$\chi_{c1}(1P)$

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

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

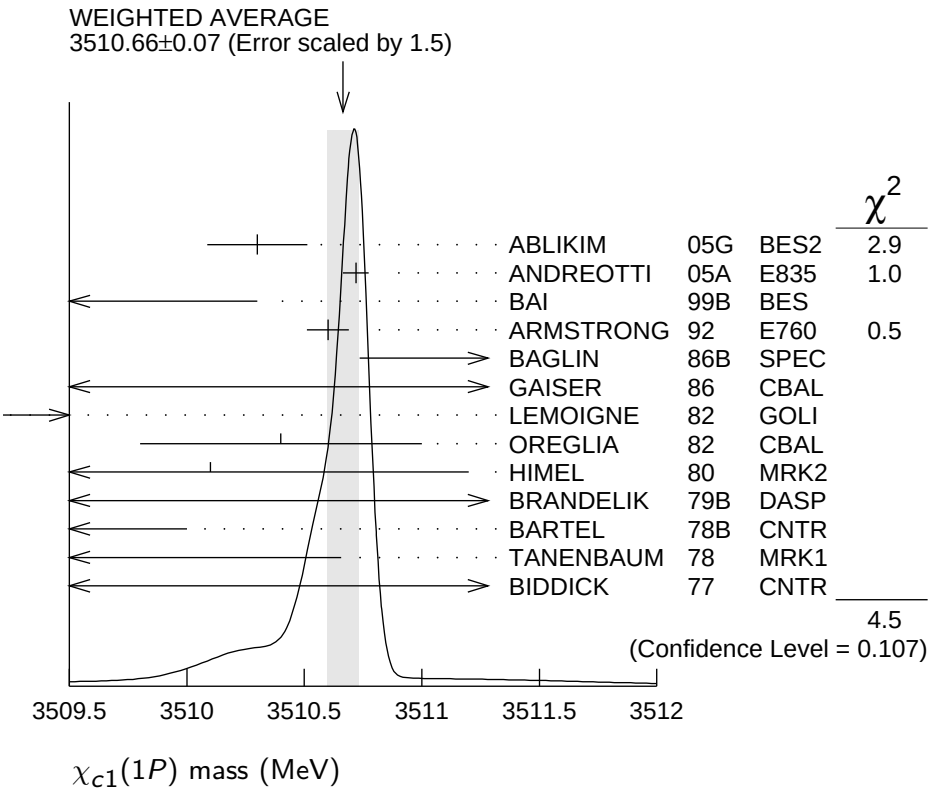
[1] Recalculated by ANDREOTTI 05A, using the value of $\psi(2S)$ mass from AULCHENKO 03.

[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.



$\chi_{c1}(1P)$ 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	$\psi(2S) \rightarrow \gamma\chi_{c1}$
0.876±0.045±0.026			ANDREOTTI	05A	E835	$p\overline{p} \rightarrow e^+e^-\gamma$
0.87 ±0.11 ±0.08		513	[6] ARMSTRONG	92	E760	$\overline{p}p \rightarrow e^+e^-\gamma$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<1.3	95		BAGLIN	86B	SPEC	$\overline{p}p \rightarrow e^+e^-X$
<3.8	90		GAISER	86	CBAL	$\psi(2S) \rightarrow \gamma X$

