$D_s^{\pm}$

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

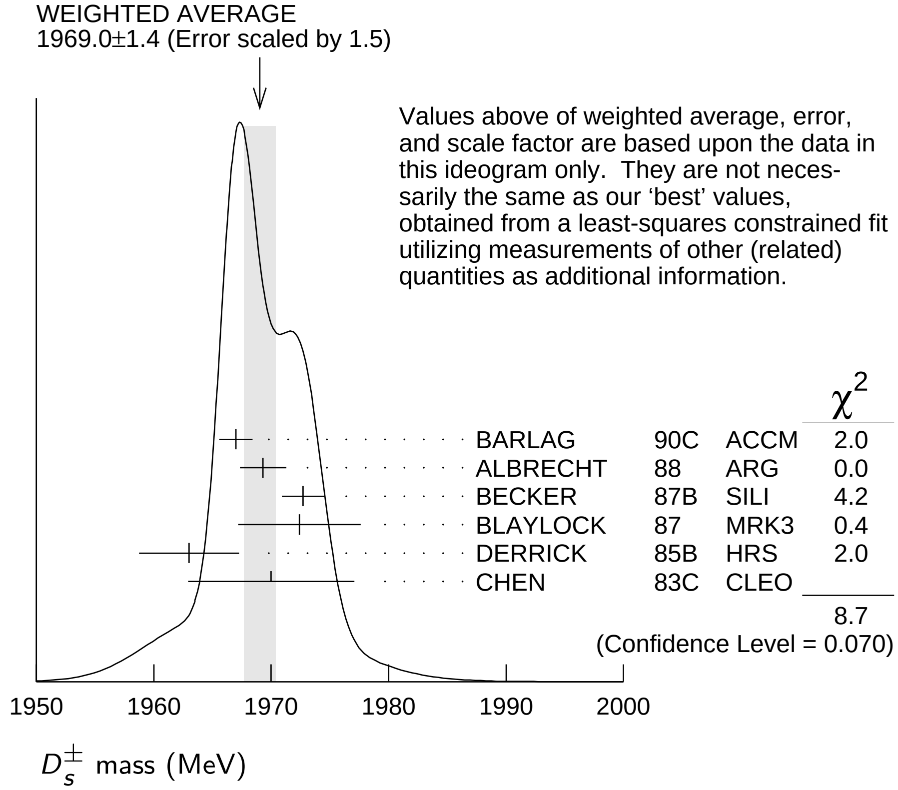
The angular distributions of the decays of the ϕ and $\overline{K}^*(892)^0$ in the $\phi\pi^+$ and $K^+\overline{K}^*(892)^0$ modes strongly indicate that the spin is zero. The parity given is that expected of a $c\overline{s}$ ground state.

$D_s^{\pm}$ MASS

The fit includes $D^{\pm}$, D^0, $D_s^{\pm}$, $D^{*\pm}$, D^{*0}, $D_s^{*\pm}$, $D_1(2420)^0$, $D_2^*(2460)^0$, and $D_{s1}(2536)^{\pm}$ mass and mass difference measurements. Measurements of the $D_s^{\pm}$ mass with an error greater than 10 MeV are omitted from the fit and average. A number of early measurements have been omitted altogether.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1968.34± 0.07 OUR FIT					
1969.0 ± 1.4 OUR AVERAGE Error includes scale factor of 1.5. See the ideogram below.					
1967.0 ± 1.0 ± 1.0	54	BARLAG	90C	ACCM	π^- Cu 230 GeV
1969.3 ± 1.4 ± 1.4		ALBRECHT	88	ARG	e^+e^- 9.4–10.6 GeV
1972.7 ± 1.5 ± 1.0	21	BECKER	87B	SILI	200 GeV π,K,p
1972.4 ± 3.7 ± 3.7	27	BLAYLOCK	87	MRK3	e^+e^- 4.14 GeV
1963 ± 3 ± 3	30	DERRICK	85B	HRS	e^+e^- 29 GeV
1970 ± 5 ± 5	104	CHEN	83C	CLEO	e^+e^- 10.5 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1968.3 ± 0.7 ± 0.7	290	[1] ANJOS	88	E691	Photoproduction
1980 ±15	6	USHIDA	86	EMUL	ν wideband
1973.6 ± 2.6 ± 3.0	163	ALBRECHT	85D	ARG	e^+e^- 10 GeV
1948 ±28 ±10	65	AIHARA	84D	TPC	e^+e^- 29 GeV
1975 ± 9 ±10	49	ALTHOFF	84	TASS	e^+e^- 14–25 GeV
1975 ± 4	3	BAILEY	84	ACCM	hadron$^+$ Be $\rightarrow$ $\phi\pi^+$X

[1] ANJOS 88 enters the fit via $m_{D_s^{\pm}} - m_{D^{\pm}}$ (see below).



$m_{D_s^\pm} - m_{D^\pm}$

The fit includes $D^\pm$, D^0, $D_s^\pm$, $D^{*\pm}$, D^{*0}, $D_s^{*\pm}$, $D_1(2420)^0$, $D_2^*(2460)^0$, and $D_{s1}(2536)^\pm$ mass and mass difference measurements.

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
98.69±0.05 OUR FIT					
98.69±0.05 OUR AVERAGE					
98.68±0.03±0.04		AAIJ	13V	LHCB	$D_s^+ \rightarrow K^+ K^- \pi^+$
99.41±0.38±0.21		ACOSTA	03D	CDF2	$\overline{p}p$, $\sqrt{s}$= 1.96 TeV
98.4 ±0.1 ±0.3	48k	AUBERT	02G	BABR	$e^+ e^- \approx \Upsilon(4S)$
99.5 ±0.6 ±0.3		BROWN	94	CLE2	$e^+ e^- \approx \Upsilon(4S)$
98.5 ±1.5	555	CHEN	89	CLEO	$e^+ e^-$ 10.5 GeV
99.0 ±0.8	290	ANJOS	88	E691	Photoproduction

$D_s^\pm$ MEAN LIFE

Measurements with an error greater than 100×10^{-15} s or with fewer than 100 events have been omitted from the Listings.

VALUE (10^{-15} s)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
504 ± 4 OUR AVERAGE Error includes scale factor of 1.2.					
506.4± 3.0± 1.7±1.7		[1] AAIJ	17AN	LHCB	pp at 7, 8 TeV
507.4± 5.5± 5.1	13.6k	LINK	05J	FOCS	$\Phi\pi^+$ and $\overline{K}^{*0} K^+$
472.5±17.2± 6.6	760	IORI	01	SELX	600 GeV Σ^-, π^-, p

518 ±14 ± 7	1662	AITALA	99	E791	π^- nucleus, 500 GeV
$486.3 \pm 15.0^{+4.9}_{-5.1}$	2167	[2] BONVICINI	99	CLE2	$e^+ e^- \approx \Upsilon(4S)$
475 ±20 ± 7	900	FRABETTI	93F	E687	γBe, $\phi \pi^+$
500 ±60 ±30	104	FRABETTI	90	E687	γBe, $\phi \pi^+$
470 ±40 ±20	228	RAAB	88	E691	Photoproduction

[1] This AAIJ 17AN value is derived from the difference between the D_s^- and D^- widths. The 3rd uncertainty, $\pm 1.7 \times 10^{-15}$ s, arises from the uncertainty of the D^- width.

[2] BONVICINI 99 obtains 1.19 ± 0.04 for the ratio of D_s^+ to D^0 lifetimes.

D_s^+ DECAY MODES

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.

	Mode		Fraction (Γ_i/Γ)	Scale factor/ Confidence level
	Inclusive modes			
Γ_1	e^+ semileptonic	[a]	(6.5 ±0.4) %	
Γ_2	π^+ anything		(119.3 ±1.4) %	
Γ_3	π^- anything		(43.2 ±0.9) %	
Γ_4	π^0 anything		(123 ±7) %	
Γ_5	K^- anything		(18.7 ±0.5) %	
Γ_6	K^+ anything		(28.9 ±0.7) %	
Γ_7	K_S^0 anything		(19.0 ±1.1) %	
Γ_8	η anything	[b]	(29.9 ±2.8) %	
Γ_9	ω anything		(6.1 ±1.4) %	
Γ_{10}	η' anything	[c]	(10.3 ±1.4) %	S=1.1
Γ_{11}	$f_0(980)$ anything, $f_0 \to \pi^+\pi^-$		< 1.3 %	CL=90%
Γ_{12}	ϕ anything		(15.7 ±1.0) %	
Γ_{13}	$K^+ K^-$ anything		(15.8 ±0.7) %	
Γ_{14}	$K_S^0 K^+$ anything		(5.8 ±0.5) %	
Γ_{15}	$K_S^0 K^-$ anything		(1.9 ±0.4) %	
Γ_{16}	$2K_S^0$ anything		(1.70±0.32) %	
Γ_{17}	$2K^+$ anything		< 2.6 $\times 10^{-3}$	CL=90%
Γ_{18}	$2K^-$ anything		< 6 $\times 10^{-4}$	CL=90%
	Leptonic and semileptonic modes			
Γ_{19}	$e^+ \nu_e$		< 8.3 $\times 10^{-5}$	CL=90%
Γ_{20}	$\mu^+ \nu_\mu$		(5.50±0.23) $\times 10^{-3}$	
Γ_{21}	$\tau^+ \nu_\tau$		(5.48±0.23) %	
Γ_{22}	$K^+ K^- e^+ \nu_e$		—	
Γ_{23}	$\phi e^+ \nu_e$	[d]	(2.39±0.16) %	S=1.3
Γ_{24}	$\phi \mu^+ \nu_\mu$		(1.9 ±0.5) %	
Γ_{25}	$\eta e^+ \nu_e + \eta'(958) e^+ \nu_e$	[d]	(3.03±0.24) %	

Γ_{26}	$\eta e^+ \nu_e$	[d]	(2.29 ± 0.19) %	
Γ_{27}	$\eta'(958) e^+ \nu_e$	[d]	$(7.4 \pm 1.4) \times 10^{-3}$	
Γ_{28}	$\eta \mu^+ \nu_\mu$		(2.4 ± 0.5) %	
Γ_{29}	$\eta'(958) \mu^+ \nu_\mu$		(1.1 ± 0.5) %	
Γ_{30}	$\omega e^+ \nu_e$	[e]	$< 2.0 \times 10^{-3}$	CL=90%
Γ_{31}	$K^0 e^+ \nu_e$		$(3.9 \pm 0.9) \times 10^{-3}$	
Γ_{32}	$K^*(892)^0 e^+ \nu_e$	[d]	$(1.8 \pm 0.4) \times 10^{-3}$	
Γ_{33}	$f_0(980) e^+ \nu_e,\ f_0 \to \pi^+ \pi^-$			

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

Γ_{34}	$K^+ K^0_S$		(1.50 ± 0.05) %	
Γ_{35}	$K^+ \overline{K}^0$		(2.95 ± 0.14) %	
Γ_{36}	$K^+ K^- \pi^+$	[f]	(5.45 ± 0.17) %	S=1.2
Γ_{37}	$\phi \pi^+$	[d,g]	(4.5 ± 0.4) %	
Γ_{38}	$\phi \pi^+,\ \phi \to K^+ K^-$	[g]	(2.27 ± 0.08) %	
Γ_{39}	$K^+ \overline{K}^*(892)^0,\ \overline{K}^{*0} \to K^- \pi^+$		(2.61 ± 0.09) %	
Γ_{40}	$f_0(980) \pi^+,\ f_0 \to K^+ K^-$		(1.15 ± 0.32) %	
Γ_{41}	$f_0(1370) \pi^+,\ f_0 \to K^+ K^-$		$(7 \pm 5) \times 10^{-4}$	
Γ_{42}	$f_0(1710) \pi^+,\ f_0 \to K^+ K^-$		$(6.7 \pm 2.9) \times 10^{-4}$	
Γ_{43}	$K^+ \overline{K}^*_0(1430)^0,\ \overline{K}^*_0 \to K^- \pi^+$		$(1.9 \pm 0.4) \times 10^{-3}$	
Γ_{44}	$K^+ K^0_S \pi^0$		(1.52 ± 0.22) %	
Γ_{45}	$2K^0_S \pi^+$		$(7.7 \pm 0.6) \times 10^{-3}$	
Γ_{46}	$K^0 \overline{K}^0 \pi^+$		—	
Γ_{47}	$K^*(892)^+ \overline{K}^0$	[d]	(5.4 ± 1.2) %	
Γ_{48}	$K^+ K^- \pi^+ \pi^0$		(6.3 ± 0.6) %	
Γ_{49}	$\phi \rho^+$	[d]	$(8.4 {}^{+1.9}_{-2.3})$ %	
Γ_{50}	$K^0_S K^- 2\pi^+$		(1.68 ± 0.10) %	
Γ_{51}	$K^*(892)^+ \overline{K}^*(892)^0$	[d]	(7.2 ± 2.6) %	
Γ_{52}	$K^+ K^0_S \pi^+ \pi^-$		(1.00 ± 0.08) %	
Γ_{53}	$K^+ K^- 2\pi^+ \pi^-$		$(8.7 \pm 1.5) \times 10^{-3}$	
Γ_{54}	$\phi 2\pi^+ \pi^-$	[d]	(1.21 ± 0.16) %	
Γ_{55}	$K^+ K^- \rho^0 \pi^+$ non-ϕ		$< 2.6 \times 10^{-4}$	CL=90%
Γ_{56}	$\phi \rho^0 \pi^+,\ \phi \to K^+ K^-$		$(6.5 \pm 1.3) \times 10^{-3}$	
Γ_{57}	$\phi a_1(1260)^+,\ \phi \to K^+ K^-,\ a_1^+ \to \rho^0 \pi^+$		$(7.5 \pm 1.2) \times 10^{-3}$	
Γ_{58}	$K^+ K^- 2\pi^+ \pi^-$ nonresonant		$(9 \pm 7) \times 10^{-4}$	
Γ_{59}	$2K^0_S 2\pi^+ \pi^-$		$(9 \pm 4) \times 10^{-4}$	

