^-\mu^+\mu^+$	*L*	< 1.4	× 10^{-3}	90%	765

$D_s^{*\pm}$

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

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

Mass $m = 2112.3 \pm 0.5$ 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±0.7) %	139
$D_s^+\pi^0$	(5.8±0.7) %	48

$D_{s0}^*(2317)^\pm$

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

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

Mass $m = 2317.8 \pm 0.6$ MeV (S = 1.1)
$m_{D_{s0}^*(2317)^\pm} - m_{D_s^\pm} = 349.3 \pm 0.6$ MeV (S = 1.1)
Full width $\Gamma < 3.8$ MeV, CL = 95%

$D_{s0}^*(2317)^-$ modes are charge conjugates of modes below.

$D_{s0}^*(2317)^\pm$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$D_s^+\pi^0$	seen	298
$D_s^+\pi^0\pi^0$	not seen	205

$D_{s1}(2460)^\pm$

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

Mass $m = 2459.6 \pm 0.6$ MeV (S = 1.1)
$m_{D_{s1}(2460)^\pm} - m_{D_s^{*\pm}} = 347.2 \pm 0.8$ MeV (S = 1.2)
$m_{D_{s1}(2460)^\pm} - m_{D_s^\pm} = 491.1 \pm 0.7$ MeV (S = 1.1)
Full width $\Gamma < 3.5$ MeV, CL = 95%

$D_{s1}(2460)^-$ modes are charge conjugates of the modes below.

$D_{s1}(2460)^+$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$D_s^{*+}\pi^0$	(48 ±11) %		297
$D_s^+\gamma$	(18 ± 4) %		442
$D_s^+\pi^+\pi^-$	(4.3± 1.3) %	S=1.1	363
$D_s^{*+}\gamma$	< 8 %	CL=90%	323
$D_{s0}^*(2317)^+\gamma$	($3.7^{+\ 5.1}_{-\ 2.4}$) %		138

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

$I(J^P) = 0(1^+)$
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	149
$D^*(2007)^0K^+$	seen	168
D^+K^0	not seen	382
D^0K^+	not seen	391
$D_s^{*+}\gamma$	possibly seen	388
$D_s^+\pi^+\pi^-$	seen	437

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

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

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

Mass $m = 2572.6 \pm 0.9$ MeV
Full width $\Gamma = 20 \pm 5$ MeV (S = 1.3)

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

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

NOTES

[*a*] See the Particle Listings for the (complicated) definition of this quantity.

[*b*] This fraction includes η from η' decays.

[*c*] 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*.

[*d*] 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.

[*e*] We decouple the $D_s^+ \to \phi\pi^+$ branching fraction obtained from mass projections (and used to get some of the other branching fractions) from the $D_s^+ \to \phi\pi^+$, $\phi \to K^+K^-$ branching fraction obtained from the Dalitz-plot analysis of $D_s^+ \to K^+K^-\pi^+$. That is, the ratio of these two branching fractions is not exactly the $\phi \to K^+K^-$ branching fraction 0.491.

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

[*g*] This comes from a *K*-matrix parametrization of the $\pi^+\pi^-$ *S*-wave and is a sum over the $f_0(980)$, $f_0(1300)$, $f_0(1200\text{–}1600)$, $f_0(1500)$, and $f_0(1750)$. Not all of these correspond to particles in our Tables.

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

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