$D_s^{\pm}$ was $F^{\pm}$

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

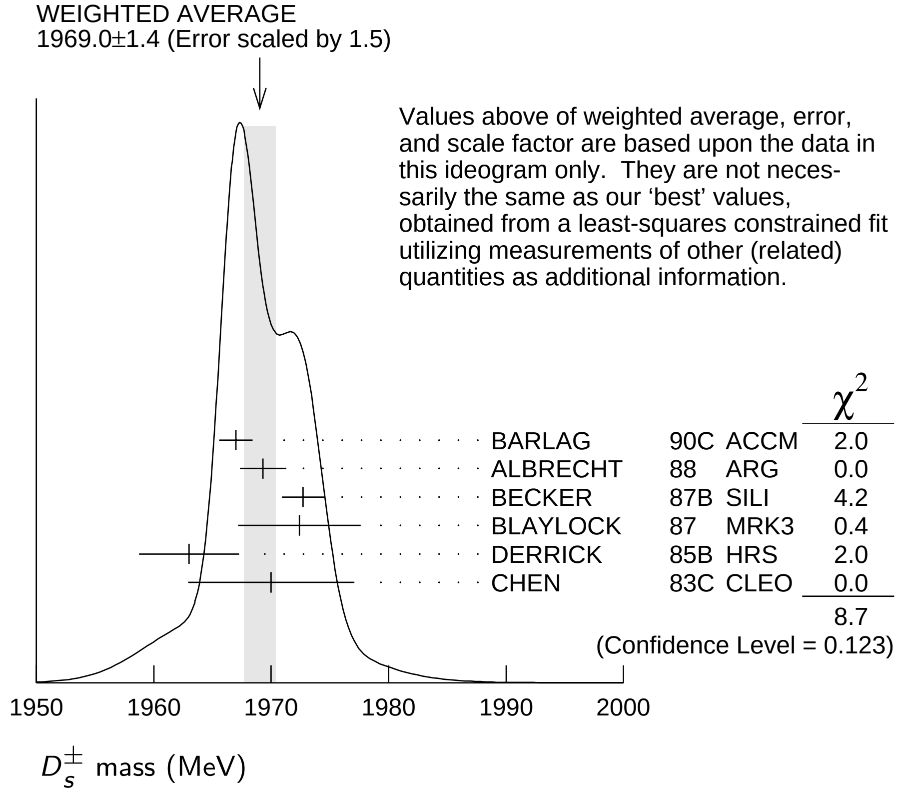
The angular distributions of the decays of the ϕ and $\overline{K}^*(892)^0$ in the $\phi\pi^+$ and $K^+\overline{K}^*(892)^0$ modes strongly indicate that the spin is zero. The parity given is that expected of a $c\overline{s}$ ground state.

$D_s^{\pm}$ 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*
1968.2± 0.5 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 → $\phi\pi^+$ 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}, and $D_s^{*\pm}$ mass and mass difference measurements.

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
98.85±0.30 OUR FIT	Error includes scale factor of 1.4.				
98.85±0.25 OUR AVERAGE	Error includes scale factor of 1.1.				
99.41±0.38±0.21		ACOSTA	03D	CDF2	$\overline{p}p$, $\sqrt{s}$= 1.96 TeV
98.4 ±0.1 ±0.3	48k	AUBERT	02G	BABR	$e^+e^- \approx \Upsilon(4S)$
99.5 ±0.6 ±0.3		BROWN	94	CLE2	$e^+e^- \approx \Upsilon(4S)$
98.5 ±1.5	555	CHEN	89	CLEO	e^+e^- 10.5 GeV
99.0 ±0.8	290	ANJOS	88	E691	Photoproduction

$D_s^\pm$ MEAN LIFE

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

VALUE (10^{-15} s)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
490 ± 9 OUR AVERAGE	Error includes scale factor of 1.1.				
472.5±17.2± 6.6	760	IORI	01	SELX	600 GeV Σ^-, π^-, p
518 ±14 ± 7	1662	AITALA	99	E791	π^- nucleus, 500 GeV
$486.3\pm15.0^{+4.9}_{-5.1}$	2167	[2] BONVICINI	99	CLE2	$e^+e^- \approx \Upsilon(4S)$

475	±20	± 7	900	FRABETTI	93F	E687	γ Be, $\phi\pi^+$
500	±60	±30	104	FRABETTI	90	E687	γ Be, $\phi\pi^+$
470	±40	±20	228	RAAB	88	E691	Photoproduction

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

D_s^+ DECAY MODES

Unless otherwise noted, the branching fractions for modes with a resonance in the final state include all the decay modes of the resonance. D_s^- modes are charge conjugates of the modes below.

