$\psi(4040)$

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

$\psi(4040)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
4039 ± 1 OUR ESTIMATE				
4039.6± 4.3	[1] ABLIKIM	08D	BES2	$e^+e^- \to$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
4037 ± 2	[2] SETH	05A	RVUE	$e^+e^- \to$ hadrons
4040 ± 1	[3] SETH	05A	RVUE	$e^+e^- \to$ 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	$e^+e^- \to$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
85 ±10	[5] SETH	05A	RVUE	$e^+e^- \to$ hadrons
89 ± 6	[6] SETH	05A	RVUE	$e^+e^- \to$ 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^-	$(1.07\pm0.16)\times10^{-5}$	
Γ_2	$D\overline{D}$	seen	
Γ_3	$D^0\overline{D}^0$	seen	
Γ_4	D^+D^-	seen	
Γ_5	$D^*\overline{D}$ + c.c.	seen	
Γ_6	$D^*(2007)^0\overline{D}^0$ + c.c.	seen	
Γ_7	$D^*(2010)^+D^-$ + c.c.	seen	
Γ_8	$D^*\overline{D}^*$	not seen	
Γ_9	$D^*(2007)^0\overline{D}^*(2007)^0$	not seen	
Γ_{10}	$D^*(2010)^+D^*(2010)^-$	not seen	

Γ_{11}	$J/\psi(1S)$hadrons			
Γ_{12}	$J/\psi\pi^+\pi^-$	< 4	$\times 10^{-3}$	90%
Γ_{13}	$J/\psi\pi^0\pi^0$	< 2	$\times 10^{-3}$	90%
Γ_{14}	$J/\psi\eta$	< 7	$\times 10^{-3}$	90%
Γ_{15}	$J/\psi\pi^0$	< 2	$\times 10^{-3}$	90%
Γ_{16}	$J/\psi\pi^+\pi^-\pi^0$	< 2	$\times 10^{-3}$	90%
Γ_{17}	$\chi_{c1}\gamma$	< 1.1	%	90%
Γ_{18}	$\chi_{c2}\gamma$	< 1.7	%	90%
Γ_{19}	$\chi_{c1}\pi^+\pi^-\pi^0$	< 1.1	%	90%
Γ_{20}	$\chi_{c2}\pi^+\pi^-\pi^0$	< 3.2	%	90%
Γ_{21}	$\phi\pi^+\pi^-$	< 3	$\times 10^{-3}$	90%
Γ_{22}	$\mu^+\mu^-$			

$\psi(4040)$ 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	$e^+e^- \to$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.88±0.11	[8] SETH	05A	RVUE	$e^+e^- \to$ hadrons
0.91±0.13	[9] SETH	05A	RVUE	$e^+e^- \to$ hadrons
0.75±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^-

$\Gamma(D\overline{D})/\Gamma(D^*\overline{D}+\text{c.c.})$ Γ_2/Γ_5

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.24±0.05±0.12	AUBERT	09M	BABR	$e^+e^- \to \gamma D^{(*)}\overline{D}$

$\Gamma(D^0\overline{D}^0)/\Gamma(D^*(2007)^0\overline{D}^0+\text{c.c.})$ Γ_3/Γ_6

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.05±0.03	[10] GOLDHABER	77	MRK1	e^+e^-

$\Gamma(D^*(2010)^+D^-+\text{c.c.})/\Gamma(D^*(2007)^0\overline{D}^0+\text{c.c.})$ Γ_7/Γ_6

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
0.95±0.09±0.10	AUBERT	09M	BABR	$e^+e^- \to \gamma D^*\overline{D}$

$\Gamma(D^*\overline{D}^*)/\Gamma(D^*\overline{D}+\text{c.c.})$ Γ_8/Γ_5

VALUE	DOCUMENT ID		TECN	COMMENT
0.18±0.14±0.03	AUBERT	09M	BABR	$e^+e^- \to \gamma D^{(*)}\overline{D}^{(*)}$

$\Gamma(D^*(2007)^0\overline{D}^*(2007)^0)/\Gamma(D^*(2007)^0\overline{D}^0+\text{c.c.})$ Γ_9/Γ_6

VALUE	DOCUMENT ID		TECN	COMMENT
32.0±12.0	[10] GOLDHABER	77	MRK1	e^+e^-

$\Gamma(J/\psi\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_{12}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<4	90	COAN	06	CLEO	3.97–4.06 $e^+e^- \to$ hadrons

$\Gamma(J/\psi\pi^0\pi^0)/\Gamma_{\text{total}}$ Γ_{13}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<2	90	COAN	06	CLEO	3.97–4.06 $e^+e^- \to$ hadrons

$\Gamma(J/\psi\eta)/\Gamma_{\text{total}}$ Γ_{14}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<7	90	COAN	06	CLEO	3.97–4.06 $e^+e^- \to$ hadrons

$\Gamma(J/\psi\pi^0)/\Gamma_{\text{total}}$ Γ_{15}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<2	90	COAN	06	CLEO	3.97–4.06 $e^+e^- \to$ hadrons

$\Gamma(J/\psi\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ Γ_{16}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<2	90	COAN	06	CLEO	3.97–4.06 $e^+e^- \to$ hadrons

$\Gamma(\chi_{c1}\gamma)/\Gamma_{\text{total}}$ Γ_{17}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<11	90	COAN	06	CLEO	3.97–4.06 $e^+e^- \to$ hadrons

$\Gamma(\chi_{c2}\gamma)/\Gamma_{\text{total}}$ Γ_{18}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<17	90	COAN	06	CLEO	3.97–4.06 $e^+e^- \to$ hadrons

$\Gamma(\chi_{c1}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ Γ_{19}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<11	90	COAN	06	CLEO	3.97–4.06 $e^+e^- \to$ hadrons

$\Gamma(\chi_{c2}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ Γ_{20}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<32	90	COAN	06	CLEO	3.97–4.06 $e^+e^- \to$ hadrons

$\Gamma(\phi\pi^+\pi^-)/\Gamma_{total}$ Γ_{21}/Γ

VALUE (units 10^{-3})	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<3	90	COAN	06	CLEO	3.97–4.06 e^+e^- → hadrons

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

$\psi(4040)$ REFERENCES

AUBERT	09M	PR D79 092001	B. Aubert *et al.*	(BABAR Collab.)
ABLIKIM	08D	PL B660 315	M. Ablikim *et al.*	(BES Collab.)
COAN	06	PRL 96 162003	T.E. Coan *et al.*	(CLEO Collab.)
SETH	05A	PR D72 017501	K.K. Seth	
BAI	02C	PRL 88 101802	J.Z. Bai *et al.*	(BES Collab.)
OSTERHELD	86	SLAC-PUB-4160	A. Osterheld *et al.*	(SLAC Crystal Ball Collab.)
BRANDELIK	78C	PL 76B 361	R. Brandelik *et al.*	(DASP Collab.)
Also		ZPHY C1 233	R. Brandelik *et al.*	(DASP Collab.)
FELDMAN	77	PRPL 33C 285	G.J. Feldman, M.L. Perl	(LBL, SLAC)
GOLDHABER	77	PL 69B 503	G. Goldhaber *et al.*	(Mark I Collab.)