

$h_c(1P)$

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

Quantum numbers are quark model prediction, $C = -$ established by $\eta_c \gamma$ decay.

 $h_c(1P)$ MASS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
3525.37 ± 0.14 OUR AVERAGE		Error includes scale factor of 1.2.		
$3525.32 \pm 0.06 \pm 0.15$	23k	ABLIKIM	22AQ BES3	$\psi(2S) \rightarrow \pi^0$ hadrons; $\pi^0 \gamma(\eta_c)$
$3525.20 \pm 0.18 \pm 0.12$	1282	¹ DOBBS	08A CLEO	$\psi(2S) \rightarrow \pi^0 \eta_c \gamma$
$3525.8 \pm 0.2 \pm 0.2$	13	ANDREOTTI	05B E835	$\bar{p} p \rightarrow \eta_c \gamma$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$3525.31 \pm 0.11 \pm 0.14$	832	^{2,3} ABLIKIM	12N BES3	$\psi(2S) \rightarrow \pi^0 \gamma$ hadrons
$3525.40 \pm 0.13 \pm 0.18$	3679	² ABLIKIM	10B BES3	$\psi(2S) \rightarrow \pi^0 \gamma \eta_c$
3525.6 ± 0.5	92	ADAMS	09 CLEO	$\psi(2S) \rightarrow 2(\pi^+ \pi^- \pi^0)$
$3524.4 \pm 0.6 \pm 0.4$	168	⁴ ROSNER	05 CLEO	$\psi(2S) \rightarrow \pi^0 \eta_c \gamma$
3527 ± 8	42	ANTONIAZZI	94 E705	$300 \pi^\pm, p\text{Li} \rightarrow$ $J/\psi \pi^0 X$
$3526.28 \pm 0.18 \pm 0.19$	59	⁵ ARMSTRONG	92D E760	$\bar{p} p \rightarrow J/\psi \pi^0$
$3525.4 \pm 0.8 \pm 0.4$	5	BAGLIN	86 SPEC	$\bar{p} p \rightarrow J/\psi X$

¹ Combination of exclusive and inclusive analyses for the reaction $\psi(2S) \rightarrow \pi^0 h_c \rightarrow \pi^0 \eta_c \gamma$. This result is the average of DOBBS 08A and ROSNER 05.

² Superseded by ABLIKIM 22AQ

³ With floating width.

⁴ Superseded by DOBBS 08A.

⁵ Mass central value and systematic error recalculated by us according to Eq. (16) in ARMSTRONG 93B, using the value for the $\psi(2S)$ mass from AULCHENKO 03.

 $h_c(1P)$ WIDTH

VALUE (MeV)	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
$0.78^{+0.27}_{-0.24} \pm 0.12$		23k	ABLIKIM	22AQ BES3	$\psi(2S) \rightarrow \pi^0$ hadrons; $\pi^0 \gamma(\eta_c)$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
$0.70 \pm 0.28 \pm 0.22$		832	^{1,2} ABLIKIM	12N BES3	$\psi(2S) \rightarrow \pi^0 \gamma$ hadrons
< 1.44	90	3679	³ ABLIKIM	10B BES3	$\psi(2S) \rightarrow \pi^0 \gamma \eta_c$
< 1		13	ANDREOTTI	05B E835	$\bar{p} p \rightarrow \eta_c \gamma$
< 1.1	90	59	ARMSTRONG	92D E760	$\bar{p} p \rightarrow J/\psi \pi^0$

¹ Superseded by ABLIKIM 22AQ

² With floating mass.

³ The central value is $\Gamma = 0.73 \pm 0.45 \pm 0.28$ MeV.

