$\chi_{c2}(1P)$

$I^G(J^{PC}) = 0^+(2^{++})$

$\chi_{c2}(1P)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
3556.18± 0.13 OUR AVERAGE					
3556.4 ± 0.7		BAI	99B	BES	$\psi(2S) \to \gamma X$
3556.15± 0.07±0.12	585	ARMSTRONG	92	E760	$\overline{p}p \to e^+e^-\gamma$
3556.9 ± 0.4 ±0.5	50	BAGLIN	86B	SPEC	$\overline{p}p \to e^+e^-X$
3557.8 ± 0.2 ±4		[1] GAISER	86	CBAL	$\psi(2S) \to \gamma X$
3553.4 ± 2.2	66	[2] LEMOIGNE	82	GOLI	190 π^- Be $\to \gamma 2\mu$
3555.9 ± 0.7		[3] OREGLIA	82	CBAL	$e^+e^- \to J/\psi 2\gamma$
3557 ± 1.5	69	[4] HIMEL	80	MRK2	$e^+e^- \to J/\psi 2\gamma$
3551 ±11	15	BRANDELIK	79B	DASP	$e^+e^- \to J/\psi 2\gamma$
3553 ± 4		[4] BARTEL	78B	CNTR	$e^+e^- \to J/\psi 2\gamma$
3553 ± 4 ±4		[4,5] TANENBAUM	78	MRK1	e^+e^-
3563 ± 7	360	[4] BIDDICK	77	CNTR	$e^+e^- \to \gamma X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3543 ±10	4	WHITAKER	76	MRK1	$e^+e^- \to J/\psi 2\gamma$

[1] Using mass of $\psi(2S)$ = 3686.0 MeV.
[2] $J/\psi(1S)$ mass constrained to 3097 MeV.
[3] Assuming $\psi(2S)$ mass = 3686 MeV and $J/\psi(1S)$ mass = 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.

$\chi_{c2}(1P)$ WIDTH

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
2.00±0.18 OUR AVERAGE					
1.98±0.17±0.07	585	ARMSTRONG	92	E760	$\overline{p}p \to e^+e^-\gamma$
$2.6\ ^{+1.4}_{-1.0}$	50	BAGLIN	86B	SPEC	$\overline{p}p \to e^+e^-X$
$2.8\ ^{+2.1}_{-2.0}$		[6] GAISER	86	CBAL	$\psi(2S) \to \gamma X$

[6] Errors correspond to 90% confidence level; authors give only width range.

$\chi_{c2}(1P)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
	Hadronic decays		
Γ_1	$2(\pi^+\pi^-)$	(1.2 ± 0.5) %	S=2.2
Γ_2	$\pi^+\pi^-K^+K^-$	$(10 \pm 4) \times 10^{-3}$	S=2.0
Γ_3	$3(\pi^+\pi^-)$	$(9.2 \pm 2.2) \times 10^{-3}$	
Γ_4	$\rho^0\pi^+\pi^-$	$(7 \pm 4) \times 10^{-3}$	
Γ_5	$K^+\overline{K}^*(892)^0\pi^- +$ c.c.	$(4.8 \pm 2.8) \times 10^{-3}$	
Γ_6	$\pi^+\pi^-p\overline{p}$	$(1.4 \pm 0.6) \times 10^{-3}$	S=1.5
Γ_7	$\phi\phi$	$(2.0 \pm 0.8) \times 10^{-3}$	
Γ_8	$\pi^+\pi^-$	$(1.52 \pm 0.25) \times 10^{-3}$	
Γ_9	K^+K^-	$(8.1 \pm 1.9) \times 10^{-4}$	
Γ_{10}	$K^+K^-K^+K^-$	$(1.5 \pm 0.4) \times 10^{-3}$	
Γ_{11}	$K^0_SK^0_S$	$(6.1 \pm 2.3) \times 10^{-4}$	
Γ_{12}	$p\overline{p}$	$(9.8 \pm 1.0) \times 10^{-5}$	
Γ_{13}	$\pi^0\pi^0$		
Γ_{14}	$\eta\eta$		
Γ_{15}	$J/\psi(1S)\pi^+\pi^-\pi^0$	< 1.5 %	CL=90%
Γ_{16}	$K^0_SK^+\pi^- +$ c.c.	$< 1.06 \times 10^{-3}$	CL=90%
	Radiative decays		
Γ_{17}	$\gamma J/\psi(1S)$	(13.5 ± 1.1) %	
Γ_{18}	$\gamma\gamma$	$(1.6 \pm 0.5) \times 10^{-4}$	

