

$\psi(4040)$

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

$\psi(4040)$ MASS

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
4039 ± 1 OUR ESTIMATE			
4039.6 ± 4.3	¹ ABLIKIM	08D BES2	$e^+e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •			
4037 ± 2	² SETH	05A RVUE	$e^+e^- \rightarrow$ hadrons
4040 ± 1	³ SETH	05A RVUE	$e^+e^- \rightarrow$ hadrons
4040 ± 10	BRANDELIK	78C DASP	e^+e^-

¹ Reanalysis of data presented in BAI 02C. From a global fit over the center-of-mass energy region 3.7–5.0 GeV covering the $\psi(3770)$, $\psi(4040)$, $\psi(4160)$, and $\psi(4415)$ resonances. Phase angle fixed in the fit to $\delta = (130 \pm 46)^\circ$.

² From a fit to Crystal Ball (OSTERHELD 86) data.

³ From a fit to BES (BAI 02C) data.

$\psi(4040)$ WIDTH

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
80 ± 10 OUR ESTIMATE			
84.5 ± 12.3	⁴ ABLIKIM	08D BES2	$e^+e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •			
85 ± 10	⁵ SETH	05A RVUE	$e^+e^- \rightarrow$ hadrons
89 ± 6	⁶ SETH	05A RVUE	$e^+e^- \rightarrow$ hadrons
52 ± 10	BRANDELIK	78C DASP	e^+e^-

⁴ Reanalysis of data presented in BAI 02C. From a global fit over the center-of-mass energy region 3.7–5.0 GeV covering the $\psi(3770)$, $\psi(4040)$, $\psi(4160)$, and $\psi(4415)$ resonances. Phase angle fixed in the fit to $\delta = (130 \pm 46)^\circ$.

⁵ From a fit to Crystal Ball (OSTERHELD 86) data.

⁶ From a fit to BES (BAI 02C) data.

$\psi(4040)$ DECAY MODES

Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1 e^+e^-	$(1.07 \pm 0.16) \times 10^{-5}$	
Γ_2 $D^0\bar{D}^0$	seen	
Γ_3 $D^*(2007)^0\bar{D}^0 + \text{c.c.}$	seen	
Γ_4 $D^*(2007)^0\bar{D}^*(2007)^0$	seen	
Γ_5 $J/\psi(1S)\text{hadrons}$		
Γ_6 $J/\psi\pi^+\pi^-$	< 4	$\times 10^{-3}$ 90%
Γ_7 $J/\psi\pi^0\pi^0$	< 2	$\times 10^{-3}$ 90%
Γ_8 $J/\psi\eta$	< 7	$\times 10^{-3}$ 90%

Γ_9	$J/\psi \pi^0$	< 2	$\times 10^{-3}$	90%
Γ_{10}	$J/\psi \pi^+ \pi^- \pi^0$	< 2	$\times 10^{-3}$	90%
Γ_{11}	$\chi_{c1} \gamma$	< 1.1	%	90%
Γ_{12}	$\chi_{c2} \gamma$	< 1.7	%	90%
Γ_{13}	$\chi_{c1} \pi^+ \pi^- \pi^0$	< 1.1	%	90%
Γ_{14}	$\chi_{c2} \pi^+ \pi^- \pi^0$	< 3.2	%	90%
Γ_{15}	$\phi \pi^+ \pi^-$	< 3	$\times 10^{-3}$	90%
Γ_{16}	$\mu^+ \mu^-$			

$\psi(4040)$ PARTIAL WIDTHS

$\Gamma(e^+ e^-)$				Γ_1
VALUE (keV)	DOCUMENT ID	TECN	COMMENT	
0.86 ± 0.07 OUR ESTIMATE				
0.83 ± 0.20	⁷ ABLIKIM	08D BES2	$e^+ e^- \rightarrow$ hadrons	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.88 \pm 0.11	⁸ SETH	05A RVUE	$e^+ e^- \rightarrow$ hadrons	
0.91 \pm 0.13	⁹ SETH	05A RVUE	$e^+ e^- \rightarrow$ hadrons	
0.75 \pm 0.15	BRANDELIK	78C DASP	$e^+ e^-$	
⁷ Reanalysis of data presented in BAI 02C. From a global fit over the center-of-mass energy region 3.7–5.0 GeV covering the $\psi(3770)$, $\psi(4040)$, $\psi(4160)$, and $\psi(4415)$ resonances. Phase angle fixed in the fit to $\delta = (130 \pm 46)^\circ$.				
⁸ From a fit to Crystal Ball (OSTERHELD 86) data.				
⁹ From a fit to BES (BAI 02C) data.				

