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

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

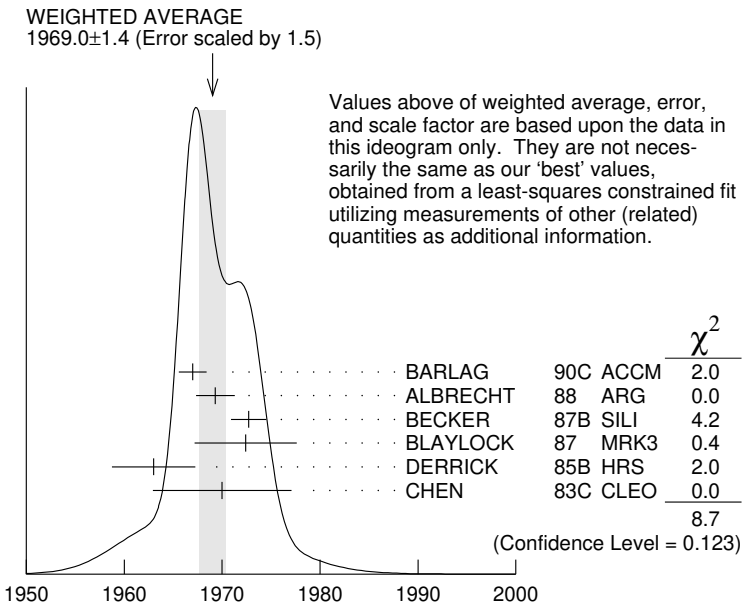
The angular distributions of the decays of the ϕ and $\overline{K}^*(892)^0$ in the $\phi\pi^+$ and $K^+\overline{K}^*(892)^0$ modes strongly indicate that the spin is zero. The parity given is that expected of a $c\overline{s}$ ground state.

$D_s^\pm$ MASS

The fit includes $D^\pm$, D^0, $D_s^\pm$, $D^{*\pm}$, D^{*0}, and $D_s^{*\pm}$ 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*
1968.5± 0.6 OUR FIT Error includes scale factor of 1.1.				
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).



$D_s^{\pm}$ mass (MeV)

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

The fit includes $D^{\pm}$, D^0, $D_s^{\pm}$, $D^{*\pm}$, D^{*0}, and $D_s^{*\pm}$ mass and mass difference measurements.

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
99.2±0.5 OUR FIT Error includes scale factor of 1.1.					
99.2±0.5 OUR AVERAGE					
99.5±0.6±0.3		BROWN	94	CLEO	$e^+e^- \approx \Upsilon(4S)$
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 0.2×10^{-12} s are omitted from the average.

VALUE (10^{-12} s)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.467±0.017 OUR AVERAGE					
0.475±0.020±0.007	900	FRABETTI	93F	E687	γ Be, $D_s^+ \rightarrow \phi\pi^+$
$0.33\ ^{+0.12}_{-0.08}\ \pm0.03$	15	ALVAREZ	90	NA14	γ, $D_s^+ \rightarrow \phi\pi^+$
$0.469^{+0.102}_{-0.086}$	54	[2] BARLAG	90C	ACCM	π^- Cu 230 GeV
0.50 ±0.06 ±0.03	104	FRABETTI	90	E687	γ Be, $\phi\pi^+$

0.56	$^{+0.13}_{-0.12}$	±0.08	144	ALBRECHT	88I	ARG	e^+e^- 10 GeV
0.47	±0.04	±0.02	228	RAAB	88	E691	Photoproduction
0.33	$^{+0.10}_{-0.06}$		21	[3] BECKER	87B	SILI	200 GeV π,K,p
0.26	$^{+0.16}_{-0.09}$		6	USHIDA	86	EMUL	ν wideband

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

0.31	$^{+0.24}_{-0.20}$	±0.05	18	AVERILL	89	HRS	e^+e^- 29 GeV
0.48	$^{+0.06}_{-0.05}$	±0.02	99	ANJOS	87B	E691	See RAAB 88
0.57	$^{+0.36}_{-0.26}$	±0.09	9	BRAUNSCH...	87	TASS	e^+e^- 35–44 GeV
0.47	±0.22	±0.05	141	CSORNA	87	CLEO	e^+e^- 10 GeV
0.35	$^{+0.24}_{-0.18}$	±0.09	17	JUNG	86	HRS	See AVERILL 89
0.32	$^{+0.30}_{-0.13}$		3	BAILEY	84	ACCM	hadron$^+$ Be $\rightarrow$ $\phi\pi^+$ X
0.19	$^{+0.13}_{-0.07}$		4	USHIDA	83	EMUL	See USHIDA 86

[2] BARLAG 90C estimates the systematic error to be negligible.
[3] BECKER 87B estimates the systematic error to be negligible.

D_s^+ DECAY MODES

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	K^- anything	(13 $^{+14}_{-12}$) %	
Γ_2	$\overline{K}^0$ anything + K^0 anything	(39 ±28) %	
Γ_3	K^+ anything	(20 $^{+18}_{-14}$) %	
Γ_4	non-$K\overline{K}$ anything	(64 ±17) %	
Γ_5	e^+ anything	< 20 %	CL=90%
	Leptonic and semileptonic modes		
Γ_6	$\mu^+\nu_\mu$	(4.0 $^{+2.2}_{-2.0}$) $\times 10^{-3}$	S=1.4
Γ_7	$\tau^+\nu_\tau$	(7 ± 4) %	
Γ_8	$\phi\ell^+\nu_\ell$	[a] (2.0 ± 0.5) %	
Γ_9	$\eta\ell^+\nu_\ell$ + $\eta'(958)\ell^+\nu_\ell$	[a] (3.4 ± 1.0) %	
Γ_{10}	$\eta\ell^+\nu_\ell$	(2.5 ± 0.7) %	
Γ_{11}	$\eta'(958)\ell^+\nu_\ell$	(8.8 ± 3.4) $\times 10^{-3}$	

