$\psi(4160)$

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

$\psi(4160)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
4191 ± 5 OUR AVERAGE				
4186.8± 8.7±30	[1] ABLIKIM	23BH	BES3	$e^+e^- \to D_s^{*+}D_s^{*-}$
$4191\ ^{+\ 9}_{-\ 8}$	AAIJ	13BC	LHCB	$B^+ \to K^+\mu^+\mu^-$
4191.7± 6.5	[2] ABLIKIM	08D	BES2	$e^+e^- \to$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
4193 ± 7	[3] MO	10	RVUE	$e^+e^- \to$ hadrons
4151 ± 4	[4] SETH	05A	RVUE	$e^+e^- \to$ hadrons
4155 ± 5	[5] SETH	05A	RVUE	$e^+e^- \to$ 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	$e^+e^- \to D_s^{*+}D_s^{*-}$
$65\ ^{+22}_{-16}$	AAIJ	13BC	LHCB	$B^+ \to K^+\mu^+\mu^-$
71.8±12.3	[2] ABLIKIM	08D	BES2	$e^+e^- \to$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
79 ±14	[3] MO	10	RVUE	$e^+e^- \to$ hadrons
107 ±10	[4] SETH	05A	RVUE	$e^+e^- \to$ hadrons
107 ±16	[5] SETH	05A	RVUE	$e^+e^- \to$ 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 $c\overline{c}$ 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	$D\overline{D}$	seen		
Γ_4	$D^0 \overline{D}^0$	seen		
Γ_5	$D^+ D^-$	seen		
Γ_6	$D^* \overline{D}$ + c.c.	seen		
Γ_7	$D^*(2007)^0 \overline{D}^0$ + c.c.	seen		
Γ_8	$D^*(2010)^+ D^-$ + c.c.	seen		
Γ_9	$D^* \overline{D}^*$	seen		
Γ_{10}	$D^*(2007)^0 \overline{D}^*(2007)^0$	seen		
Γ_{11}	$D^*(2010)^+ D^*(2010)^-$	seen		
Γ_{12}	$D^0 D^- \pi^+$ +c.c. (excl. $D^*(2010)^+ D^-$ +c.c.)	not seen		
Γ_{13}	$D\overline{D}^* \pi$ +c.c. (excl. $D^* \overline{D}^*$)	seen		
Γ_{14}	$D^0 D^{*-} \pi^+$ +c.c. (excl. $D^*(2010)^+ D^*(2010)^-$)	not seen		
Γ_{15}	$D_s^+ D_s^-$	not seen		
Γ_{16}	$D_s^{*+} D_s^-$ +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}	$\gamma\chi_{c1}(3872)$	< 1.9	$\times 10^{-3}$	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}	$K^0_S K^\pm\pi^\mp$	seen		
Γ_{46}	$p\overline{p}p\overline{p}$	not seen		
Γ_{47}	$\Lambda\overline{\Lambda}$	< 1.5	$\times 10^{-6}$	90%
Γ_{48}	$\Xi^-\overline{\Xi}^+$	< 8	$\times 10^{-5}$	90%
Γ_{49}	$pK^-\overline{\Lambda}+$ c.c.	< 6	$\times 10^{-6}$	90%

$\psi(4160)$ PARTIAL WIDTHS

$\Gamma(e^+e^-)$ Γ_1

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.48±0.22	[1] ABLIKIM	08D	BES2	$e^+e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.4 to 1.1	[2] MO	10	RVUE	$e^+e^- \rightarrow$ hadrons
0.83±0.08	[3] SETH	05A	RVUE	$e^+e^- \rightarrow$ hadrons
0.84±0.13	[4] SETH	05A	RVUE	$e^+e^- \rightarrow$ 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±1.24±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.

$\psi(4160)$ Γ(i) × Γ(e^+e^-)/Γ(total)

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

VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.17±0.04	86	[1,2] ABLIKIM	20A	BES3	$e^+e^- \to \eta' J/\psi$
1.07±0.09	86	[1,3] ABLIKIM	20A	BES3	$e^+e^- \to \eta' J/\psi$

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

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

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

[1] Using B($\eta \to \gamma\gamma$) = (39.41 ± 0.21)%.

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

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<6.1	90	[1] HAN	15	BELL	10.58 $e^+e^- \to \chi_{c2}\gamma$

[1] Using B($\eta \to \gamma\gamma$) = (39.41 ± 0.21)%.

