

# $\Upsilon(1S)$

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

## $\Upsilon(1S)$ MASS

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>9460.40 ± 0.09 ± 0.04</b>	<sup>1</sup> SHAMOV 23	RVUE	$e^+e^- \rightarrow$ hadrons
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
9460.11 ± 0.11 ± 0.07	<sup>2</sup> SHAMOV 23	RVUE	$e^+e^- \rightarrow$ hadrons
9460.51 ± 0.09 ± 0.05	<sup>3,4</sup> ARTAMONOV 00	MD1	$e^+e^- \rightarrow$ hadrons
9460.60 ± 0.09 ± 0.05	<sup>5,6</sup> BARU 92B	MD1	$e^+e^- \rightarrow$ hadrons
9460.59 ± 0.12	BARU 86	MD1	$e^+e^- \rightarrow$ hadrons
9460.6 ± 0.4	<sup>6,7</sup> ARTAMONOV 84	MD1	$e^+e^- \rightarrow$ hadrons
9459.97 ± 0.11 ± 0.07	<sup>8</sup> MACKAY 84	CUSB	$e^+e^- \rightarrow$ hadrons

<sup>1</sup> Reanalysis of MD1 data using the electron mass from COHEN 87, the radiative corrections from KURAEV 85 and interference effects.

<sup>2</sup> Obtained by reanalysing CUSB data (MACKAY 84), but not authored by the CUSB collaboration.

<sup>3</sup> Reanalysis of BARU 92B and ARTAMONOV 84 using new electron mass (COHEN 87).

<sup>4</sup> Superseded by SHAMOV 23.

<sup>5</sup> Supersedes BARU 86.

<sup>6</sup> Superseded by ARTAMONOV 00.

<sup>7</sup> Value includes data of ARTAMONOV 82.

<sup>8</sup> Reanalysed by SHAMOV 23.

## $\Upsilon(1S)$ WIDTH

<u>VALUE (keV)</u>	<u>DOCUMENT ID</u>
<b>54.02 ± 1.25 OUR EVALUATION</b>	See the Note on "Width Determinations of the $\Upsilon$ States"

## $\Upsilon(1S)$ DECAY MODES

Mode	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level
$\Gamma_1$ $\tau^+\tau^-$	( 2.60 ± 0.10 ) %	
$\Gamma_2$ $e^+e^-$	( 2.39 ± 0.08 ) %	
$\Gamma_3$ $\mu^+\mu^-$	( 2.48 ± 0.04 ) %	

### Hadronic decays

$\Gamma_4$ $ggg$	( 81.7 ± 0.7 ) %	
$\Gamma_5$ $\gamma gg$	( 2.2 ± 0.6 ) %	
$\Gamma_6$ $\eta'(958)$ anything	( 2.94 ± 0.24 ) %	
$\Gamma_7$ $J/\psi(1S)$ anything	( 5.4 ± 0.4 ) × 10 <sup>-4</sup>	S=1.4
$\Gamma_8$ $J/\psi(1S)\eta_c$	< 2.2	× 10 <sup>-6</sup> CL=90%
$\Gamma_9$ $J/\psi(1S)\chi_{c0}$	< 3.4	× 10 <sup>-6</sup> CL=90%
$\Gamma_{10}$ $J/\psi(1S)\chi_{c1}$	( 3.9 ± 1.2 ) × 10 <sup>-6</sup>	
$\Gamma_{11}$ $J/\psi(1S)\chi_{c2}$	< 1.4	× 10 <sup>-6</sup> CL=90%