$h_c(1P)$ DECAY MODES

Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1 $J/\psi(1S)\pi^0$	$< 5 \times 10^{-4}$	90%
Γ_2 $J/\psi(1S)\pi\pi$	not seen	
Γ_3 $J/\psi(1S)\pi^+\pi^-$	$< 2.7 \times 10^{-3}$	90%
Γ_4 $p\bar{p}$	$< 1.7 \times 10^{-4}$	90%
Γ_5 $p\bar{p}\pi^0$	$< 8 \times 10^{-4}$	90%
Γ_6 $p\bar{p}\pi^+\pi^-$	$(3.3 \pm 0.6) \times 10^{-3}$	
Γ_7 $p\bar{p}\pi^0\pi^0$	$< 6 \times 10^{-4}$	90%
Γ_8 $p\bar{p}\pi^+\pi^-\pi^0$	$(4.4 \pm 1.3) \times 10^{-3}$	
Γ_9 $p\bar{p}\eta$	$(7.4 \pm 2.2) \times 10^{-4}$	
Γ_{10} $\pi^+\pi^-\pi^0$	$(1.9 \pm 0.5) \times 10^{-3}$	
Γ_{11} $\pi^+\pi^-\pi^0\eta$	$(8.3 \pm 2.4) \times 10^{-3}$	
Γ_{12} $2\pi^+2\pi^-\pi^0$	$(9.4 \pm 1.7) \times 10^{-3}$	
Γ_{13} $3\pi^+3\pi^-\pi^0$	< 1.0 %	90%
Γ_{14} $K^+K^-\pi^+\pi^-$	$< 7 \times 10^{-4}$	90%
Γ_{15} $K^+K^-\pi^+\pi^-\pi^0$	$(3.8 \pm 0.8) \times 10^{-3}$	
Γ_{16} $K^+K^-\pi^+\pi^-\eta$	$< 2.7 \times 10^{-3}$	90%
Γ_{17} $K^+K^-\pi^0$	$< 6 \times 10^{-4}$	90%
Γ_{18} $K^+K^-\pi^0\eta$	$< 2.4 \times 10^{-3}$	90%
Γ_{19} $K^+K^-\eta$	$< 1.0 \times 10^{-3}$	90%
Γ_{20} $2K^+2K^-\pi^0$	$< 2.8 \times 10^{-4}$	90%
Γ_{21} $K_S^0 K^\pm \pi^\mp$	$< 6 \times 10^{-4}$	90%
Γ_{22} $K_S^0 K^\pm \pi^\mp \pi^+ \pi^-$	$(3.2 \pm 1.0) \times 10^{-3}$	

Radiative decays

Γ_{23} $\gamma\eta$	$(4.7 \pm 2.1) \times 10^{-4}$
Γ_{24} $\gamma\eta'(958)$	$(1.5 \pm 0.4) \times 10^{-3}$
Γ_{25} $\gamma\eta_c(1S)$	(60 ± 4) %

FIT INFORMATION

A multiparticle fit to $\eta_c(1S)$, $J/\psi(1S)$, $\psi(2S)$, $h_c(1P)$, and B^\pm with the total width, 10 combinations of partial widths obtained from integrated cross section, and 38 branching ratios uses 113 measurements to determine 19 parameters. The overall fit has a $\chi^2 = 184.6$ for 94 degrees of freedom.

 $h_c(1P)$ PARTIAL WIDTHS

$$\text{————— } h_c(1P) \Gamma(i)\Gamma(\bar{p}p)/\Gamma(\text{total}) \text{ —————}$$

$\Gamma(\gamma\eta_c(1S)) \times \Gamma(p\bar{p})/\Gamma_{\text{total}}$	$\Gamma_{25}\Gamma_4/\Gamma$			
VALUE (eV)	EVTS	DOCUMENT ID	TECN	COMMENT

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

12.0 \pm 4.5 13 ¹ ANDREOTTI 05B E835 $\bar{p}p \rightarrow \eta_c\gamma$

¹ Assuming $\Gamma = 1$ MeV. **$h_c(1P)$ BRANCHING RATIOS** **$\Gamma(J/\psi(1S)\pi^0)/\Gamma(\gamma\eta_c(1S))$** **$\Gamma_1/\Gamma_{25}$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<9 \times 10^{-4}$	90	¹ ABLIKIM	22N	BES3 $e^+e^- \rightarrow \pi^+\pi^- h_c$

¹ ABLIKIM 22N reports $[\Gamma(h_c(1P) \rightarrow J/\psi(1S)\pi^0)/\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))] / [B(\eta_c \rightarrow K^+K^-\pi^0)] < 7.5 \times 10^{-2}$ which we multiply by our best value $B(\eta_c \rightarrow K^+K^-\pi^0) = 1/6 B(\eta_c(1S) \rightarrow K\bar{K}\pi) = 1/6 (7.1 \times 10^{-2})$.

