$D^{\pm}$

$I(J^P) = \frac{1}{2}(0^-)$

$D^{\pm}$ MASS

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

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1869.3± 0.4 OUR FIT	Error includes scale factor of 1.1.				
1869.4± 0.5 OUR AVERAGE					
1870.0± 0.5±1.0	317	BARLAG	90C	ACCM	π^- Cu 230 GeV
1863 ± 4		DERRICK	84	HRS	e^+e^- 29 GeV
1869.4± 0.6		[1] TRILLING	81	RVUE	e^+e^- 3.77 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1875 ±10	9	ADAMOVICH	87	EMUL	Photoproduction
1860 ±16	6	ADAMOVICH	84	EMUL	Photoproduction
1868.4± 0.5		[1] SCHINDLER	81	MRK2	e^+e^- 3.77 GeV
1874 ± 5		GOLDHABER	77	MRK1	D^0, D^+ recoil spectra
1868.3± 0.9		[1] PERUZZI	77	MRK1	e^+e^- 3.77 GeV
1874 ±11		PICCOLO	77	MRK1	e^+e^- 4.03, 4.41 GeV
1876 ±15	50	PERUZZI	76	MRK1	$K^{\mp}\pi^{\pm}\pi^{\pm}$

[1] PERUZZI 77 and SCHINDLER 81 errors do not include the 0.13% uncertainty in the absolute SPEAR energy calibration. TRILLING 81 uses the high precision $J/\psi(1S)$ and $\psi(2S)$ measurements of ZHOLENTZ 80 to determine this uncertainty and combines the PERUZZI 77 and SCHINDLER 81 results to obtain the value quoted.

$D^{\pm}$ MEAN LIFE

Measurements with an error $> 100 \times 10^{-15}$ s have been omitted from the Listings.

VALUE (10^{-15} s)	EVTS	DOCUMENT ID		TECN	COMMENT
1040 ± 7 OUR AVERAGE					
1039.4± 4.3± 7.0	110k	LINK	02F	FOCS	γ nucleus, $\approx$ 180 GeV
$1033.6 \pm 22.1 {}^{+\ 9.9}_{-12.7}$	3777	BONVICINI	99	CLE2	$e^+e^- \approx \Upsilon(4S)$
1048 ±15 ±11	9k	FRABETTI	94D	E687	$D^+ \to K^-\pi^+\pi^+$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1075 ±40 ±18	2455	FRABETTI	91	E687	γ Be, $D^+ \to K^-\pi^+\pi^+$
1030 ±80 ±60	200	ALVAREZ	90	NA14	γ, $D^+ \to K^-\pi^+\pi^+$
$1050 {}^{+77}_{-72}$	317	[2] BARLAG	90C	ACCM	π^- Cu 230 GeV
1050 ±80 ±70	363	ALBRECHT	88I	ARG	e^+e^- 10 GeV
1090 ±30 ±25	2992	RAAB	88	E691	Photoproduction

[2] BARLAG 90C estimates the systematic error to be negligible.

D^+ DECAY MODES

Most decay modes (other than the semileptonic modes) that involve a neutral K meson are now given as K^0_S modes, not as $\overline{K}^0$ modes. Nearly always it is a K^0_S that is measured, and interference between Cabibbo-allowed and doubly Cabibbo-suppressed modes can invalidate the assumption that $2\,\Gamma(K^0_S) = \Gamma(\overline{K}^0)$.

	Mode		Fraction (Γ_i/Γ)	Scale factor/ Confidence level
	Inclusive modes			
Γ_1	e^+ anything		(17.2 ± 1.9) %	
Γ_2	K^- anything		(27.5 ± 2.4) %	
Γ_3	$\overline{K}^0$ anything + K^0 anything		(61 ± 8) %	
Γ_4	K^+ anything		(5.5 ± 1.6) %	
Γ_5	$\overline{K}^*(892)^0$ anything		(23 ± 5) %	
Γ_6	$K^*(892)^0$ anything		< 6.6 %	CL=90%
Γ_7	η anything	[a]	< 13 %	CL=90%
Γ_8	ϕ anything		< 1.8 %	CL=90%
Γ_9	ϕe^+ anything		< 1.6 %	CL=90%
Γ_{10}	μ^+ anything			
	Leptonic and semileptonic modes			
Γ_{11}	$e^+\nu_e$		$< 2.4 \times 10^{-5}$	CL=90%
Γ_{12}	$\mu^+\nu_\mu$		$(4.4 \pm 0.7) \times 10^{-4}$	
Γ_{13}	$\overline{K}^0\ell^+\nu_\ell$	[b]		
Γ_{14}	$\overline{K}^0 e^+\nu_e$		(8.6 ± 0.5) %	
Γ_{15}	$\overline{K}^0\mu^+\nu_\mu$		(9.5 ± 0.8) %	
Γ_{16}	$K^-\pi^+e^+\nu_e$		$(4.5 ^{+1.0}_{-0.8})$ %	S=1.1
Γ_{17}	$\overline{K}^*(892)^0 e^+\nu_e$, $\overline{K}^*(892)^0 \to K^-\pi^+$		(3.74 ± 0.21) %	
Γ_{18}	$K^-\pi^+e^+\nu_e$ nonresonant		$< 7 \times 10^{-3}$	CL=90%
Γ_{19}	$K^-\pi^+\mu^+\nu_\mu$		(4.0 ± 0.5) %	
Γ_{20}	$\overline{K}^*(892)^0\mu^+\nu_\mu$, $\overline{K}^*(892)^0 \to K^-\pi^+$		(3.7 ± 0.3) %	
Γ_{21}	$K^-\pi^+\mu^+\nu_\mu$ nonresonant		$(2.1 \pm 0.6) \times 10^{-3}$	
Γ_{22}	$(\overline{K}^*(892)\pi)^0 e^+\nu_e$		< 1.2 %	CL=90%
Γ_{23}	$(\overline{K}\pi\pi)^0 e^+\nu_e$ non-$\overline{K}^*(892)$		$< 9 \times 10^{-3}$	CL=90%
Γ_{24}	$K^-\pi^+\pi^0\mu^+\nu_\mu$		$< 1.7 \times 10^{-3}$	CL=90%
Γ_{25}	$\pi^0 e^+\nu_e$		$(4.4 \pm 0.7) \times 10^{-3}$	
Γ_{26}	$\pi^0\ell^+\nu_\ell$	[b]		

Fractions of some of the following modes with resonances have already appeared above as submodes of particular charged-particle modes.

Γ_{27}	$\overline{K}^*(892)^0 e^+ \nu_e$		(5.61 ± 0.31) %	S=1.1
Γ_{28}	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$		$(5.5\ \pm0.5)$ %	S=1.1
Γ_{29}	$\overline{K}_1(1270)^0 \mu^+ \nu_\mu$		< 4 %	CL=95%
Γ_{30}	$\overline{K}^*(1410)^0 \mu^+ \nu_\mu$			
Γ_{31}	$\overline{K}^*_0(1430)^0 \mu^+ \nu_\mu$		$< 2.5 \times 10^{-4}$	
Γ_{32}	$\overline{K}^*_2(1430)^0 \mu^+ \nu_\mu$		< 1.1 %	CL=95%
Γ_{33}	$\overline{K}^*(1680)^0 \mu^+ \nu_\mu$		$< 1.6 \times 10^{-3}$	
Γ_{34}	$\rho^0 e^+ \nu_e$		$(2.2\ \pm0.4) \times 10^{-3}$	
Γ_{35}	$\rho^0 \mu^+ \nu_\mu$		$(3.4\ \pm0.8) \times 10^{-3}$	
Γ_{36}	$\omega e^+ \nu_e$		$(1.6\ {}^{+0.7}_{-0.6}) \times 10^{-3}$	
Γ_{37}	$\phi e^+ \nu_e$		< 2.09 %	CL=90%
Γ_{38}	$\phi \mu^+ \nu_\mu$		< 3.72 %	CL=90%
Γ_{39}	$\eta \ell^+ \nu_\ell$		$< 7 \times 10^{-3}$	CL=90%
Γ_{40}	$\eta'(958) \mu^+ \nu_\mu$		< 1.1 %	CL=90%

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

Γ_{41}	$K^0_S \pi^+$		(1.47 ± 0.06) %	S=1.1
Γ_{42}	$K^- \pi^+ \pi^+$	[c]	(9.51 ± 0.34) %	S=1.1
Γ_{43}	$\overline{K}^*_0(800)^0 \pi^+$, $\overline{K}^*_0(800) \to K^- \pi^+$	[d]		
Γ_{44}	$\overline{K}^*(892)^0 \pi^+$, $\overline{K}^*(892)^0 \to K^- \pi^+$	[d]	(1.33 ± 0.11) %	
Γ_{45}	$\overline{K}^*_0(1430)^0 \pi^+$, $\overline{K}^*_0(1430)^0 \to K^- \pi^+$	[d]	(2.41 ± 0.24) %	
Γ_{46}	$\overline{K}^*_2(1430)^0 \pi^+$, $\overline{K}^*_2(1430)^0 \to K^- \pi^+$	[d]		
Γ_{47}	$\overline{K}^*(1680)^0 \pi^+$, $\overline{K}^*(1680)^0 \to K^- \pi^+$	[d]	$(4.0\ \pm0.8) \times 10^{-3}$	
Γ_{48}	$K^- \pi^+ \pi^+$ nonresonant	[d]	$(9.0\ \pm0.7)$ %	
Γ_{49}	$K^0_S \pi^+ \pi^0$	[c]	$(7.0\ \pm0.5)$ %	S=1.2
Γ_{50}	$K^0_S \rho^+$		$(4.8\ \pm1.1)$ %	
Γ_{51}	$\overline{K}^*(892)^0 \pi^+$, $\overline{K}^*(892)^0 \to K^0_S \pi^0$		$(1.3\ \pm0.6)$ %	
Γ_{52}	$K^0_S \pi^+ \pi^0$ nonresonant		$(9\ \pm7) \times 10^{-3}$	
Γ_{53}	$K^- \pi^+ \pi^+ \pi^0$	[c]	$(6.00\ \pm0.28)$ %	S=1.1
Γ_{54}	$\overline{K}^*(892)^0 \rho^+$ total, $\overline{K}^*(892)^0 \to K^- \pi^+$		$(1.3\ \pm0.8)$ %	
Γ_{55}	$\overline{K}_1(1400)^0 \pi^+$, $\overline{K}_1(1400)^0 \to K^- \pi^+ \pi^0$		$(1.8\ \pm0.7)$ %	
Γ_{56}	$K^- \rho^+ \pi^+$ total		$(2.6\ \pm1.6)$ %	

Γ_{57}	$K^- \rho^+ \pi^+$ 3-body		$(9 \pm 6) \times 10^{-3}$	
Γ_{58}	$\overline{K}^*(892)^0 \pi^+ \pi^0$ total, $\overline{K}^*(892)^0 \to K^- \pi^+$		(4.2 ± 0.6) %	
Γ_{59}	$\overline{K}^*(892)^0 \pi^+ \pi^0$ 3-body, $\overline{K}^*(892)^0 \to K^- \pi^+$		(2.7 ± 0.8) %	
Γ_{60}	$K^*(892)^- \pi^+ \pi^+$ 3-body, $K^*(892)^- \to K^- \pi^0$		$(6 \pm 3) \times 10^{-3}$	
Γ_{61}	$K^- \pi^+ \pi^+ \pi^0$ nonresonant	[e]	(1.0 ± 0.7) %	
Γ_{62}	$K^0_S \pi^+ \pi^+ \pi^-$	[c]	(3.11 ± 0.21) %	S=1.1
Γ_{63}	$K^0_S a_1(1260)^+$, $a_1(1260)^+ \to \pi^+ \pi^+ \pi^-$		(1.8 ± 0.3) %	
Γ_{64}	$\overline{K}_1(1400)^0 \pi^+$, $\overline{K}_1(1400)^0 \to K^0_S \pi^+ \pi^-$		(1.8 ± 0.7) %	
Γ_{65}	$K^*(892)^- \pi^+ \pi^+$ 3-body, $K^*(892)^- \to K^0_S \pi^-$		(1.3 ± 0.6) %	
Γ_{66}	$K^0_S \rho^0 \pi^+$ total		(1.86 ± 0.34) %	CL=90%
Γ_{67}	$K^0_S \rho^0 \pi^+$ 3-body		$(2.2 \pm 2.2) \times 10^{-3}$	
Γ_{68}	$K^0_S \pi^+ \pi^+ \pi^-$ nonresonant		$(3.7 \pm 1.9) \times 10^{-3}$	
Γ_{69}	$K^- 3\pi^+ \pi^-$	[c]	$(5.8 \pm 0.6) \times 10^{-3}$	S=1.1
Γ_{70}	$\overline{K}^*(892)^0 \pi^+ \pi^+ \pi^-$, $\overline{K}^*(892)^0 \to K^- \pi^+$		$(1.2 \pm 0.4) \times 10^{-3}$	
Γ_{71}	$\overline{K}^*(892)^0 \rho^0 \pi^+$, $\overline{K}^*(892)^0 \to K^- \pi^+$		$(2.3 \pm 0.4) \times 10^{-3}$	
Γ_{72}	$\overline{K}^*(892)^0 \pi^+ \pi^+ \pi^-$ no-ρ, $\overline{K}^*(892)^0 \to K^- \pi^+$			
Γ_{73}	$K^- \rho^0 \pi^+ \pi^+$		$(1.75 \pm 0.29) \times 10^{-3}$	
Γ_{74}	$K^- 3\pi^+ \pi^-$ nonresonant		$(4.1 \pm 3.0) \times 10^{-4}$	
Γ_{75}	$K^+ 2K^0_S$		$(4.7 \pm 2.1) \times 10^{-3}$	
Γ_{76}	$K^+ K^- K^0_S \pi^+$		$(2.4 \pm 0.6) \times 10^{-4}$	

Fractions of some of the following modes with resonances have already appeared above as submodes of particular charged-particle modes.

Γ_{77}	$K^0_S a_1(1260)^+$		(3.6 ± 0.6) %	
Γ_{78}	$K^0_S a_2(1320)^+$		$< 1.5 \times 10^{-3}$	CL=90%
Γ_{79}	$\overline{K}^*(892)^0 \rho^+$ total	[e]	(1.8 ± 1.4) %	
Γ_{80}	$\overline{K}^*(892)^0 \rho^+$ S-wave	[e]	(1.4 ± 1.5) %	
Γ_{81}	$\overline{K}^*(892)^0 \rho^+$ P-wave		$< 1 \times 10^{-3}$	CL=90%
Γ_{82}	$\overline{K}^*(892)^0 \rho^+$ D-wave		$(8 \pm 7) \times 10^{-3}$	
Γ_{83}	$\overline{K}^*(892)^0 \rho^+$ D-wave longitudinal		$< 7 \times 10^{-3}$	CL=90%
Γ_{84}	$\overline{K}_1(1270)^0 \pi^+$		$< 7 \times 10^{-3}$	CL=90%
Γ_{85}	$\overline{K}_1(1400)^0 \pi^+$		(4.3 ± 1.5) %	S=1.2

Γ_{86}	$\overline{K}^*(1410)^0\pi^+$			
Γ_{87}	$\overline{K}^*(892)^0\pi^+\pi^0$ total		(5.8 ± 2.9) %	
Γ_{88}	$\overline{K}^*(892)^0\pi^+\pi^0$ 3-body	[e]	(3.6 ± 2.1) %	
Γ_{89}	$K^*(892)^-\pi^+\pi^+$ total		—	
Γ_{90}	$K^*(892)^-\pi^+\pi^+$ 3-body		$(1.8\ ^{+1.1}_{-0.9})$ %	S=1.2
Γ_{91}	$K^0_S f_0(980)\pi^+$			
Γ_{92}	$\overline{K}^*(892)^0 a_1(1260)^+$		$(9.4 \pm 1.9) \times 10^{-3}$	

Pionic modes

Γ_{93}	$\pi^+\pi^0$		$(1.28\pm0.09) \times 10^{-3}$	
Γ_{94}	$\pi^+\pi^+\pi^-$		$(3.31\pm0.21) \times 10^{-3}$	
Γ_{95}	$\rho^0\pi^+$		$(1.07\pm0.11) \times 10^{-3}$	
Γ_{96}	$\pi^+(\pi^+\pi^-)_{S-\text{wave}}$		$(1.86\pm0.18) \times 10^{-3}$	
Γ_{97}	$\sigma\pi^+$, $\sigma \to \pi^+\pi^-$		$(1.53\pm0.32) \times 10^{-3}$	
Γ_{98}	$f_0(980)\pi^+$, $f_0(980) \to \pi^+\pi^-$		$(2.1 \pm 0.5) \times 10^{-4}$	
Γ_{99}	$f_0(1370)\pi^+$, $f_0(1370) \to \pi^+\pi^-$		$(8 \pm 6) \times 10^{-5}$	
Γ_{100}	$f_2(1270)\pi^+$, $f_2(1270) \to \pi^+\pi^-$		$(4.8 \pm 1.3) \times 10^{-4}$	
Γ_{101}	$\rho(1450)^0\pi^+$, $\rho(1450)^0 \to \pi^+\pi^-$			
Γ_{102}	$\pi^+\pi^+\pi^-$ nonresonant			
Γ_{103}	$\pi^+ 2\pi^0$		$(4.8 \pm 0.4) \times 10^{-3}$	
Γ_{104}	$\pi^+\pi^+\pi^-\pi^0$		(1.18 ± 0.09) %	
Γ_{105}	$\eta\pi^+$, $\eta \to \pi^+\pi^-\pi^0$		$(7.9 \pm 0.7) \times 10^{-4}$	
Γ_{106}	$\omega\pi^+$, $\omega \to \pi^+\pi^-\pi^0$		$< 3 \times 10^{-4}$	CL=90%
Γ_{107}	$3\pi^+ 2\pi^-$		$(1.68\pm0.17) \times 10^{-3}$	S=1.1
Γ_{108}	$3\pi^+ 2\pi^-\pi^0$			

Fractions of some of the following modes with resonances have already appeared above as submodes of particular charged-particle modes.

Γ_{109}	$\eta\pi^+$		$(3.50\pm0.32) \times 10^{-3}$	
Γ_{110}	$\omega\pi^+$		$< 3.4 \times 10^{-4}$	CL=90%
Γ_{111}	$\eta\rho^+$		$< 7 \times 10^{-3}$	CL=90%
Γ_{112}	$\eta'(958)\pi^+$		$(5.3 \pm 1.1) \times 10^{-3}$	
Γ_{113}	$\eta'(958)\rho^+$		$< 6 \times 10^{-3}$	CL=90%

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

Γ_{114}	$K^+K^0_S$		$(2.96\pm0.19) \times 10^{-3}$	
Γ_{115}	$K^+K^-\pi^+$	[c]	(1.00 ± 0.04) %	S=1.2
Γ_{116}	$\phi\pi^+$, $\phi \to K^+K^-$		$(3.2 \pm 0.4) \times 10^{-3}$	
Γ_{117}	$K^+\overline{K}^*(892)^0$, $\overline{K}^*(892)^0 \to K^-\pi^+$		$(3.02\pm0.35) \times 10^{-3}$	

Γ_{118}	$K^+ \overline{K}^*_0(1430)^0$, $\overline{K}^*_0(1430)^0 \to K^- \pi^+$	$(3.7 \pm 0.4) \times 10^{-3}$	
Γ_{119}	$K^+ K^- \pi^+$ nonresonant		
Γ_{120}	$K^0_S K^0_S \pi^+$	—	
Γ_{121}	$K^*(892)^+ K^0_S$, $K^*(892)^+ \to K^0_S \pi^+$	$(5.3 \pm 2.3) \times 10^{-3}$	
Γ_{122}	$K^+ K^- \pi^+ \pi^0$	—	
Γ_{123}	$\phi \pi^+ \pi^0$, $\phi \to K^+ K^-$	(1.1 ± 0.5) %	
Γ_{124}	$\phi \rho^+$, $\phi \to K^+ K^-$	$< 7 \times 10^{-3}$	CL=90%
Γ_{125}	$K^+ K^- \pi^+ \pi^0$ non-ϕ	$(1.5 ^{+0.7}_{-0.6})$ %	
Γ_{126}	$K^+ K^0_S \pi^+ \pi^-$	$(1.75 \pm 0.21) \times 10^{-3}$	
Γ_{127}	$K^0_S K^- \pi^+ \pi^+$	$(2.39 \pm 0.23) \times 10^{-3}$	
Γ_{128}	$K^*(892)^+ \overline{K}^*(892)^0$, $K^{*+} \to K^0_S \pi^+$, $\overline{K}^{*0} \to K^- \pi^+$	$(5.8 \pm 2.4) \times 10^{-3}$	
Γ_{129}	$K^0_S K^- \pi^+ \pi^+$ (non-$K^{*+} \overline{K}^{*0}$)	$< 4 \times 10^{-3}$	CL=90%
Γ_{130}	$K^+ K^- \pi^+ \pi^+ \pi^-$	$(2.3 \pm 1.2) \times 10^{-4}$	

Fractions of the following modes with resonances have already appeared above as submodes of particular charged-particle modes.

