

$\chi_{c0}(1P)$

$$J^{PC} = 0^+(0^{++})$$

$\chi_{c0}(1P)$ MASS

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
3415.0 ± 0.8 OUR AVERAGE			
3417.4 ^{+1.8} _{-1.9} ± 0.2	AMBROGIANI	99B E835	$\bar{p}p \rightarrow e^+e^-\gamma$
3414.1 ± 0.6 ± 0.8	BAI	99B BES	$\psi(2S) \rightarrow \gamma X$
3417.8 ± 0.4 ± 4	¹ GAISER	86 CBAL	$\psi(2S) \rightarrow \gamma X$
3422 ± 10	² BARTEL	78B CNTR	$e^+e^- \rightarrow J/\psi 2\gamma$
3416 ± 3 ± 4	² TANENBAUM	78 MRK1	e^+e^-
3415 ± 9	² BIDDICK	77 CNTR	$e^+e^- \rightarrow \gamma X$
¹ Using mass of $\psi(2S) = 3686.0$ MeV.			
² Mass value shifted by us by amount appropriate for $\psi(2S)$ mass = 3686 MeV and $J/\psi(1S)$ mass = 3097 MeV.			

$\chi_{c0}(1P)$ WIDTH

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
14.9^{+2.6}_{-2.3} OUR AVERAGE			
16.6 ^{+5.2} _{-3.7} ± 0.1	AMBROGIANI	99B E835	$\bar{p}p \rightarrow e^+e^-\gamma$
14.3 ± 2.0 ± 3.0	BAI	98I BES	$\psi(2S) \rightarrow \gamma\pi^+\pi^-$
13.5 ± 3.3 ± 4.2	GAISER	86 CBAL	$\psi(2S) \rightarrow \gamma X, \gamma\pi^0\pi^0$

$\chi_{c0}(1P)$ DECAY MODES

Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Hadronic decays		
Γ_1 $2(\pi^+\pi^-)$	(2.0 ± 0.9) %	S=2.7
Γ_2 $\pi^+\pi^- K^+ K^-$	(1.8 ± 0.6) %	S=1.9
Γ_3 $\rho^0\pi^+\pi^-$	(1.6 ± 0.5) %	
Γ_4 $3(\pi^+\pi^-)$	(1.24 ± 0.22) %	
Γ_5 $K^+ \bar{K}^*(892)^0 \pi^- + c.c.$	(1.2 ± 0.4) %	
Γ_6 $\pi^+\pi^-$	(5.0 ± 0.7) × 10 ⁻³	
Γ_7 $K^+ K^-$	(5.9 ± 0.9) × 10 ⁻³	
Γ_8 $\pi^+\pi^- p\bar{p}$	(1.8 ± 0.9) × 10 ⁻³	S=1.6
Γ_9 $K^+ K^- K^+ K^-$	(2.1 ± 0.5) × 10 ⁻³	
Γ_{10} $K_S^0 K_S^0$	(2.0 ± 0.6) × 10 ⁻³	
Γ_{11} $\phi\phi$	(9 ± 5) × 10 ⁻⁴	
Γ_{12} $\pi^0\pi^0$		
Γ_{13} $\eta\eta$		
Γ_{14} $K_S^0 K^+ \pi^- + c.c.$	< 7.1 × 10 ⁻⁴	CL=90%
Γ_{15} $p\bar{p}$	(2.2 ± 1.3) × 10 ⁻⁴	S=2.1

Radiative decays

Γ_{16}	$\gamma J/\psi(1S)$	$(6.6 \pm 1.8) \times 10^{-3}$
Γ_{17}	$\gamma\gamma$	$(10 \pm 6) \times 10^{-5}$

$\chi_{c0}(1P)$ PARTIAL WIDTHS

$\Gamma(\gamma\gamma)$					Γ_{17}
VALUE (keV)	CL%	DOCUMENT ID	TECN	COMMENT	
4.0±2.8		LEE	85 CBAL	$\psi' \rightarrow$ photons	
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
< 5.5	95	ACCIARRI	99T L3	$\gamma\gamma$	
< 6.2	95	CHEN	90B CLEO	$e^+e^- \rightarrow e^+e^- \chi_{c0}$	
<17	95	AIHARA	88D TPC	$e^+e^- \rightarrow e^+e^- X$	

$\chi_{c0}(1P)$ BRANCHING RATIOS

HADRONIC DECAYS

$\Gamma(2(\pi^+\pi^-))/\Gamma_{total}$					Γ_1/Γ
VALUE		DOCUMENT ID	TECN	COMMENT	
0.020 ±0.009 OUR AVERAGE		Error includes scale factor of 2.7.			
0.0154±0.0005±0.0037		³ BAI	99B BES	$\psi(2S) \rightarrow \gamma\chi_{c0}$	
0.037 ±0.007		⁴ TANENBAUM	78 MRK1	$\psi(2S) \rightarrow \gamma\chi_{c0}$	