$\chi_{c2}(1P)$ PARTIAL WIDTHS

$\Gamma(p\overline{p})$ — Γ_{12}

VALUE (eV)	EVTS	DOCUMENT ID		TECN	COMMENT
206±22 OUR AVERAGE					
$197 \pm 18 \pm 16$	585	[7] ARMSTRONG	92	E760	$\overline{p}p \to e^+e^-\gamma$
$252^{+55}_{-48} \pm 21$		[7] BAGLIN	86B	SPEC	$\overline{p}p \to e^+e^-X$

[7] Restated by us using $B(\chi_{c2}(1P) \to J/\psi(1S)\gamma)B(J/\psi(1S) \to e^+e^-) = 0.0085 \pm 0.0007$.

$\Gamma(\gamma\gamma)$ — Γ_{18}

VALUE (keV)	CL%	DOCUMENT ID		TECN	COMMENT
0.46 ±0.17 OUR AVERAGE		Error includes scale factor of 1.9. See the ideogram below.			
$1.02 \pm 0.40 \pm 0.17$		[8] ACCIARRI	99E	L3	$e^+e^- \to e^+e^-\chi_{c2}$
$1.76 \pm 0.47 \pm 0.40$		[8,9] ACKER..,K...	98	OPAL	$e^+e^- \to e^+e^-\chi_{c2}$
$1.08 \pm 0.30 \pm 0.26$		DOMINICK	94	CLE2	$e^+e^- \to e^+e^-\chi_{c2}$
$0.326 \pm 0.080 \pm 0.055$		[10] ARMSTRONG	93	E760	$\overline{p}p \to \gamma\gamma$
$3.4 \pm 1.7 \pm 0.9$		BAUER	93	TPC	$e^+e^- \to e^+e^-\chi_{c2}$
$2.0 \; {}^{+0.9}_{-0.7} \pm 0.3$		[10] BAGLIN	87B	SPEC	$\overline{p}p \to \gamma\gamma$

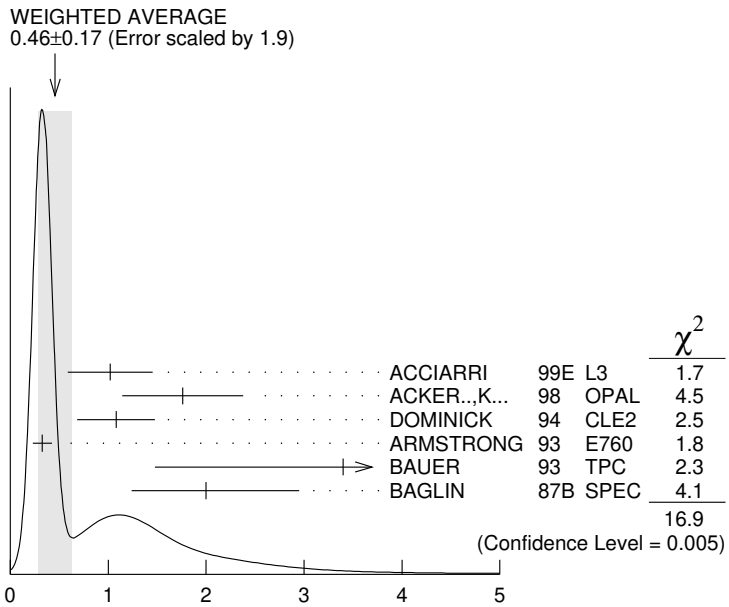
• • • We do not use the following data for averages, fits, limits, etc. • • •

<1.4	95	ACCIARRI	99T	L3	$\gamma\gamma$
<4.2	95	UEHARA	91	VNS	$e^+e^- \to e^+e^-\chi_{c2}$
<1.0	95	CHEN	90B	CLEO	$e^+e^- \to e^+e^-\chi_{c2}$
<4.2	95	AIHARA	88D	TPC	$e^+e^- \to e^+e^-X$

[8] Systematic error includes, added in quadrature, error due to $B(\chi_{c2} \to J/\psi\gamma)$ and $B(J/\psi \to \ell^+\ell^-)$ uncertainties.

[9] Using $B(\chi_{c2} \to J/\psi\gamma) = 13.5 \pm 1.1\%$ and $B(J/\psi \to \ell^+\ell^-) = 12.03 \pm 0.27\%$.