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

Γ_{12}	$K^+\overline{K}^0$		(3.6 ± 1.1) %	
Γ_{13}	$K^+K^-\pi^+$	[b]	(4.6 ± 1.2) %	
Γ_{14}	$\phi\pi^+$	[c]	(3.6 ± 0.9) %	
Γ_{15}	$K^+\overline{K}^*(892)^0$	[c]	(3.4 ± 0.9) %	
Γ_{16}	$f_0(980)\pi^+$	[c]	(1.2 ± 0.4) %	
Γ_{17}	$K^+\overline{K}_0^*(1430)^0$	[c]	(7 ± 4) $\times 10^{-3}$	
Γ_{18}	$f_J(1710)\pi^+ \rightarrow K^+K^-\pi^+$	[d]	(1.5 ± 2.0) $\times 10^{-3}$	
Γ_{19}	$K^+K^-\pi^+$ nonresonant		(9 ± 4) $\times 10^{-3}$	
Γ_{20}	$K^0\overline{K}^0\pi^+$			
Γ_{21}	$K^*(892)^+\overline{K}^0$	[c]	(4.3 ± 1.4) %	
Γ_{22}	$K^+K^-\pi^+\pi^0$			
Γ_{23}	$\phi\pi^+\pi^0$	[c]	(9 ± 5) %	
Γ_{24}	$\phi\rho^+$	[c]	(6.7 ± 2.3) %	
Γ_{25}	$\phi\pi^+\pi^0$ 3-body	[c]	< 2.6 %	CL=90%
Γ_{26}	$K^+K^-\pi^+\pi^0$ non-ϕ		< 9 %	CL=90%
Γ_{27}	$K^+\overline{K}^0\pi^+\pi^-$		< 2.8 %	CL=90%
Γ_{28}	$K^0K^-\pi^+\pi^+$		(4.3 ± 1.5) %	
Γ_{29}	$K^*(892)^+\overline{K}^*(892)^0$	[c]	(5.8 ± 2.5) %	
Γ_{30}	$K^0K^-\pi^+\pi^+$ non-$K^{*+}\overline{K}^{*0}$		< 2.9 %	CL=90%
Γ_{31}	$K^+K^-\pi^+\pi^+\pi^-$		(8.6 ± 3.4) $\times 10^{-3}$	
Γ_{32}	$\phi\pi^+\pi^+\pi^-$	[c]	(1.18± 0.35) %	
Γ_{33}	$K^+K^-\pi^+\pi^+\pi^-$ non-ϕ		(3.0 $^{+\ 3.0}_{-\ 2.0}$) $\times 10^{-3}$	

Other hadronic modes (0, 1, or 3 K's)

Γ_{34}	$\pi^+\pi^+\pi^-$		(1.4 ± 0.4) %	
Γ_{35}	$\rho^0\pi^+$		< 2.9 $\times 10^{-3}$	CL=90%
Γ_{36}	$f_0(980)\pi^+$	[c]	(1.2 ± 0.4) %	
Γ_{37}	$\pi^+\pi^+\pi^-$ nonresonant		(1.0 ± 0.4) %	
Γ_{38}	$\pi^+\pi^+\pi^-\pi^0$		< 12 %	CL=90%
Γ_{39}	$\eta\pi^+$	[c]	(2.0 ± 0.6) %	
Γ_{40}	$\omega\pi^+$	[c]	< 1.8 %	CL=90%
Γ_{41}	$\pi^+\pi^+\pi^+\pi^-\pi^-$		(7.2 ± 3.1) $\times 10^{-3}$	
Γ_{42}	$\pi^+\pi^+\pi^-\pi^0\pi^0$			
Γ_{43}	$\eta\rho^+$	[c]	(10.3 ± 3.2) %	
Γ_{44}	$\eta\pi^+\pi^0$ 3-body	[c]	< 3.0 %	CL=90%
Γ_{45}	$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^0$		(4.9 ± 3.2) %	
Γ_{46}	$\eta'(958)\pi^+$	[c]	(4.9 ± 1.8) %	
Γ_{47}	$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^0\pi^0$			
Γ_{48}	$\eta'(958)\rho^+$	[c]	(12 ± 4) %	

Γ_{49}	$\eta'(958)\pi^+\pi^0$ 3-body		[c]	$<$ 3.1	%	CL=90%
Γ_{50}	$K^0\pi^+$			$<$ 8	$\times 10^{-3}$	CL=90%
Γ_{51}	$K^+\pi^+\pi^-$			(1.0 $\pm$ 0.4) %		
Γ_{52}	$K^+\rho^0$			$<$ 2.9	$\times 10^{-3}$	CL=90%
Γ_{53}	$K^*(892)^0\pi^+$		[c]	(6.5 $\pm$ 2.8)	$\times 10^{-3}$	
Γ_{54}	$K^+K^+K^-$			$<$ 6	$\times 10^{-4}$	CL=90%
Γ_{55}	ϕK^+		[c]	$<$ 5	$\times 10^{-4}$	CL=90%

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

Γ_{56}	$\pi^+\mu^+\mu^-$		[e]	$<$ 4.3	$\times 10^{-4}$	CL=90%
Γ_{57}	$K^+\mu^+\mu^-$	$C1$		$<$ 5.9	$\times 10^{-4}$	CL=90%
Γ_{58}	$K^*(892)^+\mu^+\mu^-$	$C1$		$<$ 1.4	$\times 10^{-3}$	CL=90%
Γ_{59}	$\pi^-\mu^+\mu^+$	L		$<$ 4.3	$\times 10^{-4}$	CL=90%
Γ_{60}	$K^-\mu^+\mu^+$	L		$<$ 5.9	$\times 10^{-4}$	CL=90%
Γ_{61}	$K^*(892)^-\mu^+\mu^+$	L		$<$ 1.4	$\times 10^{-3}$	CL=90%

Γ_{62}	A dummy mode used by the fit.	(82 $\pm$ 5) %	

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

[b] The branching fractions for this mode may differ from the sum of the submodes that contribute to it, due to interference effects. See the relevant papers.

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

[d] This value includes only K^+K^- decays of the $f_J(1710)$, because branching fractions of this resonance are not known.

