



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

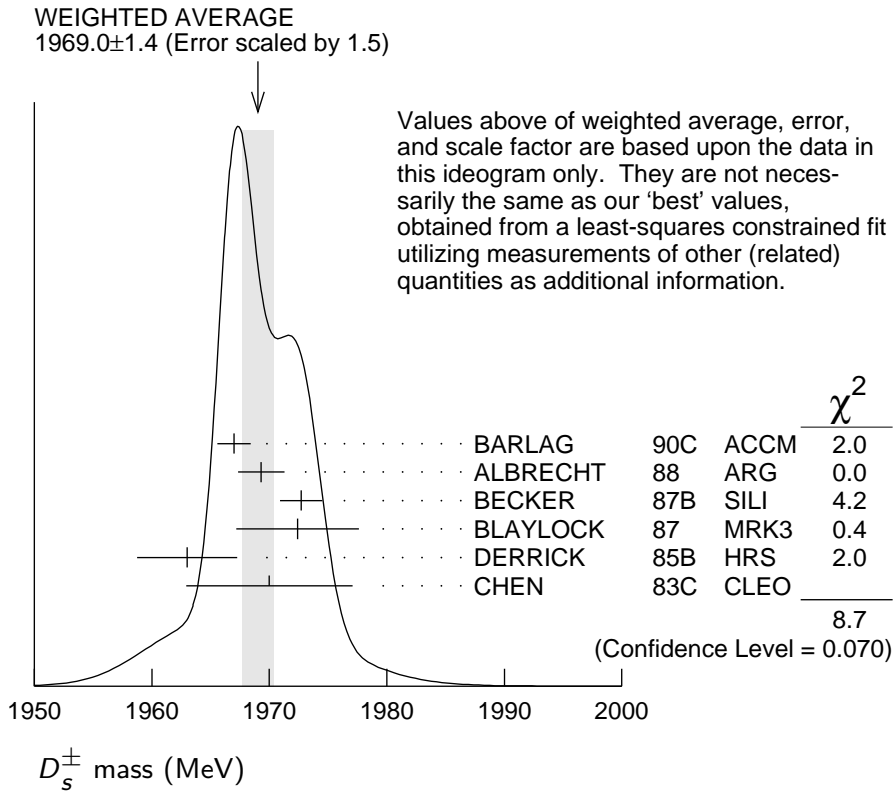
The angular distributions of the decays of the ϕ and $\bar{K}^*(892)^0$ in the $\phi\pi^+$ and $K^+\bar{K}^*(892)^0$ modes strongly indicate that the spin is zero. The parity given is that expected of a $c\bar{s}$ ground state.

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
1968.30 ± 0.10 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 → $\phi\pi^+X$

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				
$98.68 \pm 0.03 \pm 0.04$		AAIJ	13V	LHCB $D_s^+ \rightarrow K^+ K^- \pi^+$
$99.41 \pm 0.38 \pm 0.21$		ACOSTA	03D	CDF2 $\bar{p}p, \sqrt{s} = 1.96$ TeV
$98.4 \pm 0.1 \pm 0.3$	48k	AUBERT	02G	BABR $e^+e^- \approx \Upsilon(4S)$
$99.5 \pm 0.6 \pm 0.3$		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

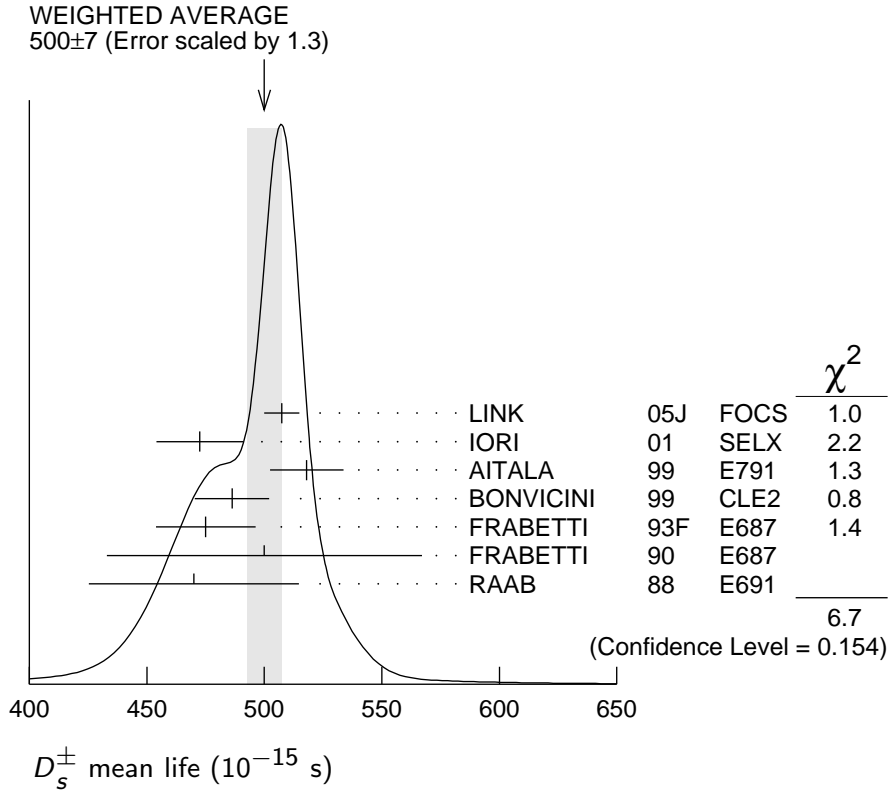
D_s^\pm MEAN LIFE

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
500 ± 7 OUR AVERAGE				Error includes scale factor of 1.3. See the ideogram below.
$507.4 \pm 5.5 \pm 5.1$	13.6k	LINK	05J	FOCS $\phi \pi^+$ and $\bar{K}^{*0} K^+$
$472.5 \pm 17.2 \pm 6.6$	760	IORI	01	SELX 600 GeV Σ^-, π^-, p
$518 \pm 14 \pm 7$	1662	AITALA	99	E791 π^- nucleus, 500 GeV

$486.3 \pm 15.0^{+4.9}_{-5.1}$	2167	¹ BONVICINI	99	CLE2	$e^+e^- \approx \Upsilon(4S)$
$475 \pm 20 \pm 7$	900	FRABETTI	93F	E687	$\gamma \text{Be}, \phi\pi^+$
$500 \pm 60 \pm 30$	104	FRABETTI	90	E687	$\gamma \text{Be}, \phi\pi^+$
$470 \pm 40 \pm 20$	228	RAAB	88	E691	Photoproduction

¹ 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 \pm 0.4) %	
Γ_2 π^+ anything	(119.3 \pm 1.4) %	
Γ_3 π^- anything	(43.2 \pm 0.9) %	
Γ_4 π^0 anything	(123 \pm 7) %	
Γ_5 K^- anything	(18.7 \pm 0.5) %	
Γ_6 K^+ anything	(28.9 \pm 0.7) %	
Γ_7 K_S^0 anything	(19.0 \pm 1.1) %	
Γ_8 η anything	[b] (29.9 \pm 2.8) %	

Γ_9	ω anything	(6.1 \pm 1.4) %	
Γ_{10}	η' anything	[c] (11.7 \pm 1.8) %	
Γ_{11}	$f_0(980)$ anything, $f_0 \rightarrow \pi^+ \pi^-$	< 1.3 %	CL=90%
Γ_{12}	ϕ anything	(15.7 \pm 1.0) %	
Γ_{13}	$K^+ K^-$ anything	(15.8 \pm 0.7) %	
Γ_{14}	$K_S^0 K^+$ anything	(5.8 \pm 0.5) %	
Γ_{15}	$K_S^0 K^-$ anything	(1.9 \pm 0.4) %	
Γ_{16}	$2K_S^0$ anything	(1.70 \pm 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}	$\mu^+ \nu_\mu$	(5.56 \pm 0.25) $\times 10^{-3}$	
Γ_{21}	$\tau^+ \nu_\tau$	(5.55 \pm 0.24) %	
Γ_{22}	$K^+ K^- e^+ \nu_e$	—	
Γ_{23}	$\phi e^+ \nu_e$	[d] (2.49 \pm 0.14) %	
Γ_{24}	$\eta e^+ \nu_e + \eta'(958) e^+ \nu_e$	[d] (3.66 \pm 0.37) %	
Γ_{25}	$\eta e^+ \nu_e$	[d] (2.67 \pm 0.29) %	S=1.1
Γ_{26}	$\eta'(958) e^+ \nu_e$	[d] (9.9 \pm 2.3) $\times 10^{-3}$	
Γ_{27}	$\omega e^+ \nu_e$	[e] < 2.0 $\times 10^{-3}$	CL=90%
Γ_{28}	$K^0 e^+ \nu_e$	(3.7 \pm 1.0) $\times 10^{-3}$	
Γ_{29}	$K^*(892)^0 e^+ \nu_e$	[d] (1.8 \pm 0.7) $\times 10^{-3}$	
Γ_{30}	$f_0(980) e^+ \nu_e, f_0 \rightarrow \pi^+ \pi^-$	(2.00 \pm 0.32) $\times 10^{-3}$	

