

# LIGHT UNFLAVORED MESONS

## ( $S = C = B = 0$ )

For  $I = 1$  ( $\pi, b, \rho, a$ ):  $u\bar{d}, (u\bar{u}-d\bar{d})/\sqrt{2}, d\bar{u}$ ;  
 for  $I = 0$  ( $\eta, \eta', h, h', \omega, \phi, f, f'$ ):  $c_1(u\bar{u} + d\bar{d}) + c_2(s\bar{s})$

$\pi^\pm$

$$I^G(J^P) = 1^-(0^-)$$

Mass  $m = 139.57018 \pm 0.00035$  MeV ( $S = 1.2$ )

Mean life  $\tau = (2.6033 \pm 0.0005) \times 10^{-8}$  s ( $S = 1.2$ )

$$c\tau = 7.8045 \text{ m}$$

$\pi^\pm \rightarrow \ell^\pm \nu \gamma$  form factors [a]

$$F_V = 0.017 \pm 0.008$$

$$F_A = 0.0116 \pm 0.0016 \quad (S = 1.3)$$

$$R = 0.059^{+0.009}_{-0.008}$$

$\pi^-$  modes are charge conjugates of the modes below.

$\pi^+$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level	$\rho$ (MeV/c)
$\mu^+ \nu_\mu$	[b] (99.98770 $\pm$ 0.00004) %		30
$\mu^+ \nu_\mu \gamma$	[c] ( 2.00 $\pm$ 0.25 ) $\times 10^{-4}$		30
$e^+ \nu_e$	[b] ( 1.230 $\pm$ 0.004 ) $\times 10^{-4}$		70
$e^+ \nu_e \gamma$	[c] ( 1.61 $\pm$ 0.23 ) $\times 10^{-7}$		70
$e^+ \nu_e \pi^0$	( 1.025 $\pm$ 0.034 ) $\times 10^{-8}$		4
$e^+ \nu_e e^+ e^-$	( 3.2 $\pm$ 0.5 ) $\times 10^{-9}$		70
$e^+ \nu_e \nu \bar{\nu}$	< 5	$\times 10^{-6}$ 90%	70

### Lepton Family number (LF) or Lepton number (L) violating modes

$\mu^+ \bar{\nu}_e$	L	[d] < 1.5	$\times 10^{-3}$ 90%	30
$\mu^+ \nu_e$	LF	[d] < 8.0	$\times 10^{-3}$ 90%	30
$\mu^- e^+ e^+ \nu$	LF	< 1.6	$\times 10^{-6}$ 90%	30



$$J^{PC} = 1^-(0^-+)$$

Mass  $m = 134.9766 \pm 0.0006$  MeV (S = 1.1)

$m_{\pi^\pm} - m_{\pi^0} = 4.5936 \pm 0.0005$  MeV

Mean life  $\tau = (8.4 \pm 0.6) \times 10^{-17}$  s (S = 3.0)

$c\tau = 25.1$  nm

$\pi^0$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$p$ (MeV/c)
$2\gamma$	$(98.798 \pm 0.032) \%$	S=1.1	67
$e^+ e^- \gamma$	$(1.198 \pm 0.032) \%$	S=1.1	67
$\gamma$ positronium	$(1.82 \pm 0.29) \times 10^{-9}$		67
$e^+ e^+ e^- e^-$	$(3.14 \pm 0.30) \times 10^{-5}$		67
$e^+ e^-$	$(6.2 \pm 0.5) \times 10^{-8}$		67
$4\gamma$	$< 2$	$\times 10^{-8}$ CL=90%	67
$\nu \bar{\nu}$	[e] $< 8.3$	$\times 10^{-7}$ CL=90%	67
$\nu_e \bar{\nu}_e$	$< 1.7$	$\times 10^{-6}$ CL=90%	67
$\nu_\mu \bar{\nu}_\mu$	$< 3.1$	$\times 10^{-6}$ CL=90%	67
$\nu_\tau \bar{\nu}_\tau$	$< 2.1$	$\times 10^{-6}$ CL=90%	67
<b>Charge conjugation (C) or Lepton Family number (LF) violating modes</b>			
$3\gamma$	C $< 3.1$	$\times 10^{-8}$ CL=90%	67
$\mu^+ e^- + e^- \mu^+$	LF $< 1.72$	$\times 10^{-8}$ CL=90%	26



$$J^{PC} = 0^+(0^-+)$$

Mass  $m = 547.30 \pm 0.12$  MeV

Full width  $\Gamma = 1.18 \pm 0.11$  keV [ $f$ ] (S = 1.8)