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

CONSTRAINED FIT INFORMATION

An overall fit to 12 branching ratios uses 20 measurements and one constraint to determine 9 parameters. The overall fit has a $\chi^2 = 10.9$ for 12 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$, 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_8	45							
x_{10}	39	86						
x_{11}	29	65	56					
x_{13}	39	84	72	55				
x_{14}	43	92	79	60	91			
x_{15}	40	86	74	56	92	93		
x_{36}	23	50	43	33	49	54	50	
x_{62}	−47	−94	−85	−66	−94	−97	−95	−60
	x_6	x_8	x_{10}	x_{11}	x_{13}	x_{14}	x_{15}	x_{36}

D_s^+ BRANCHING RATIOS

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

Inclusive modes

$\Gamma(K^-\text{ anything})/\Gamma_{\text{total}}$ Γ_1/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$0.13^{+0.14}_{-0.12} \pm 0.02$	COFFMAN	91	MRK3	e^+e^- 4.14 GeV

$[\Gamma(\overline{K}^0\text{ anything}) + \Gamma(K^0\text{ anything})]/\Gamma_{\text{total}}$ Γ_2/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$0.39^{+0.28}_{-0.27} \pm 0.04$	COFFMAN	91	MRK3	e^+e^- 4.14 GeV

$\Gamma(K^+\text{ anything})/\Gamma_{\text{total}}$ Γ_3/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$0.20^{+0.18}_{-0.13} \pm 0.04$	COFFMAN	91	MRK3	e^+e^- 4.14 GeV

$\Gamma(\text{non-}K\overline{K}\text{anything})/\Gamma_{\text{total}}$ Γ_4/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.64±0.17±0.03	[4] COFFMAN	91	MRK3	e^+e^- 4.14 GeV

[4] COFFMAN 91 uses the direct measurements of the kaon content to determine this non-$K\overline{K}$ fraction. This number implies that a large fraction of D_s^+ decays involve η, η', and/or non-spectator decays.

$\Gamma(e^+\text{anything})/\Gamma_{\text{total}}$ Γ_5/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.20	90	[5] BAI	90	MRK3	e^+e^- 4.14 GeV

[5] Expressed as a value, the BAI 90 result is $\Gamma(e^+\text{anything})/\Gamma_{\text{total}} = 0.05 \pm 0.05 \pm 0.02$.

Leptonic and semileptonic modes

$\Gamma(\mu^+\nu_\mu)/\Gamma_{\text{total}}$ Γ_6/Γ

See the "Note on Pseudoscalar-Meson Decay Constants" in the Listings for the $\pi^\pm$.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.015^{+0.013}_{-0.006}{}^{+0.003}_{-0.002}$	3	[6] BAI	95	BES	$e^+e^- \to D_s^+ D_s^-$
$0.004^{+0.0018}_{-0.0014}{}^{+0.0020}_{-0.0019}$	8	[7] AOKI	93	WA75	π^- emulsion 350 GeV
<0.03	0	[8] AUBERT	83	SPEC	μ^+ Fe, 250 GeV

[6] BAI 95 uses one actual $D_s^+ \to \mu^+\nu_\mu$ event together with two $D_s^+ \to \tau^+\nu_\tau$ events and assumes μ-τ universality. This value of $\Gamma(\mu^+\nu_\mu)/\Gamma_{\text{total}}$ gives a pseudoscalar decay constant of $(430^{+150}_{-130} \pm 40)$ MeV.

[7] AOKI 93 assumes the ratio of production cross sections of the D_s^+ and D^0 is 0.27. The value of $\Gamma(\mu^+\nu_\mu)/\Gamma_{\text{total}}$ gives a pseudoscalar decay constant $f_{D_s} = (232 \pm 45 \pm 52)$ MeV.

[8] AUBERT 83 assume that the $D_s^\pm$ production rate is 20% of total charm production rate.

$\Gamma(\mu^+\nu_\mu)/\Gamma(\phi\pi^+)$ Γ_6/Γ_{14}

See the "Note on Pseudoscalar-Meson Decay Constants" in the Listings for the $\pi^\pm$.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.11 ±0.05 OUR FIT	Error includes scale factor of 1.6.				
0.245±0.052±0.074	39	[9] ACOSTA	94	CLEO	$e^+e^- \approx \Upsilon(4S)$

[9] ACOSTA 94 obtains $f_{D_s} = (344 \pm 37 \pm 52 \pm 42)$ MeV from this measurement, using $\Gamma(D_s^+ \to \phi\pi^+)/\Gamma(\text{total}) = 0.037 \pm 0.009$.

$\Gamma(\mu^+\nu_\mu)/\Gamma(\phi\ell^+\nu_\ell)$ Γ_6/Γ_8

See the "Note on Pseudoscalar-Meson Decay Constants" in the Listings for the $\pi^\pm$.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.20±0.10 OUR FIT	Error includes scale factor of 1.6.				
0.16±0.06±0.03	23	[10] KODAMA	96	E653	π^- emulsion, 600 GeV

[10] KODAMA 96 obtains $f_{D_s} = (194 \pm 35 \pm 20 \pm 14)$ MeV from this measurement, using $\Gamma(D_s^+ \to \phi\ell^+\nu)/\Gamma_{\text{total}} = 0.0188 \pm 0.0029$. The third error is from the uncertainty on $\phi\ell^+\nu_\ell$ branching fraction.

$\Gamma(\tau^+\nu_\tau)/\Gamma_{\text{total}}$ Γ_7/Γ

See the "Note on Pseudoscalar-Meson Decay Constants" in the Listings for the $\pi^\pm$.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.074±0.028±0.024	16	[11] ACCIARRI	97F	L3	$D_s^{*+} \to \gamma D_s^+$

[11] 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.

$\Gamma(\phi\ell^+\nu_\ell)/\Gamma(\phi\pi^+)$ Γ_8/Γ_{14}

For now, we average together measurements of the $\Gamma(\phi e^+\nu_e)/\Gamma(\phi\pi^+)$ and $\Gamma(\phi\mu^+\nu_\mu)/\Gamma(\phi\pi^+)$ ratios. See the end of the D_s^+ Listings for measurements of $D_s^+ \to \phi\ell^+\nu_\ell$ form-factor ratios.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.55±0.05 OUR FIT					
0.54±0.05 OUR AVERAGE					
0.54±0.05±0.04	367	[12] BUTLER	94	CLEO	$e^+e^- \approx \Upsilon(4S)$
0.58±0.17±0.07	97	[13] FRABETTI	93G	E687	γ Be $\overline{E}_\gamma$= 220 GeV
0.57±0.15±0.15	104	[14] ALBRECHT	91	ARG	$e^+e^- \approx$ 10.4 GeV
$0.49\pm0.10^{+0.10}_{-0.14}$	54	[15] ALEXANDER	90B	CLEO	e^+e^- 10.5–11 GeV

[12] BUTLER 94 uses both $\phi e^+\nu_e$ and $\phi\mu^+\nu_\mu$ events, and makes a phase-space adjustment to the latter to use them as $\phi e^+\nu_e$ events.

[13] FRABETTI 93G measures the $\Gamma(\phi\mu^+\nu_\mu)/\Gamma(\phi\pi^+)$ ratio.