Γ_{131}	$\phi \pi^+$	$(6.5 \pm 0.7) \times 10^{-3}$	
Γ_{132}	$\phi \pi^+ \pi^0$	(2.3 ± 1.0) %	
Γ_{133}	$\phi \rho^+$	< 1.5 %	CL=90%
Γ_{134}	$K^+ \overline{K}^*(892)^0$		
Γ_{135}	$K^*(892)^+ K^0_S$	(1.6 ± 0.7) %	
Γ_{136}	$K^*(892)^+ \overline{K}^*(892)^0$	(2.6 ± 1.1) %	

Doubly Cabibbo-suppressed modes

Γ_{137}	$K^+ \pi^0$	$< 4.2 \times 10^{-4}$	CL=90%
Γ_{138}	$K^+ \pi^+ \pi^-$	$(6.4 \pm 0.8) \times 10^{-4}$	
Γ_{139}	$K^+ \rho^0$	$(2.5 \pm 0.7) \times 10^{-4}$	
Γ_{140}	$K^*(892)^0 \pi^+$, $K^*(892)^0 \to K^+ \pi^-$	$(3.0 \pm 0.6) \times 10^{-4}$	
Γ_{141}	$K^+ f_0(980)$, $f_0(980) \to \pi^+ \pi^-$	$(5.7 \pm 3.5) \times 10^{-5}$	
Γ_{142}	$K^*_2(1430)^0 \pi^+$, $K^*_2(1430)^0 \to K^+ \pi^-$	$(5.2 \pm 3.5) \times 10^{-5}$	
Γ_{143}	$K^+ \pi^+ \pi^-$ nonresonant		
Γ_{144}	$K^+ K^+ K^-$	$(9.0 \pm 2.1) \times 10^{-5}$	
Γ_{145}	ϕK^+		

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

Γ_{146}	$\pi^+ e^+ e^-$	$C1$		< 7.4	$\times 10^{-6}$	CL=90%
Γ_{147}	$\pi^+ \phi$, $\phi \to e^+ e^-$		[f]	$(2.7 \, ^{+3.6}_{-1.8}) $	$\times 10^{-6}$	
Γ_{148}	$\pi^+ \mu^+ \mu^-$	$C1$		< 8.8	$\times 10^{-6}$	CL=90%
Γ_{149}	$\rho^+ \mu^+ \mu^-$	$C1$		< 5.6	$\times 10^{-4}$	CL=90%
Γ_{150}	$K^+ e^+ e^-$		[g]	< 6.2	$\times 10^{-6}$	CL=90%
Γ_{151}	$K^+ \mu^+ \mu^-$		[g]	< 9.2	$\times 10^{-6}$	CL=90%
Γ_{152}	$\pi^+ e^\pm \mu^\mp$	LF	[h]	< 3.4	$\times 10^{-5}$	CL=90%
Γ_{153}	$\pi^+ e^+ \mu^-$					
Γ_{154}	$\pi^+ e^- \mu^+$					
Γ_{155}	$K^+ e^\pm \mu^\mp$	LF	[h]	< 6.8	$\times 10^{-5}$	CL=90%
Γ_{156}	$K^+ e^+ \mu^-$					
Γ_{157}	$K^+ e^- \mu^+$					
Γ_{158}	$\pi^- e^+ e^+$	L		< 3.6	$\times 10^{-6}$	CL=90%
Γ_{159}	$\pi^- \mu^+ \mu^+$	L		< 4.8	$\times 10^{-6}$	CL=90%
Γ_{160}	$\pi^- e^+ \mu^+$	L		< 5.0	$\times 10^{-5}$	CL=90%
Γ_{161}	$\rho^- \mu^+ \mu^+$	L		< 5.6	$\times 10^{-4}$	CL=90%
Γ_{162}	$K^- e^+ e^+$	L		< 4.5	$\times 10^{-6}$	CL=90%
Γ_{163}	$K^- \mu^+ \mu^+$	L		< 1.3	$\times 10^{-5}$	CL=90%
Γ_{164}	$K^- e^+ \mu^+$	L		< 1.3	$\times 10^{-4}$	CL=90%
Γ_{165}	$K^*(892)^- \mu^+ \mu^+$	L		< 8.5	$\times 10^{-4}$	CL=90%

Γ_{166}	A dummy mode used by the fit.	(30 ± 5) %	S=1.2

[a] This is a weighted average of $D^\pm$ (44%) and D^0 (56%) branching fractions. See "D^+ and $D^0 \to$ (η anything) / (total D^+ and D^0)" under "D^+ Branching Ratios" in these Particle Listings.

[b] An ℓ indicates an e or a μ mode, not a sum over these modes.

[c] 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.

[d] These subfractions of the $K^- \pi^+ \pi^+$ mode are uncertain: see the Particle Listings.

[e] The two experiments measuring this fraction are in serious disagreement. See the Particle Listings.

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

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

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

CONSTRAINED FIT INFORMATION

An overall fit to 32 branching ratios uses 51 measurements and one constraint to determine 21 parameters. The overall fit has a $\chi^2 = 30.9$ for 31 degrees of freedom.

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

	x_{14}	x_{15}	x_{16}	x_{27}	x_{28}	x_{34}	x_{41}	x_{42}	x_{49}	x_{53}
x_{15}	3									
x_{16}	0	1								
x_{27}	1	6	14							
x_{28}	3	61	1	6						
x_{34}	0	0	1	5	0					
x_{41}	9	33	2	12	34	1				
x_{42}	8	40	2	15	40	1	84			
x_{49}	4	14	1	5	14	0	45	35		
x_{53}	1	3	0	1	3	0	9	8	8	
x_{62}	6	24	1	9	24	0	66	60	58	14
x_{69}	3	15	1	5	15	0	31	37	13	3
x_{85}	1	5	0	2	5	0	13	12	11	61
x_{90}	1	3	0	1	3	0	7	7	6	62
x_{107}	3	14	1	5	14	0	29	34	12	3
x_{109}	3	16	1	6	16	0	33	39	13	3
x_{114}	5	21	1	8	21	0	53	52	23	5
x_{115}	6	33	2	12	33	1	68	83	21	6
x_{116}	2	12	1	4	12	0	25	31	9	2
x_{131}	2	12	1	4	12	0	25	31	9	2
x_{166}	−12	−32	−19	−13	−29	−1	−35	−36	−28	−86

x_{69}	22									
x_{85}	19	4								
x_{90}	11	2	38							
x_{107}	21	78	4	2						
x_{109}	23	14	4	3	13					
x_{114}	36	19	7	4	18	20				
x_{115}	45	31	9	5	29	35	43			
x_{116}	17	11	3	2	11	43	16	33		
x_{131}	17	11	3	2	11	43	16	33	99	
x_{166}	−37	−14	−73	−66	−13	−15	−21	−28	−13	−13
	x_{62}	x_{69}	x_{85}	x_{90}	x_{107}	x_{109}	x_{114}	x_{115}	x_{116}	x_{131}

D^+ BRANCHING RATIOS

Some now-obsolete measurements have been omitted from these Listings.

— c-quark decays —

$\Gamma(c \to e^+ \text{anything})/\Gamma(c \to \text{anything})$

For the Summary Table, we only use the average of e^+ and μ^+ measurements from $Z^0 \to c\overline{c}$ decays; see the second data block below.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$0.103 \pm 0.009 ^{+0.009}_{-0.008}$	378	[3] ABBIENDI	99K	OPAL	$Z^0 \to c\overline{c}$

[3] ABBIENDI 99K uses the excess of right-sign over wrong-sign leptons opposite reconstructed $D^*(2010)^+ \to D^0\pi^+$ decays in $Z^0 \to c\overline{c}$.

$\Gamma(c \to \mu^+ \text{anything})/\Gamma(c \to \text{anything})$

For the Summary Table, we only use the average of e^+ and μ^+ measurements from $Z^0 \to c\overline{c}$ decays; see the next data block.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.082±0.005 OUR AVERAGE					
$0.073 \pm 0.008 \pm 0.002$	73	KAYIS-TOPAK...	05	CHRS	ν_μ emulsion
$0.095 \pm 0.007 ^{+0.014}_{-0.013}$	2829	ASTIER	00D	NOMD	$\nu_\mu \text{Fe} \to \mu^- \mu^+ X$
$0.090 \pm 0.007 ^{+0.007}_{-0.006}$	476	[4] ABBIENDI	99K	OPAL	$Z^0 \to c\overline{c}$
$0.086 \pm 0.017 ^{+0.008}_{-0.007}$	69	[5] ALBRECHT	92F	ARG	$e^+e^- \approx$ 10 GeV
$0.078 \pm 0.009 \pm 0.012$		ONG	88	MRK2	e^+e^- 29 GeV
$0.078 \pm 0.015 \pm 0.02$		BARTEL	87	JADE	e^+e^- 34.6 GeV
$0.082 \pm 0.012 ^{+0.02}_{-0.01}$		ALTHOFF	84G	TASS	e^+e^- 34.5 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.093 \pm 0.009 \pm 0.009$	88	KAYIS-TOPAK...	02	CHRS	See KAYIS-TOPAKSU 05
$0.089 \pm 0.018 \pm 0.025$		BARTEL	85J	JADE	See BARTEL 87

[4] ABBIENDI 99K uses the excess of right-sign over wrong-sign leptons opposite reconstructed $D^*(2010)^+ \to D^0\pi^+$ decays in $Z^0 \to c\overline{c}$.

[5] ALBRECHT 92F uses the excess of right-sign over wrong-sign leptons in a sample of events tagged by fully reconstructed $D^*(2010)^+ \to D^0\pi^+$ decays.

$\Gamma(c \to \ell^+$ anything$)/\Gamma(c \to$ anything$)$

This is an average (not a sum) of e^+ and μ^+ measurements.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.096 ±0.004 OUR AVERAGE					
0.0958±0.0042±0.0028	1828	[6] ABREU	00O	DLPH	$Z^0 \to c\overline{c}$
0.095 ±0.006 $^{+0.007}_{-0.006}$	854	[7] ABBIENDI	99K	OPAL	$Z^0 \to c\overline{c}$

[6] ABREU 00O uses leptons opposite fully reconstructed $D^*(2010)^+$, D^+, or D^0 mesons.

[7] ABBIENDI 99K uses the excess of right-sign over wrong-sign leptons opposite reconstructed $D^*(2010)^+ \to D^0\pi^+$ decays in $Z^0 \to c\overline{c}$.

$\Gamma(c \to D^*(2010)^+$ anything$)/\Gamma(c \to$ anything$)$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.255±0.015±0.008	2371	[8] ABREU	00O	DLPH	$Z^0 \to c\overline{c}$

[8] ABREU 00O uses slow pions opposite fully reconstructed $D^*(2010)^+$, D^+, or D^0 mesons as a signal of $D^*(2010)^-$ production.

Inclusive modes

$\Gamma(e^+$ anything$)/\Gamma_{total}$ — Γ_1/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.172±0.019 OUR AVERAGE					
0.20 $^{+0.09}_{-0.07}$		AGUILAR-...	87E	HYBR	πp, pp 360, 400 GeV
0.170±0.019±0.007	158	BALTRUSAIT...	85B	MRK3	e^+e^- 3.77 GeV
0.168±0.064	23	SCHINDLER	81	MRK2	e^+e^- 3.771 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.220 $^{+0.044}_{-0.022}$		BACINO	80	DLCO	e^+e^- 3.77 GeV

D^+ and $D^0 \to (e^+$ anything$)$ / (total D^+ and D^0)

If measured at the $\psi(3770)$, this quantity is a weighted average of D^+ (44%) and D^0 (56%) branching fractions. Only experiments at E_{cm} = 3.77 GeV are included in the average here. We don't put this result in the Summary Table.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.110±0.011 OUR AVERAGE		Error includes scale factor of 1.1.			
0.117±0.011	295	BALTRUSAIT...	85B	MRK3	e^+e^- 3.77 GeV
0.10 ±0.032		[9] SCHINDLER	81	MRK2	e^+e^- 3.771 GeV
0.072±0.028		FELLER	78	MRK1	e^+e^- 3.772 GeV

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

$0.096 \pm 0.004 \pm 0.011$	2207	[10] ALBRECHT	96C	ARG	$e^+e^- \approx$ 10 GeV
$0.134 \pm 0.015 \pm 0.010$		[11] ABE	93E	VNS	e^+e^- 58 GeV
$0.098 \pm 0.009 ^{+0.006}_{-0.005}$	240	[12] ALBRECHT	92F	ARG	$e^+e^- \approx$ 10 GeV
$0.096 \pm 0.007 \pm 0.015$		[13] ONG	88	MRK2	e^+e^- 29 GeV
$0.116 ^{+0.011}_{-0.009}$		[13] PAL	86	DLCO	e^+e^- 29 GeV
$0.091 \pm 0.009 \pm 0.013$		[13] AIHARA	85	TPC	e^+e^- 29 GeV
$0.092 \pm 0.022 \pm 0.040$		[13] ALTHOFF	84J	TASS	e^+e^- 34.6 GeV
0.091 ± 0.013		[13] KOOP	84	DLCO	See PAL 86
0.08 ± 0.015		[14] BACINO	79	DLCO	e^+e^- 3.772 GeV

[9] Isolates D^+ and $D^0 \rightarrow e^+ X$ and weights for relative production (44%–56%).
[10] ALBRECHT 96C uses e^- in the hemisphere opposite to $D^{*+} \rightarrow D^0 \pi^+$ events.
[11] ABE 93E also measures forward-backward asymmetries and fragmentation functions for c and b quarks.
[12] ALBRECHT 92F uses the excess of right-sign over wrong-sign leptons in a sample of events tagged by fully reconstructed $D^*(2010)^+ \rightarrow D^0 \pi^+$ decays.
[13] Average BR for charm $\rightarrow e^+ X$. Unlike at E_{cm} = 3.77 GeV, the admixture of charmed mesons is unknown.
[14] Not independent of BACINO 80 measurements of $\Gamma(e^+ \text{anything})/\Gamma_{total}$ for the D^+ and D^0 separately.

$\Gamma(K^- \text{anything})/\Gamma_{total}$ — Γ_2/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.275±0.024 OUR AVERAGE					
$0.278 ^{+0.036}_{-0.031}$		[15] BARLAG	92C	ACCM	π^- Cu 230 GeV
$0.271 \pm 0.023 \pm 0.024$		COFFMAN	91	MRK3	e^+e^- 3.77 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.17 ± 0.07		AGUILAR-...	87E	HYBR	πp, $p p$ 360, 400 GeV
$0.16 ^{+0.08}_{-0.07}$		AGUILAR-...	86B	HYBR	See AGUILAR-BENITEZ 87E
0.19 ± 0.05	26	SCHINDLER	81	MRK2	e^+e^- 3.771 GeV
0.10 ± 0.07	3	VUILLEMIN	78	MRK1	e^+e^- 3.772 GeV

[15] BARLAG 92C computes the branching fraction using topological normalization.

$[\Gamma(\overline{K}^0 \text{anything}) + \Gamma(K^0 \text{anything})]/\Gamma_{total}$ — Γ_3/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.612±0.065±0.043		COFFMAN	91	MRK3	e^+e^- 3.77 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.52 ± 0.18	15	SCHINDLER	81	MRK2	e^+e^- 3.771 GeV
0.39 ± 0.29	3	VUILLEMIN	78	MRK1	e^+e^- 3.772 GeV

$\Gamma(K^+ \text{anything})/\Gamma_{total}$ — Γ_4/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.055±0.013±0.009		COFFMAN	91	MRK3	e^+e^- 3.77 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.08 ^{+0.06}_{-0.05}$		AGUILAR-...	87E	HYBR	πp, $p p$ 360, 400 GeV
0.06 ± 0.04	12	SCHINDLER	81	MRK2	e^+e^- 3.771 GeV
0.06 ± 0.06	2	VUILLEMIN	78	MRK1	e^+e^- 3.772 GeV

$\Gamma(\overline{K}^*(892)^0 \text{ anything})/\Gamma_{\text{total}}$ — Γ_5/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.232±0.045±0.030	189 ± 36	ABLIKIM	05P	BES	$e^+ e^- \approx$ 3773 MeV

$\Gamma(K^*(892)^0 \text{ anything})/\Gamma_{\text{total}}$ — Γ_6/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.066	90	ABLIKIM	05P	BES	$e^+ e^- \approx$ 3773 MeV

D^+ and $D^0 \rightarrow$ (η anything) / (total D^+ and D^0)

If measured at the $\psi(3770)$, this quantity is a weighted average of D^+ (44%) and D^0 (56%) branching fractions. Only the experiment at E_{cm} = 3.77 GeV is used.

VALUE	DOCUMENT ID		TECN	COMMENT
<0.13	PARTRIDGE	81	CBAL	$e^+ e^-$ 3.77 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.02	[16] BRANDELIK	79	DASP	$e^+ e^-$ 4.03 GeV

[16] The BRANDELIK 79 result is based on the absence of an η signal at E_{cm} = 4.03 GeV. PARTRIDGE 81 observes a substantially higher η cross section at 4.03 GeV.

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.018	90	[17] BAI	00C	BES	$e^+ e^- \rightarrow D\overline{D}^*, D^*\overline{D}^*$

[17] BAI 00C finds the average (ϕ anything) branching fraction for the 4.03-GeV mix of D^+ and D^0 mesons to be (1.34 ± 0.52 ± 0.12)%.

$\Gamma(\phi e^+ \text{ anything})/\Gamma_{\text{total}}$ — Γ_9/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.016	90	BAI	00C	BES	$e^+ e^- \rightarrow D\overline{D}^*, D^*\overline{D}^*$

Leptonic and semileptonic modes

$\Gamma(e^+ \nu_e)/\Gamma_{\text{total}}$ — Γ_{11}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.4 \times 10^{-5}$	90	ARTUSO	05A	CLEO	$e^+ e^-$ at $\psi(3770)$

$\Gamma(\mu^+ \nu_\mu)/\Gamma_{\text{total}}$ — Γ_{12}/Γ

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

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
$4.40 \pm 0.66^{+0.09}_{-0.12}$	47 ± 7	[18] ARTUSO	05A	CLEO	$e^+ e^-$ at $\psi(3770)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$12.2 ^{+11.1}_{-5.3} \pm 1.0$	3	[19] ABLIKIM	05D	BES	$e^+ e^- \approx$ 3.773 GeV
$3.5 \pm 1.4 \pm 0.6$	7	[20] BONVICINI	04A	CLEO	Incl. in ARTUSO 05A
$8 ^{+16}_{-5} {}^{+5}_{-2}$	1	[21] BAI	98B	BES	$e^+ e^- \rightarrow D^{*+} D^-$

[18] ARTUSO 05A obtains $f_{D^+} = 222.6 \pm 16.7^{+2.8}_{-3.4}$ MeV from this measurement.

[19] ABLIKIM 05D finds a background-subtracted 2.67 ± 1.74 $D^+ \rightarrow \mu^+ \nu_\mu$ events, and from this obtains $f_{D^+} = 371^{+129}_{-119} \pm 25$ MeV.

[20] BONVICINI 04A finds eight events with an estimated background of one, and from the branching fraction obtains $f_{D^+} = 202 \pm 41 \pm 17$ MeV.

[21] BAI 98B obtains $f_{D^+} = (300^{+180}_{-150}{}^{+80}_{-40})$ MeV from this measurement.

$\Gamma(\overline{K}^0 e^+ \nu_e)/\Gamma_{\text{total}}$ — Γ_{14}/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.086 ±0.005 OUR FIT				
0.087 ±0.005 OUR AVERAGE				
0.0895±0.0159±0.0067	34 ± 6	[22] ABLIKIM 05A	BES	e^+e^- at $\psi(3770)$
0.0871±0.0038±0.0037	545 ± 24	[23] HUANG 05B	CLEO	e^+e^- at $\psi(3770)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.06\ {}^{+0.022}_{-0.013} \pm 0.007$	13	BAI 91	MRK3	$e^+e^- \approx$ 3.77 GeV

[22] The ABLIKIM 05A result together with the $D^0 \rightarrow K^- e^+ \nu_e$ branching fraction of ABLIKIM 04C and Particle Data Group lifetimes gives $\Gamma(D^0 \rightarrow K^- e^+ \nu_e)$ / $\Gamma(D^+ \rightarrow \overline{K}^0 e^+ \nu_e) = 1.08 \pm 0.22 \pm 0.07$; isospin invariance predicts the ratio is 1.0.

[23] HUANG 05B finds $\Gamma(D^0 \rightarrow K^- e^+ \nu_e)$ / $\Gamma(D^+ \rightarrow \overline{K}^0 e^+ \nu_e) = 1.00 \pm 0.05 \pm 0.04$; isospin invariance predicts the ratio is 1.0.

$\Gamma(\overline{K}^0 e^+ \nu_e)/\Gamma(K^0_S \pi^+)$ — Γ_{14}/Γ_{41}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
5.8 ±0.4 OUR FIT				
5.20±0.70±0.52	186	[24] BEAN 93C	CLE2	$e^+e^- \approx \Upsilon(4S)$

[24] BEAN 93C uses $\overline{K}^0 \mu^+ \nu_\mu$ as well as $\overline{K}^0 e^+ \nu_e$ events and makes a small phase-space adjustment to the number of the μ^+ events to use them as e^+ events. The value given is twice that in BEAN 93C because we are using $K^0_S \pi^+$ and not $\overline{K}^0 \pi^+$, in the denominator.

$\Gamma(\overline{K}^0 e^+ \nu_e)/\Gamma(K^- \pi^+ \pi^+)$ — Γ_{14}/Γ_{42}

VALUE	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.66±0.09±0.14	ANJOS 91C	E691	γ Be 80–240 GeV

$\Gamma(\overline{K}^0 \mu^+ \nu_\mu)/\Gamma_{\text{total}}$ — Γ_{15}/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.07^{+0.028}_{-0.016} \pm 0.012$	14	BAI 91	MRK3	$e^+e^- \approx$ 3.77 GeV

$\Gamma(\overline{K}^0 \mu^+ \nu_\mu)/\Gamma(K^- \pi^+ \pi^+)$ — Γ_{15}/Γ_{42}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
1.00 ±0.08 OUR FIT				
1.019±0.076±0.065	555 ± 39	LINK 04E	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(\overline{K}^0 \mu^+ \nu_\mu)/\Gamma(\mu^+ \text{anything})$ — Γ_{15}/Γ_{10}

VALUE	EVTS	DOCUMENT ID		COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.76 ± 0.06	84	[25] AOKI	88	π^- emulsion

[25] From topological branching ratios in emulsion with an identified muon.

$\Gamma(K^- \pi^+ e^+ \nu_e)/\Gamma_{\text{total}}$ — Γ_{16}/Γ

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.045^{+0.010}_{-0.008}}$ **OUR FIT** Error includes scale factor of 1.1.						
$\mathbf{0.035^{+0.012}_{-0.007} \pm 0.004}$		14	[26] BAI	91	MRK3	$e^+ e^- \approx$ 3.77 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.057	90		[27] AGUILAR-...	87F	HYBR	πp, $p p$ 360, 400 GeV

[26] BAI 91 finds that a fraction $0.79^{+0.15}_{-0.17}{}^{+0.09}_{-0.03}$ of combined D^+ and D^0 decays to $\overline{K} \pi e^+ \nu_e$ (24 events) are $\overline{K}^*(892) e^+ \nu_e$.