$\Gamma_{12}$	$J/\psi(1S)\eta_c(2S)$	$< 2.2$	$\times 10^{-6}$	CL=90%
$\Gamma_{13}$	$J/\psi(1S)X(3940)$	$< 5.4$	$\times 10^{-6}$	CL=90%
$\Gamma_{14}$	$J/\psi(1S)X(4160)$	$< 5.4$	$\times 10^{-6}$	CL=90%
$\Gamma_{15}$	$X(4350)$ anything, $X \rightarrow J/\psi(1S)\phi$	$< 8.1$	$\times 10^{-6}$	CL=90%
$\Gamma_{16}$	$T_{c\bar{c}1}(3900)^\pm$ anything, $T_{c\bar{c}1} \rightarrow J/\psi(1S)\pi^\pm$	$< 1.3$	$\times 10^{-5}$	CL=90%
$\Gamma_{17}$	$T_{c\bar{c}1}(4200)^\pm$ anything, $Z_c \rightarrow J/\psi(1S)\pi^\pm$	$< 6.0$	$\times 10^{-5}$	CL=90%
$\Gamma_{18}$	$T_{c\bar{c}1}(4430)^\pm$ anything, $T_{c\bar{c}1} \rightarrow J/\psi(1S)\pi^\pm$	$< 4.9$	$\times 10^{-5}$	CL=90%
$\Gamma_{19}$	$X_{cs}^\pm$ anything, $X \rightarrow J/\psi K^\pm$	$< 5.7$	$\times 10^{-6}$	CL=90%
$\Gamma_{20}$	$\psi(4230)$ anything, $\psi \rightarrow J/\psi(1S)\pi^+\pi^-$	$< 3.8$	$\times 10^{-5}$	CL=90%
$\Gamma_{21}$	$\psi(4230)$ anything, $\psi \rightarrow J/\psi(1S)K^+K^-$	$< 7.5$	$\times 10^{-6}$	CL=90%
$\Gamma_{22}$	$\chi_{c1}(4140)$ anything, $\chi_{c1} \rightarrow J/\psi(1S)\phi$	$< 5.2$	$\times 10^{-6}$	CL=90%
$\Gamma_{23}$	$\chi_{c0}$ anything	$< 4$	$\times 10^{-3}$	CL=90%
$\Gamma_{24}$	$\chi_{c1}$ anything	$(1.90 \pm 0.35) \times 10^{-4}$		
$\Gamma_{25}$	$\chi_{c1}(1P)X_{tetra}$	$< 3.78$	$\times 10^{-5}$	CL=90%
$\Gamma_{26}$	$\chi_{c2}$ anything	$(2.8 \pm 0.8) \times 10^{-4}$		
$\Gamma_{27}$	$\psi(2S)$ anything	$(1.23 \pm 0.20) \times 10^{-4}$		
$\Gamma_{28}$	$\psi(2S)\eta_c$	$< 3.6$	$\times 10^{-6}$	CL=90%
$\Gamma_{29}$	$\psi(2S)\chi_{c0}$	$< 6.5$	$\times 10^{-6}$	CL=90%
$\Gamma_{30}$	$\psi(2S)\chi_{c1}$	$< 4.5$	$\times 10^{-6}$	CL=90%
$\Gamma_{31}$	$\psi(2S)\chi_{c2}$	$< 2.1$	$\times 10^{-6}$	CL=90%
$\Gamma_{32}$	$\psi(2S)\eta_c(2S)$	$< 3.2$	$\times 10^{-6}$	CL=90%
$\Gamma_{33}$	$\psi(2S)X(3940)$	$< 2.9$	$\times 10^{-6}$	CL=90%
$\Gamma_{34}$	$\psi(2S)X(4160)$	$< 2.9$	$\times 10^{-6}$	CL=90%
$\Gamma_{35}$	$\psi(4230)$ anything, $\psi \rightarrow \psi(2S)\pi^+\pi^-$	$< 7.9$	$\times 10^{-5}$	CL=90%
$\Gamma_{36}$	$\psi(4360)$ anything, $\psi \rightarrow \psi(2S)\pi^+\pi^-$	$< 5.2$	$\times 10^{-5}$	CL=90%
$\Gamma_{37}$	$\psi(4660)$ anything, $\psi \rightarrow \psi(2S)\pi^+\pi^-$	$< 2.2$	$\times 10^{-5}$	CL=90%
$\Gamma_{38}$	$T_{c\bar{c}}(4050)^\pm$ anything, $X \rightarrow \psi(2S)\pi^\pm$	$< 8.8$	$\times 10^{-5}$	CL=90%
$\Gamma_{39}$	$T_{c\bar{c}1}(4430)^\pm$ anything, $T_{c\bar{c}1} \rightarrow \psi(2S)\pi^\pm$	$< 6.7$	$\times 10^{-5}$	CL=90%
$\Gamma_{40}$	$\chi_{c1}(3872)$ anything	$< 2.7$	$\times 10^{-4}$	CL=90%
$\Gamma_{41}$	$T_{c\bar{c}1}(4200)^+ T_{c\bar{c}1}(4200)^-$	$< 2.23$	$\times 10^{-5}$	CL=90%
$\Gamma_{42}$	$T_{c\bar{c}1}(3900)^\pm T_{c\bar{c}1}(4200)^\mp$	$< 8.1$	$\times 10^{-6}$	CL=90%
$\Gamma_{43}$	$T_{c\bar{c}1}(3900)^+ T_{c\bar{c}1}(3900)^-$	$< 1.8$	$\times 10^{-6}$	CL=90%

