

$\psi(4160)$ [a]

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

[a] J^{PC} known by production in e^+e^- via single photon annihilation. I^G is not known; interpretation of this state as a single resonance is unclear because of the expectation of substantial threshold effects in this energy region.

$\psi(4160)$ MASS

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
4191 ± 5 OUR AVERAGE			
4186.8 ± 8.7 ± 30	¹ ABLIKIM	23BH BES3	$e^+e^- \rightarrow D_s^{*+} D_s^{*-}$
4191 +9 -8	AAIJ	13BC LHCb	$B^+ \rightarrow K^+ \mu^+ \mu^-$
4191.7 ± 6.5	² ABLIKIM	08D BES2	$e^+e^- \rightarrow \text{hadrons}$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
4193 ± 7	³ MO	10 RVUE	$e^+e^- \rightarrow \text{hadrons}$
4151 ± 4	⁴ SETH	05A RVUE	$e^+e^- \rightarrow \text{hadrons}$
4155 ± 5	⁵ SETH	05A RVUE	$e^+e^- \rightarrow \text{hadrons}$
4159 ± 20	BRANDELIK	78C DASP	e^+e^-

¹ Could also be the $\psi(4230)$.
² 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 $\delta = (293 \pm 57)^\circ$.
³ Reanalysis of data presented in BAI 00 and BAI 02C. From a global fit over the center-of-mass energy 3.8–4.8 GeV covering the $\psi(4040)$, $\psi(4160)$ and $\psi(4415)$ resonances and including interference effects.
⁴ From a fit to Crystal Ball (OSTERHELD 86) data.
⁵ From a fit to BES (BAI 02C) data.

$\psi(4160)$ WIDTH

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
69 ± 10 OUR AVERAGE			
55 ± 15 ± 53	¹ ABLIKIM	23BH BES3	$e^+e^- \rightarrow D_s^{*+} D_s^{*-}$
65 +22 -16	AAIJ	13BC LHCb	$B^+ \rightarrow K^+ \mu^+ \mu^-$
71.8 ± 12.3	² ABLIKIM	08D BES2	$e^+e^- \rightarrow \text{hadrons}$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
79 ± 14	³ MO	10 RVUE	$e^+e^- \rightarrow \text{hadrons}$
107 ± 10	⁴ SETH	05A RVUE	$e^+e^- \rightarrow \text{hadrons}$
107 ± 16	⁵ SETH	05A RVUE	$e^+e^- \rightarrow \text{hadrons}$
78 ± 20	BRANDELIK	78C DASP	e^+e^-

¹ Could also be the $\psi(4230)$.
² 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 $\delta = (293 \pm 57)^\circ$.

³ Reanalysis of data presented in BAI 00 and BAI 02C. From a global fit over the center-of-mass energy 3.8-4.8 GeV covering the $\psi(4040)$, $\psi(4160)$ and $\psi(4415)$ resonances and including interference effects.

⁴ From a fit to Crystal Ball (OSTERHELD 86) data.

⁵ From a fit to BES (BAI 02C) data.

$\psi(4160)$ DECAY MODES

Due to the complexity of the $c\bar{c}$ threshold region, in this listing, “seen” (“not seen”) means that a cross section for the mode in question has been measured at effective $\sqrt{s}$ near this particle’s central mass value, more (less) than 2σ above zero, without regard to any peaking behavior in $\sqrt{s}$ or absence thereof. See mode listing(s) for details and references.

Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1 $e^+ e^-$	$(6.9 \pm 3.3) \times 10^{-6}$	
Γ_2 $\mu^+ \mu^-$	seen	
Γ_3 $D \bar{D}$	seen	
Γ_4 $D^0 \bar{D}^0$	seen	
Γ_5 $D^+ D^-$	seen	
Γ_6 $D^* \bar{D} + \text{c.c.}$	seen	
Γ_7 $D^*(2007)^0 \bar{D}^0 + \text{c.c.}$	seen	
Γ_8 $D^*(2010)^+ D^- + \text{c.c.}$	seen	
Γ_9 $D^* \bar{D}^*$	seen	
Γ_{10} $D^*(2007)^0 \bar{D}^*(2007)^0$	seen	
Γ_{11} $D^*(2010)^+ D^*(2010)^-$	seen	
Γ_{12} $D^0 D^- \pi^+ + \text{c.c. (excl. } D^*(2010)^+ D^- + \text{c.c.)}$	not seen	
Γ_{13} $D \bar{D}^* \pi + \text{c.c. (excl. } D^* \bar{D}^*)$	seen	
Γ_{14} $D^0 D^{*-} \pi^+ + \text{c.c. (excl. } D^*(2010)^+ D^*(2010)^-)$	not seen	
Γ_{15} $D_s^+ D_s^-$	not seen	
Γ_{16} $D_s^{*+} D_s^- + \text{c.c.}$	seen	
Γ_{17} $J/\psi \pi^+ \pi^-$	$< 3 \times 10^{-3}$	90%
Γ_{18} $J/\psi \pi^0 \pi^0$	$< 3 \times 10^{-3}$	90%
Γ_{19} $J/\psi K^+ K^-$	$< 2 \times 10^{-3}$	90%
Γ_{20} $J/\psi \eta$	$< 8 \times 10^{-3}$	90%
Γ_{21} $J/\psi \pi^0$	$< 1 \times 10^{-3}$	90%
Γ_{22} $J/\psi \eta'$	$< 5 \times 10^{-3}$	90%
Γ_{23} $J/\psi \pi^+ \pi^- \pi^0$	$< 1 \times 10^{-3}$	90%
Γ_{24} $\psi(2S) \pi^+ \pi^-$	$< 4 \times 10^{-3}$	90%
Γ_{25} $\chi_{c1} \gamma$	$< 5 \times 10^{-3}$	90%
Γ_{26} $\chi_{c2} \gamma$	$< 1.3 \%$	90%
Γ_{27} $\chi_{c1} \pi^+ \pi^- \pi^0$	$< 2 \times 10^{-3}$	90%
Γ_{28} $\chi_{c2} \pi^+ \pi^- \pi^0$	$< 8 \times 10^{-3}$	90%

Γ_{29}	$h_c(1P)\pi^+\pi^-$	< 5	$\times 10^{-3}$	90%
Γ_{30}	$h_c(1P)\pi^0\pi^0$	< 2	$\times 10^{-3}$	90%
Γ_{31}	$h_c(1P)\eta$	< 2	$\times 10^{-3}$	90%
Γ_{32}	$h_c(1P)\pi^0$	< 4	$\times 10^{-4}$	90%
Γ_{33}	$\omega\pi^+\pi^-$	seen		
Γ_{34}	$\phi\pi^+\pi^-$	< 2	$\times 10^{-3}$	90%
Γ_{35}	$\gamma\chi_{c1}(3872)$	< 1.6	$\times 10^{-3}$	90%
Γ_{36}	$\gamma\chi_{c0}(3915) \rightarrow \gamma J/\psi\pi^+\pi^-$	< 1.36	$\times 10^{-4}$	90%
Γ_{37}	$\gamma X(3930) \rightarrow \gamma J/\psi\pi^+\pi^-$	< 1.18	$\times 10^{-4}$	90%
Γ_{38}	$\gamma X(3940) \rightarrow \gamma J/\psi\pi^+\pi^-$	< 1.47	$\times 10^{-4}$	90%
Γ_{39}	$\gamma\chi_{c0}(3915) \rightarrow \gamma\gamma J/\psi$	< 1.26	$\times 10^{-4}$	90%
Γ_{40}	$\gamma X(3930) \rightarrow \gamma\gamma J/\psi$	< 8.8	$\times 10^{-5}$	90%
Γ_{41}	$\gamma X(3940) \rightarrow \gamma\gamma J/\psi$	< 1.79	$\times 10^{-4}$	90%
Γ_{42}	$\omega\pi^0$	not seen		
Γ_{43}	$\omega\eta$	not seen		
Γ_{44}	K^+K^-	not seen		
Γ_{45}	$K_S^0 K^\pm\pi^\mp$	seen		
Γ_{46}	$p\bar{p}p\bar{p}$	not seen		
Γ_{47}	$\Lambda\bar{\Lambda}$	< 1.5	$\times 10^{-6}$	90%
Γ_{48}	$\Sigma^+\bar{\Sigma}^-$	< 2.0	$\times 10^{-4}$	90%
Γ_{49}	$\Xi^0\bar{\Xi}^0$	< 1.4	$\times 10^{-4}$	90%
Γ_{50}	$\Xi^-\bar{\Xi}^+$	< 8	$\times 10^{-5}$	90%
Γ_{51}	$pK^-\bar{\Lambda} + \text{c.c.}$	< 6	$\times 10^{-6}$	90%
Γ_{52}	$\Lambda\bar{\Xi}^+K^- + \text{c.c.}$	seen		
Γ_{53}	$\Sigma^0\bar{\Xi}^+K^- + \text{c.c.}$	< 3.1	$\times 10^{-6}$	90%