[27] AGUILAR-BENITEZ 87F computes the branching fraction using topological normalization.

$\Gamma(\overline{K}^*(892)^0 e^+ \nu_e)/\Gamma_{\text{total}}$ — Γ_{27}/Γ

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0561±0.0031 OUR FIT Error includes scale factor of 1.1.					
0.0556±0.0027±0.0023	422 ± 21	[28] HUANG	05B	CLEO	$e^+ e^-$ at $\psi(3770)$

[28] HUANG 05B finds $\Gamma(D^0 \to K^{*-} e^+ \nu_e)$ / $\Gamma(D^+ \to \overline{K}^{*0} e^+ \nu_e) = 0.98 \pm 0.08 \pm 0.04$; isospin invariance predicts the ratio is 1.0.

$\Gamma(\overline{K}^*(892)^0 e^+ \nu_e)/\Gamma(K^- \pi^+ e^+ \nu_e)$ — Γ_{27}/Γ_{16}

Unseen decay modes of the $\overline{K}^*(892)^0$ are included. See the end of the D^+ Listings for measurements of $D^+ \to \overline{K}^*(892)^0 \ell^+ \nu_\ell$ form-factor ratios.

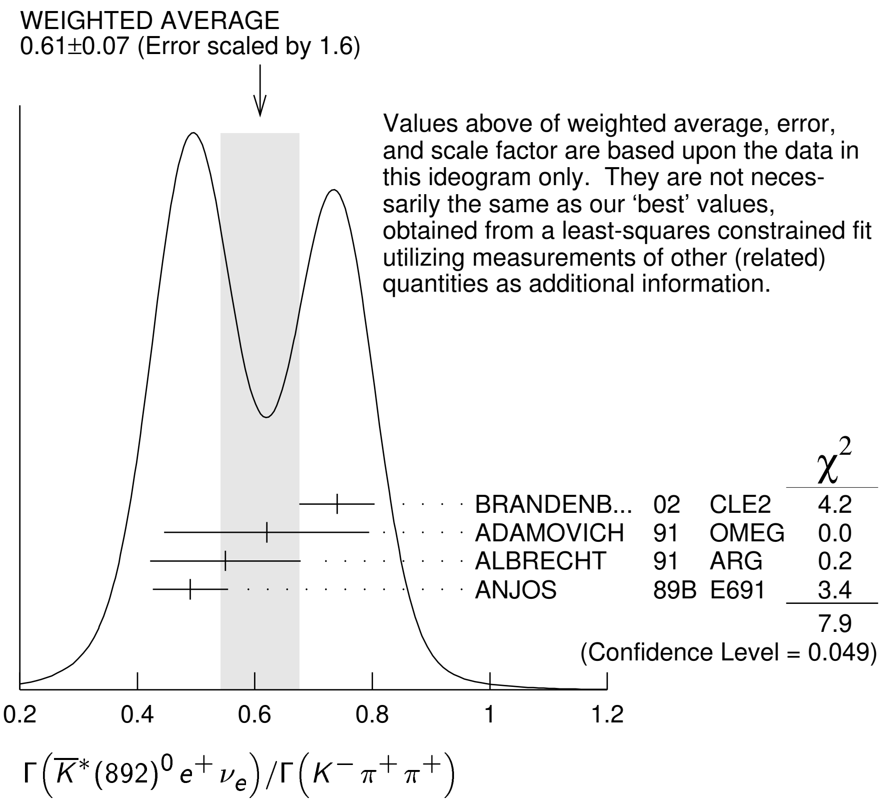
VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{1.23^{+0.23}_{-0.26}}$ **OUR FIT** Error includes scale factor of 1.2.					
1.0 ±0.3	35	ADAMOVICH	91	OMEG	π^- 340 GeV

$\Gamma(\overline{K}^*(892)^0 e^+ \nu_e)/\Gamma(K^- \pi^+ \pi^+)$ — Γ_{27}/Γ_{42}

Unseen decay modes of the $\overline{K}^*(892)^0$ are included. See the end of the D^+ Listings for measurements of $D^+ \to \overline{K}^*(892)^0 \ell^+ \nu_\ell$ form-factor ratios.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.590±0.035 OUR FIT Error includes scale factor of 1.2.					
0.61 ±0.07 OUR AVERAGE Error includes scale factor of 1.6. See the ideogram below.					
$0.74 \pm 0.04 \pm 0.05$		BRANDENB...	02	CLE2	$e^+ e^- \approx \Upsilon(4S)$
$0.62 \pm 0.15 \pm 0.09$	35	ADAMOVICH	91	OMEG	π^- 340 GeV
$0.55 \pm 0.08 \pm 0.10$	880	ALBRECHT	91	ARG	$e^+ e^- \approx$ 10.4 GeV
$0.49 \pm 0.04 \pm 0.05$		ANJOS	89B	E691	Photoproduction
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.67 \pm 0.09 \pm 0.07$	710	[29] BEAN	93C	CLE2	See BRANDENBURG 02

[29] BEAN 93C uses $\overline{K}^{*0}\mu^+\nu_\mu$ as well as $\overline{K}^{*0}e^+\nu_e$ events and makes a small phase-space adjustment to the number of the μ^+ events to use them as e^+ events.



$\Gamma\left(K^-\pi^+e^+\nu_e \text{ nonresonant}\right)/\Gamma_{\text{total}}$ Γ_{18}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.007	90	[30] ANJOS	89B	E691	Photoproduction

[30] ANJOS 89B assumes a $\Gamma(D^+ \to K^-\pi^+\pi^+)/\Gamma_{\text{total}} = 9.1 \pm 1.3 \pm 0.4\%$.

$\Gamma\left(K^-\pi^+\mu^+\nu_\mu\right)/\Gamma\left(\overline{K}^0\mu^+\nu_\mu\right)$ Γ_{19}/Γ_{15}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.417±0.030±0.023	555 ± 39	LINK	04E	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma\left(\overline{K}^*(892)^0\mu^+\nu_\mu\right)/\Gamma_{\text{total}}$ Γ_{28}/Γ

Unseen decay modes of the $\overline{K}^*(892)^0$ are included. See the end of the D^+ Listings for measurements of $D^+ \to \overline{K}^*(892)^0\ell^+\nu_\ell$ form-factor ratios.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.0325±0.0071±0.0075	224	[31] KODAMA	92C	E653	π^- emulsion 600 GeV

[31] KODAMA 92C measures $\Gamma(D^+ \to \overline{K}^{*0}\mu^+\nu_\mu)/\Gamma(D^0 \to K^-\mu^+\nu_\mu) = 0.43 \pm 0.09 \pm 0.09$ and then uses $\Gamma(D^0 \to K^-\mu^+\nu_\mu) = (7.0 \pm 0.7) \times 10^{10}\ \text{s}^{-1}$ to get the quoted branching fraction. See also the footnote to KODAMA 92C in the second data block below.

$\Gamma\big(\overline{K}^*(892)^0\mu^+\nu_\mu\big)/\Gamma\big(\overline{K}^0\mu^+\nu_\mu\big)$ — Γ_{28}/Γ_{15}

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.58 ±0.05 OUR FIT					
0.594±0.043±0.033	555 ± 39	LINK	04E	FOCS	γ nucleus, $\overline{E}_\gamma\approx$ 180 GeV

$\Gamma\big(\overline{K}^*(892)^0\mu^+\nu_\mu\big)/\Gamma\big(K^-\pi^+\pi^+\big)$ — Γ_{28}/Γ_{42}

Unseen decay modes of the $\overline{K}^*(892)^0$ are included. See the end of the D^+ Listings for measurements of $D^+\to\ \overline{K}^*(892)^0\ell^+\nu_\ell$ form-factor ratios.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.58 ±0.05 OUR FIT Error includes scale factor of 1.1.					
0.57 ±0.06 OUR AVERAGE Error includes scale factor of 1.2.					
0.72 ±0.10 ±0.05		BRANDENB...	02	CLE2	$e^+e^-\approx\ \Upsilon(4S)$
0.56 ±0.04 ±0.06	875	FRABETTI	93E	E687	γBe $\overline{E}_\gamma\approx$ 200 GeV
0.46 ±0.07 ±0.08	224	[32] KODAMA	92C	E653	π^- emulsion 600 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.602±0.010±0.021	12k	[33] LINK	02J	FOCS	γ nucleus, $\approx$ 180 GeV

[32] KODAMA 92C also uses the same $\overline{K}^{*0}\mu^+\nu_\mu$ events normalizing instead with $D^0\to K^-\mu^+\nu_\mu$ events, as reported in the second data block above.

[33] This LINK 02J result includes the effects of an interference of a small S-wave $K^-\pi^+$ amplitude with the dominant $\overline{K}^{*0}$ amplitude. (The interference effect is reported in LINK 02E.) This result is redundant with results of LINK 04E elsewhere in these Listings.

$\Gamma\big(K^-\pi^+\mu^+\nu_\mu$ nonresonant$\big)/\Gamma\big(K^-\pi^+\mu^+\nu_\mu\big)$ — Γ_{21}/Γ_{19}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$0.0530\pm0.0074^{+0.0099}_{-0.0096}$	14k	LINK	05I	FOCS	γ nucleus, $\overline{E}_\gamma\approx$ 180 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.083 ±0.029		FRABETTI	93E	E687	$<$ 0.12 (90% CL)

$\Gamma\big((\overline{K}^*(892)\pi)^0e^+\nu_e\big)/\Gamma_{\text{total}}$ — Γ_{22}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.012	90	ANJOS	92	E691	Photoproduction

$\Gamma\big((\overline{K}\pi\pi)^0e^+\nu_e$ non-$\overline{K}^*(892)\big)/\Gamma_{\text{total}}$ — Γ_{23}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.009	90	ANJOS	92	E691	Photoproduction

$\Gamma\big(K^-\pi^+\pi^0\mu^+\nu_\mu\big)/\Gamma\big(K^-\pi^+\mu^+\nu_\mu\big)$ — Γ_{24}/Γ_{19}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.042	90	FRABETTI	93E	E687	γBe $\overline{E}_\gamma\approx$ 200 GeV

$\Gamma\big(\overline{K}_1(1270)^0\mu^+\nu_\mu\big)/\Gamma\big(\overline{K}^*(892)^0\mu^+\nu_\mu\big)$ — Γ_{29}/Γ_{28}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.78	95	ABE	99P	CDF	$\overline{p}p$ 1.8 TeV

$\Gamma\big(\overline{K}^*(1410)^0 \mu^+ \nu_\mu\big)/\Gamma\big(\overline{K}^*(892)^0 \mu^+ \nu_\mu\big)$ — Γ_{30}/Γ_{28}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.60	95	ABE	99P	CDF	$\overline{p}p$ 1.8 TeV

$\Gamma\big(\overline{K}_0^*(1430)^0 \mu^+ \nu_\mu\big)/\Gamma\big(K^- \pi^+ \mu^+ \nu_\mu\big)$ — Γ_{31}/Γ_{19}

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
<0.0064	90	LINK	05I	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma\big(\overline{K}_2^*(1430)^0 \mu^+ \nu_\mu\big)/\Gamma\big(\overline{K}^*(892)^0 \mu^+ \nu_\mu\big)$ — Γ_{32}/Γ_{28}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.19	95	ABE	99P	CDF	$\overline{p}p$ 1.8 TeV

$\Gamma\big(\overline{K}^*(1680)^0 \mu^+ \nu_\mu\big)/\Gamma\big(K^- \pi^+ \mu^+ \nu_\mu\big)$ — Γ_{33}/Γ_{19}

Unseen decay modes of the $\overline{K}^*(1680)^0$ are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
<0.04	90	LINK	05I	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma\big(\pi^0 e^+ \nu_e\big)/\Gamma_{\text{total}}$ — Γ_{25}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0044±0.0006±0.0003	63 ± 9	[34] HUANG	05B	CLEO	$e^+ e^-$ at $\psi(3770)$

[34] HUANG 05B finds $\Gamma(D^0 \to \pi^- e^+ \nu_e)$ / 2 $\Gamma(D^+ \to \pi^0 e^+ \nu_e) = 0.75^{+0.14}_{-0.11} \pm 0.04$; isospin invariance predicts the ratio is 1.0.

$\Gamma\big(\pi^0 \ell^+ \nu_\ell\big)/\Gamma\big(\overline{K}^0 \ell^+ \nu_\ell\big)$ — Γ_{26}/Γ_{13}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.046±0.014±0.017	100	[35] BARTELT	97	CLE2	$e^+ e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.085±0.027±0.014	53	[36] ALAM	93	CLE2	See BARTELT 97

[35] BARTELT 97 thus directly measures the product of ratios squared of CKM matrix elements and form factors at q^2=0: $|V_{cd}/V_{cs}|^2 \cdot |f_+^\pi(0)/f_+^K(0)|^2 = 0.046 \pm 0.014 \pm 0.017$.

[36] ALAM 93 thus directly measures the product of ratios squared of CKM matrix elements and form factors at q^2=0: $|V_{cd}/V_{cs}|^2 \cdot |f_+^\pi(0)/f_+^K(0)|^2 = 0.085 \pm 0.027 \pm 0.014$.

$\Gamma\big(\rho^0 e^+ \nu_e\big)/\Gamma_{\text{total}}$ — Γ_{34}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0022±0.0004 OUR FIT					
0.0021±0.0004±0.0001	27 ± 6	[37] HUANG	05B	CLEO	$e^+ e^-$ at $\psi(3770)$

[37] HUANG 05B finds $\Gamma(D^0 \to \rho^- e^+ \nu_e)$ / 2 $\Gamma(D^+ \to \rho^0 e^+ \nu_e) = 1.2^{+0.4}_{-0.3} \pm 0.1$; isospin invariance predicts the ratio is 1.0.

$\Gamma\big(\rho^0 e^+ \nu_e\big)/\Gamma\big(\overline{K}^*(892)^0 e^+ \nu_e\big)$ — Γ_{34}/Γ_{27}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.039±0.007 OUR FIT					
0.045±0.014±0.009	49	[38] AITALA	97	E791	π^- nucleus, 500 GeV

[38] AITALA 97 explicitly subtracts $D^+ \to \eta' e^+ \nu_e$ and other backgrounds to get this result.

$\Gamma(\rho^0 \mu^+ \nu_\mu)/\Gamma(\overline{K}^*(892)^0 \mu^+ \nu_\mu)$ — Γ_{35}/Γ_{28}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.061±0.014 OUR AVERAGE					
0.051±0.015±0.009	54	[39] AITALA	97	E791	π^- nucleus, 500 GeV
0.079±0.019±0.013	39	[40] FRABETTI	97	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.044^{+0.031}_{-0.025}\pm0.014$	4	[41] KODAMA	93C	E653	π^- emulsion 600 GeV

[39] AITALA 97 explicitly subtracts $D^+ \to \eta' \mu^+ \nu_\mu$ and other backgrounds to get this result.

[40] Because the reconstruction efficiency for photons is low, this FRABETTI 97 result also includes any $D^+ \to \eta' \mu^+ \nu_\mu \to \gamma \rho^0 \mu^+ \nu_\mu$ events in the numerator.

[41] This KODAMA 93C result is based on a final signal of $4.0^{+2.8}_{-2.3}\pm1.3$ events; the estimates of backgrounds that affect this number are somewhat model dependent.

$\Gamma(\omega e^+ \nu_e)/\Gamma_{total}$ — Γ_{36}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.0016^{+0.0007}_{-0.0006}\pm0.0001}$	$7.6^{+3.3}_{-2.7}$	HUANG	05B	CLEO	$e^+ e^-$ at $\psi(3770)$

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

Decay modes of the ϕ not included in the search are corrected for.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.0209	90	BAI	91	MRK3	$e^+ e^- \approx$ 3.77 GeV

$\Gamma(\phi \mu^+ \nu_\mu)/\Gamma_{total}$ — Γ_{38}/Γ

Decay modes of the ϕ not included in the search are corrected for.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.0372	90	BAI	91	MRK3	$e^+ e^- \approx$ 3.77 GeV

$\Gamma(\eta \ell^+ \nu_\ell)/\Gamma(\pi^0 \ell^+ \nu_\ell)$ — Γ_{39}/Γ_{26}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.5	90	BARTELT	97	CLE2	$e^+ e^- \approx \Upsilon(4S)$

$\Gamma(\eta'(958) \mu^+ \nu_\mu)/\Gamma(\overline{K}^*(892)^0 \mu^+ \nu_\mu)$ — Γ_{40}/Γ_{28}

Decay modes of the $\eta'(958)$ not included in the search are corrected for.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.20	90	KODAMA	93B	E653	π^- emulsion 600 GeV

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

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0147±0.0006 OUR FIT	Error includes scale factor of 1.1.				
0.0155±0.0005±0.0006	2230 ± 60	[42] HE	05	CLEO	$e^+ e^-$ at $\psi(3770)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.016 ±0.003 ±0.001	161	ADLER	88C	MRK3	$e^+ e^-$ 3.77 GeV
0.017 ±0.004	36	[43] SCHINDLER	81	MRK2	$e^+ e^-$ 3.771 GeV
0.017 ±0.006	17	[44] PERUZZI	77	MRK1	$e^+ e^-$ 3.77 GeV

[42] HE 05 uses single- and double-tagged events in an overall fit. The fraction here includes (unobserved) final-state photons.

[43] SCHINDLER 81 (MARK-2) measures $\sigma(e^+e^- \to \psi(3770)) \times$ branching fraction to be 0.14 ± 0.03 nb. We use the MARK-3 (ADLER 88C) value of $\sigma = 4.2 \pm 0.6 \pm 0.3$ nb.

[44] PERUZZI 77 (MARK-1) measures $\sigma(e^+e^- \to \psi(3770)) \times$ branching fraction to be 0.14 ± 0.05 nb. We use the MARK-3 (ADLER 88C) value of $\sigma = 4.2 \pm 0.6 \pm 0.3$ nb.

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.1548±0.0032 OUR FIT Error includes scale factor of 1.3.					
0.1533±0.0027 OUR AVERAGE					
0.1530±0.0023±0.0016	10.6k	LINK	02B	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV
0.174 ±0.012 ±0.011	473	[45] BISHAI	97	CLE2	$e^+e^- \approx \Upsilon(4S)$
0.137 ±0.015 ±0.016	264	ANJOS	90C	E691	Photoproduction

[45] See BISHAI 97 for an isospin analysis of $D^+ \to \overline{K}\pi$ amplitudes.

$\Gamma(K^-\pi^+\pi^+)/\Gamma_{\text{total}}$ — Γ_{42}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0951±0.0034 OUR FIT Error includes scale factor of 1.1.					
0.0945±0.0033 OUR AVERAGE					
0.095 ±0.002 ±0.003	15.1k±130	[46] HE	05	CLEO	e^+e^- at $\psi(3770)$
0.093 ±0.006 ±0.008	1502	[47] BALEST	94	CLE2	$e^+e^- \approx \Upsilon(4S)$
0.091 ±0.013 ±0.004	1164	ADLER	88C	MRK3	e^+e^- 3.77 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.064 $^{+0.015}_{-0.014}$		[48] BARLAG	92C	ACCM	π^- Cu 230 GeV
0.063 $^{+0.028}_{-0.014}$ ±0.011	8	[48] AGUILAR-...	87F	HYBR	πp, pp 360, 400 GeV
0.091 ±0.019	239	[49] SCHINDLER	81	MRK2	e^+e^- 3.771 GeV
0.086 ±0.020	85	[50] PERUZZI	77	MRK1	e^+e^- 3.77 GeV

[46] HE 05 uses single- and double-tagged events in an overall fit. The fraction here includes (unobserved) final-state photons.

[47] BALEST 94 measures the ratio of $D^+ \to K^-\pi^+\pi^+$ and $D^0 \to K^-\pi^+$ branching fractions to be $2.35 \pm 0.16 \pm 0.16$ and uses their absolute measurement of the $D^0 \to K^-\pi^+$ fraction (AKERIB 93).

[48] AGUILAR-BENITEZ 87F and BARLAG 92C compute the branching fraction by topological normalization.

[49] SCHINDLER 81 (MARK-2) measures $\sigma(e^+e^- \to \psi(3770)) \times$ branching fraction to be 0.38 ± 0.05 nb. We use the MARK-3 (ADLER 88C) value of $\sigma = 4.2 \pm 0.6 \pm 0.3$ nb.

[50] PERUZZI 77 (MARK-1) measures $\sigma(e^+e^- \to \psi(3770)) \times$ branching fraction to be 0.36 ± 0.06 nb. We use the MARK-3 (ADLER 88C) value of $\sigma = 4.2 \pm 0.6 \pm 0.3$ nb.

DALITZ PLOT ANALYSIS FORMALISM

Written January 2006 by D. Asner (Carleton University)

Introduction: Weak nonleptonic decays of D and B mesons are expected to proceed dominantly through resonant two-body decays [1]; see Ref. [2] for a review of resonance phenomenology.

The amplitudes are typically calculated with the Dalitz-plot analysis technique [3], which uses the minimum number of independent observable quantities. For three-body decays of a spin-0 particle to all pseudo-scalar final states, D or $B \to abc$, the decay rate [4] is

$$\Gamma = \frac{1}{(2\pi)^3 32\sqrt{s^3}} \left|\mathcal{M}\right|^2 dm_{ab}^2 \, dm_{bc}^2 \,, \tag{1}$$

where m_{ij} is the invariant mass of particles i and j. The coefficient of the amplitude includes all kinematic factors, and $\left|\mathcal{M}\right|^2$ contains the dynamics. The scatter plot in m_{ab}^2 versus m_{bc}^2 is the Dalitz plot. If $\left|\mathcal{M}\right|^2$ is constant, the kinematically allowed region of the plot will be populated uniformly with events. Any variation in the population over the Dalitz plot is due to dynamical rather than kinematical effects. It is straightforward to extend the formalism beyond three-body final states. For N-body final states with only spin-0 particles, phase space has dimension $3N-7$. Other decays of interest include one vector particle or a fermion/anti-fermion pair (*e.g.*, $B \to D^*\pi\pi$, $B \to \overline{\Lambda}_c p\pi$, $B \to K\ell\ell$) in the final state. For the first case, phase space has dimension $3N-5$, and for the latter two the dimension is $3N-4$.