	Mode		Fraction (Γ_i/Γ)	Scale factor/ Confidence level
	Inclusive modes			
Γ_1	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		$(8 {}^{+6}_{-5})$ %	
Γ_6	ϕ anything		$(18 {}^{+15}_{-10})$ %	
	Leptonic and semileptonic modes			
Γ_7	$\mu^+\nu_\mu$		(5.0 ± 1.9) $\times 10^{-3}$	S=1.3
Γ_8	$\tau^+\nu_\tau$		(6.4 ± 1.5) %	
Γ_9	$\phi\ell^+\nu_\ell$	[a]	(2.0 ± 0.5) %	
Γ_{10}	$\eta\ell^+\nu_\ell$ + $\eta'(958)\ell^+\nu_\ell$	[a]	(3.4 ± 1.0) %	
Γ_{11}	$\eta\ell^+\nu_\ell$	[a]	(2.5 ± 0.7) %	
Γ_{12}	$\eta'(958)\ell^+\nu_\ell$	[a]	(8.9 ± 3.3) $\times 10^{-3}$	
	Hadronic modes with a $K\overline{K}$ pair			
Γ_{13}	$K^+\overline{K}^0$		(3.6 ± 1.1) %	
Γ_{14}	$K^+K^-\pi^+$	[b]	(4.3 ± 1.2) %	
Γ_{15}	$\phi\pi^+$	[c]	(3.6 ± 0.9) %	
Γ_{16}	$\phi\pi^+$, $\phi \to K^+K^-$		(1.8 ± 0.4) %	
Γ_{17}	$K^+\overline{K}^*(892)^0$			
Γ_{18}	$K^+\overline{K}^*(892)^0$, $\overline{K}^{*0} \to K^-\pi^+$		(2.0 ± 0.6) %	
Γ_{19}	$f_0(980)\pi^+$, $f_0 \to K^+K^-$		(4.7 ± 2.3) $\times 10^{-3}$	
Γ_{20}	$K^+\overline{K}^*_0(1430)^0$, $\overline{K}^*_0 \to K^-\pi^+$		(4.0 ± 2.2) $\times 10^{-3}$	
Γ_{21}	$f_0(1710)\pi^+$, $f_0 \to K^+K^-$			
Γ_{22}	$K^+K^-\pi^+$ nonresonant			
Γ_{23}	$K^0\overline{K}^0\pi^+$		—	
Γ_{24}	$K^*(892)^+\overline{K}^0$	[c]	(4.3 ± 1.4) %	

Γ_{25}	$K^+K^-\pi^+\pi^0$		—	
Γ_{26}	$\phi\pi^+\pi^0$	[c]	(9 ± 5) %	
Γ_{27}	$\phi\rho^+$	[c]	(6.7 ± 2.3) %	
Γ_{28}	$\phi\pi^+\pi^0$ 3-body	[c]	< 2.6 %	CL=90%
Γ_{29}	$K^+K^-\pi^+\pi^0$ non-ϕ		< 9 %	CL=90%
Γ_{30}	$K^+\overline{K}^0\pi^+\pi^-$		(2.5 ± 0.9) %	
Γ_{31}	$K^0K^-\pi^+\pi^+$		(4.3 ± 1.5) %	
Γ_{32}	$K^*(892)^+\overline{K}^*(892)^0$	[c]	(5.8 ± 2.5) %	
Γ_{33}	$K^0K^-\pi^+\pi^+$(non-$K^{*+}\overline{K}^{*0}$)		< 2.9 %	CL=90%
Γ_{34}	$K^+K^-\pi^+\pi^+\pi^-$		$(6.8 \pm 2.2) \times 10^{-3}$	
Γ_{35}	$\phi\pi^+\pi^+\pi^-$	[c]	$(9.7 \pm 2.6) \times 10^{-3}$	
Γ_{36}	$K^+K^-\rho^0\pi^+$ non-ϕ		$< 2.0 \times 10^{-4}$	CL=90%
Γ_{37}	$\phi\rho^0\pi^+$	[c]	(1.02 ± 0.34) %	
Γ_{38}	$\phi a_1(1260)^+$	[c]	(2.4 ± 0.8) %	
Γ_{39}	$K^+K^-\pi^+\pi^+\pi^-$ nonresonant		$(7 \pm 6) \times 10^{-4}$	
Γ_{40}	$K^0_SK^0_S\pi^+\pi^+\pi^-$		$(2.2 \pm 1.2) \times 10^{-3}$	

Hadronic modes without K's

Γ_{41}	$\pi^+\pi^+\pi^-$		(1.00 ± 0.28) %	S=1.1
Γ_{42}	$\rho^0\pi^+$			
Γ_{43}	$\pi^+(\pi^+\pi^-)_{S-\text{wave}}$		$(8.7 \pm 2.5) \times 10^{-3}$	
Γ_{44}	$f_0(980)\pi^+$, $f_0 \to \pi^+\pi^-$			
Γ_{45}	$f_0(1370)\pi^+$, $f_0 \to \pi^+\pi^-$			
Γ_{46}	$f_0(1500)\pi^+$, $f_0 \to \pi^+\pi^-$			
Γ_{47}	$f_2(1270)\pi^+$, $f_2 \to \pi^+\pi^-$		$(10 \pm 6) \times 10^{-4}$	
Γ_{48}	$\rho(1450)^0\pi^+$, $\rho^0 \to \pi^+\pi^-$		$(7 \pm 6) \times 10^{-4}$	
Γ_{49}	$\pi^+\pi^+\pi^-$ nonresonant		$(5 {}^{+22}_{-5}) \times 10^{-5}$	
Γ_{50}	$\pi^+\pi^+\pi^-\pi^0$		< 12 %	CL=90%
Γ_{51}	$\eta\pi^+$	[c]	(1.7 ± 0.5) %	
Γ_{52}	$\omega\pi^+$	[c]	$(2.8 \pm 1.1) \times 10^{-3}$	
Γ_{53}	$3\pi^+2\pi^-$		$(6.2 \pm 1.8) \times 10^{-3}$	
Γ_{54}	$\pi^+\pi^+\pi^-\pi^0\pi^0$		—	
Γ_{55}	$\eta\rho^+$	[c]	(10.8 ± 3.1) %	
Γ_{56}	$\eta\pi^+\pi^0$ 3-body	[c]	< 4 %	CL=90%
Γ_{57}	$3\pi^+2\pi^-\pi^0$		(4.9 ± 3.2) %	
Γ_{58}	$\eta'(958)\pi^+$	[c]	(3.9 ± 1.0) %	
Γ_{59}	$3\pi^+2\pi^-2\pi^0$		—	
Γ_{60}	$\eta'(958)\rho^+$	[c]	(10.1 ± 2.8) %	
Γ_{61}	$\eta'(958)\pi^+\pi^0$ 3-body	[c]	< 1.4 %	CL=90%

