$\chi_{c1}(1P)$

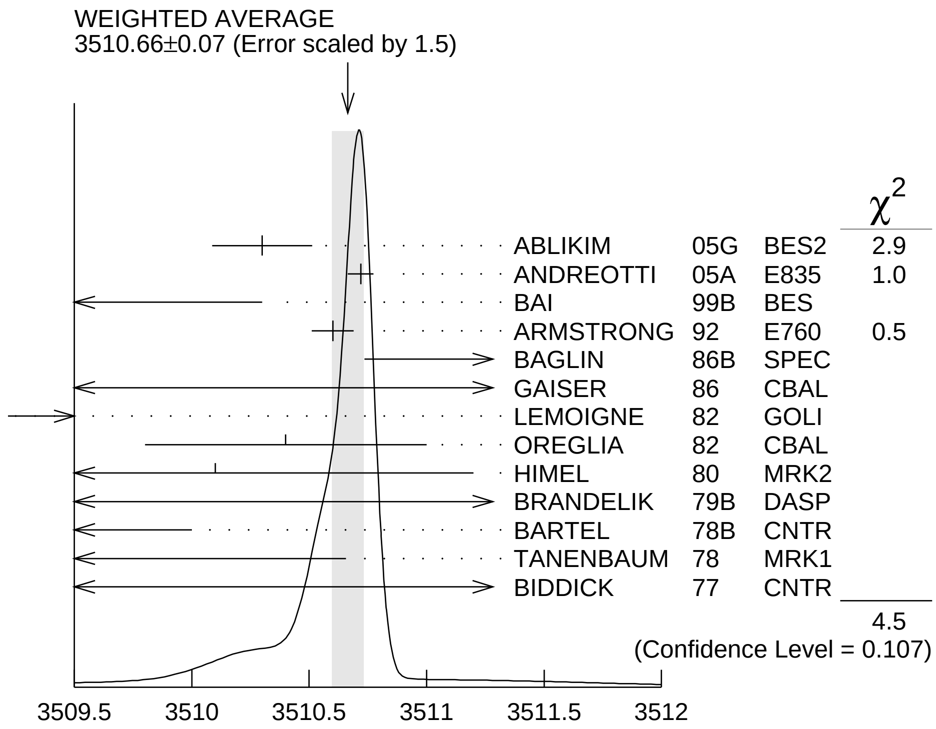
$I^G(J^{PC}) = 0^+(1^{++})$

See the Review on "$\psi(2S)$ and χ_c branching ratios" before the $\chi_{c0}(1P)$ Listings.

$\chi_{c1}(1P)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
3510.66 ± 0.07 OUR AVERAGE		Error includes scale factor of 1.5. See the ideogram below.			
3510.30 ± 0.14 ±0.16		ABLIKIM	05G	BES2	$\psi(2S) \to \gamma\chi_{c1}$
3510.719 ± 0.051 ± 0.019		ANDREOTTI	05A	E835	$p\overline{p} \to e^+e^-\gamma$
3509.4 ± 0.9		BAI	99B	BES	$\psi(2S) \to \gamma X$
3510.60 ± 0.087 ± 0.019	513	[1] ARMSTRONG	92	E760	$\overline{p}p \to e^+e^-\gamma$
3511.3 ± 0.4 ±0.4	30	BAGLIN	86B	SPEC	$\overline{p}p \to e^+e^-X$
3512.3 ± 0.3 ±4.0		[2] GAISER	86	CBAL	$\psi(2S) \to \gamma X$
3507.4 ± 1.7	91	[3] LEMOIGNE	82	GOLI	185 π^- Be $\to \gamma\mu^+\mu^-$ A
3510.4 ± 0.6		OREGLIA	82	CBAL	$e^+e^- \to J/\psi 2\gamma$
3510.1 ± 1.1	254	[4] HIMEL	80	MRK2	$e^+e^- \to J/\psi 2\gamma$
3509 ±11	21	BRANDELIK	79B	DASP	$e^+e^- \to J/\psi 2\gamma$
3507 ± 3		[4] BARTEL	78B	CNTR	$e^+e^- \to J/\psi 2\gamma$
3505.0 ± 4 ±4		[4,5] TANENBAUM	78	MRK1	e^+e^-
3513 ± 7	367	[4] BIDDICK	77	CNTR	$\psi(2S) \to \gamma X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3500 ±10	40	TANENBAUM	75	MRK1	Hadrons γ

[1] Recalculated by ANDREOTTI 05A, using the value of $\psi(2S)$ mass from AULCHENKO 03.
[2] Using mass of $\psi(2S) = 3686.0$ MeV.
[3] $J/\psi(1S)$ mass constrained to 3097 MeV.
[4] Mass value shifted by us by amount appropriate for $\psi(2S)$ mass = 3686 MeV and $J/\psi(1S)$ mass = 3097 MeV.
[5] From a simultaneous fit to radiative and hadronic decay channels.



$\chi_{c1}(1P)$ mass (MeV)

$\chi_{c1}(1P)$ WIDTH

VALUE (MeV)	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.86 ±0.05 OUR FIT						
0.88 ±0.05 OUR AVERAGE						
1.39 $^{+0.40}_{-0.38}$ $^{+0.26}_{-0.77}$			ABLIKIM	05G	BES2	$\psi(2S) \to \gamma\chi_{c1}$
0.876±0.045±0.026			ANDREOTTI	05A	E835	$p\overline{p} \to e^+e^-\gamma$
0.87 ±0.11 ±0.08		513	[6] ARMSTRONG	92	E760	$\overline{p}p \to e^+e^-\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<1.3	95		BAGLIN	86B	SPEC	$\overline{p}p \to e^+e^-X$
<3.8	90		GAISER	86	CBAL	$\psi(2S) \to \gamma X$

[6] Recalculated by ANDREOTTI 05A.