$\psi(4160)$ PARTIAL WIDTHS

$\Gamma(e^+e^-)$				Γ_1
VALUE (keV)	DOCUMENT ID	TECN	COMMENT	
0.48 ± 0.22	¹ ABLIKIM	08D BES2	$e^+e^- \rightarrow \text{hadrons}$	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.4 to 1.1	² MO	10 RVUE	$e^+e^- \rightarrow \text{hadrons}$	
0.83 ± 0.08	³ SETH	05A RVUE	$e^+e^- \rightarrow \text{hadrons}$	
0.84 ± 0.13	⁴ SETH	05A RVUE	$e^+e^- \rightarrow \text{hadrons}$	
0.77 ± 0.23	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 Reanalysis of data presented in BAI 00 and BAI 02C. From a global fit over the center-of-mass energy 3.8–4.8 GeV covering the $\psi(4040)$, $\psi(4160)$ and $\psi(4415)$ resonances and including interference effects. Four sets of solutions are obtained with the same fit quality, mass and total width, but with different e^+e^- partial widths. We quote only the range of values.

³ From a fit to Crystal Ball (OSTERHELD 86) data.

⁴ From a fit to BES (BAI 02C) data.

$\Gamma(\mu^+\mu^-)$ Γ_2

VALUE (keV)	DOCUMENT ID	TECN	COMMENT
$2.45 \pm 1.24 \pm 0.94$	^{1,2} ABLIKIM	20AG BES3	$e^+e^- \rightarrow \mu^+\mu^-$

¹ From a fit to the $e^+e^- \rightarrow \mu^+\mu^-$ cross section between 3.8 and 4.6 GeV to the coherent sum of four resonant amplitudes assuming $\Gamma(\mu^+\mu^-) = \Gamma(e^+e^-)$.

² From solution 1 of 8 with equal fit quality. Other solutions range from $2.08 \pm 0.99 \pm 0.80$ to $2.45 \pm 1.24 \pm 0.94$ keV.

 $\psi(4160) \Gamma(i) \times \Gamma(e^+e^-)/\Gamma(\text{total})$ $\Gamma(J/\psi\eta') \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{22}\Gamma_1/\Gamma$

VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.17 ± 0.04 86 ^{1,2} ABLIKIM 20A BES3 $e^+e^- \rightarrow \eta' J/\psi$

1.07 ± 0.09 86 ^{1,3} ABLIKIM 20A BES3 $e^+e^- \rightarrow \eta' J/\psi$

¹ Based on a fit to $\sigma(e^+e^- \rightarrow \eta' J/\psi)$ from $\sqrt{s} = 4.18$ to 4.60 GeV assuming interfering $\psi(4160)$ and $\psi(4260)$ contributions. At $\sqrt{s} = 4.18$ GeV, $\sigma(e^+e^- \rightarrow \eta' J/\psi) = 2.4 \pm 0.3 \pm 0.2$ pb.

² Solution I of the fit, corresponding to a phase of -0.03 ± 0.44 rad.

³ Solution II of the fit, corresponding to a phase of 2.54 ± 0.04 rad.

 $\Gamma(\chi_{c1}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{25}\Gamma_1/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
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<2.2 90 ¹ HAN 15 BELL $10.58 e^+e^- \rightarrow \chi_{c1}\gamma$

¹ Using $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$.

 $\Gamma(\chi_{c2}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{26}\Gamma_1/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<6.1 90 ¹ HAN 15 BELL $10.58 e^+e^- \rightarrow \chi_{c2}\gamma$

¹ Using $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$.

 $\Gamma(\omega\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{33}\Gamma_1/\Gamma$

VALUE (eV)	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.0011 ± 0.0008 ± 0.0001 ^{1,2} ABLIKIM 23AQ BES3 fit to cross sections

0.651 ± 0.012 ± 0.040 ^{2,3} ABLIKIM 23AQ BES3 fit to cross sections

¹ Solution I of the fit.