$\Gamma(\pi^+\pi^-K^+K^-)/\Gamma_{total}$					Γ_2/Γ
VALUE		DOCUMENT ID	TECN	COMMENT	
0.018 ±0.006 OUR AVERAGE		Error includes scale factor of 1.9.			
0.0147±0.0007±0.0038		³ BAI	99B BES	$\psi(2S) \rightarrow \gamma\chi_{c0}$	
0.030 ±0.007		⁴ TANENBAUM	78 MRK1	$\psi(2S) \rightarrow \gamma\chi_{c0}$	

$\Gamma(\rho^0\pi^+\pi^-)/\Gamma_{total}$					Γ_3/Γ
VALUE		DOCUMENT ID	TECN	COMMENT	
0.016±0.005		⁴ TANENBAUM	78 MRK1	$\psi(2S) \rightarrow \gamma\chi_{c0}$	

$\Gamma(3(\pi^+\pi^-))/\Gamma_{total}$					Γ_4/Γ
VALUE		DOCUMENT ID	TECN	COMMENT	
0.0124±0.0022 OUR AVERAGE					
0.0117±0.0010±0.0023		³ BAI	99B BES	$\psi(2S) \rightarrow \gamma\chi_{c0}$	
0.015 ±0.005		⁴ TANENBAUM	78 MRK1	$\psi(2S) \rightarrow \gamma\chi_{c0}$	

$\Gamma(K^+\bar{K}^*(892)^0\pi^- + c.c.)/\Gamma_{total}$					Γ_5/Γ
VALUE		DOCUMENT ID	TECN	COMMENT	
0.012±0.004		⁴ TANENBAUM	78 MRK1	$\psi(2S) \rightarrow \gamma\chi_{c0}$	

$\Gamma(\pi^+\pi^-)/\Gamma_{total}$					Γ_6/Γ
VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT	
5.0 ±0.7 OUR AVERAGE					
4.68±0.26±0.65	720±32	³ BAI	98I BES	$\psi(2S) \rightarrow \gamma\chi_{c0}$	
7 ±3		⁴ BRANDELIK	79B DASP	$\psi(2S) \rightarrow \gamma\chi_{c0}$	
8 ±3		⁴ TANENBAUM	78 MRK1	$\psi(2S) \rightarrow \gamma\chi_{c0}$	

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

<u>VALUE (units 10^{-3})</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
5.9 ± 0.9 OUR AVERAGE				
5.68 ± 0.35 ± 0.85	774 ± 38	³ BAI	98I BES	$\psi(2S) \rightarrow \gamma \chi_{c0}$
6 ± 3		⁴ BRANDELIK	79B DASP	$\psi(2S) \rightarrow \gamma \chi_{c0}$
9 ± 4		⁴ TANENBAUM	78 MRK1	$\psi(2S) \rightarrow \gamma \chi_{c0}$

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

<u>VALUE (units 10^{-3})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1.8 ± 0.9 OUR AVERAGE	Error includes scale factor of 1.6.		
1.57 ± 0.21 ± 0.54	³ BAI	99B BES	$\psi(2S) \rightarrow \gamma \chi_{c0}$
5 ± 2	⁴ TANENBAUM	78 MRK1	$\psi(2S) \rightarrow \gamma \chi_{c0}$

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

<u>VALUE (units 10^{-3})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
2.14 ± 0.26 ± 0.40	³ BAI	99B BES	$\psi(2S) \rightarrow \gamma \chi_{c0}$

$\Gamma(K_S^0 K_S^0)/\Gamma_{\text{total}}$ Γ_{10}/Γ

<u>VALUE (units 10^{-3})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1.96 ± 0.28 ± 0.52	³ BAI	99B BES	$\psi(2S) \rightarrow \gamma \chi_{c0}$

$\Gamma(\phi\phi)/\Gamma_{\text{total}}$ Γ_{11}/Γ

<u>VALUE (units 10^{-3})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.92 ± 0.34 ± 0.38	³ BAI	99B BES	$\psi(2S) \rightarrow \gamma \chi_{c0}$

$\Gamma(\pi^0 \pi^0)/\Gamma_{\text{total}}$ Γ_{12}/Γ

<u>VALUE (units 10^{-3})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
• • • We do not use the following data for averages, fits, limits, etc. • • •			
3.1 ± 0.4 ± 0.5	³ LEE	85 CBAL	$\psi' \rightarrow \text{photons}$

$\Gamma(\eta\eta)/\Gamma_{\text{total}}$ Γ_{13}/Γ

<u>VALUE (units 10^{-3})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
• • • We do not use the following data for averages, fits, limits, etc. • • •			
2.5 ± 0.8 ± 0.8	³ LEE	85 CBAL	$\psi' \rightarrow \text{photons}$