$\chi_{c1}(1P)$ DECAY MODES

Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level

Hadronic decays

Γ_1	$3(\pi^+\pi^-)$	$(5.8 \pm 1.4) \times 10^{-3}$	S=1.2
Γ_2	$2(\pi^+\pi^-)$	$(7.6 \pm 2.6) \times 10^{-3}$	
Γ_3	$\pi^+\pi^-\pi^0\pi^0$	(1.26 ± 0.17) %	
Γ_4	$\rho^+\pi^-\pi^0 +$ c.c.	(1.53 ± 0.26) %	
Γ_5	$\rho^0\pi^+\pi^-$	$(3.9 \pm 3.5) \times 10^{-3}$	
Γ_6	$4\pi^0$	$(5.7 \pm 0.8) \times 10^{-4}$	
Γ_7	$\pi^+\pi^-K^+K^-$	$(4.5 \pm 1.0) \times 10^{-3}$	
Γ_8	$K^+K^-\pi^0\pi^0$	$(1.18\pm0.29) \times 10^{-3}$	
Γ_9	$K^+\pi^-K^0\pi^0 +$ c.c.	$(9.0 \pm 1.5) \times 10^{-3}$	
Γ_{10}	$\rho^+K^-K^0 +$ c.c.	$(5.3 \pm 1.3) \times 10^{-3}$	
Γ_{11}	$K^*(892)^0K^0\pi^0 \to K^+\pi^-K^0\pi^0 +$ c.c.	$(2.5 \pm 0.7) \times 10^{-3}$	
Γ_{12}	$K^+K^-\eta\pi^0$	$(1.2 \pm 0.4) \times 10^{-3}$	
Γ_{13}	$\pi^+\pi^-K^0_SK^0_S$	$(7.2 \pm 3.1) \times 10^{-4}$	
Γ_{14}	$K^+K^-\eta$	$(3.3 \pm 1.0) \times 10^{-4}$	
Γ_{15}	$K^0K^+\pi^- +$ c.c.	$(7.3 \pm 0.6) \times 10^{-3}$	
Γ_{16}	$K^*(892)^0\overline{K}^0 +$ c.c.	$(1.0 \pm 0.4) \times 10^{-3}$	
Γ_{17}	$K^*(892)^+K^- +$ c.c.	$(1.5 \pm 0.7) \times 10^{-3}$	
Γ_{18}	$K^*_J(1430)^0\overline{K}^0 +$ c.c. $\to K^0_SK^+\pi^- +$ c.c.	$< 8 \times 10^{-4}$	CL=90%
Γ_{19}	$K^*_J(1430)^+K^- +$ c.c. $\to K^0_SK^+\pi^- +$ c.c.	$< 2.3 \times 10^{-3}$	CL=90%
Γ_{20}	$K^+K^-\pi^0$	$(1.91\pm0.26) \times 10^{-3}$	
Γ_{21}	$\eta\pi^+\pi^-$	$(5.0 \pm 0.5) \times 10^{-3}$	
Γ_{22}	$a_0(980)^+\pi^- +$ c.c. $\to \eta\pi^+\pi^-$	$(1.9 \pm 0.7) \times 10^{-3}$	
Γ_{23}	$f_2(1270)\eta$	$(2.8 \pm 0.8) \times 10^{-3}$	
Γ_{24}	$\pi^+\pi^-\eta'$	$(2.4 \pm 0.5) \times 10^{-3}$	
Γ_{25}	$\pi^0 f_0(980) \to \pi^0\pi^+\pi^-$	$< 6 \times 10^{-6}$	CL=90%
Γ_{26}	$K^+\overline{K}^*(892)^0\pi^- +$ c.c.	$(3.2 \pm 2.1) \times 10^{-3}$	
Γ_{27}	$K^*(892)^0\overline{K}^*(892)^0$	$(1.5 \pm 0.4) \times 10^{-3}$	
Γ_{28}	$K^+K^-K^0_SK^0_S$	$< 5 \times 10^{-4}$	CL=90%
Γ_{29}	$K^+K^-K^+K^-$	$(5.6 \pm 1.2) \times 10^{-4}$	
Γ_{30}	$K^+K^-\phi$	$(4.3 \pm 1.6) \times 10^{-4}$	
Γ_{31}	$\omega\omega$	$(6.0 \pm 0.7) \times 10^{-4}$	
Γ_{32}	$\omega\phi$	$(2.2 \pm 0.6) \times 10^{-5}$	
Γ_{33}	$\phi\phi$	$(4.4 \pm 0.6) \times 10^{-4}$	
Γ_{34}	$p\overline{p}$	$(7.3 \pm 0.4) \times 10^{-5}$	
Γ_{35}	$p\overline{p}\pi^0$	$(1.64\pm0.20) \times 10^{-4}$	
Γ_{36}	$p\overline{p}\eta$	$(1.53\pm0.26) \times 10^{-4}$	
Γ_{37}	$p\overline{p}\omega$	$(2.24\pm0.33) \times 10^{-4}$	
Γ_{38}	$p\overline{p}\phi$	$< 1.8 \times 10^{-5}$	CL=90%
Γ_{39}	$p\overline{p}\pi^+\pi^-$	$(5.0 \pm 1.9) \times 10^{-4}$	
Γ_{40}	$p\overline{p}\pi^0\pi^0$		

Γ_{41}	$p\overline{p}K^+K^-$ (non-resonant)	$(1.34\pm0.24)\times10^{-4}$	
Γ_{42}	$p\overline{p}K^0_S K^0_S$	$< 4.5 \times10^{-4}$	CL=90%
Γ_{43}	$\Lambda\overline{\Lambda}$	$(1.18\pm0.19)\times10^{-4}$	
Γ_{44}	$\Lambda\overline{\Lambda}\pi^+\pi^-$	$< 1.5 \times10^{-3}$	CL=90%
Γ_{45}	$K^+\overline{p}\Lambda$	$(3.2\pm1.0)\times10^{-4}$	
Γ_{46}	$K^+p\Lambda(1520)+$ c.c.	$(1.8\pm0.5)\times10^{-4}$	
Γ_{47}	$\Lambda(1520)\overline{\Lambda}(1520)$	$< 1.0 \times10^{-4}$	CL=90%
Γ_{48}	$\Sigma^0\overline{\Sigma}^0$	$< 4 \times10^{-5}$	CL=90%
Γ_{49}	$\Sigma^+\overline{\Sigma}^-$	$< 6 \times10^{-5}$	CL=90%
Γ_{50}	$\Xi^0\overline{\Xi}^0$	$< 6 \times10^{-5}$	CL=90%
Γ_{51}	$\Xi^-\overline{\Xi}^+$	$(8.4\pm2.3)\times10^{-5}$	
Γ_{52}	$\pi^+\pi^- + K^+K^-$	$< 2.1 \times10^{-3}$	
Γ_{53}	$K^0_S K^0_S$	$< 6 \times10^{-5}$	CL=90%

Radiative decays

Γ_{54}	$\gamma J/\psi(1S)$	(34.4 ± 1.5) %	
Γ_{55}	$\gamma\rho^0$	$(2.28\pm0.19)\times10^{-4}$	
Γ_{56}	$\gamma\omega$	$(7.1\pm0.9)\times10^{-5}$	
Γ_{57}	$\gamma\phi$	$(2.6\pm0.6)\times10^{-5}$	
Γ_{58}	$\gamma\gamma$		

CONSTRAINED FIT INFORMATION

A multiparticle fit to $\chi_{c1}(1P)$, $\chi_{c0}(1P)$, $\chi_{c2}(1P)$, and $\psi(2S)$ with 4 total widths, a partial width, 25 combinations of partial widths obtained from integrated cross section, and 84 branching ratios uses 223 measurements to determine 49 parameters. The overall fit has a $\chi^2 = 312.2$ for 174 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\left\langle\delta p_i \delta p_j\right\rangle/(\delta p_i\cdot\delta p_j)$, in percent, from the fit to parameters p_i, including the branching fractions, $x_i \equiv \Gamma_i/\Gamma_{\rm total}$.

x_{29}	8				
x_{34}	−9	−4			
x_{43}	11	5	−5		
x_{54}	36	16	−32	20	
Γ	−13	−5	−59	−7	−30
	x_{15}	x_{29}	x_{34}	x_{43}	x_{54}

$\chi_{c1}(1P)$ PARTIAL WIDTHS

—— $\chi_{c1}(1P)$ $\Gamma(i)\Gamma(\gamma J/\psi(1S))/\Gamma(\text{total})$ ——

$\Gamma(p\overline{p}) \times \Gamma(\gamma J/\psi(1S))/\Gamma_{\text{total}}$ — $\Gamma_{34}\Gamma_{54}/\Gamma$

VALUE (eV)	DOCUMENT ID		TECN	COMMENT
21.7±0.8 OUR FIT				
21.4±0.9 OUR AVERAGE				
21.5±0.5±0.8	[7] ANDREOTTI	05A	E835	$p\overline{p} \to e^+e^-\gamma$
21.4±1.5±2.2	[7,8] ARMSTRONG	92	E760	$\overline{p}p \to e^+e^-\gamma$
$19.9^{+4.4}_{-4.0}$	[7] BAGLIN	86B	SPEC	$\overline{p}p \to e^+e^-X$

[7] Calculated by us using $B(J/\psi(1S) \to e^+e^-) = 0.0593 \pm 0.0010$.
[8] Recalculated by ANDREOTTI 05A.

$\chi_{c1}(1P)$ BRANCHING RATIOS

—— HADRONIC DECAYS ——

$\Gamma(3(\pi^+\pi^-))/\Gamma_{\text{total}}$ — Γ_1/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
5.8±1.4 OUR EVALUATION Error includes scale factor of 1.2. Treating systematic error as correlated.				
5.8±1.1 OUR AVERAGE				
5.4±0.7±0.9	[9] BAI	99B	BES	$\psi(2S) \to \gamma\chi_{c1}$
16.0±5.9±0.8	[9] TANENBAUM	78	MRK1	$\psi(2S) \to \gamma\chi_{c1}$

[9] Rescaled by us using $B(\psi(2S) \to \gamma\chi_{c1}) = (8.8 \pm 0.4)\%$ and $B(\psi(2S) \to J/\psi(1S)\pi^+\pi^-) = (32.6 \pm 0.5)\%$.