Formalism: The amplitude for the process, $R \to rc, r \to ab$ where R is a D or B, r is an intermediate resonance, and a, b, c are pseudo-scalars, is given by

$$\begin{aligned}\mathcal{M}_r(J,L,l,m_{ab},m_{bc}) &= \sum_\lambda \langle ab|r_\lambda\rangle \, T_r(m_{ab}) \, \langle cr_\lambda|R_J\rangle \qquad (2)\\ &= Z(J,L,l,\vec{p},\vec{q}) B_L^R(|\vec{p}|) B_L^r(|\vec{q}|) T_r(m_{ab}) \,.\end{aligned}$$

The sum is over the helicity states λ of r, J is the total angular momentum of R (for D and B decays, J=0), L is the orbital angular momentum between r and c, l is the orbital angular momentum between a and b (the spin of r), $\vec{p}$ and $\vec{q}$ are the momenta of c and of a in the r rest frame, Z describes the angular distribution of the final-state particles, B_L^R and B_L^r are the barrier factors for the production of rc and of ab, and T_r is the dynamical function describing the resonance r. The amplitude for modeling the Dalitz plot is a phenomenological object. Differences in the parametrizations of Z, B_L, and T_r, as well as in the set of resonances r, complicate the comparison of results from different experiments.

Usually the resonances are modeled with a Breit-Wigner form, although some more recent analyses use a K-matrix formalism [5,6,7] with the P-vector approximation [8] to describe the $\pi\pi$ S-wave.

The nonresonant (NR) contribution to $D \to abc$ is parametrized as constant (S-wave) with no variation in magnitude or phase across the Dalitz plot. The available phase space is much greater for B decays, and the nonresonant contribution to $B \to abc$ requires a more sophisticated parametrization. Theoretical models of the NR amplitude [9-12] do not reproduce the distributions observed in the data. Experimentally, several parametrizations have been used [13,14].

Barrier Factor B_L: The maximum angular momentum L in a strong decay is limited by the linear momentum q. Decay particles moving slowly with an impact parameter (meson radius) d of order 1 fm have difficulty generating sufficient angular momentum to conserve the spin of the resonance. The Blatt-Weisskopf [15,16] functions B_L, given in Table 1, weight the reaction amplitudes to account for this spin-dependent effect. These functions are normalized to give $B_L = 1$ for $z = (|q|\, d)^2 = 1$. Another common formulation, B'_L, also in

Table 1, is normalized to give $B'_L = 1$ for $z = z_0 = (|q_0|\, d)^2$ where q_0 is the value of q when $m_{ab} = m_r$.

Table 1: Blatt-Weisskopf barrier factors.

L	$B_L(q)$	$B'_L(q, q_0)$
0	1	1
1	$\sqrt{\frac{2z}{1+z}}$	$\sqrt{\frac{1+z_0}{1+z}}$
2	$\sqrt{\frac{13z^2}{(z-3)^2+9z}}$	$\sqrt{\frac{(z_0-3)^2+9z_0}{(z-3)^2+9z}}$
where $z = (\|q\|\, d)^2$ and $z_0 = (\|q_0\|\, d)^2$		

Angular distribution: The tensor or Zemach formalism [17,18] and the helicity formalism [19,18] yield identical descriptions of the angular distributions for the decay process $R \to rc, r \to ab$ when a, b and c all have spin-0. The angular distributions for $L = 0, 1,$ and 2 are given in Table 2. For final-state particles with non-zero spin (*e.g.*, radiative decays), the helicity formalism is required.

Dynamical Function T_r: The dynamical function T_r is derived from the S-matrix formalism. In general, the amplitude that a final state f couples to an initial state i is $S_{fi} = \langle f|S|i\rangle$, where the scattering operator S is unitary and satisfies $SS^\dagger = S^\dagger S = I$. The Lorentz-invariant transition operator $\hat{T}$ is defined by separating the probability that $f = i$, yielding

$$S = I + 2iT = I + 2i\, \{\rho\}^{1/2}\, \hat{T}\, \{\rho\}^{1/2}\,, \tag{3}$$

Table 2: Angular distributions for $L = 0, 1, 2$ where θ is the angle between particles a and c in the rest frame of resonance r, $\sqrt{1+\zeta^2} = E_r/m_{ab}$ is a relativistic correction, and $E_r = (m_R^2 + m_{ab}^2 - m_c^2)/2m_R$.

$J \to L + l$	Angular distribution
$0 \to 0+0$	uniform
$0 \to 1+1$	$(1+\zeta^2)\cos^2\theta$
$0 \to 2+2$	$\left(\zeta^2+\frac{3}{2}\right)^2 (\cos^2\theta - 1/3)^2$

where I is the identity operator, ρ is the diagonal phase-space matrix, with $\rho_{ii} = 2q_i/m$, and q_i is the momentum of a in the r rest frame for decay channel i. In the single-channel S-wave case, $S = e^{2i\delta}$ satisfies unitarity and

$$\hat{T} = \frac{1}{\rho}\, e^{i\delta} \sin\delta. \tag{4}$$

There are three common formulations of the dynamical function. The Breit-Wigner formalism—the first term in a Taylor expansion about a T-matrix pole—is the simplest formulation. The K-matrix formalism [5] is more general (allowing more than one T-matrix pole and coupled channels while preserving unitarity). The Flatté distribution [20] is used to parametrize resonances near threshold and is equivalent to a one-pole, two-channel K-matrix.

Breit-Wigner Formulation: The common formulation of a Breit-Wigner resonance decaying to spin-0 particles a and b is

$$T_r(m_{ab}) = \frac{1}{m_r^2 - m_{ab}^2 - i m_r \Gamma_{ab}(q)}\,. \tag{5}$$

The "mass-dependent" width Γ is

$$\Gamma = \Gamma_r \left(\frac{q}{q_r}\right)^{2L+1} \left(\frac{m_r}{m_{ab}}\right) B'_L(q,q_0)^2 \,, \qquad (6)$$

and $B'_L(q,q_0)$ is the Blatt-Weisskopf barrier factor from Table 1. A Breit-Wigner parametrization best describes isolated, non-overlapping resonances far from the threshold of additional decay channels. For the ρ and $\rho(1450)$ a more complex parametrization suggested by Gounaris-Sakarai [21] is often used [22-26]. Unitarity can be violated when the dynamical function is parametrized as the sum of two or more overlapping Breit-Wigners. The proximity of a threshold to a resonance distorts the line shape from a simple Breit-Wigner. Here the Flatté formula provides a better description and is discussed below.

K-matrix Formalism: The T matrix can be written as

$$\hat{T} = (I - i\hat{K}\rho)^{-1}\hat{K}, \qquad (7)$$

where $\hat{K}$ is the Lorentz-invariant K-matrix describing the scattering process and ρ is the phase-space factor. Resonances appear as poles in the K-matrix:

$$\hat{K}_{ij} = \sum_{\alpha} \frac{\sqrt{m_\alpha \Gamma_{\alpha i}(m) m_\alpha \Gamma_{\alpha j}(m)}}{(m_\alpha^2 - m^2)\sqrt{\rho_i \rho_j}}. \qquad (8)$$

The K-matrix is real by construction, and so the associated T-matrix respects unitarity.

For a single pole in a single channel, K is

$$K = \frac{m_0\,\Gamma(m)}{m_0^2 - m^2} \qquad (9)$$

and

$$T = K(1 - iK)^{-1} = \frac{m_0\Gamma(m)}{m_0^2 - m^2 - i m_0 \Gamma(m)}\,, \qquad (10)$$

which is the relativistic Breit-Wigner formula. For two poles in a single channel, K is

$$K = \frac{m_\alpha \Gamma_\alpha(m)}{m_\alpha^2 - m^2} + \frac{m_\beta \Gamma_\beta(m)}{m_\beta^2 - m^2} \, . \tag{11}$$

If m_α and m_β are far apart relative to the widths, the T matrix is approximately the sum of two Breit-Wigners, $T(K_\alpha + K_\beta) \approx T(K_\alpha) + T(K_\beta)$, each of the form of Eq. (10). This approximation is not valid for two nearby resonances, in which case T can violate unitarity.

This formulation, which applies to S-channel production in two-body scattering, $ab \to cd$, can be generalized to describe the production of resonances in processes such as the decay of charm mesons. The key assumption here is that the two-body system described by the K-matrix does *not* interact with the rest of the final state [8]. The validity of this assumption varies with the production process and is appropriate for reactions such as $\pi^- p \to \pi^0 \pi^0 n$ and semileptonic decays such as $D \to K\pi\ell\nu$. The assumption may be of limited validity for production processes such as $p\overline{p} \to \pi\pi\pi$ or $D \to \pi\pi\pi$. In these cases, the two-body Lorentz-invariant amplitude, $\hat{F}$, is given by

$$\hat{F}_i = (I - i\hat{K}\rho)^{-1}_{ij} \hat{P}_j = (\hat{T}\hat{K}^{-1})_{ij} \hat{P}_j \, , \tag{12}$$

where P is the production vector that parametrizes the resonance production in the open channels.

For the $\pi\pi$ S-wave, a common formulation of the K-matrix [7,24,25] is

$$K_{ij}(s) = \left[\sum_\alpha \left(\frac{g_i^{(\alpha)} g_j^{(\alpha)}}{m_\alpha^2 - s} \right) + f_{ij}^{sc} \frac{1 - s_0^{sc}}{s - s_0^{sc}} \right] \left[\frac{(s - s_A m_\pi^2/2)(1 - s_{A0})}{(s - s_{A0})} \right] . \tag{13}$$

The factor $g_i^{(\alpha)}$ is the real coupling constant of the K-matrix pole m_α to meson channel i; the parameters f_{ij}^{sc} and s_0^{sc} describe a smooth part of the K-matrix elements; the second factor in square brackets suppresses a false kinematical singularity near the $\pi\pi$ threshold (the Adler zero); and the number 1 has units GeV^2.

The production vector, with $i = 1$ denoting $\pi\pi$, is

$$P_j(s) = \left[\sum_\alpha \left(\frac{\beta_\alpha g_j^{(\alpha)}}{m_\alpha^2 - s} \right) + f_{1j}^{pr} \frac{1 - s_0^{pr}}{s - s_0^{pr}} \right] \left[\frac{(s - s_A m_\pi^2/2)(1 - s_{A0})}{(s - s_{A0})} \right] . \tag{14}$$

where the free parameters of the Dalitz plot fit are the complex production couplings β_α and the production-vector background parameters f_{1j}^{pr} and s_0^{pr}. All other parameters are fixed by scattering experiments. Ref. [6] describes the $\pi\pi$ scattering data with a 4-pole, 2-channel ($\pi\pi$, $K\bar{K}$) model, while Ref. [7] describes the scattering data with 5-pole, 5-channel ($\pi\pi$, $K\bar{K}$, $\eta\eta$, $\eta'\eta'$ and 4π) model. The former has been implemented by CLEO [27] and the latter by FOCUS [25] and BABAR [24]. In both cases, only the $\pi\pi$ channel was analyzed. A more complete coupled-channel analysis would simultaneously fit all final states accessible by rescattering.

Flatté Formalism: The Flatté formulation is used when a second channel opens close to a resonance:

$$\hat{T}(m_{ab}) = \frac{1}{m_r^2 - m_{ab}^2 - i(\rho_1 g_1^2 + \rho_2 g_2^2)} , \tag{15}$$

where $g_1^2 + g_2^2 = m_0 \Gamma_r$. This situation occurs in the $\pi\pi$ S-wave where the $f_0(980)$ is near the $K\overline{K}$ threshold, and in the $\pi\eta$ channel where the $a_0(980)$ also lies near the $K\overline{K}$ threshold. For the $a_0(980)$ resonance, the relevant coupling constants are

$g_1 = g_{\pi\eta}$ and $g_2 = g_{KK}$, and the phase space terms are $\rho_1 = \rho_{\pi\eta}$ and $\rho_2 = \rho_{KK}$, where

$$\rho_{ab} = \sqrt{\left(1 - (\frac{m_a - m_b}{m_{ab}})^2\right)\left(1 + (\frac{m_a - m_b}{m_{ab}})^2\right)}. \tag{16}$$

For the $f_0(980)$ the relevant coupling constants are $g_1 = g_{\pi\pi}$ and $g_2 = g_{KK}$, and the phase space terms are $\rho_1 = \rho_{\pi\pi}$ and $\rho_2 = \rho_{KK}$. The charged and neutral K channels are usually assumed to have the same coupling constant but different phase space factors, due to $m_{K^+} \neq m_{K^0}$; the result is

$$\rho_{KK} = \frac{1}{2}\left(\sqrt{1 - \left(\frac{2m_{K^\pm}}{m_{KK}}\right)^2} + \sqrt{1 - \left(\frac{2m_{K^0}}{m_{KK}}\right)^2}\right). \tag{17}$$

Branching Ratios from Dalitz Plot Fits: A fit to the Dalitz plot distribution using either a Breit-Wigner or a K-matrix formalism factorizes into a resonant contribution to the amplitude $\mathcal{M}_j$ and a complex coefficient, $a_j e^{i\delta_j}$, where a_j and δ_j are real. The definition of a rate of a single process, given a set of amplitudes a_j and phases δ_j, is the square of the relevant matrix element (see Eq. (1)). The "fit fraction" is usually defined as the integral over the Dalitz plot (m_{ab} vs. m_{bc}) of a single amplitude squared divided by the integral over the Dalitz plot of the square of the coherent sum of all amplitudes, or

$$\text{fit fraction}_j = \frac{\int \left|a_j e^{i\delta_j}\mathcal{M}_j\right|^2 dm_{ab}^2 dm_{bc}^2}{\int \left|\sum_k a_k e^{i\delta_k}\mathcal{M}_k\right|^2 dm_{ab}^2 dm_{bc}^2}, \tag{18}$$

where $\mathcal{M}_j$ is defined in Eq. (2) and described in Ref. [28]. In general, the sum of the fit fractions for all components will not be unity due to interference.

When the K-matrix of Eq. (12) is used to describe a wave (*e.g.*, the $\pi\pi$ S-wave), then $\mathcal{M}_j$ refers to the entire wave. In this case, it may not be straightforward to separate $\mathcal{M}_j$ into a sum of individual resonances unless these are narrow and well separated.

Reconstruction Efficiency and Resolution: The efficiency for reconstructing an event as a function of position on the Dalitz plot is in general non-uniform. Typically, a Monte Carlo sample generated with a uniform distribution in phase space is used to determine the efficiency. The variation in efficiency across the Dalitz plot varies with experiment and decay mode. Most recent analyses utilize a full GEANT [29] detector simulation.

Finite detector resolution can usually be safely neglected as most resonances are comparatively broad. Notable exceptions where detector resolution effects must be modeled are $\phi \to K^+K^-$, $\omega \to \pi^+\pi^-$, and $a_0 \to \eta\pi^0$. One approach is to convolve the resolution function in the Dalitz-plot variables m^2_{ab} and m^2_{bc} with the function that parametrizes the resonant amplitudes. In high-statistics data samples, resolution effects near the phase-space boundary typically contribute to a poor goodness of fit. The momenta of the final-state particles can be recalculated with a D or B mass constraint, which forces the kinematic boundaries of the Dalitz plot to be strictly respected. If the three-body mass is not constrained, then the efficiency (and the parametrization of background) may also depend on the reconstructed mass.

Backgrounds: The contribution of background to the D and B samples varies by experiment and final state. The background naturally falls into five categories: (i) purely combinatoric background containing no resonances; (ii) combinatoric background containing intermediate resonances, such as a real K^{*-} or ρ, plus additional random particles; (iii) final states containing identical particles as in $D^0 \to K^0_S\pi^0$ background to $D^0 \to \pi^+\pi^-\pi^0$ and $B \to D\pi$ background to $B \to K\pi\pi$; (iv) mistagged decays such as a real $\overline{D}^0$ or $\overline{B}^0$ incorrectly identified as a D^0 or B^0; and (v) particle misidentification of the decay products such as $D^+ \to \pi^-\pi^+\pi^+$ or $D_s^+ \to K^-K^+\pi^+$ reconstructed as $D^+ \to K^-\pi^+\pi^+$.

The contribution from combinatoric background with intermediate resonances is distinct from the resonances in the signal because the former do *not* interfere with the latter since they are not from true resonances. Similarly, $D^0 \to \rho\pi$ and $D^0 \to K^0_S\pi^0$ do not interfere since strong and weak transitions proceed on different time scales. The usual identification tag of the initial particle as a D^0 or a $\overline{D}^0$ is the charge of the distinctive slow pion in the decay sequence $D^{*+} \to D^0\pi_s^+$ or $D^{*-} \to \overline{D}^0\pi_s^-$. Another possibility is the identification or "tagging" of one of the D mesons from $\psi(3770) \to D^0\overline{D}^0$, as is done for B mesons from $\Upsilon(4S)$. The mistagged background is subtle and may be mistakenly enumerated in the *signal* fraction determined by a D^0 mass fit. Mistagged decays contain true $\overline{D}^0$'s or $\overline{B}^0$'s and so the resonances in the mistagged sample exhibit interference on the Dalitz plot.

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REVIEW OF CHARM DALITZ PLOT ANALYSES

Written January 2006 by D. Asner (Carleton University)

For references given here in the form SMITH 05, see the references at the end of the D^+, D^0, and D_s^+ Listings.

The formalism of Dalitz-Plot analysis is reviewed in the preceeding note. Table 1 lists reported analyses of D mesons. In the following, we discuss a number of subjects of current interest: (1) $D^0 \to K_S^0\pi^+\pi^-$; (2) $D \to \pi\pi\pi$: a $\sigma(500)$ or $f_0(600)$; (3) $D^+ \to K^-\pi^+\pi^+$: a $\kappa(800)$? (4) the $f_0(980)$, $f_0(1370)$ and $f_0(1500)$; (5) doubly Cabibbo-suppressed decays; and (6) CP violation.

$\boldsymbol{D^0 \to K_S^0\pi^+\pi^-}$: Several experiments have analyzed $D^0 \to K_S^0\pi^+\pi^-$ decay (see Table 1). The most precise results are from CLEO (BABAR and Belle, discussed below, have not yet evaluated systematic uncertainties). The CLEO analysis included ten resonances: $K_S^0\rho^0$, $K_S^0\omega$, $K_S^0 f_0(980)$, $K_S^0 f_2(1270)$, $K_S^0 f_0(1370)$, $K^*(892)^-\pi^+$, $K_0^*(1430)^-\pi^+$, $K_2^*(1430)^-\pi^+$, $K^*(1680)^-\pi^+$, and the doubly Cabibbo-suppressed mode $K^*(892)^+\pi^-$. CLEO found a much smaller nonresonant contribution than did the earliest experiments.

Table 1: Reported Dalitz plot analyses.

Decay	Experiment(s)
$D^0 \to K^0_S \pi^+\pi^-$	Mark II [a], Mark III [b], E691 [c], E687 [d,e], ARGUS [f], CLEO [g], Belle [10,11], BABAR [12,13]
$D^0 \to K^-\pi^+\pi^0$	Mark III [b], E687 [e], E691 [c], CLEO [h]
$D^0 \to \overline{K}^0 K^+\pi^-$	BABAR [14]
$D^0 \to K^0 K^-\pi^+$	BABAR [14]
$D^0 \to K^0_S \eta\pi^0$	CLEO [i]
$D^0 \to \pi^+\pi^-\pi^0$	CLEO [j]
$D^0 \to K^0_S K^+K^-$	BABAR [k]
$D^0 \to K^-K^+K^-\pi^+$	FOCUS [l]
$D^0 \to K^-K^+\pi^-\pi^+$	FOCUS [m]
$D^+ \to K^-\pi^+\pi^+$	Mark III [b], E687 [e], E691 [c], E791 [n]
$D^+ \to \overline{K}^0\pi^+\pi^0$	Mark III [b]
$D^+ \to \pi^+\pi^+\pi^-$	E687 [o], E791 [p], FOCUS [5] [q]
$D^+ \to K^+K^-\pi^+$	FOCUS [15], E687 [r], BABAR [s]
$D^+ \to K^+\pi^+\pi^-$	E791 [t], FOCUS [u]
$D_s^+ \to K^+K^-\pi^+$	E687 [r], FOCUS [15]
$D_s^+ \to \pi^+\pi^+\pi^-$	E687 [o], E791 [v], FOCUS [5]
$D_s^+ \to K^+\pi^+\pi^-$	FOCUS [u]

See the end of the D^+, D^0 and D_s^+ Listings for these references: [a]SCHINDLER 81, [b]ADLER 87, [c]ANJOS 93, [d]FRABETTI 92B, [e]FRABETTI 94G, [f]ALBRECHT 93D, [g]MURAMATSU 02, [h]KOPP 01, [i]RUBIN 04, [j]CRONIN-HENNESSY 05, [k]AUBERT 05B, [l]LINK 03G, [m]LINK 05C, [n]AITALA 02, [o]FRABETTI 97D, [p]AITALA 01B, [q]LINK 04, [r]FRABETTI 95B, [s]AUBERT 05A, [t]AITALA 97C, [u]LINK 04F, [v]AITALA 01A.

The source of the nonresonant component found in the early experiments has been attributed to the broad scalar resonances, the $K_0^*(1430)^-$ and $f_0(1370)$, found in the later, larger data samples. The observation of a small but significant nonresonant component in the largest data samples suggests the presence of additional broad scalar resonances, the $\kappa(800)$ and $\sigma(500)$. The CLEO analysis could accommodate the $\sigma(500)$ in lieu of the nonresonant component, but found no evidence for the $\kappa(800)$.

The ten quasi-two-body intermediate states in the CLEO analysis include both CP-even and CP-odd eigenstates and one doubly Cabibbo-suppressed channel. A time-dependent analysis of the Dalitz plot allows simultaneous determination of the strong transition amplitudes and phases and the mixing parameters x and y without phase or sign ambiguity. Using 9 fb^{-1}, CLEO obtained $(-4.5 < x < 9.3)\%$ and $(-6.4 < y < 3.6)\%$ [1].

The decay $D^0 \to K_S^0\pi^+\pi^-$, important for the study of the CKM angle γ/ϕ_3 [6], is under study by Belle [10,11] and BABAR [12,13]. The CLEO model does not provide a good description of the higher-statistics BABAR and Belle data samples. An improved description is obtained in two ways: First, by adding more Breit-Wigner resonances, including two $\pi\pi$ resonances with arbitrary mass and width, denoted as σ_1 and σ_2. Second, following the methodology of FOCUS [LINK 04], by applying a K-matrix model to the $\pi\pi$ S-wave [12].