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

Γ_{31}	$K^+ K_S^0$	(1.50 \pm 0.05) %	
Γ_{32}	$K^+ \bar{K}^0$	(2.95 \pm 0.14) %	
Γ_{33}	$K^+ K^- \pi^+$	[f] (5.45 \pm 0.17) %	S=1.2
Γ_{34}	$\phi \pi^+$	[d,g] (4.5 \pm 0.4) %	
Γ_{35}	$\phi \pi^+, \phi \rightarrow K^+ K^-$	[g] (2.27 \pm 0.08) %	
Γ_{36}	$K^+ \bar{K}^*(892)^0, \bar{K}^{*0} \rightarrow K^- \pi^+$	(2.61 \pm 0.09) %	
Γ_{37}	$f_0(980) \pi^+, f_0 \rightarrow K^+ K^-$	(1.15 \pm 0.32) %	
Γ_{38}	$f_0(1370) \pi^+, f_0 \rightarrow K^+ K^-$	(7 \pm 5) $\times 10^{-4}$	
Γ_{39}	$f_0(1710) \pi^+, f_0 \rightarrow K^+ K^-$	(6.7 \pm 2.9) $\times 10^{-4}$	
Γ_{40}	$K^+ \bar{K}_0^*(1430)^0, \bar{K}_0^{*0} \rightarrow K^- \pi^+$	(1.9 \pm 0.4) $\times 10^{-3}$	
Γ_{41}	$K^+ K_S^0 \pi^0$	(1.52 \pm 0.22) %	
Γ_{42}	$2K_S^0 \pi^+$	(7.7 \pm 0.6) $\times 10^{-3}$	
Γ_{43}	$K^0 \bar{K}^0 \pi^+$	—	
Γ_{44}	$K^*(892)^+ \bar{K}^0$	[d] (5.4 \pm 1.2) %	
Γ_{45}	$K^+ K^- \pi^+ \pi^0$	(6.3 \pm 0.6) %	
Γ_{46}	$\phi \rho^+$	[d] (8.4 \pm 1.9 \pm 2.3) %	

Γ_{47}	$K_S^0 K^- 2\pi^+$	(1.67±0.10) %	
Γ_{48}	$K^*(892)^+ \bar{K}^*(892)^0$	[d] (7.2 ±2.6) %	
Γ_{49}	$K^+ K_S^0 \pi^+ \pi^-$	(1.03±0.10) %	
Γ_{50}	$K^+ K^- 2\pi^+ \pi^-$	(8.7 ±1.5) × 10 ⁻³	
Γ_{51}	$\phi 2\pi^+ \pi^-$	[d] (1.21±0.16) %	
Γ_{52}	$K^+ K^- \rho^0 \pi^+$ non- ϕ	< 2.6 × 10 ⁻⁴	CL=90%
Γ_{53}	$\phi \rho^0 \pi^+$, $\phi \rightarrow K^+ K^-$	(6.5 ±1.3) × 10 ⁻³	
Γ_{54}	$\phi a_1(1260)^+$, $\phi \rightarrow K^+ K^-$, $a_1^+ \rightarrow \rho^0 \pi^+$	(7.5 ±1.2) × 10 ⁻³	
Γ_{55}	$K^+ K^- 2\pi^+ \pi^-$ nonresonant	(9 ±7) × 10 ⁻⁴	
Γ_{56}	$2K_S^0 2\pi^+ \pi^-$	(9 ±4) × 10 ⁻⁴	

Hadronic modes without K's

Γ_{57}	$\pi^+ \pi^0$	< 3.5 × 10 ⁻⁴	CL=90%
Γ_{58}	$2\pi^+ \pi^-$	(1.09±0.05) %	S=1.1
Γ_{59}	$\rho^0 \pi^+$	(2.0 ±1.2) × 10 ⁻⁴	
Γ_{60}	$\pi^+ (\pi^+ \pi^-)_{S\text{-wave}}$	[h] (9.1 ±0.4) × 10 ⁻³	
Γ_{61}	$f_0(980) \pi^+$, $f_0 \rightarrow \pi^+ \pi^-$		
Γ_{62}	$f_0(1370) \pi^+$, $f_0 \rightarrow \pi^+ \pi^-$		
Γ_{63}	$f_0(1500) \pi^+$, $f_0 \rightarrow \pi^+ \pi^-$		
Γ_{64}	$f_2(1270) \pi^+$, $f_2 \rightarrow \pi^+ \pi^-$	(1.10±0.20) × 10 ⁻³	
Γ_{65}	$\rho(1450)^0 \pi^+$, $\rho^0 \rightarrow \pi^+ \pi^-$	(3.0 ±2.0) × 10 ⁻⁴	
Γ_{66}	$\pi^+ 2\pi^0$	(6.5 ±1.3) × 10 ⁻³	
Γ_{67}	$2\pi^+ \pi^- \pi^0$	—	
Γ_{68}	$\eta \pi^+$	[d] (1.70±0.09) %	S=1.1
Γ_{69}	$\omega \pi^+$	[d] (2.4 ±0.6) × 10 ⁻³	
Γ_{70}	$3\pi^+ 2\pi^-$	(8.0 ±0.8) × 10 ⁻³	
Γ_{71}	$2\pi^+ \pi^- 2\pi^0$	—	
Γ_{72}	$\eta \rho^+$	[d] (8.9 ±0.8) %	
Γ_{73}	$\eta \pi^+ \pi^0$	(9.2 ±1.2) %	
Γ_{74}	$\omega \pi^+ \pi^0$	[d] (2.8 ±0.7) %	
Γ_{75}	$3\pi^+ 2\pi^- \pi^0$	(4.9 ±3.2) %	
Γ_{76}	$\omega 2\pi^+ \pi^-$	[d] (1.6 ±0.5) %	
Γ_{77}	$\eta'(958) \pi^+$	[c,d] (3.94±0.25) %	
Γ_{78}	$3\pi^+ 2\pi^- 2\pi^0$	—	
Γ_{79}	$\omega \eta \pi^+$	[d] < 2.13 %	CL=90%
Γ_{80}	$\eta'(958) \rho^+$	[c,d] (12.5 ±2.2) %	
Γ_{81}	$\eta'(958) \pi^+ \pi^0$	(5.6 ±0.8) %	

Modes with one or three K's

Γ_{82}	$K^+ \pi^0$	(6.3 ±2.1) × 10 ⁻⁴	
Γ_{83}	$K_S^0 \pi^+$	(1.22±0.06) × 10 ⁻³	
Γ_{84}	$K^+ \eta$	[d] (1.77±0.35) × 10 ⁻³	
Γ_{85}	$K^+ \omega$	[d] < 2.4 × 10 ⁻³	CL=90%
Γ_{86}	$K^+ \eta'(958)$	[d] (1.8 ±0.6) × 10 ⁻³	

Γ_{87}	$K^+ \pi^+ \pi^-$		$(6.6 \pm 0.4) \times 10^{-3}$	
Γ_{88}	$K^+ \rho^0$		$(2.5 \pm 0.4) \times 10^{-3}$	
Γ_{89}	$K^+ \rho(1450)^0, \rho^0 \rightarrow \pi^+ \pi^-$		$(7.0 \pm 2.4) \times 10^{-4}$	
Γ_{90}	$K^*(892)^0 \pi^+, K^{*0} \rightarrow K^+ \pi^-$		$(1.42 \pm 0.24) \times 10^{-3}$	
Γ_{91}	$K^*(1410)^0 \pi^+, K^{*0} \rightarrow$		$(1.24 \pm 0.29) \times 10^{-3}$	
Γ_{92}	$K^*(1430)^0 \pi^+, K^{*0} \rightarrow$		$(5.0 \pm 3.5) \times 10^{-4}$	
Γ_{93}	$K^+ \pi^+ \pi^-$ nonresonant		$(1.04 \pm 0.34) \times 10^{-3}$	
Γ_{94}	$K^0 \pi^+ \pi^0$		$(1.00 \pm 0.18) \%$	
Γ_{95}	$K_S^0 2\pi^+ \pi^-$		$(3.0 \pm 1.1) \times 10^{-3}$	
Γ_{96}	$K^+ \omega \pi^0$	$[d] <$	8.2×10^{-3}	CL=90%
Γ_{97}	$K^+ \omega \pi^+ \pi^-$	$[d] <$	5.4×10^{-3}	CL=90%
Γ_{98}	$K^+ \omega \eta$	$[d] <$	7.9×10^{-3}	CL=90%
Γ_{99}	$2K^+ K^-$		$(2.18 \pm 0.21) \times 10^{-4}$	
Γ_{100}	$\phi K^+, \phi \rightarrow K^+ K^-$		$(8.9 \pm 2.0) \times 10^{-5}$	