 $\Gamma(J/\psi(1S)\pi\pi)/\Gamma(J/\psi(1S)\pi^0)$ **Γ_2/Γ_1**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.18	90	ARMSTRONG	92D	E760 $\bar{p}p \rightarrow J/\psi\pi^0$

 $\Gamma(J/\psi(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$ **Γ_3/Γ**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<2.7 \times 10^{-3}$	90	¹ ABLIKIM	18M	BES3 $\psi(2S) \rightarrow \pi^0\pi^+\pi^- J/\psi$

¹ ABLIKIM 18M reports $[\Gamma(h_c(1P) \rightarrow J/\psi(1S)\pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] < 2.0 \times 10^{-6}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = 7.4 \times 10^{-4}$.

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$ **Γ_4/Γ**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<1.7 \times 10^{-4}$	90	¹ ABLIKIM	13V	BES3 $\psi(2S) \rightarrow \gamma p\bar{p}$

¹ ABLIKIM 13V reports $[\Gamma(h_c(1P) \rightarrow p\bar{p})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] < 1.3 \times 10^{-7}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = 7.4 \times 10^{-4}$.

 $\Gamma(p\bar{p}\pi^0)/\Gamma_{\text{total}}$ **Γ_5/Γ**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<8 \times 10^{-4}$	90	¹ ABLIKIM	22M	BES3 $\psi(2S) \rightarrow \pi^0 h_c(1P)$

¹ ABLIKIM 22M reports $[\Gamma(h_c(1P) \rightarrow p\bar{p}\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] < 5.67 \times 10^{-7}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = 7.4 \times 10^{-4}$.

 $\Gamma(p\bar{p}\pi^+\pi^-)/\Gamma_{\text{total}}$ **Γ_6/Γ**

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
$3.3 \pm 0.5 \pm 0.2$	230	¹ ABLIKIM	19AG	BES3 $\psi(2S) \rightarrow \pi^0 h_c(1P)$

¹ ABLIKIM 19AG reports $[\Gamma(h_c(1P) \rightarrow p\bar{p}\pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] = (2.49 \pm 0.27 \pm 0.28) \times 10^{-6}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = (7.4 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

 $\Gamma(p\bar{p}\pi^0\pi^0)/\Gamma_{\text{total}}$ **Γ_7/Γ**

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
$<6 \times 10^{-4}$	90	12	¹ ABLIKIM	20AH	BES3 $\psi(2S) \rightarrow \pi^0 h_c(1P)$

¹ ABLIKIM 20AH reports $[\Gamma(h_c(1P) \rightarrow p\bar{p}\pi^0\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] < 4.4 \times 10^{-7}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = 7.4 \times 10^{-4}$.

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

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
4.4±1.2±0.3	86	¹ ABLIKIM	22M BES3	$\psi(2S) \rightarrow \pi^0 h_c(1P)$

¹ ABLIKIM 22M reports $[\Gamma(h_c(1P) \rightarrow p\bar{p}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] = (3.30 \pm 0.71 \pm 0.59) \times 10^{-6}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = (7.4 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

 $\Gamma(p\bar{p}\eta)/\Gamma_{\text{total}}$ Γ_9/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID	TECN	COMMENT
7.4±2.1±0.5	20	¹ ABLIKIM	22M BES3	$\psi(2S) \rightarrow \pi^0 h_c(1P)$

¹ ABLIKIM 22M reports $[\Gamma(h_c(1P) \rightarrow p\bar{p}\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] = (5.51 \pm 1.50 \pm 0.46) \times 10^{-7}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = (7.4 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

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

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
1.9±0.5±0.1		101	¹ ABLIKIM	19AG BES3	$\psi(2S) \rightarrow \pi^0 h_c(1P)$

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

<2.6 90 ² ADAMS 09 CLEO $\psi(2S) \rightarrow \pi^0 \gamma \eta_c$

¹ ABLIKIM 19AG reports $[\Gamma(h_c(1P) \rightarrow \pi^+\pi^-\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] = (1.38 \pm 0.35 \pm 0.17) \times 10^{-6}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = (7.4 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

² ADAMS 09 reports $[\Gamma(h_c(1P) \rightarrow \pi^+\pi^-\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] < 0.19 \times 10^{-5}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = 7.4 \times 10^{-4}$.