[14] ALBRECHT 91 measures the $\Gamma(\phi e^+\nu_e)/\Gamma(\phi\pi^+)$ ratio.

[15] ALEXANDER 90B measures an average of the $\Gamma(\phi e^+\nu_e)/\Gamma(\phi\pi^+)$ and $\Gamma(\phi\mu^+\nu_\mu)/\Gamma(\phi\pi^+)$ ratios.

$\Gamma(\eta\ell^+\nu_\ell)/\Gamma(\phi\ell^+\nu_\ell)$ Γ_{10}/Γ_8

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.27±0.19 OUR FIT					
1.24±0.12±0.15	440	[16] BRANDENB...	95	CLEO	$e^+e^- \approx \Upsilon(4S)$

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

$\Gamma(\eta'(958)\ell^+\nu_\ell)/\Gamma(\phi\ell^+\nu_\ell)$ Γ_{11}/Γ_8

Unseen decay modes of the resonances are included.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.44±0.13 OUR FIT						
0.43±0.11±0.07		29	[17] BRANDENB...	95	CLEO	$e^+e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<1.6	90		[18] KODAMA	93B	E653	π^- emulsion 600 GeV

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

[18] KODAMA 93B uses μ^+ events.

$[\Gamma(\eta\ell^+\nu_\ell)+\Gamma(\eta'(958)\ell^+\nu_\ell)]/\Gamma(\phi\ell^+\nu_\ell)$ $\Gamma_9/\Gamma_8=(\Gamma_{10}+\Gamma_{11})/\Gamma_8$

Unseen decay modes of the resonances are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.72±0.23 OUR FIT					
3.9 ±1.6	13	[19] KODAMA	93	E653	π^- emulsion 600 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.67±0.17±0.17		[20] BRANDENB...	95	CLEO	$e^+e^-\approx\ \Upsilon(4S)$

[19] KODAMA 93 uses μ^+ events.

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

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

$\Gamma(K^+\overline{K}^0)/\Gamma(\phi\pi^+)$ Γ_{12}/Γ_{14}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.01±0.16 OUR AVERAGE					
1.15±0.31±0.19	68	ANJOS	90C	E691	γ Be
0.92±0.32±0.20		ADLER	89B	MRK3	e^+e^- 4.14 GeV
0.99±0.17±0.10		CHEN	89	CLEO	e^+e^- 10 GeV

$\Gamma(\phi\pi^+)/\Gamma_{total}$ Γ_{14}/Γ

For the first time, we have model-independent measurements of this branching fraction, and so we no longer use the earlier, model-dependent results. See the "Note on D Mesons" in the D^+ Listings for a discussion.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.036 ±0.009 OUR FIT						
0.036 ±0.009 OUR AVERAGE						
0.0359±0.0077±0.0048			[21] ARTUSO	96	CLEO	e^+e^- at $\Upsilon(4S)$
$0.039\ ^{+0.051}_{-0.019}\ ^{+0.018}_{-0.011}$			[22] BAI	95C	BES	e^+e^- 4.03 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.051 ±0.004 ±0.008			[23] BUTLER	94	CLEO	$e^+e^-\approx\ \Upsilon(4S)$
<0.048	90		MUHEIM	94		
0.046 ±0.015			[24] MUHEIM	94		
0.031 ±0.009			[24] MUHEIM	94		
0.031 ±0.009 ±0.006			[23] FRABETTI	93G	E687	γ Be $\overline{E}_\gamma$= 220 GeV
0.024 ±0.010			[23] ALBRECHT	91	ARG	$e^+e^-\approx$ 10.4 GeV
<0.041	90	0	[22] ADLER	90B	MRK3	e^+e^- 4.14 GeV
$0.031 \pm0.006\ ^{+0.011}_{-0.009}$			[23] ALEXANDER	90B	CLEO	e^+e^- 10.5–11 GeV
0.048 ±0.017 ±0.019			[25] ALVAREZ	90C	NA14	Photoproduction
>0.034	90		[23] ANJOS	90B	E691	γ Be, $\overline{E}_\gamma\ \approx$ 145 GeV
0.02 ±0.01		405	[26] CHEN	89	CLEO	e^+e^- 10 GeV
0.033 ±0.016 ±0.010		9	[26] BRAUNSCH...	87	TASS	e^+e^- 35–44 GeV
0.033 ±0.011		30	[26] DERRICK	85B	HRS	e^+e^- 29 GeV

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

[22] 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 too large for the result to be competitive with indirect measurements. ADLER 90B used the same method to set a limit.

[23] BUTLER 94, FRABETTI 93G, ALBRECHT 91, ALEXANDER 90B, and ANJOS 90B measure the ratio $\Gamma(D_s^+ \to \phi\ell^+\nu_\ell)/\Gamma(D_s^+ \to \phi\pi^+)$, where $\ell = e$ and/or μ, and then use a theoretical calculation of the ratio of widths $\Gamma(D_s^+ \to \phi\ell^+\nu_\ell)/\Gamma(D^+ \to \overline{K}^{*0}\ell^+\nu)$. Not everyone uses the same value for this ratio.

[24] The two MUHEIM 94 values here are model-dependent calculations based on distinct data sets. The first uses measurements of the $D_2^*(2460)^0$ and $D_{s1}(2536)^+$, the second uses B-decay factorization and $\Gamma(D_s^+ \to \mu^+\nu_\mu)/\Gamma(D_s^+ \to \phi\ell^+\nu_\ell)$. A third calculation using the semileptonic width of $D_s^+ \to \phi\ell^+\nu_\ell$ is not independent of other results listed here. Note also the upper limit, based on the sum of established D_s^+ branching ratios.

[25] ALVAREZ 90C relies on the Lund model to estimate the ratio of D_s^+ to D^+ cross sections.

[26] Values based on crude estimates of the $D_s^{\pm}$ production level. DERRICK 85B errors are statistical only.

$\Gamma(\phi\pi^+)/\Gamma(K^+K^-\pi^+)$ Γ_{14}/Γ_{13}

Unseen decay modes of the ϕ are included.