Doubly Cabibbo-suppressed modes

Γ_{101}	$2K^+ \pi^-$		$(1.27 \pm 0.13) \times 10^{-4}$	
Γ_{102}	$K^+ K^*(892)^0, K^{*0} \rightarrow$		$(6.0 \pm 3.4) \times 10^{-5}$	
	$K^+ \pi^-$			

Baryon-antibaryon mode

Γ_{103}	$\rho \bar{n}$		$(1.3 \pm 0.4) \times 10^{-3}$	
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**$\Delta C = 1$ weak neutral current (C1) modes,
Lepton family number (LF), or
Lepton number (L) violating modes**

Γ_{104}	$\pi^+ e^+ e^-$		$[i] <$	1.3×10^{-5}	CL=90%
Γ_{105}	$\pi^+ \phi, \phi \rightarrow e^+ e^-$		$[j] (6 \begin{smallmatrix} +8 \\ -4 \end{smallmatrix}) \times 10^{-6}$		
Γ_{106}	$\pi^+ \mu^+ \mu^-$		$[i] <$	4.1×10^{-7}	CL=90%
Γ_{107}	$K^+ e^+ e^-$	C1	$<$	3.7×10^{-6}	CL=90%
Γ_{108}	$K^+ \mu^+ \mu^-$	C1	$<$	2.1×10^{-5}	CL=90%
Γ_{109}	$K^*(892)^+ \mu^+ \mu^-$	C1	$<$	1.4×10^{-3}	CL=90%
Γ_{110}	$\pi^+ e^+ \mu^-$	LF	$<$	1.2×10^{-5}	CL=90%
Γ_{111}	$\pi^+ e^- \mu^+$	LF	$<$	2.0×10^{-5}	CL=90%
Γ_{112}	$K^+ e^+ \mu^-$	LF	$<$	1.4×10^{-5}	CL=90%
Γ_{113}	$K^+ e^- \mu^+$	LF	$<$	9.7×10^{-6}	CL=90%
Γ_{114}	$\pi^- 2e^+$	L	$<$	4.1×10^{-6}	CL=90%
Γ_{115}	$\pi^- 2\mu^+$	L	$<$	1.2×10^{-7}	CL=90%
Γ_{116}	$\pi^- e^+ \mu^+$	L	$<$	8.4×10^{-6}	CL=90%
Γ_{117}	$K^- 2e^+$	L	$<$	5.2×10^{-6}	CL=90%
Γ_{118}	$K^- 2\mu^+$	L	$<$	1.3×10^{-5}	CL=90%
Γ_{119}	$K^- e^+ \mu^+$	L	$<$	6.1×10^{-6}	CL=90%
Γ_{120}	$K^*(892)^- 2\mu^+$	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 , K^{*0} , or $f_0(980)$ — is 7.0 ± 0.4 %
 - [b] This fraction includes η from η' decays.
 - [c] Two times (to include μ decays) the $\eta' e^+ \nu_e$ branching fraction, plus the $\eta' \pi^+$, $\eta' \rho^+$, and $\eta' K^+$ fractions, is $(18.6 \pm 2.3)\%$, which considerably exceeds the inclusive η' fraction of $(11.7 \pm 1.8)\%$. Our best guess is that the $\eta' \rho^+$ fraction, $(12.5 \pm 2.2)\%$, is too large.
 - [d] This branching fraction includes all the decay modes of the final-state resonance.
 - [e] A test for $u\bar{u}$ or $d\bar{d}$ content in the D_s^+ . Neither Cabibbo-favored nor Cabibbo-suppressed decays can contribute, and ω - ϕ 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 $\Delta C=1$ weak neutral current because both quarks must change flavor in this decay.
 - [j] This is *not* a test for the $\Delta C=1$ weak neutral current, but leads to the $\pi^+ \ell^+ \ell^-$ final state.
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CONSTRAINED FIT INFORMATION

An overall fit to 16 branching ratios uses 20 measurements and one constraint to determine 12 parameters. The overall fit has a $\chi^2 = 6.7$ for 9 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle \delta x_i \delta x_j \rangle / (\delta x_i \delta x_j)$, 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_{25}	16									
x_{26}	12	2								
x_{31}	0	0	0							
x_{33}	0	0	0	56						
x_{45}	0	0	0	15	27					
x_{47}	0	0	0	35	34	11				
x_{58}	0	0	0	36	55	16	22			
x_{68}	0	0	0	16	1	-2	7	-1		
x_{69}	0	0	0	2	0	0	1	0	11	
x_{87}	0	0	0	21	20	3	12	10	11	1
	x_{23}	x_{25}	x_{26}	x_{31}	x_{33}	x_{45}	x_{47}	x_{58}	x_{68}	x_{69}

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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 , K^{*0} , or $f_0(980)$ — is $6.90 \pm 0.4\%$

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
$6.52 \pm 0.39 \pm 0.15$	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 $0.828 \pm 0.051 \pm 0.025$.

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

Γ_2 / Γ

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

VALUE (units 10^{-2})	DOCUMENT ID	TECN	COMMENT
$119.3 \pm 1.2 \pm 0.7$	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 $K_S^0 \rightarrow \pi^+ \pi^-$ are not included.

<u>VALUE (units 10^{-2})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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 $K_S^0 \rightarrow 2\pi^0$ are not included.

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

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

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

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

<u>VALUE (units 10^{-2})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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**

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

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

This ratio includes η particles from η' decays.

<u>VALUE (units 10^{-2})</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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
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$\Gamma(\omega \text{ anything})/\Gamma_{\text{total}}$ **Γ_9/Γ**

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

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

<u>VALUE (units 10^{-2})</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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 ± 15	HUANG	06B	CLEO See DOBBS 09
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$\Gamma(f_0(980) \text{ anything, } f_0 \rightarrow \pi^+ \pi^-)/\Gamma_{\text{total}}$ **Γ_{11}/Γ**

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

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

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

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

<u>VALUE (units 10^{-2})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$15.8 \pm 0.6 \pm 0.3$	DOBBS 09	CLEO	$e^+ e^-$ at 4170 MeV

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

<u>VALUE (units 10^{-2})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$5.8 \pm 0.5 \pm 0.1$	DOBBS 09	CLEO	$e^+ e^-$ at 4170 MeV

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

<u>VALUE (units 10^{-2})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$1.9 \pm 0.4 \pm 0.1$	DOBBS 09	CLEO	$e^+ e^-$ at 4170 MeV

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

<u>VALUE (units 10^{-2})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$1.7 \pm 0.3 \pm 0.1$	DOBBS 09	CLEO	$e^+ e^-$ at 4170 MeV

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

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

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

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

————— **Leptonic and semileptonic modes** —————

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

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$<0.83 \times 10^{-4}$	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

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

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

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

<u>VALUE (units 10^{-3})</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
5.56 ± 0.25 OUR AVERAGE				
5.31 ± 0.28 ± 0.20	492 ± 26	¹ ZUPANC 13	BELL	e^+e^- at $\Upsilon(4S), \Upsilon(5S)$
6.02 ± 0.38 ± 0.34	275 ± 17	² 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	³ WIDHALM 08	BELL	See ZUPANC 13
5.94 ± 0.66 ± 0.31	88	⁴ PEDLAR 07A	CLEO	See ALEXANDER 09
6.8 ± 1.1 ± 1.8	553	⁵ HEISTER 02I	ALEP	Z decays

- ¹ ZUPANC 13 uses both $\mu^+\nu$ and $\tau^+\nu$ events to get $f_{D_s} = (255.5 \pm 4.2 \pm 5.1)$ MeV.
² 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.
³ WIDHALM 08 gets $f_{D_s} = (275 \pm 16 \pm 12)$ MeV from the branching fraction.
⁴ PEDLAR 07A also fits μ^+ and τ^+ events together and gets an effective $\mu^+\nu_\mu$ branching fraction of $(6.38 \pm 0.59 \pm 0.33) \times 10^{-3}$
⁵ 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 $D_s^+ \rightarrow \tau^+\nu_\tau$ 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_{34}

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

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.143 ± 0.018 ± 0.006	489 ± 55	¹ AUBERT 07V	BABR	$e^+e^- \approx \Upsilon(4S)$
0.23 ± 0.06 ± 0.04	18	² ALEXANDROV 00	BEAT	π^- nucleus, 350 GeV
0.173 ± 0.023 ± 0.035	182	³ CHADHA 98	CLE2	$e^+e^- \approx \Upsilon(4S)$
0.245 ± 0.052 ± 0.074	39	⁴ ACOSTA 94	CLE2	See CHADHA 98

- ¹ AUBERT 07V gets $f_{D_s^+} = (283 \pm 17 \pm 16)$ MeV, using $\Gamma(D_s^+ \rightarrow \phi\pi^+)/\Gamma(\text{total}) = (4.71 \pm 0.46)\%$.
² ALEXANDROV 00 uses $f_D^2/f_{D_s}^2 = 0.82 \pm 0.09$ from a lattice-gauge-theory calculation to get the relative numbers of $D^+ \rightarrow \mu^+\nu_\mu$ and $D_s^+ \rightarrow \mu^+\nu_\mu$ events. The present result leads to $f_{D_s} = (323 \pm 44 \pm 36)$ MeV.
³ CHADHA 98 obtains $f_{D_s} = (280 \pm 19 \pm 28 \pm 34)$ MeV from this measurement, using $\Gamma(D_s^+ \rightarrow \phi\pi^+)/\Gamma(\text{total}) = 0.036 \pm 0.009$.
⁴ ACOSTA 94 obtains $f_{D_s} = (344 \pm 37 \pm 52 \pm 42)$ MeV from this measurement, using $\Gamma(D_s^+ \rightarrow \phi\pi^+)/\Gamma(\text{total}) = 0.037 \pm 0.009$.