Modes with one or three K's

Γ_{62}	$K^0\pi^+$		$< 8 \times 10^{-3}$	CL=90%
Γ_{63}	$K^+\pi^+\pi^-$		$(5.4 \pm 1.6) \times 10^{-3}$	
Γ_{64}	$K^+\rho^0$		$(2.1 \pm 0.7) \times 10^{-3}$	
Γ_{65}	$K^+\rho(1450)^0$, $\rho^0 \to \pi^+\pi^-$		$(5.7 \pm 2.6) \times 10^{-4}$	

Γ_{66}	$K^*(892)^0\pi^+$, $K^{*0}\rightarrow K^+\pi^-$			$(1.2 \pm 0.4)\times 10^{-3}$	
Γ_{67}	$K^*(1410)^0\pi^+$, $K^{*0}\rightarrow K^+\pi^-$			$(1.0 \pm 0.4)\times 10^{-3}$	
Γ_{68}	$K^*(1430)^0\pi^+$, $K^{*0}\rightarrow K^+\pi^-$			$(4.1 \pm 3.1)\times 10^{-4}$	
Γ_{69}	$K^+\pi^+\pi^-$ nonresonant			$(9 \pm 4)\times 10^{-4}$	
Γ_{70}	$K^+K^+K^-$			$(3.8 \pm 1.7)\times 10^{-4}$	
Γ_{71}	ϕK^+		[c]	$< 5 \times 10^{-4}$	CL=90%

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

Γ_{72}	$\pi^+e^+e^-$		[d]	$< 2.7 \times 10^{-4}$	CL=90%
Γ_{73}	$\pi^+\mu^+\mu^-$		[d]	$< 2.6 \times 10^{-5}$	CL=90%
Γ_{74}	$K^+e^+e^-$	*C1*		$< 1.6 \times 10^{-3}$	CL=90%
Γ_{75}	$K^+\mu^+\mu^-$	*C1*		$< 3.6 \times 10^{-5}$	CL=90%
Γ_{76}	$K^*(892)^+\mu^+\mu^-$	*C1*		$< 1.4 \times 10^{-3}$	CL=90%
Γ_{77}	$\pi^+e^\pm\mu^\mp$	*LF*	[e]	$< 6.1 \times 10^{-4}$	CL=90%
Γ_{78}	$K^+e^\pm\mu^\mp$	*LF*	[e]	$< 6.3 \times 10^{-4}$	CL=90%
Γ_{79}	$\pi^-e^+e^+$	*L*		$< 6.9 \times 10^{-4}$	CL=90%
Γ_{80}	$\pi^-\mu^+\mu^+$	*L*		$< 2.9 \times 10^{-5}$	CL=90%
Γ_{81}	$\pi^-e^+\mu^+$	*L*		$< 7.3 \times 10^{-4}$	CL=90%
Γ_{82}	$K^-e^+e^+$	*L*		$< 6.3 \times 10^{-4}$	CL=90%
Γ_{83}	$K^-\mu^+\mu^+$	*L*		$< 1.3 \times 10^{-5}$	CL=90%
Γ_{84}	$K^-e^+\mu^+$	*L*		$< 6.8 \times 10^{-4}$	CL=90%
Γ_{85}	$K^*(892)^-\mu^+\mu^+$	*L*		$< 1.4 \times 10^{-3}$	CL=90%
Γ_{86}	A dummy mode used by the fit.			(83 ± 4) %	

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

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

CONSTRAINED FIT INFORMATION

An overall fit to 11 branching ratios uses 19 measurements and one constraint to determine 9 parameters. The overall fit has a $\chi^2 = 10.2$ for 11 degrees of freedom.

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

x_9	70							
x_{11}	60	85						
x_{12}	45	64	54					
x_{14}	64	85	73	54				
x_{15}	72	96	81	61	89			
x_{16}	72	96	81	61	89	100		
x_{41}	63	84	72	54	85	88	88	
x_{86}	−73	−96	−87	−66	−93	−98	−98	−90
	x_7	x_9	x_{11}	x_{12}	x_{14}	x_{15}	x_{16}	x_{41}

D_s^+ BRANCHING RATIOS

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

Inclusive modes

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

VALUE	DOCUMENT ID		TECN	COMMENT
$0.13^{+0.14}_{-0.12}\pm0.02$	COFFMAN	91	MRK3	$e^+ e^-$ 4.14 GeV

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

VALUE	DOCUMENT ID		TECN	COMMENT
$0.39^{+0.28}_{-0.27}\pm0.04$	COFFMAN	91	MRK3	$e^+ e^-$ 4.14 GeV

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

VALUE	DOCUMENT ID		TECN	COMMENT
$0.20^{+0.18}_{-0.13}\pm0.04$	COFFMAN	91	MRK3	$e^+ e^-$ 4.14 GeV

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

VALUE	DOCUMENT ID		TECN	COMMENT
$0.64\pm0.17\pm0.03$	[3] COFFMAN	91	MRK3	$e^+ e^-$ 4.14 GeV

[3] 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
$0.077^{+0.057+0.024}_{-0.043-0.021}$		BAI	97	BES	$e^+e^- \to D_s^+ D_s^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.20	90	[4] BAI	90	MRK3	e^+e^- 4.14 GeV