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

VALUE (eV)	DOCUMENT ID		TECN	COMMENT
• • • 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 $e^+e^- \to \omega\pi^+\pi^-$ cross sections between 4 and 4.6 GeV. Recalculated from 12 π $\Gamma(e^+e^-)$ B($\psi(4230) \to \omega\pi^+\pi^-$). 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.

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

VALUE (eV)	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.71 ±0.13 ±0.12	[1] ABLIKIM	19AE	BES3	$e^+e^- \to K^0_S K^\pm\pi^\mp$
0.0095±0.0088±0.0004	[2] ABLIKIM	19AE	BES3	$e^+e^- \to K^0_S K^\pm\pi^\mp$

[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 ± 3.3 ± 5.1 MeV and width 56.0 ± 3.6 ± 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 ± 3.3 ± 5.1 MeV and width 56.0 ± 3.6 ± 6.9 MeV from GAO 17.

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

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

[1] From a measurement of the $e^+e^- \to \Lambda\overline{\Lambda}$ cross section between 3.5 and 4.6 GeV.

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

VALUE (eV)	CL%	DOCUMENT ID		TECN	COMMENT
$<3.72 \times 10^{-2}$	90	[1] ABLIKIM	23BK	BES3	$e^+e^- \to \psi(4160)$

[1] From a fit to $e^+e^- \to \Xi^-\overline{\Xi}^+$ cross sections.

$\Gamma(pK^-\overline{\Lambda}+\text{c.c.}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ $\Gamma_{49}\Gamma_1/\Gamma$

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

[1] From a fit to $e^+e^- \to pK^-\overline{\Lambda}+$ c.c. cross sections.

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

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

VALUE (units 10^{-8})	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$2.8 \pm 0.9 \pm 0.9$	[1] WANG	13B	BELL	$e^+e^- \to J/\psi\eta\gamma$
$12.8 \pm 1.7 \pm 2.0$	[2] WANG	13B	BELL	$e^+e^- \to J/\psi\eta\gamma$

[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

$\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}}$ Γ_2/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
seen	[1] AAIJ	13BC	LHCB	$B^+ \to K^+\mu^+\mu^-$

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

$\Gamma(D\overline{D})/\Gamma(D^*\overline{D}^*)$ Γ_3/Γ_9

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

$\Gamma(D^0\overline{D}^0)/\Gamma_{\text{total}}$ Γ_4/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
seen	CRONIN-HEN..09		CLEO	$e^+e^- \to D^0\overline{D}^0$
seen	PAKHLOVA	08	BELL	$e^+e^- \to D^0\overline{D}^0\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	AUBERT	09M	BABR	$e^+e^- \to D^0\overline{D}^0\gamma$

$\Gamma(D^+D^-)/\Gamma_{\text{total}}$ Γ_5/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
seen	CRONIN-HEN..09		CLEO	$e^+e^- \to D^+D^-$
seen	PAKHLOVA	08	BELL	$e^+e^- \to D^+D^-\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
not seen	AUBERT	09M	BABR	$e^+e^- \to D^+D^-\gamma$

$\Gamma(D^*(2007)^0\overline{D}^0 + \text{c.c.})/\Gamma_{\text{total}}$ Γ_7/Γ

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

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

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

[1] Supersedes PAKHLOVA 07.

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

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

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

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

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

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

[1] Supersedes PAKHLOVA 07.

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

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

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

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

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

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

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

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

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

VALUE	DOCUMENT ID		TECN	COMMENT
seen	PAKHLOVA	11	BELL	$e^+e^- \to D_s^{*+} D_s^-\gamma$
seen	DEL-AMO-SA..	10N	BABR	$e^+e^- \to D_s^{*+} D_s^-\gamma$
seen	CRONIN-HEN..	09	CLEO	$e^+e^- \to D_s^{*+} D_s^-$

$\Gamma(J/\psi\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_{17}/Γ

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

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

possibly seen	[1] ABLIKIM		15L	BES3	$e^+e^- \to J/\psi\eta$
seen	WANG		13B	BELL	$e^+e^- \to J/\psi\eta\gamma$

[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 $e^+e^- \to$ 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 $e^+e^- \to$ hadrons

$\Gamma(J/\psi\pi^+\pi^-\pi^0)/\Gamma_{total}$ Γ_{23}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<1	90	COAN	06	CLEO	4.12–4.2 e^+e^- → hadrons