[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 ±1.4)	$\times 10^{-3}$	S=1.2
Γ_2	$2(\pi^+\pi^-)$	(7.6 ±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 ±3.5)	$\times 10^{-3}$	
Γ_6	$\pi^+\pi^- K^+K^-$	(4.5 ±1.0)	$\times 10^{-3}$	
Γ_7	$K^+K^-\pi^0\pi^0$	(1.18±0.29)	$\times 10^{-3}$	
Γ_8	$K^+\pi^- K^0\pi^0$ + c.c.	(9.0 ±1.5)	$\times 10^{-3}$	
Γ_9	$\rho^+ K^- K^0$ + c.c.	(5.3 ±1.3)	$\times 10^{-3}$	
Γ_{10}	$K^*(892)^0 K^0\pi^0 \to$ $K^+\pi^- K^0\pi^0$ + c.c.	(2.5 ±0.7)	$\times 10^{-3}$	
Γ_{11}	$K^+K^-\eta\pi^0$	(1.2 ±0.4)	$\times 10^{-3}$	
Γ_{12}	$\pi^+\pi^- K^0_S K^0_S$	(7.3 ±3.1)	$\times 10^{-4}$	
Γ_{13}	$K^+K^-\eta$	(3.3 ±1.0)	$\times 10^{-4}$	
Γ_{14}	$K^0 K^+\pi^-$ + c.c.	(7.3 ±0.6)	$\times 10^{-3}$	
Γ_{15}	$K^*(892)^0\overline{K}^0$ + c.c.	(1.0 ±0.4)	$\times 10^{-3}$	
Γ_{16}	$K^*(892)^+ K^-$ + c.c.	(1.5 ±0.7)	$\times 10^{-3}$	
Γ_{17}	$K^*_J(1430)^0\overline{K}^0$ + c.c. $\to$ $K^0_S K^+\pi^-$ + c.c.	< 8	$\times 10^{-4}$	CL=90%
Γ_{18}	$K^*_J(1430)^+ K^-$ + c.c. $\to$ $K^0_S K^+\pi^-$ + c.c.	< 2.3	$\times 10^{-3}$	CL=90%
Γ_{19}	$K^+K^-\pi^0$	(1.92±0.26)	$\times 10^{-3}$	
Γ_{20}	$\eta\pi^+\pi^-$	(5.0 ±0.5)	$\times 10^{-3}$	
Γ_{21}	$a_0(980)^+\pi^-$ + c.c. $\to$ $\eta\pi^+\pi^-$	(1.9 ±0.7)	$\times 10^{-3}$	
Γ_{22}	$f_2(1270)\eta$	(2.8 ±0.8)	$\times 10^{-3}$	
Γ_{23}	$\pi^+\pi^-\eta'$	(2.4 ±0.5)	$\times 10^{-3}$	
Γ_{24}	$K^+\overline{K}^*(892)^0\pi^-$ + c.c.	(3.2 ±2.1)	$\times 10^{-3}$	
Γ_{25}	$K^*(892)^0\overline{K}^*(892)^0$	(1.5 ±0.4)	$\times 10^{-3}$	
Γ_{26}	$K^+K^- K^0_S K^0_S$	< 5	$\times 10^{-4}$	CL=90%
Γ_{27}	$K^+K^- K^+K^-$	(5.6 ±1.2)	$\times 10^{-4}$	
Γ_{28}	$K^+K^-\phi$	(4.3 ±1.6)	$\times 10^{-4}$	
Γ_{29}	$p\overline{p}$	(7.4 ±0.4)	$\times 10^{-5}$	
Γ_{30}	$p\overline{p}\pi^0$	(1.2 ±0.5)	$\times 10^{-4}$	
Γ_{31}	$p\overline{p}\eta$	< 1.6	$\times 10^{-4}$	CL=90%
Γ_{32}	$\pi^+\pi^- p\overline{p}$	(5.0 ±1.9)	$\times 10^{-4}$	
Γ_{33}	$\pi^0\pi^0 p\overline{p}$			
Γ_{34}	$K^0_S K^0_S p\overline{p}$	< 4.5	$\times 10^{-4}$	CL=90%
Γ_{35}	$\Lambda\overline{\Lambda}$	(1.19±0.19)	$\times 10^{-4}$	
Γ_{36}	$\Lambda\overline{\Lambda}\pi^+\pi^-$	< 1.5	$\times 10^{-3}$	CL=90%
Γ_{37}	$K^+\overline{p}\Lambda$	(3.2 ±1.0)	$\times 10^{-4}$	
Γ_{38}	$\Sigma^0\overline{\Sigma}^0$	< 4	$\times 10^{-5}$	CL=90%
Γ_{39}	$\Sigma^+\overline{\Sigma}^-$	< 6	$\times 10^{-5}$	CL=90%

Γ_{40}	$\Xi^0\overline{\Xi}^0$	$<$	6	$\times 10^{-5}$	CL=90%
Γ_{41}	$\Xi^-\overline{\Xi}^+$		(8.4 $\pm$2.3)	$\times 10^{-5}$	
Γ_{42}	$\pi^+\pi^- + K^+K^-$	$<$	2.1	$\times 10^{-3}$	
Γ_{43}	$K^0_S K^0_S$	$<$	6	$\times 10^{-5}$	CL=90%

Radiative decays

Γ_{44}	$\gamma J/\psi(1S)$		(34.1 $\pm$1.5) %		
Γ_{45}	$\gamma\rho^0$		(2.29$\pm$0.27)	$\times 10^{-4}$	
Γ_{46}	$\gamma\omega$		(7.8 $\pm$1.8)	$\times 10^{-5}$	
Γ_{47}	$\gamma\phi$	$<$	2.5	$\times 10^{-5}$	CL=90%
Γ_{48}	$\gamma\gamma$				