Γ <sub>44</sub>	$T_{c\bar{c}}(4050)^+ T_{c\bar{c}}(4050)^-$	< 1.58	$\times 10^{-5}$	CL=90%
Γ <sub>45</sub>	$T_{c\bar{c}}(4250)^+ T_{c\bar{c}}(4250)^-$	< 2.66	$\times 10^{-5}$	CL=90%
Γ <sub>46</sub>	$T_{c\bar{c}}(4050)^\pm T_{c\bar{c}}(4250)^\mp$	< 4.42	$\times 10^{-5}$	CL=90%
Γ <sub>47</sub>	$T_{c\bar{c}1}(4430)^+ T_{c\bar{c}1}(4430)^-$	< 2.03	$\times 10^{-5}$	CL=90%
Γ <sub>48</sub>	$T_{c\bar{c}}(4055)^\pm T_{c\bar{c}}(4055)^\mp$	< 2.33	$\times 10^{-5}$	CL=90%
Γ <sub>49</sub>	$T_{c\bar{c}}(4055)^\pm T_{c\bar{c}1}(4430)^\mp$	< 4.55	$\times 10^{-5}$	CL=90%
Γ <sub>50</sub>	$\rho\pi$	< 3.68	$\times 10^{-6}$	CL=90%
Γ <sub>51</sub>	$\omega\pi^0$	< 3.90	$\times 10^{-6}$	CL=90%
Γ <sub>52</sub>	$\pi^+\pi^-$	< 5	$\times 10^{-4}$	CL=90%
Γ <sub>53</sub>	$K^+K^-$	< 5	$\times 10^{-4}$	CL=90%
Γ <sub>54</sub>	$p\bar{p}$	< 5	$\times 10^{-4}$	CL=90%
Γ <sub>55</sub>	$\pi^+\pi^-\pi^0$	( 2.1 ± 0.8 )	$\times 10^{-6}$	
Γ <sub>56</sub>	$\phi K^+K^-$	( 2.4 ± 0.5 )	$\times 10^{-6}$	
Γ <sub>57</sub>	$\omega\pi^+\pi^-$	( 4.5 ± 1.0 )	$\times 10^{-6}$	
Γ <sub>58</sub>	$K^*(892)^0 K^- \pi^+ + \text{c.c.}$	( 4.4 ± 0.8 )	$\times 10^{-6}$	
Γ <sub>59</sub>	$\phi f'_2(1525)$	< 1.63	$\times 10^{-6}$	CL=90%
Γ <sub>60</sub>	$\omega f_2(1270)$	< 1.79	$\times 10^{-6}$	CL=90%
Γ <sub>61</sub>	$\rho(770) a_2(1320)$	< 2.24	$\times 10^{-6}$	CL=90%
Γ <sub>62</sub>	$K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.}$	( 3.0 ± 0.8 )	$\times 10^{-6}$	
Γ <sub>63</sub>	$K_1(1270)^\pm K^\mp$	< 2.41	$\times 10^{-6}$	CL=90%
Γ <sub>64</sub>	$K_1(1400)^\pm K^\mp$	( 1.0 ± 0.4 )	$\times 10^{-6}$	
Γ <sub>65</sub>	$b_1(1235)^\pm \pi^\mp$	< 1.25	$\times 10^{-6}$	CL=90%
Γ <sub>66</sub>	$\pi^+\pi^-\pi^0\pi^0$	( 1.28 ± 0.30 )	$\times 10^{-5}$	
Γ <sub>67</sub>	$K_S^0 K^+ \pi^- + \text{c.c.}$	( 1.6 ± 0.4 )	$\times 10^{-6}$	
Γ <sub>68</sub>	$K^*(892)^0 \bar{K}^0 + \text{c.c.}$	( 2.9 ± 0.9 )	$\times 10^{-6}$	
Γ <sub>69</sub>	$K^*(892)^- K^+ + \text{c.c.}$	< 1.11	$\times 10^{-6}$	CL=90%
Γ <sub>70</sub>	$f_1(1285)$ anything	( 4.6 ± 3.1 )	$\times 10^{-3}$	
Γ <sub>71</sub>	$D^*(2010)^\pm$ anything	( 2.52 ± 0.20 )	%	
Γ <sub>72</sub>	$\frac{f_1(1285)}{2} X_{tetra}$	< 6.24	$\times 10^{-5}$	CL=90%
Γ <sub>73</sub>	${}^2H$ anything	( 2.85 ± 0.25 )	$\times 10^{-5}$	
Γ <sub>74</sub>	Sum of 100 exclusive modes	( 1.200 ± 0.017 )	%	