Hadronic modes without K's

Γ_{60}	$\pi^+\pi^0$		$<$ 3.5	$\times 10^{-4}$	CL=90%
Γ_{61}	$2\pi^+\pi^-$		(1.09±0.05)	%	S=1.1
Γ_{62}	$\rho^0\pi^+$		(2.0 ±1.2)	$\times 10^{-4}$	
Γ_{63}	$\pi^+(\pi^+\pi^-)_{S-\text{wave}}$	[h]	(9.1 ±0.4)	$\times 10^{-3}$	
Γ_{64}	$f_0(980)\pi^+$, $f_0 \to \pi^+\pi^-$				
Γ_{65}	$f_0(1370)\pi^+$, $f_0 \to \pi^+\pi^-$				
Γ_{66}	$f_0(1500)\pi^+$, $f_0 \to \pi^+\pi^-$				
Γ_{67}	$f_2(1270)\pi^+$, $f_2 \to \pi^+\pi^-$		(1.10±0.20)	$\times 10^{-3}$	
Γ_{68}	$\rho(1450)^0\pi^+$, $\rho^0 \to \pi^+\pi^-$		(3.0 ±2.0)	$\times 10^{-4}$	
Γ_{69}	$\pi^+2\pi^0$		(6.5 ±1.3)	$\times 10^{-3}$	
Γ_{70}	$2\pi^+\pi^-\pi^0$		—		
Γ_{71}	$\eta\pi^+$	[d]	(1.70±0.09)	%	S=1.1
Γ_{72}	$\omega\pi^+$	[d]	(2.4 ±0.6)	$\times 10^{-3}$	
Γ_{73}	$3\pi^+2\pi^-$		(8.0 ±0.8)	$\times 10^{-3}$	
Γ_{74}	$2\pi^+\pi^-2\pi^0$		—		
Γ_{75}	$\eta\rho^+$	[d]	(8.9 ±0.8)	%	
Γ_{76}	$\eta\pi^+\pi^0$		(9.2 ±1.2)	%	
Γ_{77}	$\omega\pi^+\pi^0$	[d]	(2.8 ±0.7)	%	
Γ_{78}	$3\pi^+2\pi^-\pi^0$		(4.9 ±3.2)	%	
Γ_{79}	$\omega 2\pi^+\pi^-$	[d]	(1.6 ±0.5)	%	
Γ_{80}	$\eta'(958)\pi^+$	[c,d]	(3.94±0.25)	%	
Γ_{81}	$3\pi^+2\pi^-2\pi^0$		—		
Γ_{82}	$\omega\eta\pi^+$	[d]	$<$ 2.13	%	CL=90%
Γ_{83}	$\eta'(958)\rho^+$	[c,d]	(5.8 ±1.5)	%	
Γ_{84}	$\eta'(958)\pi^+\pi^0$		(5.6 ±0.8)	%	
Γ_{85}	$\eta'(958)\pi^+\pi^0$ nonresonant		$<$ 5.1	%	CL=90%

Modes with one or three K's

Γ_{86}	$K^+\pi^0$		(6.3 ±2.1)	$\times 10^{-4}$	
Γ_{87}	$K^0_S\pi^+$		(1.22±0.06)	$\times 10^{-3}$	
Γ_{88}	$K^+\eta$	[d]	(1.77±0.35)	$\times 10^{-3}$	
Γ_{89}	$K^+\omega$	[d]	$<$ 2.4	$\times 10^{-3}$	CL=90%
Γ_{90}	$K^+\eta'(958)$	[d]	(1.8 ±0.6)	$\times 10^{-3}$	
Γ_{91}	$K^+\pi^+\pi^-$		(6.6 ±0.4)	$\times 10^{-3}$	
Γ_{92}	$K^+\rho^0$		(2.5 ±0.4)	$\times 10^{-3}$	
Γ_{93}	$K^+\rho(1450)^0$, $\rho^0 \to \pi^+\pi^-$		(7.0 ±2.4)	$\times 10^{-4}$	
Γ_{94}	$K^*(892)^0\pi^+$, $K^{*0} \to K^+\pi^-$		(1.42±0.24)	$\times 10^{-3}$	
Γ_{95}	$K^*(1410)^0\pi^+$, $K^{*0} \to K^+\pi^-$		(1.24±0.29)	$\times 10^{-3}$	
Γ_{96}	$K^*(1430)^0\pi^+$, $K^{*0} \to K^+\pi^-$		(5.0 ±3.5)	$\times 10^{-4}$	
Γ_{97}	$K^+\pi^+\pi^-$ nonresonant		(1.04±0.34)	$\times 10^{-3}$	
Γ_{98}	$K^0\pi^+\pi^0$		(1.00±0.18)	%	

Γ_{99}	$K^0_S 2\pi^+\pi^-$			$(3.0 \pm 1.1) \times 10^{-3}$	
Γ_{100}	$K^+\omega\pi^0$		[d] $<$	8.2×10^{-3}	CL=90%
Γ_{101}	$K^+\omega\pi^+\pi^-$		[d] $<$	5.4×10^{-3}	CL=90%
Γ_{102}	$K^+\omega\eta$		[d] $<$	7.9×10^{-3}	CL=90%
Γ_{103}	$2K^+K^-$			$(2.18 \pm 0.21) \times 10^{-4}$	
Γ_{104}	ϕK^+, $\phi \to K^+K^-$			$(8.9 \pm 2.0) \times 10^{-5}$	

Doubly Cabibbo-suppressed modes

Γ_{105}	$2K^+\pi^-$			$(1.27 \pm 0.13) \times 10^{-4}$	
Γ_{106}	$K^+K^*(892)^0$, $K^{*0} \to K^+\pi^-$			$(6.0 \pm 3.4) \times 10^{-5}$	

Baryon-antibaryon mode

Γ_{107}	$p\overline{n}$			$(1.3 \pm 0.4) \times 10^{-3}$	

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

Γ_{108}	$\pi^+e^+e^-$		[i] $<$	1.3×10^{-5}	CL=90%
Γ_{109}	$\pi^+\phi$, $\phi \to e^+e^-$		[j]	$(6\ ^{+8}_{-4}) \times 10^{-6}$	
Γ_{110}	$\pi^+\mu^+\mu^-$		[i] $<$	4.1×10^{-7}	CL=90%
Γ_{111}	$K^+e^+e^-$	*C1*	$<$	3.7×10^{-6}	CL=90%
Γ_{112}	$K^+\mu^+\mu^-$	*C1*	$<$	2.1×10^{-5}	CL=90%
Γ_{113}	$K^*(892)^+\mu^+\mu^-$	*C1*	$<$	1.4×10^{-3}	CL=90%
Γ_{114}	$\pi^+e^+\mu^-$	*LF*	$<$	1.2×10^{-5}	CL=90%
Γ_{115}	$\pi^+e^-\mu^+$	*LF*	$<$	2.0×10^{-5}	CL=90%
Γ_{116}	$K^+e^+\mu^-$	*LF*	$<$	1.4×10^{-5}	CL=90%
Γ_{117}	$K^+e^-\mu^+$	*LF*	$<$	9.7×10^{-6}	CL=90%
Γ_{118}	π^-2e^+	*L*	$<$	4.1×10^{-6}	CL=90%
Γ_{119}	$\pi^-2\mu^+$	*L*	$<$	1.2×10^{-7}	CL=90%
Γ_{120}	$\pi^-e^+\mu^+$	*L*	$<$	8.4×10^{-6}	CL=90%
Γ_{121}	K^-2e^+	*L*	$<$	5.2×10^{-6}	CL=90%
Γ_{122}	$K^-2\mu^+$	*L*	$<$	1.3×10^{-5}	CL=90%
Γ_{123}	$K^-e^+\mu^+$	*L*	$<$	6.1×10^{-6}	CL=90%
Γ_{124}	$K^*(892)^-2\mu^+$	*L*	$<$	1.4×10^{-3}	CL=90%

[a] This is the purely e^+ semileptonic branching fraction: the e^+ fraction from τ^+ decays has been subtracted off. The sum of our (non-τ) e^+ exclusive fractions — an $e^+\nu_e$ with an η, η', ϕ, K^0, or K^{*0} — is 5.99 ± 0.31 %.

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

[c] The sum of our exclusive η' fractions — $\eta' e^+\nu_e$, $\eta'\mu^+\nu_\mu$, $\eta'\pi^+$, $\eta'\rho^+$, and $\eta' K^+$ — is 11.8 ± 1.6%.

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

[*e*] A test for $u\overline{u}$ or $d\overline{d}$ content in the D_s^+. Neither Cabibbo-favored nor Cabibbo-suppressed decays can contribute, and $\omega - \phi$ mixing is an unlikely explanation for any fraction above about 2×10^{-4}.

[*f*] 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.

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

[*h*] This is the average of a model-independent and a *K*-matrix parametrization of the $\pi^+ \pi^-$ *S*-wave and is a sum over several f_0 mesons.

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

[*j*] This is *not* a test for the ΔC=1 weak neutral current, but leads to the $\pi^+ \ell^+ \ell^-$ final state.

CONSTRAINED FIT INFORMATION

An overall fit to 13 branching ratios uses 16 measurements and one constraint to determine 10 parameters. The overall fit has a $\chi^2 = 4.8$ for 7 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\left\langle \delta x_i \delta x_j \right\rangle / (\delta x_i \cdot \delta x_j)$, in percent, from the fit to the branching fractions, $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$. The fit constrains the x_i whose labels appear in this array to sum to one.

x_{36}	55							
x_{48}	15	27						
x_{50}	36	33	10					
x_{52}	24	26	9	38				
x_{61}	36	55	16	21	18			
x_{71}	16	0	−3	10	2	−1		
x_{72}	2	0	0	1	0	0	11	
x_{91}	21	19	3	13	7	10	12	1
	x_{34}	x_{36}	x_{48}	x_{50}	x_{52}	x_{61}	x_{71}	x_{72}

See the related review(s):

D_s^+ Branching Fractions

D_s^+ BRANCHING RATIOS

A number of older, now obsolete results have been omitted. They may be found in earlier editions.

Inclusive modes

$\Gamma(e^+ \text{semileptonic})/\Gamma_{\text{total}}$ Γ_1/Γ

This is the purely e^+ semileptonic branching fraction: the e^+ fraction from τ^+ decays has been subtracted off. The sum of our (non-τ) e^+ exclusive fractions — an $e^+\nu_e$ with an η, η', ϕ, K^0, or K^{*0} — is 5.99 ± 0.31 %.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
6.52±0.39±0.15	536 ± 29	[1] ASNER	10	CLEO	e^+e^- at 3774 MeV

[1] Using the D_s^+ and D^0 lifetimes, ASNER 10 finds that the ratio of the D_s^+ and D^0 semileptonic widths is 0.828 ± 0.051 ± 0.025.

$\Gamma(\pi^+ \text{anything})/\Gamma_{\text{total}}$ Γ_2/Γ

Events with two π^+'s count twice, etc. But π^+'s from $K_S^0 \to \pi^+\pi^-$ are not included.

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
119.3±1.2±0.7	DOBBS	09	CLEO	e^+e^- at 4170 MeV

$\Gamma(\pi^- \text{anything})/\Gamma_{\text{total}}$ Γ_3/Γ

Events with two π^-'s count twice, etc. But π^-'s from $K_S^0 \to \pi^+\pi^-$ are not included.

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
43.2±0.9±0.3	DOBBS	09	CLEO	e^+e^- at 4170 MeV

$\Gamma(\pi^0 \text{anything})/\Gamma_{\text{total}}$ Γ_4/Γ

Events with two π^0's count twice, etc. But π^0's from $K_S^0 \to 2\pi^0$ are not included.

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
123.4±3.8±5.3	DOBBS	09	CLEO	e^+e^- at 4170 MeV

$\Gamma(K^- \text{anything})/\Gamma_{\text{total}}$ Γ_5/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
18.7±0.5±0.2	DOBBS	09	CLEO	e^+e^- at 4170 MeV

$\Gamma(K^+ \text{anything})/\Gamma_{\text{total}}$ Γ_6/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
28.9±0.6±0.3	DOBBS	09	CLEO	e^+e^- at 4170 MeV

$\Gamma(K_S^0 \text{anything})/\Gamma_{\text{total}}$ Γ_7/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
19.0±1.0±0.4	DOBBS	09	CLEO	e^+e^- at 4170 MeV

$\Gamma(\eta \text{ anything})/\Gamma_{total}$ — Γ_8/Γ

This ratio includes η particles from η' decays.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
29.9±2.2±1.7		DOBBS	09	CLEO	e^+e^- at 4170 MeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
23.5±3.1±2.0	674 ± 91	HUANG	06B	CLEO	See DOBBS 09

$\Gamma(\omega \text{ anything})/\Gamma_{total}$ — Γ_9/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
6.1±1.4±0.3	DOBBS	09	CLEO	e^+e^- at 4170 MeV

$\Gamma(\eta' \text{ anything})/\Gamma_{total}$ — Γ_{10}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
10.3±1.4 OUR AVERAGE Error includes scale factor of 1.1.					
8.8±1.8±0.5	68	ABLIKIM	15Z	BES3	482 pb^{-1}, 4009 MeV
11.7±1.7±0.7		DOBBS	09	CLEO	e^+e^- at 4170 MeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
8.7±1.9±0.8	68	HUANG	06B	CLEO	See DOBBS 09

$\Gamma(f_0(980) \text{ anything}, f_0 \to \pi^+\pi^-)/\Gamma_{total}$ — Γ_{11}/Γ

VALUE (units 10^{-2})	CL%	DOCUMENT ID		TECN	COMMENT
<1.3	90	DOBBS	09	CLEO	e^+e^- at 4170 MeV

$\Gamma(\phi \text{ anything})/\Gamma_{total}$ — Γ_{12}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
15.7±0.8±0.6		DOBBS	09	CLEO	e^+e^- at 4170 MeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
16.1±1.2±1.1	398 ± 27	HUANG	06B	CLEO	See DOBBS 09

