

$\Upsilon(3S)$

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

$\Upsilon(3S)$ MASS

<u>VALUE (GeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
10.3552±0.0005	¹ ARTAMONOV 00	MD1	$e^+e^- \rightarrow$ hadrons
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
10.3553±0.0005	^{2,3} BARU	86B REDE	$e^+e^- \rightarrow$ hadrons
¹ Reanalysis of BARU 86B using new electron mass (COHEN 87).			
² Reanalysis of ARTAMONOV 84.			
³ Superseded by ARTAMONOV 00.			

$\Upsilon(3S)$ WIDTH

<u>VALUE (keV)</u>	<u>DOCUMENT ID</u>
26.3±3.5 OUR EVALUATION	See the Note on Width Determinations of the Υ states

$\Upsilon(3S)$ DECAY MODES

Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1 $\Upsilon(2S)$ anything	(10.6 ± 0.8) %	
Γ_2 $\Upsilon(2S)\pi^+\pi^-$	(2.8 ± 0.6) %	S=2.2
Γ_3 $\Upsilon(2S)\pi^0\pi^0$	(2.00±0.32) %	
Γ_4 $\Upsilon(2S)\gamma\gamma$	(5.0 ± 0.7) %	
Γ_5 $\Upsilon(1S)\pi^+\pi^-$	(4.48±0.21) %	
Γ_6 $\Upsilon(1S)\pi^0\pi^0$	(2.06±0.28) %	
Γ_7 $\Upsilon(1S)\eta$	< 2.2 × 10 ⁻³	CL=90%
Γ_8 $\mu^+\mu^-$	(1.81±0.17) %	
Γ_9 e^+e^-	seen	
Radiative decays		
Γ_{10} $\gamma\chi_{b2}(2P)$	(11.4 ± 0.8) %	S=1.3
Γ_{11} $\gamma\chi_{b1}(2P)$	(11.3 ± 0.6) %	
Γ_{12} $\gamma\chi_{b0}(2P)$	(5.4 ± 0.6) %	S=1.1

$\Upsilon(3S)$ $\Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$

<u>$\Gamma(\text{hadrons}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	$\Gamma_0\Gamma_9/\Gamma$
0.45±0.03±0.03	⁴ GILES	84B CLEO	$e^+e^- \rightarrow$ hadrons	
⁴ Radiative corrections reevaluated by BUCHMUELLER 88 following KURAEV 85.				

$\Upsilon(3S)$ BRANCHING RATIOS

$\Gamma(\Upsilon(2S)\text{anything})/\Gamma_{\text{total}}$

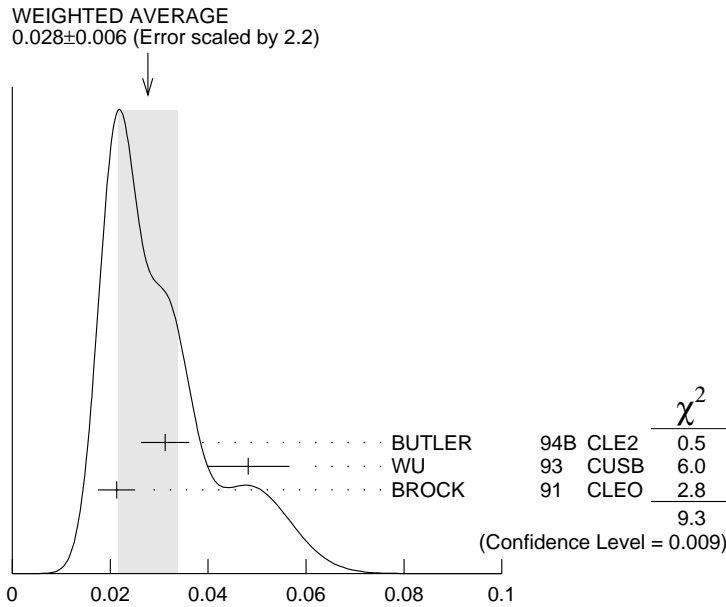
Γ_1/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.106 ± 0.008 OUR AVERAGE				
0.1023 ± 0.0105	4625	5,6,7 BUTLER	94B CLE2	$e^+e^- \rightarrow \ell^+\ell^- X$
0.111 ± 0.012	4891	6,7,8 BROCK	91 CLEO	$e^+e^- \rightarrow \pi^+\pi^- X,$ $\pi^+\pi^-\ell^+\ell^-$

$\Gamma(\Upsilon(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$

Γ_2/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.028 ± 0.006 OUR AVERAGE				Error includes scale factor of 2.2. See the ideogram below.
0.0312 ± 0.0049	980	5,9 BUTLER	94B CLE2	$e^+e^- \rightarrow \pi^+\pi^-\ell^+\ell^-$
0.0482 ± 0.0065 ± 0.0053	138	8 WU	93 CUSB	$\Upsilon(3S) \rightarrow \pi^+\pi^-\ell^+\ell^-$
0.0213 ± 0.0038	974	8 BROCK	91 CLEO	$e^+e^- \rightarrow \pi^+\pi^- X,$ $\pi^+\pi^-\ell^+\ell^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.031 ± 0.020	5	MAGERAS	82 CUSB	$\Upsilon(3S) \rightarrow \pi^+\pi^-\ell^+\ell^-$



$$\Gamma(\Upsilon(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$$

$\Gamma(\Upsilon(2S)\pi^0\pi^0)/\Gamma_{\text{total}}$ Γ_3/Γ

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.0200±0.0032 OUR AVERAGE				
0.0216±0.0039	9,10	BUTLER	94B CLE2	$e^+e^- \rightarrow \ell^+\ell^-\pi^0\pi^0$
0.017 ±0.005 ±0.002	10 11	HEINTZ	92 CSB2	$e^+e^- \rightarrow \ell^+\ell^-\pi^0\pi^0$