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

$\Gamma(\phi \text{ anything})/\Gamma_{\text{total}}$ — Γ_6/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$0.178^{+0.151+0.006}_{-0.072-0.063}$	3	BAI	98	BES	$e^+e^- \to D_s^+ D_s^-$

Leptonic and semileptonic modes

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.0068 \pm 0.0011 \pm 0.0018$	553	[5] HEISTER	02I	ALEP	Z decays
$0.015\ ^{+0.013}_{-0.006}\ ^{+0.003}_{-0.002}$	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

[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 $3.6 \pm 0.9\%$, so it cannot be included in our overall fit. HEISTER 02I combines its $D_s^+ \to \tau^+\nu_\tau$ and $\mu^+\nu_\mu$ branching fractions to get $f_{D_s} = (285 \pm 19 \pm 40)$ MeV.

[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_7/Γ_{15}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.14 ±0.04 OUR FIT Error includes scale factor of 1.4.					
0.19 ±0.04 OUR AVERAGE					
$0.23 \pm 0.06 \pm 0.04$	18	[9] ALEXANDROV	00	BEAT	π^- nucleus, 350 GeV
$0.173 \pm 0.023 \pm 0.035$	182	[10] CHADHA	98	CLE2	$e^+e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.245 \pm 0.052 \pm 0.074$	39	[11] ACOSTA	94	CLE2	See CHADHA 98

[9] ALEXANDROV 00 uses $f^2_D/f^2_{D_s} = 0.82 \pm 0.09$ 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.

[10] CHADHA 98 obtains $f_{D_s} = (280 \pm 19 \pm 28 \pm 34)$ MeV from this measurement, using $\Gamma(D^+_s \rightarrow \phi\pi^+)/\Gamma(\text{total}) = 0.036 \pm 0.009$.

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

$\Gamma(\mu^+\nu_\mu)/\Gamma(\phi\ell^+\nu_\ell)$ — Γ_7/Γ_9

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.25±0.07 OUR FIT Error includes scale factor of 1.5.					
0.16±0.06±0.03	23	[12] KODAMA	96	E653	π^- emulsion, 600 GeV

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

$\Gamma(\tau^+\nu_\tau)/\Gamma_{\text{total}}$ — Γ_8/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.064 ±0.015 OUR AVERAGE					
0.0579±0.0077±0.0184	881	[13] HEISTER	02I	ALEP	Z decays
0.070 ±0.021 ±0.020	22	[14] ABBIENDI	01L	OPAL	$D^{*+}_s \rightarrow \gamma D^+_s$ from Z's
0.074 ±0.028 ±0.024	16	[15] ACCIARRI	97F	L3	$D^{*+}_s \rightarrow \gamma D^+_s$ from Z's

[13] 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.

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

[15] 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_9/Γ_{15}

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 $D^+_s \rightarrow \phi\ell^+\nu_\ell$ form-factor ratios.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.55 ±0.04 OUR FIT					
0.54 ±0.04 OUR AVERAGE					
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 $\phi\mu^+\nu_\mu$

$\Gamma(\eta\ell^+\nu_\ell)/\Gamma(\phi\ell^+\nu_\ell)$ — Γ_{11}/Γ_9

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.27±0.19 OUR FIT					
1.24±0.12±0.15	440	[16] BRANDENB...	95	CLE2	$e^+e^- \approx \Upsilon(4S)$

[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_{12}/Γ_9

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	CLE2	$e^+e^- \approx \Upsilon(4S)$
• • • 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.

$[\Gamma(\eta\ell^+\nu_\ell)+\Gamma(\eta'(958)\ell^+\nu_\ell)]/\Gamma(\phi\ell^+\nu_\ell)$ — $\Gamma_{10}/\Gamma_9 = (\Gamma_{11}+\Gamma_{12})/\Gamma_9$

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	CLE2	$e^+e^- \approx \Upsilon(4S)$

[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_{13}/Γ_{15}

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_{15}/Γ

We now have model-independent measurements of this branching fraction, and so we no longer use the earlier, model-dependent results.

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	CLE2	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	CLE2	$e^+e^- \approx \Upsilon(4S)$
<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	γBe $\overline{E}_\gamma$= 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 ±0.006 $^{+0.011}_{-0.009}$			[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	γBe, $\overline{E}_\gamma \approx$ 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 $\overline{B}^0 \to D^{*+} D_s^{*-}$ decays to get a model-independent value for $\Gamma(D_s^- \to \phi\pi^-)/\Gamma(D^0 \to K^-\pi^+)$ of 0.92 ± 0.20 ± 0.11.

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

$\Gamma(\phi\pi^+, \phi \to K^+K^-)/\Gamma(\phi\pi^+)$ — Γ_{16}/Γ_{15}

VALUE	DOCUMENT ID	
0.491±0.006 OUR FIT		
0.491±0.006	[27] PDG	04

[27] This is, of course, just the $\phi \to K^+K^-$ branching fraction, but we need it to connect other modes in the fit.