VALUE	DOCUMENT ID		TECN	COMMENT
0.79 ±0.09 OUR FIT				
0.807±0.067±0.096	FRABETTI	95B	E687	Dalitz plot analysis

$\Gamma(K^+\overline{K}^*(892)^0)/\Gamma(K^+K^-\pi^+)$ Γ_{15}/Γ_{13}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.74 ±0.08 OUR FIT				
0.717±0.069±0.060	FRABETTI	95B	E687	Dalitz plot analysis

$\Gamma(K^+\overline{K}^*(892)^0)/\Gamma(\phi\pi^+)$ Γ_{15}/Γ_{14}

Unseen decay modes of the resonances are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.93±0.09 OUR FIT					
0.95±0.10 OUR AVERAGE					
0.85±0.34±0.20	9	ALVAREZ	90C	NA14	Photoproduction
0.84±0.30±0.22		ADLER	89B	MRK3	e^+e^- 4.14 GeV
1.05±0.17±0.12		CHEN	89	CLEO	e^+e^- 10 GeV
0.87±0.13±0.05	117	ANJOS	88	E691	Photoproduction
1.44±0.37	87	ALBRECHT	87F	ARG	e^+e^- 10 GeV

$\Gamma(f_0(980)\pi^+)/\Gamma(K^+K^-\pi^+)$ Γ_{36}/Γ_{13}

Unseen decay modes of the $f_0(980)$ are included.

VALUE	DOCUMENT ID		TECN	COMMENT
0.25±0.09 OUR FIT				
1.00±0.32±0.24	FRABETTI	95B	E687	Dalitz plot analysis

$\Gamma(f_J(1710)\pi^+ \to K^+K^-\pi^+)/\Gamma(K^+K^-\pi^+)$ Γ_{18}/Γ_{13}

This includes *only* K^+K^- decays of the $f_J(1710)$, because branching ratios of this resonance are not known.

VALUE	DOCUMENT ID		TECN	COMMENT
0.034±0.023±0.035	FRABETTI	95B	E687	Dalitz plot analysis

$\Gamma(K^+\overline{K}_0^*(1430)^0)/\Gamma(K^+K^-\pi^+)$ Γ_{17}/Γ_{13}

Unseen decay modes of the $\overline{K}_0^*(1430)^0$ are included.

VALUE	DOCUMENT ID		TECN	COMMENT
0.150±0.052±0.052	FRABETTI	95B	E687	Dalitz plot analysis

$\Gamma(K^+K^-\pi^+\text{ nonresonant})/\Gamma(\phi\pi^+)$ Γ_{19}/Γ_{14}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.25±0.07±0.05	48	ANJOS	88	E691	Photoproduction

$\Gamma(K^*(892)^+\overline{K}^0)/\Gamma(\phi\pi^+)$ Γ_{21}/Γ_{14}

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

$\Gamma(K^*(892)^+\overline{K}^0)/\Gamma(K^+\overline{K}^0)$ Γ_{21}/Γ_{12}

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.9	90	FRABETTI	95	E687	γ Be $\overline{E}_\gamma \approx 200$ GeV

$\Gamma(\phi\pi^+\pi^0)/\Gamma(\phi\pi^+)$ Γ_{23}/Γ_{14}

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
2.4±1.0±0.5		11	ANJOS	89E	E691	Photoproduction
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<2.6	90		ALVAREZ	90C	NA14	Photoproduction

$\Gamma(\phi\rho^+)/\Gamma(\phi\pi^+)$ Γ_{24}/Γ_{14}

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

$\Gamma(\phi\pi^+\pi^0\text{ 3-body})/\Gamma(\phi\pi^+)$ Γ_{25}/Γ_{14}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.71	90	DAOUDI	92	CLEO	$e^+e^- \approx 10.5$ GeV

$\Gamma(K^+K^-\pi^+\pi^0\text{ non-}\phi)/\Gamma(\phi\pi^+)$ Γ_{26}/Γ_{14}

VALUE	CL%		DOCUMENT ID		TECN	COMMENT
<2.4	90	[27]	ANJOS	89E	E691	Photoproduction

[27] Total minus ϕ component.

$\Gamma(K^+\overline{K}^0\pi^+\pi^-)/\Gamma(\phi\pi^+)$ Γ_{27}/Γ_{14}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.77	90	ALBRECHT	92B	ARG	$e^+e^- \simeq 10.4$ GeV

$\Gamma(K^0K^-\pi^+\pi^+)/\Gamma(\phi\pi^+)$ Γ_{28}/Γ_{14}

VALUE	DOCUMENT ID		TECN	COMMENT
1.2 ±0.2 ±0.2	ALBRECHT	92B	ARG	$e^+e^- \simeq 10.4$ GeV

$\Gamma(K^*(892)^+\overline{K}^*(892)^0)/\Gamma(\phi\pi^+)$ Γ_{29}/Γ_{14}

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

$\Gamma(K^0K^-\pi^+\pi^+$ non-$K^{*+}\overline{K}^{*0})/\Gamma(\phi\pi^+)$ Γ_{30}/Γ_{14}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.80	90	ALBRECHT	92B	ARG	$e^+e^-\simeq$ 10.4 GeV

$\Gamma(K^+K^-\pi^+\pi^+\pi^-)/\Gamma(K^+K^-\pi^+)$ Γ_{31}/Γ_{13}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.188±0.036±0.040	75	FRABETTI	97C	E687	γ Be, $\overline{E}_\gamma\approx$ 200 GeV

$\Gamma(\phi\pi^+\pi^+\pi^-)/\Gamma(\phi\pi^+)$ Γ_{32}/Γ_{14}

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.33±0.06 OUR AVERAGE						
0.28±0.06±0.01		40	FRABETTI	97C	E687	γ Be, $\overline{E}_\gamma\approx$ 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
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.24	90		ALVAREZ	90C	NA14	Photoproduction

$\Gamma(K^+K^-\pi^+\pi^+\pi^-$ non-$\phi)/\Gamma_{\text{total}}$ Γ_{33}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.003 $^{+0.003}_{-0.002}$	BARLAG	92C	ACCM	π^- 230 GeV

$\Gamma(K^+K^-\pi^+\pi^+\pi^-$ non-$\phi)/\Gamma(\phi\pi^+)$ Γ_{33}/Γ_{14}

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.32	90	10	ANJOS	88	E691	Photoproduction

Other hadronic modes (0, 1, or 3 K's)

$\Gamma(\pi^+\pi^+\pi^-)/\Gamma(\phi\pi^+)$ Γ_{34}/Γ_{14}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.39±0.08 OUR AVERAGE					
0.33±0.10±0.04	29	ADAMOVICH	93	WA82	π^- 340 GeV
0.44±0.10±0.04		ANJOS	89	E691	Photoproduction

$\Gamma(\rho^0\pi^+)/\Gamma(\phi\pi^+)$ Γ_{35}/Γ_{14}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.08	90	ANJOS	89	E691	Photoproduction
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.22	90	ALBRECHT	87G	ARG	e^+e^- 10 GeV

$\Gamma(f_0(980)\pi^+)/\Gamma(\phi\pi^+)$ Γ_{36}/Γ_{14}

Unseen decay modes of the resonances are included.