**C-nonconserving decay parameters**

$\pi^+ \pi^- \pi^0$  Left-right asymmetry =  $(0.09 \pm 0.17) \times 10^{-2}$

$\pi^+ \pi^- \pi^0$  Sextant asymmetry =  $(0.18 \pm 0.16) \times 10^{-2}$

$\pi^+ \pi^- \pi^0$  Quadrant asymmetry =  $(-0.17 \pm 0.17) \times 10^{-2}$

$\pi^+ \pi^- \gamma$  Left-right asymmetry =  $(0.9 \pm 0.4) \times 10^{-2}$

$\pi^+ \pi^- \gamma$   $\beta$  (D-wave) =  $0.05 \pm 0.06$  (S = 1.5)

**Dalitz plot parameter**

$\pi^0 \pi^0 \pi^0$   $\alpha = -0.039 \pm 0.015$

$\eta$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$p$ (MeV/c)
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		<b>Neutral modes</b>		
neutral modes		(71.6 ± 0.4 ) %	S=1.2	—
2γ	[f]	(39.33±0.25) %	S=1.1	274
3π <sup>0</sup>		(32.24±0.29) %	S=1.2	178
π <sup>0</sup> 2γ		( 7.1 ± 1.4 ) × 10 <sup>-4</sup>		257
other neutral modes		< 2.8 %	CL=90%	—

		<b>Charged modes</b>		
charged modes		(28.3 ± 0.4 ) %	S=1.2	—
π <sup>+</sup> π <sup>-</sup> π <sup>0</sup>		(23.0 ± 0.4 ) %	S=1.2	173
π <sup>+</sup> π <sup>-</sup> γ		( 4.75±0.11) %	S=1.1	235
e <sup>+</sup> e <sup>-</sup> γ		( 4.9 ± 1.1 ) × 10 <sup>-3</sup>		274
μ <sup>+</sup> μ <sup>-</sup> γ		( 3.1 ± 0.4 ) × 10 <sup>-4</sup>		252
e <sup>+</sup> e <sup>-</sup>		< 7.7 × 10 <sup>-5</sup>	CL=90%	274
μ <sup>+</sup> μ <sup>-</sup>		( 5.8 ± 0.8 ) × 10 <sup>-6</sup>		252
π <sup>+</sup> π <sup>-</sup> e <sup>+</sup> e <sup>-</sup>		( 1.3 <sup>+1.2</sup> <sub>-0.8</sub> ) × 10 <sup>-3</sup>		235
π <sup>+</sup> π <sup>-</sup> 2γ		< 2.1 × 10 <sup>-3</sup>		235
π <sup>+</sup> π <sup>-</sup> π <sup>0</sup> γ		< 6 × 10 <sup>-4</sup>	CL=90%	173
π <sup>0</sup> μ <sup>+</sup> μ <sup>-</sup> γ		< 3 × 10 <sup>-6</sup>	CL=90%	210

**Charge conjugation (C), Parity (P),  
Charge conjugation × Parity (CP), or  
Lepton Family number (LF) violating modes**

π <sup>+</sup> π <sup>-</sup>	<i>P, CP</i>	< 3.3	× 10 <sup>-4</sup>	CL=90%	235
π <sup>0</sup> π <sup>0</sup>	<i>P, CP</i>	< 4.3	× 10 <sup>-4</sup>	CL=90%	—
3γ	<i>C</i>	< 5	× 10 <sup>-4</sup>	CL=95%	274
π <sup>0</sup> e <sup>+</sup> e <sup>-</sup>	<i>C</i>	[g] < 4	× 10 <sup>-5</sup>	CL=90%	257
π <sup>0</sup> μ <sup>+</sup> μ <sup>-</sup>	<i>C</i>	[g] < 5	× 10 <sup>-6</sup>	CL=90%	210
μ <sup>+</sup> e <sup>-</sup> + μ <sup>-</sup> e <sup>+</sup>	<i>LF</i>	< 6	× 10 <sup>-6</sup>	CL=90%	263

**f<sub>0</sub>(400–1200) [h]**  
or σ

$$I^G(J^{PC}) = 0^+(0^{++})$$

Mass  $m = (400-1200)$  MeV

Full width  $\Gamma = (600-1000)$  MeV

<b>f<sub>0</sub>(400–1200) DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
ππ	dominant	—
γγ	seen	—

**$\rho(770)$  [i]**

$$J^{PC} = 1^{+}(1^{-}-)$$

Mass  $m = 769.3 \pm 0.8$  MeV (S = 2.1)