$\Gamma(2(\pi^+\pi^-))/\Gamma_{\text{total}}$ — Γ_2/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
7.6±2.6 OUR EVALUATION Treating systematic error as correlated.				
8 ±4 OUR AVERAGE Error includes scale factor of 1.5.				
4.6±2.1±2.6	[10] BAI	99B	BES	$\psi(2S) \to \gamma\chi_{c1}$
12.5±4.2±0.6	[10] TANENBAUM	78	MRK1	$\psi(2S) \to \gamma\chi_{c1}$

[10] Rescaled by us using $B(\psi(2S) \to \gamma\chi_{c1}) = (8.8 \pm 0.4)\%$ and $B(\psi(2S) \to J/\psi(1S)\pi^+\pi^-) = (32.6 \pm 0.5)\%$.

$\Gamma(\pi^+\pi^-\pi^0\pi^0)/\Gamma_{\text{total}}$ — Γ_3/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
1.26±0.16±0.05	604.7	[11] HE	08B	CLEO	$e^+e^- \to \gamma h^+h^-h^0h^0$

[11] HE 08B reports $1.28 \pm 0.06 \pm 0.15 \pm 0.08$ % from a measurement of $[\Gamma(\chi_{c1}(1P) \to \pi^+\pi^-\pi^0\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\rho^+\pi^-\pi^0 + \text{c.c.})/\Gamma_{\text{total}}$ Γ_4/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
1.53±0.25±0.06	712.3	[12,13] HE	08B	CLEO	$e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$

[12] HE 08B reports 1.56 ± 0.13 ± 0.22 ± 0.10 % from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow \rho^+\pi^-\pi^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[13] Calculated by us. We have added the values from HE 08B for $\rho^+\pi^-\pi^0$ and $\rho^-\pi^+\pi^0$ decays assuming uncorrelated statistical and fully correlated systematic uncertainties.

$\Gamma(\rho^0\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_5/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
39±35	[14] TANENBAUM	78	MRK1	$\psi(2S) \rightarrow \gamma\chi_{c1}$

[14] Estimated using $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = 0.087$. The errors do not contain the uncertainty in the $\psi(2S)$ decay.

$\Gamma(4\pi^0)/\Gamma_{\text{total}}$ Γ_6/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
0.57±0.03±0.08	608	[15] ABLIKIM	11A	BES3	$e^+e^- \rightarrow \psi(2S) \rightarrow \gamma\chi_{c1}$

[15] ABLIKIM 11A reports $(0.57 \pm 0.03 \pm 0.08) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow 4\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$.

$\Gamma(\pi^+\pi^-K^+K^-)/\Gamma_{\text{total}}$ Γ_7/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
4.5±1.0 OUR EVALUATION	Treating systematic error as correlated.			
4.5±0.9 OUR AVERAGE				
4.2±0.4±0.9	[16] BAI	99B	BES	$\psi(2S) \rightarrow \gamma\chi_{c1}$
7.3±3.0±0.4	[16] TANENBAUM	78	MRK1	$\psi(2S) \rightarrow \gamma\chi_{c1}$

[16] Rescaled by us using $B(\psi(2S) \rightarrow \gamma\chi_{c1}) = (8.8 \pm 0.4)\%$ and $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (32.6 \pm 0.5)\%$.

$\Gamma(K^+K^-\pi^0\pi^0)/\Gamma_{\text{total}}$ Γ_8/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
0.118±0.029±0.005	45.1	[17] HE	08B	CLEO	$e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$

[17] HE 08B reports 0.12 ± 0.02 ± 0.02 ± 0.01 % from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow K^+K^-\pi^0\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(K^+\pi^-K^0\pi^0 + \text{c.c.})/\Gamma_{\text{total}}$ Γ_9/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
0.90±0.14±0.03	141.3	[18] HE	08B	CLEO	$e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$

[18] HE 08B reports 0.92 ± 0.09 ± 0.11 ± 0.06 % from a measurement of [$\Gamma(\chi_{c1}(1P) \rightarrow K^+\pi^- K^0\pi^0 +$ c.c.$)/\Gamma_{total}$] × [B($\psi(2S) \rightarrow \gamma\chi_{c1}(1P)$)] assuming B($\psi(2S) \rightarrow \gamma\chi_{c1}(1P)$) = $(9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value B($\psi(2S) \rightarrow \gamma\chi_{c1}(1P)$) = $(9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\rho^+ K^- K^0 +$ c.c.$)/\Gamma_{total}$ Γ_{10}/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
0.53±0.13±0.02	141.3	[19] HE	08B	CLEO	$e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$

[19] HE 08B reports 0.54 ± 0.11 ± 0.07 ± 0.03 % from a measurement of [$\Gamma(\chi_{c1}(1P) \rightarrow \rho^+ K^- K^0 +$ c.c.$)/\Gamma_{total}$] × [B($\psi(2S) \rightarrow \gamma\chi_{c1}(1P)$)] assuming B($\psi(2S) \rightarrow \gamma\chi_{c1}(1P)$) = $(9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value B($\psi(2S) \rightarrow \gamma\chi_{c1}(1P)$) = $(9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(K^*(892)^0 K^0 \pi^0 \rightarrow K^+\pi^- K^0\pi^0 +$ c.c.$)/\Gamma_{total}$ Γ_{11}/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
0.25±0.07±0.01	141.3	[20] HE	08B	CLEO	$e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$

[20] HE 08B reports 0.25 ± 0.06 ± 0.03 ± 0.02 % from a measurement of [$\Gamma(\chi_{c1}(1P) \rightarrow K^*(892)^0 K^0\pi^0 \rightarrow K^+\pi^- K^0\pi^0 +$ c.c.$)/\Gamma_{total}$] × [B($\psi(2S) \rightarrow \gamma\chi_{c1}(1P)$)] assuming B($\psi(2S) \rightarrow \gamma\chi_{c1}(1P)$) = $(9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value B($\psi(2S) \rightarrow \gamma\chi_{c1}(1P)$) = $(9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(K^+K^-\eta\pi^0)/\Gamma_{total}$ Γ_{12}/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
0.118±0.036±0.005	141.3	[21] HE	08B	CLEO	$e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$

[21] HE 08B reports 0.12 ± 0.03 ± 0.02 ± 0.01 % from a measurement of [$\Gamma(\chi_{c1}(1P) \rightarrow K^+K^-\eta\pi^0)/\Gamma_{total}$] × [B($\psi(2S) \rightarrow \gamma\chi_{c1}(1P)$)] assuming B($\psi(2S) \rightarrow \gamma\chi_{c1}(1P)$) = $(9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value B($\psi(2S) \rightarrow \gamma\chi_{c1}(1P)$) = $(9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\pi^+\pi^- K^0_S K^0_S)/\Gamma_{total}$ Γ_{13}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
7.2±3.1±0.3	19.8 ± 7.7	[22] ABLIKIM	05O	BES2	$\psi(2S) \rightarrow \chi_{c1}\gamma$

[22] ABLIKIM 05O reports [$\Gamma(\chi_{c1}(1P) \rightarrow \pi^+\pi^- K^0_S K^0_S)/\Gamma_{total}$] × [B($\psi(2S) \rightarrow \gamma\chi_{c1}(1P)$)] = $(0.67 \pm 0.26 \pm 0.11) \times 10^{-4}$ which we divide by our best value B($\psi(2S) \rightarrow \gamma\chi_{c1}(1P)$) = $(9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(K^+K^-\eta)/\Gamma_{total}$ Γ_{14}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
0.33±0.10±0.01	[23] ATHAR	07	CLEO	$\psi(2S) \rightarrow \gamma h^+ h^- h^0$