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, 24 combinations of partial widths obtained from integrated cross section, and 78 branching ratios uses 203 measurements to determine 47 parameters. The overall fit has a $\chi^2 = 273.3$ for 156 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_{27}	8				
x_{29}	−9	−4			
x_{35}	11	5	−5		
x_{44}	36	16	−32	20	
Γ	−13	−6	−59	−7	−30
	x_{14}	x_{27}	x_{29}	x_{35}	x_{44}

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

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

$\Gamma(p\overline{p}) \times \Gamma(\gamma J/\psi(1S))/\Gamma_{\rm total}$ **$\Gamma_{29}\Gamma_{44}/\Gamma$**

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 ± 0.0010.
[8] Recalculated by ANDREOTTI 05A.

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

HADRONIC DECAYS

$\Gamma(3(\pi^+\pi^-))/\Gamma_{total}$ 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 $B(\psi(2S) \to J/\psi(1S)\pi^+\pi^-) = (32.6 \pm 0.5)\%$.

$\Gamma(2(\pi^+\pi^-))/\Gamma_{total}$ 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 $B(\psi(2S) \to J/\psi(1S)\pi^+\pi^-) = (32.6 \pm 0.5)\%$.

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

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

[11] HE 08B reports $1.28 \pm 0.06 \pm 0.15 \pm 0.08$ % from a measurement of $[\Gamma(\chi_{c1}(1P) \to \pi^+\pi^-\pi^0\pi^0)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$. 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.

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

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

[12] HE 08B reports $1.56 \pm 0.13 \pm 0.22 \pm 0.10$ % from a measurement of $[\Gamma(\chi_{c1}(1P) \to \rho^+\pi^-\pi^0 + \text{c.c.})/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$. 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.

[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.

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

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

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

$\Gamma(\pi^+\pi^- K^+ K^-)/\Gamma_{total}$ Γ_6/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	[15] BAI	99B	BES	$\psi(2S) \to \gamma\chi_{c1}$
7.3±3.0±0.4	[15] TANENBAUM	78	MRK1	$\psi(2S) \to \gamma\chi_{c1}$

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

$\Gamma(K^+ K^- \pi^0 \pi^0)/\Gamma_{total}$ Γ_7/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
0.118±0.029±0.005	45.1	[16] HE	08B	CLEO	$e^+e^- \to \gamma h^+ h^- h^0 h^0$

[16] HE 08B reports $0.12 \pm 0.02 \pm 0.02 \pm 0.01$ % from a measurement of $[\Gamma(\chi_{c1}(1P) \to K^+K^-\pi^0\pi^0)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$. 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.

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

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
0.90±0.14±0.03	141.3	[17] HE	08B	CLEO	$e^+e^- \to \gamma h^+ h^- h^0 h^0$

[17] HE 08B reports $0.92 \pm 0.09 \pm 0.11 \pm 0.06$ % from a measurement of $[\Gamma(\chi_{c1}(1P) \to K^+\pi^- K^0\pi^0 + \text{c.c.})/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$. 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.

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

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
0.53±0.13±0.02	141.3	[18] HE	08B	CLEO	$e^+e^- \to \gamma h^+ h^- h^0 h^0$

[18] HE 08B reports $0.54 \pm 0.11 \pm 0.07 \pm 0.03$ % from a measurement of $[\Gamma(\chi_{c1}(1P) \to \rho^+ K^- K^0 + \text{c.c.})/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$. 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.

$\Gamma(K^*(892)^0 K^0\pi^0 \to K^+\pi^- K^0\pi^0 + \text{c.c.})/\Gamma_{total}$ Γ_{10}/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
0.25±0.07±0.01	141.3	[19] HE	08B	CLEO	$e^+e^- \to \gamma h^+ h^- h^0 h^0$

[19] HE 08B reports $0.25 \pm 0.06 \pm 0.03 \pm 0.02$ % from a measurement of $[\Gamma(\chi_{c1}(1P) \to K^*(892)^0 K^0\pi^0 \to K^+\pi^- K^0\pi^0 + \text{c.c.})/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$. 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.