[10] Using $B(\chi_{c2}(1P) \to p\overline{p}) = (0.98 \pm 0.10) \times 10^{-4}$ and $\Gamma_{total} = 2.00 \pm 0.18$ MeV.



$\Gamma(\gamma\gamma)$ Γ_{18}

$\chi_{c2}(1P)$ BRANCHING RATIOS

HADRONIC DECAYS

$\Gamma(2(\pi^+\pi^-))/\Gamma_{total}$ **Γ_1/Γ**

VALUE	DOCUMENT ID		TECN	COMMENT
0.012 ±0.005 OUR AVERAGE	Error includes scale factor of 2.2.			
0.0096±0.0005±0.0024	[11] BAI	99B	BES	$\psi(2S) \to \gamma\chi_{c2}$
0.022 ±0.005	[12] TANENBAUM	78	MRK1	$\psi(2S) \to \gamma\chi_{c2}$

$\Gamma(\pi^+\pi^-K^+K^-)/\Gamma_{total}$ **Γ_2/Γ**

VALUE	DOCUMENT ID		TECN	COMMENT
0.010 ±0.004 OUR AVERAGE	Error includes scale factor of 2.0.			
0.0079±0.0006±0.0021	[11] BAI	99B	BES	$\psi(2S) \to \gamma\chi_{c2}$
0.019 ±0.005	[12] TANENBAUM	78	MRK1	$\psi(2S) \to \gamma\chi_{c2}$

$\Gamma(3(\pi^+\pi^-))/\Gamma_{total}$ — Γ_3/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.0092±0.0022 OUR AVERAGE				
0.009 ±0.001 ±0.002	[11] BAI	99B	BES	$\psi(2S) \to \gamma\chi_{c2}$
0.012 ±0.008	[12] TANENBAUM	78	MRK1	$\psi(2S) \to \gamma\chi_{c2}$

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

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
68±40	[12] TANENBAUM	78	MRK1	$\psi(2S) \to \gamma\chi_{c2}$

$\Gamma(K^+\overline{K}^*(892)^0\pi^- + c.c.)/\Gamma_{total}$ — Γ_5/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
48±28	[12] TANENBAUM	78	MRK1	$\psi(2S) \to \gamma\chi_{c2}$

$\Gamma(\pi^+\pi^-p\overline{p})/\Gamma_{total}$ — Γ_6/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
14 ± 6 OUR AVERAGE Error includes scale factor of 1.5.				
12.3± 2.0±3.5	[11] BAI	99B	BES	$\psi(2S) \to \gamma\chi_{c2}$
33 ±13	[12] TANENBAUM	78	MRK1	$\psi(2S) \to \gamma\chi_{c2}$

$\Gamma(\phi\phi)/\Gamma_{total}$ — Γ_7/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
2.00±0.55±0.61	[11] BAI	99B	BES	$\psi(2S) \to \gamma\chi_{c2}$

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

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
1.52±0.25 OUR AVERAGE					
1.49±0.14±0.22	185±16	[11] BAI	98I	BES	$\psi(2S) \to \gamma\chi_{c2}$
1.9 ±1.0	4	[12] BRANDELIK	79C	DASP	$\psi(2S) \to \gamma\chi_{c2}$

$[\Gamma(\pi^+\pi^-) + \Gamma(K^+K^-)]/\Gamma_{total}$ — $(\Gamma_8+\Gamma_9)/\Gamma$

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
24±10	[12] TANENBAUM	78	MRK1	$\psi(2S) \to \gamma\chi_{c2}$

$\Gamma(K^+K^-)/\Gamma_{total}$ — Γ_9/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
0.81±0.19 OUR AVERAGE					
0.79±0.14±0.13	115±13	[11] BAI	98I	BES	$\psi(2S) \to \gamma\chi_{c2}$
1.5 ±1.1	2	[12] BRANDELIK	79C	DASP	$\psi(2S) \to \gamma\chi_{c2}$

$\Gamma(K^+K^-K^+K^-)/\Gamma_{total}$ — Γ_{10}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
1.48±0.26±0.32	[11] BAI	99B	BES	$\psi(2S) \to \gamma\chi_{c2}$

$\Gamma(K^0_S K^0_S)/\Gamma_{total}$ — Γ_{11}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
0.61±0.17±0.16	[11] BAI	99B	BES	$\psi(2S) \to \gamma\chi_{c2}$