[23] ATHAR 07 reports $(0.34 \pm 0.10 \pm 0.04) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow K^+ K^- \eta)/\Gamma_{total}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 0.0907 \pm 0.0011 \pm 0.0054$, which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(K^0 K^+ \pi^- + c.c.)/\Gamma_{total}$ — Γ_{15}/Γ

VALUE (units 10^{-3})	DOCUMENT ID
7.3±0.6 OUR FIT	

$\Gamma(K^*(892)^0 \overline{K}^0 + c.c.)/\Gamma_{total}$ — Γ_{16}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.03±0.38±0.04	22	[24] ABLIKIM	06R	BES2	$\psi(2S) \rightarrow \gamma \chi_{c1}$

[24] ABLIKIM 06R reports $(1.1 \pm 0.4 \pm 0.1) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow K^*(892)^0 \overline{K}^0 + c.c.)/\Gamma_{total}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(K^*(892)^+ K^- + c.c.)/\Gamma_{total}$ — Γ_{17}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.5±0.7±0.1	27	[25] ABLIKIM	06R	BES2	$\psi(2S) \rightarrow \gamma \chi_{c1}$

[25] ABLIKIM 06R reports $(1.6 \pm 0.7 \pm 0.2) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow K^*(892)^+ K^- + c.c.)/\Gamma_{total}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(K_J^*(1430)^0 \overline{K}^0 + c.c. \rightarrow K_S^0 K^+ \pi^- + c.c.)/\Gamma_{total}$ — Γ_{18}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<0.8	90	[26] ABLIKIM	06R	BES2	$\psi(2S) \rightarrow \gamma \chi_{c1}$

[26] ABLIKIM 06R reports $< 0.9 \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow K_J^*(1430)^0 \overline{K}^0 + c.c. \rightarrow K_S^0 K^+ \pi^- + c.c.)/\Gamma_{total}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.2 \times 10^{-2}$.

$\Gamma(K_J^*(1430)^+ K^- + c.c. \rightarrow K_S^0 K^+ \pi^- + c.c.)/\Gamma_{total}$ — Γ_{19}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<2.3	90	[27] ABLIKIM	06R	BES2	$\psi(2S) \rightarrow \gamma \chi_{c1}$

[27] ABLIKIM 06R reports $< 2.4 \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow K_J^*(1430)^+ K^- + c.c. \rightarrow K_S^0 K^+ \pi^- + c.c.)/\Gamma_{total}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.2 \times 10^{-2}$.

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

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
1.91±0.25±0.07	[28] ATHAR	07	CLEO	$\psi(2S) \to \gamma h^+ h^- h^0$

[28] ATHAR 07 reports $(1.95 \pm 0.16 \pm 0.23) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to K^+ K^- \pi^0)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 0.0907 \pm 0.0011 \pm 0.0054$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

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

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
5.0±0.5 OUR AVERAGE					
4.9±0.5±0.2		[29] ATHAR	07	CLEO	$\psi(2S) \to \gamma h^+ h^- h^0$
5.5±1.0±0.2	222	[30] ABLIKIM	06R	BES2	$\psi(2S) \to \gamma\chi_{c1}$

[29] ATHAR 07 reports $(5.0 \pm 0.3 \pm 0.5) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to \eta\pi^+\pi^-)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 0.0907 \pm 0.0011 \pm 0.0054$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[30] ABLIKIM 06R reports $(5.9 \pm 0.7 \pm 0.8) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to \eta\pi^+\pi^-)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(a_0(980)^+\pi^- + c.c. \to \eta\pi^+\pi^-)/\Gamma_{total}$ Γ_{22}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.9±0.7±0.1	58	[31] ABLIKIM	06R	BES2	$\psi(2S) \to \gamma\chi_{c1}$

[31] ABLIKIM 06R reports $(2.0 \pm 0.5 \pm 0.5) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to a_0(980)^+\pi^- + c.c. \to \eta\pi^+\pi^-)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(f_2(1270)\eta)/\Gamma_{total}$ Γ_{23}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
2.8±0.8±0.1	53	[32] ABLIKIM	06R	BES2	$\psi(2S) \to \gamma\chi_{c1}$

[32] ABLIKIM 06R reports $(3.0 \pm 0.7 \pm 0.5) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to f_2(1270)\eta)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\pi^+\pi^-\eta')/\Gamma_{total}$ Γ_{24}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
2.4±0.5±0.1	[33] ATHAR	07	CLEO	$\psi(2S) \to \gamma h^+ h^- h^0$

[33] ATHAR 07 reports $(2.4 \pm 0.4 \pm 0.3) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to \pi^+\pi^-\eta')/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 0.0907 \pm 0.0011 \pm 0.0054$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\pi^0 f_0(980) \to \pi^0\pi^+\pi^-)/\Gamma_{total}$ — Γ_{25}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<6 × 10^−6	90	[34] ABLIKIM	11D	BES3	$\psi(2S) \to \gamma\pi^0\pi^+\pi^-$

[34] ABLIKIM 11D reports $[\Gamma(\chi_{c1}(1P) \to \pi^0 f_0(980) \to \pi^0\pi^+\pi^-)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))] < 6.0 \times 10^{-7}$ which we divide by our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 9.2 \times 10^{-2}$.

$\Gamma(K^+\overline{K}^*(892)^0\pi^- + \text{c.c.})/\Gamma_{total}$ — Γ_{26}/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
32±21	[35] TANENBAUM	78	MRK1	$\psi(2S) \to \gamma\chi_{c1}$

[35] Estimated using $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 0.087$. The errors do not contain the uncertainty in the $\psi(2S)$ decay.

$\Gamma(K^*(892)^0\overline{K}^*(892)^0)/\Gamma_{total}$ — Γ_{27}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.5±0.4±0.1	28.4 ± 5.5	[36,37] ABLIKIM	04H	BES	$\psi(2S) \to \gamma K^+K^-\pi^+\pi^-$

[36] ABLIKIM 04H reports $[\Gamma(\chi_{c1}(1P) \to K^*(892)^0\overline{K}^*(892)^0)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))] = (1.40 \pm 0.27 \pm 0.22) \times 10^{-4}$ which we divide by our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[37] Assumes $B(K^*(892)^0 \to K^-\pi^+) = 2/3$.

$\Gamma(K^+K^-K^0_S K^0_S)/\Gamma_{total}$ — Γ_{28}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<5	90	3.2 ± 2.4	[38] ABLIKIM	05O	BES2	$\psi(2S) \to \chi_{c1}\gamma$

[38] ABLIKIM 05O reports $[\Gamma(\chi_{c1}(1P) \to K^+K^-K^0_S K^0_S)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))] < 4.2 \times 10^{-5}$ which we divide by our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 9.2 \times 10^{-2}$.

$\Gamma(K^+K^-K^+K^-)/\Gamma_{total}$ — Γ_{29}/Γ

VALUE (units 10^{-3})	DOCUMENT ID
0.56±0.12 OUR FIT	

$\Gamma(K^+K^-\phi)/\Gamma_{total}$ — Γ_{30}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
0.43±0.16±0.02	17	[39] ABLIKIM	06T	BES2	$\psi(2S) \to \gamma 2K^+2K^-$

[39] ABLIKIM 06T reports $(0.46 \pm 0.16 \pm 0.06) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to K^+K^-\phi)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\omega\omega)/\Gamma_{total}$ Γ_{31}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
6.0±0.3±0.7	597	[40] ABLIKIM	11K	BES3	$\psi(2S) \to \gamma$ hadrons

[40] ABLIKIM 11K reports $(6.0 \pm 0.3 \pm 0.7) \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to \omega\omega)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$.

$\Gamma(\omega\phi)/\Gamma_{total}$ Γ_{32}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
0.22±0.06±0.02	15	[41] ABLIKIM	11K	BES3	$\psi(2S) \to \gamma$ hadrons

[41] ABLIKIM 11K reports $(0.22 \pm 0.06 \pm 0.02) \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to \omega\phi)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$.