Full width  $\Gamma = 150.2 \pm 0.8$  MeV

$\Gamma_{ee} = 6.77 \pm 0.32$  keV

$\rho(770)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$\rho$ (MeV/c)
$\pi^+\pi^-$	$\sim 100$	%	358
<b><math>\rho(770)^\pm</math> decays</b>			
$\pi^\pm\gamma$	$(4.5 \pm 0.5) \times 10^{-4}$	S=2.2	372
$\pi^\pm\eta$	$< 6 \times 10^{-3}$	CL=84%	146
$\pi^\pm\pi^+\pi^-\pi^0$	$< 2.0 \times 10^{-3}$	CL=84%	249
<b><math>\rho(770)^0</math> decays</b>			
$\pi^+\pi^-\gamma$	$(9.9 \pm 1.6) \times 10^{-3}$		358
$\pi^0\gamma$	$(6.8 \pm 1.7) \times 10^{-4}$		372
$\eta\gamma$	$(2.4^{+0.8}_{-0.9}) \times 10^{-4}$	S=1.6	189
$\mu^+\mu^-$	[j] $(4.60 \pm 0.28) \times 10^{-5}$		369
$e^+e^-$	[j] $(4.49 \pm 0.22) \times 10^{-5}$		384
$\pi^+\pi^-\pi^0$	$< 1.2 \times 10^{-4}$	CL=90%	319
$\pi^+\pi^-\pi^+\pi^-$	$(1.8 \pm 0.9) \times 10^{-5}$		246
$\pi^+\pi^-\pi^0\pi^0$	$< 4 \times 10^{-5}$	CL=90%	252

**$\omega(782)$**

$$J^{PC} = 0^-(1^{-}-)$$

Mass  $m = 782.57 \pm 0.12$  MeV (S = 1.8)

Full width  $\Gamma = 8.44 \pm 0.09$  MeV

$\Gamma_{ee} = 0.60 \pm 0.02$  keV

$\omega(782)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$\rho$ (MeV/c)
$\pi^+\pi^-\pi^0$	$(88.8 \pm 0.7) \%$		327
$\pi^0\gamma$	$(8.5 \pm 0.5) \%$		379
$\pi^+\pi^-$	$(2.21 \pm 0.30) \%$		365
neutrals (excluding $\pi^0\gamma$ )	$(5.3^{+8.7}_{-3.5}) \times 10^{-3}$		—
$\eta\gamma$	$(6.5 \pm 1.0) \times 10^{-4}$		199
$\pi^0e^+e^-$	$(5.9 \pm 1.9) \times 10^{-4}$		379
$\pi^0\mu^+\mu^-$	$(9.6 \pm 2.3) \times 10^{-5}$		349

$e^+ e^-$		$(7.07 \pm 0.19) \times 10^{-5}$	S=1.1	391
$\pi^+ \pi^- \pi^0 \pi^0$		< 2	% CL=90%	261
$\pi^+ \pi^- \gamma$		< 3.6	$\times 10^{-3}$ CL=95%	365
$\pi^+ \pi^- \pi^+ \pi^-$		< 1	$\times 10^{-3}$ CL=90%	256
$\pi^0 \pi^0 \gamma$		$(7.2 \pm 2.5) \times 10^{-5}$		367
$\mu^+ \mu^-$		< 1.8	$\times 10^{-4}$ CL=90%	376
$3\gamma$		< 1.9	$\times 10^{-4}$ CL=95%	391

**Charge conjugation (C) violating modes**

$\eta \pi^0$	C	< 1	$\times 10^{-3}$	CL=90%	162
$3\pi^0$	C	< 3	$\times 10^{-4}$	CL=90%	329

**$\eta'(958)$**

$$J^{PC} = 0^+(0^-+)$$

Mass  $m = 957.78 \pm 0.14$  MeV

Full width  $\Gamma = 0.202 \pm 0.016$  MeV (S = 1.3)

<b><math>\eta'(958)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$p$ (MeV/c)
$\pi^+ \pi^- \eta$	$(44.3 \pm 1.5) \%$	S=1.2	232
$\rho^0 \gamma$ (including non-resonant $\pi^+ \pi^- \gamma$ )	$(29.5 \pm 1.0) \%$	S=1.2	169
$\pi^0 \pi^0 \eta$	$(20.9 \pm 1.2) \%$	S=1.2	239
$\omega \gamma$	$(3.03 \pm 0.31) \%$		160
$\gamma \gamma$	$(2.12 \pm 0.14) \%$	S=1.3	479
$3\pi^0$	$(1.56 \pm 0.26) \times 10^{-3}$		430
$\mu^+ \mu^- \gamma$	$(1.04 \pm 0.26) \times 10^{-4}$		467
$\pi^+ \pi^- \pi^0$	< 5	% CL=90%	427
$\pi^0 \rho^0$	< 4	% CL=90%	118
$\pi^+ \pi^+ \pi^- \pi^-$	< 1	% CL=90%	372
$\pi^+ \pi^+ \pi^- \pi^-$ neutrals	< 1	% CL=95%	—
$\pi^+ \pi^+ \pi^- \pi^- \pi^0$	< 1	% CL=90%	298
$6\pi$	< 1	% CL=90%	189
$\pi^+ \pi^- e^+ e^-$	< 6	$\times 10^{-3}$ CL=90%	458
$\pi^0 \gamma \gamma$	< 8	$\times 10^{-4}$ CL=90%	469
$4\pi^0$	< 5	$\times 10^{-4}$ CL=90%	379
$e^+ e^-$	< 2.1	$\times 10^{-7}$ CL=90%	479