VALUE	DOCUMENT ID		TECN	COMMENT
0.32±0.10 OUR FIT				
0.28±0.10±0.03	ANJOS	89	E691	Photoproduction

$\Gamma(\pi^+\pi^+\pi^-\text{nonresonant})/\Gamma(\phi\pi^+)$ Γ_{37}/Γ_{14}

VALUE	DOCUMENT ID		TECN	COMMENT
0.29±0.09±0.03	ANJOS	89	E691	Photoproduction

$\Gamma(\pi^+\pi^+\pi^-\pi^0)/\Gamma(\phi\pi^+)$ Γ_{38}/Γ_{14}

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

$\Gamma(\eta\pi^+)/\Gamma(\phi\pi^+)$ Γ_{39}/Γ_{14}

Unseen decay modes of the resonances are included.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.54±0.09±0.06		165	ALEXANDER	92	CLEO	$\eta \to \gamma\gamma$, $\pi^+\pi^-\pi^0$

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

<1.5	90	ANJOS	89E	E691	Photoproduction

$\Gamma(\omega\pi^+)/\Gamma(\phi\pi^+)$ Γ_{40}/Γ_{14}

Unseen decay modes of the resonances are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.5	90	ANJOS	89E	E691	Photoproduction

$\Gamma(\pi^+\pi^+\pi^+\pi^-\pi^-)/\Gamma_{\text{total}}$ Γ_{41}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT

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

$0.003^{+0.004}_{-0.003}$	BARLAG	92C	ACCM	π^- 230 GeV

$\Gamma(\pi^+\pi^+\pi^+\pi^-\pi^-)/\Gamma(K^+K^-\pi^+)$ Γ_{41}/Γ_{13}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.158±0.042±0.031	37	FRABETTI	97C	E687	γ Be, $\overline{E}_\gamma \approx$ 200 GeV

$\Gamma(\pi^+\pi^+\pi^+\pi^-\pi^-)/\Gamma(\phi\pi^+)$ Γ_{41}/Γ_{14}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT

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

<0.29	90	ANJOS	89	E691	Photoproduction

$\Gamma(\eta\rho^+)/\Gamma(\phi\pi^+)$ Γ_{43}/Γ_{14}

Unseen decay modes of the resonances are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
2.86±0.38$^{+0.36}_{-0.38}$	217	AVERY	92	CLEO	$\eta \to \gamma\gamma$, $\pi^+\pi^-\pi^0$

$\Gamma(\eta\pi^+\pi^0\text{ 3-body})/\Gamma(\phi\pi^+)$ Γ_{44}/Γ_{14}

Unseen decay modes of the resonances are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.82	90	DAOUDI	92	CLEO	$e^+e^- \approx$ 10.5 GeV

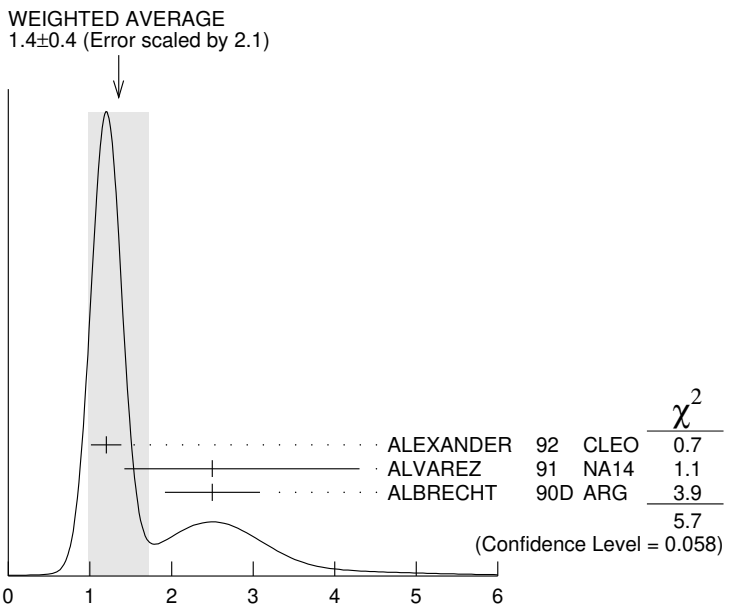
$\Gamma(\pi^+\pi^+\pi^+\pi^-\pi^-\pi^0)/\Gamma_{total}$ Γ_{45}/Γ

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

$\Gamma(\eta'(958)\pi^+)/\Gamma(\phi\pi^+)$ Γ_{46}/Γ_{14}

Unseen decay modes of the resonances are included.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
1.4 ±0.4 OUR AVERAGE			Error includes scale factor of 2.1. See the ideogram below.			
1.20±0.15±0.11		281	ALEXANDER	92	CLEO	$\eta' \to \eta\pi^+\pi^-$, $\rho^0\gamma$
2.5 ±1.0 $^{+1.5}_{-0.4}$		22	ALVAREZ	91	NA14	Photoproduction
2.5 ±0.5 ±0.3		215	ALBRECHT	90D	ARG	$e^+e^- \approx 10.4$ GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<1.3	90		ANJOS	91B	E691	γBe, $\overline{E}_\gamma \approx 145$ GeV



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

$\Gamma(\eta'(958)\rho^+)/\Gamma(\phi\pi^+)$ Γ_{48}/Γ_{14}

Unseen decay modes of the resonances are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$3.44\pm0.62^{+0.44}_{-0.46}$	68	AVERY	92	CLEO	$\eta' \to \eta\pi^+\pi^-$

$\Gamma(\eta'(958)\pi^+\pi^0\text{3-body})/\Gamma(\phi\pi^+)$ Γ_{49}/Γ_{14}

Unseen decay modes of the resonances are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.85	90	DAOUDI	92	CLEO	$e^+e^- \approx 10.5$ GeV

$\Gamma(K^0\pi^+)/\Gamma(\phi\pi^+)$ Γ_{50}/Γ_{14}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.21	90	ADLER	89B	MRK3	e^+e^- 4.14 GeV