$\Gamma(\phi\phi)/\Gamma_{total}$ Γ_{33}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
4.4±0.3±0.5	366	[42] ABLIKIM	11K	BES3	$\psi(2S) \to \gamma$ hadrons

[42] ABLIKIM 11K reports $(4.4 \pm 0.3 \pm 0.5) \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to \phi\phi)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$.

$\Gamma(p\overline{p})/\Gamma_{total}$ Γ_{34}/Γ

VALUE (units 10^{-4})	DOCUMENT ID
0.73±0.04 OUR FIT	

$\Gamma(p\overline{p}\pi^0)/\Gamma_{total}$ Γ_{35}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
0.164±0.020 OUR AVERAGE				
0.172±0.020±0.007	[43] ONYISI	10	CLE3	$\psi(2S) \to \gamma p\overline{p}X$
0.118±0.049±0.005	[44] ATHAR	07	CLEO	$\psi(2S) \to \gamma h^+ h^- h^0$

[43] ONYISI 10 reports $(1.75 \pm 0.16 \pm 0.13 \pm 0.11) \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to p\overline{p}\pi^0)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[44] ATHAR 07 reports $(1.2 \pm 0.5 \pm 0.1) \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to p\overline{p}\pi^0)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(p\overline{p}\eta)/\Gamma_{total}$ Γ_{36}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
0.153±0.026±0.006		[45] ONYISI	10	CLE3	$\psi(2S) \to \gamma p\overline{p}X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.16	90	[46] ATHAR	07	CLEO	$\psi(2S) \to \gamma h^+ h^- h^0$

[45] ONYISI 10 reports $(1.56 \pm 0.22 \pm 0.14 \pm 0.10) \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to p\overline{p}\eta)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[46] ATHAR 07 reports $< 0.16 \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to p\overline{p}\eta)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 9.2 \times 10^{-2}$.

$\Gamma(p\overline{p}\omega)/\Gamma_{total}$ — Γ_{37}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
0.224±0.032±0.009	[47] ONYISI	10	CLE3	$\psi(2S) \to \gamma p\overline{p}X$

[47] ONYISI 10 reports $(2.28 \pm 0.28 \pm 0.16 \pm 0.14) \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to p\overline{p}\omega)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(p\overline{p}\phi)/\Gamma_{total}$ — Γ_{38}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<1.8	90	[48] ABLIKIM	11F	BES3	$\psi(2S) \to \gamma p\overline{p}K^+K^-$

[48] ABLIKIM 11F reports $< 1.82 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to p\overline{p}\phi)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$.

$\Gamma(p\overline{p}\pi^+\pi^-)/\Gamma_{total}$ — Γ_{39}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
0.50±0.19 OUR EVALUATION	Treating systematic error as correlated.			
0.50±0.19 OUR AVERAGE				
0.46±0.12±0.15	[49] BAI	99B	BES	$\psi(2S) \to \gamma\chi_{c1}$
1.08±0.77±0.05	[49] TANENBAUM	78	MRK1	$\psi(2S) \to \gamma\chi_{c1}$

[49] Rescaled by us using $B(\psi(2S) \to \gamma\chi_{c1}) = (8.8 \pm 0.4)\%$ and $B(\psi(2S) \to J/\psi(1S)\pi^+\pi^-) = (32.6 \pm 0.5)\%$.

$\Gamma(p\overline{p}\pi^0\pi^0)/\Gamma_{total}$ — Γ_{40}/Γ

VALUE (%)	CL%	DOCUMENT ID		TECN	COMMENT
<0.05	90	[50] HE	08B	CLEO	$e^+e^- \to \gamma h^+h^-h^0h^0$

[50] HE 08B reports < 0.05 % from a measurement of $[\Gamma(\chi_{c1}(1P) \to p\overline{p}\pi^0\pi^0)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 9.2 \times 10^{-2}$.

$\Gamma(p\overline{p}K^+K^-\text{(non-resonant)})/\Gamma_{total}$ — Γ_{41}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
1.35±0.15±0.19	82 ± 9	[51] ABLIKIM	11F	BES3	$\psi(2S) \to \gamma p\overline{p}K^+K^-$

[51] ABLIKIM 11F reports $(1.35 \pm 0.15 \pm 0.19) \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to p\overline{p}K^+K^-\text{ (non-resonant)})/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$.

$\Gamma(p\overline{p}K^0_S K^0_S)/\Gamma_{\text{total}}$ Γ_{42}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<4.5	90	[52] ABLIKIM	06D	BES2	$\psi(2S) \to \gamma\chi_{c1}$

[52] Using B($\psi(2S) \to \chi_{c1}\gamma$) (9.1 ± 0.6)%.

$\Gamma(\Lambda\overline{\Lambda})/\Gamma_{\text{total}}$ Γ_{43}/Γ

VALUE (units 10^{-4})	DOCUMENT ID
1.18±0.19 OUR FIT	

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

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<1.5	90	[53] ABLIKIM	06D	BES2	$\psi(2S) \to \gamma\chi_{c1}$

[53] Using B($\psi(2S) \to \chi_{c1}\gamma$) (9.1 ± 0.6)%.

$\Gamma(K^+\overline{p}\Lambda)/\Gamma_{\text{total}}$ Γ_{45}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
0.32±0.09±0.01	[54] ATHAR	07	CLEO	$\psi(2S) \to \gamma h^+ h^- h^0$

[54] ATHAR 07 reports $(0.33 \pm 0.09 \pm 0.04) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to K^+\overline{p}\Lambda)/\Gamma_{\text{total}}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 0.0907 \pm 0.0011 \pm 0.0054$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(K^+ p\Lambda(1520) + \text{c.c.})/\Gamma_{\text{total}}$ Γ_{46}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
1.8±0.4±0.3	48 ± 10	[55] ABLIKIM	11F	BES3	$\psi(2S) \to \gamma p\overline{p}K^+K^-$

[55] ABLIKIM 11F reports $(1.81 \pm 0.38 \pm 0.28) \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to K^+ p\Lambda(1520) + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$.

$\Gamma(\Lambda(1520)\overline{\Lambda}(1520))/\Gamma_{\text{total}}$ Γ_{47}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<1.0	90	[56] ABLIKIM	11F	BES3	$\psi(2S) \to \gamma p\overline{p}K^+K^-$

[56] ABLIKIM 11F reports $< 1.00 \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to \Lambda(1520)\overline{\Lambda}(1520))/\Gamma_{\text{total}}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$.

$\Gamma(\Sigma^0\overline{\Sigma}^0)/\Gamma_{\text{total}}$ Γ_{48}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.4	90	3.8 ± 2.5	[57] NAIK	08	CLEO	$\psi(2S) \to \gamma\Sigma^0\overline{\Sigma}^0$

[57] NAIK 08 reports $< 0.44 \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to \Sigma^0\overline{\Sigma}^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 9.2 \times 10^{-2}$.

$\Gamma(\Sigma^+\overline{\Sigma}^-)/\Gamma_{total}$ Γ_{49}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.6	90	4.3 ± 2.3	[58] NAIK	08	CLEO	$\psi(2S) \to \gamma\Sigma^+\overline{\Sigma}^-$

[58] NAIK 08 reports $< 0.65 \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to \Sigma^+\overline{\Sigma}^-)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 9.2 \times 10^{-2}$.

$\Gamma(\Xi^0\overline{\Xi}^0)/\Gamma_{total}$ Γ_{50}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.6	90	1.7 ± 2.4	[59] NAIK	08	CLEO	$\psi(2S) \to \gamma\Xi^0\overline{\Xi}^0$

[59] NAIK 08 reports $< 0.60 \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to \Xi^0\overline{\Xi}^0)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 9.2 \times 10^{-2}$.

$\Gamma(\Xi^-\overline{\Xi}^+)/\Gamma_{total}$ Γ_{51}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.84±0.22±0.03		16.4 ± 4.3	[60] NAIK	08	CLEO	$\psi(2S) \to \gamma\Xi^+\overline{\Xi}^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
< 3.4	90		[61] ABLIKIM	06D	BES2	$\psi(2S) \to \gamma\chi_{c1}$

[60] NAIK 08 reports $(0.86 \pm 0.22 \pm 0.08) \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to \Xi^-\overline{\Xi}^+)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$, which we rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[61] Using $B(\psi(2S) \to \chi_{c1}\gamma)$ (9.1 ± 0.6)%.