² From a fit to $e^+e^- \rightarrow \omega\pi^+\pi^-$ cross sections between 4 and 4.6 GeV. Recalculated from 12 $\pi \Gamma(e^+e^-) B(\psi(4230) \rightarrow \omega\pi^+\pi^-)$. First uncertainty is from statistical and uncommon systematic uncertainties, and the second is a 6.2% common systematic uncertainty quoted in the paper.

³ Solution II of the fit.

 $\Gamma(K_S^0 K^\pm \pi^\mp) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{45}\Gamma_1/\Gamma$

VALUE (eV)	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

2.71 ± 0.13 ± 0.12 ¹ ABLIKIM 19AE BES3 $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp$

0.0095 ± 0.0088 ± 0.0004 ² ABLIKIM 19AE BES3 $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp$

¹ Solution I of the fit including the $\psi(4160)$ with mass 4191 ± 5 MeV and width 70 ± 10 MeV from PDG 16 and the $\psi(4230)$ with mass $4219.6 \pm 3.3 \pm 5.1$ MeV and width $56.0 \pm 3.6 \pm 6.9$ MeV from GAO 17.

² Solution II of the fit including the $\psi(4160)$ with mass 4191 ± 5 MeV and width 70 ± 10 MeV from PDG 16 and the $\psi(4230)$ with mass $4219.6 \pm 3.3 \pm 5.1$ MeV and width $56.0 \pm 3.6 \pm 6.9$ MeV from GAO 17.

$\Gamma(\Lambda\bar{\Lambda}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{47}\Gamma_1/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
$<0.7 \times 10^{-3}$	90	¹ ABLIKIM	21AS BES3	$e^+e^- \rightarrow \psi(4160)$

¹ From a measurement of the $e^+e^- \rightarrow \Lambda\bar{\Lambda}$ cross section between 3.5 and 4.6 GeV.

$\Gamma(\Sigma^+\bar{\Sigma}^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{48}\Gamma_1/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
$<94.6 \times 10^{-3}$	90	¹ ABLIKIM	24AH BES3	$e^+e^- \rightarrow \Sigma^+\bar{\Sigma}^-$

¹ Interference effect between resonance and continuum amplitudes is considered. Two solutions from the fit.

$\Gamma(\Xi^0\bar{\Xi}^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{49}\Gamma_1/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
$<69.0 \times 10^{-3}$	90	¹ ABLIKIM	24CD BES3	$e^+e^- \rightarrow \psi(4160)$

¹ From a fit to $e^+e^- \rightarrow \Xi^0\bar{\Xi}^0$ cross sections.

$\Gamma(\Xi^-\bar{\Xi}^+) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{50}\Gamma_1/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
$<37.2 \times 10^{-3}$	90	¹ ABLIKIM	23BK BES3	$e^+e^- \rightarrow \psi(4160)$

¹ From a fit to $e^+e^- \rightarrow \Xi^-\bar{\Xi}^+$ cross sections.

$\Gamma(pK^-\bar{\Lambda} + \text{c.c.}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{51}\Gamma_1/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
$<3.0 \times 10^{-3}$	90	¹ ABLIKIM	23BL BES3	$e^+e^- \rightarrow \psi(4160)$

¹ From a fit to $e^+e^- \rightarrow pK^-\bar{\Lambda} + \text{c.c.}$ cross sections.

$\Gamma(\Lambda\bar{\Xi}^+K^- + \text{c.c.}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{52}\Gamma_1/\Gamma$

VALUE (10^{-3} eV)	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

2.1 ± 0.2	¹ ABLIKIM	24AL BES3	$e^+e^- \rightarrow \Lambda\bar{\Xi}^+K^- + \text{c.c.}$
1.5 ± 0.4	² ABLIKIM	24AL BES3	$e^+e^- \rightarrow \Lambda\bar{\Xi}^+K^- + \text{c.c.}$

¹ A fit to the Born cross section of $e^+e^- \rightarrow \Lambda\bar{\Xi}^+K^- + \text{c.c.}$ including interference with the continuum. Significance is 4.4σ . Solution 1 of 2.

² A fit to the Born cross section of $e^+e^- \rightarrow \Lambda\bar{\Xi}^+K^- + \text{c.c.}$ including interference with the continuum. Significance is 4.4σ . Solution 2 of 2.