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

<u>VALUE (units 10^{-3})</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<0.71	90	³ BAI	99B BES	$\psi(2S) \rightarrow \gamma \chi_{c0}$

$\Gamma(\rho\bar{\rho})/\Gamma_{\text{total}}$ Γ_{15}/Γ

<u>VALUE (units 10^{-3})</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.22 ± 0.13 OUR AVERAGE		Error includes scale factor of 2.1.		
0.48 ^{+0.09} _{-0.08} ^{+0.21} _{-0.11}		⁵ AMBROGIANI	99B E835	$\bar{p}p \rightarrow e^+ e^- \gamma$
0.159 ± 0.043 ± 0.053		³ BAI	98I BES	$\psi(2S) \rightarrow \gamma \chi_{c0}$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.9	90	⁴ BRANDELIK	79B DASP	$\psi(2S) \rightarrow \gamma \chi_{c0}$

³ Calculated using $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 0.093 \pm 0.008$.

⁴ Calculated using $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 0.094$; the errors do not contain the uncertainty in the $\psi(2S)$ decay.

⁵ Estimated using $B(\chi_{c0} \rightarrow \gamma J/\psi) = (6.0 \pm 1.8) \times 10^{-3}$ and $B(J/\psi \rightarrow e^+e^-) = (6.02 \pm 0.19) \times 10^{-2}$.

RADIATIVE DECAYS

$\Gamma(\gamma J/\psi(1S))/\Gamma_{\text{total}}$				Γ_{16}/Γ
VALUE (units 10^{-4})	DOCUMENT ID	TECN	COMMENT	
66 ± 18 OUR AVERAGE				
60 ± 18	GAISER	86	CBAL	$\psi(2S) \rightarrow \gamma\chi_{c0}$
320 ± 210	⁶ BRANDELIK	79B	DASP	$\psi(2S) \rightarrow \gamma\chi_{c0}$
150 ± 100	⁶ BARTEL	78B	CNTR	$\psi(2S) \rightarrow \gamma\chi_{c0}$
210 ± 210	⁶ TANENBAUM	78	MRK1	$\psi(2S) \rightarrow \gamma\chi_{c0}$

$\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$				Γ_{17}/Γ
VALUE (units 10^{-4})	DOCUMENT ID	TECN	COMMENT	
0.97 ± 0.50 ± 0.28				
	⁷ AMBROGIANI	00B	E835	$\bar{p}p \rightarrow \gamma\gamma$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
4.0 ± 2.0 ± 1.1	³ LEE	85	CBAL	$\psi' \rightarrow \text{photons}$
⁶ Calculated using $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 0.094$; the errors do not contain the uncertainty in the $\psi(2S)$ decay.				
⁷ Estimated using $B(\chi_{c0} \rightarrow \gamma J/\psi \rightarrow \gamma e^+e^-) = (3.97 \pm 1.15) \times 10^{-4}$.				

$\chi_{c0}(1P)$ REFERENCES

AMBROGIANI	00B	PR D62 052002	M. Ambrogiani <i>et al.</i>	(FNAL E835 Collab.)
ACCIARRI	99T	PL B461 155	M. Acciarri <i>et al.</i>	(L3 Collab.)
AMBROGIANI	99B	PRL 83 2902	M. Ambrogiani <i>et al.</i>	(FNAL E835 Collab.)
BAI	99B	PR D60 072001	J.Z. Bai <i>et al.</i>	(BES Collab.)
BAI	98I	PRL 81 3091	J.Z. Bai <i>et al.</i>	(BES Collab.)
CHEN	90B	PL B243 169	W.Y. Chen <i>et al.</i>	(CLEO Collab.)
AIHARA	88D	PRL 60 2355	H. Aihara <i>et al.</i>	(TPC Collab.)
GAISER	86	PR D34 711	J. Gaiser <i>et al.</i>	(Crystal Ball Collab.)
LEE	85	SLAC 282	R.A. Lee	(SLAC)
BRANDELIK	79B	NP B160 426	R. Brandelik <i>et al.</i>	(DASP Collab.)
BARTEL	78B	PL 79B 492	W. Bartel <i>et al.</i>	(DESY, HEIDP)
TANENBAUM	78	PR D17 1731	W.M. Tanenbaum <i>et al.</i>	(SLAC, LBL)
Also	82	Private Comm.	G. Trilling	(LBL, UCB)
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OTHER RELATED PAPERS

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FELDMAN	75B	PRL 35 821	G.J. Feldman <i>et al.</i>	(LBL, SLAC)
Also	75C	PRL 35 1189	G.J. Feldman	
Erratum.				
TANENBAUM	75	PRL 35 1323	W.M. Tanenbaum <i>et al.</i>	(LBL, SLAC)