**Charge conjugation (C), Parity (P),  
Lepton family number (LF) violating modes**

$\pi^+ \pi^-$	P, CP	< 2	%	CL=90%	458
$\pi^0 \pi^0$	P, CP	< 9	$\times 10^{-4}$	CL=90%	459
$\gamma e^+ e^-$	C	< 9	$\times 10^{-4}$	CL=90%	—
$\pi^0 e^+ e^-$	C [g]	< 1.4	$\times 10^{-3}$	CL=90%	469

$\eta e^+ e^-$	C	[g] < 2.4	$\times 10^{-3}$	CL=90%	322
$3\gamma$	C	< 1.0	$\times 10^{-4}$	CL=90%	479
$\mu^+ \mu^- \pi^0$	C	[g] < 6.0	$\times 10^{-5}$	CL=90%	445
$\mu^+ \mu^- \eta$	C	[g] < 1.5	$\times 10^{-5}$	CL=90%	274
$e\mu$	LF	< 4.7	$\times 10^{-4}$	CL=90%	—

**$f_0(980)$  [k]**

$$I^G(J^{PC}) = 0^+(0^{++})$$

Mass  $m = 980 \pm 10$  MeV

Full width  $\Gamma = 40$  to 100 MeV

<b><math>f_0(980)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\pi\pi$	dominant	470
$K\bar{K}$	seen	—

**$a_0(980)$  [k]**

$$I^G(J^{PC}) = 1^-(0^{++})$$

Mass  $m = 984.8 \pm 1.4$  MeV ( $S = 1.7$ )

Full width  $\Gamma = 50$  to 100 MeV

<b><math>a_0(980)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\eta\pi$	dominant	321
$K\bar{K}$	seen	—
$\gamma\gamma$	seen	492

**$\phi(1020)$**

$$I^G(J^{PC}) = 0^-(1^{--})$$

Mass  $m = 1019.417 \pm 0.014$  MeV ( $S = 1.8$ )

Full width  $\Gamma = 4.458 \pm 0.032$  MeV

<b><math>\phi(1020)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$p$ (MeV/c)
$K^+ K^-$	(49.2 $\pm$ 0.7 ) %	S=1.2	127
$K_L^0 K_S^0$	(33.8 $\pm$ 0.6 ) %	S=1.2	110
$\rho\pi + \pi^+\pi^-\pi^0$	(15.5 $\pm$ 0.6 ) %	S=1.4	—
$\eta\gamma$	( 1.297 $\pm$ 0.033 ) %	S=1.2	363
$\pi^0\gamma$	( 1.26 $\pm$ 0.10 ) $\times 10^{-3}$		501
$e^+ e^-$	( 2.91 $\pm$ 0.07 ) $\times 10^{-4}$	S=1.2	510
$\mu^+ \mu^-$	( 3.7 $\pm$ 0.5 ) $\times 10^{-4}$		499
$\eta e^+ e^-$	( 1.3 $^{+0.8}_{-0.6}$ ) $\times 10^{-4}$		363
$\pi^+\pi^-$	( 7.5 $\pm$ 1.4 ) $\times 10^{-5}$		490
$\omega\pi^0$	( 4.8 $\pm$ 2.0 ) $\times 10^{-5}$		—

$\omega\gamma$	$< 5$	%	CL=84%	210
$\rho\gamma$	$< 1.2$	$\times 10^{-5}$	CL=90%	219
$\pi^+\pi^-\gamma$	$(4.1 \pm 1.3)$	$\times 10^{-5}$		490
$f_0(980)\gamma$	$(3.4 \pm 0.4)$	$\times 10^{-4}$		39
$\pi^0\pi^0\gamma$	$(1.08 \pm 0.19)$	$\times 10^{-4}$		492
$\pi^+\pi^-\pi^+\pi^-$	$< 8.7$	$\times 10^{-4}$	CL=90%	410
$\pi^+\pi^+\pi^-\pi^-\pi^0$	$< 1.5$	$\times 10^{-4}$	CL=95%	341
$\pi^0e^+e^-$	$< 1.2$	$\times 10^{-4}$	CL=90%	501
$\pi^0\eta\gamma$	$(8.6 \pm 1.8)$	$\times 10^{-5}$		346
$a_0(980)\gamma$	$< 5$	$\times 10^{-3}$	CL=90%	36
$\eta'(958)\gamma$	$(6.7 \pm 3.5)$	$\times 10^{-5}$		—
$\eta\pi^0\pi^0\gamma$	$< 2$	$\times 10^{-5}$	CL=90%	—
$\mu^+\mu^-\gamma$	$(1.4 \pm 0.5)$	$\times 10^{-5}$		—
$\rho\gamma\gamma$	$< 5$	$\times 10^{-4}$	CL=90%	—
$\eta\pi^+\pi^-$	$< 3$	$\times 10^{-4}$	CL=90%	—