$\Gamma(\Sigma^0\bar{\Xi}^+K^- + \text{c.c.}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{53}\Gamma_1/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
$<1.5 \times 10^{-3}$	90	¹ ABLIKIM	24AL BES3	$e^+e^- \rightarrow \Sigma^0\bar{\Xi}^+K^- + \text{c.c.}$

¹ A fit to the Born cross section of $e^+e^- \rightarrow \Sigma^0\bar{\Xi}^+K^- + \text{c.c.}$ including interference with the continuum. Two solutions from the fit.

$\psi(4160) \Gamma(i) \times \Gamma(e^+ e^-) / \Gamma^2(\text{total})$

$$\Gamma(J/\psi\eta) / \Gamma_{\text{total}} \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{20} / \Gamma \times \Gamma_1 / \Gamma$$

VALUE (units 10^{-8})	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

$2.8 \pm 0.9 \pm 0.9$	¹ WANG	13B	BELL $e^+ e^- \rightarrow J/\psi \eta \gamma$
$12.8 \pm 1.7 \pm 2.0$	² WANG	13B	BELL $e^+ e^- \rightarrow J/\psi \eta \gamma$

¹ Solution I of two equivalent solutions in a fit using two interfering resonances. Mass and width fixed at 4153 MeV and 103 MeV, respectively.

² Solution II of two equivalent solutions in a fit using two interfering resonances. Mass and width fixed at 4153 MeV and 103 MeV, respectively.

 $\psi(4160)$ BRANCHING RATIOS

$$\Gamma(\mu^+ \mu^-) / \Gamma_{\text{total}} \quad \Gamma_2 / \Gamma$$

VALUE	DOCUMENT ID	TECN	COMMENT
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seen ¹ AAIJ 13BC LHCb $B^+ \rightarrow K^+ \mu^+ \mu^-$

¹ AAIJ 13BC report $B(B^+ \rightarrow K^+ \psi(4160)) B(\psi(4160) \rightarrow \mu^+ \mu^-) = (3.5^{+0.9}_{-0.8}) \times 10^{-9}$.

$$\Gamma(D\bar{D}) / \Gamma(D^* \bar{D}^*) \quad \Gamma_3 / \Gamma_9$$

VALUE	DOCUMENT ID	TECN	COMMENT
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0.02 $\pm$ 0.03 $\pm$ 0.02 AUBERT 09M BABR $e^+ e^- \rightarrow \gamma D^{(*)} \bar{D}^{(*)}$

$$\Gamma(D^0 \bar{D}^0) / \Gamma_{\text{total}} \quad \Gamma_4 / \Gamma$$

VALUE	DOCUMENT ID	TECN	COMMENT
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seen ¹ ABLIKIM 24BH BES3 $e^+ e^- \rightarrow D^0 \bar{D}^0$

seen CRONIN-HEN..09 CLEO $e^+ e^- \rightarrow D^0 \bar{D}^0$

seen PAKHLOVA 08 BELL $e^+ e^- \rightarrow D^0 \bar{D}^0 \gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •

not seen AUBERT 09M BABR $e^+ e^- \rightarrow D^0 \bar{D}^0 \gamma$

¹ A precision measurement of the $e^+ e^- \rightarrow D^0 \bar{D}^0$ cross section shows complex structure in this mass region.

$$\Gamma(D^+ D^-) / \Gamma_{\text{total}} \quad \Gamma_5 / \Gamma$$

VALUE	DOCUMENT ID	TECN	COMMENT
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seen ¹ ABLIKIM 24BH BES3 $e^+ e^- \rightarrow D^+ D^-$

seen CRONIN-HEN..09 CLEO $e^+ e^- \rightarrow D^+ D^-$

seen PAKHLOVA 08 BELL $e^+ e^- \rightarrow D^+ D^- \gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •

not seen AUBERT 09M BABR $e^+ e^- \rightarrow D^+ D^- \gamma$

¹ A precision measurement of the $e^+ e^- \rightarrow D^+ D^-$ cross section shows complex structure in this mass region.

$$\Gamma(D^*(2007)^0 \bar{D}^0 + \text{c.c.}) / \Gamma_{\text{total}} \quad \Gamma_7 / \Gamma$$