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

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
8.3±2.3±0.6	35	¹ ABLIKIM	20AH BES3	$\psi(2S) \rightarrow \pi^0 h_c(1P)$

¹ ABLIKIM 20AH reports $[\Gamma(h_c(1P) \rightarrow \pi^+\pi^-\pi^0\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] = (6.2 \pm 1.6 \pm 0.7) \times 10^{-6}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = (7.4 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

 $\Gamma(2\pi^+2\pi^-\pi^0)/\Gamma_{\text{total}}$ Γ_{12}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
0.94±0.17 OUR AVERAGE				

0.86±0.16±0.06 254 ¹ ABLIKIM 19AG BES3 $\psi(2S) \rightarrow \pi^0 h_c(1P)$

2.5 $^{+0.9}_{-0.7}$ ±0.2 92 ² ADAMS 09 CLEO $\psi(2S) \rightarrow \pi^0 \gamma \eta_c$

¹ ABLIKIM 19AG reports $[\Gamma(h_c(1P) \rightarrow 2\pi^+2\pi^-\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] = (6.40 \pm 0.81 \pm 0.87) \times 10^{-6}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = (7.4 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

² ADAMS 09 reports $[\Gamma(h_c(1P) \rightarrow 2\pi^+ 2\pi^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] = (1.88_{-0.45}^{+0.48+0.47}) \times 10^{-5}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = (7.4 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(3\pi^+ 3\pi^- \pi^0)/\Gamma_{\text{total}}$ Γ_{13}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.010	90	¹ ABLIKIM	19AG BES3	$\psi(2S) \rightarrow \pi^0 h_c(1P)$

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

<0.034 90 ² ADAMS 09 CLEO $\psi(2S) \rightarrow \pi^0 \gamma \eta_c$
¹ ABLIKIM 19AG reports $[\Gamma(h_c(1P) \rightarrow 3\pi^+ 3\pi^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] < 7.5 \times 10^{-6}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = 7.4 \times 10^{-4}$.
² ADAMS 09 reports $[\Gamma(h_c(1P) \rightarrow 3\pi^+ 3\pi^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] < 2.5 \times 10^{-5}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = 7.4 \times 10^{-4}$.

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

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<7 × 10⁻⁴	90	¹ ABLIKIM	19AG BES3	$\psi(2S) \rightarrow \pi^0 h_c(1P)$

¹ ABLIKIM 19AG reports $[\Gamma(h_c(1P) \rightarrow K^+ K^- \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] < 0.5 \times 10^{-6}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = 7.4 \times 10^{-4}$.

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

VALUE (units 10 ⁻³)	EVTS	DOCUMENT ID	TECN	COMMENT
3.8±0.8±0.3	80	¹ ABLIKIM	20AH BES3	$\psi(2S) \rightarrow \pi^0 h_c(1P)$

¹ ABLIKIM 20AH reports $[\Gamma(h_c(1P) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] = (2.8 \pm 0.5 \pm 0.3) \times 10^{-6}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = (7.4 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(K^+ K^- \pi^+ \pi^- \eta)/\Gamma_{\text{total}}$ Γ_{16}/Γ

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<2.7 × 10⁻³	90	24	¹ ABLIKIM	20AH BES3	$\psi(2S) \rightarrow \pi^0 h_c(1P)$

¹ ABLIKIM 20AH reports $[\Gamma(h_c(1P) \rightarrow K^+ K^- \pi^+ \pi^- \eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] < 2.0 \times 10^{-6}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = 7.4 \times 10^{-4}$.

$\Gamma(K^+ K^- \pi^0)/\Gamma_{\text{total}}$ Γ_{17}/Γ

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<6 × 10⁻⁴	90	20	¹ ABLIKIM	20AH BES3	$\psi(2S) \rightarrow \pi^0 h_c(1P)$

¹ ABLIKIM 20AH reports $[\Gamma(h_c(1P) \rightarrow K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] < 4.8 \times 10^{-7}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = 7.4 \times 10^{-4}$.