### $h_1(1170)$

$$I^G(J^{PC}) = 0^-(1^{+-})$$

Mass  $m = 1170 \pm 20$  MeV

Full width  $\Gamma = 360 \pm 40$  MeV

$h_1(1170)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\rho\pi$	seen	310

### $b_1(1235)$

$$I^G(J^{PC}) = 1^+(1^{+-})$$

Mass  $m = 1229.5 \pm 3.2$  MeV ( $S = 1.6$ )

Full width  $\Gamma = 142 \pm 9$  MeV ( $S = 1.2$ )

$b_1(1235)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level	$p$ (MeV/c)
$\omega\pi$	dominant		348
	[D/S amplitude ratio = $0.29 \pm 0.04$ ]		
$\pi^\pm\gamma$	$(1.6 \pm 0.4) \times 10^{-3}$		608
$\eta\rho$	seen		—
$\pi^+\pi^+\pi^-\pi^0$	$< 50$	%	84%
$(K\bar{K})^\pm\pi^0$	$< 8$	%	90%
$K_S^0 K_L^0 \pi^\pm$	$< 6$	%	90%
$K_S^0 K_S^0 \pi^\pm$	$< 2$	%	90%
$\phi\pi$	$< 1.5$	%	84%

**$a_1(1260)$  [1]**

$$J^{PC} = 1^-(1^{++})$$

Mass  $m = 1230 \pm 40$  MeV [ $m$ ]

Full width  $\Gamma = 250$  to  $600$  MeV

<b><math>a_1(1260)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$(\rho\pi)_{S\text{-wave}}$	seen	—
$(\rho\pi)_{D\text{-wave}}$	seen	—
$(\rho(1450)\pi)_{S\text{-wave}}$	seen	—
$(\rho(1450)\pi)_{D\text{-wave}}$	seen	—
$\sigma\pi$	seen	—
$f_0(980)\pi$	not seen	—
$f_0(1370)\pi$	seen	—
$f_2(1270)\pi$	seen	—
$K\bar{K}^*(892)+c.c.$	seen	—
$\pi(1300)\pi$	not seen	—
$\pi\gamma$	seen	607

**$f_2(1270)$**

$$J^{PC} = 0^+(2^{++})$$

Mass  $m = 1275.4 \pm 1.2$  MeV

Full width  $\Gamma = 185.1^{+3.4}_{-2.6}$  MeV ( $S = 1.5$ )

<b><math>f_2(1270)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$p$ (MeV/c)
$\pi\pi$	$(84.7^{+2.4}_{-1.3})\%$	S=1.3	622
$\pi^+\pi^-\pi^0$	$(7.1^{+1.5}_{-2.6})\%$	S=1.3	562
$K\bar{K}$	$(4.6 \pm 0.5)\%$	S=2.8	403
$2\pi^+2\pi^-$	$(2.8 \pm 0.4)\%$	S=1.2	559
$\eta\eta$	$(4.5 \pm 1.0) \times 10^{-3}$	S=2.4	327
$4\pi^0$	$(3.0 \pm 1.0) \times 10^{-3}$		564
$\gamma\gamma$	$(1.41 \pm 0.13) \times 10^{-5}$		637
$\eta\pi\pi$	$< 8 \times 10^{-3}$	CL=95%	475
$K^0K^-\pi^+ + c.c.$	$< 3.4 \times 10^{-3}$	CL=95%	293
$e^+e^-$	$< 9 \times 10^{-9}$	CL=90%	637



## $f_1(1285)$

$$J^{PC} = 0^+(1^{++})$$

Mass  $m = 1281.9 \pm 0.6$  MeV (S = 1.7)

Full width  $\Gamma = 24.0 \pm 1.2$  MeV (S = 1.4)

$f_1(1285)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$p$ (MeV/c)
$4\pi$	$(33.1^{+2.1}_{-1.8})\%$	S=1.3	563
$\pi^0\pi^0\pi^+\pi^-$	$(22.0^{+1.4}_{-1.2})\%$	S=1.3	566
$2\pi^+2\pi^-$	$(11.0^{+0.7}_{-0.6})\%$	S=1.3	563
$\rho^0\pi^+\pi^-$	$(11.0^{+0.7}_{-0.6})\%$	S=1.3	340
$4\pi^0$	$< 7 \times 10^{-4}$	CL=90%	568
$\eta\pi\pi$	$(52 \pm 16)\%$		479
$a_0(980)\pi$ [ignoring $a_0(980) \rightarrow K\bar{K}$ ]	$(36 \pm 7)\%$		234
$\eta\pi\pi$ [excluding $a_0(980)\pi$ ]	$(16 \pm 7)\%$		—
$K\bar{K}\pi$	$(9.0 \pm 0.4)\%$	S=1.1	308
$K\bar{K}^*(892)$	not seen		—
$\gamma\rho^0$	$(5.5 \pm 1.3)\%$	S=2.8	410
$\phi\gamma$	$(7.4 \pm 2.6) \times 10^{-4}$		236