$\Gamma(K^+K^-\eta\pi^0)/\Gamma_{total}$ Γ_{11}/Γ

VALUE (%)	EVTS	DOCUMENT ID		TECN	COMMENT
0.118±0.036±0.005	141.3	[20] HE	08B	CLEO	$e^+e^- \to \gamma h^+ h^- h^0 h^0$

[20] HE 08B reports 0.12 ± 0.03 ± 0.02 ± 0.01 % from a measurement of $[\Gamma(\chi_{c1}(1P) \to K^+K^-\eta\pi^0)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$. 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.

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

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
7.3±3.1±0.3	19.8 ± 7.7	[21] ABLIKIM	05O	BES2	$\psi(2S) \to \chi_{c1}\gamma$

[21] ABLIKIM 05O reports $[\Gamma(\chi_{c1}(1P) \to \pi^+\pi^- K^0_S K^0_S)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))] = (0.67 \pm 0.26 \pm 0.11) \times 10^{-4}$. 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.

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

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
0.33±0.10±0.01	[22] ATHAR	07	CLEO	$\psi(2S) \to \gamma h^+ h^- h^0$

[22] ATHAR 07 reports $(0.34 \pm 0.10 \pm 0.04) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to K^+K^-\eta)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 0.0907 \pm 0.0011 \pm 0.0054$. 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.

$\Gamma(K^0K^+\pi^- + c.c.)/\Gamma_{total}$ Γ_{14}/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_{15}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.04±0.39±0.04	22	[23] ABLIKIM	06R	BES2	$\psi(2S) \to \gamma\chi_{c1}$

[23] ABLIKIM 06R reports $(1.1 \pm 0.4 \pm 0.1) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to K^*(892)^0\overline{K}^0 + c.c.)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$. 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.

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

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.5±0.7±0.1	27	[24] ABLIKIM	06R	BES2	$\psi(2S) \to \gamma\chi_{c1}$

[24] ABLIKIM 06R reports $(1.6 \pm 0.7 \pm 0.2) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to K^*(892)^+K^- + c.c.)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$. 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.

$\Gamma(K_J^*(1430)^0\overline{K}^0 + \text{c.c.} \to K_S^0 K^+\pi^- + \text{c.c.})/\Gamma_{\text{total}}$ Γ_{17}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<0.8	90	[25] ABLIKIM	06R	BES2	$\psi(2S) \to \gamma\chi_{c1}$

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

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

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<2.3	90	[26] ABLIKIM	06R	BES2	$\psi(2S) \to \gamma\chi_{c1}$

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

$\Gamma(K^+K^-\pi^0)/\Gamma_{\text{total}}$ Γ_{19}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
1.92±0.25±0.07	[27] ATHAR	07	CLEO	$\psi(2S) \to \gamma h^+ h^- h^0$

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

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

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
5.0±0.5 OUR AVERAGE					
4.9±0.5±0.2		[28] ATHAR	07	CLEO	$\psi(2S) \to \gamma h^+ h^- h^0$
5.6±1.0±0.2	222	[29] ABLIKIM	06R	BES2	$\psi(2S) \to \gamma\chi_{c1}$

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

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

$\Gamma(a_0(980)^+\pi^- + \text{c.c.} \to \eta\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_{21}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.9±0.7±0.1	58	[30] ABLIKIM	06R	BES2	$\psi(2S) \to \gamma\chi_{c1}$

[30] 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 $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$. 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_{22}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
2.8±0.8±0.1	53	[31] ABLIKIM	06R	BES2	$\psi(2S) \to \gamma\chi_{c1}$

[31] 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 $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$. 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_{23}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
2.4±0.5±0.1	[32] ATHAR	07	CLEO	$\psi(2S) \to \gamma h^+ h^- h^0$

[32] 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 $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 0.0907 \pm 0.0011 \pm 0.0054$. 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.

$\Gamma(K^+\overline{K}^*(892)^0\pi^- + \text{c.c.})/\Gamma_{total}$ Γ_{24}/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
32±21	[33] TANENBAUM	78	MRK1	$\psi(2S) \to \gamma\chi_{c1}$

[33] 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_{25}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.5±0.4±0.1	28.4 ± 5.5	[34,35] ABLIKIM	04H	BES	$\psi(2S) \to \gamma K^+ K^- \pi^+ \pi^-$

[34] ABLIKIM 04H reports $[\Gamma(\chi_{c1}(1P) \to K^*(892)^0\overline{K}^*(892)^0)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))] = (1.40 \pm 0.27 \pm 0.22) \times 10^{-4}$. 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.