$[\Gamma(\pi^+\pi^-) + \Gamma(K^+K^-)]/\Gamma_{total}$ Γ_{52}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<21		[62] FELDMAN	77	MRK1	$\psi(2S) \to \gamma\chi_{c1}$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<38	90	[62] BRANDELIK	79B	DASP	$\psi(2S) \to \gamma\chi_{c1}$

[62] Estimated using $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 0.087$. The errors do not contain the uncertainty in the $\psi(2S)$ decay.

$\Gamma(K^0_S K^0_S)/\Gamma_{total}$ Γ_{53}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<0.6	90	[63] ABLIKIM	05O	BES2	$\psi(2S) \to \chi_{c1}\gamma$

[63] ABLIKIM 05O reports $[\Gamma(\chi_{c1}(1P) \to K^0_S K^0_S)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))] < 0.6 \times 10^{-5}$ which we divide by our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 9.2 \times 10^{-2}$.

RADIATIVE DECAYS

$\Gamma(\gamma J/\psi(1S))/\Gamma_{total}$ — Γ_{54}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.344±0.015 OUR FIT				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.379±0.008±0.021	[64] ADAM	05A	CLEO	$e^+e^- \to \psi(2S) \to \gamma\chi_{c1}$

[64] Uses B($\psi(2S) \to \gamma\chi_{c1} \to \gamma\gamma J/\psi$) from ADAM 05A and B($\psi(2S) \to \gamma\chi_{c1}$) from ATHAR 04.

$\Gamma(\gamma\rho^0)/\Gamma_{total}$ — Γ_{55}/Γ

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
228±19 OUR AVERAGE					
228±13±22	432 ± 25	[65] ABLIKIM	11E	BES3	$\psi(2S) \to \gamma\gamma\rho^0$
229±25± 9	186 ± 15	[66] BENNETT	08A	CLEO	$\psi(2S) \to \gamma\gamma\rho^0$

[65] ABLIKIM 11E reports (228 ± 13 ± 22) × 10^{-6} from a measurement of [$\Gamma(\chi_{c1}(1P) \to \gamma\rho^0)/\Gamma_{total}$] × [B($\psi(2S) \to \gamma\chi_{c1}(1P)$)] assuming B($\psi(2S) \to \gamma\chi_{c1}(1P)$) = (9.2 ± 0.4) × 10^{-2}.

[66] BENNETT 08A reports (243 ± 19 ± 22) × 10^{-6} from a measurement of [$\Gamma(\chi_{c1}(1P) \to \gamma\rho^0)/\Gamma_{total}$] × [B($\psi(2S) \to \gamma\chi_{c1}(1P)$)] assuming B($\psi(2S) \to \gamma\chi_{c1}(1P)$) = (8.7 ± 0.4) × 10^{-2}, which we rescale to our best value B($\psi(2S) \to \gamma\chi_{c1}(1P)$) = (9.2 ± 0.4) × 10^{-2}. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\gamma\omega)/\Gamma_{total}$ — Γ_{56}/Γ

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
71± 9 OUR AVERAGE					
70± 7±7	136 ± 14	[67] ABLIKIM	11E	BES3	$\psi(2S) \to \gamma\gamma\omega$
78±18±3	39 ± 7	[68] BENNETT	08A	CLEO	$\psi(2S) \to \gamma\gamma\omega$

[67] ABLIKIM 11E reports (69.7 ± 7.2 ± 6.6) × 10^{-6} from a measurement of [$\Gamma(\chi_{c1}(1P) \to \gamma\omega)/\Gamma_{total}$] × [B($\psi(2S) \to \gamma\chi_{c1}(1P)$)] assuming B($\psi(2S) \to \gamma\chi_{c1}(1P)$) = (9.2 ± 0.4) × 10^{-2}.

[68] BENNETT 08A reports (83 ± 15 ± 12) × 10^{-6} from a measurement of [$\Gamma(\chi_{c1}(1P) \to \gamma\omega)/\Gamma_{total}$] × [B($\psi(2S) \to \gamma\chi_{c1}(1P)$)] assuming B($\psi(2S) \to \gamma\chi_{c1}(1P)$) = (8.7 ± 0.4) × 10^{-2}, which we rescale to our best value B($\psi(2S) \to \gamma\chi_{c1}(1P)$) = (9.2 ± 0.4) × 10^{-2}. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\gamma\phi)/\Gamma_{total}$ — Γ_{57}/Γ

VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
26±5±2		43 ± 9	[69] ABLIKIM	11E	BES3	$\psi(2S) \to \gamma\gamma\phi$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<24	90	5.2 ± 3.1	[70] BENNETT	08A	CLEO	$\psi(2S) \to \gamma\gamma\phi$

[69] ABLIKIM 11E reports (25.8 ± 5.2 ± 2.3) × 10^{-6} from a measurement of [$\Gamma(\chi_{c1}(1P) \to \gamma\phi)/\Gamma_{total}$] × [B($\psi(2S) \to \gamma\chi_{c1}(1P)$)] assuming B($\psi(2S) \to \gamma\chi_{c1}(1P)$) = (9.2 ± 0.4) × 10^{-2}.

[70] BENNETT 08A reports < 26×10^{-6} from a measurement of [$\Gamma(\chi_{c1}(1P) \to \gamma\phi)/\Gamma_{total}$] × [B($\psi(2S) \to \gamma\chi_{c1}(1P)$)] assuming B($\psi(2S) \to \gamma\chi_{c1}(1P)$) = (8.7 ± 0.4) × 10^{-2}, which we rescale to our best value B($\psi(2S) \to \gamma\chi_{c1}(1P)$) = 9.2 × 10^{-2}.

$\Gamma(\gamma\gamma)/\Gamma_{total}$ — Γ_{58}/Γ

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<$ 3.5	90	ECKLUND	08A	CLEO	$\psi(2S) \to \gamma\chi_{c1} \to 3\gamma$
$<$150	90	[71] YAMADA	77	DASP	$e^+e^- \to 3\gamma$

[71] Estimated using B($\psi(2S) \to \gamma\chi_{c1}(1P)$) = 0.087. The errors do not contain the uncertainty in the $\psi(2S)$ decay.

$\chi_{c1}(1P)$ CROSS-PARTICLE BRANCHING RATIOS

$\Gamma(\chi_{c1}(1P) \to p\overline{p})/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\chi_{c1}(1P))/\Gamma(\psi(2S) \to J/\psi(1S)\pi^+\pi^-)$ — $\Gamma_{34}/\Gamma \times \Gamma_{110}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
2.02±0.16 OUR FIT				
1.1 ±1.0	[72] BAI	98I	BES	$\psi(2S) \to \gamma\chi_{c1} \to \gamma\overline{p}p$

[72] Calculated by us. The value for B($\chi_{c1} \to p\overline{p}$) reported in BAI 98I is derived using B($\psi(2S) \to \gamma\chi_{c1}$) = (8.7 ± 0.8)% and B($\psi(2S) \to J/\psi(1S)\pi^+\pi^-$) = (32.4 ± 2.6)% [BAI 98D].

$\Gamma(\chi_{c1}(1P) \to \Lambda\overline{\Lambda})/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\chi_{c1}(1P))/\Gamma_{total}$ — $\Gamma_{43}/\Gamma \times \Gamma_{110}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
10.9±1.7 OUR FIT					
10.5±1.6±0.6	46 ± 7	[73] NAIK	08	CLEO	$\psi(2S) \to \gamma\Lambda\overline{\Lambda}$

[73] Calculated by us. NAIK 08 reports B($\chi_{c1} \to \Lambda\overline{\Lambda}$) = $(11.6 \pm 1.8 \pm 0.7 \pm 0.7) \times 10^{-5}$ using B($\psi(2S) \to \gamma\chi_{c1}$) = $(9.07 \pm 0.11 \pm 0.54)$%.