$\Gamma(K^+K^- \text{ anything})/\Gamma_{total}$ — Γ_{13}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
15.8±0.6±0.3	DOBBS	09	CLEO	e^+e^- at 4170 MeV

$\Gamma(K^0_S K^+ \text{ anything})/\Gamma_{total}$ — Γ_{14}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
5.8±0.5±0.1	DOBBS	09	CLEO	e^+e^- at 4170 MeV

$\Gamma(K^0_S K^- \text{ anything})/\Gamma_{total}$ — Γ_{15}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
1.9±0.4±0.1	DOBBS	09	CLEO	e^+e^- at 4170 MeV

$\Gamma(2K^0_S \text{ anything})/\Gamma_{total}$ — Γ_{16}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
1.7±0.3±0.1	DOBBS	09	CLEO	e^+e^- at 4170 MeV

$\Gamma(2K^+ \text{anything})/\Gamma_{total}$ — Γ_{17}/Γ

VALUE (units 10^{-2})	CL%	DOCUMENT ID		TECN	COMMENT
<0.26	90	DOBBS	09	CLEO	e^+e^- at 4170 MeV

$\Gamma(2K^- \text{anything})/\Gamma_{total}$ — Γ_{18}/Γ

VALUE (units 10^{-2})	CL%	DOCUMENT ID		TECN	COMMENT
<0.06	90	DOBBS	09	CLEO	e^+e^- at 4170 MeV

Leptonic and semileptonic modes

See the related review(s):

Leptonic Decays of Charged Pseudoscalar Mesons

$\Gamma(e^+\nu_e)/\Gamma_{total}$ — Γ_{19}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<0.83 \times 10^{-4}$	90	[1] ZUPANC	13	BELL	e^+e^- at $\Upsilon(4S), \Upsilon(5S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<2.3 \times 10^{-4}$	90	DEL-AMO-SA..	10J	BABR	e^+e^-, 10.58 GeV
$<1.2 \times 10^{-4}$	90	ALEXANDER	09	CLEO	e^+e^- at 4170 MeV
$<1.3 \times 10^{-4}$	90	PEDLAR	07A	CLEO	See ALEXANDER 09

[1] ZUPANC 13 also gives the limit as $< 1.0 \times 10^{-4}$ at 95% CL.

$\Gamma(\mu^+\nu_\mu)/\Gamma_{total}$ — Γ_{20}/Γ

See the note on "Decay Constants of Charged Pseudoscalar Mesons" above.

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
5.50±0.23 OUR AVERAGE					
4.95±0.67±0.26	69	[1] ABLIKIM	16O	BES3	e^+e^- at 4.009 GeV
5.31±0.28±0.20	492 ± 26	[2] ZUPANC	13	BELL	e^+e^- at $\Upsilon(4S), \Upsilon(5S)$
6.02±0.38±0.34	275 ± 17	[3] DEL-AMO-SA..	10J	BABR	e^+e^-, 10.58 GeV
5.65±0.45±0.17	235 ± 14	ALEXANDER	09	CLEO	e^+e^- at 4170 MeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
6.44±0.76±0.57	169 ± 18	[4] WIDHALM	08	BELL	See ZUPANC 13
5.94±0.66±0.31	88	[5] PEDLAR	07A	CLEO	See ALEXANDER 09
6.8 ±1.1 ±1.8	553	[6] HEISTER	02I	ALEP	Z decays

[1] ABLIKIM 16O value is constrained by the Standard Model ratio of $\Gamma(D_s^+ \to \tau^+\nu_\tau)/\Gamma(D_s^+ \to \mu^+\nu_\mu) = 9.76$; the unconstrained value is $(0.517 \pm 0.075 \pm 0.021)$%. The constrained value is used to obtain the decay constant, $f_{D_s^+} = (241.0 \pm 16.3 \pm 6.6)$ MeV.

[2] ZUPANC 13 uses both $\mu^+\nu$ and $\tau^+\nu$ events to get $f_{D_s} = (255.5 \pm 4.2 \pm 5.1)$ MeV.

[3] DEL-AMO-SANCHEZ 10J uses $\mu^+\nu_\mu$ and $\tau^+\nu_\tau$ events together to get $f_{D_s} = (258.6 \pm 6.4 \pm 7.5)$ MeV.

[4] WIDHALM 08 gets $f_{D_s} = (275 \pm 16 \pm 12)$ MeV from the branching fraction.

[5] PEDLAR 07A also fits μ^+ and τ^+ events together and gets an effective $\mu^+\nu_\mu$ branching fraction of $(6.38 \pm 0.59 \pm 0.33) \times 10^{-3}$

[6] This HEISTER 02I result is not actually an independent measurement of the absolute $\mu^+\nu_\mu$ branching fraction, but is in fact based on our $\phi\pi^+$ branching fraction of 3.6 ± 0.9%, so it cannot be included in our overall fit. HEISTER 02I combines its $D_s^+ \to \tau^+\nu_\tau$ and $\mu^+\nu_\mu$ branching fractions to get $f_{D_s} = (285 \pm 19 \pm 40)$ MeV.

$\Gamma(\mu^+\nu_\mu)/\Gamma(\phi\pi^+)$ Γ_{20}/Γ_{37}

See the note on "Decay Constants of Charged Pseudoscalar Mesons" above.

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.143\pm0.018\pm0.006$	489 ± 55	[1] AUBERT 07V	BABR	$e^+e^-\approx\Upsilon(4S)$
$0.23\pm0.06\pm0.04$	18	[2] ALEXANDROV 00	BEAT	π^- nucleus, 350 GeV
$0.173\pm0.023\pm0.035$	182	[3] CHADHA 98	CLE2	$e^+e^-\approx\Upsilon(4S)$
$0.245\pm0.052\pm0.074$	39	[4] ACOSTA 94	CLE2	See CHADHA 98

[1] AUBERT 07V gets $f_{D_s^+}=(283\pm17\pm16)$ MeV, using $\Gamma(D_s^+\to\phi\pi^+)/\Gamma(\text{total})=(4.71\pm0.46)\%$.

[2] ALEXANDROV 00 uses $f_D^2/f_{D_s}^2=0.82\pm0.09$ from a lattice-gauge-theory calculation to get the relative numbers of $D^+\to\mu^+\nu_\mu$ and $D_s^+\to\mu^+\nu_\mu$ events. The present result leads to $f_{D_s}=(323\pm44\pm36)$ MeV.

[3] CHADHA 98 obtains $f_{D_s}=(280\pm19\pm28\pm34)$ MeV from this measurement, using $\Gamma(D_s^+\to\phi\pi^+)/\Gamma(\text{total})=0.036\pm0.009$.

[4] ACOSTA 94 obtains $f_{D_s}=(344\pm37\pm52\pm42)$ MeV from this measurement, using $\Gamma(D_s^+\to\phi\pi^+)/\Gamma(\text{total})=0.037\pm0.009$.

$\Gamma(\tau^+\nu_\tau)/\Gamma_{\text{total}}$ Γ_{21}/Γ

See the note on "Decay Constants of Charged Pseudoscalar Mesons" above.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
5.48±0.23 OUR AVERAGE				
$4.83\pm0.65\pm0.26$	33	[1] ABLIKIM 16O	BES3	e^+e^- at 4.009 GeV
$5.70\pm0.21{}^{+0.31}_{-0.30}$	2.2k	[2] ZUPANC 13	BELL	e^+e^- at $\Upsilon(4S)$, $\Upsilon(5S)$
$4.96\pm0.37\pm0.57$	748 ± 53	[3] DEL-AMO-SA...10J	BABR	$e^-\overline{\nu}_e\nu_\tau$, $\mu^-\overline{\nu}_\mu\nu_\tau$
$6.42\pm0.81\pm0.18$	126 ± 16	[4] ALEXANDER 09	CLEO	$\tau^+\to\pi^+\overline{\nu}_\tau$
$5.52\pm0.57\pm0.21$	155 ± 17	[4] NAIK 09A	CLEO	$\tau^+\to\rho^+\overline{\nu}_\tau$
$5.30\pm0.47\pm0.22$	181 ± 16	[4] ONYISI 09	CLEO	$\tau^+\to e^+\nu_e\overline{\nu}_\tau$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$6.17\pm0.71\pm0.34$	102	[5] ECKLUND 08	CLEO	See ONYISI 09
$8.0\pm1.3\pm0.4$	47	[5] PEDLAR 07A	CLEO	See ALEXANDER 09
$5.79\pm0.77\pm1.84$	881	[6] HEISTER 02I	ALEP	Z decays
$7.0\pm2.1\pm2.0$	22	[7] ABBIENDI 01L	OPAL	$D_s^{*+}\to\gamma D_s^+$ from Z's
$7.4\pm2.8\pm2.4$	16	[8] ACCIARRI 97F	L3	$D_s^{*+}\to\gamma D_s^+$ from Z's

[1] ABLIKIM 16O value is constrained by the Standard Model ratio of $\Gamma(D_s^+\to\tau^+\nu_\tau)/\Gamma(D_s^+\to\mu^+\nu_\mu)=9.76$; the unconstrained value is $(3.28\pm1.83\pm0.37)\%$.

[2] ZUPANC 13 uses both $\mu^+\nu$ and $\tau^+\nu$ events to get $f_{D_s}=(255.5\pm4.2\pm5.1)$ MeV.

[3] DEL-AMO-SANCHEZ 10J (with a small correction; see LEES 15D) uses $\mu^+\nu_\mu$ and $\tau^+\nu_\tau$ events together to get $f_{D_s}=(259.9\pm6.6\pm7.6)$ MeV.

[4] ALEXANDER 09, NAIK 09A, and ONYISI 09 use different τ decay modes and are independent. The three papers combined give $f_{D_s}=(259.7\pm7.8\pm3.4)$ MeV.

[5] ECKLUND 08 and PEDLAR 07A are independent: ECKLUND 08 uses $\tau^+\to e^+\nu_e\overline{\nu}_\tau$ events, PEDLAR 07A uses $\tau^+\to\pi^+\overline{\nu}_\tau$ events.

[6] HEISTER 02I combines its $D_s^+ \to \tau^+ \nu_\tau$ and $\mu^+ \nu_\mu$ branching fractions to get f_{D_s}= (285 ± 19 ± 40) MeV.

[7] This ABBIENDI 01L value gives a decay constant f_{D_s} of (286 ± 44 ± 41) MeV.

[8] The second ACCIARRI 97F error here combines in quadrature systematic (0.016) and normalization (0.018) errors. The branching fraction gives f_{D_s} = (309 ± 58 ± 33 ± 38) MeV.

$\Gamma(\tau^+\nu_\tau)/\Gamma(\mu^+\nu_\mu)$ — Γ_{21}/Γ_{20}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$10.73 \pm 0.69 ^{+0.56}_{-0.53}$	2.2k/492	[1] ZUPANC	13	BELL	e^+e^- at $\Upsilon(4S), \Upsilon(5S)$
$11.0 \pm 1.4 \pm 0.6$	102	[2] ECKLUND	08	CLEO	See ONYISI 09

[1] This ZUPANC 13 ratio is not independent of the separate $\tau\nu$ and $\mu\nu$ fractions listed above.

[2] This ECKLUND 08 value also uses results from PEDLAR 07A, and it is not independent of other results in these Listings. Combined with earlier CLEO results, the decay constant f_{D_s} is 274 ± 10 ± 5 MeV.

$\Gamma(K^+K^-e^+\nu_e)/\Gamma(K^+K^-\pi^+)$ — Γ_{22}/Γ_{36}

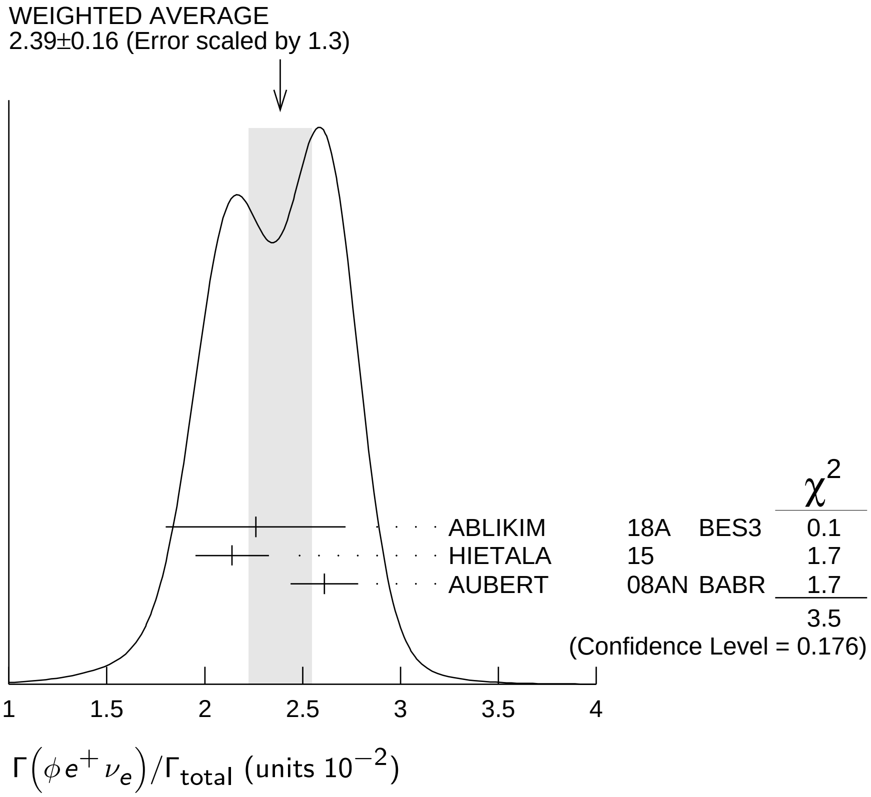
VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.558 \pm 0.007 \pm 0.016$	[1] AUBERT	08AN	BABR	e^+e^- at $\Upsilon(4S)$

[1] This AUBERT 08AN ratio is only for the K^+K^- mass in the range 1.01–to–1.03 GeV in the numerator and 1.0095–to–1.0295 GeV in the denominator.

