

$\psi(4160)$

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

$\psi(4160)$ MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
4153 ± 3 OUR ESTIMATE			
4191.7 ± 6.5	¹ ABLIKIM	08D BES2	$e^+e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •			
4151 ± 4	² SETH	05A RVUE	$e^+e^- \rightarrow$ hadrons
4155 ± 5	³ SETH	05A RVUE	$e^+e^- \rightarrow$ hadrons
4159 ± 20	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 $\delta = (293 \pm 57)^\circ$.

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

³ From a fit to BES (BAI 02C) data.

$\psi(4160)$ WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
103 ± 8 OUR ESTIMATE			
71.8 ± 12.3	⁴ ABLIKIM	08D BES2	$e^+e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •			
107 ± 10	⁵ SETH	05A RVUE	$e^+e^- \rightarrow$ hadrons
107 ± 16	⁶ SETH	05A RVUE	$e^+e^- \rightarrow$ hadrons
78 ± 20	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 $\delta = (293 \pm 57)^\circ$.

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

⁶ From a fit to BES (BAI 02C) data.

$\psi(4160)$ DECAY MODES

Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1 e^+e^-	$(8.1 \pm 0.9) \times 10^{-6}$	
Γ_2 $J/\psi \pi^+ \pi^-$	$< 3 \times 10^{-3}$	90%
Γ_3 $J/\psi \pi^0 \pi^0$	$< 3 \times 10^{-3}$	90%
Γ_4 $J/\psi K^+ K^-$	$< 2 \times 10^{-3}$	90%
Γ_5 $J/\psi \eta$	$< 8 \times 10^{-3}$	90%
Γ_6 $J/\psi \pi^0$	$< 1 \times 10^{-3}$	90%
Γ_7 $J/\psi \eta'$	$< 5 \times 10^{-3}$	90%

Γ_8	$J/\psi \pi^+ \pi^- \pi^0$	< 1	$\times 10^{-3}$	90%
Γ_9	$\psi(2S) \pi^+ \pi^-$	< 4	$\times 10^{-3}$	90%
Γ_{10}	$\chi_{c1} \gamma$	< 7	$\times 10^{-3}$	90%
Γ_{11}	$\chi_{c2} \gamma$	< 1.3	%	90%
Γ_{12}	$\chi_{c1} \pi^+ \pi^- \pi^0$	< 2	$\times 10^{-3}$	90%
Γ_{13}	$\chi_{c2} \pi^+ \pi^- \pi^0$	< 8	$\times 10^{-3}$	90%
Γ_{14}	$\phi \pi^+ \pi^-$	< 2	$\times 10^{-3}$	90%

$\psi(4160)$ PARTIAL WIDTHS

$\Gamma(e^+ e^-)$				Γ_1
VALUE (keV)	DOCUMENT ID	TECN	COMMENT	
0.83 ± 0.07	OUR ESTIMATE			
0.48 ± 0.22	⁷ ABLIKIM	08D	BES2	$e^+ e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.83 ± 0.08	⁸ SETH	05A	RVUE	$e^+ e^- \rightarrow$ hadrons
0.84 ± 0.13	⁹ SETH	05A	RVUE	$e^+ e^- \rightarrow$ hadrons
0.77 ± 0.23	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 $\delta = (293 \pm 57)^\circ$.				
⁸ From a fit to Crystal Ball (OSTERHELD 86) data.				
⁹ From a fit to BES (BAI 02c) data.				

$\psi(4160)$ BRANCHING RATIOS

$\Gamma(J/\psi \pi^+ \pi^-) / \Gamma_{\text{total}}$				Γ_2 / Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
< 3	90	COAN	06	CLEO 4.12–4.2 $e^+ e^- \rightarrow$ hadrons
$\Gamma(J/\psi \pi^0 \pi^0) / \Gamma_{\text{total}}$				Γ_3 / Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
< 3	90	COAN	06	CLEO 4.12–4.2 $e^+ e^- \rightarrow$ hadrons
$\Gamma(J/\psi K^+ K^-) / \Gamma_{\text{total}}$				Γ_4 / Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
< 2	90	COAN	06	CLEO 4.12–4.2 $e^+ e^- \rightarrow$ hadrons
$\Gamma(J/\psi \eta) / \Gamma_{\text{total}}$				Γ_5 / Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
< 8	90	COAN	06	CLEO 4.12–4.2 $e^+ e^- \rightarrow$ hadrons
$\Gamma(J/\psi \pi^0) / \Gamma_{\text{total}}$				Γ_6 / Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
< 1	90	COAN	06	CLEO 4.12–4.2 $e^+ e^- \rightarrow$ hadrons

$\Gamma(J/\psi\eta')/\Gamma_{\text{total}}$					Γ_7/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<5	90	COAN 06	CLEO	4.12-4.2 $e^+e^- \rightarrow$ hadrons	
$\Gamma(J/\psi\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$					Γ_8/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<1	90	COAN 06	CLEO	4.12-4.2 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$					Γ_9/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<4	90	COAN 06	CLEO	4.12-4.2 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\chi_{c1}\gamma)/\Gamma_{\text{total}}$					Γ_{10}/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<7	90	COAN 06	CLEO	4.12-4.2 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\chi_{c2}\gamma)/\Gamma_{\text{total}}$					Γ_{11}/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<13	90	COAN 06	CLEO	4.12-4.2 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\chi_{c1}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$					Γ_{12}/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<2	90	COAN 06	CLEO	4.12-4.2 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\chi_{c2}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$					Γ_{13}/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<8	90	COAN 06	CLEO	4.12-4.2 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\phi\pi^+\pi^-)/\Gamma_{\text{total}}$					Γ_{14}/Γ
VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT	
<2	90	COAN 06	CLEO	4.12-4.2 $e^+e^- \rightarrow$ hadrons	

$\psi(4160)$ 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.)

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.)
IDDIR	98	PL B433 125	F. Iddir <i>et al.</i>	
ONO	84	ZPHY C26 307	S. Ono	(ORSAY)
BURMESTER	77	PL 66B 395	J. Burmester <i>et al.</i>	(DESY, HAMB, SIEG+)