$\phi(1020)$

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

ϕ(1020) MASS

We average mass and width values only when the systematic errors have been evaluated.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1019.413±0.008 OUR AVERAGE					
1019.7 ±0.3	2012	DAVENPORT	86	MPSF	400 $pA \rightarrow 4KX$
1019.411±0.008	642k	[1] DIJKSTRA	86	SPEC	100–200 $\pi^\pm$, $\overline{p}$, p, $K^\pm$, on Be
1019.7 ±0.1 ±0.1	5079	ALBRECHT	85D	ARG	10 $e^+e^- \rightarrow K^+K^-X$
1019.3 ±0.1	1500	ARENTON	82	AEMS	11.8 polar. $pp \rightarrow KK$
1019.67 ±0.17	25080	[2] PELLINEN	82	RVUE	
1019.54 ±0.12	1100	BARKOV	79B	EMUL	$e^+e^- \rightarrow K^+K^-$
1019.52 ±0.13	3681	BUKIN	78C	OLYA	$e^+e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1019.8 ±0.7		ARMSTRONG	86	OMEG	85 $\pi^+/pp \rightarrow \pi^+/p4Kp$
1020.1 ±0.11	5526	[3] ATKINSON	86	OMEG	20–70 γp
1019.7 ±1.0		BEBEK	86	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
1020.9 ±0.2		[3] FRAME	86	OMEG	13 $K^+p \rightarrow \phi K^+p$
1021.0 ±0.2		[3] ARMSTRONG	83B	OMEG	18.5 $K^-p \rightarrow K^-K^+\Lambda$
1020.0 ±0.5		[3] ARMSTRONG	83B	OMEG	18.5 $K^-p \rightarrow K^-K^+\Lambda$
1019.7 ±0.3		[3] BARATE	83	GOLI	190 π^- Be $\rightarrow 2\mu X$
1019.8 ±0.2 ±0.5	766	IVANOV	81	OLYA	1–1.4 $e^+e^- \rightarrow K^+K^-$
1019.4 ±0.5	337	COOPER	78B	HBC	0.7–0.8 $\overline{p}p \rightarrow K^0_S K^0_L \pi^+\pi^-$
1020.0 ±1.0	383	[3] BALDI	77	CNTR	10 $\pi^-p \rightarrow \pi^-\phi p$
1018.9 ±0.6	800	COHEN	77	ASPK	6 $\pi^\pm N \rightarrow K^+K^-N$
1019.7 ±0.5	454	KALBFLEISCH	76	HBC	2.18 $K^-p \rightarrow \Lambda K\overline{K}$
1019.4 ±0.8	984	BESCH	74	CNTR	2 $\gamma p \rightarrow pK^+K^-$
1020.3 ±0.4	100	BALLAM	73	HBC	2.8–9.3 γp
1019.4 ±0.7		BINNIE	73B	CNTR	$\pi^-p \rightarrow \phi n$
1019.6 ±0.5	120	[4] AGUILAR-...	72B	HBC	3.9,4.6 $K^-p \rightarrow \Lambda K^+K^-$
1019.9 ±0.5	100	[4] AGUILAR-...	72B	HBC	3.9,4.6 $K^-p \rightarrow K^-pK^+K^-$
1020.4 ±0.5	131	COLLEY	72	HBC	10 $K^+p \rightarrow K^+p\phi$
1019.9 ±0.3	410	STOTTLE...	71	HBC	2.9 $K^-p \rightarrow \Sigma/\Lambda K\overline{K}$

[1] Weighted and scaled average of 12 measurements of DIJKSTRA 86.
[2] PELLINEN 82 review includes AKERLOF 77, DAUM 81, BALDI 77, AYRES 74, DEGROOT 74.
[3] Systematic errors not evaluated.
[4] Mass errors enlarged by us to $\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.