VALUE	DOCUMENT ID	TECN	COMMENT
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seen AUBERT 09M BABR $e^+ e^- \rightarrow D^{*0} \bar{D}^0 \gamma$

seen CRONIN-HEN..09 CLEO $e^+ e^- \rightarrow D^{*0} \bar{D}^0$

$\Gamma(D^*(2010)^+ D^- + \text{c.c.})/\Gamma_{\text{total}}$ Γ_8/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	¹ ZHUKOVA 18	BELL	$e^+ e^- \rightarrow D^{*+} D^- \gamma$
seen	AUBERT 09M	BABR	$e^+ e^- \rightarrow D^{*+} D^- \gamma$
seen	CRONIN-HEN..09	CLEO	$e^+ e^- \rightarrow D^{*+} D^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
seen	PAKHLOVA 07	BELL	$e^+ e^- \rightarrow D^{*+} D^- \gamma$

¹Supersedes PAKHLOVA 07.
 $\Gamma(D^* \bar{D} + \text{c.c.})/\Gamma(D^* \bar{D}^*)$ Γ_6/Γ_9

VALUE	DOCUMENT ID	TECN	COMMENT
0.34 ± 0.14 ± 0.05	AUBERT 09M	BABR	$e^+ e^- \rightarrow \gamma D^{(*)} \bar{D}^{(*)}$

 $\Gamma(D^*(2007)^0 \bar{D}^*(2007)^0)/\Gamma_{\text{total}}$ Γ_{10}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	AUBERT 09M	BABR	$e^+ e^- \rightarrow D^{*0} \bar{D}^{*0} \gamma$
seen	CRONIN-HEN..09	CLEO	$e^+ e^- \rightarrow D^{*0} \bar{D}^{*0}$

 $\Gamma(D^*(2010)^+ D^*(2010)^-)/\Gamma_{\text{total}}$ Γ_{11}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	¹ ZHUKOVA 18	BELL	$e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$
seen	AUBERT 09M	BABR	$e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$
seen	CRONIN-HEN..09	CLEO	$e^+ e^- \rightarrow D^{*+} D^{*-}$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
seen	PAKHLOVA 07	BELL	$e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$

¹Supersedes PAKHLOVA 07.
 $\Gamma(D^0 D^- \pi^+ + \text{c.c. (excl. } D^*(2010)^+ D^- + \text{c.c.}))/\Gamma_{\text{total}}$ Γ_{12}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
not seen	PAKHLOVA 08A	BELL	$e^+ e^- \rightarrow D^0 D^- \pi^+ \gamma$

 $\Gamma(D \bar{D}^* \pi + \text{c.c. (excl. } D^* \bar{D}^*))/\Gamma_{\text{total}}$ Γ_{13}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	CRONIN-HEN..09	CLEO	$e^+ e^- \rightarrow D \bar{D}^* \pi$

 $\Gamma(D^0 D^{*-} \pi^+ + \text{c.c. (excl. } D^*(2010)^+ D^*(2010)^-))/\Gamma_{\text{total}}$ Γ_{14}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
not seen	PAKHLOVA 09	BELL	$e^+ e^- \rightarrow D^0 D^{*-} \pi^+ \gamma$

 $\Gamma(D_s^+ D_s^-)/\Gamma_{\text{total}}$ Γ_{15}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
not seen	PAKHLOVA 11	BELL	$e^+ e^- \rightarrow D_s^+ D_s^- \gamma$
not seen	DEL-AMO-SA..10N	BABR	$e^+ e^- \rightarrow D_s^+ D_s^- \gamma$
not seen	CRONIN-HEN..09	CLEO	$e^+ e^- \rightarrow D_s^+ D_s^-$

 $\Gamma(D_s^{*+} D_s^- + \text{c.c.})/\Gamma_{\text{total}}$ Γ_{16}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	PAKHLOVA 11	BELL	$e^+ e^- \rightarrow D_s^{*+} D_s^- \gamma$

seen

DEL-AMO-SA...10N BABR $e^+e^- \rightarrow D_s^{*+} D_s^- \gamma$

seen

CRONIN-HEN...09 CLEO $e^+e^- \rightarrow D_s^{*+} D_s^-$ $\Gamma(J/\psi \pi^+ \pi^-)/\Gamma_{\text{total}}$ Γ_{17}/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_{18}/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_{19}/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_{20}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
<8	90	COAN	06	CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons

• • • We do not use the following data for averages, fits, limits, etc. • • •

possibly seen

¹ ABLIKIM 15L BES3 $e^+e^- \rightarrow J/\psi \eta$

seen

WANG 13B BELL $e^+e^- \rightarrow J/\psi \eta \gamma$ ¹ An enhancement around 4.2 GeV is observed. $\Gamma(J/\psi \pi^0)/\Gamma_{\text{total}}$ Γ_{21}/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_{22}/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_{23}/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_{24}/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_{25}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
<7	90	COAN	06	CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons