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

$\Gamma(K^+K^-K^0_SK^0_S)/\Gamma_{total}$ Γ_{26}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<5	90	3.2 ± 2.4	[36] ABLIKIM	05O	BES2	$\psi(2S) \to \chi_{c1}\gamma$

[36] ABLIKIM 05O reports $[\Gamma(\chi_{c1}(1P) \to K^+K^-K^0_SK^0_S)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))] < 4.2 \times 10^{-5}$. 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_{27}/Γ

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

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

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
0.43±0.16±0.02	17	[37] ABLIKIM	06T	BES2	$\psi(2S) \to \gamma 2K^+ 2K^-$

[37] 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 $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$. 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.

$\Gamma(p\overline{p})/\Gamma_{total}$ Γ_{29}/Γ

VALUE (units 10^{-4})	DOCUMENT ID
0.74±0.04 OUR FIT	

$\Gamma(p\overline{p}\pi^0)/\Gamma_{total}$ Γ_{30}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
0.118±0.050±0.005	[38] ATHAR	07	CLEO	$\psi(2S) \to \gamma h^+ h^- h^0$

[38] ATHAR 07 reports $(0.12 \pm 0.05 \pm 0.01) \times 10^{-3}$ 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 $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 0.0907 \pm 0.0011 \pm 0.0054$. 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_{31}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<0.16	90	[39] ATHAR	07	CLEO	$\psi(2S) \to \gamma h^+ h^- h^0$

[39] 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 $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 0.0907 \pm 0.0011 \pm 0.0054$. We rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 9.2 \times 10^{-2}$.

$\Gamma(\pi^+\pi^-p\overline{p})/\Gamma_{total}$ Γ_{32}/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	[40] BAI	99B	BES	$\psi(2S) \to \gamma\chi_{c1}$
1.08±0.77±0.05	[40] TANENBAUM	78	MRK1	$\psi(2S) \to \gamma\chi_{c1}$

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

$\Gamma(\pi^0\pi^0p\overline{p})/\Gamma_{total}$ Γ_{33}/Γ

VALUE (%)	CL%	DOCUMENT ID		TECN	COMMENT
<0.05	90	[41] HE	08B	CLEO	$e^+e^- \to \gamma h^+ h^- h^0 h^0$

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

$\Gamma(K^0_S K^0_S p\overline{p})/\Gamma_{total}$ Γ_{34}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<4.5	90	[42] ABLIKIM	06D	BES2	$\psi(2S) \to \gamma\chi_{c1}$

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

$\Gamma(\Lambda\overline{\Lambda})/\Gamma_{total}$ Γ_{35}/Γ

VALUE (units 10^{-4})	DOCUMENT ID
1.19±0.19 OUR FIT	

$\Gamma(\Lambda\overline{\Lambda}\pi^+\pi^-)/\Gamma_{total}$ Γ_{36}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<1.5	90	[43] ABLIKIM	06D	BES2	$\psi(2S) \to \gamma\chi_{c1}$

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

$\Gamma(K^+\overline{p}\Lambda)/\Gamma_{total}$ Γ_{37}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
0.32±0.09±0.01	[44] ATHAR	07	CLEO	$\psi(2S) \to \gamma h^+ h^- h^0$

[44] ATHAR 07 reports $(0.33 \pm 0.09 \pm 0.04) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to K^+\overline{p}\Lambda)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 0.0907 \pm 0.0011 \pm 0.0054$. 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.

$\Gamma(\Sigma^0\overline{\Sigma}^0)/\Gamma_{total}$ Γ_{38}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.4	90	3.8 ± 2.5	[45] NAIK	08	CLEO	$\psi(2S) \to \gamma\Sigma^0\overline{\Sigma}^0$

[45] NAIK 08 reports $< 0.44 \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to \Sigma^0\overline{\Sigma}^0)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$. 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_{39}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.6	90	4.3 ± 2.3	[46] NAIK	08	CLEO	$\psi(2S) \to \gamma\Sigma^+\overline{\Sigma}^-$

[46] 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 $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$. 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_{40}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.6	90	1.7 ± 2.4	[47] NAIK	08	CLEO	$\psi(2S) \to \gamma\Xi^0\overline{\Xi}^0$

[47] 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 $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$. We rescale to our best value $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = 9.2 \times 10^{-2}$.