$\Gamma(\phi e^+\nu_e)/\Gamma_{total}$ — Γ_{23}/Γ

See the end of the D_s^+ Listings for measurements of $D_s^+ \to \phi e^+ \nu_e$ form factors. Unseen decay modes of the ϕ are included.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.39±0.16 OUR AVERAGE	Error includes scale factor of 1.3. See the ideogram below.				
$2.26 \pm 0.45 \pm 0.09$	26	ABLIKIM	18A	BES3	e^+e^- at 4.009 GeV
$2.14 \pm 0.17 \pm 0.08$	207	HIETALA	15		Uses CLEO data
$2.61 \pm 0.03 \pm 0.17$	25k	AUBERT	08AN	BABR	e^+e^- at $\Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$2.36 \pm 0.23 \pm 0.13$	106	ECKLUND	09	CLEO	See HIETALA 15
$2.29 \pm 0.37 \pm 0.11$	45	YELTON	09	CLEO	See ECKLUND 09



$\Gamma(\phi e^+ \nu_e)/\Gamma(\phi \pi^+)$ Γ_{23}/Γ_{37}

As noted in the comment column, most of these measurements use $\phi \mu^+ \nu_\mu$ events in addition to or instead of $\phi e^+ \nu_e$ events.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.540 \pm 0.033 \pm 0.048$	793	LINK	02J	FOCS	Uses $\phi \mu^+ \nu_\mu$
$0.54 \pm 0.05 \pm 0.04$	367	BUTLER	94	CLE2	Uses $\phi e^+ \nu_e$ and $\phi \mu^+ \nu_\mu$
$0.58 \pm 0.17 \pm 0.07$	97	FRABETTI	93G	E687	Uses $\phi \mu^+ \nu_\mu$
$0.57 \pm 0.15 \pm 0.15$	104	ALBRECHT	91	ARG	Uses $\phi e^+ \nu_e$
$0.49 \pm 0.10 {}^{+0.10}_{-0.14}$	54	ALEXANDER	90B	CLEO	Uses $\phi e^+ \nu_e$ and $\phi \mu^+ \nu_\mu$

$\Gamma(\phi \mu^+ \nu_\mu)/\Gamma_{total}$ Γ_{24}/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
$1.94 \pm 0.53 \pm 0.09$	22	ABLIKIM	18A	BES3	$e^+ e^-$ at 4.009 GeV

$\Gamma(\eta e^+ \nu_e)/\Gamma_{total}$ Γ_{26}/Γ

Unseen decay modes of the η are included.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.29 ± 0.19 OUR AVERAGE					
$2.30 \pm 0.31 \pm 0.08$	63	ABLIKIM	16T	BES3	$e^+ e^-$ at 4.009 GeV
$2.28 \pm 0.14 \pm 0.19$	358	HIETALA	15		Uses CLEO data
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$2.48 \pm 0.29 \pm 0.13$	82	YELTON	09	CLEO	See HIETALA 15

$\Gamma(\eta e^+ \nu_e)/\Gamma(\phi e^+ \nu_e)$ — Γ_{26}/Γ_{23}

Unseen decay modes of the η and the ϕ are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.24±0.12±0.15	440	[1] BRANDENB...	95	CLE2	See HIETALA 15

[1] BRANDENBURG 95 uses both e^+ and μ^+ events and makes a phase-space adjustment to use the μ^+ events as e^+ events.

$\Gamma(\eta'(958) e^+ \nu_e)/\Gamma_{total}$ — Γ_{27}/Γ

Unseen decay modes of the $\eta'(958)$ are included.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
0.74±0.14 OUR AVERAGE					
0.93±0.30±0.05	14	ABLIKIM	16T	BES3	$e^+ e^-$ at 4170 MeV
0.68±0.15±0.06	20	HIETALA	15		Uses CLEO data
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.91±0.33±0.05	7.5	YELTON	09	CLEO	See HIETALA 15

$\Gamma(\eta'(958) e^+ \nu_e)/\Gamma(\phi e^+ \nu_e)$ — Γ_{27}/Γ_{23}

Unseen decay modes of the resonances are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.43±0.11±0.07	29	[1] BRANDENB...	95	CLE2	See HIETALA 15

[1] BRANDENBURG 95 uses both e^+ and μ^+ events and makes a phase-space adjustment to use the μ^+ events as e^+ events.

$\left[\Gamma(\eta e^+ \nu_e) + \Gamma(\eta'(958) e^+ \nu_e)\right]/\Gamma(\phi e^+ \nu_e)$ — $\Gamma_{25}/\Gamma_{23} = (\Gamma_{26}+\Gamma_{27})/\Gamma_{23}$

Unseen decay modes of the resonances are included.

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.67±0.17±0.17	[1] BRANDENB...	95	CLE2	See HIETALA 15

[1] This BRANDENBURG 95 data is redundant with data in previous blocks.

$\Gamma(\eta \mu^+ \nu_\mu)/\Gamma_{total}$ — Γ_{28}/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
2.42±0.46±0.11	44	ABLIKIM	18A	BES3	$e^+ e^-$ at 4.009 GeV

$\Gamma(\eta'(958) \mu^+ \nu_\mu)/\Gamma_{total}$ — Γ_{29}/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
1.06±0.54±0.07	10	ABLIKIM	18A	BES3	$e^+ e^-$ at 4.009 GeV

$\Gamma(\omega e^+ \nu_e)/\Gamma_{total}$ — Γ_{30}/Γ

A test for $u\overline{u}$ or $d\overline{d}$ content in the D_s^+. Neither Cabibbo-favored nor Cabibbo-suppressed decays can contribute, and $\omega - \phi$ mixing is an unlikely explanation for any fraction above about 2×10^{-4}.

VALUE (%)	CL%	DOCUMENT ID		TECN	COMMENT
<0.20	90	MARTIN	11	CLEO	$e^+ e^-$ at 4170 MeV

$\Gamma(K^0 e^+ \nu_e)/\Gamma_{total}$ Γ_{31}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
0.39±0.08±0.03	42	HIETALA	15		Uses CLEO data
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.37±0.10±0.02	14	YELTON	09	CLEO	See HIETALA 15

$\Gamma(K^*(892)^0 e^+ \nu_e)/\Gamma_{total}$ Γ_{32}/Γ

Unseen decay modes of the $K^*(892)^0$ are included.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
0.18±0.04±0.01	32	HIETALA	15		Uses CLEO data
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.18±0.07±0.01	7.5	YELTON	09	CLEO	See HIETALA 15

$\Gamma(f_0(980) e^+ \nu_e,\ f_0 \to \pi^+\pi^-)/\Gamma_{total}$ Γ_{33}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.13±0.03±0.01	42	[1] HIETALA	15		Uses CLEO data
0.20±0.03±0.01	44	ECKLUND	09	CLEO	See HIETALA 15
0.13±0.04±0.01	13	YELTON	09	CLEO	See ECKLUND 09

[1] HIETALA 15 uses a tighter cut on the reconstructed $\pi^+\pi^-$ mass (±60 MeV around the f^0) than ECKLUND 09. It finds that applying the same tight cut to both analyses gives consistent results.

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

$\Gamma(K^+ K^0_S)/\Gamma_{total}$ Γ_{34}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
1.50±0.05 OUR FIT				
1.52±0.05±0.03	ONYISI	13	CLEO	e^+e^- at 4.17 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.49±0.07±0.05	[1] ALEXANDER	08	CLEO	See ONYISI 13

[1] ALEXANDER 08 uses single- and double-tagged events in an overall fit.

$\Gamma(K^+ \overline{K}^0)/\Gamma_{total}$ Γ_{35}/Γ

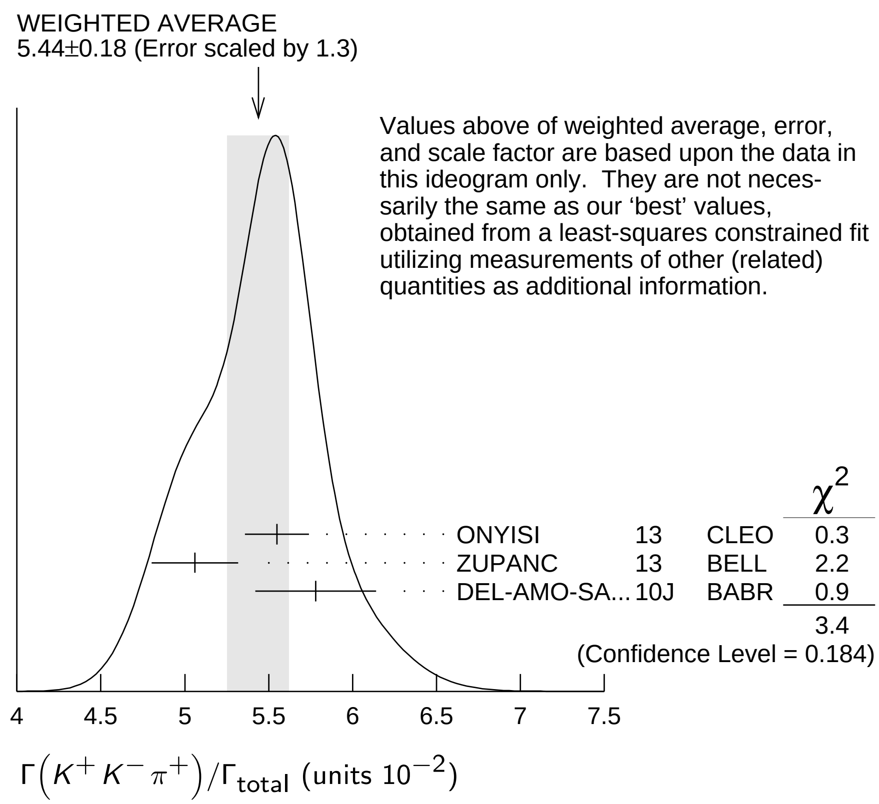
VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.95±0.11±0.09	2.0k	[1] ZUPANC	13	BELL	e^+e^- at $\Upsilon(4S), \Upsilon(5S)$

[1] ZUPANC 13 finds the $\overline{K}^0$ from its missing-mass squared, not from $K^0_S \to \pi^+\pi^-$. The DCS ($D^+_s \to K^+ K^0$) contribution to this fraction is estimated to be an order of magnitude below the statistical uncertainty.

$\Gamma(K^+ K^- \pi^+)/\Gamma_{total}$ Γ_{36}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
5.45±0.17 OUR FIT Error includes scale factor of 1.2.					
5.44±0.18 OUR AVERAGE Error includes scale factor of 1.3. See the ideogram below.					
5.55±0.14±0.13		ONYISI	13	CLEO	$e^+ e^-$ at 4.17 GeV
5.06±0.15±0.21	4.1k	ZUPANC	13	BELL	$e^+ e^-$ at $\Upsilon(4S), \Upsilon(5S)$
5.78±0.20±0.30		DEL-AMO-SA...	10J	BABR	$e^+ e^-$, 10.58 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
5.50±0.23±0.16		[1] ALEXANDER	08	CLEO	See ONYISI 13

[1] ALEXANDER 08 uses single- and double-tagged events in an overall fit.



$\Gamma(\phi\pi^+)/\Gamma_{total}$ Γ_{37}/Γ

The results here are model-independent. For earlier, model-dependent results, see our PDG 06 edition. We decouple the $D_s^+ \rightarrow \phi\pi^+$ branching fraction obtained from mass projections (and used to get some of the other branching fractions) from the $D_s^+ \rightarrow \phi\pi^+$, $\phi \rightarrow K^+ K^-$ branching fraction obtained from the Dalitz-plot analysis of $D_s^+ \rightarrow K^+ K^- \pi^+$. That is, the ratio of these two branching fractions is not exactly the $\phi \rightarrow K^+ K^-$ branching fraction 0.491.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
4.5 ±0.4 OUR AVERAGE					
4.62±0.36±0.51		[1] AUBERT	06N	BABR	$e^+ e^-$ at $\Upsilon(4S)$
4.81±0.52±0.38	212 ± 19	[2] AUBERT	05V	BABR	$e^+ e^- \approx \Upsilon(4S)$
3.59±0.77±0.48		[3] ARTUSO	96	CLE2	$e^+ e^-$ at $\Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					

$3.9\ ^{+5.1}_{-1.9}\ ^{+1.8}_{-1.1}$	[4] BAI	95C	BES	e^+e^- 4.03 GeV

[1] This AUBERT 06N measurement uses $\overline{B}^0 \to D_s^{(*)-} D^{(*)+}$ and $B^- \to D_s^{(*)-} D^{(*)0}$ decays, including some from other papers. However, the result is independent of AUBERT 05V.

[2] AUBERT 05V uses the ratio of $B^0 \to D^{*-} D_s^{*+}$ events seen in two different ways, in both of which the $D^{*-} \to \overline{D}^0 \pi^-$ decay is fully reconstructed: (1) The $D_s^{*+} \to D_s^+ \gamma$, $D_s^+ \to \phi\pi^+$ decay is fully reconstructed. (2) The number of events in the D_s^+ peak in the missing mass spectrum against the $D^{*-}\gamma$ is measured.

[3] ARTUSO 96 uses partially reconstructed $\overline{B}^0 \to D^{*+} D_s^{*-}$ decays to get a model-independent value for $\Gamma(D_s^- \to \phi\pi^-)/\Gamma(D^0 \to K^-\pi^+)$ of $0.92 \pm 0.20 \pm 0.11$.

[4] BAI 95C uses $e^+e^- \to D_s^+ D_s^-$ events in which one or both of the $D_s^\pm$ are observed to obtain the first model-independent measurement of the $D_s^+ \to \phi\pi^+$ branching fraction, without assumptions about $\sigma(D_s^\pm)$. However, with only two "doubly-tagged" events, the statistical error is very large.