$\Gamma(K^0\pi^+)/\Gamma(K^+\overline{K}^0)$ Γ_{50}/Γ_{12}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.53	90	FRABETTI	95	E687	γ Be $\overline{E}_\gamma \approx 200$ GeV

$\Gamma(K^+\pi^+\pi^-)/\Gamma(\phi\pi^+)$ Γ_{51}/Γ_{14}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.28±0.06±0.05	85	FRABETTI	95E	E687	γ Be, $\overline{E}_\gamma$= 220 GeV

$\Gamma(K^+\rho^0)/\Gamma(\phi\pi^+)$ Γ_{52}/Γ_{14}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.08	90	FRABETTI	95E	E687	γ Be, $\overline{E}_\gamma$= 220 GeV

$\Gamma(K^*(892)^0\pi^+)/\Gamma(\phi\pi^+)$ Γ_{53}/Γ_{14}

Unseen decay modes of the resonances are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.18±0.05±0.04	25	FRABETTI	95E	E687	γ Be, $\overline{E}_\gamma$= 220 GeV

$\Gamma(K^+K^+K^-)/\Gamma(\phi\pi^+)$ Γ_{54}/Γ_{14}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.016	90	FRABETTI	95F	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV

$\Gamma(\phi K^+)/\Gamma(\phi\pi^+)$ Γ_{55}/Γ_{14}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.013	90	FRABETTI	95F	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.071	90	ANJOS	92D	E691	γ Be, $\overline{E}_\gamma$ = 145 GeV

Rare or forbidden modes

$\Gamma(\pi^+\mu^+\mu^-)/\Gamma_{total}$ Γ_{56}/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%	EVTS	DOCUMENT ID		TECN	COMMENT
<4.3 × 10^{-4}	90	0	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(K^+\mu^+\mu^-)/\Gamma_{total}$ Γ_{57}/Γ

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

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<5.9 × 10^{-4}	90	0	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(K^*(892)^+\mu^+\mu^-)/\Gamma_{total}$ Γ_{58}/Γ

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

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$<1.4\times10^{-3}$	90	0	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(\pi^-\mu^+\mu^+)/\Gamma_{total}$ Γ_{59}/Γ

A test of lepton-number conservation.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$<4.3\times10^{-4}$	90	0	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(K^-\mu^+\mu^+)/\Gamma_{total}$ Γ_{60}/Γ

A test of lepton-number conservation.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$<5.9\times10^{-4}$	90	0	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(K^*(892)^-\mu^+\mu^+)/\Gamma_{total}$ Γ_{61}/Γ

A test of lepton-number conservation.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$<1.4\times10^{-3}$	90	0	KODAMA	95	E653	π^- emulsion 600 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
1.6±0.4 OUR AVERAGE					
$1.4\pm0.5\pm0.3$	308	[28] AVERY	94B	CLEO	e^+e^- 10 GeV
$1.1\pm0.8\pm0.1$	90	[29] FRABETTI	94F	E687	γ Be, $\overline{E}_\gamma$= 220 GeV
$2.1^{+0.6}_{-0.5}\pm0.2$	19	[29] KODAMA	93	E653	600 GeV π^- N

[28] AVERY 94B uses $D_s^+ \to \phi e^+\nu_e$ decays.

[29] FRABETTI 94F and KODAMA 93 use $D_s^+ \to \phi\mu^+\nu_\mu$ decays.

$r_V \equiv V(0)/A_1(0)$ in $D_s^+ \to \phi\ell^+\nu_\ell$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.5±0.5 OUR AVERAGE					
$0.9\pm0.6\pm0.3$	308	[30] AVERY	94B	CLEO	e^+e^- 10 GeV
$1.8\pm0.9\pm0.2$	90	[31] FRABETTI	94F	E687	γ Be, $\overline{E}_\gamma$= 220 GeV
$2.3^{+1.1}_{-0.9}\pm0.4$	19	[31] KODAMA	93	E653	600 GeV π^- N

[30] AVERY 94B uses $D_s^+ \to \phi e^+\nu_e$ decays.

[31] FRABETTI 94F and KODAMA 93 use $D_s^+ \to \phi\mu^+\nu_\mu$ decays.

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	[32] AVERY	94B	CLEO	e^+e^- 10 GeV
1.0 ±0.5 ±0.1	90	[33] FRABETTI	94F	E687	γ Be, $\overline{E}_\gamma$= 220 GeV
0.54±0.21±0.10	19	[33] KODAMA	93	E653	600 GeV π^- N

[32] AVERY 94B uses $D_s^+ \to \phi e^+\nu_e$ decays.

[33] FRABETTI 94F and KODAMA 93 use $D_s^+ \to \phi\mu^+\nu_\mu$ decays. Γ_L/Γ_T is evaluated for a lepton mass of zero.