Charm Dalitz-plot analyses might also prove useful for calibrating tools used to study B decays: specifically, to extract α from $B^0 \to \pi^+\pi^-\pi^0$, β from $b \to s$ penguin decays (*e.g.*, $B^0 \to \overline{K}^0K^+K^-$), and γ from $B^\pm \to DK^\pm$ followed by $D^0 \to \pi^+\pi^-\pi^0$ or $K_S^0K^+K^-$ or $K^+K^-\pi^0$, in addition to the well-studied $D^0 \to K_S^0\pi^+\pi^-$[2, 3].

$D \to \pi\pi\pi$: a $\sigma(500)$ or $f_0(600)$: The decay $D^+ \to \pi^+\pi^+\pi^-$ has been studied by the E687, E791 and FOCUS experiments (see Table 1). The E687 analysis considered the modes $\rho(770)^0\pi^+$, $f_0(980)\pi^+$, $f_2(1270)\pi^+$, and a nonresonant component. E791 included, in addition, $f_0(1370)\pi^+$ and $\rho(1450)^0\pi^+$. Both analyses found a very large fraction ($\sim 50\%$) for the nonresonant component, perhaps indicating a broad scalar contribution. E791 found the nonresonant amplitude to be consistent with zero if a broad scalar resonance was included. FOCUS analyzed its data using both the Breit-Wigner formalism and the K-matrix formalism for the $\pi^+\pi^-$ S-wave, following a 5-pole, 5-resonance model of Anisovich and Sarantsev [16]. The Breit-Wigner analysis included $\rho(770)^0, f_0(980), f_2(1270)^0,$ $f_0(1500), \sigma(500)$, and a nonresonant component. The K-matrix formalism, with Breit-Wigner forms for the $\rho(770)$ and $f_2(1270)$, also describe the FOCUS data well. None of these analyses has modeled the dynamics of the $\pi^+\pi^+$ interaction. Consideration of the $I = 2$ S- and D-wave phase shifts, also measured in $\pi^+ p \to \pi^+\pi^+ n$ [18], could affect the $\pi^+\pi^-$ S-wave result.

Using the E791 data, Bediaga and Miranda [19] found additional evidence that the low-mass $\pi^+\pi^-$ feature is resonant by examining the phase of the $\pi^+\pi^-$ amplitude in the vicinity of the reported $\sigma(500)$ mass. The phase variation with invariant mass is consistent with a resonant interpretation.

Table 1 gives the parameters of the $\sigma(500)$ determined in charm Dalitz-plot analyses. A consistent relative phase between the $\sigma(500)$ and $\rho(770)$ resonances is observed.

Table 2: Parameters of the $\sigma(500)$ resonance. The amplitude and phase are relative to the $\rho(770)$.

Experiment	E791[a]	CLEO[b]	FOCUS [5]
Decay mode	$D^+ \to \pi^+\pi^+\pi^-$	$D^0 \to K^0_S\pi^+\pi^-$	$D^+ \to \pi^+\pi^+\pi^-$
Amplitude	$1.17 \pm 0.13 \pm 0.06$	0.57 ± 0.13	—
Phase (°)	$205.7 \pm 8.0 \pm 5.2$	214 ± 11	200 ± 31
m (MeV/c^2)	$478^{+24}_{-23} \pm 17$	513 ± 32	443 ± 27
Γ (MeV/c^2)	$324^{+42}_{-40} \pm 21$	335 ± 67	443 ± 80

See the end of the D^+ and D^0 listings for these references: [a]AITALA 01B, [b]MURAMATSU 02.

CLEO has studied $D^0 \to \pi^+\pi^-\pi^0$ (see Table 1). Only the three $\rho(770)\pi$ resonant contributions are observed. No evidence is found for any $\pi\pi$ S-wave, either with the Breit-Wigner or with a K-matrix parametrization, using the 4-pole, 2-resonance model of Au, Morgan, and Pennington [17].

$D^+ \to K^-\pi^+\pi^+$: a $\kappa(800)$?: Evidence for a broad $K\pi$ scalar resonance has been found by E791 in $D^+ \to K^-\pi^+\pi^+$ (see Table 1). Fitting the Dalitz plot with $\overline{K}^*(892)^0\pi^+$, $\overline{K}^*_0(1430)^0\pi^+$, $\overline{K}^*_2(1430)^0\pi^+$, and $\overline{K}^*(1680)^0\pi^+$, plus a constant nonresonant component, E791 found results consistent with earlier analyses by E691 and E687, with a nonresonant fit fraction of over 90%. With more events than the other experiments, E791 was then led to include an extra low-mass S-wave $\overline{K}\pi$ resonance to account for the poor fit already seen by earlier experiments. A $\kappa(800)$ with mass $797 \pm 19 \pm 43$ MeV and width $410 \pm 43 \pm 87$ MeV much improved the fit. The $\kappa(800)$ became the dominant resonance and the nonresonant fit fraction was reduced from $90.9 \pm 2.6\%$ to $13.0 \pm 5.8 \pm 4.4\%$.

In addition, E791 modeled the $K\pi$ S-wave phase variation as a function of $K\pi$ mass with only the $K_0^*(1430)$ resonance and a nonresonant component following a parametrization of LASS [20]. It was necessary to relax the unitarity constraint to describe the data [21]. The $K\pi$ S-wave phase behavior in this model was consistent with the model that included the κ resonance.

Finally, E791 performed a model-independent partial-wave analysis [AITALA 05] of the S-wave component of the $K\pi$ system, finding the amplitude and phase from the $K\pi$ threshold up to 1.72 GeV. No assumptions were made regarding dependence on invariant mass, but the analysis did use the relatively well-understood P- and D-waves, described by the $K^*(892)$ and $K^*(1680)$ and by the $K_2(1430)$, respectively. The results were similar to those obtained by AITALA 02, which parametrized the S-wave with κ and $K_0(1430)$ Breit-Wigner forms and a constant complex non-resonant term. As with the $\sigma(500)$, the $K^-\pi^+$ S-wave result could be affected by including dynamics of the $I = 2$ $\pi^+\pi^+$ interaction; however in AITALA 05, the $I = 2$ elastic amplitude was found to be negligible compared to the κ.

CLEO allowed scalar $K\pi$ resonances in fits to $D^0 \to K^-\pi^+\pi^0$ and $D^0 \to K_S^0\pi^+\pi^-$ (see Table 1), and observed a significant contribution from only the $K_0^*(1430)$ [22]. BABAR fit $D^0 \to K^0 K^-\pi^+$ with both positively charged and neutral $\overline{K}^*(892)$, $\overline{K}_0^*(1430)$, $\overline{K}_2^*(1430)$, and $\overline{K}^*(1680)$ resonances, as well as the $a_0(980)^-$, $a_0(1450)^-$, and $a_2(1310)^-$ resonances, and a nonresonant component [14]. BABAR also fit $D^0 \to \overline{K}^0 K^+\pi^-$ with the same resonances except for the $a_2(1310)^-$. In both cases, a good fit was obtained without including the κ.

FOCUS has conclusively observed a $K\pi$ S-wave as a distortion of the $K^*(892)$ line-shape in semileptonic charm decays [LINK 02E, LINK 05D].

The $f_0(980)$, $f_0(1370)$ and $f_0(1500)$: The meson content of the 0^{++} nonet and the quark content of the $f_0(980)$, $a_0(980)$, $f_0(1370)$, $f_0(1500)$, and $f_0(1710)$ mesons are current puzzles in light-meson spectroscopy [22]. Measuring branching fractions and couplings to different final states and comparing scalar-meson production rates among D^0, D^+, and D_s^+ mesons may help solve these puzzles.

For example: A large contribution of $f_0(980)$ to $D^0 \to K_S^0 K^+ K^-$ was reported by ARGUS [ALBRECHT 87E] and by BABAR [14]. This is inconsistent with the smaller contribution of $f_0(980)$ observed in $D^0 \to K_S^0 \pi^+\pi^-$ by CLEO. The explanation is that $D^0 \to K_S^0 K^+ K^-$ has a large contribution from $a_0(980)^0 \to K^+K^-$. Therefore CLEO studied $D^0 \to K_S^0 \eta\pi^0$ [RUBIN 04], where the dominant contribution is from $K_S^0\, a_0(980)^0, a_0(980)^0 \to \eta\pi^0$, and there can be no $f_0(980)$. A more recent BABAR analysis of $D^0 \to K_s^0 K^+ K^-$ found a large amount of $a_0(980) \to K\overline{K}$ and little $f_0(980)$ [AUBERT 05B].

The proximity of the $K\overline{K}$ threshold requires either a coupled-channel Breit-Wigner function [23] or a Flatte parametrization [24] of the $f_0(980)$. The width of the $f_0(980)$ is poorly known. E791 and FOCUS [LINK 05C] [5] used a coupled-channel Breit-Wigner function to describe the $f_0(980)$ in $D_s^+ \to \pi^+\pi^+\pi^-$. BESII studied the $f_0(980)$ in $J/\psi \to \phi\pi^+\pi^-$ and ϕK^+K^- [25]. The values found for the couplings to the $\pi\pi$ and $K\overline{K}$ channels, $g_{\pi\pi}$ and g_{KK}, were not consistent. Results such as these are desirable for input to the analysis of $D_s^+ \to K^+K^-\pi^+$ [15], which includes both the $f_0(980)$ and $a_0(980)$.

The quark content of the $f_0(1370)$ and $f_0(1500)$ can perhaps be inferred from how they populate various Dalitz plots. Results so far are confusing. The E791 analysis of

$D^+ \to \pi^+\pi^+\pi^-$ [AITALA 01B] found some $f_0(1370)$ but no $f_0(1500)$, while the FOCUS analysis [5] of this mode found little $f_0(1370)$. In $D_s^+ \to \pi^+\pi^+\pi^-$, E687 and FOCUS [5] found no $f_0(1370)$, but did find a resonance with parameters similar to the $f_0(1500)$, whereas E791 found a $\pi^+\pi^-$ resonance with mass $1434 \pm 18 \pm 9$ MeV and width $172 \pm 32 \pm 6$ MeV, consistent with neither the $f_0(1370)$ or $f_0(1500)$. BABAR [AUBERT 05B] in $D^0 \to \overline{K}^0 K^+K^-$ found neither the $f_0(1370)$ nor the $f_0(1500)$, but did observe a K^+K^- resonance consistent with the values from E791 given above, while CLEO has observed the $f_0(1370)$ in $D^0 \to K^0_S\pi^+\pi^-$. The FOCUS analysis that used the K-matrix formalism for the $\pi\pi$ S-wave observed significant couplings to five T-matrix poles—$f_0(980), f_0(1300), f_0(1200-1600), f_0(1500), f_0(1750)$— in both $D^+ \to \pi^+\pi^-\pi^+$ and $D_s^+ \to \pi^+\pi^-\pi^+$. Again, the quark content of each pole might be inferred from the coupling to various Dalitz plots.

It is noteworthy that the S-wave observed in B Dalitz-plot analyses appears to be different than that observed in D-meson decays.

Doubly Cabibbo-Suppressed Decays: There are two classes of multibody doubly Cabibbo-suppressed (DCS) decays of D mesons. The first consists of those in which the DCS and corresponding Cabbibo-favored (CF) decays populate distinct Dalitz plots: the pairs $D^0 \to K^+\pi^-\pi^0$ and $D^0 \to K^-\pi^+\pi^0$, or $D^+ \to K^+\pi^+\pi^-$ and $D^+ \to K^-\pi^+\pi^+$, are examples. CLEO [BRANDENBURG 01] and Belle [TIAN 05] have reported $\Gamma(D^0 \to K^+\pi^-\pi^0)/\Gamma(D^0 \to K^-\pi^+\pi^0) = (0.43^{+0.11}_{-0.10} \pm 0.07)\%$ and $(0.229 \pm 0.015^{+0.013}_{-0.009})\%$, respectively. E791 and FOCUS have reported $\Gamma(D^+ \to K^+\pi^-\pi^+)/\Gamma(D^+ \to K^-\pi^+\pi^+) = (0.77 \pm 0.17 \pm 0.08)\%$ and $(0.65 \pm 0.08 \pm 0.04)\%$, respectively.

The second class consists of decays in which the DCS and CF modes populate the same Dalitz plot; for example, $D^0 \to K^{*-}\pi^+$ and $D^0 \to K^{*+}\pi^-$ both contribute to $D^0 \to K^0_S\pi^+\pi^-$. In this case, the potential for interference of DCS and CF amplitudes increases the sensitivity to the DCS amplitude. CLEO found the relative amplitude and phase to be $(7.1 \pm 1.3^{+2.6}_{-0.6}{}^{+2.6}_{-0.6})\%$ and $(189 \pm 10 \pm 3^{+15}_{-5})^\circ$, corresponding to $\Gamma(D^0 \to K^*(892)^+\pi^-)/\Gamma(D^0 \to K^*(892)^-\pi^+) = (0.5 \pm 0.2^{+0.5}_{-0.1}{}^{+0.4}_{-0.1})\%$. In addition to $D^0 \to K^*(892)^+\pi^-$, Belle [10,11] and BABAR [12,13] have found evidence for $D^0 \to K_0(1430)^+\pi^-$ and $K_2(1430)^+\pi^-$, and Belle has also found evidence for $K^*(1680)^+\pi^-$.

***CP* Violation**: In the limit of CP conservation, charge conjugate decays will have the same Dalitz-plot distribution. The $D^{*\pm}$ tag enables the discrimination between D^0 and $\overline{D}^0$. The integrated CP violation across the Dalitz plot is determined in two ways. The first uses

$$\mathcal{A}_{CP} = \int \left(\frac{|\mathcal{M}|^2 - |\overline{\mathcal{M}}|^2}{|\mathcal{M}|^2 + |\overline{\mathcal{M}}|^2} \right) dm^2_{ab}\, dm^2_{bc} \Bigg/ \int dm^2_{ab}\, dm^2_{bc} \,, \quad (1)$$

where $\mathcal{M}$ and $\overline{\mathcal{M}}$ are the D^0 and $\overline{D}^0$ Dalitz-plot amplitudes. The second uses the asymmetry in the efficiency-corrected D^0 and $\overline{D}^0$ yields,

$$\mathcal{A}_{CP} = \frac{N_{D^0} - N_{\overline{D}^0}}{N_{D^0} + N_{\overline{D}^0}} \,. \quad (2)$$

These expressions are less sensitive to CP violation than are the individual resonant submodes [ASNER 04A]. Table 3 lists the results for CP violation. No evidence of CP violation has been observed in D-meson decays.

Table 3: Dalitz-plot-integrated CP violation. Measurements computing $\mathcal{A}_{CP}$ with Eq. (2) rather than Eq. (1) are denoted †.

Experiment	Decay mode	$\mathcal{A}_{CP}(\%)$
BABAR [a]	$D^+ \to K^+K^-\pi^+$	$1.4 \pm 1.0 \pm 0.8$
Belle [b]†	$D^0 \to K^+\pi^-\pi^0$	-0.6 ± 5.3
Belle [b]†	$D^0 \to K^+\pi^-\pi^+\pi^-$	-1.8 ± 4.4
CLEO [c]	$D^0 \to K^-\pi^+\pi^0$	-3.1 ± 8.6
CLEO [d]†	$D^0 \to K^+\pi^-\pi^0$	$+9^{+22}_{-25}$
CLEO [e]	$D^0 \to K^0_S\pi^+\pi^-$	$-0.9 \pm 2.1^{+1.0}_{-4.3}{}^{+1.3}_{-3.7}$
CLEO [f]	$D^0 \to \pi^+\pi^-\pi^0$	$+1^{+9}_{-7} \pm 9$

See the end of the D^+ and D^0 Listings for these references: [a]AUBERT 05A, [b]TIAN 05, [c]KOPP 01, [d]BRANDENBURG 01, [e]ASNER 04A, [f]CRONIN-HENNESSY 05.

The possibility of interference between CP–conserving and CP–violating amplitudes provides a more sensitive probe of CP violation. The constraints on the square of the CP–violating amplitude obtained in the resonant submodes of $D^0 \to K^0_S\pi^+\pi^-$ range from 3.5×10^{-4} to 28.4×10^{-4} at 95% confidence level [ASNER 04A].

References

1. See the note on "D^0–$\overline{D}^0$ Mixing" in this *Review*.
2. See the note on "The CKM Quark Mixing Matrix" in this *Review*.
3. See the note on "CP Violation in Meson Decays" in this *Review*.
4. Dalitz plot analysis of the wrong sign rate $D^0 \to K^+\pi^-\pi^0$ [BRANDENBURG 01] and the time dependence of Dalitz

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$\Gamma\big(\overline{K}_0^*(800)^0\pi^+, \overline{K}_0^*(800) \to K^-\pi^+\big)/\Gamma\big(K^-\pi^+\pi^+\big)$ Γ_{43}/Γ_{42}

This is the "fit fraction" from the Dalitz-plot analysis. The $K_0^*(800)$ is a broad scalar resonance that may not exist and is not included in the Summary Tables. AITALA 02 finds that including such a resonance in the fit to the $D^+ \to K^-\pi^+\pi^+$ Dalitz plot greatly improves the fit. However, the results of AITALA 02 for the $D^+ \to K^-\pi^+\pi^+$ Dalitz plot analysis so disagree with earlier analyses that averaging the results makes no sense. For now, we exclude AITALA 02 from the average.

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.478 \pm 0.121 \pm 0.053$	AITALA	02	E791	π^- nucleus, 500 GeV

$\Gamma\big(\overline{K}^*(892)^0\pi^+, \overline{K}^*(892)^0 \to K^-\pi^+\big)/\Gamma\big(K^-\pi^+\pi^+\big)$ Γ_{44}/Γ_{42}

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

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.140±0.010 OUR AVERAGE				
$0.137 \pm 0.006 \pm 0.009$	FRABETTI	94G	E687	γ Be, $\overline{E}_\gamma \approx 220$ GeV
$0.170 \pm 0.009 \pm 0.034$	ANJOS	93	E691	γ Be 90–260 GeV
$0.14 \pm 0.04 \pm 0.04$	ALVAREZ	91B	NA14	Photoproduction
$0.13 \pm 0.01 \pm 0.07$	ADLER	87	MRK3	e^+e^- 3.77 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.123 \pm 0.010 \pm 0.009$	[51] AITALA	02	E791	π^- nucleus, 500 GeV

[51] AITALA 02 includes a broad scalar $K_0^*(800)$ in the fit to the $D^+ \to K^-\pi^+\pi^+$ Dalitz plot. This (a) greatly improves the fit, and (b) gives results in other channels that greatly disagree with previous analyses. The disagreement is so large that it makes no sense to average the results with those of earlier experiments. For now, we exclude AITALA 02 from the average.

$\Gamma\big(\overline{K}_0^*(1430)^0\pi^+, \overline{K}_0^*(1430)^0 \to K^-\pi^+\big)/\Gamma\big(K^-\pi^+\pi^+\big)$ Γ_{45}/Γ_{42}

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

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.253±0.024 OUR AVERAGE				
$0.284 \pm 0.022 \pm 0.059$	FRABETTI	94G	E687	γ Be, $\overline{E}_\gamma \approx 220$ GeV
$0.248 \pm 0.019 \pm 0.017$	ANJOS	93	E691	γ Be 90–260 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.125 \pm 0.014 \pm 0.005$	[52] AITALA	02	E791	π^- nucleus, 500 GeV

[52] AITALA 02 includes a broad scalar $K_0^*(800)$ in the fit to the $D^+ \to K^-\pi^+\pi^+$ Dalitz plot. This (a) greatly improves the fit, and (b) gives results in other channels that greatly disagree with previous analyses. The disagreement is so large that it makes no sense to average the results with those of earlier experiments. For now, we exclude AITALA 02 from the average.

$\Gamma(\overline{K}_2^*(1430)^0\pi^+, \overline{K}_2^*(1430)^0 \to K^-\pi^+)/\Gamma(K^-\pi^+\pi^+)$ — Γ_{46}/Γ_{42}

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. • • •				
$0.005 \pm 0.001 \pm 0.002$	[53] AITALA	02	E791	π^- nucleus, 500 GeV

[53] AITALA 02 includes a broad scalar $K_0^*(800)$ in the fit to the $D^+ \to K^-\pi^+\pi^+$ Dalitz plot. This (a) greatly improves the fit, and (b) gives results in other channels that greatly disagree with previous analyses. The disagreement is so large that it makes no sense to average the results with those of earlier experiments. For now, we exclude AITALA 02 from the average.

$\Gamma(\overline{K}^*(1680)^0\pi^+, \overline{K}^*(1680)^0 \to K^-\pi^+)/\Gamma(K^-\pi^+\pi^+)$ — Γ_{47}/Γ_{42}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.042±0.008 OUR AVERAGE				
$0.047 \pm 0.006 \pm 0.007$	FRABETTI	94G	E687	γ Be, $\overline{E}_\gamma \approx 220$ GeV
$0.030 \pm 0.004 \pm 0.013$	ANJOS	93	E691	γ Be 90–260 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.025 \pm 0.007 \pm 0.003$	[54] AITALA	02	E791	π^- nucleus, 500 GeV

[54] AITALA 02 includes a broad scalar $K_0^*(800)$ in the fit to the $D^+ \to K^-\pi^+\pi^+$ Dalitz plot. This (a) greatly improves the fit, and (b) gives results in other channels that greatly disagree with previous analyses. The disagreement is so large that it makes no sense to average the results with those of earlier experiments. For now, we exclude AITALA 02 from the average.

$\Gamma(K^-\pi^+\pi^+ \text{ nonresonant})/\Gamma(K^-\pi^+\pi^+)$ — Γ_{48}/Γ_{42}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.95 ±0.07 OUR AVERAGE				
$0.998 \pm 0.037 \pm 0.072$	FRABETTI	94G	E687	γ Be, $\overline{E}_\gamma \approx 220$ GeV
$0.838 \pm 0.088 \pm 0.275$	ANJOS	93	E691	γ Be 90–260 GeV
$0.79 \pm 0.07 \pm 0.15$	ADLER	87	MRK3	e^+e^- 3.77 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.130 \pm 0.058 \pm 0.044$	[55] AITALA	02	E791	π^- nucleus, 500 GeV

[55] AITALA 02 includes a broad scalar $K_0^*(800)$ in the fit to the $D^+ \to K^-\pi^+\pi^+$ Dalitz plot. This (a) greatly improves the fit, and (b) gives results in other channels that greatly disagree with previous analyses. The disagreement is so large that it makes no sense to average the results with those of earlier experiments. For now, we exclude AITALA 02 from the average.