$\Gamma(\phi\pi^+,\ \phi \to K^+K^-)/\Gamma(K^+K^-\pi^+)$ $\qquad$ Γ_{38}/Γ_{36}

This is the "fit fraction" from the Dalitz-plot analysis. 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.

VALUE (%)	*DOCUMENT ID*		*TECN*	*COMMENT*
41.6±0.8 OUR AVERAGE				
41.4±0.8±0.5	DEL-AMO-SA...	11G	BABR	Dalitz fit, 96k±369 evts
42.2±1.6±0.3	MITCHELL	09A	CLEO	Dalitz fit, 12k evts
• • • We do not use the following data for averages, fits, limits, etc. • • •				
39.6±3.3±4.7	FRABETTI	95B	E687	Dalitz fit, 701 evts

$\Gamma(K^+\overline{K}^*(892)^0,\ \overline{K}^{*0} \to K^-\pi^+)/\Gamma(K^+K^-\pi^+)$ $\qquad$ Γ_{39}/Γ_{36}

This is the "fit fraction" from the Dalitz-plot analysis.

VALUE (%)	*DOCUMENT ID*		*TECN*	*COMMENT*
47.8±0.6 OUR AVERAGE				
47.9±0.5±0.5	DEL-AMO-SA...	11G	BABR	Dalitz fit, 96k±369 evts
47.4±1.5±0.4	MITCHELL	09A	CLEO	Dalitz fit, 12k evts
• • • We do not use the following data for averages, fits, limits, etc. • • •				
47.8±4.6±4.0	FRABETTI	95B	E687	Dalitz fit, 701 evts

$\Gamma(f_0(980)\pi^+,\ f_0 \to K^+K^-)/\Gamma(K^+K^-\pi^+)$ $\qquad$ Γ_{40}/Γ_{36}

This is the "fit fraction" from the Dalitz-plot analysis.

VALUE (%)	*DOCUMENT ID*		*TECN*	*COMMENT*
21 ±6 OUR AVERAGE	Error includes scale factor of 3.5.			
16.4±0.7±2.0	DEL-AMO-SA...	11G	BABR	Dalitz fit, 96k±369 evts
28.2±1.9±1.8	MITCHELL	09A	CLEO	Dalitz fit, 12k evts
• • • We do not use the following data for averages, fits, limits, etc. • • •				
11.0±3.5±2.6	FRABETTI	95B	E687	Dalitz fit, 701 evts

$\Gamma(f_0(1370)\pi^+, f_0 \to K^+K^-)/\Gamma(K^+K^-\pi^+)$ — Γ_{41}/Γ_{36}

This is the "fit fraction" from the Dalitz-plot analysis.

VALUE (%)	DOCUMENT ID	TECN	COMMENT
1.3±0.8 OUR AVERAGE	Error includes scale factor of 3.9.		
1.1±0.1±0.2	DEL-AMO-SA..11G	BABR	Dalitz fit, 96k±369 evts
4.3±0.6±0.5	MITCHELL 09A	CLEO	Dalitz fit, 12k evts

$\Gamma(f_0(1710)\pi^+, f_0 \to K^+K^-)/\Gamma(K^+K^-\pi^+)$ — Γ_{42}/Γ_{36}

This is the "fit fraction" from the Dalitz-plot analysis.

VALUE (%)	DOCUMENT ID	TECN	COMMENT
1.2±0.5 OUR AVERAGE	Error includes scale factor of 3.8.		
1.1±0.1±0.1	DEL-AMO-SA..11G	BABR	Dalitz fit, 96k±369 evts
3.4±0.5±0.3	MITCHELL 09A	CLEO	Dalitz fit, 12k evts
• • • We do not use the following data for averages, fits, limits, etc. • • •			
3.4±2.3±3.5	FRABETTI 95B	E687	Dalitz fit, 701 evts

$\Gamma(K^+\overline{K}^*_0(1430)^0, \overline{K}^*_0 \to K^-\pi^+)/\Gamma(K^+K^-\pi^+)$ — Γ_{43}/Γ_{36}

This is the "fit fraction" from the Dalitz-plot analysis.

VALUE (%)	DOCUMENT ID	TECN	COMMENT
3.4±0.7 OUR AVERAGE	Error includes scale factor of 1.2.		
2.4±0.3±1.0	DEL-AMO-SA..11G	BABR	Dalitz fit, 96k±369 evts
3.9±0.5±0.5	MITCHELL 09A	CLEO	Dalitz fit, 12k evts
• • • We do not use the following data for averages, fits, limits, etc. • • •			
9.3±3.2±3.2	FRABETTI 95B	E687	Dalitz fit, 701 evts

$\Gamma(K^+K^0_S\pi^0)/\Gamma_{total}$ — Γ_{44}/Γ

VALUE (units 10^{-2})	DOCUMENT ID	TECN	COMMENT
1.52±0.09±0.20	ONYISI 13	CLEO	e^+e^- at 4.17 GeV

$\Gamma(2K^0_S\pi^+)/\Gamma_{total}$ — Γ_{45}/Γ

VALUE (units 10^{-2})	DOCUMENT ID	TECN	COMMENT
0.77±0.05±0.03	ONYISI 13	CLEO	e^+e^- at 4.17 GeV

$\Gamma(K^*(892)^+\overline{K}^0)/\Gamma(\phi\pi^+)$ — Γ_{47}/Γ_{37}

Unseen decay modes of the resonances are included.

VALUE	DOCUMENT ID	TECN	COMMENT
1.20±0.21±0.13	CHEN 89	CLEO	e^+e^- 10 GeV

$\Gamma(K^+K^-\pi^+\pi^0)/\Gamma_{total}$ — Γ_{48}/Γ

VALUE (units 10^{-2})	DOCUMENT ID	TECN	COMMENT
6.3 ±0.6 OUR FIT			
6.37±0.21±0.56	ONYISI 13	CLEO	e^+e^- at 4.17 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •			
5.65±0.29±0.40	[1] ALEXANDER 08	CLEO	See ONYISI 13

[1] ALEXANDER 08 uses single- and double-tagged events in an overall fit.

$\Gamma(\phi\rho^+)/\Gamma(\phi\pi^+)$ — Γ_{49}/Γ_{37}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
$1.86\pm0.26^{+0.29}_{-0.40}$	253	AVERY 92	CLE2	$e^+e^- \simeq$ 10.5 GeV

$\Gamma(K^0_S K^- 2\pi^+)/\Gamma_{total}$ — Γ_{50}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
1.68±0.10 OUR FIT				
1.69±0.07±0.08	ONYISI	13	CLEO	e^+e^- at 4.17 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.64±0.10±0.07	[1] ALEXANDER	08	CLEO	See ONYISI 13

[1] ALEXANDER 08 uses single- and double-tagged events in an overall fit.

$\Gamma(K^*(892)^+\overline{K}^*(892)^0)/\Gamma(\phi\pi^+)$ — Γ_{51}/Γ_{37}

Unseen decay modes of the resonances are included.

VALUE	DOCUMENT ID		TECN	COMMENT
1.6±0.4±0.4	ALBRECHT	92B	ARG	$e^+e^- \simeq$ 10.4 GeV

$\Gamma(K^+ K^0_S \pi^+\pi^-)/\Gamma_{total}$ — Γ_{52}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
1.00±0.08 OUR FIT				
1.03±0.06±0.08	ONYISI	13	CLEO	e^+e^- at 4.17 GeV

$\Gamma(K^+ K^0_S \pi^+\pi^-)/\Gamma(K^0_S K^- 2\pi^+)$ — Γ_{52}/Γ_{50}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.60 ±0.05 OUR FIT					
0.586±0.052±0.043	476	LINK	01C	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(K^+K^- 2\pi^+\pi^-)/\Gamma(K^+K^-\pi^+)$ — Γ_{53}/Γ_{36}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.160±0.027 OUR AVERAGE					
0.150±0.019±0.025	240	LINK	03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV
0.188±0.036±0.040	75	FRABETTI	97C	E687	γBe, $\overline{E}_\gamma \approx$ 200 GeV

$\Gamma(\phi 2\pi^+\pi^-)/\Gamma(\phi\pi^+)$ — Γ_{54}/Γ_{37}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.269±0.027 OUR AVERAGE					
0.249±0.024±0.021	136	LINK	03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV
0.28 ±0.06 ±0.01	40	FRABETTI	97C	E687	γBe, $\overline{E}_\gamma \approx$ 200 GeV
0.58 ±0.21 ±0.10	21	FRABETTI	92	E687	γBe
0.42 ±0.13 ±0.07	19	ANJOS	88	E691	Photoproduction
1.11 ±0.37 ±0.28	62	ALBRECHT	85D	ARG	e^+e^- 10 GeV

$\Gamma(K^+K^-\rho^0\pi^+ \text{non-}\phi)/\Gamma(K^+K^- 2\pi^+\pi^-)$ — Γ_{55}/Γ_{53}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.03	90	LINK	03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(\phi\rho^0\pi^+,\ \phi \to K^+K^-)/\Gamma(K^+K^- 2\pi^+\pi^-)$ — Γ_{56}/Γ_{53}

VALUE	DOCUMENT ID		TECN	COMMENT
0.75±0.06±0.04	LINK	03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(\phi a_1(1260)^+,\ \phi \to K^+K^-,\ a_1^+ \to \rho^0\pi^+)/\Gamma(K^+K^-\pi^+)$ — Γ_{57}/Γ_{36}

VALUE	DOCUMENT ID		TECN	COMMENT
0.137±0.019±0.011	LINK	03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(K^+K^-2\pi^+\pi^- \text{nonresonant})/\Gamma(K^+K^-2\pi^+\pi^-)$ — Γ_{58}/Γ_{53}

VALUE	DOCUMENT ID		TECN	COMMENT
0.10±0.06±0.05	LINK	03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(2K^0_S 2\pi^+\pi^-)/\Gamma(K^0_S K^- 2\pi^+)$ — Γ_{59}/Γ_{50}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.051±0.015±0.015	37 ± 10	LINK	04D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

Pionic modes

$\Gamma(\pi^+\pi^0)/\Gamma(K^+K^0_S)$ — Γ_{60}/Γ_{34}

VALUE (units 10^{-2})	CL%	DOCUMENT ID		TECN	COMMENT
<2.3	90	MENDEZ	10	CLEO	e^+e^- at 4170 MeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<4.1	90	ADAMS	07A	CLEO	See MENDEZ 10

$\Gamma(2\pi^+\pi^-)/\Gamma_{total}$ — Γ_{61}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
1.09±0.05 OUR FIT Error includes scale factor of 1.1.				
1.11±0.04±0.04	ONYISI	13	CLEO	e^+e^- at 4.17 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.11±0.07±0.04	[1] ALEXANDER	08	CLEO	See ONYISI 13

[1] ALEXANDER 08 uses single- and double-tagged events in an overall fit.

$\Gamma(2\pi^+\pi^-)/\Gamma(K^+K^-\pi^+)$ — Γ_{61}/Γ_{36}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.201±0.007 OUR FIT					
0.199±0.004±0.009	≈ 10.5k	AUBERT	09O	BABR	$e^+e^- \approx$ 10.6 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.265±0.041±0.031	98	FRABETTI	97D	E687	γ Be ≈ 200 GeV

$\Gamma(\rho^0\pi^+)/\Gamma(2\pi^+\pi^-)$ — Γ_{62}/Γ_{61}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
0.018±0.005±0.010		AUBERT	09O	BABR	Dalitz fit, ≈ 10.5k evts
• • • We do not use the following data for averages, fits, limits, etc. • • •					
not seen		LINK	04	FOCS	Dalitz fit, 1475 ± 50 evts
0.058±0.023±0.037		AITALA	01A	E791	Dalitz fit, 848 evts
<0.073	90	FRABETTI	97D	E687	γ Be ≈ 200 GeV

$\Gamma(\pi^+(\pi^+\pi^-)_{S-\text{wave}})/\Gamma(2\pi^+\pi^-)$ — Γ_{63}/Γ_{61}

This is the "fit fraction" from the Dalitz-plot analysis. See also KLEMPT 08, which uses 568 $D_s^+ \to 3\pi$ decays (over 280 background events) from FNAL E791 to study various parametrizations of the decay amplitudes. The emphasis there is more on S-wave $\pi\pi$ decay products — 20 different solutions are given — than on D_s^+ fit fractions.

VALUE	DOCUMENT ID		TECN	COMMENT
0.833 ±0.020 OUR AVERAGE				
0.830 ±0.009 ±0.019	[1] AUBERT	09O	BABR	Dalitz fit, ≈ 10.5k evts
0.8704±0.0560±0.0438	[2] LINK	04	FOCS	Dalitz fit, 1475 ± 50 evts

[1] AUBERT 09O gives the amplitude and phase of the $\pi^+\pi^-$ S-wave in 29 $\pi^+\pi^-$ invariant-mass bins.
[2] LINK 04 borrows a K-matrix parametrization from ANISOVICH 03 of the full π-π S-wave isoscalar scattering amplitude to describe the $\pi^+\pi^-$ S-wave component of the $\pi^+\pi^+\pi^-$ state. The fit fraction given above is a sum over five f_0 mesons, the $f_0(980)$, $f_0(1300)$, $f_0(1200–1600)$, $f_0(1500)$, and $f_0(1750)$. See LINK 04 for details and discussion.

$\Gamma\big(f_0(980)\pi^+, f_0 \to \pi^+\pi^-\big)/\Gamma\big(2\pi^+\pi^-\big)$ — Γ_{64}/Γ_{61}

This is the "fit fraction" from the Dalitz-plot analysis. See above for the full $\pi^+(\pi^+\pi^-)_{S-wave}$ fit fraction.

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.565±0.043±0.047	AITALA	01A	E791	Dalitz fit, 848 evts
1.074±0.140±0.043	FRABETTI	97D	E687	γ Be ≈ 200 GeV

$\Gamma\big(f_0(1370)\pi^+, f_0 \to \pi^+\pi^-\big)/\Gamma\big(2\pi^+\pi^-\big)$ — Γ_{65}/Γ_{61}

This is the "fit fraction" from the Dalitz-plot analysis. See above for the full $\pi^+(\pi^+\pi^-)_{S-wave}$ fit fraction.