$\Gamma(\phi\pi^+, \phi \to K^+K^-)/\Gamma(K^+K^-\pi^+)$ — Γ_{16}/Γ_{14}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.42 ±0.05 OUR FIT				
0.396±0.033±0.047	FRABETTI	95B	E687	Dalitz fit, 701 evts

$\Gamma\left(K^+\overline{K}^*(892)^0, \overline{K}^{*0} \rightarrow K^-\pi^+\right)/\Gamma\left(K^+K^-\pi^+\right)$ Γ_{18}/Γ_{14}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.478±0.046±0.040	FRABETTI	95B	E687	Dalitz fit, 701 evts

$\Gamma\left(K^+\overline{K}^*(892)^0\right)/\Gamma\left(\phi\pi^+\right)$ Γ_{17}/Γ_{15}

Unseen decay modes of the resonances are included. However, we now get branching fractions for resonant submodes of 3-body decays from Dalitz-plot analyses.

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

$\Gamma\left(f_0(980)\pi^+, f_0 \rightarrow K^+K^-\right)/\Gamma\left(K^+K^-\pi^+\right)$ Γ_{19}/Γ_{14}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.11±0.035±0.026	FRABETTI	95B	E687	Dalitz fit, 701 evts

$\Gamma\left(f_0(1710)\pi^+, f_0 \rightarrow K^+K^-\right)/\Gamma\left(K^+K^-\pi^+\right)$ Γ_{21}/Γ_{14}

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

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.034±0.023±0.035	[28] FRABETTI	95B	E687	Dalitz fit, 701 evts

[28] In other words, FRABETTI 95B doesn't see this resonance.

$\Gamma\left(K^+\overline{K}_0^*(1430)^0, \overline{K}_0^* \rightarrow K^-\pi^+\right)/\Gamma\left(K^+K^-\pi^+\right)$ Γ_{20}/Γ_{14}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.093±0.032±0.032	FRABETTI	95B	E687	Dalitz fit, 701 evts

$\Gamma\left(K^+K^-\pi^+ \text{nonresonant}\right)/\Gamma\left(\phi\pi^+\right)$ Γ_{22}/Γ_{15}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.25±0.07±0.05	48	ANJOS	88	E691	Photoproduction

$\Gamma\left(K^*(892)^+\overline{K}^0\right)/\Gamma\left(\phi\pi^+\right)$ Γ_{24}/Γ_{15}

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

$\Gamma\left(K^*(892)^+\overline{K}^0\right)/\Gamma\left(K^+\overline{K}^0\right)$ Γ_{24}/Γ_{13}

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_{26}/Γ_{15}

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_{27}/Γ_{15}

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

$\Gamma(\phi\pi^+\pi^0\,\text{3-body})/\Gamma(\phi\pi^+)$ — Γ_{28}/Γ_{15}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.71	90	DAOUDI	92	CLE2	$e^+e^- \approx$ 10.5 GeV

$\Gamma(K^+K^-\pi^+\pi^0\,\text{non-}\phi)/\Gamma(\phi\pi^+)$ — Γ_{29}/Γ_{15}

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

$\Gamma(K^+\overline{K}^0\pi^+\pi^-)/\Gamma(\phi\pi^+)$ — Γ_{30}/Γ_{15}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.77	90	ALBRECHT	92B	ARG	$e^+e^- \simeq$ 10.4 GeV

$\Gamma(K^+\overline{K}^0\pi^+\pi^-)/\Gamma(K^0K^-\pi^+\pi^+)$ — Γ_{30}/Γ_{31}

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

$\Gamma(K^0K^-\pi^+\pi^+)/\Gamma(\phi\pi^+)$ — Γ_{31}/Γ_{15}

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_{32}/Γ_{15}

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

$\Gamma(K^0K^-\pi^+\pi^+(\text{non-}K^{*+}\overline{K}^{*0}))/\Gamma(\phi\pi^+)$ — Γ_{33}/Γ_{15}

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_{34}/Γ_{14}

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

$\Gamma(\phi\pi^+\pi^+\pi^-)/\Gamma(\phi\pi^+)$ — Γ_{35}/Γ_{15}

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.269±0.027 OUR AVERAGE						
0.249±0.024±0.021		136	LINK	03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV
0.28 ±0.06 ±0.01		40	FRABETTI	97C	E687	γBe, $\overline{E}_\gamma \approx$ 200 GeV
0.58 ±0.21 ±0.10		21	FRABETTI	92	E687	γBe
0.42 ±0.13 ±0.07		19	ANJOS	88	E691	Photoproduction
1.11 ±0.37 ±0.28		62	ALBRECHT	85D	ARG	e^+e^- 10 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.24	90		ALVAREZ	90C	NA14	Photoproduction

$\Gamma(\phi\pi^+\pi^+\pi^-)/\Gamma(K^+K^-\pi^+\pi^+\pi^-)$ — Γ_{35}/Γ_{34}

Unseen decay modes of the ϕ are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.42±0.10±0.12	136	[29] LINK	03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

[29] This LINK 03D result is redundant with its $\Gamma(\phi\pi^+\pi^+\pi^-)/\Gamma(\phi\pi^+)$ result above.

$\Gamma(K^+K^-\rho^0\pi^+\text{ non-}\phi)/\Gamma(K^+K^-\pi^+\pi^+\pi^-)$ — Γ_{36}/Γ_{34}

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

$\Gamma(\phi\rho^0\pi^+)/\Gamma(K^+K^-\pi^+\pi^+\pi^-)$ — Γ_{37}/Γ_{34}

Unseen decay modes of the ϕ are included.

VALUE	DOCUMENT ID		TECN	COMMENT
1.50±0.12±0.08	LINK	03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(\phi a_1(1260)^+)/\Gamma(K^+K^-\pi^+)$ — Γ_{38}/Γ_{14}

Unseen decay modes of the ϕ and $a_1(1260)^+$ are included.