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.070±0.005 OUR FIT	Error includes scale factor of 1.2.				
0.072±0.002±0.004	5090 ± 100	[56] HE	05	CLEO	e^+e^- at $\psi(3770)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.051 \pm 0.013 \pm 0.008$	159	ADLER	88C	MRK3	e^+e^- 3.77 GeV
0.09 ± 0.06	10	[57] SCHINDLER	81	MRK2	e^+e^- 3.771 GeV

[56] HE 05 uses single- and double-tagged events in an overall fit. The fraction here includes (unobserved) final-state photons.

[57] SCHINDLER 81 (MARK-2) measures $\sigma(e^+e^- \to \psi(3770)) \times$ branching fraction to be 0.78 ± 0.48 nb. We use the MARK-3 (ADLER 88C) value of $\sigma = 4.2 \pm 0.6 \pm 0.3$ nb.

$\Gamma(K^0_S \rho^+)/\Gamma(K^0_S \pi^+ \pi^0)$ — Γ_{50}/Γ_{49}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.68±0.08±0.12	ADLER	87	MRK3	$e^+ e^-$ 3.77 GeV

$\Gamma(\overline{K}^*(892)^0 \pi^+, \overline{K}^*(892)^0 \to K^0_S \pi^0)/\Gamma(K^0_S \pi^+ \pi^0)$ — Γ_{51}/Γ_{49}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.19±0.06±0.06	ADLER	87	MRK3	$e^+ e^-$ 3.77 GeV

$\Gamma(K^0_S \pi^+ \pi^0$ nonresonant$)/\Gamma(K^0_S \pi^+ \pi^0)$ — Γ_{52}/Γ_{49}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.13±0.07±0.08	ADLER	87	MRK3	$e^+ e^-$ 3.77 GeV

$\Gamma(K^- \pi^+ \pi^+ \pi^0)/\Gamma_{total}$ — Γ_{53}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.060±0.002 ±0.002	4840 ± 100	[58] HE	05	CLEO	$e^+ e^-$ at $\psi(3770)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.058±0.012 ±0.012	142	COFFMAN	92B	MRK3	$e^+ e^-$ 3.77 GeV
$0.063^{+0.014}_{-0.013}$ ±0.012	175	BALTRUSAIT...	86E	MRK3	See COFFMAN 92B

[58] HE 05 uses single- and double-tagged events in an overall fit. The fraction here includes (unobserved) final-state photons.

$\Gamma(K^- \pi^+ \pi^+ \pi^0)/\Gamma(K^- \pi^+ \pi^+)$ — Γ_{53}/Γ_{42}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.76±0.11±0.12	91	ANJOS	92C	E691	γ Be 90–260 GeV
0.69±0.10±0.16		ANJOS	89E	E691	See ANJOS 92C

$\Gamma(\overline{K}^*(892)^0 \rho^+$ total$)/\Gamma(K^- \pi^+ \pi^+ \pi^0)$ — Γ_{79}/Γ_{53}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.33±0.165±0.12	[59] ANJOS	92C	E691	γ Be 90–260 GeV

[59] See, however, the next entry, where the two experiments disagree completely.

$\Gamma(\overline{K}^*(892)^0 \rho^+$ S-wave$)/\Gamma(K^- \pi^+ \pi^+ \pi^0)$ — Γ_{80}/Γ_{53}

Unseen decay modes of the $\overline{K}^*(892)^0$ are included. The two experiments here disagree completely.

VALUE	DOCUMENT ID		TECN	COMMENT
0.26 ±0.25 OUR AVERAGE	Error includes scale factor of 3.1.			
0.15 ±0.075±0.045	ANJOS	92C	E691	γ Be 90–260 GeV
0.833±0.116±0.165	COFFMAN	92B	MRK3	$e^+ e^-$ 3.77 GeV

$\Gamma(\overline{K}^*(892)^0 \rho^+$ P-wave$)/\Gamma_{total}$ — Γ_{81}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.001	90	ANJOS	92C	E691	γ Be 90–260 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.005	90	COFFMAN	92B	MRK3	$e^+ e^-$ 3.77 GeV

$\Gamma\big(\overline{K}^*(892)^0\rho^+\ D\text{-wave}\big)/\Gamma\big(K^-\pi^+\pi^+\pi^0\big)$ — Γ_{82}/Γ_{53}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.15±0.09±0.045	ANJOS	92C	E691	γ Be 90–260 GeV

$\Gamma\big(\overline{K}^*(892)^0\rho^+\ D\text{-wave longitudinal}\big)/\Gamma_{\text{total}}$ — Γ_{83}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.007	90	COFFMAN	92B	MRK3	e^+e^- 3.77 GeV

$\Gamma\big(\overline{K}_1(1400)^0\pi^+\big)/\Gamma\big(K^-\pi^+\pi^+\pi^0\big)$ — Γ_{85}/Γ_{53}

Unseen decay modes of the $\overline{K}_1(1400)^0$ are included.

VALUE	DOCUMENT ID		TECN	COMMENT
0.79 ±0.32 OUR FIT Error includes scale factor of 1.2.				
0.907±0.218±0.180	COFFMAN	92B	MRK3	e^+e^- 3.77 GeV

$\Gamma\big(K^-\rho^+\pi^+\ \text{total}\big)/\Gamma\big(K^-\pi^+\pi^+\pi^0\big)$ — Γ_{56}/Γ_{53}

This includes $\overline{K}^*(892)^0\rho^+$, *etc.* The next entry gives the specifically 3-body fraction.

VALUE	DOCUMENT ID		TECN	COMMENT
0.48±0.13±0.09	ANJOS	92C	E691	γ Be 90–260 GeV

$\Gamma\big(K^-\rho^+\pi^+\ 3\text{-body}\big)/\Gamma\big(K^-\pi^+\pi^+\pi^0\big)$ — Γ_{57}/Γ_{53}

VALUE	DOCUMENT ID		TECN	COMMENT
0.17 ±0.06 OUR AVERAGE				
0.18 ±0.08 ±0.04	ANJOS	92C	E691	γ Be 90–260 GeV
0.159±0.065±0.060	COFFMAN	92B	MRK3	e^+e^- 3.77 GeV

$\Gamma\big(\overline{K}^*(892)^0\pi^+\pi^0\ \text{total}\big)/\Gamma\big(K^-\pi^+\pi^+\pi^0\big)$ — Γ_{87}/Γ_{53}

This includes $\overline{K}^*(892)^0\rho^+$, *etc.* The next two entries give the specifically 3-body fraction. Unseen decay modes of the $\overline{K}^*(892)^0$ are included.

VALUE	DOCUMENT ID		TECN	COMMENT
1.05±0.11±0.08	ANJOS	92C	E691	γ Be 90–260 GeV

$\Gamma\big(\overline{K}^*(892)^0\pi^+\pi^0\ 3\text{-body}\big)/\Gamma_{\text{total}}$ — Γ_{88}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.008	90	[60] COFFMAN	92B	MRK3	e^+e^- 3.77 GeV

[60] See, however, the next entry: ANJOS 92C sees a large signal in this channel.

$\Gamma\big(\overline{K}^*(892)^0\pi^+\pi^0\ 3\text{-body}\big)/\Gamma\big(K^-\pi^+\pi^+\pi^0\big)$ — Γ_{88}/Γ_{53}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.66±0.09±0.17	ANJOS	92C	E691	γ Be 90–260 GeV

$\Gamma\big(K^*(892)^-\pi^+\pi^+\ 3\text{-body}\big)/\Gamma\big(K^-\pi^+\pi^+\pi^0\big)$ — Γ_{90}/Γ_{53}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.32±0.16 OUR FIT Error includes scale factor of 1.2.				
0.24±0.12±0.09	ANJOS	92C	E691	γ Be 90–260 GeV

$\Gamma(K^-\pi^+\pi^+\pi^0$ nonresonant$)/\Gamma_{total}$ — Γ_{61}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.002	90	[61] ANJOS 92C	E691	γ Be 90–260 GeV

[61] Whereas ANJOS 92C finds no signal here, COFFMAN 92B finds a fairly large one; see the next entry.

$\Gamma(K^-\pi^+\pi^+\pi^0$ nonresonant$)/\Gamma(K^-\pi^+\pi^+\pi^0)$ — Γ_{61}/Γ_{53}

VALUE	DOCUMENT ID	TECN	COMMENT
0.184±0.070±0.050	COFFMAN 92B	MRK3	e^+e^- 3.77 GeV

$\Gamma(K^0_S\pi^+\pi^+\pi^-)/\Gamma_{total}$ — Γ_{62}/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.0311±0.0021 OUR FIT Error includes scale factor of 1.1.				
0.032 ±0.001 ±0.002	3210 ± 85	[62] HE 05	CLEO	e^+e^- at $\psi(3770)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.021\ ^{+0.010}_{-0.009}$		[63] BARLAG 92C	ACCM	π^- Cu 230 GeV
0.033 ±0.008 ±0.002	168	ADLER 88C	MRK3	e^+e^- 3.77 GeV
$0.122\ ^{+0.032}_{-0.021}\ \pm0.021$	11	[63] AGUILAR-... 87F	HYBR	πp, pp 360, 400 GeV
0.06 ±0.03	21	[64] SCHINDLER 81	MRK2	e^+e^- 3.771 GeV

[62] HE 05 uses single- and double-tagged events in an overall fit. The fraction here includes (unobserved) final-state photons.

[63] AGUILAR-BENITEZ 87F and BARLAG 92C compute the branching fraction by topological normalization.

[64] SCHINDLER 81 (MARK-2) measures $\sigma(e^+e^- \rightarrow \psi(3770)) \times$ branching fraction to be 0.51 ± 0.08 nb. We use the MARK-3 (ADLER 88C) value of $\sigma = 4.2 \pm 0.6 \pm 0.3$ nb.

$\Gamma(K^0_S\pi^+\pi^+\pi^-)/\Gamma(K^-\pi^+\pi^+)$ — Γ_{62}/Γ_{42}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.327±0.018 OUR FIT Error includes scale factor of 1.1.				
0.39 ±0.04 ±0.06	229 ± 17	ANJOS 92C	E691	γ Be 90–260 GeV

$\Gamma(K^0_S a_1(1260)^+)/\Gamma(K^0_S\pi^+\pi^+\pi^-)$ — Γ_{77}/Γ_{62}

Unseen decay modes of the $a_1(1260)^+$ are included, assuming that the $a_1(1260)^+$ decays entirely to $\rho\pi$ [or at least to $(\pi\pi)_{I=1}\ \pi$].

VALUE	DOCUMENT ID	TECN	COMMENT
1.15 ±0.19 OUR AVERAGE Error includes scale factor of 1.1.			
1.66 ±0.28 ±0.40	ANJOS 92C	E691	γ Be 90–260 GeV
1.078±0.114±0.140	COFFMAN 92B	MRK3	e^+e^- 3.77 GeV

$\Gamma(K^0_S a_2(1320)^+)/\Gamma_{total}$ — Γ_{78}/Γ

Unseen decay modes of the $a_2(1320)^+$ are included.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.0015	90	ANJOS 92C	E691	γ Be 90–260 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.004	90	COFFMAN 92B	MRK3	e^+e^- 3.77 GeV

$\Gamma(\overline{K}_1(1270)^0 \pi^+)/\Gamma_{total}$ — Γ_{84}/Γ

Unseen decay modes of the $\overline{K}_1(1270)^0$ are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.007	90	ANJOS	92C	E691	γ Be 90–260 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.011	90	COFFMAN	92B	MRK3	$e^+ e^-$ 3.77 GeV

$\Gamma(\overline{K}_1(1400)^0 \pi^+)/\Gamma_{total}$ — Γ_{85}/Γ

Unseen decay modes of the $\overline{K}_1(1400)^0$ are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.009	90	[65] ANJOS	92C	E691	γ Be 90–260 GeV

[65] ANJOS 92C sees no evidence for $\overline{K}_1(1400)^0 \pi^+$ in either the $\overline{K}^0 \pi^+ \pi^+ \pi^-$ or $K^- \pi^+ \pi^+ \pi^0$ channels, whereas COFFMAN 92B finds the $\overline{K}_1(1400)^0 \pi^+$ branching fraction to be large; see the next entry.

$\Gamma(\overline{K}_1(1400)^0 \pi^+)/\Gamma(K^0_S \pi^+ \pi^+ \pi^-)$ — Γ_{85}/Γ_{62}

Unseen decay modes of the $\overline{K}_1(1400)^0$ are included.

VALUE	DOCUMENT ID		TECN	COMMENT
1.4 ±0.5 OUR FIT Error includes scale factor of 1.2.				
1.246±0.212±0.360	COFFMAN	92B	MRK3	$e^+ e^-$ 3.77 GeV

$\Gamma(\overline{K}^*(1410)^0 \pi^+)/\Gamma_{total}$ — Γ_{86}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.007	90	COFFMAN	92B	MRK3	$e^+ e^-$ 3.77 GeV

$\Gamma(K^*(892)^- \pi^+ \pi^+ \text{total})/\Gamma(K^0_S \pi^+ \pi^+ \pi^-)$ — Γ_{89}/Γ_{62}

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.82±0.28	14	ALEEV	94	BIS2	nN 20–70 GeV

$\Gamma(K^*(892)^- \pi^+ \pi^+ \text{3-body})/\Gamma_{total}$ — Γ_{90}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.013	90	COFFMAN	92B	MRK3	$e^+ e^-$ 3.77 GeV

$\Gamma(K^*(892)^- \pi^+ \pi^+ \text{3-body})/\Gamma(K^0_S \pi^+ \pi^+ \pi^-)$ — Γ_{90}/Γ_{62}

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

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.57^{+0.35}_{-0.30}}$ **OUR FIT** Error includes scale factor of 1.2.				
1.00±0.18±0.42	ANJOS	92C	E691	γ Be 90–260 GeV

$\Gamma(K^0_S \rho^0 \pi^+ \text{total})/\Gamma(K^0_S \pi^+ \pi^+ \pi^-)$ — Γ_{66}/Γ_{62}

This includes $\overline{K}^0 a_1(1260)^+$. The next two entries give the specifically 3-body reaction.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
0.60±0.10±0.17	90	ANJOS	92C	E691	γ Be 90–260 GeV

$\Gamma(K^0_S \rho^0 \pi^+ \text{3-body})/\Gamma_{\text{total}}$ — Γ_{67}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.002	90	COFFMAN	92B	MRK3	$e^+ e^-$ 3.77 GeV

$\Gamma(K^0_S \rho^0 \pi^+ \text{3-body})/\Gamma(K^0_S \pi^+ \pi^+ \pi^-)$ — Γ_{67}/Γ_{62}

VALUE	DOCUMENT ID		TECN	COMMENT
0.07±0.04±0.06	ANJOS	92C	E691	γ Be 90–260 GeV

$\Gamma(K^0_S f_0(980) \pi^+)/\Gamma_{\text{total}}$ — Γ_{91}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.0025	90	ANJOS	92C	E691	γ Be 90–260 GeV

$\Gamma(K^0_S \pi^+ \pi^+ \pi^- \text{ nonresonant})/\Gamma(K^0_S \pi^+ \pi^+ \pi^-)$ — Γ_{68}/Γ_{62}

VALUE	DOCUMENT ID		TECN	COMMENT
0.12±0.06 OUR AVERAGE				
0.10±0.04 ±0.06	ANJOS	92C	E691	γ Be 90–260 GeV
0.17±0.056±0.100	COFFMAN	92B	MRK3	$e^+ e^-$ 3.77 GeV

$\Gamma(K^- 3\pi^+ \pi^-)/\Gamma(K^- \pi^+ \pi^+)$ — Γ_{69}/Γ_{42}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.061±0.005 OUR FIT Error includes scale factor of 1.1.					
0.062±0.008 OUR AVERAGE Error includes scale factor of 1.3.					
0.058±0.002±0.006	2923	LINK	03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV
0.077±0.008±0.010	239	FRABETTI	97C	E687	γ Be, $\overline{E}_\gamma \approx$ 200 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.09 ±0.01 ±0.01	113	ANJOS	90D	E691	Photoproduction

$\Gamma(\overline{K}^*(892)^0 \pi^+ \pi^+ \pi^-, \overline{K}^*(892)^0 \to K^- \pi^+)/\Gamma(K^- 3\pi^+ \pi^-)$ — Γ_{70}/Γ_{69}

VALUE	DOCUMENT ID		TECN	COMMENT
0.21±0.04±0.06	LINK	03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(\overline{K}^*(892)^0 \rho^0 \pi^+, \overline{K}^*(892)^0 \to K^- \pi^+)/\Gamma(K^- 3\pi^+ \pi^-)$ — Γ_{71}/Γ_{69}

VALUE	DOCUMENT ID		TECN	COMMENT
0.40±0.03±0.06	LINK	03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(\overline{K}^*(892)^0 \rho^0 \pi^+, \overline{K}^*(892)^0 \to K^- \pi^+)/\Gamma(K^- \pi^+ \pi^+)$ — Γ_{71}/Γ_{42}

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.016±0.007±0.004	FRABETTI	97C	E687	γ Be, $\overline{E}_\gamma \approx$ 200 GeV

$\Gamma\big(\overline{K}^*(892)^0\pi^+\pi^+\pi^-$ no-ρ, $\overline{K}^*(892)^0\to K^-\pi^+\big)/\Gamma\big(K^-\pi^+\pi^+\big)$ — Γ_{72}/Γ_{42}

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.032\pm0.010\pm0.008$	FRABETTI	97C	E687	γ Be, $\overline{E}_\gamma\approx$ 200 GeV

$\Gamma\big(K^-\rho^0\pi^+\pi^+\big)/\Gamma\big(K^-\pi^+\pi^+\big)$ — Γ_{73}/Γ_{42}

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.034\pm0.009\pm0.005$	FRABETTI	97C	E687	γ Be, $\overline{E}_\gamma\approx$ 200 GeV

$\Gamma\big(K^-\rho^0\pi^+\pi^+\big)/\Gamma\big(K^-3\pi^+\pi^-\big)$ — Γ_{73}/Γ_{69}

VALUE	DOCUMENT ID		TECN	COMMENT
$0.30\pm0.04\pm0.01$	LINK	03D	FOCS	γ A, $\overline{E}_\gamma\approx$ 180 GeV

$\Gamma\big(\overline{K}^*(892)^0 a_1(1260)^+\big)/\Gamma\big(K^-\pi^+\pi^+\big)$ — Γ_{92}/Γ_{42}

Unseen decay modes of the $\overline{K}^*(892)^0$ and $a_1(1260)^+$ are included.

VALUE	DOCUMENT ID		TECN	COMMENT
$0.099\pm0.008\pm0.018$	LINK	03D	FOCS	γ A, $\overline{E}_\gamma\approx$ 180 GeV

$\Gamma\big(K^-3\pi^+\pi^-$ nonresonant$\big)/\Gamma\big(K^-3\pi^+\pi^-\big)$ — Γ_{74}/Γ_{69}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$0.07\pm0.05\pm0.01$		LINK	03D	FOCS	γ A, $\overline{E}_\gamma\approx$ 180 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.026	90	FRABETTI	97C	E687	γ Be, $\overline{E}_\gamma\approx$ 200 GeV

$\Gamma\big(K^+2K^0_S\big)/\Gamma\big(K^-\pi^+\pi^+\big)$ — Γ_{75}/Γ_{42}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.049 ± 0.022 OUR AVERAGE	Error includes scale factor of 2.4.				
$0.035\pm0.010\pm0.005$	39 ± 9	ALBRECHT	94I	ARG	$e^+e^-\approx$ 10 GeV
0.085 ± 0.018	70 ± 12	AMMAR	91	CLEO	$e^+e^-\approx$ 10.5 GeV

$\Gamma\big(K^+K^-K^0_S\pi^+\big)/\Gamma\big(K^0_S\pi^+\pi^+\pi^-\big)$ — Γ_{76}/Γ_{62}

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
$7.7\pm1.5\pm0.9$	35 ± 7	LINK	01C	FOCS	γ nucleus, $\overline{E}_\gamma\approx$ 180 GeV

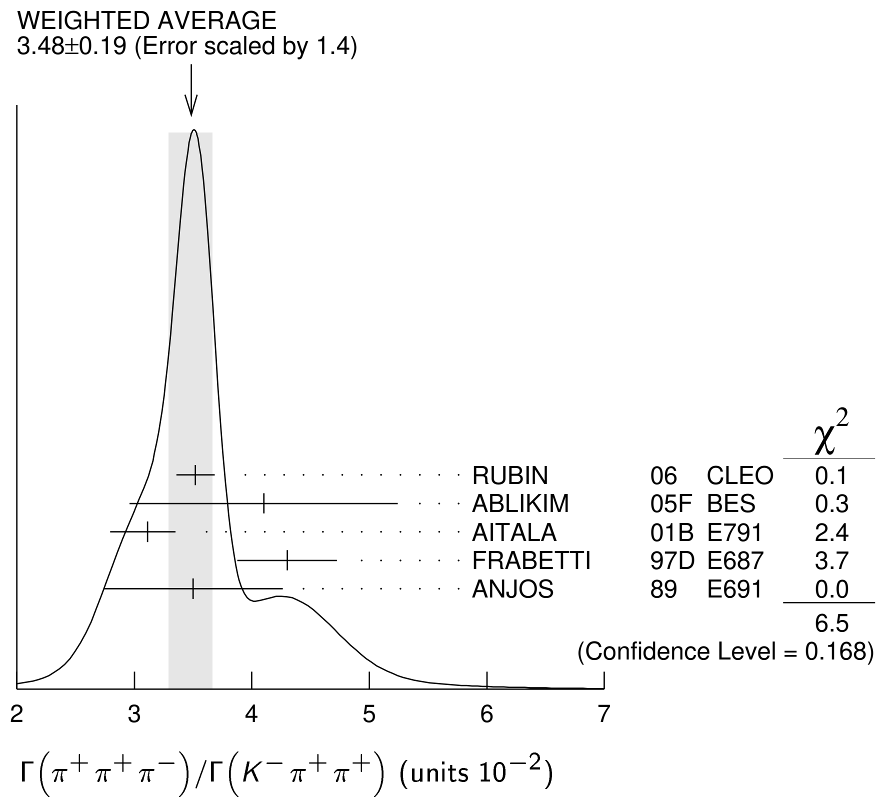
Pionic modes

$\Gamma\big(\pi^+\pi^0\big)/\Gamma\big(K^-\pi^+\pi^+\big)$ — Γ_{93}/Γ_{42}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
1.35 ± 0.08 OUR AVERAGE					
$1.33\pm0.07\pm0.06$	914 ± 46	RUBIN	06	CLEO	e^+e^- at $\psi(3770)$
$1.44\pm0.19\pm0.10$	171 ± 22	ARMS	04	CLEO	$e^+e^-\approx$ 10 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$2.8\pm0.6\pm0.5$	34	SELEN	93	CLE2	See ARMS 04

$\Gamma(\pi^+\pi^+\pi^-)/\Gamma(K^-\pi^+\pi^+)$ Γ_{94}/Γ_{42}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
3.48±0.19 OUR AVERAGE	Error includes scale factor of 1.4. See the ideogram below.				
$3.52\pm0.11\pm0.12$	3303 ± 95	RUBIN	06	CLEO	e^+e^- at $\psi(3770)$
$4.1\ \pm1.1\ \pm0.3$	85 ± 22	ABLIKIM	05F	BES	$e^+e^-\approx\ \psi(3770)$
$3.11\pm0.18^{+0.16}_{-0.26}$	1172	AITALA	01B	E791	π^- nucleus, 500 GeV
$4.3\ \pm0.3\ \pm0.3$	236	FRABETTI	97D	E687	γ Be $\approx$ 200 GeV
$3.5\ \pm0.7\ \pm0.3$	83	ANJOS	89	E691	Photoproduction
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$3.2\ \pm1.1\ \pm0.3$	20	ADAMOVICH	93	WA82	π^- 340 GeV
$4.2\ \pm1.6\ \pm1.0$	57	BALTRUSAIT...	85E	MRK3	e^+e^- 3.77 GeV



$\Gamma(\rho^0\pi^+)/\Gamma(\pi^+\pi^+\pi^-)$ Γ_{95}/Γ_{94}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.322 ±0.027 OUR AVERAGE				
$0.3082\pm0.0314\pm0.0230$	LINK	04	FOCS	Dalitz fit, 1527 ± 51 evts
$0.336\ \pm0.032\ \pm0.022$	AITALA	01B	E791	Dalitz fit, 1172 evts
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.289\ \pm0.055\ \pm0.058$	[66] FRABETTI	97D	E687	γ Be $\approx$ 200 GeV

[66] FRABETTI 97D also includes $f_2(1270)\pi^+$ and $f_0(980)\pi^+$ modes in the fit, but the resulting decay fractions are not statistically significant.