### Radiative decays

Γ <sub>75</sub>	$\gamma\pi^+\pi^-$	( 6.3 ± 1.8 )	$\times 10^{-5}$	
Γ <sub>76</sub>	$\gamma\pi^0\pi^0$	( 1.7 ± 0.7 )	$\times 10^{-5}$	
Γ <sub>77</sub>	$\gamma\pi\pi$ (S-wave)	( 4.6 ± 0.7 )	$\times 10^{-5}$	
Γ <sub>78</sub>	$\gamma\pi^0\eta$	< 2.4	$\times 10^{-6}$	CL=90%
Γ <sub>79</sub>	$\gamma K^+K^-$	[a] ( 1.14 ± 0.13 )	$\times 10^{-5}$	
Γ <sub>80</sub>	$\gamma p\bar{p}$	[b] < 6	$\times 10^{-6}$	CL=90%
Γ <sub>81</sub>	$\gamma 2h^+ 2h^-$	( 7.0 ± 1.5 )	$\times 10^{-4}$	
Γ <sub>82</sub>	$\gamma 3h^+ 3h^-$	( 5.4 ± 2.0 )	$\times 10^{-4}$	
Γ <sub>83</sub>	$\gamma 4h^+ 4h^-$	( 7.4 ± 3.5 )	$\times 10^{-4}$	
Γ <sub>84</sub>	$\gamma\pi^+\pi^- K^+ K^-$	( 2.9 ± 0.9 )	$\times 10^{-4}$	
Γ <sub>85</sub>	$\gamma 2\pi^+ 2\pi^-$	( 2.5 ± 0.9 )	$\times 10^{-4}$	