$\Gamma(K^+ K^- \pi^0 \eta)/\Gamma_{\text{total}}$ Γ_{18}/Γ

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<2.4 × 10⁻³	90	20	¹ ABLIKIM	20AH BES3	$\psi(2S) \rightarrow \pi^0 h_c(1P)$

¹ ABLIKIM 20AH reports $[\Gamma(h_c(1P) \rightarrow K^+ K^- \pi^0 \eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] < 1.8 \times 10^{-6}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = 7.4 \times 10^{-4}$.

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

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<1.0 × 10⁻³	90	18	¹ ABLIKIM	20AH BES3	$\psi(2S) \rightarrow \pi^0 h_c(1P)$

¹ ABLIKIM 20AH reports $[\Gamma(h_c(1P) \rightarrow K^+ K^- \eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] < 7.5 \times 10^{-7}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = 7.4 \times 10^{-4}$.

$\Gamma(2K^+ 2K^- \pi^0)/\Gamma_{\text{total}}$ Γ_{20}/Γ

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<2.8 × 10⁻⁴	90	11	¹ ABLIKIM	20AH BES3	$\psi(2S) \rightarrow \pi^0 h_c(1P)$

¹ ABLIKIM 20AH reports $[\Gamma(h_c(1P) \rightarrow 2K^+ 2K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] < 2.1 \times 10^{-7}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = 7.4 \times 10^{-4}$.

$\Gamma(K_S^0 K^\pm \pi^\mp)/\Gamma_{\text{total}}$ Γ_{21}/Γ

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<6 × 10⁻⁴	90	17	¹ ABLIKIM	20AH BES3	$\psi(2S) \rightarrow \pi^0 h_c(1P)$

¹ ABLIKIM 20AH reports $[\Gamma(h_c(1P) \rightarrow K_S^0 K^\pm \pi^\mp)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] < 4.8 \times 10^{-7}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = 7.4 \times 10^{-4}$.

$\Gamma(K_S^0 K^\pm \pi^\mp \pi^+ \pi^-)/\Gamma_{\text{total}}$ Γ_{22}/Γ

VALUE (units 10 ⁻³)	EVTS	DOCUMENT ID	TECN	COMMENT
3.2 ± 1.0 ± 0.2	41	¹ ABLIKIM	20AH BES3	$\psi(2S) \rightarrow \pi^0 h_c(1P)$

¹ ABLIKIM 20AH reports $[\Gamma(h_c(1P) \rightarrow K_S^0 K^\pm \pi^\mp \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_c(1P)\pi^0)] = (2.4 \pm 0.7 \pm 0.3) \times 10^{-6}$ which we divide by our best value $B(\psi(2S) \rightarrow h_c(1P)\pi^0) = (7.4 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

———— RADIATIVE DECAYS ————

$\Gamma(\gamma\eta)/\Gamma_{\text{total}}$ Γ_{23}/Γ

VALUE (units 10 ⁻⁴)	EVTS	DOCUMENT ID	TECN	COMMENT
4.7 ± 1.5 ± 1.4	18	ABLIKIM	16i BES3	$\psi(2S) \rightarrow \pi^0 \gamma \eta$

$\Gamma(\gamma\eta'(958))/\Gamma_{\text{total}}$ Γ_{24}/Γ

VALUE (units 10 ⁻³)	EVTS	DOCUMENT ID	TECN	COMMENT
1.52 ± 0.27 ± 0.29	44	ABLIKIM	16i BES3	$\psi(2S) \rightarrow \pi^0 \gamma \eta'(958)$

$\Gamma(\gamma\eta_c(1S))/\Gamma_{\text{total}}$ Γ_{25}/Γ

VALUE (units 10 ⁻²)	EVTS	DOCUMENT ID	TECN	COMMENT
60 ± 4 OUR FIT				
57 ± 5 OUR AVERAGE				
57 ± 4 ± 4	23k	¹ ABLIKIM	22AQ BES3	$\psi(2S) \rightarrow \pi^0 \text{ hadrons};$ $\pi^0 \gamma(\eta_c)$
56 ± 6 ± 4		² DOBBS	08A CLEO	$\psi(2S) \rightarrow \pi^0 \eta_c \gamma$