$\Gamma(\psi(2S)\pi^+\pi^-)/\Gamma_{total}$ Γ_{24}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<4	90	COAN	06	CLEO	4.12–4.2 e^+e^- → hadrons

$\Gamma(\chi_{c1}\gamma)/\Gamma_{total}$ Γ_{25}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<7	90	COAN	06	CLEO	4.12–4.2 e^+e^- → hadrons

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

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<13	90	COAN	06	CLEO	4.12–4.2 e^+e^- → hadrons

$\Gamma(\chi_{c1}\pi^+\pi^-\pi^0)/\Gamma_{total}$ Γ_{27}/Γ

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

$\Gamma(\chi_{c2}\pi^+\pi^-\pi^0)/\Gamma_{total}$ Γ_{28}/Γ

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

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

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

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

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

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

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

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

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<2	90		[1] PEDLAR	11	CLEO	e^+e^- → $h_c(1P)\eta$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
possibly seen	41		[2] ABLIKIM	17R	BES3	e^+e^- → $h_c(1P)\eta$

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

[2] An enhancement around 4.2 GeV is observed.

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

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

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

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

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

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

VALUE	CL%	DOCUMENT ID		COMMENT
<1.9 × 10^{-3}	90	[1,2] XIAO	13	$\psi(4160) \to \gamma J/\psi\pi^+\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.013	90	[1,3] XIAO	13	$\psi(4160) \to \gamma J/\psi\pi^+\pi^-$

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

[2] XIAO 13 reports $[\Gamma(\psi(4160) \to \gamma\chi_{c1}(3872))/\Gamma_{total}] \times [B(\chi_{c1}(3872) \to \pi^+\pi^- J/\psi(1S))] < 0.68 \times 10^{-4}$ which we divide by our best value $B(\chi_{c1}(3872) \to \pi^+\pi^- J/\psi(1S)) = 3.5 \times 10^{-2}$.

[3] XIAO 13 reports $[\Gamma(\psi(4160) \to \gamma\chi_{c1}(3872))/\Gamma_{total}] \times [B(\chi_{c1}(3872) \to \gamma J/\psi)] < 1.05 \times 10^{-4}$ which we divide by our best value $B(\chi_{c1}(3872) \to \gamma J/\psi) = 7.8 \times 10^{-3}$.

$\Gamma(\gamma\chi_{c0}(3915) \to \gamma J/\psi\pi^+\pi^-)/\Gamma_{total}$ Γ_{36}/Γ

VALUE	CL%	DOCUMENT ID		COMMENT
<1.36 × 10^{-4}	90	[1] XIAO	13	$\psi(4160) \to \gamma J/\psi\pi^+\pi^-$

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

$\Gamma(\gamma X(3930) \to \gamma J/\psi\pi^+\pi^-)/\Gamma_{total}$ Γ_{37}/Γ

VALUE	CL%	DOCUMENT ID		COMMENT
<1.18 × 10^{-4}	90	[1] XIAO	13	$\psi(4160) \to \gamma J/\psi\pi^+\pi^-$

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

$\Gamma(\gamma X(3940) \to \gamma J/\psi\pi^+\pi^-)/\Gamma_{total}$ Γ_{38}/Γ

VALUE	CL%	DOCUMENT ID		COMMENT
<1.47 × 10^{-4}	90	[1] XIAO	13	$\psi(4160) \to \gamma J/\psi\pi^+\pi^-$

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

$\Gamma(\gamma\chi_{c0}(3915) \to \gamma\gamma J/\psi)/\Gamma_{total}$ Γ_{39}/Γ

VALUE	CL%	DOCUMENT ID		COMMENT
<1.26 × 10^{-4}	90	[1] XIAO	13	$\psi(4160) \to \gamma\gamma J/\psi$

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

$\Gamma(\gamma X(3930) \to \gamma\gamma J/\psi)/\Gamma_{\text{total}}$ Γ_{40}/Γ

VALUE	CL%	DOCUMENT ID		COMMENT
$<0.88 \times 10^{-4}$	90	[1] XIAO	13	$\psi(4160) \to \gamma\gamma J/\psi$

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

$\Gamma(\gamma X(3940) \to \gamma\gamma J/\psi)/\Gamma_{\text{total}}$ Γ_{41}/Γ

VALUE	CL%	DOCUMENT ID		COMMENT
$<1.79 \times 10^{-4}$	90	[1] XIAO	13	$\psi(4160) \to \gamma\gamma J/\psi$

