

$\psi(4160)$ 

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

### $\psi(4160)$ MASS

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>4153 ± 3 OUR ESTIMATE</b>			
<b>4191.7 ± 6.5</b>	<sup>1</sup> ABLIKIM	08D BES2	$e^+e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •			
4151 ± 4	<sup>2</sup> SETH	05A RVUE	$e^+e^- \rightarrow$ hadrons
4155 ± 5	<sup>3</sup> SETH	05A RVUE	$e^+e^- \rightarrow$ hadrons
4159 ± 20	BRANDELIK	78C DASP	$e^+e^-$

<sup>1</sup> 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  $\delta = (293 \pm 57)^\circ$ .

<sup>2</sup> From a fit to Crystal Ball (OSTERHELD 86) data.

<sup>3</sup> From a fit to BES (BAI 02C) data.

### $\psi(4160)$ WIDTH

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

<sup>4</sup> 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  $\delta = (293 \pm 57)^\circ$ .

<sup>5</sup> From a fit to Crystal Ball (OSTERHELD 86) data.

<sup>6</sup> From a fit to BES (BAI 02C) data.

### $\psi(4160)$ DECAY MODES

Mode	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level
$\Gamma_1$ $e^+e^-$	$(8.1 \pm 0.9) \times 10^{-6}$	
$\Gamma_2$ $J/\psi \pi^+ \pi^-$	$< 3 \times 10^{-3}$	90%
$\Gamma_3$ $J/\psi \pi^0 \pi^0$	$< 3 \times 10^{-3}$	90%
$\Gamma_4$ $J/\psi K^+ K^-$	$< 2 \times 10^{-3}$	90%
$\Gamma_5$ $J/\psi \eta$	$< 8 \times 10^{-3}$	90%
$\Gamma_6$ $J/\psi \pi^0$	$< 1 \times 10^{-3}$	90%
$\Gamma_7$ $J/\psi \eta'$	$< 5 \times 10^{-3}$	90%

$\Gamma_8$	$J/\psi \pi^+ \pi^- \pi^0$	$< 1$	$\times 10^{-3}$	90%
$\Gamma_9$	$\psi(2S) \pi^+ \pi^-$	$< 4$	$\times 10^{-3}$	90%
$\Gamma_{10}$	$\chi_{c1} \gamma$	$< 7$	$\times 10^{-3}$	90%
$\Gamma_{11}$	$\chi_{c2} \gamma$	$< 1.3$	%	90%
$\Gamma_{12}$	$\chi_{c1} \pi^+ \pi^- \pi^0$	$< 2$	$\times 10^{-3}$	90%
$\Gamma_{13}$	$\chi_{c2} \pi^+ \pi^- \pi^0$	$< 8$	$\times 10^{-3}$	90%
$\Gamma_{14}$	$\phi \pi^+ \pi^-$	$< 2$	$\times 10^{-3}$	90%

### $\psi(4160)$ PARTIAL WIDTHS

$\Gamma(e^+ e^-)$				$\Gamma_1$
VALUE (keV)	DOCUMENT ID	TECN	COMMENT	
<b><math>0.83 \pm 0.07</math></b>	<b>OUR ESTIMATE</b>			
<b><math>0.48 \pm 0.22</math></b>	<sup>7</sup> ABLIKIM	08D	BES2 $e^+ e^- \rightarrow$ hadrons	
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$0.83 \pm 0.08$	<sup>8</sup> SETH	05A	RVUE $e^+ e^- \rightarrow$ hadrons	
$0.84 \pm 0.13$	<sup>9</sup> SETH	05A	RVUE $e^+ e^- \rightarrow$ hadrons	
$0.77 \pm 0.23$	BRANDELIK	78C	DASP $e^+ e^-$	
<sup>7</sup> 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 $\delta = (293 \pm 57)^\circ$ .				
<sup>8</sup> From a fit to Crystal Ball (OSTERHELD 86) data.				
<sup>9</sup> From a fit to BES (BAI 02C) data.				

### $\psi(4160)$ BRANCHING RATIOS

$\Gamma(J/\psi \pi^+ \pi^-) / \Gamma_{\text{total}}$					$\Gamma_2 / \Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<b><math>&lt; 3</math></b>	90	COAN	06	CLEO 4.12–4.2 $e^+ e^- \rightarrow$ hadrons	
$\Gamma(J/\psi \pi^0 \pi^0) / \Gamma_{\text{total}}$					$\Gamma_3 / \Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<b><math>&lt; 3</math></b>	90	COAN	06	CLEO 4.12–4.2 $e^+ e^- \rightarrow$ hadrons	
$\Gamma(J/\psi K^+ K^-) / \Gamma_{\text{total}}$					$\Gamma_4 / \Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<b><math>&lt; 2</math></b>	90	COAN	06	CLEO 4.12–4.2 $e^+ e^- \rightarrow$ hadrons	
$\Gamma(J/\psi \eta) / \Gamma_{\text{total}}$					$\Gamma_5 / \Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<b><math>&lt; 8</math></b>	90	COAN	06	CLEO 4.12–4.2 $e^+ e^- \rightarrow$ hadrons	
$\Gamma(J/\psi \pi^0) / \Gamma_{\text{total}}$					$\Gamma_6 / \Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<b><math>&lt; 1</math></b>	90	COAN	06	CLEO 4.12–4.2 $e^+ e^- \rightarrow$ hadrons	

$\Gamma(J/\psi\eta')/\Gamma_{\text{total}}$					$\Gamma_7/\Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<5	90	COAN 06	CLEO	4.12–4.2 $e^+e^- \rightarrow$ hadrons	
$\Gamma(J/\psi\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$					$\Gamma_8/\Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<1	90	COAN 06	CLEO	4.12–4.2 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$					$\Gamma_9/\Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<4	90	COAN 06	CLEO	4.12–4.2 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\chi_{c1}\gamma)/\Gamma_{\text{total}}$					$\Gamma_{10}/\Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<7	90	COAN 06	CLEO	4.12–4.2 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\chi_{c2}\gamma)/\Gamma_{\text{total}}$					$\Gamma_{11}/\Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<13	90	COAN 06	CLEO	4.12–4.2 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\chi_{c1}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$					$\Gamma_{12}/\Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<2	90	COAN 06	CLEO	4.12–4.2 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\chi_{c2}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$					$\Gamma_{13}/\Gamma$
VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT	
<8	90	COAN 06	CLEO	4.12–4.2 $e^+e^- \rightarrow$ hadrons	
$\Gamma(\phi\pi^+\pi^-)/\Gamma_{\text{total}}$					$\Gamma_{14}/\Gamma$
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+)