$\Gamma(\Xi^-\overline{\Xi}^+)/\Gamma_{\text{total}}$ Γ_{41}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$0.84\pm0.22\pm0.03$		16.4 ± 4.3	[48] 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		[49] ABLIKIM	06D	BES2	$\psi(2S) \to \gamma\chi_{c1}$

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

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

$\left[\Gamma(\pi^+\pi^-) + \Gamma(K^+K^-)\right]/\Gamma_{\text{total}}$ Γ_{42}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<21		[50] FELDMAN	77	MRK1	$\psi(2S) \to \gamma\chi_{c1}$

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

<38	90	[50] BRANDELIK	79B	DASP	$\psi(2S) \to \gamma\chi_{c1}$

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

$\Gamma(K^0_S K^0_S)/\Gamma_{\text{total}}$ Γ_{43}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<0.6	90	[51] ABLIKIM	05O	BES2	$\psi(2S) \to \chi_{c1}\gamma$

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

RADIATIVE DECAYS

$\Gamma(\gamma J/\psi(1S))/\Gamma_{\text{total}}$ Γ_{44}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.341 ± 0.015 OUR FIT				

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

$0.379\pm0.008\pm0.021$	[52] ADAM	05A	CLEO	$e^+e^- \to \psi(2S) \to \gamma\chi_{c1}$	

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

$\Gamma(\gamma\rho^0)/\Gamma_{\text{total}}$ Γ_{45}/Γ

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
$229\pm25\pm9$	186 ± 15	[53] BENNETT	08A	CLEO	$\psi(2S) \to \gamma\gamma\rho^0$

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

$\Gamma(\gamma\omega)/\Gamma_{total}$ Γ_{46}/Γ

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
78±18±3	39.2 ± 7.1	[54] BENNETT	08A	CLEO	$\psi(2S) \to \gamma\gamma\omega$

[54] BENNETT 08A reports $(83 \pm 15 \pm 12) \times 10^{-6}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \to \gamma\omega)/\Gamma_{total}] \times [B(\psi(2S) \to \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \to \gamma\chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$. 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.

$\Gamma(\gamma\phi)/\Gamma_{total}$ Γ_{47}/Γ

VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<25	90	5.2 ± 3.1	[55] BENNETT	08A	CLEO	$\psi(2S) \to \gamma\gamma\phi$

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

$\Gamma(\gamma\gamma)/\Gamma_{total}$ Γ_{48}/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	[56] YAMADA	77	DASP	$e^+e^- \to 3\gamma$

[56] 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

$\Gamma(\chi_{c1}(1P) \to p\overline{p})/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\chi_{c1}(1P))/\Gamma(\psi(2S) \to J/\psi(1S)\pi^+\pi^-)$ $\Gamma_{29}/\Gamma \times \Gamma_{103}^{\psi(2S)}/\Gamma_{9}^{\psi(2S)}$

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
2.06±0.16 OUR FIT				
1.1 ±1.0	[57] BAI	98I	BES	$\psi(2S) \to \gamma\chi_{c1} \to \gamma\overline{p}p$

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

$\Gamma(\chi_{c1}(1P) \to \Lambda\overline{\Lambda})/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\chi_{c1}(1P))/\Gamma_{total}$ $\Gamma_{35}/\Gamma \times \Gamma_{103}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE (units 10^{-6})	EVTS	DOCUMENT ID		TECN	COMMENT
10.9±1.7 OUR FIT					
10.5±1.6±0.6	46 ± 7	[58] NAIK	08	CLEO	$\psi(2S) \to \gamma\Lambda\overline{\Lambda}$

[58] 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 $B(\psi(2S) \to \gamma\chi_{c1}) = (9.07 \pm 0.11 \pm 0.54)\%$.

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

$\Gamma_{35}/\Gamma \times \Gamma_{103}^{\psi(2S)}/\Gamma_{9}^{\psi(2S)}$

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	COMMENT
3.3±0.5 OUR FIT					
$7.1^{+2.8}_{-2.4}\pm1.3$	$9.0^{+3.5}_{-3.1}$	[59] BAI	03E	BES	$\psi(2S) \to \gamma\Lambda\overline{\Lambda}$

[59] 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 $B(\Lambda \to \pi^- p) = (63.9 \pm 0.5)\%$ and $B(J/\psi \to p\overline{p}) = (2.17 \pm 0.07) \times 10^{-3}$.