$\Gamma(\Upsilon(2S)\gamma\gamma)/\Gamma_{\text{total}}$ Γ_4/Γ

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.0502±0.0069			
9	BUTLER	94B CLE2	$e^+e^- \rightarrow \ell^+\ell^-2\gamma$

$\Gamma(\Upsilon(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$ Γ_5/Γ

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.0448±0.0021 OUR AVERAGE				
0.0452±0.0035	11830	6 BUTLER	94B CLE2	$e^+e^- \rightarrow \pi^+\pi^-X,$ $\pi^+\pi^-\ell^+\ell^-$
0.0446±0.0034±0.0050	451	6 WU	93 CUSB	$\Upsilon(3S) \rightarrow \pi^+\pi^-\ell^+\ell^-$
0.0446±0.0030	11221	6 BROCK	91 CLEO	$e^+e^- \rightarrow \pi^+\pi^-X,$ $\pi^+\pi^-\ell^+\ell^-$

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

0.049 ±0.010	22	GREEN	82 CLEO	$\Upsilon(3S) \rightarrow \pi^+\pi^-\ell^+\ell^-$
0.039 ±0.013	26	MAGERAS	82 CUSB	$\Upsilon(3S) \rightarrow \pi^+\pi^-\ell^+\ell^-$

$\Gamma(\Upsilon(1S)\pi^0\pi^0)/\Gamma_{\text{total}}$ Γ_6/Γ

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.0206±0.0028 OUR AVERAGE				
0.0199±0.0034	56	6 BUTLER	94B CLE2	$e^+e^- \rightarrow \ell^+\ell^-\pi^0\pi^0$
0.022 ±0.004 ±0.003	33	12 HEINTZ	92 CSB2	$e^+e^- \rightarrow \ell^+\ell^-\pi^0\pi^0$

$\Gamma(\Upsilon(1S)\eta)/\Gamma_{\text{total}}$ Γ_7/Γ

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<0.0022	90	BROCK	91 CLEO	$e^+e^- \rightarrow \pi^+\pi^-\pi^0\ell^+\ell^-$

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

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.0181±0.0017 OUR AVERAGE				
0.0202±0.0019±0.0033		CHEN	89B CLEO	$e^+e^- \rightarrow \mu^+\mu^-$
0.0173±0.0015±0.0011		KAARSBERG	89 CSB2	$e^+e^- \rightarrow \mu^+\mu^-$
0.033 ±0.013 ±0.007	1096	ANDREWS	83 CLEO	$e^+e^- \rightarrow \mu^+\mu^-$

$\Gamma(\Upsilon\chi_{b2}(2P))/\Gamma_{\text{total}}$ Γ_{10}/Γ

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.114±0.008 OUR AVERAGE				
Error includes scale factor of 1.3.				
0.111±0.005±0.004	10319	13 HEINTZ	92 CSB2	$e^+e^- \rightarrow \gamma$
0.135±0.003±0.017	30741	MORRISON	91 CLE2	$e^+e^- \rightarrow \gamma X$

$\Gamma(\gamma\chi_{b1}(2P))/\Gamma_{\text{total}}$						Γ_{11}/Γ
<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>		
0.113±0.006 OUR AVERAGE						
0.115±0.005±0.005	11147	¹³ HEINTZ	92 CSB2	e ⁺ e ⁻ → γ		
0.105 ^{+0.003} _{-0.002} ±0.013	25759	MORRISON	91 CLE2	e ⁺ e ⁻ → γX		

$\Gamma(\gamma\chi_{b0}(2P))/\Gamma_{\text{total}}$						Γ_{12}/Γ
<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>		
0.054±0.006 OUR AVERAGE	Error includes scale factor of 1.1.					
0.060±0.004±0.006	4959	¹³ HEINTZ	92 CSB2	e ⁺ e ⁻ → γ		
0.049 ^{+0.003} _{-0.004} ±0.006	9903	MORRISON	91 CLE2	e ⁺ e ⁻ → γX		

⁵ Using $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\gamma\gamma) = (0.038 \pm 0.007)\%$, and $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^0\pi^0) = (1/2)B(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-)$.

⁶ Using $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.06)\%$. With the assumption of $e\mu$ universality.

⁷ Using $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-) = (18.5 \pm 0.8)\%$.

⁸ Using $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.31 \pm 0.21)\%$, $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\gamma\gamma) \times 2B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (0.188 \pm 0.035)\%$, and $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^0\pi^0) \times 2B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (0.436 \pm 0.056)\%$. With the assumption of $e\mu$ universality.

⁹ From the exclusive mode.

¹⁰ $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.31 \pm 0.21)\%$ and assuming $e\mu$ universality.

¹¹ $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.44 \pm 0.10)\%$ and assuming $e\mu$ universality. Supersedes HEINTZ 91.

¹² Using $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.57 \pm 0.07)\%$ and assuming $e\mu$ universality. Supersedes HEINTZ 91.

¹³ Supersedes NARAIN 91.

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