$\Gamma(\pi^+(\pi^+\pi^-)_{S-\mathrm{wave}})/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{96}/Γ_{94}

This is the "fit fraction" from the Dalitz-plot analysis. See also the next three data blocks.

VALUE	DOCUMENT ID		TECN	COMMENT
0.5600±0.0324±0.0214	[67] LINK	04	FOCS	Dalitz fit, 1527 ± 51 evts

[67] 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.

$\Gamma(\sigma\pi^+, \sigma\to\pi^+\pi^-)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{97}/Γ_{94}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.463±0.090±0.021	AITALA	01B	E791	Dalitz fit, 1172 evts

$\Gamma(f_0(980)\pi^+, f_0(980)\to\pi^+\pi^-)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{98}/Γ_{94}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.062±0.013±0.004	AITALA	01B	E791	Dalitz fit, 1172 evts

$\Gamma(f_0(1370)\pi^+, f_0(1370)\to\pi^+\pi^-)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{99}/Γ_{94}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.023±0.015±0.008	AITALA	01B	E791	Dalitz fit, 1172 evts

$\Gamma(f_2(1270)\pi^+, f_2(1270)\to\pi^+\pi^-)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{100}/Γ_{94}

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.15 ±0.04 OUR AVERAGE	Error includes scale factor of 2.4.			
0.1174±0.0190±0.0029	LINK	04	FOCS	Dalitz fit, 1527 ± 51 evts
0.194 ±0.025 ±0.004	AITALA	01B	E791	Dalitz fit, 1172 evts

$\Gamma(\rho(1450)^0\pi^+, \rho(1450)^0\to\pi^+\pi^-)/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{101}/Γ_{94}

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. • • •				
0.007±0.007±0.003	AITALA	01B	E791	Dalitz fit, 1172 evts

$\Gamma(\pi^+\pi^+\pi^-\ \mathrm{nonresonant})/\Gamma(\pi^+\pi^+\pi^-)$ — Γ_{102}/Γ_{94}

This is the "fit fraction" from the Dalitz-plot analysis. The big difference between the results here of AITALA 01B and FRABETTI 97D is the addition of the $\sigma\pi^+$ channel to the AITALA 01B fit. LINK 04 (see earlier data blocks), in agreement with AITALA 01B, finds no evidence for a large nonresonant fraction.

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.078±0.060±0.027	AITALA	01B	E791	Dalitz fit, 1172 evts
0.589±0.105±0.081	[68] FRABETTI	97D	E687	γ Be ≈ 200 GeV

[68] FRABETTI 97D also includes $f_2(1270)\pi^+$ and $f_0(980)\pi^+$ modes in the fit, but the resulting decay fractions are not statistically significant.

$\Gamma(\pi^+ 2\pi^0)/\Gamma(K^-\pi^+\pi^+)$ — Γ_{103}/Γ_{42}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
5.0±0.3±0.3	1535 ± 89	RUBIN	06	CLEO	e^+e^- at $\psi(3770)$

$\Gamma(\pi^+\pi^+\pi^-\pi^0)/\Gamma(K^-\pi^+\pi^+)$ — Γ_{104}/Γ_{42}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
12.4±0.5±0.6	5701 ± 205	RUBIN	06	CLEO	e^+e^- at $\psi(3770)$

$\Gamma(\eta\pi^+)/\Gamma(\phi\pi^+)$ — $\Gamma_{109}/\Gamma_{131}$

Unseen decay modes of the η are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.54±0.06 OUR FIT					
0.49±0.08	275	JESSOP	98	CLE2	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\eta\pi^+)/\Gamma(K^-\pi^+\pi^+)$ — Γ_{109}/Γ_{42}

Unseen decay modes of the η are included.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
3.68±0.31 OUR FIT					
3.81±0.26±0.21	377 ± 26	RUBIN	06	CLEO	e^+e^- at $\psi(3770)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
8.3 ±2.3 ±1.4	99	DAOUDI	92	CLE2	See JESSOP 98

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

Unseen decay modes of the ω are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<3.4 × 10⁻⁴	90	RUBIN	06	CLEO	e^+e^- at $\psi(3770)$

$\Gamma(3\pi^+ 2\pi^-)/\Gamma(K^-\pi^+\pi^+)$ — Γ_{107}/Γ_{42}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
1.77±0.17 OUR FIT					
1.73±0.20±0.17	732 ± 77	RUBIN	06	CLEO	e^+e^- at $\psi(3770)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2.3 ±0.4 ±0.2	58	FRABETTI	97C	E687	γBe, $\overline{E}_\gamma \approx$ 200 GeV

$\Gamma(3\pi^+ 2\pi^-)/\Gamma(K^- 3\pi^+\pi^-)$ — Γ_{107}/Γ_{69}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.289±0.019 OUR FIT					
0.290±0.017±0.011	835	LINK	03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(\eta\rho^+)/\Gamma(\phi\pi^+)$ — $\Gamma_{111}/\Gamma_{131}$

Unseen decay modes of the η are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.11	90	JESSOP	98	CLE2	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\eta'(958)\pi^+)/\Gamma(\phi\pi^+)$ — $\Gamma_{112}/\Gamma_{131}$

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.82±0.14	126	JESSOP	98	CLE2	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\eta'(958)\rho^+)/\Gamma(\phi\pi^+)$ — $\Gamma_{113}/\Gamma_{131}$

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.86	90	JESSOP	98	CLE2	$e^+e^- \approx \Upsilon(4S)$

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

$\Gamma(K^+K^0_S)/\Gamma(K^0_S\pi^+)$ — Γ_{114}/Γ_{41}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.201 ±0.011 OUR FIT					
0.206 ±0.014 OUR AVERAGE					
0.222 ±0.037 ±0.013	63 ± 10	ABLIKIM	05F	BES	$e^+e^- \approx \psi(3770)$
0.1892±0.0155±0.0073	278 ± 21	ARMS	04	CLEO	$e^+e^- \approx$ 10 GeV
0.25 ±0.04 ±0.02	129	FRABETTI	95	E687	γBe $\overline{E}_\gamma \approx$ 200 GeV
0.271 ±0.065 ±0.039	69	ANJOS	90C	E691	γBe
0.317 ±0.086 ±0.048	31	BALTRUSAIT...	85E	MRK3	e^+e^- 3.77 GeV
0.25 ±0.15	6	SCHINDLER	81	MRK2	e^+e^- 3.771 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.1996±0.0119±0.0096	949	[69] LINK	02B	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV
0.222 ±0.041 ±0.019	70	[70] BISHAI	97	CLE2	See ARMS 04

[69] This LINK 02B result is redundant with a result in the next datablock.
[70] This BISHAI 97 result is redundant with results elsewhere in the Listings.

$\Gamma(K^+K^0_S)/\Gamma(K^-\pi^+\pi^+)$ — Γ_{114}/Γ_{42}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
3.11±0.17 OUR FIT					
3.02±0.18±0.15	949	LINK	02B	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3.86±0.69±0.37	70	[71] BISHAI	97	CLE2	See ARMS 04

[71] See BISHAI 97 for an isospin analysis of $D^+ \to K\overline{K}$ amplitudes.

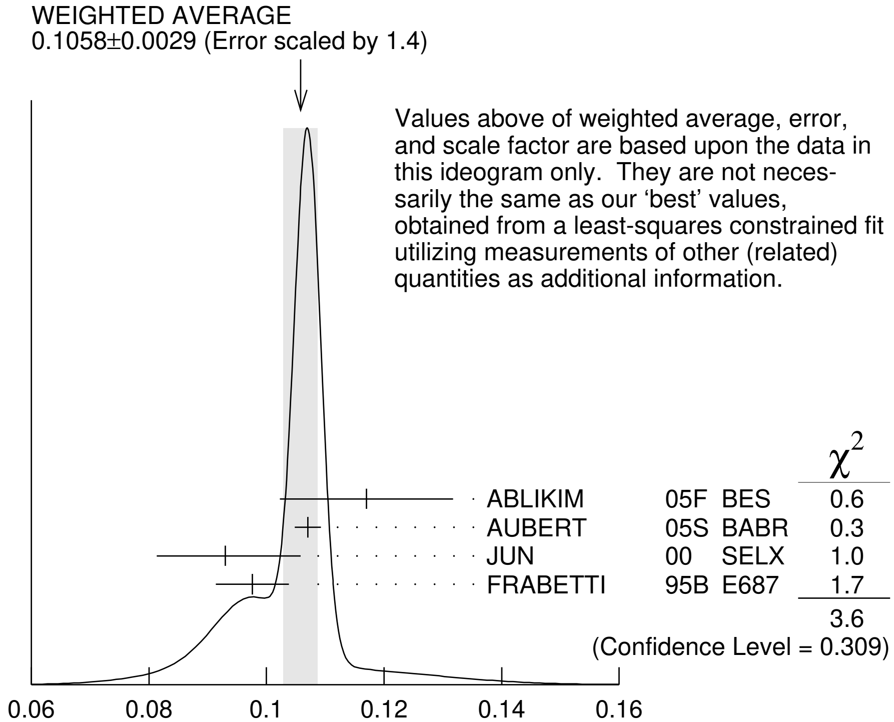
$\Gamma(K^+K^-\pi^+)/\Gamma_{total}$ — Γ_{115}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.0100±0.0004 OUR FIT Error includes scale factor of 1.2.					
0.0097±0.0004±0.0004	1250 ± 40	[72] HE	05	CLEO	e^+e^- at $\psi(3770)$

[72] HE 05 uses single- and double-tagged events in an overall fit. The fraction here includes (unobserved) final-state photons.

$\Gamma(K^+K^-\pi^+)/\Gamma(K^-\pi^+\pi^+)$ — Γ_{115}/Γ_{42}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.1054±0.0025 OUR FIT Error includes scale factor of 1.3.					
0.1058±0.0029 OUR AVERAGE Error includes scale factor of 1.4. See the ideogram below.					
0.117 ±0.013 ±0.007	181 ± 20	ABLIKIM	05F	BES	$e^+e^- \approx \psi(3770)$
0.107 ±0.001 ±0.002	43k	AUBERT	05S	BABR	$e^+e^- \approx \Upsilon(4S)$
0.093 ±0.010 $^{+0.008}_{-0.006}$		JUN	00	SELX	Σ^- nucleus, 600 GeV
0.0976±0.0042±0.0046		FRABETTI	95B	E687	γ Be, $\overline{E}_\gamma \approx$ 200 GeV



$\Gamma\left(K^+K^-\pi^+\right)/\Gamma\left(K^-\pi^+\pi^+\right)$ Γ_{115}/Γ_{42}

$\Gamma\left(\phi\pi^+, \phi\to K^+K^-\right)/\Gamma\left(K^+K^-\pi^+\right)$ $\Gamma_{116}/\Gamma_{115}$

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.317±0.034 OUR FIT				
0.292±0.031±0.030	FRABETTI	95B	E687	Dalitz fit, 915 evts

$\Gamma\left(\phi\pi^+, \phi\to K^+K^-\right)/\Gamma\left(\phi\pi^+\right)$ $\Gamma_{116}/\Gamma_{131}$

VALUE		DOCUMENT ID	
0.491±0.006 OUR FIT			
0.491±0.006	[73]	PDG	06

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

$\Gamma\left(\phi\pi^+\right)/\Gamma\left(K^-\pi^+\pi^+\right)$ Γ_{131}/Γ_{42}

Unseen decay modes of the ϕ are included. However, we now get branching fractions for resonant submodes of $K^+K^-\pi^+$ decays from Dalitz-plot analyses.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.062±0.017±0.006	19	ADAMOVICH	93	WA82	π^- 340 GeV
0.077±0.011±0.005	128	DAOUDI	92	CLE2	$e^+e^-\approx$ 10.5 GeV
0.098±0.032±0.014	12	ALVAREZ	90C	NA14	Photoproduction
0.071±0.008±0.007	84	ANJOS	88	E691	Photoproduction
0.084±0.021±0.011	21	BALTRUSAIT...	85E	MRK3	e^+e^- 3.77 GeV

$\Gamma(K^+\overline{K}^*(892)^0, \overline{K}^*(892)^0 \to K^-\pi^+)/\Gamma(K^+K^-\pi^+)$ — $\Gamma_{117}/\Gamma_{115}$

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.301±0.020±0.025	FRABETTI	95B	E687	Dalitz fit, 915 evts

$\Gamma(K^+\overline{K}_0^*(1430)^0, \overline{K}_0^*(1430)^0 \to K^-\pi^+)/\Gamma(K^+K^-\pi^+)$ — $\Gamma_{118}/\Gamma_{115}$

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.370±0.035±0.018	FRABETTI	95B	E687	Dalitz fit, 915 evts

$\Gamma(K^+\overline{K}^*(892)^0)/\Gamma(K^-\pi^+\pi^+)$ — Γ_{134}/Γ_{42}

Unseen decay modes of the $\overline{K}^*(892)^0$ are included. However, we now get branching fractions for resonant submodes of $K^+K^-\pi^+$ decays from Dalitz-plot analyses.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.058±0.009±0.006	73	ANJOS	88	E691	Photoproduction
0.048±0.021±0.011	14	BALTRUSAIT...	85E	MRK3	e^+e^- 3.77 GeV

$\Gamma(K^+K^-\pi^+$ nonresonant$)/\Gamma(K^-\pi^+\pi^+)$ — Γ_{119}/Γ_{42}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.049±0.008±0.006	95	ANJOS	88	E691	Photoproduction
0.059±0.026±0.009	37	BALTRUSAIT...	85E	MRK3	e^+e^- 3.77 GeV

$\Gamma(K^*(892)^+K_S^0)/\Gamma(K_S^0\pi^+)$ — Γ_{135}/Γ_{41}

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.1±0.3±0.4	67	FRABETTI	95	E687	γ Be $\overline{E}_\gamma \approx$ 200 GeV

$\Gamma(\phi\pi^+\pi^0)/\Gamma_{total}$ — Γ_{132}/Γ

Unseen decay modes of the ϕ are included.

VALUE	DOCUMENT ID		TECN	COMMENT
0.023±0.010	[74] BARLAG	92C	ACCM	π^- Cu 230 GeV

[74] BARLAG 92C computes the branching fraction using topological normalization.

$\Gamma(\phi\pi^+\pi^0)/\Gamma(K^-\pi^+\pi^+)$ — Γ_{132}/Γ_{42}

Unseen decay modes of the ϕ are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.58	90	ALVAREZ	90C	NA14	Photoproduction
<0.28	90	ANJOS	89E	E691	Photoproduction

$\Gamma(\phi\rho^+)/\Gamma(K^-\pi^+\pi^+)$ — Γ_{133}/Γ_{42}

Unseen decay modes of the ϕ are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.16	90	DAOUDI	92	CLE2	$e^+e^- \approx$ 10.5 GeV

$\Gamma(K^+ K^- \pi^+ \pi^0 \text{ non-}\phi)/\Gamma_{total}$ — Γ_{125}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
$\mathbf{0.015^{+0.007}_{-0.006}}$	[75] BARLAG 92C	ACCM	π^- Cu 230 GeV

[75] BARLAG 92C computes the branching fraction using topological normalization.

$\Gamma(K^+ K^- \pi^+ \pi^0 \text{ non-}\phi)/\Gamma(K^- \pi^+ \pi^+)$ — Γ_{125}/Γ_{42}

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.25	90	ANJOS 89E	E691	Photoproduction

$\Gamma(K^+ K^0_S \pi^+ \pi^-)/\Gamma(K^0_S \pi^+ \pi^+ \pi^-)$ — Γ_{126}/Γ_{62}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
5.62±0.39±0.40	469 ± 32	LINK 01C	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(K^0_S K^- \pi^+ \pi^+)/\Gamma(K^0_S \pi^+ \pi^+ \pi^-)$ — Γ_{127}/Γ_{62}

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
7.68±0.41±0.32	670 ± 35	LINK 01C	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(K^*(892)^+ \overline{K}^*(892)^0)/\Gamma_{total}$ — Γ_{136}/Γ

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

VALUE	DOCUMENT ID	TECN	COMMENT
0.026±0.008±0.007	ALBRECHT 92B	ARG	$e^+ e^- \simeq$ 10.4 GeV

$\Gamma(K^0_S K^- \pi^+ \pi^+ (\text{non-}K^{*+} \overline{K}^{*0}))/\Gamma_{total}$ — Γ_{129}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.004	90	ALBRECHT 92B	ARG	$e^+ e^- \simeq$ 10.4 GeV

$\Gamma(K^+ K^- \pi^+ \pi^+ \pi^-)/\Gamma(K^- 3\pi^+ \pi^-)$ — Γ_{130}/Γ_{69}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.040±0.009±0.019	38	LINK 03D	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

Doubly Cabibbo-suppressed modes

$\Gamma(K^+ \pi^0)/\Gamma_{total}$ — Γ_{137}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$\mathbf{<4.2 \times 10^{-4}}$	90	ARMS 04	CLEO	$e^+ e^- \approx$ 10 GeV

$\Gamma(K^+ \pi^+ \pi^-)/\Gamma(K^- \pi^+ \pi^+)$ — Γ_{138}/Γ_{42}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.0068±0.0008 OUR AVERAGE				
0.0065±0.0008±0.0004	189 ± 24	LINK 04F	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV
0.0077±0.0017±0.0008	59 ± 13	AITALA 97C	E791	π^- A, 500 GeV
0.0072±0.0023±0.0017	21	FRABETTI 95E	E687	γBe, $\overline{E}_\gamma$= 220 GeV

$\Gamma(K^+\rho^0)/\Gamma(K^+\pi^+\pi^-)$ — $\Gamma_{139}/\Gamma_{138}$

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.39 ±0.09 OUR AVERAGE				
0.3943±0.0787±0.0815	LINK	04F	FOCS	Dalitz fit, 189 evts
0.37 ±0.14 ±0.07	AITALA	97C	E791	Dalitz fit, 59 evts

$\Gamma(K^+ f_0(980), f_0(980)\to\pi^+\pi^-)/\Gamma(K^+\pi^+\pi^-)$ — $\Gamma_{141}/\Gamma_{138}$

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.0892±0.0333±0.0412	LINK	04F	FOCS	Dalitz fit, 189 evts

$\Gamma(K^*(892)^0\pi^+, K^*(892)^0\to K^+\pi^-)/\Gamma(K^+\pi^+\pi^-)$ — $\Gamma_{140}/\Gamma_{138}$

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.47 ±0.08 OUR AVERAGE				
0.5220±0.0684±0.0638	LINK	04F	FOCS	Dalitz fit, 189 evts
0.35 ±0.14 ±0.01	AITALA	97C	E791	Dalitz fit, 59 evts

$\Gamma(K_2^*(1430)^0\pi^+, K_2^*(1430)^0\to K^+\pi^-)/\Gamma(K^+\pi^+\pi^-)$ — $\Gamma_{142}/\Gamma_{138}$

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.0803±0.0372±0.0391	LINK	04F	FOCS	Dalitz fit, 189 evts

$\Gamma(K^+\pi^+\pi^-$ nonresonant$)/\Gamma(K^+\pi^+\pi^-)$ — $\Gamma_{143}/\Gamma_{138}$

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. • • •				
0.36±0.14±0.07	[76] AITALA	97C	E791	Dalitz fit, 59 evts

[76] LINK 04F, with three times as many events, finds no need for a nonresonant amplitude.