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

$\Gamma_{44}/\Gamma \times \Gamma_{103}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
3.15±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		[60] OREGLIA	82	CBAL	$\psi(2S) \to \gamma\chi_{c1}$
2.2 ±0.5		[61] BRANDELIK	79B	DASP	$\psi(2S) \to \gamma\chi_{c1}$
2.9 ±0.5		[61] BARTEL	78B	CNTR	$\psi(2S) \to \gamma\chi_{c1}$
5.0 ±1.5		[62] BIDDICK	77	CNTR	$e^+e^- \to \gamma X$
2.8 ±0.9		[60] 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	[63] MENDEZ	08	CLEO	$\psi(2S) \to \gamma\chi_{c1}$
3.44±0.06±0.13	3.7k	[64] ADAM	05A	CLEO	Repl. by MENDEZ 08

[60] Recalculated by us using $B(J/\psi(1S) \to \ell^+\ell^-) = 0.1181 \pm 0.0020$.
[61] Recalculated by us using $B(J/\psi(1S) \to \mu^+\mu^-) = 0.0588 \pm 0.0010$.
[62] Assumes isotropic gamma distribution.
[63] Not independent from other measurements of MENDEZ 08.
[64] Not independent from other values reported by ADAM 05A.

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

$\Gamma_{44}/\Gamma_{103}^{\psi(2S)}/\Gamma_{7}^{\psi(2S)}$

$\Gamma_{44}/\Gamma \times \Gamma_{103}^{\psi(2S)}/\Gamma_{7}^{\psi(2S)} = \Gamma_{44}/\Gamma \times \Gamma_{103}^{\psi(2S)}/(\Gamma_{9}^{\psi(2S)} + \Gamma_{10}^{\psi(2S)} + \Gamma_{11}^{\psi(2S)} + 0.341\Gamma_{103}^{\psi(2S)} + 0.194\Gamma_{104}^{\psi(2S)})$

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
5.37±0.12 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
5.70±0.04±0.15	24.9k	[65] MENDEZ	08	CLEO	$\psi(2S) \to \gamma\chi_{c1}$
5.77±0.10±0.12	3.7k	ADAM	05A	CLEO	Repl. by MENDEZ 08

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

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

$\Gamma_{44}/\Gamma \times \Gamma_{103}^{\psi(2S)}/\Gamma_{9}^{\psi(2S)}$

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
9.52±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	[66] ABLIKIM	04B	BES	$\psi(2S) \to J/\psi X$
8.5 ±2.1		[67] 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	[68] ADAM	05A	CLEO	Repl. by MENDEZ 08

[66] From a fit to the J/ψ recoil mass spectra.

[67] The value for $B(\psi(2S) \to \gamma\chi_{c1}) \times B(\chi_{c1} \to \gamma J/\psi(1S))$ quoted in HIMEL 80 is derived using $B(\psi(2S) \to J/\psi(1S)\pi^+\pi^-) = (33 \pm 3)\%$ and $B(J/\psi(1S) \to \ell^+\ell^-) = 0.138 \pm 0.018$. Calculated by us using $B(J/\psi(1S) \to \ell^+\ell^-) = 0.1181 \pm 0.0020$.

[68] Not independent from other values reported by ADAM 05A.

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

$\Gamma_{14}/\Gamma \times \Gamma_{103}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
6.7±0.5 OUR FIT				
7.2±0.6 OUR AVERAGE				
7.3±0.5±0.5	[69] ATHAR	07	CLEO	$\psi(2S) \to \gamma K_S^0 K^+\pi^-$
7.0±0.5±0.9	[70] ABLIKIM	06R	BES2	$\psi(2S) \to \gamma\chi_{c1}$

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

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

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

$\Gamma_{14}/\Gamma \times \Gamma_{103}^{\psi(2S)}/\Gamma_{9}^{\psi(2S)}$

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
20.4±1.6 OUR FIT				
13.2±2.4±3.2	[71] BAI	99B	BES	$\psi(2S) \to \gamma K_S^0 K^+\pi^-$

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

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

$\Gamma_{27}/\Gamma \times \Gamma_{103}^{\psi(2S)}/\Gamma^{\psi(2S)}$

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
0.51±0.10 OUR FIT					
0.61±0.11±0.08	54	[72] ABLIKIM	06T	BES2	$\psi(2S) \to \gamma K^+K^+K^-K^-$

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

$\Gamma(\chi_{c1}(1P) \to K^+K^-K^+K^-)/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\chi_{c1}(1P))/\Gamma(\psi(2S) \to J/\psi(1S)\pi^+\pi^-)$ $\Gamma_{27}/\Gamma \times \Gamma_{103}^{\psi(2S)}/\Gamma_{9}^{\psi(2S)}$