ϕ(1020) WIDTH

We average mass and width values only when the systematic errors have been evalutated.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
4.43±0.06 OUR FIT					
4.43±0.06 OUR AVERAGE					
4.45±0.06	271k	DIJKSTRA	86	SPEC	100 π^- Be
4.5 ±0.7	1500	ARENTON	82	AEMS	11.8 polar. $pp \rightarrow KK$
4.2 ±0.6	766	[5] IVANOV	81	OLYA	1–1.4 $e^+e^- \rightarrow K^+K^-$
4.3 ±0.6		[5] CORDIER	80	WIRE	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$
4.58±0.55	1100	[5] BARKOV	79B	EMUL	$e^+e^- \rightarrow K^+K^-$
4.36±0.29	3681	[5] BUKIN	78C	OLYA	$e^+e^- \rightarrow$ hadrons
4.4 ±0.6	984	[5] BESCH	74	CNTR	$2\gamma p \rightarrow pK^+K^-$
4.67±0.72	681	[5] BALAKIN	71	OSPK	$e^+e^- \rightarrow$ hadrons
4.09±0.29		BIZOT	70	OSPK	$e^+e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •					
4.08±0.14	13714	KURDADZE	84	OLYA	$e^+e^- \rightarrow$ hadrons
3.6 ±0.8	337	[5] COOPER	78B	HBC	0.7–0.8 $\overline{p}p \rightarrow K^0_S K^0_L \pi^+\pi^-$
4.5 ±0.50	1300	[5,6] AKERLOF	77	SPEC	400 $pA \rightarrow K^+K^-X$
4.5 ±0.8	500	[5,6] AYRES	74	ASPK	3–6 $\pi^-p \rightarrow K^+K^-n$, $K^-p \rightarrow K^+K^-\Lambda/\Sigma^0$
3.81±0.37		COSME	74B	OSPK	$e^+e^- \rightarrow K^0_L K^0_S$
3.8 ±0.7	454	[5] BORENSTEIN	72	HBC	2.18 $K^-p \rightarrow K\overline{K}n$

[5] Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.
[6] Systematic errors not evaluated.

ϕ(1020) DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1	K^+K^-	(49.1 ±0.9) %	S=1.3
Γ_2	$K^0_L K^0_S$	(34.3 ±0.7) %	S=1.2
Γ_3	$\rho\pi$	(12.9 ±0.7) %	
Γ_4	$\pi^+\pi^-\pi^0$	(2.5 ±0.9) %	S=1.1
Γ_5	$\eta\gamma$	(1.28±0.06) %	S=1.2
Γ_6	$\pi^0\gamma$	(1.31±0.13) $\times 10^{-3}$	
Γ_7	e^+e^-	(3.09±0.07) $\times 10^{-4}$	
Γ_8	$\mu^+\mu^-$	(2.48±0.34) $\times 10^{-4}$	
Γ_9	ηe^+e^-	(1.3 $^{+0.8}_{-0.6}$) $\times 10^{-4}$	
Γ_{10}	$\pi^+\pi^-$	(8 $^{+5}_{-4}$) $\times 10^{-5}$	S=1.5
Γ_{11}	$\omega\gamma$	< 5 %	CL=84%
Γ_{12}	$\rho\gamma$	< 2 %	CL=84%
Γ_{13}	$\pi^+\pi^-\gamma$	< 7 $\times 10^{-3}$	CL=90%
Γ_{14}	$f_0(980)\gamma$	< 2 $\times 10^{-3}$	CL=90%
Γ_{15}	$\pi^0\pi^0\gamma$	< 1 $\times 10^{-3}$	CL=90%
Γ_{16}	$\pi^+\pi^-\pi^+\pi^-$	< 8.7 $\times 10^{-4}$	CL=90%
Γ_{17}	$\eta'(958)\gamma$	< 4.1 $\times 10^{-4}$	CL=90%
Γ_{18}	$\pi^+\pi^+\pi^-\pi^-\pi^0$	< 1.5 $\times 10^{-4}$	CL=95%
Γ_{19}	$\pi^0 e^+e^-$	< 1.2 $\times 10^{-4}$	CL=90%
Γ_{20}	$\pi^0\eta\gamma$	< 2.5 $\times 10^{-3}$	CL=90%
Γ_{21}	$a_0(980)\gamma$	< 5 $\times 10^{-3}$	CL=90%

CONSTRAINED FIT INFORMATION

An overall fit to the total width, a partial width, and 9 branching ratios uses 38 measurements and one constraint to determine 6 parameters. The overall fit has a $\chi^2 = 27.1$ for 33 degrees of freedom.

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

x_2	−70				
x_3	0	0			
x_4	−39	−10	−75		
x_5	−5	−2	0	0	
Γ	0	0	−24	18	0
	x_1	x_2	x_3	x_4	x_5

	Mode	Rate (MeV)	Scale factor
Γ_1	K^+K^-	2.17 ±0.05	1.2
Γ_2	$K^0_L K^0_S$	1.52 ±0.04	1.1
Γ_3	$\rho\pi$	0.570 ±0.030	
Γ_4	$\pi^+\pi^-\pi^0$	0.11 ±0.04	1.1
Γ_5	$\eta\gamma$	0.0569±0.0029	1.2

ϕ(1020) PARTIAL WIDTHS

$\Gamma(\rho\pi)$ Γ_3

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
0.570±0.030 OUR FIT				
0.57 ±0.03	JULLIAN	76	OSPK	e^+e^-

$\Gamma(e^+e^-)$ Γ_7

VALUE (keV)	DOCUMENT ID
1.37±0.05 OUR EVALUATION	