$\Gamma(p\overline{p})/\Gamma_{total}$ — Γ_{12}/Γ

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
0.98±0.10 OUR AVERAGE						
0.58±0.31±0.32		4.7 ± 2.5	[11] BAI	98I	BES	$\psi(2S) \to \gamma\chi_{c2}$
1.00±0.11		585	[13] ARMSTRONG	92	E760	$\overline{p}p \to e^+e^-\gamma$
$0.97^{+0.44}_{-0.28}\pm0.08$			BAGLIN	86B	SPEC	$\overline{p}p \to e^+e^-X$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<9.5	90		[12] BRANDELIK	79B	DASP	$\psi(2S) \to \gamma\chi_{c2}$

$\Gamma_i\Gamma_f/\Gamma^2_{total}$ in $p\overline{p} \to \chi_{c2}(1P) \to \gamma\gamma$ — $\Gamma_{12}\Gamma_{18}/\Gamma^2$

VALUE (units 10^{-7})	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.160±0.039±0.016		ARMSTRONG	93	E760	$\overline{p}p \to \gamma\gamma$
$0.99\ ^{+0.46}_{-0.35}$	6	[14] BAGLIN	87B	SPEC	$\overline{p}p \to \gamma\gamma$

$\Gamma(\pi^0\pi^0)/\Gamma_{total}$ — Γ_{13}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.1±0.2±0.2	[11] LEE	85	CBAL	$\psi' \to$ photons

$\Gamma(\eta\eta)/\Gamma_{total}$ — Γ_{14}/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
7.9±4.1±2.4	[11] LEE	85	CBAL	$\psi' \to$ photons

$\Gamma(J/\psi(1S)\pi^+\pi^-\pi^0)/\Gamma_{total}$ — Γ_{15}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.015	90	BARATE	81	SPEC	190 GeV π^- Be $\to 2\pi 2\mu$

$\Gamma(K^0_S K^+\pi^- + c.c.)/\Gamma_{total}$ — Γ_{16}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<1.06	90	[11] BAI	99B	BES	$\psi(2S) \to \gamma\chi_{c2}$

[11] Calculated using $B(\psi(2S) \to \gamma\chi_{c2}(1P)) = 0.078 \pm 0.008$.

[12] Estimated using $B(\psi(2S) \to \gamma\chi_{c2}(1P)) = 0.078$; the errors do not contain the uncertainty in the $\psi(2S)$ decay.

[13] Restated by us using $B(\chi_{c2}(1P) \to J/\psi(1S)\gamma)B(J/\psi(1S) \to e^+e^-) = 0.0085 \pm 0.0007$.

[14] Assuming isotropic $\chi_{c2}(1P) \to \gamma\gamma$ distribution.

RADIATIVE DECAYS

$\Gamma(\gamma J/\psi(1S))/\Gamma_{total}$ — Γ_{17}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.135±0.011 OUR AVERAGE					
0.124±0.015		GAISER	86	CBAL	$\psi(2S) \to \gamma X$
0.162±0.028	479	[15] OREGLIA	82	CBAL	$\psi(2S) \to \gamma \chi_{c2}$
0.14 ±0.04		[15] HIMEL	80	MRK2	$\psi(2S) \to \gamma \chi_{c2}$
0.18 ±0.05		[15] BRANDELIK	79B	DASP	$\psi(2S) \to \gamma \chi_{c2}$
0.13 ±0.03		[15] BARTEL	78B	CNTR	$\psi(2S) \to \gamma \chi_{c2}$
0.13 ±0.08		[15] TANENBAUM	78	MRK1	$\psi(2S) \to \gamma \chi_{c2}$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.28 ±0.13		[15] BIDDICK	77	CNTR	$\psi(2S) \to \gamma X$

[15] Estimated using $B(\psi(2S) \to \gamma \chi_{c2}(1P)) = 0.078$; the errors do not contain the uncertainty in the $\psi(2S)$ decay.

$\Gamma(\gamma\gamma)/\Gamma_{total}$ — Γ_{18}/Γ

VALUE (units 10^{-4})	DOCUMENT ID		TECN	COMMENT
1.60±0.39±0.23	[16] ARMSTRONG	93	E760	$\overline{p}p \to \gamma\gamma$

[16] Using $B(\chi_{c2}(1P) \to p\overline{p}) = (1.00 \pm 0.23) \times 10^{-4}$.

$\chi_{c2}(1P)$ REFERENCES

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LEE	85	SLAC 282	R.A. Lee	(SLAC)
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Erratum.				
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