## $\eta(1295)$

$$J^{PC} = 0^+(0^{-+})$$

Mass  $m = 1297.0 \pm 2.8$  MeV

Full width  $\Gamma = 53 \pm 6$  MeV

$\eta(1295)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\eta\pi^+\pi^-$	seen	488
$a_0(980)\pi$	seen	245
$\eta\pi^0\pi^0$	seen	—
$\eta(\pi\pi)$ S-wave	seen	—

**$\pi(1300)$**

$$I^G(J^{PC}) = 1^-(0^-+)$$

Mass  $m = 1300 \pm 100$  MeV [ $m$ ]

Full width  $\Gamma = 200$  to 600 MeV

$\pi(1300)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$\rho$ (MeV/c)
$\rho\pi$	seen	406
$\pi(\pi\pi)_{S\text{-wave}}$	seen	—

**$a_2(1320)$**

$$I^G(J^{PC}) = 1^-(2^{++})$$

Mass  $m = 1318.0 \pm 0.6$  MeV ( $S = 1.1$ )

Full width  $\Gamma = 107 \pm 5$  MeV [ $m$ ]

$a_2(1320)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$\rho$ (MeV/c)
$\rho\pi$	(70.1±2.7) %	S=1.2	419
$\eta\pi$	(14.5±1.2) %		535
$\omega\pi\pi$	(10.6±3.2) %	S=1.3	362
$K\bar{K}$	( 4.9±0.8) %		437
$\eta'(958)\pi$	( 5.3±0.9) × 10 <sup>-3</sup>		287
$\pi^\pm\gamma$	( 2.8±0.6) × 10 <sup>-3</sup>		652
$\gamma\gamma$	( 9.4±0.7) × 10 <sup>-6</sup>		659
$\pi^+\pi^-\pi^-$	< 8 %	CL=90%	621
$e^+e^-$	< 2.3 × 10 <sup>-7</sup>	CL=90%	659

**$f_0(1370)$  [ $k$ ]**

$$I^G(J^{PC}) = 0^+(0^{++})$$

Mass  $m = 1200$  to 1500 MeV

Full width  $\Gamma = 200$  to 500 MeV

$f_0(1370)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$\rho$ (MeV/c)
$\pi\pi$	seen	—
$4\pi$	seen	—
$4\pi^0$	seen	—
$2\pi^+2\pi^-$	seen	—
$\pi^+\pi^-2\pi^0$	seen	—
$2(\pi\pi)_{S\text{-wave}}$	seen	—
$\eta\eta$	seen	—
$K\bar{K}$	seen	—
$\gamma\gamma$	seen	—
$e^+e^-$	not seen	—

**$f_1(1420)$**  [ $\eta$ ]

$$I^G(J^{PC}) = 0^+(1^{++})$$

Mass  $m = 1426.3 \pm 1.1$  MeV ( $S = 1.3$ )

Full width  $\Gamma = 55.5 \pm 2.9$  MeV

<b><math>f_1(1420)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$K \bar{K} \pi$	dominant	439
$K \bar{K}^*(892) + \text{c.c.}$	dominant	155
$\eta \pi \pi$	possibly seen	571
$\phi \gamma$	seen	—

**$\omega(1420)$**  [ $\phi$ ]

$$I^G(J^{PC}) = 0^-(1^{--})$$

Mass  $m = 1419 \pm 31$  MeV

Full width  $\Gamma = 174 \pm 60$  MeV

<b><math>\omega(1420)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\rho \pi$	dominant	488

**$\eta(1440)$**  [ $\rho$ ]

$$I^G(J^{PC}) = 0^+(0^{-+})$$

Mass  $m = 1400 - 1470$  MeV [ $m$ ]

Full width  $\Gamma = 50 - 80$  MeV [ $m$ ]

<b><math>\eta(1440)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$K \bar{K} \pi$	seen	—
$K \bar{K}^*(892) + \text{c.c.}$	seen	—
$\eta \pi \pi$	seen	—
$a_0(980) \pi$	seen	—
$\eta(\pi \pi)_{S\text{-wave}}$	seen	—
$f_0(980) \eta$	seen	—
$4\pi$	seen	—

**$a_0(1450)$**

$$I^G(J^{PC}) = 1^-(0^{++})$$

Mass  $m = 1474 \pm 19$  MeV

Full width  $\Gamma = 265 \pm 13$  MeV

<b><math>a_0(1450)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\pi\eta$	seen	613
$\pi\eta'(958)$	seen	392
$K\bar{K}$	seen	530

**$\rho(1450)$  [q]**

$$I^G(J^{PC}) = 1^+(1^{--})$$

Mass  $m = 1465 \pm 25$  MeV [m]