VALUE (units 10^{-4})	*DOCUMENT ID*		*TECN*	*COMMENT*
1.55±0.32 OUR FIT				
1.13±0.40±0.29	[73] BAI	99B	BES	$\psi(2S) \to \gamma K^+K^+K^-K^-$

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

$\Gamma(\chi_{c1}(1P) \to p\overline{p})/\Gamma_{total} \times \Gamma(\psi(2S) \to \gamma\chi_{c1}(1P))/\Gamma_{total}$ $\Gamma_{29}/\Gamma \times \Gamma_{103}^{\psi(2S)}/\Gamma^{\psi(2S)}$

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.					
$8.2 \pm 0.7 \pm 0.4$	141 ± 13	[74] NAIK	08	CLEO	$\psi(2S) \to \gamma p\overline{p}$
$4.8^{+1.4}_{-1.3} \pm 0.6$	$18.2^{+5.5}_{-4.9}$	BAI	04F	BES	$\psi(2S) \to \gamma\chi_{c1}(1P) \to \gamma\overline{p}p$

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

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

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

VALUE	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
$\mathbf{-0.002^{+0.008}_{-0.017}}$ **OUR AVERAGE**					
$0.002 \pm 0.032 \pm 0.004$	2090	AMBROGIANI	02	E835	$p\overline{p} \to \chi_{c1} \to J/\psi\gamma$
$-0.002^{+0.008}_{-0.020}$	921	OREGLIA	82	CBAL	$\psi(2S) \to \chi_{c1}\gamma \to J/\psi\gamma\gamma$

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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.)
ABLIKIM	06R	PR D74 072001	M. Ablikim *et al.*	(BES Collab.)
ABLIKIM	06T	PL B642 197	M. Ablikim *et al.*	(BES Collab.)
ABLIKIM	05G	PR D71 092002	M. Ablikim *et al.*	(BES Collab.)
ABLIKIM	05O	PL B630 21	M. Ablikim *et al.*	(BES Collab.)
ADAM	05A	PRL 94 232002	N.E. Adam *et al.*	(CLEO Collab.)
ANDREOTTI	05A	NP B717 34	M. Andreotti *et al.*	(FNAL E835 Collab.)
ABLIKIM	04B	PR D70 012003	M. Ablikim *et al.*	(BES Collab.)
ABLIKIM	04H	PR D70 092003	M. Ablikim *et al.*	(BES Collab.)
ATHAR	04	PR D70 112002	S.B. Athar *et al.*	(CLEO Collab.)
BAI	04F	PR D69 092001	J.Z. Bai *et al.*	(BES Collab.)
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AULCHENKO	03	PL B573 63	V.M. Aulchenko *et al.*	(KEDR Collab.)
BAI	03E	PR D67 112001	J.Z. Bai *et al.*	(BES Collab.)

AMBROGIANI	02	PR D65 052002	M. Ambrogiani *et al.*	(FNAL E835 Collab.)
BAI	99B	PR D60 072001	J.Z. Bai *et al.*	(BES Collab.)
BAI	98D	PR D58 092006	J.Z. Bai *et al.*	(BES Collab.)
BAI	98I	PRL 81 3091	J.Z. Bai *et al.*	(BES Collab.)
ARMSTRONG	92	NP B373 35	T.A. Armstrong *et al.*	(FNAL, FERR, GENO+)
Also		PRL 68 1468	T.A. Armstrong *et al.*	(FNAL, FERR, GENO+)
BAGLIN	86B	PL B172 455	C. Baglin	(LAPP, CERN, GENO, LYON, OSLO+)
GAISER	86	PR D34 711	J. Gaiser *et al.*	(Crystal Ball Collab.)
LEMOIGNE	82	PL 113B 509	Y. Lemoigne *et al.*	(SACL, LOIC, SHMP+)
OREGLIA	82	PR D25 2259	M.J. Oreglia *et al.*	(SLAC, CIT, HARV+)
Also		Private Comm.	M.J. Oreglia	(EFI)
HIMEL	80	PRL 44 920	T. Himel *et al.*	(LBL, SLAC)
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BRANDELIK	79B	NP B160 426	R. Brandelik *et al.*	(DASP Collab.)
BARTEL	78B	PL 79B 492	W. Bartel *et al.*	(DESY, HEIDP)
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