• • • We do not use the following data for averages, fits, limits, etc. • • •

 $\Gamma(\chi_{c2} \gamma)/\Gamma_{\text{total}}$ Γ_{26}/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_{27}/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_{28}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
<8	90	COAN	06	CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons

 $\Gamma(h_c(1P)\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_{29}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
<5	90	¹ PEDLAR	11	CLEO $e^+e^- \rightarrow h_c(1P)\pi^+\pi^-$

¹ At $\sqrt{s} = 4170$ MeV, PEDLAR 11 measures $\sigma(e^+e^- \rightarrow h_c(1P)\pi^+\pi^-) = 15.6 \pm 2.3 \pm 1.9 \pm 3.0$ pb, where the errors are statistical, systematic, and due to uncertainty in $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$, respectively.

 $\Gamma(h_c(1P)\pi^0\pi^0)/\Gamma_{\text{total}}$ Γ_{30}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
<2	90	¹ PEDLAR	11	CLEO $e^+e^- \rightarrow h_c(1P)\pi^0\pi^0$

¹ At $\sqrt{s} = 4170$ MeV, PEDLAR 11 measures $\sigma(e^+e^- \rightarrow h_c(1P)\pi^0\pi^0) = 3.0 \pm 3.3 \pm 1.1 \pm 0.6$ pb, where the errors are statistical, systematic, and due to uncertainty in $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$, respectively.

 $\Gamma(h_c(1P)\eta)/\Gamma_{\text{total}}$ Γ_{31}/Γ

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<2	90		¹ PEDLAR	11	CLEO $e^+e^- \rightarrow h_c(1P)\eta$

• • • We do not use the following data for averages, fits, limits, etc. • • •

possibly seen

41

² ABLIKIM

17R

BES3

$e^+e^- \rightarrow h_c(1P)\eta$

¹ At $\sqrt{s} = 4170$ MeV, PEDLAR 11 measures $\sigma(e^+e^- \rightarrow h_c(1P)\eta) = 4.7 \pm 1.7 \pm 1.0 \pm 0.9$ pb, where the errors are statistical, systematic, and due to uncertainty in $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$, respectively.

² An enhancement around 4.2 GeV is observed.

 $\Gamma(h_c(1P)\pi^0)/\Gamma_{\text{total}}$ Γ_{32}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
<0.4	90	¹ PEDLAR	11	CLEO $e^+e^- \rightarrow h_c(1P)\pi^0$

¹ At $\sqrt{s} = 4170$ MeV, PEDLAR 11 measures $\sigma(e^+e^- \rightarrow h_c(1P)\pi^0) = -0.7 \pm 1.8 \pm 0.7 \pm 0.1$ pb, where the errors are statistical, systematic, and due to uncertainty in $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$, respectively.

 $\Gamma(\phi\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_{34}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID	TECN	COMMENT
<2	90	COAN	06	CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons

 $\Gamma(\gamma\chi_{c1}(3872))/\Gamma_{\text{total}}$ Γ_{35}/Γ

VALUE	CL%	DOCUMENT ID	COMMENT
<1.6 $\times 10^{-3}$	90	^{1,2} XIAO	13 $\psi(4160) \rightarrow \gamma J/\psi \pi^+\pi^-$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.011	90	^{1,3} XIAO	13 $\psi(4160) \rightarrow \gamma J/\psi \pi^+\pi^-$
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¹ Obtained by analyzing CLEO data but not authored by the CLEO Collaboration.

² XIAO 13 reports $[\Gamma(\psi(4160) \rightarrow \gamma\chi_{c1}(3872))/\Gamma_{\text{total}}] \times [B(\chi_{c1}(3872) \rightarrow \pi^+\pi^-J/\psi(1S))] < 0.68 \times 10^{-4}$ which we divide by our best value $B(\chi_{c1}(3872) \rightarrow \pi^+\pi^-J/\psi(1S)) = 4.3 \times 10^{-2}$.

³ XIAO 13 reports $[\Gamma(\psi(4160) \rightarrow \gamma\chi_{c1}(3872))/\Gamma_{\text{total}}] \times [B(\chi_{c1}(3872) \rightarrow \gamma J/\psi)] < 1.05 \times 10^{-4}$ which we divide by our best value $B(\chi_{c1}(3872) \rightarrow \gamma J/\psi) = 10 \times 10^{-3}$.