Full width  $\Gamma = 310 \pm 60$  MeV [m]

<b><math>\rho(1450)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level	$p$ (MeV/c)
$\pi\pi$	seen		719
$4\pi$	seen		665
$\omega\pi$	<2.0 %	95%	512
$e^+e^-$	seen		732
$\eta\rho$	<4 %		317
$a_2(1320)\pi$	not seen		—
$\phi\pi$	<1 %		358
$K\bar{K}$	< $1.6 \times 10^{-3}$	95%	541

**$f_0(1500)$  [r]**

$$I^G(J^{PC}) = 0^+(0^{++})$$

Mass  $m = 1500 \pm 10$  MeV (S = 1.3)

Full width  $\Gamma = 112 \pm 10$  MeV

<b><math>f_0(1500)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\eta\eta'(958)$	seen	—
$\eta\eta$	seen	513
$4\pi$	seen	—
$4\pi^0$	seen	690
$2\pi^+2\pi^-$	seen	686
$\pi\pi$	seen	—
$\pi^+\pi^-$	seen	737
$2\pi^0$	seen	738
$K\bar{K}$	seen	563

**$f'_2(1525)$**

$$I^G(J^{PC}) = 0^+(2^{++})$$

Mass  $m = 1525 \pm 5$  MeV [ $m$ ]

Full width  $\Gamma = 76 \pm 10$  MeV [ $m$ ]

<b><math>f'_2(1525)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$K\bar{K}$	(88.8 $\pm$ 3.1 ) %	581
$\eta\eta$	(10.3 $\pm$ 3.1 ) %	531
$\pi\pi$	( 8.2 $\pm$ 1.5 ) $\times 10^{-3}$	750
$\gamma\gamma$	( 1.32 $\pm$ 0.21) $\times 10^{-6}$	763

**$\omega(1650)$  [s]**  
was  $\omega(1600)$

$$I^G(J^{PC}) = 0^-(1^{--})$$

Mass  $m = 1649 \pm 24$  MeV ( $S = 2.3$ )

Full width  $\Gamma = 220 \pm 35$  MeV ( $S = 1.6$ )

<b><math>\omega(1650)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\rho\pi$	seen	637
$\omega\pi\pi$	seen	601
$e^+e^-$	seen	824

**$\omega_3(1670)$**

$$I^G(J^{PC}) = 0^-(3^{--})$$

Mass  $m = 1667 \pm 4$  MeV

Full width  $\Gamma = 168 \pm 10$  MeV [ $m$ ]

<b><math>\omega_3(1670)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\rho\pi$	seen	647
$\omega\pi\pi$	seen	614
$b_1(1235)\pi$	possibly seen	359

**$\pi_2(1670)$**

$$J^{PC} = 1^-(2^-+)$$

Mass  $m = 1670 \pm 20$  MeV [ $m$ ]

Full width  $\Gamma = 259 \pm 11$  MeV [ $m$ ] (S = 1.5)

$\pi_2(1670)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level	$p$ (MeV/c)
$3\pi$	(95.8±1.4) %		806
$f_2(1270)\pi$	(56.2±3.2) %		325
$\rho\pi$	(31 ±4 ) %		649
$\sigma\pi$	(13 ±6 ) %		—
$f_0(1370)\pi$	( 8.7±3.4) %		—
$K\bar{K}^*(892)+$ c.c.	( 4.2±1.4) %		453
$\omega\rho$	( 2.7±1.1) %		—
$\rho(1450)\pi$	< 3.6	$\times 10^{-3}$	97.7%
$b_1(1235)\pi$	< 1.9	$\times 10^{-3}$	97.7%

**$\phi(1680)$**

$$J^{PC} = 0^-(1^{--})$$

Mass  $m = 1680 \pm 20$  MeV [ $m$ ]

Full width  $\Gamma = 150 \pm 50$  MeV [ $m$ ]

$\phi(1680)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$K\bar{K}^*(892)+$ c.c.	dominant	463
$K_S^0 K\pi$	seen	620
$K\bar{K}$	seen	681
$e^+e^-$	seen	840
$\omega\pi\pi$	not seen	622

**$\rho_3(1690)$**

$$I^G(J^{PC}) = 1^+(3^{--})$$

Mass  $m = 1691 \pm 5$  MeV [ $m$ ]

Full width  $\Gamma = 161 \pm 10$  MeV [ $m$ ] (S = 1.5)

<b><math>\rho_3(1690)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor	$\rho$ (MeV/c)
$4\pi$	(71.1 $\pm$ 1.9 ) %		788
$\pi^\pm \pi^+ \pi^- \pi^0$	(67 $\pm$ 22 ) %		788
$\omega \pi$	(16 $\pm$ 6 ) %		656
$\pi \pi$	(23.6 $\pm$ 1.3 ) %		834
$K \bar{K} \pi$	( 3.8 $\pm$ 1.2 ) %		628
$K \bar{K}$	( 1.58 $\pm$ 0.26) %	1.2	686
$\eta \pi^+ \pi^-$	seen		728
$\rho(770)\eta$	seen		—