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.324±0.077±0.017	AITALA	01A	E791	Dalitz fit, 848 evts

$\Gamma\big(f_0(1500)\pi^+, f_0 \to \pi^+\pi^-\big)/\Gamma\big(2\pi^+\pi^-\big)$ — Γ_{66}/Γ_{61}

This is the "fit fraction" from the Dalitz-plot analysis. See above for the full $\pi^+(\pi^+\pi^-)_{S-wave}$ fit fraction.

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.274±0.114±0.019	[1] FRABETTI	97D	E687	γ Be ≈ 200 GeV

[1] FRABETTI 97D calls this mode $S(1475)\pi^+$, but finds the mass and width of this $S(1475)$ to be in excellent agreement with those of the $f_0(1500)$.

$\Gamma\big(f_2(1270)\pi^+, f_2 \to \pi^+\pi^-\big)/\Gamma\big(2\pi^+\pi^-\big)$ — Γ_{67}/Γ_{61}

This is the "fit fraction" from the Dalitz-plot analysis.

VALUE	DOCUMENT ID		TECN	COMMENT
0.101 ±0.018 OUR AVERAGE				
0.101 ±0.015 ±0.011	AUBERT	09O	BABR	Dalitz fit, ≈ 10.5k evts
0.0974±0.0449±0.0294	LINK	04	FOCS	Dalitz fit, 1475 ± 50 evts
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.197 ±0.033 ±0.006	AITALA	01A	E791	Dalitz fit, 848 evts
0.123 ±0.056 ±0.018	FRABETTI	97D	E687	γ Be ≈ 200 GeV

$\Gamma\big(\rho(1450)^0\pi^+, \rho^0 \to \pi^+\pi^-\big)/\Gamma\big(2\pi^+\pi^-\big)$ — Γ_{68}/Γ_{61}

This is the "fit fraction" from the Dalitz-plot analysis.

VALUE	DOCUMENT ID		TECN	COMMENT
0.027 ±0.018 OUR AVERAGE				
0.023 ±0.008 ±0.017	AUBERT	09O	BABR	Dalitz fit, ≈ 10.5k evts
0.0656±0.0343±0.0440	LINK	04	FOCS	Dalitz fit, 1475 ± 50 evts
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.044 ±0.021 ±0.002	AITALA	01A	E791	Dalitz fit, 848 evts

$\Gamma(\pi^+ 2\pi^0)/\Gamma_{total}$ — Γ_{69}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
0.65±0.13±0.03	72 ± 16	NAIK	09A	CLEO	e^+e^- at 4170 MeV

$\Gamma(2\pi^+\pi^-\pi^0)/\Gamma(\phi\pi^+)$ — Γ_{70}/Γ_{37}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<3.3	90	ANJOS	89E	E691	Photoproduction

$\Gamma(\eta\pi^+)/\Gamma_{total}$ — Γ_{71}/Γ

Unseen decay modes of the η are included.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
1.70±0.09 OUR FIT Error includes scale factor of 1.1.					
1.71±0.08 OUR AVERAGE					
1.67±0.08±0.06		ONYISI	13	CLEO	e^+e^- at 4.17 GeV
1.82±0.14±0.07	0.8k	ZUPANC	13	BELL	e^+e^- at $\Upsilon(4S), \Upsilon(5S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.58±0.11±0.18		[1] ALEXANDER	08	CLEO	See ONYISI 13

[1] ALEXANDER 08 uses single- and double-tagged events in an overall fit.

$\Gamma(\eta\pi^+)/\Gamma(K^+K^0_S)$ — Γ_{71}/Γ_{34}

Unseen decay modes of the η are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.13 ±0.07 OUR FIT Error includes scale factor of 1.1.					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.236±0.043±0.063	2587 ± 89	MENDEZ	10	CLEO	See ONYISI 13

$\Gamma(\eta\pi^+)/\Gamma(\phi\pi^+)$ — Γ_{71}/Γ_{37}

Unseen decay modes of the resonances are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.48±0.03±0.04	920	JESSOP	98	CLE2	$e^+e^- \approx \Upsilon(4S)$
0.54±0.09±0.06	165	ALEXANDER	92	CLE2	See JESSOP 98

$\Gamma(\omega\pi^+)/\Gamma_{total}$ — Γ_{72}/Γ

Unseen decay modes of the ω are included.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
0.24±0.06 OUR FIT					
0.21±0.09±0.01	6 ± 2.4	GE	09A	CLEO	e^+e^- at 4170 MeV

$\Gamma(\omega\pi^+)/\Gamma(\eta\pi^+)$ — Γ_{72}/Γ_{71}

Unseen decay modes of the resonances are included.

VALUE	DOCUMENT ID		TECN	COMMENT
0.14±0.04 OUR FIT				
0.16±0.04±0.03	BALEST	97	CLE2	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(3\pi^+2\pi^-)/\Gamma(K^+K^-\pi^+)$ — Γ_{73}/Γ_{36}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.146±0.014 OUR AVERAGE					
0.145±0.011±0.010	671	LINK	03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV
0.158±0.042±0.031	37	FRABETTI	97C	E687	γBe, $\overline{E}_\gamma \approx$ 200 GeV

$\Gamma(\eta\rho^+)/\Gamma_{total}$ — Γ_{75}/Γ

Unseen decay modes of the η are included.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
8.9±0.6±0.5	328 ± 22	NAIK	09A	CLEO	$\eta \to 2\gamma$

$\Gamma(\eta\rho^+)/\Gamma(\phi\pi^+)$ — Γ_{75}/Γ_{37}

Unseen decay modes of the resonances are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2.98±0.20±0.39	447	JESSOP	98	CLE2	$e^+e^- \approx \Upsilon(4S)$
$2.86\pm0.38^{+0.36}_{-0.38}$	217	AVERY	92	CLE2	See JESSOP 98

$\Gamma(\eta\pi^+\pi^0)/\Gamma_{total}$ — Γ_{76}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
9.2±0.4±1.1	ONYISI	13	CLEO	e^+e^- at 4.17 GeV

$\Gamma(\omega\pi^+\pi^0)/\Gamma_{total}$ — Γ_{77}/Γ

Unseen decay modes of the ω are included.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.78±0.65±0.25	34 ± 7.9	GE	09A	CLEO	e^+e^- at 4170 MeV

$\Gamma(3\pi^+2\pi^-\pi^0)/\Gamma_{total}$ — Γ_{78}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.049^{+0.033}_{-0.030}}$	BARLAG	92C	ACCM	π^- 230 GeV

$\Gamma(\omega 2\pi^+\pi^-)/\Gamma_{total}$ — Γ_{79}/Γ

Unseen decay modes of the ω are included.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
1.58±0.45±0.09	29 ± 8.2	GE	09A	CLEO	e^+e^- at 4170 MeV

$\Gamma(\eta'(958)\pi^+)/\Gamma_{total}$ — Γ_{80}/Γ

Unseen decay modes of the $\eta'(958)$ are included.

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
3.94±0.15±0.20	ONYISI	13	CLEO	e^+e^- at 4.17 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
3.77±0.25±0.30	[1] ALEXANDER	08	CLEO	See ONYISI 13

[1] ALEXANDER 08 uses single- and double-tagged events in an overall fit.

$\Gamma(\eta'(958)\pi^+)/\Gamma(K^+K^0_S)$ — Γ_{80}/Γ_{34}

Unseen decay modes of the $\eta'(958)$ are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2.654±0.088±0.139	1436 ± 47	MENDEZ	10	CLEO	See ONYISI 13

$\Gamma(\eta'(958)\pi^+)/\Gamma(\phi\pi^+)$ — Γ_{80}/Γ_{37}

Unseen decay modes of the resonances are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$1.03\pm0.06\pm0.07$	537	JESSOP	98	CLE2	$e^+e^- \approx \Upsilon(4S)$
$1.20\pm0.15\pm0.11$	281	ALEXANDER	92	CLE2	See JESSOP 98
$2.5\ \pm1.0\ ^{+1.5}_{-0.4}$	22	ALVAREZ	91	NA14	Photoproduction
$2.5\ \pm0.5\ \pm0.3$	215	ALBRECHT	90D	ARG	$e^+e^- \approx 10.4$ GeV

$\Gamma(\omega\eta\pi^+)/\Gamma_{\rm total}$ — Γ_{82}/Γ

Unseen decay modes of the ω and η are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.13\times10^{-2}$	90	GE	09A	CLEO	e^+e^- at 4170 MeV

$\Gamma(\eta'(958)\rho^+)/\Gamma_{\rm total}$ — Γ_{83}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
$5.8\pm1.4\pm0.4$	ABLIKIM	15Z	BES3	482 pb^{-1}, 4009 MeV

$\Gamma(\eta'(958)\rho^+)/\Gamma(\phi\pi^+)$ — Γ_{83}/Γ_{37}

Unseen decay modes of the resonances are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$2.78\pm0.28\pm0.30$	137	[1] JESSOP	98	CLE2	$e^+e^- \approx \Upsilon(4S)$
$3.44\pm0.62^{+0.44}_{-0.46}$	68	AVERY	92	CLE2	See JESSOP 98

[1] This JESSOP 98 fraction, when combined with other η' fractions, greatly overshoots the inclusive η' fraction. See the measurement just above, which fits nicely.

$\Gamma(\eta'(958)\pi^+\pi^0)/\Gamma_{\rm total}$ — Γ_{84}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
$5.6\pm0.5\pm0.6$	ONYISI	13	CLEO	e^+e^- at 4.17 GeV

$\Gamma(\eta'(958)\pi^+\pi^0\ \text{nonresonant})/\Gamma_{\rm total}$ — Γ_{85}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<5.1\times10^{-2}$	90	ABLIKIM	15Z	BES3	482 pb^{-1}, 4009 MeV

Modes with one or three K's

$\Gamma(K^+\pi^0)/\Gamma(K^+K^0_S)$ — Γ_{86}/Γ_{34}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
$4.2\pm1.4\pm0.2$	202 ± 70	MENDEZ	10	CLEO	e^+e^- at 4170 MeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$5.5\pm1.3\pm0.7$	141 ± 34	ADAMS	07A	CLEO	See MENDEZ 10

$\Gamma(K^0_S\pi^+)/\Gamma(K^+K^0_S)$ — Γ_{87}/Γ_{34}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
8.12±0.28 OUR AVERAGE					
8.5 ±0.7 ±0.2	393 ± 33	MENDEZ	10	CLEO	e^+e^- at 4170 MeV
8.03±0.24±0.19	17.6k±481	WON	09	BELL	e^+e^- at $\Upsilon(4S)$
10.4 ±2.4 ±1.4	113 ± 26	LINK	08	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
8.2 ±0.9 ±0.2	206 ± 22	ADAMS	07A	CLEO	See MENDEZ 10

$\Gamma(K^+\eta)/\Gamma(K^+K^0_S)$ — Γ_{88}/Γ_{34}

Unseen decay modes of the η are included.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
11.8±2.2±0.6	222 ± 41	MENDEZ	10	CLEO	e^+e^- at 4170 MeV

$\Gamma(K^+\eta)/\Gamma(\eta\pi^+)$ — Γ_{88}/Γ_{71}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
8.9±1.5±0.4	113 ± 18	ADAMS	07A	CLEO	See MENDEZ 10

$\Gamma(K^+\omega)/\Gamma_{total}$ — Γ_{89}/Γ

Unseen decay modes of the ω are included.

VALUE (units 10^{-2})	CL%	DOCUMENT ID		TECN	COMMENT
<0.24	90	GE	09A	CLEO	e^+e^- at 4170 MeV

$\Gamma(K^+\eta'(958))/\Gamma(K^+K^0_S)$ — Γ_{90}/Γ_{34}

Unseen decay modes of the $\eta'(958)$ are included.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
11.8±3.6±0.7	56 ± 17	MENDEZ	10	CLEO	e^+e^- at 4170 MeV

$\Gamma(K^+\eta'(958))/\Gamma(\eta'(958)\pi^+)$ — Γ_{90}/Γ_{80}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
4.2±1.3±0.3	28 ± 9	ADAMS	07A	CLEO	See MENDEZ 10

$\Gamma(K^+\pi^+\pi^-)/\Gamma_{total}$ — Γ_{91}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
0.66 ±0.04 OUR FIT				
0.654±0.033±0.025	ONYISI	13	CLEO	e^+e^- at 4.17 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.69 ±0.05 ±0.03	[1] ALEXANDER	08	CLEO	See ONYISI 13

[1] ALEXANDER 08 uses single- and double-tagged events in an overall fit.

$\Gamma(K^+\pi^+\pi^-)/\Gamma(K^+K^-\pi^+)$ — Γ_{91}/Γ_{36}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.120±0.007 OUR FIT	Error includes scale factor of 1.1.				
0.127±0.007±0.014	567 ± 31	LINK	04F	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(K^+\rho^0)/\Gamma(K^+\pi^+\pi^-)$ Γ_{92}/Γ_{91}

This is the "fit fraction" from the Dalitz-plot analysis.

VALUE	DOCUMENT ID		TECN	COMMENT
0.3883±0.0531±0.0261	LINK	04F	FOCS	Dalitz fit, 567 evts

$\Gamma(K^+\rho(1450)^0, \rho^0 \to \pi^+\pi^-)/\Gamma(K^+\pi^+\pi^-)$ Γ_{93}/Γ_{91}

This is the "fit fraction" from the Dalitz-plot analysis.

VALUE	DOCUMENT ID		TECN	COMMENT
0.1062±0.0351±0.0104	LINK	04F	FOCS	Dalitz fit, 567 evts

$\Gamma(K^*(892)^0\pi^+, K^{*0} \to K^+\pi^-)/\Gamma(K^+\pi^+\pi^-)$ Γ_{94}/Γ_{91}

This is the "fit fraction" from the Dalitz-plot analysis.