VALUE	DOCUMENT ID		TECN	COMMENT
0.559±0.078±0.044	LINK	03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(K^+K^-\pi^+\pi^+\pi^-\text{ nonresonant})/\Gamma(K^+K^-\pi^+\pi^+\pi^-)$ — Γ_{39}/Γ_{34}

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

$\Gamma(K^0_S K^0_S\pi^+\pi^+\pi^-)/\Gamma(K^0K^-\pi^+\pi^+)$ — Γ_{40}/Γ_{31}

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

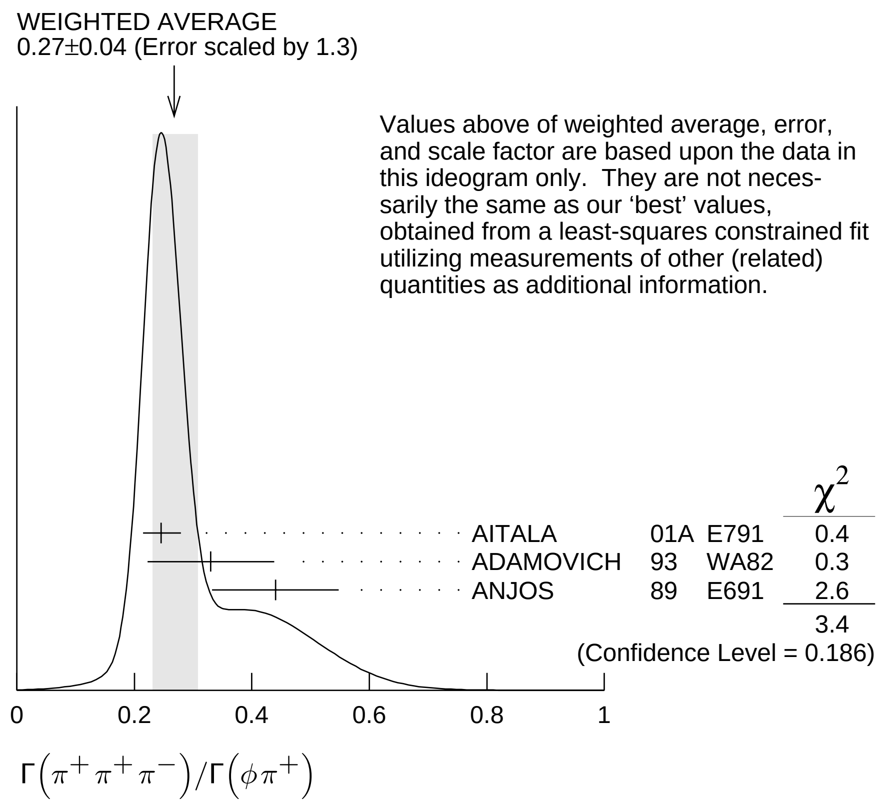
Pionic modes

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.235±0.035 OUR FIT Error includes scale factor of 1.1.					
0.265±0.041±0.031	98	FRABETTI	97D	E687	γ Be $\approx$ 200 GeV

$\Gamma(\pi^+\pi^+\pi^-)/\Gamma(\phi\pi^+)$ — Γ_{41}/Γ_{15}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.277±0.035 OUR FIT Error includes scale factor of 1.3.					
0.27 ±0.04 OUR AVERAGE Error includes scale factor of 1.3. See the ideogram below.					
$0.245 \pm 0.028 ^{+0.019}_{-0.012}$	848	AITALA	01A	E791	π^- nucleus, 500 GeV
$0.33 \pm 0.10 \pm 0.04$	29	ADAMOVICH	93	WA82	π^- 340 GeV
$0.44 \pm 0.10 \pm 0.04$	68	ANJOS	89	E691	Photoproduction



$\Gamma(\rho^0\pi^+)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{42}/Γ_{41}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.058 \pm 0.023 \pm 0.037$		AITALA	01A	E791	Dalitz fit, 848 evts
<0.073	90	FRABETTI	97D	E687	γ Be $\approx$ 200 GeV

$\Gamma(\rho^0\pi^+)/\Gamma(\phi\pi^+)$ — Γ_{42}/Γ_{15}

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

$\Gamma(\pi^+ (\pi^+\pi^-)_{S-wave})/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{43}/Γ_{41}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.8704±0.0560±0.0438	[30] LINK	04	FOCS	Dalitz fit, 1475 ± 50 evts

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

$\Gamma(f_0(980)\pi^+, f_0 \to \pi^+\pi^-)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{44}/Γ_{41}

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

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

$\Gamma(f_0(980)\pi^+, f_0 \to \pi^+\pi^-)/\Gamma(\phi\pi^+)$ — Γ_{44}/Γ_{15}

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

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.28±0.10±0.03	ANJOS	89	E691	Photoproduction

$\Gamma(f_2(1270)\pi^+, f_2 \to \pi^+\pi^-)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{47}/Γ_{41}

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

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

$\Gamma(f_0(1370)\pi^+, f_0 \to \pi^+\pi^-)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{45}/Γ_{41}

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

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

$\Gamma(\rho(1450)^0\pi^+, \rho^0 \to \pi^+\pi^-)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{48}/Γ_{41}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.0656±0.0343±0.0440	LINK	04	FOCS	Dalitz fit, 1475 ± 50 evts
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.044 ±0.021 ±0.002	AITALA	01A	E791	Dalitz fit, 848 evts

$\Gamma(f_0(1500)\pi^+, f_0 \to \pi^+\pi^-)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{46}/Γ_{41}