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

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

<u>VALUE (units 10^{-2})</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
5.55 ± 0.24 OUR AVERAGE				
5.70 ± 0.21 ^{+0.31} _{-0.30}	2.2k	¹ ZUPANC	13 BELL	$e^+ e^-$ at $\Upsilon(4S)$, $\Upsilon(5S)$
4.96 ± 0.37 ± 0.57	748 ± 53	² DEL-AMO-SA..10J	BABR	$e^- \bar{\nu}_e \nu_\tau, \mu^- \bar{\nu}_\mu \nu_\tau$
6.42 ± 0.81 ± 0.18	126 ± 16	³ ALEXANDER	09 CLEO	$\tau^+ \rightarrow \pi^+ \bar{\nu}_\tau$
5.52 ± 0.57 ± 0.21	155 ± 17	³ NAIK	09A CLEO	$\tau^+ \rightarrow \rho^+ \bar{\nu}_\tau$
5.30 ± 0.47 ± 0.22	181 ± 16	³ ONYISI	09 CLEO	$\tau^+ \rightarrow e^+ \nu_e \bar{\nu}_\tau$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
6.17 ± 0.71 ± 0.34	102	⁴ ECKLUND	08 CLEO	See ONYISI 09
8.0 ± 1.3 ± 0.4	47	⁴ PEDLAR	07A CLEO	See ALEXANDER 09
5.79 ± 0.77 ± 1.84	881	⁵ HEISTER	02I ALEP	Z decays
7.0 ± 2.1 ± 2.0	22	⁶ ABBIENDI	01L OPAL	$D_s^{*+} \rightarrow \gamma D_s^+$ from Z's
7.4 ± 2.8 ± 2.4	16	⁷ ACCIARRI	97F L3	$D_s^{*+} \rightarrow \gamma D_s^+$ from Z's

¹ ZUPANC 13 uses both $\mu^+ \nu$ and $\tau^+ \nu$ events to get $f_{D_s} = (255.5 \pm 4.2 \pm 5.1)$ MeV.

² DEL-AMO-SANCHEZ 10J (with a small correction; see LEES 15D) uses $\mu^+ \nu_\mu$ and $\tau^+ \nu_\tau$ events together to get $f_{D_s} = (259.9 \pm 6.6 \pm 7.6)$ MeV.

³ ALEXANDER 09, NAIK 09A, and ONYISI 09 use different τ decay modes and are independent. The three papers combined give $f_{D_s} = (259.7 \pm 7.8 \pm 3.4)$ MeV.

⁴ ECKLUND 08 and PEDLAR 07A are independent: ECKLUND 08 uses $\tau^+ \rightarrow e^+ \nu_e \bar{\nu}_\tau$ events, PEDLAR 07A uses $\tau^+ \rightarrow \pi^+ \bar{\nu}_\tau$ events.

⁵ HEISTER 02I combines its $D_s^+ \rightarrow \tau^+ \nu_\tau$ and $\mu^+ \nu_\mu$ branching fractions to get $f_{D_s} = (285 \pm 19 \pm 40)$ MeV.

⁶ This ABBIENDI 01L value gives a decay constant f_{D_s} of $(286 \pm 44 \pm 41)$ MeV.

⁷ The second ACCIARRI 97F error here combines in quadrature systematic (0.016) and normalization (0.018) errors. The branching fraction gives $f_{D_s} = (309 \pm 58 \pm 33 \pm 38)$ MeV.

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

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
10.73 ± 0.69 ^{+0.56} _{-0.53}	2.2k/492	¹ ZUPANC	13 BELL	$e^+ e^-$ at $\Upsilon(4S)$, $\Upsilon(5S)$
11.0 ± 1.4 ± 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 $274 \pm 10 \pm 5$ MeV.

$\Gamma(K^+ K^- e^+ \nu_e) / \Gamma(K^+ K^- \pi^+)$ $\Gamma_{22} / \Gamma_{33}$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
0.558 ± 0.007 ± 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.

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

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

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
2.49±0.14 OUR FIT				
2.54±0.14 OUR AVERAGE				
2.36±0.23±0.13	106 ± 10	ECKLUND	09	CLEO $e^+ e^-$ at 4170 MeV
2.61±0.03±0.17	(25 ± 0.5)k	AUBERT	08AN	BABR $e^+ e^-$ at $\Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.29±0.37±0.11	45	YELTON	09	CLEO See ECKLUND 09

$\Gamma(\phi e^+ \nu_e)/\Gamma(\phi \pi^+)$ Γ_{23}/Γ_{34}

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±0.033±0.048	793	LINK	02J	FOCS Uses $\phi \mu^+ \nu_\mu$
0.54 ±0.05 ±0.04	367	BUTLER	94	CLE2 Uses $\phi e^+ \nu_e$ and $\phi \mu^+ \nu_\mu$
0.58 ±0.17 ±0.07	97	FRABETTI	93G	E687 Uses $\phi \mu^+ \nu_\mu$
0.57 ±0.15 ±0.15	104	ALBRECHT	91	ARG Uses $\phi e^+ \nu_e$
0.49 ±0.10 ^{+0.10} _{-0.14}	54	ALEXANDER	90B	CLEO Uses $\phi e^+ \nu_e$ and $\phi \mu^+ \nu_\mu$

$\Gamma(\eta e^+ \nu_e)/\Gamma_{\text{total}}$ Γ_{25}/Γ

Unseen decay modes of the η are included.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
2.67±0.29 OUR FIT	Error includes scale factor of 1.1.			
2.48±0.29±0.13	82	YELTON	09	CLEO $e^+ e^-$ at 4170 MeV

$\Gamma(\eta e^+ \nu_e)/\Gamma(\phi e^+ \nu_e)$ Γ_{25}/Γ_{23}

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
1.07±0.12 OUR FIT	Error includes scale factor of 1.1.			
1.24±0.12±0.15	440	¹ BRANDENB...	95	CLE2 $e^+ e^- \approx \Upsilon(4S)$
¹ BRANDENBURG 95 uses both e^+ and μ^+ events and makes a phase-space adjustment to use the μ^+ events as e^+ events.				

$\Gamma(\eta'(958) e^+ \nu_e)/\Gamma_{\text{total}}$ Γ_{26}/Γ

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

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
0.99±0.23 OUR FIT				
0.91±0.33±0.05	7.5	YELTON	09	CLEO $e^+ e^-$ at 4170 MeV

$\Gamma(\eta'(958) e^+ \nu_e)/\Gamma(\phi e^+ \nu_e)$ Γ_{26}/Γ_{23}

Unseen decay modes of the resonances are included.

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.40±0.09 OUR FIT				
0.43±0.11±0.07	29	¹ BRANDENB...	95	CLE2 $e^+ e^- \approx \Upsilon(4S)$
¹ BRANDENBURG 95 uses both e^+ and μ^+ events and makes a phase-space adjustment to use the μ^+ events as e^+ events.				

$$\frac{[\Gamma(\eta e^+ \nu_e) + \Gamma(\eta'(958) e^+ \nu_e)]}{\Gamma(\phi e^+ \nu_e)} \quad \Gamma_{24}/\Gamma_{23} = (\Gamma_{25} + \Gamma_{26})/\Gamma_{23}$$

Unseen decay modes of the resonances are included.