$\Gamma(\gamma\chi_{c0}(3915) \rightarrow \gamma J/\psi \pi^+ \pi^-)/\Gamma_{\text{total}}$				Γ_{36}/Γ
VALUE	CL%	DOCUMENT ID	COMMENT	
<1.36 × 10⁻⁴	90	¹ XIAO 13	$\psi(4160) \rightarrow \gamma J/\psi \pi^+ \pi^-$	

¹ Obtained by analyzing CLEO data but not authored by the CLEO Collaboration.

$\Gamma(\gamma X(3930) \rightarrow \gamma J/\psi \pi^+ \pi^-)/\Gamma_{\text{total}}$				Γ_{37}/Γ
VALUE	CL%	DOCUMENT ID	COMMENT	
<1.18 × 10⁻⁴	90	¹ XIAO 13	$\psi(4160) \rightarrow \gamma J/\psi \pi^+ \pi^-$	

¹ Obtained by analyzing CLEO data but not authored by the CLEO Collaboration.

$\Gamma(\gamma X(3940) \rightarrow \gamma J/\psi \pi^+ \pi^-)/\Gamma_{\text{total}}$				Γ_{38}/Γ
VALUE	CL%	DOCUMENT ID	COMMENT	
<1.47 × 10⁻⁴	90	¹ XIAO 13	$\psi(4160) \rightarrow \gamma J/\psi \pi^+ \pi^-$	

¹ Obtained by analyzing CLEO data but not authored by the CLEO Collaboration.

$\Gamma(\gamma\chi_{c0}(3915) \rightarrow \gamma\gamma J/\psi)/\Gamma_{\text{total}}$				Γ_{39}/Γ
VALUE	CL%	DOCUMENT ID	COMMENT	
<1.26 × 10⁻⁴	90	¹ XIAO 13	$\psi(4160) \rightarrow \gamma\gamma J/\psi$	

¹ Obtained by analyzing CLEO data but not authored by the CLEO Collaboration.

$\Gamma(\gamma X(3930) \rightarrow \gamma\gamma J/\psi)/\Gamma_{\text{total}}$				Γ_{40}/Γ
VALUE	CL%	DOCUMENT ID	COMMENT	
<0.88 × 10⁻⁴	90	¹ XIAO 13	$\psi(4160) \rightarrow \gamma\gamma J/\psi$	

¹ Obtained by analyzing CLEO data but not authored by the CLEO Collaboration.

$\Gamma(\gamma X(3940) \rightarrow \gamma\gamma J/\psi)/\Gamma_{\text{total}}$				Γ_{41}/Γ
VALUE	CL%	DOCUMENT ID	COMMENT	
<1.79 × 10⁻⁴	90	¹ XIAO 13	$\psi(4160) \rightarrow \gamma\gamma J/\psi$	

¹ Obtained by analyzing CLEO data but not authored by the CLEO Collaboration.

$\Gamma(\omega\pi^0)/\Gamma_{\text{total}}$				Γ_{42}/Γ
VALUE		DOCUMENT ID	TECN	COMMENT
not seen		ABLIKIM 22K	BES3	$e^+e^- \rightarrow \omega\pi^0$

$\Gamma(\omega\eta)/\Gamma_{\text{total}}$				Γ_{43}/Γ
VALUE		DOCUMENT ID	TECN	COMMENT
not seen		ABLIKIM 22K	BES3	$e^+e^- \rightarrow \omega\eta$

$\Gamma(K^+K^-)/\Gamma_{\text{total}}$				Γ_{44}/Γ
VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • •				We do not use the following data for averages, fits, limits, etc. • • •

<2 × 10⁻⁵ 90 ¹ DRUZHININ 15 RVUE $e^+e^- \rightarrow \psi(3770)$

¹ DRUZHININ 15 uses BABAR and CLEO data taking into account interference of the processes $e^+e^- \rightarrow K^+K^-$ and $e^+e^- \rightarrow K_S^0 K_L^0$.

$\Gamma(p\bar{p}p\bar{p})/\Gamma_{\text{total}}$				Γ_{46}/Γ
VALUE	DOCUMENT ID	TECN	COMMENT	
not seen	ABLIKIM	21D	BES3	4.0–4.6 $e^+e^- \rightarrow p\bar{p}p\bar{p}$

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