**$\rho(1700)$  [ $q$ ]**

$$I^G(J^{PC}) = 1^+(1^{--})$$

Mass  $m = 1700 \pm 20$  MeV [ $m$ ] ( $\eta \rho^0$  and  $\pi^+ \pi^-$  modes)

Full width  $\Gamma = 240 \pm 60$  MeV [ $m$ ] ( $\eta \rho^0$  and  $\pi^+ \pi^-$  modes)

<b><math>\rho(1700)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$\rho$ (MeV/c)
$\rho \pi \pi$	dominant	640
$\rho^0 \pi^+ \pi^-$	large	640
$\rho^\pm \pi^\mp \pi^0$	large	642
$2(\pi^+ \pi^-)$	large	792
$\pi^+ \pi^-$	seen	838
$\pi^- \pi^0$	seen	839
$K \bar{K}^*(892) + \text{c.c.}$	seen	479
$\eta \rho$	seen	533
$a_2(1320)\pi$	not seen	—
$K \bar{K}$	seen	692
$e^+ e^-$	seen	850
$\pi^0 \omega$	seen	662

**$f_0(1710)$  [t]**

$$I^G(J^{PC}) = 0^+(0^{++})$$

Mass  $m = 1715 \pm 7$  MeV (S = 1.1)

Full width  $\Gamma = 125 \pm 12$  MeV

<b><math>f_0(1710)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$K\bar{K}$	seen	690
$\eta\eta$	seen	648
$\pi\pi$	seen	837

**$\pi(1800)$**

$$I^G(J^{PC}) = 1^-(0^{-+})$$

Mass  $m = 1801 \pm 13$  MeV (S = 1.9)

Full width  $\Gamma = 210 \pm 15$  MeV

<b><math>\pi(1800)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\pi^+\pi^-\pi^-$	seen	—
$f_0(980)\pi^-$	seen	623
$f_0(1370)\pi^-$	seen	—
$\rho\pi^-$	not seen	728
$\eta\eta\pi^-$	seen	—
$a_0(980)\eta$	seen	459
$f_0(1500)\pi^-$	seen	240
$\eta\eta'(958)\pi^-$	seen	—
$K_0^*(1430)K^-$	seen	—
$K^*(892)K^-$	not seen	560

**$\phi_3(1850)$**

$$I^G(J^{PC}) = 0^-(3^{--})$$

Mass  $m = 1854 \pm 7$  MeV

Full width  $\Gamma = 87^{+28}_{-23}$  MeV (S = 1.2)

<b><math>\phi_3(1850)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$K\bar{K}$	seen	785
$K\bar{K}^*(892) + \text{c.c.}$	seen	602



**$f_2(2010)$**

$$I^G(J^{PC}) = 0^+(2^{++})$$

Mass  $m = 2011^{+60}_{-80}$  MeV

Full width  $\Gamma = 202 \pm 60$  MeV

<b><math>f_2(2010)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\phi\phi$	seen	—

**$a_4(2040)$**

$$I^G(J^{PC}) = 1^-(4^{++})$$

Mass  $m = 2014 \pm 15$  MeV

Full width  $\Gamma = 361 \pm 50$  MeV

<b><math>a_4(2040)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$K\bar{K}$	seen	892
$\pi^+\pi^-\pi^0$	seen	—
$\eta\pi^0$	seen	941

**$f_4(2050)$**

$$I^G(J^{PC}) = 0^+(4^{++})$$

Mass  $m = 2034 \pm 11$  MeV ( $S = 1.6$ )

Full width  $\Gamma = 222 \pm 19$  MeV ( $S = 1.8$ )

<b><math>f_4(2050)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\omega\omega$	(26 $\pm$ 6 ) %	658
$\pi\pi$	(17.0 $\pm$ 1.5) %	1012
$K\bar{K}$	( 6.8 $^{+3.4}_{-1.8}$ ) $\times 10^{-3}$	895
$\eta\eta$	( 2.1 $\pm$ 0.8) $\times 10^{-3}$	863
$4\pi^0$	< 1.2 %	977
$a_2(1320)\pi$	seen	—

**$f_2(2300)$**

$$I^G(J^{PC}) = 0^+(2^{++})$$

Mass  $m = 2297 \pm 28$  MeV

Full width  $\Gamma = 149 \pm 40$  MeV

<b><math>f_2(2300)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\phi\phi$	seen	529

**$f_2(2340)$**

$$I^G(J^{PC}) = 0^+(2^{++})$$

Mass  $m = 2339 \pm 60$  MeV

Full width  $\Gamma = 319^{+80}_{-70}$  MeV

<b><math>f_2(2340)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\phi\phi$	seen	573