VALUE	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

1.67 ± 0.17 ± 0.17 ¹ BRANDENB... 95 CLE2 e⁺ e⁻ ≈ γ(4S)

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

$$\Gamma(\omega e^+ \nu_e)/\Gamma_{\text{total}} \quad \Gamma_{27}/\Gamma$$

A test for $u\bar{u}$ or $d\bar{d}$ 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
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<0.20 90 MARTIN 11 CLEO e⁺ e⁻ at 4170 MeV

$$\Gamma(K^0 e^+ \nu_e)/\Gamma_{\text{total}} \quad \Gamma_{28}/\Gamma$$

VALUE (units 10 ⁻²)	EVTS	DOCUMENT ID	TECN	COMMENT
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0.37 ± 0.10 ± 0.02 14 YELTON 09 CLEO e⁺ e⁻ at 4170 MeV

$$\Gamma(K^*(892)^0 e^+ \nu_e)/\Gamma_{\text{total}} \quad \Gamma_{29}/\Gamma$$

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

VALUE (units 10 ⁻²)	EVTS	DOCUMENT ID	TECN	COMMENT
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0.18 ± 0.07 ± 0.01 7.5 YELTON 09 CLEO e⁺ e⁻ at 4170 MeV

$$\Gamma(f_0(980) e^+ \nu_e, f_0 \rightarrow \pi^+ \pi^-)/\Gamma_{\text{total}} \quad \Gamma_{30}/\Gamma$$

VALUE (units 10 ⁻²)	EVTS	DOCUMENT ID	TECN	COMMENT
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0.20 ± 0.03 ± 0.01 44 ± 7 ECKLUND 09 CLEO e⁺ e⁻ at 4170 MeV

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.13 ± 0.04 ± 0.01 13 YELTON 09 CLEO See ECKLUND 09

———— Hadronic modes with a $K\bar{K}$ pair. ————

$$\Gamma(K^+ K_S^0)/\Gamma_{\text{total}} \quad \Gamma_{31}/\Gamma$$

VALUE (units 10 ⁻²)	DOCUMENT ID	TECN	COMMENT
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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. The correlation matrix for the branching fractions is used in the fit.

$$\Gamma(K^+ \bar{K}^0)/\Gamma_{\text{total}} \quad \Gamma_{32}/\Gamma$$

VALUE (units 10 ⁻²)	EVTS	DOCUMENT ID	TECN	COMMENT
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2.95 ± 0.11 ± 0.09 2.0k ¹ ZUPANC 13 BELL e⁺ e⁻ at γ(4S), γ(5S)

¹ ZUPANC 13 finds the \bar{K}^0 from its missing-mass squared, not from $K_S^0 \rightarrow \pi^+ \pi^-$.

The DCS ($D_s^+ \rightarrow K^+ K^0$) contribution to this fraction is estimated to be an order of magnitude below the statistical uncertainty.

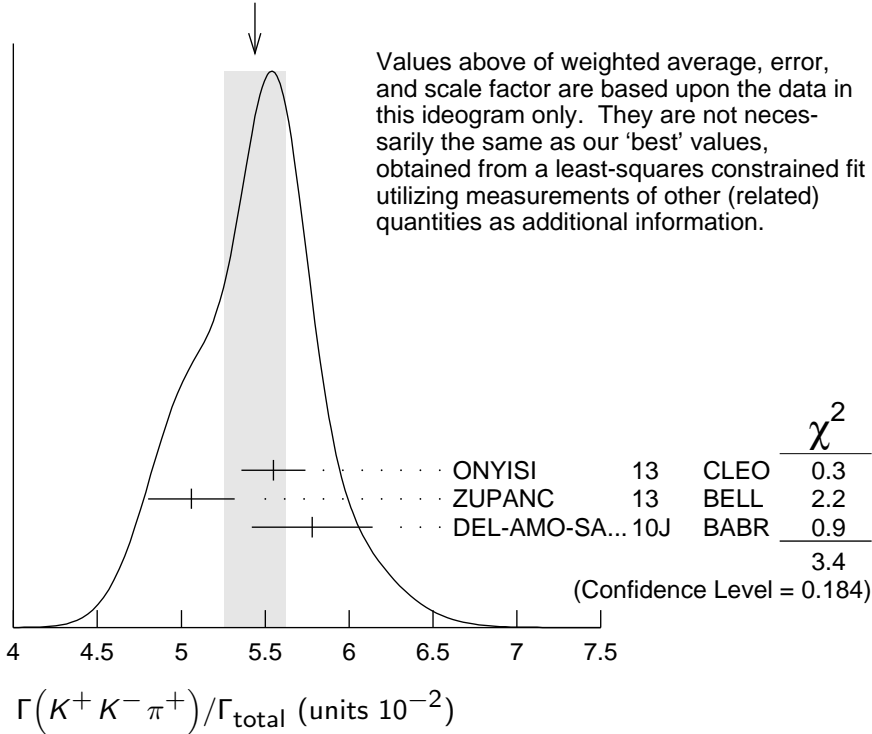
$\Gamma(K^+ K^- \pi^+)/\Gamma_{\text{total}}$

Γ_{33}/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

¹ALEXANDER 08 uses single- and double-tagged events in an overall fit. The correlation matrix for the branching fractions is used in the fit.

WEIGHTED AVERAGE
5.44±0.18 (Error scaled by 1.3)



$\Gamma(\phi\pi^+)/\Gamma_{\text{total}}$

Γ_{34}/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 $\begin{matrix} +5.1 & +1.8 \\ -1.9 & -1.1 \end{matrix}$ 4 BAI 95C BES e^+e^- 4.03 GeV

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

² AUBERT 05V uses the ratio of $B^0 \rightarrow D^{*-} D_S^{*+}$ events seen in two different ways, in both of which the $D^{*-} \rightarrow \bar{D}^0 \pi^-$ decay is fully reconstructed: (1) The $D_S^{*+} \rightarrow D_S^+ \gamma$, $D_S^+ \rightarrow \phi \pi^+$ 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 $\bar{B}^0 \rightarrow D^{*+} D_S^{*-}$ decays to get a model-independent value for $\Gamma(D_S^- \rightarrow \phi \pi^-) / \Gamma(D^0 \rightarrow K^- \pi^+)$ of $0.92 \pm 0.20 \pm 0.11$.

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

$\Gamma(\phi \pi^+, \phi \rightarrow K^+ K^-) / \Gamma(K^+ K^- \pi^+)$ $\Gamma_{35} / \Gamma_{33}$

This is the “fit fraction” from the Dalitz-plot analysis. 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.

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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

$\Gamma(K^+ \bar{K}^*(892)^0, \bar{K}^{*0} \rightarrow K^- \pi^+) / \Gamma(K^+ K^- \pi^+)$ $\Gamma_{36} / \Gamma_{33}$

This is the “fit fraction” from the Dalitz-plot analysis.

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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

$\Gamma(f_0(980) \pi^+, f_0 \rightarrow K^+ K^-) / \Gamma(K^+ K^- \pi^+)$ $\Gamma_{37} / \Gamma_{33}$

This is the “fit fraction” from the Dalitz-plot analysis.

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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

$\Gamma(f_0(1370)\pi^+, f_0 \rightarrow K^+K^-)/\Gamma(K^+K^-\pi^+)$ Γ_{38}/Γ_{33}

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

$\Gamma(f_0(1710)\pi^+, f_0 \rightarrow K^+K^-)/\Gamma(K^+K^-\pi^+)$ Γ_{39}/Γ_{33}

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

$\Gamma(K^+\bar{K}_0^*(1430)^0, \bar{K}_0^* \rightarrow K^-\pi^+)/\Gamma(K^+K^-\pi^+)$ Γ_{40}/Γ_{33}

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

$\Gamma(K^+K_S^0\pi^0)/\Gamma_{total}$ Γ_{41}/Γ

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

$\Gamma(2K_S^0\pi^+)/\Gamma_{total}$ Γ_{42}/Γ

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

$\Gamma(K^*(892)^+\bar{K}^0)/\Gamma(\phi\pi^+)$ Γ_{44}/Γ_{34}

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_{45}/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

¹ALEXANDER 08 uses single- and double-tagged events in an overall fit. The correlation matrix for the branching fractions is used in the fit.

$\Gamma(\phi\rho^+)/\Gamma(\phi\pi^+)$ Γ_{46}/Γ_{34}

VALUE	EVTs	DOCUMENT ID	TECN	COMMENT
1.86±0.26^{+0.29}_{-0.40}	253	AVERY 92	CLE2	e ⁺ e ⁻ ≈ 10.5 GeV

$\Gamma(K_S^0 K^- 2\pi^+)/\Gamma_{\text{total}}$ Γ_{47}/Γ

VALUE (units 10^{-2})	DOCUMENT ID	TECN	COMMENT
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1.67±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 ¹ALEXANDER 08 CLEO See ONYISI 13

¹ALEXANDER 08 uses single- and double-tagged events in an overall fit. The correlation matrix for the branching fractions is used in the fit.

$\Gamma(K^*(892)^+ \bar{K}^*(892)^0)/\Gamma(\phi\pi^+)$ Γ_{48}/Γ_{34}

Unseen decay modes of the resonances are included.