$\Gamma(K^+K^+K^-)/\Gamma(K^-\pi^+\pi^+)$ — Γ_{144}/Γ_{42}

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
9.49±2.17±0.22		65	[77] LINK	02I	FOCS	γ nucleus, $\approx$ 180 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<16	90		[78] FRABETTI	95F	E687	γBe, $\overline{E}_\gamma\approx$ 220 GeV
570 ± 200 ± 70		13	ADAMOVICH	93	WA82	π^- 340 GeV

[77] LINK 02I finds little evidence for ϕK^+ or $f_0(980)K^+$ submodes.

[78] Using the $\phi\pi^+$ mode to normalize, FRABETTI 95F gets $\Gamma(K^+K^+K^-)/\Gamma(\phi\pi^+)<$ 0.025.

$\Gamma(\phi K^+)/\Gamma(\phi\pi^+)$ — $\Gamma_{145}/\Gamma_{131}$

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.021	90		FRABETTI	95F	E687	γBe, $\overline{E}_\gamma\approx$ 220 GeV
$0.058^{+0.032}_{-0.026}\pm0.007$		4	[79] ANJOS	92D	E691	γBe, $\overline{E}_\gamma=$ 145 GeV

[79] The evidence of ANJOS 92D is a small excess of events $(4.5^{+2.4}_{-2.0})$.

Rare or forbidden modes

$\Gamma(\pi^+ e^+ e^-)/\Gamma_{total}$ Γ_{146}/Γ

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

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$<7.4 \times 10^{-6}$	90		HE	05A	CLEO	$e^+ e^-$ at $\psi(3770)$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$<5.2 \times 10^{-5}$	90		AITALA	99G	E791	$\pi^- N$ 500 GeV
$<1.1 \times 10^{-4}$	90		FRABETTI	97B	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
$<6.6 \times 10^{-5}$	90		AITALA	96	E791	$\pi^- N$ 500 GeV
$<2.5 \times 10^{-3}$	90		WEIR	90B	MRK2	$e^+ e^-$ 29 GeV
$<2.6 \times 10^{-3}$	90	39	HAAS	88	CLEO	$e^+ e^-$ 10 GeV

$\Gamma(\pi^+ \phi, \phi \to e^+ e^-)/\Gamma_{total}$ Γ_{147}/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
$(2.7^{+3.6}_{-1.8} \pm 0.2) \times 10^{-6}$	2	[80] HE	05A	CLEO	$e^+ e^-$ at $\psi(3770)$

[80] This HE 05A result is consistent with the branching fraction for $D^+ \to \phi \pi^+$, $\phi \to K^+ K^-$.

$\Gamma(\pi^+ \mu^+ \mu^-)/\Gamma_{total}$ Γ_{148}/Γ

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

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$<8.8 \times 10^{-6}$	90		LINK	03F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$<1.5 \times 10^{-5}$	90		AITALA	99G	E791	$\pi^- N$ 500 GeV
$<8.9 \times 10^{-5}$	90		FRABETTI	97B	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
$<1.8 \times 10^{-5}$	90		AITALA	96	E791	$\pi^- N$ 500 GeV
$<2.2 \times 10^{-4}$	90	0	KODAMA	95	E653	π^- emulsion 600 GeV
$<5.9 \times 10^{-3}$	90		WEIR	90B	MRK2	$e^+ e^-$ 29 GeV
$<2.9 \times 10^{-3}$	90	36	HAAS	88	CLEO	$e^+ e^-$ 10 GeV

$\Gamma(\rho^+ \mu^+ \mu^-)/\Gamma_{total}$ Γ_{149}/Γ

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

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$<5.6 \times 10^{-4}$	90	0	KODAMA	95	E653	π^- emulsion 600 GeV

$\Gamma(K^+ e^+ e^-)/\Gamma_{total}$ Γ_{150}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<6.2 \times 10^{-6}$	90	HE	05A	CLEO	$e^+ e^-$ at $\psi(3770)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<2.0 \times 10^{-4}$	90	AITALA	99G	E791	$\pi^- N$ 500 GeV
$<2.0 \times 10^{-4}$	90	FRABETTI	97B	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
$<4.8 \times 10^{-3}$	90	WEIR	90B	MRK2	$e^+ e^-$ 29 GeV

$\Gamma(K^+\mu^+\mu^-)/\Gamma_{\text{total}}$ Γ_{151}/Γ

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<9.2 × 10^{-6}	90		LINK	03F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<4.4 × 10^{-5}	90		AITALA	99G	E791	π^- N 500 GeV
<9.7 × 10^{-5}	90		FRABETTI	97B	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
<3.2 × 10^{-4}	90	0	KODAMA	95	E653	π^- emulsion 600 GeV
<9.2 × 10^{-3}	90		WEIR	90B	MRK2	e^+e^- 29 GeV

$\Gamma(\pi^+e^\pm\mu^\mp)/\Gamma_{\text{total}}$ Γ_{152}/Γ

A test of lepton-family-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<3.4 × 10^{-5}	90	AITALA	99G	E791	π^- N 500 GeV

$\Gamma(\pi^+e^+\mu^-)/\Gamma_{\text{total}}$ Γ_{153}/Γ

A test of lepton-family-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.1 × 10^{-4}	90	FRABETTI	97B	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
<3.3 × 10^{-3}	90	WEIR	90B	MRK2	e^+e^- 29 GeV

$\Gamma(\pi^+e^-\mu^+)/\Gamma_{\text{total}}$ Γ_{154}/Γ

A test of lepton-family-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.3 × 10^{-4}	90	FRABETTI	97B	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
<3.3 × 10^{-3}	90	WEIR	90B	MRK2	e^+e^- 29 GeV

$\Gamma(K^+e^\pm\mu^\mp)/\Gamma_{\text{total}}$ Γ_{155}/Γ

A test of lepton-family-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<6.8 × 10^{-5}	90	AITALA	99G	E791	π^- N 500 GeV

$\Gamma(K^+e^+\mu^-)/\Gamma_{\text{total}}$ Γ_{156}/Γ

A test of lepton-family-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.3 × 10^{-4}	90	FRABETTI	97B	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
<3.4 × 10^{-3}	90	WEIR	90B	MRK2	e^+e^- 29 GeV

$\Gamma(K^+e^-\mu^+)/\Gamma_{\text{total}}$ Γ_{157}/Γ

A test of lepton-family-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<1.2 × 10^{-4}	90	FRABETTI	97B	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
<3.4 × 10^{-3}	90	WEIR	90B	MRK2	e^+e^- 29 GeV

$\Gamma(\pi^- e^+ e^+)/\Gamma_{total}$ Γ_{158}/Γ

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<3.6 \times 10^{-6}$	90	HE 05A	CLEO	$e^+ e^-$ at $\psi(3770)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<9.6 \times 10^{-5}$	90	AITALA 99G	E791	$\pi^- N$ 500 GeV
$<1.1 \times 10^{-4}$	90	FRABETTI 97B	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
$<4.8 \times 10^{-3}$	90	WEIR 90B	MRK2	$e^+ e^-$ 29 GeV

$\Gamma(\pi^- \mu^+ \mu^+)/\Gamma_{total}$ Γ_{159}/Γ

A test of lepton-number conservation.

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
$<4.8 \times 10^{-6}$	90		LINK 03F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<1.7 \times 10^{-5}$	90		AITALA 99G	E791	$\pi^- N$ 500 GeV
$<8.7 \times 10^{-5}$	90		FRABETTI 97B	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
$<2.2 \times 10^{-4}$	90	0	KODAMA 95	E653	π^- emulsion 600 GeV
$<6.8 \times 10^{-3}$	90		WEIR 90B	MRK2	$e^+ e^-$ 29 GeV

$\Gamma(\pi^- e^+ \mu^+)/\Gamma_{total}$ Γ_{160}/Γ

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<5.0 \times 10^{-5}$	90	AITALA 99G	E791	$\pi^- N$ 500 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<1.1 \times 10^{-4}$	90	FRABETTI 97B	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
$<3.7 \times 10^{-3}$	90	WEIR 90B	MRK2	$e^+ e^-$ 29 GeV

$\Gamma(\rho^- \mu^+ \mu^+)/\Gamma_{total}$ Γ_{161}/Γ

A test of lepton-number conservation.

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
$<5.6 \times 10^{-4}$	90	0	KODAMA 95	E653	π^- emulsion 600 GeV

$\Gamma(K^- e^+ e^+)/\Gamma_{total}$ Γ_{162}/Γ

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<4.5 \times 10^{-6}$	90	HE 05A	CLEO	$e^+ e^-$ at $\psi(3770)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<1.2 \times 10^{-4}$	90	FRABETTI 97B	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
$<9.1 \times 10^{-3}$	90	WEIR 90B	MRK2	$e^+ e^-$ 29 GeV

$\Gamma(K^- \mu^+ \mu^+)/\Gamma_{total}$ Γ_{163}/Γ

A test of lepton-number conservation.

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
$<1.3 \times 10^{-5}$	90		LINK 03F	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<1.2 \times 10^{-4}$	90		FRABETTI 97B	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
$<3.2 \times 10^{-4}$	90	0	KODAMA 95	E653	π^- emulsion 600 GeV
$<4.3 \times 10^{-3}$	90		WEIR 90B	MRK2	$e^+ e^-$ 29 GeV

$\Gamma(K^- e^+ \mu^+)/\Gamma_{total}$ Γ_{164}/Γ

A test of lepton-number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.3 \times 10^{-4}$	90	FRABETTI	97B	E687	γ Be, $\overline{E}_\gamma \approx$ 220 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<4.0 \times 10^{-3}$	90	WEIR	90B	MRK2	$e^+ e^-$ 29 GeV

$\Gamma(K^*(892)^- \mu^+ \mu^+)/\Gamma_{total}$ Γ_{165}/Γ

A test of lepton-number conservation.

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$<8.5 \times 10^{-4}$	90	0	KODAMA	95	E653	π^- emulsion 600 GeV

$D^\pm$ *CP*-VIOLATING DECAY-RATE ASYMMETRIES

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

This is the difference between D^+ and D^- partial widths for these modes divided by the sum of the widths.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$-0.016 \pm 0.015 \pm 0.009$	10.6k	[81] LINK	02B	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

[81] LINK 02B measures $N(D^+ \rightarrow K^0_S \pi^+)/N(D^+ \rightarrow K^- \pi^+ \pi^+)$, the ratio of numbers of events observed, and similarly for the D^-.

$A_{CP}(K^0_S K^\pm)$ in $D^\pm \rightarrow K^0_S K^\pm$

This is the difference between D^+ and D^- partial widths for these modes divided by the sum of the widths.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$+0.071 \pm 0.061 \pm 0.012$	949	[82] LINK	02B	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$+0.069 \pm 0.060 \pm 0.015$	949	[83] LINK	02B	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

[82] LINK 02B measures $N(D^+ \rightarrow K^0_S K^+)/N(D^+ \rightarrow K^0_S \pi^+)$, the ratio of numbers of events observed, and similarly for the D^-.

[83] LINK 02B measures $N(D^+ \rightarrow K^0_S K^+)/N(D^+ \rightarrow K^- \pi^+ \pi^+)$, the ratio of numbers of events observed, and similarly for the D^-.

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

This is the difference between D^+ and D^- partial widths for these modes divided by the sum of the widths.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.007 ± 0.008 OUR AVERAGE					
$+0.014 \pm 0.010 \pm 0.008$	43k±321	[84] AUBERT	05S	BABR	$e^+ e^- \approx \Upsilon(4S)$
$+0.006 \pm 0.011 \pm 0.005$	14k	[85] LINK	00B	FOCS	
-0.014 ± 0.029		[85] AITALA	97B	E791	$-0.062 < A_{CP} < +0.034$ (90% CL)
-0.031 ± 0.068		[85] FRABETTI	94I	E687	$-0.14 < A_{CP} < +0.081$ (90% CL)

[84] AUBERT 05S measures $N(D^+ \to K^+K^-\pi^+)/N(D_s^+ \to K^+K^-\pi^+)$, the ratio of the numbers of events observed, and similarly for the D^-.
[85] FRABETTI 94I, AITALA 98C, and LINK 00B measure $N(D^+ \to K^-K^+\pi^+)/N(D^+ \to K^-\pi^+\pi^+)$, the ratio of numbers of events observed, and similarly for the D^-.

$A_{CP}(K^\pm K^{*0})$ in $D^+ \to K^+\overline{K}^{*0}$, $D^- \to K^-K^{*0}$

This is the difference between D^+ and D^- partial widths for these modes divided by the sum of the widths.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.005±0.017 OUR AVERAGE					
+0.009±0.017±0.007	11k±122	[86] AUBERT	05S	BABR	$e^+e^- \approx \Upsilon(4S)$
−0.010±0.050		[87] AITALA	97B	E791	$-0.092 < A_{CP} < +0.072$ (90% CL)
−0.12 ±0.13		[87] FRABETTI	94I	E687	$-0.33 < A_{CP} < +0.094$ (90% CL)

[86] AUBERT 05S measures $N(D^+ \to K^+\overline{K}^{*0})/N(D_s^+ \to K^+K^-\pi^+)$, the ratio of the numbers of events observed, and similarly for the D^-.
[87] FRABETTI 94I and AITALA 97B measure $N(D^+ \to K^+\overline{K}^*(892)^0)/N(D^+ \to K^-\pi^+\pi^+)$, the ratio of numbers of events observed, and similarly for the D^-.

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

This is the difference between D^+ and D^- partial widths for these modes divided by the sum of the widths.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.001±0.015 OUR AVERAGE					
+0.002±0.015±0.006	10k±136	[88] AUBERT	05S	BABR	$e^+e^- \approx \Upsilon(4S)$
−0.028±0.036		[89] AITALA	97B	E791	$-0.087 < A_{CP} < +0.031$ (90% CL)
+0.066±0.086		[89] FRABETTI	94I	E687	$-0.075 < A_{CP} < +0.21$ (90% CL)

[88] AUBERT 05S measures $N(D^+ \to \phi\pi^+)/N(D_s^+ \to K^+K^-\pi^+)$, the ratio of the numbers of events observed, and similarly for the D^-.
[89] FRABETTI 94I and AITALA 97B measure $N(D^+ \to \phi\pi^+)/N(D^+ \to K^-\pi^+\pi^+)$, the ratio of numbers of events observed, and similarly for the D^-.

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

This is the difference between D^+ and D^- partial widths for these modes divided by the sum of the widths.

VALUE	DOCUMENT ID		TECN	COMMENT
−0.017±0.042	[90] AITALA	97B	E791	$-0.086 < A_{CP} < +0.052$ (90% CL)

[90] AITALA 97B measure $N(D^+ \to \pi^+\pi^-\pi^+)/N(D^+ \to K^-\pi^+\pi^+)$, the ratio of numbers of events observed, and similarly for the D^-.

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

This is the difference between D^+ and D^- partial widths for these modes divided by the sum of the widths.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.042±0.064±0.022	523 ± 32	LINK	05E	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

D^+-D^- T-VIOLATING DECAY-RATE ASYMMETRIES

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

$C_T \equiv \vec{p}_{K^+} \cdot (\vec{p}_{\pi^+} \times \vec{p}_{\pi^-})$ is a T-odd correlation of the K^+, π^+, and π^- momenta for the D^+. $\overline{C}_T \equiv \vec{p}_{K^-} \cdot (\vec{p}_{\pi^-} \times \vec{p}_{\pi^+})$ is the corresponding quantity for the D^-. $A_T \equiv [\Gamma(C_T > 0) - \Gamma(C_T < 0)] / [\Gamma(C_T > 0) + \Gamma(C_T < 0)]$ would, in the absence of strong phases, test for T violation in D^+ decays (the Γ's are partial widths). With $\overline{A}_T \equiv [\Gamma(-\overline{C}_T > 0) - \Gamma(-\overline{C}_T < 0)] / [\Gamma(-\overline{C}_T > 0) + \Gamma(-\overline{C}_T < 0)]$, the asymmetry $A_{Tviol} \equiv \frac{1}{2}(A_T - \overline{A}_T)$ tests for T violation even with nonzero strong phases.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$+0.023 \pm 0.062 \pm 0.022$	523 ± 32	LINK	05E	FOCS	γ A, $\overline{E}_\gamma \approx$ 180 GeV

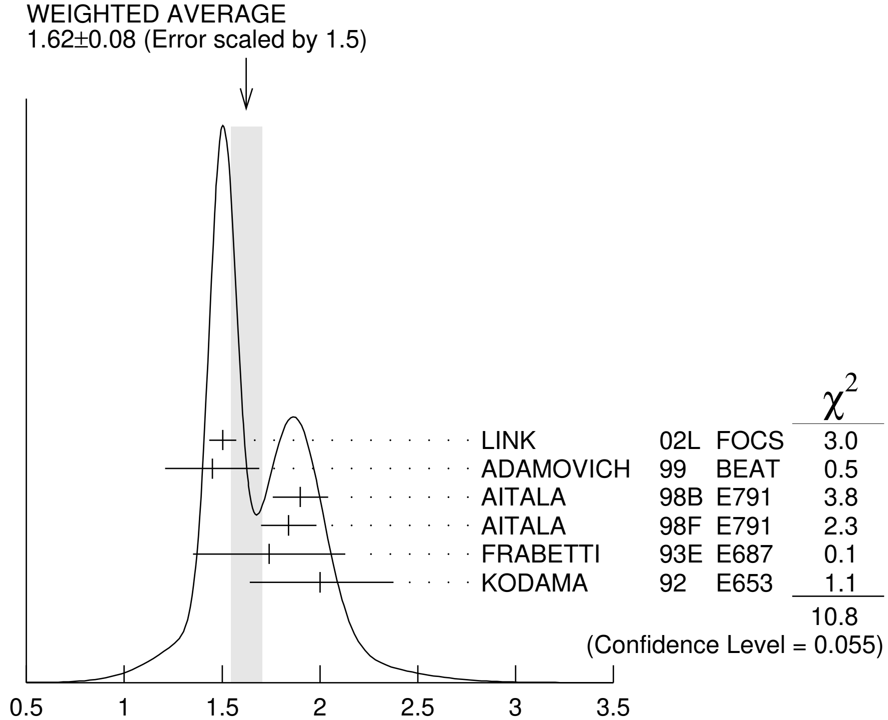
$D^+ \to \overline{K}^*(892)^0 \ell^+ \nu_\ell$ FORM FACTORS

$r_v \equiv V(0)/A_1(0)$ in $D^+ \to \overline{K}^*(892)^0 \ell^+ \nu_\ell$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.62 ±0.08 OUR AVERAGE		Error includes scale factor of 1.5. See the ideogram below.			
$1.504 \pm 0.057 \pm 0.039$	15k	[91] LINK	02L	FOCS	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$
$1.45 \pm 0.23 \pm 0.07$	763	ADAMOVICH	99	BEAT	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$
$1.90 \pm 0.11 \pm 0.09$	3000	[92] AITALA	98B	E791	$\overline{K}^*(892)^0 e^+ \nu_e$
$1.84 \pm 0.11 \pm 0.09$	3034	AITALA	98F	E791	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$
$1.74 \pm 0.27 \pm 0.28$	874	FRABETTI	93E	E687	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$
$2.00 {}^{+0.34}_{-0.32} \pm 0.16$	305	KODAMA	92	E653	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$2.0 \pm 0.6 \pm 0.3$	183	ANJOS	90E	E691	$\overline{K}^*(892)^0 e^+ \nu_e$

[91] LINK 02L includes the effects of interference with an S-wave background. This much improves the goodness of fit, but does not much shift the values of the form factors.

[92] This is slightly different from the AITALA 98B value: see ref. [5] in AITALA 98F.



$r_v \equiv V(0)/A_1(0)$ in $D^+ \to \overline{K}^*(892)^0 \ell^+ \nu_\ell$

$r_2 \equiv A_2(0)/A_1(0)$ in $D^+ \to \overline{K}^*(892)^0 \ell^+ \nu_\ell$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.83 ±0.05 OUR AVERAGE					
0.875±0.049±0.064	15k	[93] LINK	02L	FOCS	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$
1.00 ±0.15 ±0.03	763	ADAMOVICH	99	BEAT	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$
0.71 ±0.08 ±0.09	3000	AITALA	98B	E791	$\overline{K}^*(892)^0 e^+ \nu_e$
0.75 ±0.08 ±0.09	3034	AITALA	98F	E791	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$
0.78 ±0.18 ±0.10	874	FRABETTI	93E	E687	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$
0.82 $^{+0.22}_{-0.23}$ ±0.11	305	KODAMA	92	E653	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.0 ±0.5 ±0.2	183	ANJOS	90E	E691	$\overline{K}^*(892)^0 e^+ \nu_e$

[93] LINK 02L includes the effects of interference with an S-wave background. This much improves the goodness of fit, but does not much shift the values of the form factors.

$r_3 \equiv A_3(0)/A_1(0)$ in $D^+ \to \overline{K}^*(892)^0 \ell^+ \nu_\ell$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.04±0.33±0.29	3034	AITALA	98F	E791	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$

Γ_L/Γ_T in $D^+ \to \overline{K}^*(892)^0 \ell^+ \nu_\ell$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.13±0.08 OUR AVERAGE					
1.09±0.10±0.02	763	ADAMOVICH	99	BEAT	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$
1.20±0.13±0.13	874	FRABETTI	93E	E687	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$
1.18±0.18±0.08	305	KODAMA	92	E653	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$

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

$1.8\ ^{+0.6}_{-0.4}\ \pm 0.3$	183	ANJOS	90E	E691	$\overline{K}^*(892)^0 e^+ \nu_e$

Γ_+/Γ_- in $D^+ \to \overline{K}^*(892)^0 \ell^+ \nu_\ell$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.22±0.06 OUR AVERAGE Error includes scale factor of 1.6.					
$0.28 \pm 0.05 \pm 0.02$	763	ADAMOVICH	99	BEAT	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$
$0.16 \pm 0.05 \pm 0.02$	305	KODAMA	92	E653	$\overline{K}^*(892)^0 \mu^+ \nu_\mu$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.15^{+0.07}_{-0.05} \pm 0.03$	183	ANJOS	90E	E691	$\overline{K}^*(892)^0 e^+ \nu_e$

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