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

$62 \pm 9 \pm 4$	3679	^{3,4} ABLIKIM	10B	BES3	$\psi(2S) \rightarrow \pi^0 \eta_C \gamma$
$56 \pm 7 \pm 4$	1282	⁵ DOBBS	08A	CLEO	$\psi(2S) \rightarrow \pi^0 \eta_C \gamma$
$54 \pm 14 \pm 4$	168	⁶ ROSNER	05	CLEO	$\psi(2S) \rightarrow \pi^0 \eta_C \gamma$

¹ ABLIKIM 22AQ reports $[\Gamma(h_C(1P) \rightarrow \gamma \eta_C(1S))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_C(1P)\pi^0)] = (4.22^{+0.27}_{-0.26} \pm 0.19) \times 10^{-4}$ which we divide by our best value $B(\psi(2S) \rightarrow h_C(1P)\pi^0) = (7.4 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

² Average of DOBBS 08A and ROSNER 05. DOBBS 08A reports $[\Gamma(h_C(1P) \rightarrow \gamma \eta_C(1S))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_C(1P)\pi^0)] = (4.16 \pm 0.30 \pm 0.37) \times 10^{-4}$ which we divide by our best value $B(\psi(2S) \rightarrow h_C(1P)\pi^0) = (7.4 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

³ ABLIKIM 10B reports $[\Gamma(h_C(1P) \rightarrow \gamma \eta_C(1S))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_C(1P)\pi^0)] = (4.58 \pm 0.40 \pm 0.50) \times 10^{-4}$ which we divide by our best value $B(\psi(2S) \rightarrow h_C(1P)\pi^0) = (7.4 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

⁴ Superseded by ABLIKIM 22AQ

⁵ DOBBS 08A reports $[\Gamma(h_C(1P) \rightarrow \gamma \eta_C(1S))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_C(1P)\pi^0)] = (4.19 \pm 0.32 \pm 0.45) \times 10^{-4}$ which we divide by our best value $B(\psi(2S) \rightarrow h_C(1P)\pi^0) = (7.4 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

⁶ ROSNER 05 reports $[\Gamma(h_C(1P) \rightarrow \gamma \eta_C(1S))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow h_C(1P)\pi^0)] = (4.0 \pm 0.8 \pm 0.7) \times 10^{-4}$ which we divide by our best value $B(\psi(2S) \rightarrow h_C(1P)\pi^0) = (7.4 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$h_C(1P)$ REFERENCES

ABLIKIM	22AQ	PR D106 072007	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ABLIKIM	22M	JHEP 2205 108	M. Ablikim <i>et al.</i>	(BESIII Collab.)
Also		JHEP 2303 022 (errata.)	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ABLIKIM	22N	JHEP 2205 003	M. Ablikim	(BESIII Collab.)
ABLIKIM	20AH	PR D102 112007	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ABLIKIM	19AG	PR D99 072008	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ABLIKIM	18M	PR D97 052008	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ABLIKIM	16I	PRL 116 251802	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ABLIKIM	13V	PR D88 112001	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ABLIKIM	12N	PR D86 092009	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ABLIKIM	10B	PRL 104 132002	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ADAMS	09	PR D80 051106	G.S. Adams <i>et al.</i>	(CLEO Collab.)
DOBBS	08A	PRL 101 182003	S. Dobbs <i>et al.</i>	(CLEO Collab.)
ANDREOTTI	05B	PR D72 032001	M. Andreotti <i>et al.</i>	(FNAL E835 Collab.)
ROSNER	05	PRL 95 102003	J.L. Rosner <i>et al.</i>	(CLEO Collab.)
AULCHENKO	03	PL B573 63	V.M. Aulchenko <i>et al.</i>	(KEDR Collab.)
ANTONIAZZI	94	PR D50 4258	L. Antoniazzi <i>et al.</i>	(E705 Collab.)
ARMSTRONG	93B	PR D47 772	T.A. Armstrong <i>et al.</i>	(FNAL E760 Collab.)
ARMSTRONG	92D	PRL 69 2337	T.A. Armstrong <i>et al.</i>	(FNAL, FERR, GENO+)
BAGLIN	86	PL B171 135	C. Baglin <i>et al.</i>	(LAPP, CERN, TORI, STRB+)