VALUE	DOCUMENT ID		TECN	COMMENT
0.2164±0.0321±0.0114	LINK	04F	FOCS	Dalitz fit, 567 evts

$\Gamma(K^*(1410)^0\pi^+, K^{*0} \to K^+\pi^-)/\Gamma(K^+\pi^+\pi^-)$ Γ_{95}/Γ_{91}

This is the "fit fraction" from the Dalitz-plot analysis.

VALUE	DOCUMENT ID		TECN	COMMENT
0.1882±0.0403±0.0122	LINK	04F	FOCS	Dalitz fit, 567 evts

$\Gamma(K^*(1430)^0\pi^+, K^{*0} \to K^+\pi^-)/\Gamma(K^+\pi^+\pi^-)$ Γ_{96}/Γ_{91}

This is the "fit fraction" from the Dalitz-plot analysis.

VALUE	DOCUMENT ID		TECN	COMMENT
0.0765±0.0500±0.0170	LINK	04F	FOCS	Dalitz fit, 567 evts

$\Gamma(K^+\pi^+\pi^-$ nonresonant$)/\Gamma(K^+\pi^+\pi^-)$ Γ_{97}/Γ_{91}

This is the "fit fraction" from the Dalitz-plot analysis.

VALUE	DOCUMENT ID		TECN	COMMENT
0.1588±0.0492±0.0153	LINK	04F	FOCS	Dalitz fit, 567 evts

$\Gamma(K^0\pi^+\pi^0)/\Gamma_{total}$ Γ_{98}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
1.00±0.18±0.04	44 ± 8	NAIK	09A	CLEO	e^+e^- at 4170 MeV

$\Gamma(K^0_S 2\pi^+\pi^-)/\Gamma(K^0_S K^- 2\pi^+)$ Γ_{99}/Γ_{50}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.18±0.04±0.05	179 ± 36	LINK	08	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(K^+\omega\pi^0)/\Gamma_{total}$ Γ_{100}/Γ

Unseen decay modes of the ω are included.

VALUE (units 10^{-2})	CL%	DOCUMENT ID		TECN	COMMENT
<0.82	90	GE	09A	CLEO	e^+e^- at 4170 MeV

$\Gamma(K^+\omega\pi^+\pi^-)/\Gamma_{total}$ Γ_{101}/Γ

Unseen decay modes of the ω are included.

VALUE (units 10^{-2})	CL%	DOCUMENT ID		TECN	COMMENT
<0.54	90	GE	09A	CLEO	e^+e^- at 4170 MeV

$\Gamma(K^+\omega\eta)/\Gamma_{total}$ — Γ_{102}/Γ

Unseen decay modes of the ω and η are included.

VALUE (units 10^{-2})	CL%	DOCUMENT ID		TECN	COMMENT
<0.79	90	GE	09A	CLEO	e^+e^- at 4170 MeV

$\Gamma(2K^+K^-)/\Gamma(K^+K^-\pi^+)$ — Γ_{103}/Γ_{36}

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
4.0 ±0.3 ±0.2	748 ± 60	DEL-AMO-SA...	11G	BABR	$e^+e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$8.95\pm2.12^{+2.24}_{-2.31}$	31	LINK	02I	FOCS	γ A, ≈ 180 GeV

$\Gamma(\phi K^+, \phi\to K^+K^-)/\Gamma(2K^+K^-)$ — $\Gamma_{104}/\Gamma_{103}$

VALUE	DOCUMENT ID		TECN	COMMENT
0.41±0.08±0.03	DEL-AMO-SA...	11G	BABR	$e^+e^- \approx \Upsilon(4S)$

Doubly Cabibbo-suppressed modes

$\Gamma(2K^+\pi^-)/\Gamma(K^+K^-\pi^+)$ — Γ_{105}/Γ_{36}

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
2.33±0.23 OUR AVERAGE					
2.3 ±0.3 ±0.2	356 ± 52	DEL-AMO-SA...	11G	BABR	$e^+e^- \approx \Upsilon(4S)$
2.29±0.28±0.12	281 ± 34	KO	09	BELL	e^+e^- at $\Upsilon(4S)$
5.2 ±1.7 ±1.1	27 ± 9	LINK	05K	FOCS	<0.78%, CL = 90%

$\Gamma(K^+K^*(892)^0, K^{*0}\to K^+\pi^-)/\Gamma(2K^+\pi^-)$ — $\Gamma_{106}/\Gamma_{105}$

VALUE	DOCUMENT ID		TECN	COMMENT
0.47±0.22±0.15	DEL-AMO-SA...	11G	BABR	$e^+e^- \approx \Upsilon(4S)$

Baryon-antibaryon mode

$\Gamma(p\overline{n})/\Gamma_{total}$ — Γ_{107}/Γ

This is the only baryonic mode allowed kinematically.

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{1.30\pm0.36^{+0.12}_{-0.16}}$	13.0 ± 3.6	ATHAR	08	CLEO	e^+e^-, $E_{cm} \approx$ 4170 MeV

Rare or forbidden modes

$\Gamma(\pi^+e^+e^-)/\Gamma_{total}$ — Γ_{108}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$\mathbf{<13 \times 10^{-6}}$	90	LEES	11G	BABR	$e^+e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$< 2.2\times10^{-5}$	90	[1] RUBIN	10	CLEO	e^+e^- at 4170 MeV
$<27 \times10^{-5}$	90	AITALA	99G	E791	$\pi^- N$ 500 GeV

[1] This RUBIN 10 limit is for the e^+e^- mass in the continuum away from the $\phi(1020)$. See the next data block.

$\Gamma(\pi^+\phi,\ \phi\rightarrow e^+e^-)/\Gamma_{total}$ Γ_{109}/Γ

This is *not* a test for the $\Delta C = 1$ weak neutral current, but leads to the $\pi^+e^+e^-$ final state.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$(6^{+8}_{-4}\pm1)\times10^{-6}$	3	RUBIN	10	CLEO	e^+e^- at 4170 MeV

$\Gamma(\pi^+\mu^+\mu^-)/\Gamma_{total}$ Γ_{110}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<4.1\times10^{-7}$	90	AAIJ	13AF	LHCB	pp at 7 TeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<4.3\times10^{-5}$	90	LEES	11G	BABR	$e^+e^-\approx\ \Upsilon(4S)$
$<2.6\times10^{-5}$	90	LINK	03F	FOCS	γ A, $\overline{E}_\gamma\approx$ 180 GeV
$<1.4\times10^{-4}$	90	AITALA	99G	E791	π^-N 500 GeV
$<4.3\times10^{-4}$	90	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(K^+e^+e^-)/\Gamma_{total}$ Γ_{111}/Γ

A test for the ΔC=1 weak neutral current. Allowed by higher-order electroweak interactions.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<3.7\times10^{-6}$	90	LEES	11G	BABR	$e^+e^-\approx\ \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<5.2\times10^{-5}$	90	RUBIN	10	CLEO	e^+e^- at 4170 MeV
$<1.6\times10^{-3}$	90	AITALA	99G	E791	π^-N 500 GeV

$\Gamma(K^+\mu^+\mu^-)/\Gamma_{total}$ Γ_{112}/Γ

A test for the ΔC=1 weak neutral current. Allowed by higher-order electroweak interactions.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<21\ \times10^{-6}$	90	LEES	11G	BABR	$e^+e^-\approx\ \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<\ 3.6\times10^{-5}$	90	LINK	03F	FOCS	γ A, $\overline{E}_\gamma\approx$ 180 GeV
$<\ 1.4\times10^{-4}$	90	AITALA	99G	E791	π^-N 500 GeV
$<\ 5.9\times10^{-4}$	90	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(K^*(892)^+\mu^+\mu^-)/\Gamma_{total}$ Γ_{113}/Γ

A test for the ΔC=1 weak neutral current. Allowed by higher-order electroweak interactions.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.4\times10^{-3}$	90	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(\pi^+e^+\mu^-)/\Gamma_{total}$ Γ_{114}/Γ

A test of lepton-family-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<12\times10^{-6}$	90	LEES	11G	BABR	$e^+e^-\approx\ \Upsilon(4S)$

$\Gamma(\pi^+ e^- \mu^+)/\Gamma_{total}$ Γ_{115}/Γ

A test of lepton-family-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<20 \times 10^{-6}$	90	LEES	11G	BABR	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(K^+ e^+ \mu^-)/\Gamma_{total}$ Γ_{116}/Γ

A test of lepton-family-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<14 \times 10^{-6}$	90	LEES	11G	BABR	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(K^+ e^- \mu^+)/\Gamma_{total}$ Γ_{117}/Γ

A test of lepton-family-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<9.7 \times 10^{-6}$	90	LEES	11G	BABR	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\pi^- 2e^+)/\Gamma_{total}$ Γ_{118}/Γ

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$< 4.1 \times 10^{-6}$	90	LEES	11G	BABR	$e^+e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$< 1.8 \times 10^{-5}$	90	RUBIN	10	CLEO	e^+e^- at 4170 MeV
$<69 \times 10^{-5}$	90	AITALA	99G	E791	$\pi^- N$ 500 GeV

$\Gamma(\pi^- 2\mu^+)/\Gamma_{total}$ Γ_{119}/Γ

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.2 \times 10^{-7}$	90	AAIJ	13AF	LHCB	pp at 7 TeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<1.4 \times 10^{-5}$	90	LEES	11G	BABR	$e^+e^- \approx \Upsilon(4S)$
$<2.9 \times 10^{-5}$	90	LINK	03F	FOCS	γ A, $\overline{E}_\gamma \approx 180$ GeV
$<8.2 \times 10^{-5}$	90	AITALA	99G	E791	$\pi^- N$ 500 GeV
$<4.3 \times 10^{-4}$	90	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(\pi^- e^+ \mu^+)/\Gamma_{total}$ Γ_{120}/Γ

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<8.4 \times 10^{-6}$	90	LEES	11G	BABR	$e^+e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<7.3 \times 10^{-4}$	90	AITALA	99G	E791	$\pi^- N$ 500 GeV

$\Gamma(K^- 2e^+)/\Gamma_{total}$ Γ_{121}/Γ

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$< 5.2 \times 10^{-6}$	90	LEES	11G	BABR	$e^+e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$< 1.7 \times 10^{-5}$	90	RUBIN	10	CLEO	e^+e^- at 4170 MeV
$<63 \times 10^{-5}$	90	AITALA	99G	E791	$\pi^- N$ 500 GeV

$\Gamma(K^- 2\mu^+)/\Gamma_{total}$ — Γ_{122}/Γ

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.3 × 10^{-5}	90	LEES	11G	BABR	$e^+ e^- \approx \Upsilon(4S)$
<1.3 × 10^{-5}	90	LINK	03F	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<1.8 \times 10^{-4}$	90	AITALA	99G	E791	π^- N 500 GeV
$<5.9 \times 10^{-4}$	90	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(K^- e^+ \mu^+)/\Gamma_{total}$ — Γ_{123}/Γ

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<6.1 × 10^{-6}	90	LEES	11G	BABR	$e^+ e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<6.8 \times 10^{-4}$	90	AITALA	99G	E791	π^- N 500 GeV

$\Gamma(K^*(892)^- 2\mu^+)/\Gamma_{total}$ — Γ_{124}/Γ

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.4 × 10^{-3}	90	KODAMA	95	E653	π^- emulsion 600 GeV

$D_s^+ - D_s^-$ *CP*-VIOLATING DECAY-RATE ASYMMETRIES

This is the difference between D_s^+ and D_s^- partial widths for the decay to state f, divided by the sum of the widths:
$A_{CP}(f) = [\Gamma(D_s^+ \to f) - \Gamma(D_s^- \to \overline{f})] \,/\, [\Gamma(D_s^+ \to f) + \Gamma(D_s^- \to \overline{f})]$.

$A_{CP}(\mu^\pm \nu)$ in $D_s^+ \to \mu^+ \nu$, $D_s^- \to \mu^- \overline{\nu}_\mu$

VALUE (%)	DOCUMENT ID		TECN	COMMENT
4.8±6.1	ALEXANDER	09	CLEO	$e^+ e^-$ at 4170 MeV

$A_{CP}(K^\pm K^0_S)$ in $D_s^\pm \to K^\pm K^0_S$

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
0.08±0.26 OUR AVERAGE					
$-0.05\pm0.23\pm0.24$	288k	[1] LEES	13E	BABR	$e^+ e^-$ at $\Upsilon(4S)$
$2.6 \pm1.5 \pm0.6$		ONYISI	13	CLEO	$e^+ e^-$ at 4.17 GeV
$0.12\pm0.36\pm0.22$		KO	10	BELL	$e^+ e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$4.7 \pm1.8 \pm0.9$	4.0k	MENDEZ	10	CLEO	See ONYISI 13
$4.9 \pm2.1 \pm0.9$		ALEXANDER	08	CLEO	See MENDEZ 10

[1] LEES 13E finds that after subtracting the contribution due to $K^0 - \overline{K}^0$ mixing, the *CP* asymmetry is $(+0.28 \pm 0.23 \pm 0.24)$%.