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

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.274±0.114±0.019	[31] FRABETTI	97D	E687	γ Be ≈ 200 GeV

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

$\Gamma(\pi^+\pi^+\pi^-\text{nonresonant})/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{49}/Γ_{41}

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.005 \pm 0.014 \pm 0.017$		AITALA	01A	E791	π^- nucleus, 500 GeV
<0.269	90	FRABETTI	97D	E687	γ Be $\approx$ 200 GeV

$\Gamma(\pi^+\pi^+\pi^-\text{nonresonant})/\Gamma(\phi\pi^+)$ — Γ_{49}/Γ_{15}

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.29 \pm 0.09 \pm 0.03$	ANJOS	89	E691	Photoproduction

$\Gamma(\pi^+\pi^+\pi^-\pi^0)/\Gamma(\phi\pi^+)$ — Γ_{50}/Γ_{15}

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

$\Gamma(\eta\pi^+)/\Gamma(\phi\pi^+)$ — Γ_{51}/Γ_{15}

Unseen decay modes of the resonances are included.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$0.48 \pm 0.03 \pm 0.04$		920	JESSOP	98	CLE2	$e^+e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$0.54 \pm 0.09 \pm 0.06$		165	ALEXANDER	92	CLE2	See JESSOP 98
<1.5	90		ANJOS	89E	E691	Photoproduction

$\Gamma(\omega\pi^+)/\Gamma(\phi\pi^+)$ — Γ_{52}/Γ_{15}

Unseen decay modes of the resonances are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.5	90	ANJOS	89E	E691	Photoproduction

$\Gamma(\omega\pi^+)/\Gamma(\eta\pi^+)$ — Γ_{52}/Γ_{51}

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

$\Gamma(3\pi^+2\pi^-)/\Gamma(K^+K^-\pi^+)$ — Γ_{53}/Γ_{14}

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

$\Gamma(3\pi^+2\pi^-)/\Gamma(\phi\pi^+)$ — Γ_{53}/Γ_{15}

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_{55}/Γ_{15}

Unseen decay modes of the resonances are included.

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

$\Gamma(\eta\pi^+\pi^0\,3\text{-body})/\Gamma(\phi\pi^+)$ — Γ_{56}/Γ_{15}

Unseen decay modes of the resonances are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.1	90	JESSOP	98	CLE2	$e^+e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.82	90	[32] DAOUDI	92	CLE2	See JESSOP 98

[32] We use the JESSOP 98 limit, even though the DAOUDI 92 limit, from the same experiment but with a much smaller data sample, is more restrictive.

$\Gamma(3\pi^+2\pi^-\pi^0)/\Gamma_{\text{total}}$ — Γ_{57}/Γ

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

$\Gamma(\eta'(958)\pi^+)/\Gamma(\phi\pi^+)$ — Γ_{58}/Γ_{15}

Unseen decay modes of the resonances are included.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
1.08±0.09 OUR AVERAGE						
1.03±0.06±0.07		537	JESSOP	98	CLE2	$e^+e^- \approx \Upsilon(4S)$
$2.5\ \pm1.0\ ^{+1.5}_{-0.4}$		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. • • •						
1.20±0.15±0.11		281	ALEXANDER	92	CLE2	See JESSOP 98
<1.3	90		ANJOS	91B	E691	γ Be, $\overline{E}_\gamma \approx$ 145 GeV

$\Gamma(\eta'(958)\rho^+)/\Gamma(\phi\pi^+)$ — Γ_{60}/Γ_{15}

Unseen decay modes of the resonances are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
2.78±0.28±0.30	137	JESSOP	98	CLE2	$e^+e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$3.44\pm0.62^{+0.44}_{-0.46}$	68	AVERY	92	CLE2	See JESSOP 98

$\Gamma(\eta'(958)\pi^+\pi^0\,3\text{-body})/\Gamma(\phi\pi^+)$ — Γ_{61}/Γ_{15}

Unseen decay modes of the resonances are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.4	90	JESSOP	98	CLE2	$e^+e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.85	90	DAOUDI	92	CLE2	See JESSOP 98

Modes with one or three K's

$\Gamma(K^0\pi^+)/\Gamma(\phi\pi^+)$ — Γ_{62}/Γ_{15}

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_{62}/Γ_{13}

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

$\Gamma(K^+\pi^+\pi^-)/\Gamma(K^+K^-\pi^+)$ — Γ_{63}/Γ_{14}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.127±0.007±0.014	567 ± 31	LINK	04F	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(K^+\pi^+\pi^-)/\Gamma(\phi\pi^+)$ — Γ_{63}/Γ_{15}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.28±0.06±0.05	85	FRABETTI	95E	E687	γ Be, $\overline{E}_\gamma$ = 220 GeV

$\Gamma(K^+\rho^0)/\Gamma(K^+\pi^+\pi^-)$ — Γ_{64}/Γ_{63}

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

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

$\Gamma(K^+\rho(1450)^0, \rho^0 \to \pi^+\pi^-)/\Gamma(K^+\pi^+\pi^-)$ — Γ_{65}/Γ_{63}

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

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

$\Gamma(K^*(892)^0\pi^+, K^{*0} \to K^+\pi^-)/\Gamma(K^+\pi^+\pi^-)$ — Γ_{66}/Γ_{63}

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

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

$\Gamma(K^*(892)^0\pi^+, K^{*0} \to K^+\pi^-)/\Gamma(\phi\pi^+)$ — Γ_{66}/Γ_{15}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.12±0.04±0.03	25	FRABETTI	95E	E687	γ Be, $\overline{E}_\gamma$ = 220 GeV