$\psi(4040)$ BRANCHING RATIOS

$\Gamma(e^+ e^-)/\Gamma_{\text{total}}$				Γ_1/Γ
VALUE (units 10^{-5})	DOCUMENT ID	TECN	COMMENT	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
~ 1.0	FELDMAN	77 MRK1	$e^+ e^-$	
$\Gamma(D^0 \bar{D}^0)/\Gamma(D^*(2007)^0 \bar{D}^0 + \text{c.c.})$				Γ_2/Γ_3
VALUE	DOCUMENT ID	TECN	COMMENT	
0.05 ± 0.03	¹⁰ GOLDHABER	77 MRK1	$e^+ e^-$	
$\Gamma(D^*(2007)^0 \bar{D}^*(2007)^0)/\Gamma(D^*(2007)^0 \bar{D}^0 + \text{c.c.})$				Γ_4/Γ_3
VALUE	DOCUMENT ID	TECN	COMMENT	
32.0 ± 12.0	¹⁰ GOLDHABER	77 MRK1	$e^+ e^-$	
$\Gamma(J/\psi \pi^+ \pi^-)/\Gamma_{\text{total}}$				Γ_6/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
< 4	90	COAN	06 CLEO	3.97–4.06 $e^+ e^- \rightarrow$ hadrons
$\Gamma(J/\psi \pi^0 \pi^0)/\Gamma_{\text{total}}$				Γ_7/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
< 2	90	COAN	06 CLEO	3.97–4.06 $e^+ e^- \rightarrow$ hadrons

$\Gamma(J/\psi\eta)/\Gamma_{\text{total}}$					Γ_8/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<7	90	COAN 06	CLEO	3.97–4.06 $e^+e^- \rightarrow$ hadrons	
$\Gamma(J/\psi\pi^0)/\Gamma_{\text{total}}$					Γ_9/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<2	90	COAN 06	CLEO	3.97–4.06 $e^+e^- \rightarrow$ hadrons	
$\Gamma(J/\psi\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$					Γ_{10}/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<2	90	COAN 06	CLEO	3.97–4.06 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\chi_{c1}\gamma)/\Gamma_{\text{total}}$					Γ_{11}/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<11	90	COAN 06	CLEO	3.97–4.06 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\chi_{c2}\gamma)/\Gamma_{\text{total}}$					Γ_{12}/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<17	90	COAN 06	CLEO	3.97–4.06 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\chi_{c1}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$					Γ_{13}/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<11	90	COAN 06	CLEO	3.97–4.06 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\chi_{c2}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$					Γ_{14}/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<32	90	COAN 06	CLEO	3.97–4.06 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\phi\pi^+\pi^-)/\Gamma_{\text{total}}$					Γ_{15}/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<3	90	COAN 06	CLEO	3.97–4.06 $e^+e^- \rightarrow$ hadrons	

¹⁰ Phase-space factor (p^3) explicitly removed.

$\psi(4040)$ REFERENCES

ABLIKIM	08D	PL B660 315	M. Ablikim <i>et al.</i>	(BES Collab.)
COAN	06	PRL 96 162003	T.E. Coan <i>et al.</i>	(CLEO Collab.)
SETH	05A	PR D72 017501	K.K. Seth	
BAI	02C	PRL 88 101802	J.Z. Bai <i>et al.</i>	(BES Collab.)
OSTERHELD	86	SLAC-PUB-4160	A. Osterheld <i>et al.</i>	(SLAC Crystal Ball Collab.)
BRANDELIK	78C	PL 76B 361	R. Brandelik <i>et al.</i>	(DASP Collab.)
		Also ZPHY C1 233	R. Brandelik <i>et al.</i>	(DASP Collab.)
FELDMAN	77	PRPL 33C 285	G.J. Feldman, M.L. Perl	(LBL, SLAC)
GOLDHABER	77	PL 69B 503	G. Goldhaber <i>et al.</i>	(Mark I Collab.)

————— **OTHER RELATED PAPERS** —————

PAKHLOVA	08	PR D77 011103R	G. Pakhlova <i>et al.</i>	(BELLE Collab.)
PAKHLOVA	07	PRL 98 092001	G. Pakhlova <i>et al.</i>	(BELLE Collab.)
DUBYNSKIY	06A	MPL A21 2779	S. Dubynskiy, M.B. Voloshin	
HEIKKILA	84	PR D29 110	K. Heikkila, N.A. Tornqvist, S. Ono	(HELS, AACHT)
ONO	84	ZPHY C26 307	S. Ono	(ORSAY)
SIEGRIST	82	PR D26 969	J.L. Siegrist <i>et al.</i>	(SLAC, LBL)
AUGUSTIN	75	PRL 34 764	J.E. Augustin <i>et al.</i>	(SLAC, LBL)
BACCI	75	PL 58B 481	C. Bacci <i>et al.</i>	(ROMA, FRAS)
BOYARSKI	75B	PRL 34 762	A.M. Boyarski <i>et al.</i>	(SLAC, LBL)
ESPOSITO	75	PL 58B 478	B. Esposito <i>et al.</i>	(FRAS, NAPL, PADO+)