$A_{CP}(K^+ K^- \pi^\pm)$ in $D_s^\pm \to K^+ K^- \pi^\pm$

VALUE (%)	DOCUMENT ID		TECN	COMMENT
−0.5±0.8±0.4	ONYISI	13	CLEO	$e^+ e^-$ at 4.17 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.3\pm1.1\pm0.8$	ALEXANDER	08	CLEO	See ONYISI 13

$A_{CP}(\phi\pi^{\pm})$ in $D_s^{\pm} \to \phi\pi^{\pm}$

VALUE (%)	DOCUMENT ID		TECN	COMMENT
−0.38±0.26±0.08	ABAZOV	14B	D0	$p\overline{p}$ at 1.96 TeV

$A_{CP}(K^{\pm}K^0_S\pi^0)$ in $D_s^{\pm} \to K^{\pm}K^0_S\pi^0$

VALUE (%)	DOCUMENT ID		TECN	COMMENT
−1.6±6.0±1.1	ONYISI	13	CLEO	e^+e^- at 4.17 GeV

$A_{CP}(2K^0_S\pi^{\pm})$ in $D_s^{\pm} \to 2K^0_S\pi^{\pm}$

VALUE (%)	DOCUMENT ID		TECN	COMMENT
3.1±5.2±0.6	ONYISI	13	CLEO	e^+e^- at 4.17 GeV

$A_{CP}(K^+K^-\pi^{\pm}\pi^0)$ in $D_s^{\pm} \to K^+K^-\pi^{\pm}\pi^0$

VALUE (%)	DOCUMENT ID		TECN	COMMENT
0.0±2.7±1.2	ONYISI	13	CLEO	e^+e^- at 4.17 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−5.9±4.2±1.2	ALEXANDER	08	CLEO	See ONYISI 13

$A_{CP}(K^{\pm}K^0_S\pi^+\pi^-)$ in $D_s^{\pm} \to K^{\pm}K^0_S\pi^+\pi^-$

VALUE (%)	DOCUMENT ID		TECN	COMMENT
−5.7±5.3±0.9	ONYISI	13	CLEO	e^+e^- at 4.17 GeV

$A_{CP}(K^0_S K^{\mp}2\pi^{\pm})$ in $D_s^{+} \to K^0_S K^{\mp}2\pi^{\pm}$

VALUE (%)	DOCUMENT ID		TECN	COMMENT
4.1±2.7±0.9	ONYISI	13	CLEO	e^+e^- at 4.17 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.7±3.6±1.1	ALEXANDER	08	CLEO	See ONYISI 13

$A_{CP}(\pi^+\pi^-\pi^{\pm})$ in $D_s^{\pm} \to \pi^+\pi^-\pi^{\pm}$

VALUE (%)	DOCUMENT ID		TECN	COMMENT
−0.7±3.0±0.6	ONYISI	13	CLEO	e^+e^- at 4.17 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.0±4.6±0.7	ALEXANDER	08	CLEO	See ONYISI 13

$A_{CP}(\pi^{\pm}\eta)$ in $D_s^{\pm} \to \pi^{\pm}\eta$

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
1.1±3.0±0.8		ONYISI	13	CLEO	e^+e^- at 4.17 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−4.6±2.9±0.3	2.5k	MENDEZ	10	CLEO	See ONYISI 13
−8.2±5.2±0.8		ALEXANDER	08	CLEO	See MENDEZ 10

$A_{CP}(\pi^{\pm}\eta')$ in $D_s^{\pm} \to \pi^{\pm}\eta'$

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
−0.9 ±0.5 OUR AVERAGE					
−0.82±0.36±0.35	152k	AAIJ	17AF	LHCB	pp at 7, 8 TeV
−2.2 ±2.2 ±0.6		ONYISI	13	CLEO	e^+e^- at 4.17 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−6.1 ±3.0 ±0.3	1.4k	MENDEZ	10	CLEO	See ONYISI 13
−5.5 ±3.7 ±1.2		ALEXANDER	08	CLEO	See MENDEZ 10

$A_{CP}(\eta\pi^{\pm}\pi^0)$ in $D_s^{\pm} \to \eta\pi^{\pm}\pi^0$

VALUE (%)	DOCUMENT ID		TECN	COMMENT
−0.5±3.9±2.0	ONYISI	13	CLEO	e^+e^- at 4.17 GeV

$A_{CP}(\eta'\pi^{\pm}\pi^0)$ in $D_s^{\pm} \to \eta'\pi^{\pm}\pi^0$

VALUE (%)	DOCUMENT ID		TECN	COMMENT
−0.4±7.4±1.9	ONYISI	13	CLEO	e^+e^- at 4.17 GeV

$A_{CP}(K^{\pm}\pi^0)$ in $D_s^{\pm} \to K^{\pm}\pi^0$

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
−26.6±23.8±0.9	202 ± 70	MENDEZ	10	CLEO	e^+e^- at 4170 MeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2 ±29		ADAMS	07A	CLEO	See MENDEZ 10

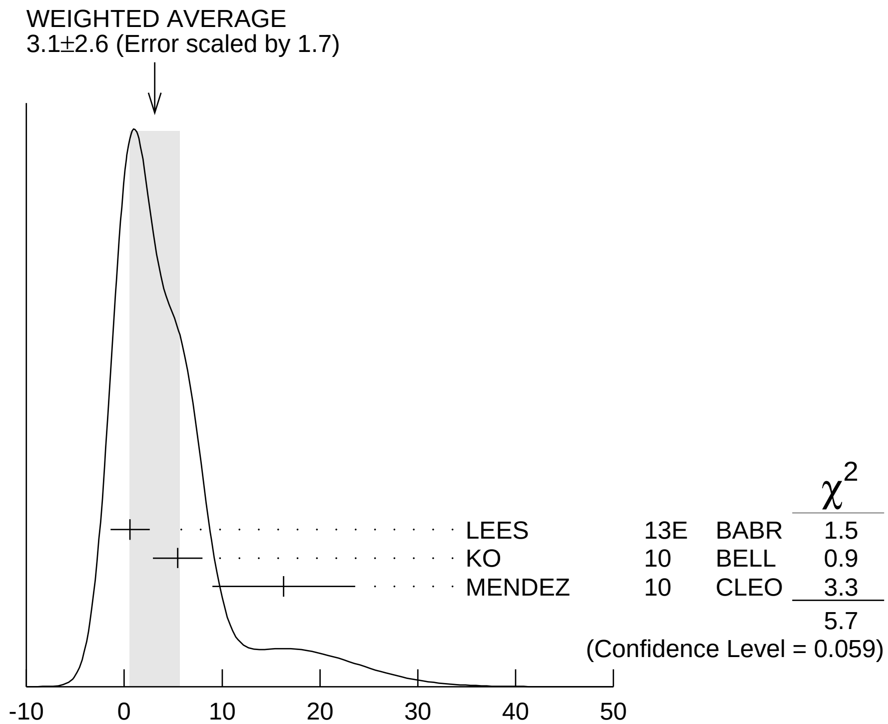
$A_{CP}(\overline{K}^0/K^0\pi^{\pm})$ in $D_s^+ \to \overline{K}^0\pi^+$, $D_s^- \to K^0\pi^-$

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
0.4 ±0.5 OUR AVERAGE					
0.38±0.46±0.17	121k	[1] AAIJ	14BD	LHCB	pp at 7, 8 TeV
0.3 ±2.0 ±0.3	14k	LEES	13E	BABR	e^+e^- at $\Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.61±0.83±0.14	26k	AAIJ	13W	LHCB	See AAIJ 14BD

[1] AAIJ 14BD reports its result as $A_{CP}(D_s^{\pm} \to K_S^0 K^{\pm})$ with CP-violation effects in the $K^0 - \overline{K}^0$ system subtracted. It also measures $A_{CP}(D^{\pm} \to \overline{K}^0/K^0 K^{\pm}) + A_{CP}(D_s^{\pm} \to \overline{K}^0/K^0\pi^{\pm}) = (0.41 \pm 0.49 \pm 0.26)\%$.

$A_{CP}(K_S^0\pi^{\pm})$ in $D_s^{\pm} \to K_S^0\pi^{\pm}$

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
3.1 ± 2.6 OUR AVERAGE	Error includes scale factor of 1.7. See the ideogram below.				
0.6 ± 2.0 ±0.3	14k	LEES	13E	BABR	e^+e^- at $\Upsilon(4S)$
5.45± 2.50±0.33		KO	10	BELL	$e^+e^- \approx \Upsilon(4S)$
16.3 ± 7.3 ±0.3	0.4k	MENDEZ	10	CLEO	e^+e^- at 4170 MeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
27 ±11		ADAMS	07A	CLEO	See MENDEZ 10



$A_{CP}(K^0_S \pi^\pm)$ in $D^\pm_s \to K^0_S \pi^\pm$ (%)

$A_{CP}(K^\pm \pi^+ \pi^-)$ in $D^\pm_s \to K^\pm \pi^+ \pi^-$

VALUE (%)	DOCUMENT ID		TECN	COMMENT
4.5±4.8±0.6	ONYISI	13	CLEO	$e^+ e^-$ at 4.17 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
11.2±7.0±0.9	ALEXANDER	08	CLEO	See ONYISI 13

$A_{CP}(K^\pm \eta)$ in $D^\pm_s \to K^\pm \eta$

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
9.3±15.2±0.9	222 ± 41	MENDEZ	10	CLEO	$e^+ e^-$ at 4170 MeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−20 ±18		ADAMS	07A	CLEO	See MENDEZ 10

$A_{CP}(K^\pm \eta'(958))$ in $D^\pm_s \to K^\pm \eta'(958)$

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
6.0±18.9±0.9	56 ± 17	MENDEZ	10	CLEO	$e^+ e^-$ at 4170 MeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
−17 ±37		ADAMS	07A	CLEO	See MENDEZ 10

CP VIOLATING ASYMMETRIES OF P-ODD (T-ODD) MOMENTS

$A_{Tviol}(K^0_S K^\pm \pi^+ \pi^-)$ in $D^\pm_s \to K^0_S K^\pm \pi^+ \pi^-$

$C_T \equiv \vec{p}_{K^+} \cdot (\vec{p}_{\pi^+} \times \vec{p}_{\pi^-})$ is a parity-odd correlation of the K^+, π^+, and π^- momenta for the D^+_s. $\overline{C}_T \equiv \vec{p}_{K^-} \cdot (\vec{p}_{\pi^-} \times \vec{p}_{\pi^+})$ is the corresponding quantity for the D^-_s. Then
$A_T \equiv [\Gamma(C_T > 0) - \Gamma(C_T < 0)] / [\Gamma(C_T > 0) + \Gamma(C_T < 0)]$, and
$\overline{A}_T \equiv [\Gamma(-\overline{C}_T > 0) - \Gamma(-\overline{C}_T < 0)] / [\Gamma(-\overline{C}_T > 0) + \Gamma(-\overline{C}_T < 0)]$, and
$A_{Tviol} \equiv \frac{1}{2}(A_T - \overline{A}_T)$. C_T and $\overline{C}_T$ are commonly referred to as T-odd moments, because they are odd under T reversal. However, the T-conjugate process $K^0_S K^\pm \pi^+ \pi^- \to D^\pm_s$ is not accessible, while the P-conjugate process is.

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
−13.6± 7.7± 3.4	29.8±0.3k	LEES 11E	BABR	$e^+ e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−36 ±67 ±23	508 ± 34	LINK 05E	FOCS	γ A, $\overline{E}_\gamma \approx 180$ GeV

$D^+_s \to \phi \ell^+ \nu_\ell$ FORM FACTORS

$r_2 \equiv A_2(0)/A_1(0)$ in $D^+_s \to \phi \ell^+ \nu_\ell$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.84 ±0.11 OUR AVERAGE Error includes scale factor of 2.4.				
0.816±0.036±0.030	25±0.5k	[1] AUBERT 08AN	BABR	$\phi e^+ \nu_e$
0.713±0.202±0.284	793	LINK 04C	FOCS	$\phi \mu^+ \nu_\mu$
1.57 ±0.25 ±0.19	271	AITALA 99D	E791	$\phi e^+ \nu_e$, $\phi \mu^+ \nu_\mu$
1.4 ±0.5 ±0.3	308	AVERY 94B	CLE2	$\phi e^+ \nu_e$
1.1 ±0.8 ±0.1	90	FRABETTI 94F	E687	$\phi \mu^+ \nu_\mu$
2.1 $^{+0.6}_{-0.5}$ ±0.2	19	KODAMA 93	E653	$\phi \mu^+ \nu_\mu$

[1] To compare with previous measurements, this AUBERT 08AN value is from a fit that fixes the pole masses at $m_A = 2.5$ GeV/c^2 and $m_V = 2.1$ GeV/c^2. A simultaneous fit to r_2, r_V, r_0 (a significant s-wave contribution) and m_A, gives $r_2 = 0.763 \pm 0.071 \pm 0.065$.

$r_v \equiv V(0)/A_1(0)$ in $D^+_s \to \phi \ell^+ \nu_\ell$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
1.80 ±0.08 OUR AVERAGE				
1.807±0.046±0.065	25±0.5k	[1] AUBERT 08AN	BABR	$\phi e^+ \nu_e$
1.549±0.250±0.148	793	LINK 04C	FOCS	$\phi \mu^+ \nu_\mu$
2.27 ±0.35 ±0.22	271	AITALA 99D	E791	$\phi e^+ \nu_e$, $\phi \mu^+ \nu_\mu$
0.9 ±0.6 ±0.3	308	AVERY 94B	CLE2	$\phi e^+ \nu_e$
1.8 ±0.9 ±0.2	90	FRABETTI 94F	E687	$\phi \mu^+ \nu_\mu$
2.3 $^{+1.1}_{-0.9}$ ±0.4	19	KODAMA 93	E653	$\phi \mu^+ \nu_\mu$

[1] To compare with previous measurements, this AUBERT 08AN value is from a fit that fixes the pole masses at $m_A = 2.5$ GeV/c^2 and $m_V = 2.1$ GeV/c^2. A simultaneous fit to r_2, r_V, r_0 (a significant s-wave contribution) and m_A, gives $r_V = 1.849 \pm 0.060 \pm 0.095$.

Γ_L/Γ_T in $D_s^+ \to \phi \ell^+ \nu_\ell$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.72±0.18 OUR AVERAGE					
1.0 ±0.3 ±0.2	308	AVERY	94B	CLE2	$\phi e^+ \nu_e$
1.0 ±0.5 ±0.1	90	[1] FRABETTI	94F	E687	$\phi \mu^+ \nu_\mu$
0.54±0.21±0.10	19	[1] KODAMA	93	E653	$\phi \mu^+ \nu_\mu$

[1] FRABETTI 94F and KODAMA 93 evaluate Γ_L/Γ_T for a lepton mass of zero.

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