$\Gamma(\chi_{c1}(1P) \to \Lambda\overline{\Lambda})/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\chi_{c1}(1P))/\Gamma(\psi(2S) \to J/\psi(1S)\pi^+\pi^-)$ — $\Gamma_{43}/\Gamma \times \Gamma_{110}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	COMMENT
3.3±0.5 OUR FIT					
$7.1^{+2.8}_{-2.4}$±1.3	$9.0^{+3.5}_{-3.1}$	[74] BAI	03E	BES	$\psi(2S) \to \gamma\Lambda\overline{\Lambda}$

[74] BAI 03E reports [B($\chi_{c1} \to \Lambda\overline{\Lambda}$) B($\psi(2S) \to \gamma\chi_{c1}$) / B($\psi(2S) \to J/\psi\pi^+\pi^-$)] × [B^2($\Lambda \to \pi^- p$) / B($J/\psi \to p\overline{p}$)] = $(1.33^{+0.52}_{-0.46} \pm 0.25)$%. We calculate from this measurement the presented value using B($\Lambda \to \pi^- p$) = (63.9 ± 0.5)% and B($J/\psi \to p\overline{p}$) = $(2.17 \pm 0.07) \times 10^{-3}$.

$\Gamma(\chi_{c1}(1P) \to \gamma J/\psi(1S))/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\chi_{c1}(1P))/\Gamma_{total}$ — $\Gamma_{54}/\Gamma \times \Gamma_{110}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
3.18±0.08 OUR FIT					
2.70±0.13 OUR AVERAGE					
2.81±0.05±0.23	13k	BAI	04I	BES2	$\psi(2S) \to J/\psi\gamma\gamma$
2.56±0.12±0.20		GAISER	86	CBAL	$\psi(2S) \to \gamma X$
2.78±0.30		[75] OREGLIA	82	CBAL	$\psi(2S) \to \gamma\chi_{c1}$

2.2 ±0.5		[76] BRANDELIK	79B	DASP	$\psi(2S) \to \gamma\chi_{c1}$
2.9 ±0.5		[76] BARTEL	78B	CNTR	$\psi(2S) \to \gamma\chi_{c1}$
5.0 ±1.5		[77] BIDDICK	77	CNTR	$e^+e^- \to \gamma X$
2.8 ±0.9		[75] WHITAKER	76	MRK1	e^+e^-

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

3.56±0.03±0.12	24.9k	[78] MENDEZ	08	CLEO	$\psi(2S) \to \gamma\chi_{c1}$
3.44±0.06±0.13	3.7k	[79] ADAM	05A	CLEO	Repl. by MENDEZ 08

[75] Recalculated by us using B($J/\psi(1S) \to \ell^+\ell^-$) = 0.1181 ± 0.0020.
[76] Recalculated by us using B($J/\psi(1S) \to \mu^+\mu^-$) = 0.0588 ± 0.0010.
[77] Assumes isotropic gamma distribution.
[78] Not independent from other measurements of MENDEZ 08.
[79] Not independent from other values reported by ADAM 05A.

$\Gamma(\chi_{c1}(1P) \to \gamma J/\psi(1S))/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\chi_{c1}(1P))/\Gamma(\psi(2S) \to J/\psi(1S)\text{anything})$ $\Gamma_{54}/\Gamma \times \Gamma^{\psi(2S)}_{110}/\Gamma^{\psi(2S)}_{9}$

$\Gamma_{54}/\Gamma \times \Gamma^{\psi(2S)}_{110}/\Gamma^{\psi(2S)}_{9} = \Gamma_{54}/\Gamma \times \Gamma^{\psi(2S)}_{110}/(\Gamma^{\psi(2S)}_{11}+\Gamma^{\psi(2S)}_{12}+\Gamma^{\psi(2S)}_{13}+0.344\Gamma^{\psi(2S)}_{110}+0.195\Gamma^{\psi(2S)}_{111})$

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
5.34±0.12 OUR FIT					

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

5.70±0.04±0.15	24.9k	[80] MENDEZ	08	CLEO	$\psi(2S) \to \gamma\chi_{c1}$
5.77±0.10±0.12	3.7k	ADAM	05A	CLEO	Repl. by MENDEZ 08

[80] Not independent from other measurements of MENDEZ 08.

$\Gamma(\chi_{c1}(1P) \to \gamma J/\psi(1S))/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\chi_{c1}(1P))/\Gamma(\psi(2S) \to J/\psi(1S)\pi^+\pi^-)$ $\Gamma_{54}/\Gamma \times \Gamma^{\psi(2S)}_{110}/\Gamma^{\psi(2S)}_{11}$

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
9.46±0.23 OUR FIT					
10.15±0.28 OUR AVERAGE					
10.17±0.07±0.27	24.9k	MENDEZ	08	CLEO	$\psi(2S) \to \gamma\chi_{c1}$
12.6 ±0.3 ±3.8	3k	[81] ABLIKIM	04B	BES	$\psi(2S) \to J/\psi X$
8.5 ±2.1		[82] HIMEL	80	MRK2	$\psi(2S) \to \gamma\chi_{c1}$

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

10.24±0.17±0.23	3.7k	[83] ADAM	05A	CLEO	Repl. by MENDEZ 08

[81] From a fit to the J/ψ recoil mass spectra.
[82] The value for B($\psi(2S) \to \gamma\chi_{c1}$)×B($\chi_{c1} \to \gamma J/\psi(1S)$) quoted in HIMEL 80 is derived using B($\psi(2S) \to J/\psi(1S)\pi^+\pi^-$) = (33 ± 3)% and B($J/\psi(1S) \to \ell^+\ell^-$) = 0.138 ± 0.018. Calculated by us using B($J/\psi(1S) \to \ell^+\ell^-$) = 0.1181 ± 0.0020.
[83] Not independent from other values reported by ADAM 05A.

$\Gamma(\chi_{c1}(1P) \to K^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \to \gamma\chi_{c1}(1P))/\Gamma_{\text{total}}$ $\Gamma_{15}/\Gamma \times \Gamma_{110}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
6.8±0.5 OUR FIT				
7.2±0.6 OUR AVERAGE				
7.3±0.5±0.5	[84] ATHAR	07	CLEO	$\psi(2S) \to \gamma K^0_S K^+ \pi^-$
7.0±0.5±0.9	[85] ABLIKIM	06R	BES2	$\psi(2S) \to \gamma\chi_{c1}$

[84] Calculated by us. The value of B($\chi_{c1} \to K^0 K^+ \pi^-$ + c.c.) reported by ATHAR 07 was derived using B($\psi(2S) \to \gamma\chi_{c1}(1P)$) = (9.07 ± 0.11 ± 0.54)%.

[85] Calculated by us. ABLIKIM 06R reports B($\chi_{c1} \to K^0_S K^+ \pi^-$) = (4.0 ± 0.3 ± 0.5) × 10^{-3}. We use B($\psi(2S) \to \gamma\chi_{c1}$) = (8.7 ± 0.4) × 10^{-2}.

$\Gamma(\chi_{c1}(1P) \to K^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \to \gamma\chi_{c1}(1P))/\Gamma(\psi(2S) \to J/\psi(1S)\pi^+\pi^-)$ $\Gamma_{15}/\Gamma \times \Gamma_{110}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
20.1±1.6 OUR FIT				
13.2±2.4±3.2	[86] BAI	99B	BES	$\psi(2S) \to \gamma K^0_S K^+ \pi^-$

[86] Calculated by us. The value of B($\chi_{c1} \to K^0_S K^+ \pi^-$) reported by BAI 99B was derived using B($\psi(2S) \to \gamma\chi_{c1}(1P)$) = (8.7 ± 0.8)% and B($\psi(2S) \to J/\psi\pi^+\pi^-$) = (32.4 ± 2.6)% [BAI 98D].