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

$\Gamma(K^+ K_S^0 \pi^+ \pi^-)/\Gamma_{\text{total}}$ Γ_{49}/Γ

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

$\Gamma(K^+ K_S^0 \pi^+ \pi^-)/\Gamma(K_S^0 K^- 2\pi^+)$ Γ_{49}/Γ_{47}

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

$\Gamma(K^+ K^- 2\pi^+ \pi^-)/\Gamma(K^+ K^- \pi^+)$ Γ_{50}/Γ_{33}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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0.160±0.027 OUR AVERAGE

0.150±0.019±0.025 240 LINK 03D FOCS γ A, $\bar{E}_\gamma \approx 180$ GeV

0.188±0.036±0.040 75 FRABETTI 97C E687 γ Be, $\bar{E}_\gamma \approx 200$ GeV

$\Gamma(\phi 2\pi^+ \pi^-)/\Gamma(\phi\pi^+)$ Γ_{51}/Γ_{34}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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0.269±0.027 OUR AVERAGE

0.249±0.024±0.021 136 LINK 03D FOCS γ A, $\bar{E}_\gamma \approx 180$ GeV

0.28 ±0.06 ±0.01 40 FRABETTI 97C E687 γ Be, $\bar{E}_\gamma \approx 200$ GeV

0.58 ±0.21 ±0.10 21 FRABETTI 92 E687 γ Be

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_{52}/Γ_{50}

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

$\Gamma(\phi \rho^0 \pi^+, \phi \rightarrow K^+ K^-)/\Gamma(K^+ K^- 2\pi^+ \pi^-)$ Γ_{53}/Γ_{50}

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

$\Gamma(\phi a_1(1260)^+, \phi \rightarrow K^+ K^-, a_1^+ \rightarrow \rho^0 \pi^+)/\Gamma(K^+ K^- \pi^+)$ Γ_{54}/Γ_{33}

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

$\Gamma(K^+ K^- 2\pi^+ \pi^- \text{ nonresonant})/\Gamma(K^+ K^- 2\pi^+ \pi^-)$ Γ_{55}/Γ_{50}

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

$\Gamma(2K_S^0 2\pi^+ \pi^-)/\Gamma(K_S^0 K^- 2\pi^+)$ Γ_{56}/Γ_{47}

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

———— Pionic modes ————

$\Gamma(\pi^+ \pi^0)/\Gamma(K^+ K_S^0)$ Γ_{57}/Γ_{31}

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

$\Gamma(2\pi^+ \pi^-)/\Gamma_{\text{total}}$ Γ_{58}/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. The correlation matrix for the branching fractions is used in the fit.			

$\Gamma(2\pi^+ \pi^-)/\Gamma(K^+ K^- \pi^+)$ Γ_{58}/Γ_{33}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.201±0.007 OUR FIT				
0.199±0.004±0.009	$\approx 10.5k$	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_{59}/Γ_{58}

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
0.018±0.005±0.010		AUBERT	09O BABR	Dalitz fit, $\approx 10.5k$ 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_{60}/Γ_{58}

This is the "fit fraction" from the Dalitz-plot analysis. See also KLEMPT 08, which uses 568 $D_S^+ \rightarrow 3\pi$ 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, $\approx 10.5k$ evts
0.8704±0.0560±0.0438	² LINK	04 FOCS	Dalitz fit, 1475 ± 50 evts

¹AUBERT 090 gives the amplitude and phase of the $\pi^+\pi^-$ *S*-wave in 29 $\pi^+\pi^-$ invariant-mass bins.

²LINK 04 borrows a K-matrix parametrization from ANISOVICH 03 of the full $\pi-\pi$ *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.

$\Gamma(f_0(980)\pi^+, f_0 \rightarrow \pi^+\pi^-)/\Gamma(2\pi^+\pi^-)$ Γ_{61}/Γ_{58}

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

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • 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
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1.074 ± 0.140 ± 0.043	FRABETTI	97D E687	γ Be \approx 200 GeV
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$\Gamma(f_0(1370)\pi^+, f_0 \rightarrow \pi^+\pi^-)/\Gamma(2\pi^+\pi^-)$ Γ_{62}/Γ_{58}

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

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • 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
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$\Gamma(f_0(1500)\pi^+, f_0 \rightarrow \pi^+\pi^-)/\Gamma(2\pi^+\pi^-)$ Γ_{63}/Γ_{58}

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

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.274 ± 0.114 ± 0.019	¹ FRABETTI	97D E687	γ Be \approx 200 GeV
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¹FRABETTI 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 $f_0(1500)$.

$\Gamma(f_2(1270)\pi^+, f_2 \rightarrow \pi^+\pi^-)/\Gamma(2\pi^+\pi^-)$ Γ_{64}/Γ_{58}

This is the “fit fraction” from the Dalitz-plot analysis.

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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0.101 ± 0.018 OUR AVERAGE

0.101 ± 0.015 ± 0.011	AUBERT	090 BABR	Dalitz fit, \approx 10.5k evts
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0.0974 ± 0.0449 ± 0.0294	LINK	04 FOCS	Dalitz fit, 1475 ± 50 evts
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• • • 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
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0.123 ± 0.056 ± 0.018	FRABETTI	97D E687	γ Be \approx 200 GeV
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$\Gamma(\rho(1450)^0\pi^+, \rho^0 \rightarrow \pi^+\pi^-)/\Gamma(2\pi^+\pi^-)$ Γ_{65}/Γ_{58}

This is the “fit fraction” from the Dalitz-plot analysis.

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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0.027 ± 0.018 OUR AVERAGE

0.023 ± 0.008 ± 0.017	AUBERT	090 BABR	Dalitz fit, \approx 10.5k evts
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0.0656 ± 0.0343 ± 0.0440	LINK	04 FOCS	Dalitz fit, 1475 ± 50 evts
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• • • 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
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$\Gamma(\pi^+ 2\pi^0)/\Gamma_{\text{total}}$ Γ_{66}/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_{67}/Γ_{34}

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<3.3	90	ANJOS	89E	E691 Photoproduction

$\Gamma(\eta\pi^+)/\Gamma_{\text{total}}$ Γ_{68}/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
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¹ ALEXANDER 08 uses single- and double-tagged events in an overall fit.

$\Gamma(\eta\pi^+)/\Gamma(K^+ K_S^0)$ Γ_{68}/Γ_{31}

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
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$\Gamma(\eta\pi^+)/\Gamma(\phi\pi^+)$ Γ_{68}/Γ_{34}

Unseen decay modes of the resonances are included.

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.48±0.03±0.04	920	JESSOP	98	CLE2 $e^+ e^- \approx \Upsilon(4S)$
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0.54±0.09±0.06	165	ALEXANDER	92	CLE2 See JESSOP 98
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$\Gamma(\omega\pi^+)/\Gamma_{\text{total}}$ Γ_{69}/Γ

Unseen decay modes of the ω are included.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
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0.24±0.06 OUR FIT

0.21±0.09±0.01	6 ± 2.4	GE	09A	CLEO $e^+ e^-$ at 4170 MeV
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$\Gamma(\omega\pi^+)/\Gamma(\eta\pi^+)$ Γ_{69}/Γ_{68}

Unseen decay modes of the resonances are included.

VALUE	DOCUMENT ID	TECN	COMMENT
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0.14±0.04 OUR FIT

0.16±0.04±0.03	BALEST	97	CLE2 $e^+ e^- \approx \Upsilon(4S)$
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$\Gamma(3\pi^+ 2\pi^-)/\Gamma(K^+ K^- \pi^+)$ Γ_{70}/Γ_{33}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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0.146±0.014 OUR AVERAGE

0.145±0.011±0.010	671	LINK	03D	FOCS $\gamma A, \bar{E}_\gamma \approx 180$ GeV
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0.158±0.042±0.031	37	FRABETTI	97C	E687 $\gamma Be, \bar{E}_\gamma \approx 200$ GeV
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$\Gamma(\eta\rho^+)/\Gamma_{\text{total}}$ Γ_{72}/Γ

Unseen decay modes of the η are included.

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

$\Gamma(\eta\rho^+)/\Gamma(\phi\pi^+)$ Γ_{72}/Γ_{34}

Unseen decay modes of the resonances are included.

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

$\Gamma(\eta\pi^+\pi^0)/\Gamma_{\text{total}}$ Γ_{73}/Γ

<u>VALUE (units 10^{-2})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$9.2 \pm 0.4 \pm 1.1$	ONYISI 13	CLEO	e^+e^- at 4.17 GeV

$\Gamma(\omega\pi^+\pi^0)/\Gamma_{\text{total}}$ Γ_{74}/Γ

Unseen decay modes of the ω are included.

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

$\Gamma(3\pi^+2\pi^-\pi^0)/\Gamma_{\text{total}}$ Γ_{75}/Γ

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$0.049^{+0.033}_{-0.030}$	BARLAG 92C	ACCM	π^- 230 GeV

$\Gamma(\omega 2\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_{76}/Γ

Unseen decay modes of the ω are included.

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

$\Gamma(\eta'(958)\pi^+)/\Gamma_{\text{total}}$ Γ_{77}/Γ

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

<u>VALUE (units 10^{-2})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$3.94 \pm 0.15 \pm 0.20$	ONYISI 13	CLEO	e^+e^- at 4.17 GeV

● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●

$3.77 \pm 0.25 \pm 0.30$	¹ ALEXANDER 08	CLEO	See ONYISI 13
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¹ALEXANDER 08 uses single- and double-tagged events in an overall fit.