$D_s^\pm$ REFERENCES

ACCIARRI	97F	PL B396 327	+Adriani, Aguilar-Benitez+	(CERN L3 Collab.)
FRABETTI	97C	PL B401 131	+Cheung, Cumalat+	(FNAL E687 Collab.)
ARTUSO	96	PL B378 364	+Efimov, Gao, Goldberg+	(CLEO Collab.)
KODAMA	96	PL B382 299	+Torikai, Ushida+	(FNAL E653 Collab.)
BAI	95	PRL 74 4599	+Bardon, Blum, Breakstone+	(BES Collab.)
BAI	95C	PR D52 3781	+Bardon, Blum, Breakstone+	(BES Collab.)
BRANDENB...	95	PRL 75 3804	Brandenburg, Cinabro, Liu+	(CLEO Collab.)
FRABETTI	95	PL B346 199	+Cheung, Cumalat+	(FNAL E687 Collab.)
FRABETTI	95B	PL B351 591	+Cheung, Cumalat+	(FNAL E687 Collab.)
FRABETTI	95E	PL B359 403	+Cheung, Cumalat+	(FNAL E687 Collab.)
FRABETTI	95F	PL B363 259	+Cheung, Cumalat+	(FNAL E687 Collab.)
KODAMA	95	PL B345 85	+Ushida, Mokhtarani+	(FNAL E653 Collab.)
ACOSTA	94	PR D49 5690	+Athanas, Masek, Paar+	(CLEO Collab.)
AVERY	94B	PL B337 405	+Freyberger, Rodriguez+	(CLEO Collab.)
BROWN	94	PR D50 1884	+Fast, McIlwain, Miao+	(CLEO Collab.)
BUTLER	94	PL B324 255	+Fu, Kalbfleisch, Ross+	(CLEO Collab.)
FRABETTI	94F	PL B328 187	+Cheung, Cumalat+	(FNAL E687 Collab.)
MUHEIM	94	PR D49 3767	+Stone	(SYRA)
ADAMOVICH	93	PL B305 177	+Alexandrov, Antinori+	(CERN WA82 Collab.)
AOKI	93	PTP 89 131	+Baroni, Bisi, Breslin+	(CERN WA75 Collab.)
FRABETTI	93F	PRL 71 827	+Cheung, Cumalat, Dallapiccola+	(FNAL E687 Collab.)
FRABETTI	93G	PL B313 253	+Cheung, Cumalat+	(FNAL E687 Collab.)
KODAMA	93	PL B309 483	+Ushida, Mokhtarani+	(FNAL E653 Collab.)
KODAMA	93B	PL B313 260	+Ushida, Mokhtarani+	(FNAL E653 Collab.)
ALBRECHT	92B	ZPHY C53 361	+Ehrlichmann, Hamacher, Krueger+	(ARGUS Collab.)
ALEXANDER	92	PRL 68 1275	+Bebek, Berkelman, Besson+	(CLEO Collab.)
ANJOS	92D	PRL 69 2892	+Appel, Bean, Bediaga+	(FNAL E691 Collab.)
AVERY	92	PRL 68 1279	+Freyberger, Rodriguez, Yelton+	(CLEO Collab.)
BARLAG	92C	ZPHY C55 383	+Becker, Bozek, Boehringer+	(ACCMOR Collab.)
Also	90D	ZPHY C48 29	Barlag, Becker, Boehringer, Bosman+	(ACCMOR Collab.)
DAOUDI	92	PR D45 3965	+Ford, Johnson, Lingel+	(CLEO Collab.)
FRABETTI	92	PL B281 167	+Bogart, Cheung, Culy+	(FNAL E687 Collab.)
ALBRECHT	91	PL B255 634	+Ehrlichmann, Hamacher, Krueger+	(ARGUS Collab.)
ALVAREZ	91	PL B255 639	+Barate, Bloch, Bonamy+	(CERN NA14/2 Collab.)
ANJOS	91B	PR D43 R2063	+Appel, Bean, Bracker+	(FNAL E691 Collab.)
COFFMAN	91	PL B263 135	+DeJongh, Dubois, Eigen, Hitlin+	(Mark III Collab.)
ADLER	90B	PRL 64 169	+Bai, Blaylock, Bolton+	(Mark III Collab.)
ALBRECHT	90D	PL B245 315	+Ehrlichmann, Glaeser, Harder+	(ARGUS Collab.)
ALEXANDER	90B	PRL 65 1531	+Artuso, Bebek, Berkelman+	(CLEO Collab.)
ALVAREZ	90	ZPHY C47 539	+Barate, Bloch, Bonamy+	(CERN NA14/2 Collab.)
ALVAREZ	90C	PL B246 261	+Barate, Bloch, Bonamy+	(CERN NA14/2 Collab.)
ANJOS	90B	PRL 64 2885	+Appel, Bean, Bracker+	(FNAL E691 Collab.)
ANJOS	90C	PR D41 2705	+Appel, Bean+	(FNAL E691 Collab.)
BAI	90	PRL 65 686	+Blaylock, Bolton, Brient+	(Mark III Collab.)
BARLAG	90C	ZPHY C46 563	+Becker, Boehringer, Bosman+	(ACCMOR Collab.)
FRABETTI	90	PL B251 639	+Bogart, Cheung, Coteus+	(FNAL E687 Collab.)
ADLER	89B	PRL 63 1211	+Bai, Becker, Blaylock, Bolton+	(Mark III Collab.)
Also	89D	PRL 63 2858 erratum		

ANJOS	89	PRL 62 125	+Appel, Bean, Bracker+	(FNAL E691 Collab.)
ANJOS	89E	PL B223 267	+Appel, Bean, Bracker+	(FNAL E691 Collab.)
AVERILL	89	PR D39 123	+Blockus, Brabson+	(HRS Collab.)
CHEN	89	PL B226 192	+McIlwain, Miller, Ng, Shibata+	(CLEO Collab.)
ALBRECHT	88	PL B207 349	+Binder, Boeckmann+	(ARGUS Collab.)
ALBRECHT	88I	PL B210 267	+Boeckmann, Glaeser+	(ARGUS Collab.)
ANJOS	88	PRL 60 897	+Appel+	(FNAL E691 Collab.)
RAAB	88	PR D37 2391	+Anjos, Appel, Bracker+	(FNAL E691 Collab.)
ALBRECHT	87F	PL B179 398	+Binder, Boeckmann, Glaeser+	(ARGUS Collab.)
ALBRECHT	87G	PL B195 102	+Andam, Binder, Boeckmann+	(ARGUS Collab.)
ANJOS	87B	PRL 58 1818	+Appel, Bracker, Browder+	(FNAL E691 Collab.)
BECKER	87B	PL B184 277	+Boehringer, Bosman+	(NA11 and NA32 Collab.)
BLAYLOCK	87	PRL 58 2171	+Bolton, Brown, Bunnell+	(Mark III Collab.)
BRAUNSCH...	87	ZPHY C35 317	Braunschweig, Gerhards+	(TASSO Collab.)
CSORNA	87	PL B191 318	+Mestayer, Panvini, Word+	(CLEO Collab.)
JUNG	86	PRL 56 1775	+Abachi+	(HRS Collab.)
USHIDA	86	PRL 56 1767	+Kondo, Tasaka, Park+	(FNAL E531 Collab.)
ALBRECHT	85D	PL 153B 343	+Drescher, Binder, Drews+	(ARGUS Collab.)
DERRICK	85B	PRL 54 2568	+Fernandez, Fries, Hyman+	(HRS Collab.)
AIHARA	84D	PRL 53 2465	+Alston-Garnjost, Badtke, Bakken+	(TPC Collab.)
ALTHOFF	84	PL 136B 130	+Braunschweig, Kirschfink+	(TASSO Collab.)
BAILEY	84	PL 139B 320	+Belau, Bohringer, Bosman+	(ACCMOR Collab.)
AUBERT	83	NP B213 31	+Bassompierre, Becks, Best+	(EMC Collab.)
CHEN	83C	PRL 51 634	+Alam, Giles, Kagan+	(CLEO Collab.)
USHIDA	83	PRL 51 2362	+Kondo, Fujioka, Fukushima+	(FNAL E653 Collab.)

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