[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	$e^+e^- \to \omega\pi^0$

$\Gamma(\omega\eta)/\Gamma_{\text{total}}$ Γ_{43}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
not seen	ABLIKIM	22K	BES3	$e^+e^- \to \omega\eta$

$\Gamma(K^+K^-)/\Gamma_{\text{total}}$ Γ_{44}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<2 \times 10^{-5}$	90	[1] DRUZHININ	15	RVUE	$e^+e^- \to \psi(3770)$

[1] DRUZHININ 15 uses BABAR and CLEO data taking into account interference of the processes $e^+e^- \to K^+K^-$ and $e^+e^- \to K^0_S K^0_L$.

$\Gamma(p\overline{p}p\overline{p})/\Gamma_{\text{total}}$ Γ_{46}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
not seen	ABLIKIM	21D	BES3	4.0–4.6 $e^+e^- \to p\overline{p}p\overline{p}$

$\psi(4160)$ REFERENCES

ABLIKIM	23AQ	JHEP 2308 159	M. Ablikim *et al.*	(BESIII Collab.)
ABLIKIM	23BH	PRL 131 151903	M. Ablikim *et al.*	(BESIII Collab.)
ABLIKIM	23BK	JHEP 2311 228	M. Ablikim *et al.*	(BESIII Collab.)
ABLIKIM	23BL	JHEP 2312 027	M. Ablikim *et al.*	(BESIII Collab.)
ABLIKIM	22K	JHEP 2207 064	M. Ablikim *et al.*	(BESIII Collab.)
ABLIKIM	21AS	PR D104 L091104	M. Ablikim *et al.*	(BESIII Collab.)
ABLIKIM	21D	PR D103 052003	M. Ablikim *et al.*	(BESIII Collab.)
ABLIKIM	20A	PR D101 012008	M. Ablikim *et al.*	(BESIII Collab.)
ABLIKIM	20AG	PR D102 112009	M. Ablikim *et al.*	(BESIII Collab.)
ABLIKIM	19AE	PR D99 072005	M. Ablikim *et al.*	(BESIII Collab.)
ZHUKOVA	18	PR D97 012002	V. Zhukova *et al.*	(BELLE Collab.)
ABLIKIM	17R	PR D96 012001	M. Ablikim *et al.*	(BESIII Collab.)
GAO	17	PR D95 092007	X.Y. Gao, C.P. Shen, C.Z. Yuan	
PDG	16	CP C40 100001	C. Patrignani *et al.*	(PDG Collab.)
ABLIKIM	15L	PR D91 112005	M. Ablikim *et al.*	(BESIII Collab.)
DRUZHININ	15	PR D92 054024	V.P. Druzhinin	(NOVO)
HAN	15	PR D92 012011	Y.L. Han *et al.*	(BELLE Collab.)
AAIJ	13BC	PRL 111 112003	R. Aaij *et al.*	(LHCb Collab.)
WANG	13B	PR D87 051101	X.L. Wang *et al.*	(BELLE Collab.)
XIAO	13	PR D87 057501	T. Xiao *et al.*	(NWES, WAYN)
PAKHLOVA	11	PR D83 011101	G. Pakhlova *et al.*	(BELLE Collab.)

PEDLAR	11	PRL 107 041803	T. Pedlar *et al.*	(CLEO Collab.)
DEL-AMO-SA...	10N	PR D82 052004	P. del Amo Sanchez *et al.*	(BABAR Collab.)
MO	10	PR D82 077501	X.H. Mo, C.Z. Yuan, P. Wang	(BHEP)
AUBERT	09M	PR D79 092001	B. Aubert *et al.*	(BABAR Collab.)
CRONIN-HEN...	09	PR D80 072001	D. Cronin-Hennessy *et al.*	(CLEO Collab.)
PAKHLOVA	09	PR D80 091101	G. Pakhlova *et al.*	(BELLE Collab.)
ABLIKIM	08D	PL B660 315	M. Ablikim *et al.*	(BES Collab.)
PAKHLOVA	08	PR D77 011103	G. Pakhlova *et al.*	(BELLE Collab.)
PAKHLOVA	08A	PRL 100 062001	G. Pakhlova *et al.*	(BELLE Collab.)
PAKHLOVA	07	PRL 98 092001	G. Pakhlova *et al.*	(BELLE 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.)
BAI	00	PRL 84 594	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.)