$\Gamma(\eta'(958)\pi^+)/\Gamma(K^+K_S^0)$ Γ_{77}/Γ_{31}

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

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$2.654 \pm 0.088 \pm 0.139$	1436 ± 47	MENDEZ 10	CLEO	See ONYISI 13

$\Gamma(\eta'(958)\pi^+)/\Gamma(\phi\pi^+)$

Γ_{77}/Γ_{34}

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. • • •				
$1.03 \pm 0.06 \pm 0.07$	537	JESSOP	98	CLE2 $e^+e^- \approx \Upsilon(4S)$
$1.20 \pm 0.15 \pm 0.11$	281	ALEXANDER	92	CLE2 See JESSOP 98
$2.5 \pm 1.0 \begin{smallmatrix} +1.5 \\ -0.4 \end{smallmatrix}$	22	ALVAREZ	91	NA14 Photoproduction
$2.5 \pm 0.5 \pm 0.3$	215	ALBRECHT	90D	ARG $e^+e^- \approx 10.4$ GeV

$\Gamma(\omega\eta\pi^+)/\Gamma_{\text{total}}$

Γ_{79}/Γ

Unseen decay modes of the ω and η are included.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<2.13 \times 10^{-2}$	90	GE	09A	CLEO e^+e^- at 4170 MeV

$\Gamma(\eta'(958)\rho^+)/\Gamma(\phi\pi^+)$

Γ_{80}/Γ_{34}

Unseen decay modes of the resonances are included.

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
$2.78 \pm 0.28 \pm 0.30$	137	JESSOP	98	CLE2 $e^+e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$3.44 \pm 0.62 \begin{smallmatrix} +0.44 \\ -0.46 \end{smallmatrix}$	68	AVERY	92	CLE2 See JESSOP 98

$\Gamma(\eta'(958)\pi^+\pi^0)/\Gamma_{\text{total}}$

Γ_{81}/Γ

VALUE (units 10^{-2})	DOCUMENT ID	TECN	COMMENT
$5.6 \pm 0.5 \pm 0.6$	ONYISI	13	CLEO e^+e^- at 4.17 GeV

———— Modes with one or three K's ————

$\Gamma(K^+\pi^0)/\Gamma(K^+K_S^0)$

Γ_{82}/Γ_{31}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
$4.2 \pm 1.4 \pm 0.2$	202 ± 70	MENDEZ	10	CLEO e^+e^- at 4170 MeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$5.5 \pm 1.3 \pm 0.7$	141 ± 34	ADAMS	07A	CLEO See MENDEZ 10

$\Gamma(K_S^0\pi^+)/\Gamma(K^+K_S^0)$

Γ_{83}/Γ_{31}

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

$\Gamma(K^+\eta)/\Gamma(K^+K_S^0)$

Γ_{84}/Γ_{31}

Unseen decay modes of the η are included.

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

$\Gamma(K^+\eta)/\Gamma(\eta\pi^+)$ Γ_{84}/Γ_{68}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
$8.9 \pm 1.5 \pm 0.4$	113 ± 18	ADAMS	07A	CLEO See MENDEZ 10

$\Gamma(K^+\omega)/\Gamma_{\text{total}}$ Γ_{85}/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

$\Gamma(K^+\eta'(958))/\Gamma(K^+K_S^0)$ Γ_{86}/Γ_{31}

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

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

$\Gamma(K^+\eta'(958))/\Gamma(\eta'(958)\pi^+)$ Γ_{86}/Γ_{77}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
$4.2 \pm 1.3 \pm 0.3$	28 ± 9	ADAMS	07A	CLEO See MENDEZ 10

$\Gamma(K^+\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_{87}/Γ

VALUE (units 10^{-2})	DOCUMENT ID	TECN	COMMENT
0.66 ± 0.04 OUR FIT			
$0.654 \pm 0.033 \pm 0.025$	ONYISI 13	CLEO	e^+e^- at 4.17 GeV
$0.69 \pm 0.05 \pm 0.03$	¹ ALEXANDER 08	CLEO	See ONYISI 13

¹ALEXANDER 08 uses single- and double-tagged events in an overall fit. The correlation matrix for the branching fractions is used in the fit.

$\Gamma(K^+\pi^+\pi^-)/\Gamma(K^+K^-\pi^+)$ Γ_{87}/Γ_{33}

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

$\Gamma(K^+\rho^0)/\Gamma(K^+\pi^+\pi^-)$ Γ_{88}/Γ_{87}

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

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

$\Gamma(K^+\rho(1450)^0, \rho^0 \rightarrow \pi^+\pi^-)/\Gamma(K^+\pi^+\pi^-)$ Γ_{89}/Γ_{87}

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

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

$\Gamma(K^*(892)^0\pi^+, K^{*0} \rightarrow K^+\pi^-)/\Gamma(K^+\pi^+\pi^-)$ Γ_{90}/Γ_{87}

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

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

$\Gamma(K^*(1410)^0 \pi^+, K^{*0} \rightarrow K^+ \pi^-) / \Gamma(K^+ \pi^+ \pi^-)$ $\Gamma_{91} / \Gamma_{87}$

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

$\Gamma(K^*(1430)^0 \pi^+, K^{*0} \rightarrow K^+ \pi^-) / \Gamma(K^+ \pi^+ \pi^-)$ $\Gamma_{92} / \Gamma_{87}$

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

$\Gamma(K^+ \pi^+ \pi^- \text{ nonresonant}) / \Gamma(K^+ \pi^+ \pi^-)$ $\Gamma_{93} / \Gamma_{87}$

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

$\Gamma(K^0 \pi^+ \pi^0) / \Gamma_{\text{total}}$ Γ_{94} / 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

$\Gamma(K_S^0 2\pi^+ \pi^-) / \Gamma(K_S^0 K^- 2\pi^+)$ $\Gamma_{95} / \Gamma_{47}$

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

$\Gamma(K^+ \omega \pi^0) / \Gamma_{\text{total}}$ Γ_{96} / 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

$\Gamma(K^+ \omega \pi^+ \pi^-) / \Gamma_{\text{total}}$ Γ_{97} / 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

$\Gamma(K^+ \omega \eta) / \Gamma_{\text{total}}$ Γ_{98} / 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

$\Gamma(2K^+ K^-) / \Gamma(K^+ K^- \pi^+)$ $\Gamma_{99} / \Gamma_{33}$

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 ± 2.12 ^{+2.24} _{-2.31}	31	LINK	02I	FOCS γ A, ≈ 180 GeV

$\Gamma(\phi K^+, \phi \rightarrow K^+ K^-) / \Gamma(2K^+ K^-)$ $\Gamma_{100} / \Gamma_{99}$

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_{101}/Γ_{33}

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	$e^+e^- \approx \mathcal{Y}(4S)$
2.29±0.28±0.12	281 ± 34	KO	09 BELL	e^+e^- at $\mathcal{Y}(4S)$
5.2 ±1.7 ±1.1	27 ± 9	LINK	05K FOCS	<0.78%, CL = 90%

$\Gamma(K^+K^*(892)^0, K^{*0} \rightarrow K^+\pi^-)/\Gamma(2K^+\pi^-)$ $\Gamma_{102}/\Gamma_{101}$

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

————— Baryon-antibaryon mode —————

$\Gamma(p\bar{n})/\Gamma_{\text{total}}$ Γ_{103}/Γ

This is the only baryonic mode allowed kinematically.

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
1.30±0.36^{+0.12}_{-0.16}	13.0 ± 3.6	ATHAR	08 CLEO	e^+e^- , $E_{\text{cm}} \approx 4170$ MeV

————— Rare or forbidden modes —————

$\Gamma(\pi^+e^+e^-)/\Gamma_{\text{total}}$ Γ_{104}/Γ

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

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

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

$\Gamma(\pi^+\phi, \phi \rightarrow e^+e^-)/\Gamma_{\text{total}}$ Γ_{105}/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 ± 1) × 10⁻⁶	3	RUBIN	10 CLEO	e^+e^- at 4170 MeV

$\Gamma(\pi^+\mu^+\mu^-)/\Gamma_{\text{total}}$ Γ_{106}/Γ

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

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<4.1 × 10⁻⁷	90	AAIJ	13AF LHCB	pp at 7 TeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<4.3 × 10 ⁻⁵	90	LEES	11G BABR	$e^+e^- \approx \mathcal{Y}(4S)$
<2.6 × 10 ⁻⁵	90	LINK	03F FOCS	γA , $\bar{E}_\gamma \approx 180$ GeV
<1.4 × 10 ⁻⁴	90	AITALA	99G E791	$\pi^- N$ 500 GeV
<4.3 × 10 ⁻⁴	90	KODAMA	95 E653	π^- emulsion 600 GeV

$\Gamma(K^+ e^+ e^-)/\Gamma_{\text{total}}$ Γ_{107}/Γ

A test for the $\Delta C=1$ weak neutral current. Allowed by higher-order electroweak interactions.