$\Gamma(\chi_{c1}(1P) \to K^+ K^- K^+ K^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \to \gamma\chi_{c1}(1P))/\Gamma_{\text{total}}$ $\Gamma_{29}/\Gamma \times \Gamma_{110}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
0.52±0.11 OUR FIT					
0.61±0.11±0.08	54	[87] ABLIKIM	06T	BES2	$\psi(2S) \to \gamma K^+ K^+ K^- K^-$

[87] Calculated by us. The value of B($\chi_{c1} \to 2K^+ 2K^-$) reported by ABLIKIM 06T was derived using B($\psi(2S) \to \gamma\chi_{c1}(1P)$) = (8.7 ± 0.8)%.

$\Gamma(\chi_{c1}(1P) \to K^+ K^- K^+ K^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \to \gamma\chi_{c1}(1P))/\Gamma(\psi(2S) \to J/\psi(1S)\pi^+\pi^-)$ $\Gamma_{29}/\Gamma \times \Gamma_{110}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
1.54±0.31 OUR FIT				
1.13±0.40±0.29	[88] BAI	99B	BES	$\psi(2S) \to \gamma K^+ K^+ K^- K^-$

[88] Calculated by us. The value of B($\chi_{c1} \to 2K^+ 2K^-$) reported by BAI 99B was derived using B($\psi(2S) \to \gamma\chi_{c1}(1P)$) = (8.7 ± 0.8)% and B($\psi(2S) \to J/\psi\pi^+\pi^-$) = (32.4 ± 2.6)% [BAI 98D].

$\Gamma(\chi_{c1}(1P) \to p\overline{p})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \to \gamma\chi_{c1}(1P))/\Gamma_{\text{total}}$ $\Gamma_{34}/\Gamma \times \Gamma_{110}^{\psi(2S)}/\Gamma^{\psi(2S)}$

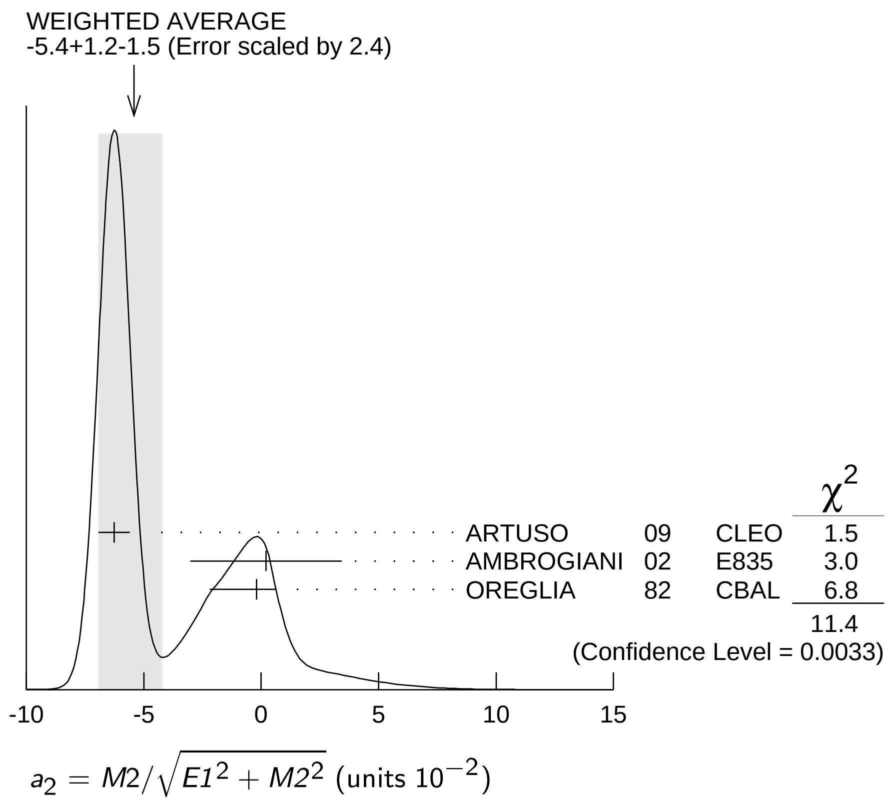
VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
6.8±0.5 OUR FIT					
7.5±1.4 OUR AVERAGE Error includes scale factor of 2.0.					
8.2±0.7±0.4	141 ± 13	[89] NAIK	08	CLEO	$\psi(2S) \to \gamma p\overline{p}$
$4.8^{+1.4}_{-1.3}$±0.6	$18.2^{+5.5}_{-4.9}$	BAI	04F	BES	$\psi(2S) \to \gamma\chi_{c1}(1P) \to \gamma\overline{p}p$

[89] Calculated by us. NAIK 08 reports $B(\chi_{c1} \rightarrow p\overline{p}) = (9.0 \pm 0.8 \pm 0.4 \pm 0.5) \times 10^{-5}$ using $B(\psi(2S) \rightarrow \gamma\chi_{c1}) = (9.07 \pm 0.11 \pm 0.54)\%$.

MULTIPOLE AMPLITUDES IN $\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S)$

$a_2 = M2/\sqrt{E1^2 + M2^2}$ Magnetic quadrupole fractional transition amplitude

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
$-5.4^{+1.2}_{-1.5}$ OUR AVERAGE		Error includes scale factor of 2.4. See the ideogram below.			
$-6.26 \pm 0.63 \pm 0.24$	39k	ARTUSO	09	CLEO	$\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$
$0.2 \pm 3.2 \pm 0.4$	2090	AMBROGIANI	02	E835	$p\overline{p} \rightarrow \chi_{c1} \rightarrow J/\psi\gamma$
$-0.2^{+0.8}_{-2.0}$	921	OREGLIA	82	CBAL	$\psi(2S) \rightarrow \chi_{c1}\gamma \rightarrow J/\psi\gamma\gamma$



MULTIPOLE AMPLITUDES IN $\psi(2S) \rightarrow \gamma\chi_{c1}(1S)$ RADIATIVE DECAY

$b_2 = M2/\sqrt{E1^2 + M2^2}$ Magnetic quadrupole fractional transition amplitude

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.9 ± 0.8 OUR AVERAGE					
$2.76 \pm 0.73 \pm 0.23$	39k	ARTUSO	09	CLEO	$\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$
$7.7^{+5.0}_{-4.5}$	921	OREGLIA	82	CBAL	$\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$

MULTIPOLE AMPLITUDE RATIOS IN RADIATIVE DECAYS $\psi(2S) \rightarrow \gamma\chi_{c1}(1S)$ and $\chi_{c1} \rightarrow \gamma J/\psi(1S)$

a_2/b_2 Magnetic quadrupole transition amplitude ratio

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$-2.27^{+0.57}_{-0.99}$	39k	[90] ARTUSO	09	CLEO	$\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$

[90] Statistical and systematic errors combined. Not independent of $a_2(\chi_{c1})$ and $b_2(\chi_{c1})$ values from ARTUSO 09.

$\chi_{c1}(1P)$ REFERENCES

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ABLIKIM	11D	PR D83 032003	M. Ablikim et al.	(BES III Collab.)
ABLIKIM	11E	PR D83 112005	M. Ablikim et al.	(BES III Collab.)
ABLIKIM	11F	PR D83 112009	M. Ablikim et al.	(BES III Collab.)
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ECKLUND	08A	PR D78 091501R	K.M. Ecklund et al.	(CLEO Collab.)
HE	08B	PR D78 092004	Q. He et al.	(CLEO Collab.)
MENDEZ	08	PR D78 011102R	H. Mendez et al.	(CLEO Collab.)
NAIK	08	PR D78 031101R	P. Naik et al.	(CLEO Collab.)
ATHAR	07	PR D75 032002	S.B. Athar et al.	(CLEO Collab.)
ABLIKIM	06D	PR D73 052006	M. Ablikim et al.	(BES Collab.)
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YAMADA	77	Hamburg Conf. 69	S. Yamada	(DASP Collab.)
WHITAKER	76	PRL 37 1596	J.S. Whitaker et al.	(SLAC, LBL)
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