$\Gamma(K^*(1410)^0\pi^+, K^{*0} \to K^+\pi^-)/\Gamma(K^+\pi^+\pi^-)$ — Γ_{67}/Γ_{63}

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

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

$\Gamma(K^*(1430)^0\pi^+, K^{*0} \to K^+\pi^-)/\Gamma(K^+\pi^+\pi^-)$ — Γ_{68}/Γ_{63}

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

$\Gamma(K^+\pi^+\pi^-\text{ nonresonant})/\Gamma(K^+\pi^+\pi^-)$ — Γ_{69}/Γ_{63}

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

$\Gamma(K^+K^+K^-)/\Gamma(K^+K^-\pi^+)$ — Γ_{70}/Γ_{14}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.00895\pm0.00212^{+0.00224}_{-0.00231}}$	31	LINK	02I	FOCS	γ nucleus, $\approx$ 180 GeV

$\Gamma(K^+K^+K^-)/\Gamma(\phi\pi^+)$ — Γ_{70}/Γ_{15}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.016	90	FRABETTI	95F	E687	γBe, $\overline{E}_\gamma \approx$ 220 GeV

$\Gamma(\phi K^+)/\Gamma(\phi\pi^+)$ — Γ_{71}/Γ_{15}

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

Rare or forbidden modes

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

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$\mathbf{<2.7\times10^{-4}}$	90	AITALA	99G	E791	π^-N 500 GeV

$\Gamma(\pi^+\mu^+\mu^-)/\Gamma_{\text{total}}$ — Γ_{73}/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
$\mathbf{<2.6\times10^{-5}}$	90		LINK	03F	FOCS	γ nucleus,$\overline{E}_\gamma\approx$ 180 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$<1.4\times10^{-4}$	90		AITALA	99G	E791	π^-N 500 GeV
$<4.3\times10^{-4}$	90	0	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(K^+e^+e^-)/\Gamma_{\text{total}}$ — Γ_{74}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$\mathbf{<1.6\times10^{-3}}$	90	AITALA	99G	E791	π^-N 500 GeV

$\Gamma(K^+\mu^+\mu^-)/\Gamma_{\text{total}}$ — Γ_{75}/Γ

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

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{<3.6\times10^{-5}}$	90		LINK	03F	FOCS	γ nucleus,$\overline{E}_\gamma\approx$ 180 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$<1.4\times10^{-4}$	90		AITALA	99G	E791	π^-N 500 GeV
$<5.9\times10^{-4}$	90	0	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(K^*(892)^+\mu^+\mu^-)/\Gamma_{total}$ — Γ_{76}/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 × 10^{-3}	90	0	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(\pi^+ e^\pm \mu^\mp)/\Gamma_{total}$ — Γ_{77}/Γ

A test of lepton-family-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<6.1 × 10^{-4}	90	AITALA	99G	E791	$\pi^- N$ 500 GeV

$\Gamma(K^+ e^\pm \mu^\mp)/\Gamma_{total}$ — Γ_{78}/Γ

A test of lepton-family-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<6.3 × 10^{-4}	90	AITALA	99G	E791	$\pi^- N$ 500 GeV

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

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<6.9 × 10^{-4}	90	AITALA	99G	E791	$\pi^- N$ 500 GeV

$\Gamma(\pi^- \mu^+ \mu^+)/\Gamma_{total}$ — Γ_{80}/Γ

A test of lepton-number conservation.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<2.9 × 10^{-5}	90		LINK	03F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<8.2 × 10^{-5}	90		AITALA	99G	E791	$\pi^- N$ 500 GeV
<4.3 × 10^{-4}	90	0	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(\pi^- e^+ \mu^+)/\Gamma_{total}$ — Γ_{81}/Γ

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<7.3 × 10^{-4}	90	AITALA	99G	E791	$\pi^- N$ 500 GeV

$\Gamma(K^- e^+ e^+)/\Gamma_{total}$ — Γ_{82}/Γ

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<6.3 × 10^{-4}	90	AITALA	99G	E791	$\pi^- N$ 500 GeV

$\Gamma(K^- \mu^+ \mu^+)/\Gamma_{total}$ — Γ_{83}/Γ

A test of lepton-number conservation.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<1.3 × 10^{-5}	90		LINK	03F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<1.8 × 10^{-4}	90		AITALA	99G	E791	$\pi^- N$ 500 GeV
<5.9 × 10^{-4}	90	0	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(K^- e^+ \mu^+)/\Gamma_{total}$ — Γ_{84}/Γ

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<6.8 × 10^{-4}	90	AITALA	99G	E791	$\pi^- N$ 500 GeV

$\Gamma(K^*(892)^- \mu^+ \mu^+)/\Gamma_{total}$ Γ_{85}/Γ

A test of lepton-number conservation.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<1.4 × 10^{-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
1.32 ±0.24 OUR AVERAGE	Error includes scale factor of 1.2.				
0.713±0.202±0.284		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	$\phi \mu^+ \nu_\mu$

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.72 ±0.21 OUR AVERAGE					
1.549±0.250±0.148		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	$\phi \mu^+ \nu_\mu$

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.72±0.18 OUR AVERAGE					
1.0 ±0.3 ±0.2	308	AVERY	94B	CLE2	$\phi e^+ \nu_e$
1.0 ±0.5 ±0.1	90	[33] FRABETTI	94F	E687	$\phi \mu^+ \nu_\mu$
0.54±0.21±0.10	19	[33] KODAMA	93	E653	$\phi \mu^+ \nu_\mu$

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

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