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

$\Gamma(K^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$ Γ_{108}/Γ

A test for the $\Delta C=1$ weak neutral current. Allowed by higher-order electroweak interactions.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<21 \times 10^{-6}$	90	LEES	11G BABR	$e^+ e^- \approx \gamma(4S)$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$<3.6 \times 10^{-5}$	90	LINK	03F FOCS	$\gamma A, \bar{E}_\gamma \approx 180$ GeV
$<1.4 \times 10^{-4}$	90	AITALA	99G E791	$\pi^- N$ 500 GeV
$<5.9 \times 10^{-4}$	90	KODAMA	95 E653	π^- emulsion 600 GeV

$\Gamma(K^*(892)^+ \mu^+ \mu^-)/\Gamma_{\text{total}}$ Γ_{109}/Γ

A test for the $\Delta C=1$ weak neutral current. Allowed by higher-order electroweak interactions.

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

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

A test of lepton-family-number conservation.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<12 \times 10^{-6}$	90	LEES	11G BABR	$e^+ e^- \approx \gamma(4S)$

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

A test of lepton-family-number conservation.

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

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

A test of lepton-family-number conservation.

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

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

A test of lepton-family-number conservation.

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

$\Gamma(\pi^- 2e^+)/\Gamma_{\text{total}}$ Γ_{114}/Γ

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<4.1 \times 10^{-6}$	90	LEES	11G BABR	$e^+ e^- \approx \gamma(4S)$
● ● ● 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

$\Gamma(\pi^- 2\mu^+)/\Gamma_{\text{total}}$ Γ_{115}/Γ

A test of lepton-number conservation.

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$<1.2 \times 10^{-7}$	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 $\gamma A, \bar{E}_\gamma \approx 180$ 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

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

A test of lepton-number conservation.

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$<8.4 \times 10^{-6}$	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

$\Gamma(K^- 2e^+)/\Gamma_{\text{total}}$ Γ_{117}/Γ

A test of lepton-number conservation.

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$< 5.2 \times 10^{-6}$	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

$\Gamma(K^- 2\mu^+)/\Gamma_{\text{total}}$ Γ_{118}/Γ

A test of lepton-number conservation.

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

$\Gamma(K^- e^+ \mu^+)/\Gamma_{\text{total}}$ Γ_{119}/Γ

A test of lepton-number conservation.

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

$\Gamma(K^*(892)^- 2\mu^+)/\Gamma_{\text{total}}$ Γ_{120}/Γ

A test of lepton-number conservation.

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$<1.4 \times 10^{-3}$	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:

$$A_{CP}(f) = [\Gamma(D_s^+ \rightarrow f) - \Gamma(D_s^- \rightarrow \bar{f})] / [\Gamma(D_s^+ \rightarrow f) + \Gamma(D_s^- \rightarrow \bar{f})].$$

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

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

$A_{CP}(K^\pm K_S^0)$ in $D_s^\pm \rightarrow K^\pm K_S^0$

VALUE (%)	EVTS	DOCUMENT ID	TECN	COMMENT
0.08±0.26 OUR AVERAGE				
-0.05±0.23±0.24	288k	¹ LEES	13E	BABR $e^+ e^-$ at $\Upsilon(4S)$
2.6 ±1.5 ±0.6		ONYISI	13	CLEO $e^+ e^-$ at 4.17 GeV
0.12±0.36±0.22		KO	10	BELL $e^+ e^- \approx \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

4.7 ±1.8 ±0.9	4.0k	MENDEZ	10	CLEO See ONYISI 13
4.9 ±2.1 ±0.9		ALEXANDER	08	CLEO See MENDEZ 10

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

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

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±1.1±0.8	ALEXANDER	08	CLEO See ONYISI 13
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$A_{CP}(\phi \pi^\pm)$ in $D_s^\pm \rightarrow \phi \pi^\pm$

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

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

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

$A_{CP}(2K_S^0 \pi^\pm)$ in $D_s^\pm \rightarrow 2K_S^0 \pi^\pm$

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 $D_s^\pm \rightarrow K^+ K^- \pi^\pm \pi^0$

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

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$-5.7 \pm 5.3 \pm 0.9$	ONYISI 13	CLEO	$e^+ e^-$ at 4.17 GeV

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

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

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

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

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

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

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

<u>VALUE (%)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$-2.2 \pm 2.2 \pm 0.6$		ONYISI 13	CLEO	$e^+ e^-$ at 4.17 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$-6.1 \pm 3.0 \pm 0.3$	1.4k	MENDEZ 10	CLEO	See ONYISI 13
$-5.5 \pm 3.7 \pm 1.2$		ALEXANDER 08	CLEO	See MENDEZ 10

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

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$-0.5 \pm 3.9 \pm 2.0$	ONYISI 13	CLEO	$e^+ e^-$ at 4.17 GeV

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

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$-0.4 \pm 7.4 \pm 1.9$	ONYISI 13	CLEO	$e^+ e^-$ at 4.17 GeV

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

<u>VALUE (%)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$-26.6 \pm 23.8 \pm 0.9$	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

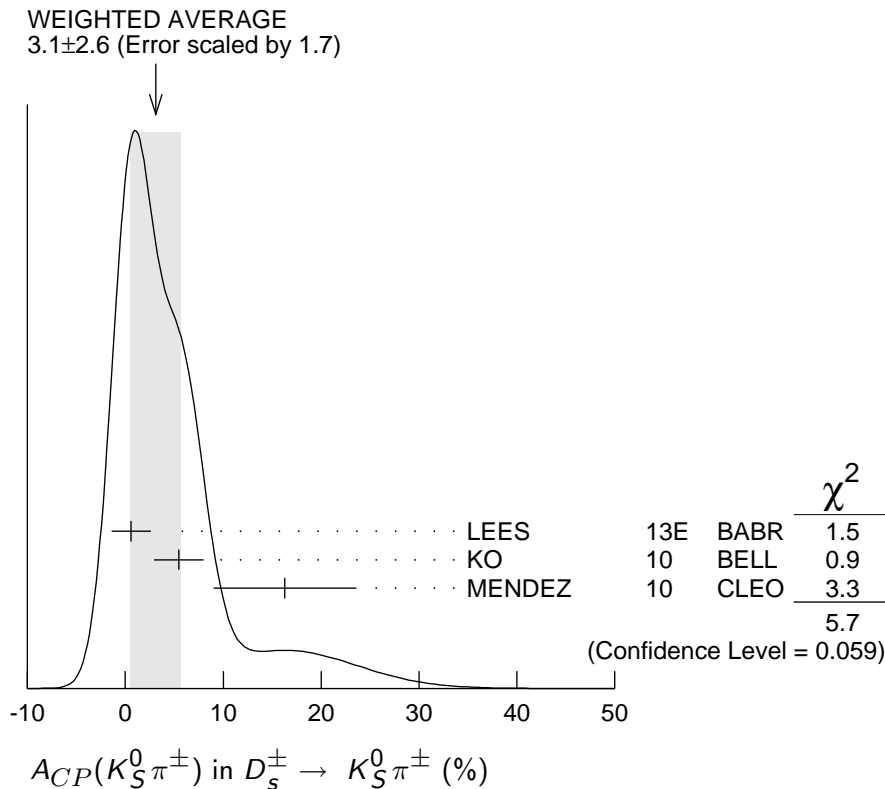
$A_{CP}(\bar{K}^0 / K^0 \pi^\pm)$

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

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

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

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



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

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 $D_s^\pm \rightarrow K^\pm \eta$

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 $D_s^\pm \rightarrow K^\pm \eta'(958)$

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

$A_{Tviol}(K_S^0 K^\pm \pi^+ \pi^-)$ in $D_s^\pm \rightarrow K_S^0 K^\pm \pi^+ \pi^-$

$C_T \equiv \vec{p}_{K^+} \cdot (\vec{p}_{\pi^+} \times \vec{p}_{\pi^-})$ is a parity-odd correlation of the K^+ , π^+ , and π^- momenta for the D_s^+ . $\bar{C}_T \equiv \vec{p}_{K^-} \cdot (\vec{p}_{\pi^-} \times \vec{p}_{\pi^+})$ 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

$\bar{A}_T \equiv [\Gamma(-\bar{C}_T > 0) - \Gamma(-\bar{C}_T < 0)] / [\Gamma(-\bar{C}_T > 0) + \Gamma(-\bar{C}_T < 0)]$, and

$A_{Tviol} \equiv \frac{1}{2}(A_T - \bar{A}_T)$. C_T and \bar{C}_T are commonly referred to as T -odd moments, because they are odd under T reversal. However, the T -conjugate process $K_S^0 K^\pm \pi^+ \pi^- \rightarrow D_s^\pm$ 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	$\gamma A, \bar{E}_\gamma \approx 180$ GeV

$D_s^+ \rightarrow \phi \ell^+ \nu_\ell$ FORM FACTORS

$r_2 \equiv A_2(0)/A_1(0)$ in $D_s^+ \rightarrow \phi \ell^+ \nu_\ell$

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	$\phi \mu^+ \nu_\mu$

¹To 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 $D_s^+ \rightarrow \phi \ell^+ \nu_\ell$

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 $m_A = 2.5 \text{ GeV}/c^2$ and $m_V = 2.1 \text{ GeV}/c^2$. 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 $D_s^+ \rightarrow \phi \ell^+ \nu_\ell$

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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