$\Gamma_{86}$	$\gamma 3\pi^+ 3\pi^-$	$( 2.5 \pm 1.2 ) \times 10^{-4}$	
$\Gamma_{87}$	$\gamma 2\pi^+ 2\pi^- K^+ K^-$	$( 2.4 \pm 1.2 ) \times 10^{-4}$	
$\Gamma_{88}$	$\gamma \pi^+ \pi^- p \bar{p}$	$( 1.5 \pm 0.6 ) \times 10^{-4}$	
$\Gamma_{89}$	$\gamma 2\pi^+ 2\pi^- p \bar{p}$	$( 4 \pm 6 ) \times 10^{-5}$	
$\Gamma_{90}$	$\gamma 2K^+ 2K^-$	$( 2.0 \pm 2.0 ) \times 10^{-5}$	
$\Gamma_{91}$	$\gamma \eta'(958)$	$< 1.9$	$\times 10^{-6}$ CL=90%
$\Gamma_{92}$	$\gamma \eta$	$< 1.0$	$\times 10^{-6}$ CL=90%
$\Gamma_{93}$	$\gamma f_0(980)$	$< 3$	$\times 10^{-5}$ CL=90%
$\Gamma_{94}$	$\gamma f_2'(1525)$	$( 2.9 \pm 0.6 ) \times 10^{-5}$	
$\Gamma_{95}$	$\gamma f_2(1270)$	$( 1.01 \pm 0.06 ) \times 10^{-4}$	
$\Gamma_{96}$	$\gamma \eta(1405)$	$< 8.2$	$\times 10^{-5}$ CL=90%
$\Gamma_{97}$	$\gamma f_0(1500)$	$< 1.5$	$\times 10^{-5}$ CL=90%
$\Gamma_{98}$	$\gamma f_0(1500) \rightarrow \gamma K^+ K^-$	$( 1.0 \pm 0.4 ) \times 10^{-5}$	
$\Gamma_{99}$	$\gamma f_0(1710)$	$< 2.6$	$\times 10^{-4}$ CL=90%
$\Gamma_{100}$	$\gamma f_0(1710) \rightarrow \gamma K^+ K^-$	$( 1.01 \pm 0.32 ) \times 10^{-5}$	
$\Gamma_{101}$	$\gamma f_0(1710) \rightarrow \gamma \pi^+ \pi^-$	$( 5.3 \pm 2.0 ) \times 10^{-6}$	
$\Gamma_{102}$	$\gamma f_0(1710) \rightarrow \gamma \pi^0 \pi^0$	$< 1.4$	$\times 10^{-6}$ CL=90%
$\Gamma_{103}$	$\gamma f_0(1710) \rightarrow \gamma \eta \eta$	$< 1.8$	$\times 10^{-6}$ CL=90%
$\Gamma_{104}$	$\gamma f_4(2050)$	$< 5.3$	$\times 10^{-5}$ CL=90%
$\Gamma_{105}$	$\gamma f_0(2200) \rightarrow \gamma K^+ K^-$	$< 2$	$\times 10^{-4}$ CL=90%
$\Gamma_{106}$	$\gamma f_J(2220) \rightarrow \gamma K^+ K^-$	$< 8$	$\times 10^{-7}$ CL=90%
$\Gamma_{107}$	$\gamma f_J(2220) \rightarrow \gamma \pi^+ \pi^-$	$< 6$	$\times 10^{-7}$ CL=90%
$\Gamma_{108}$	$\gamma f_J(2220) \rightarrow \gamma p \bar{p}$	$< 1.1$	$\times 10^{-6}$ CL=90%
$\Gamma_{109}$	$\gamma \eta(2225) \rightarrow \gamma \phi \phi$	$< 3$	$\times 10^{-3}$ CL=90%
$\Gamma_{110}$	$\gamma \eta_c(1S)$	$< 2.9$	$\times 10^{-5}$ CL=90%
$\Gamma_{111}$	$\gamma \eta_c(2S)$	$< 4$	$\times 10^{-4}$ CL=90%
$\Gamma_{112}$	$\gamma \chi_{c0}$	$< 6.6$	$\times 10^{-5}$ CL=90%
$\Gamma_{113}$	$\gamma \chi_{c1}$	$( 4.7 \begin{smallmatrix} +2.4 \\ -1.9 \end{smallmatrix} ) \times 10^{-5}$	
$\Gamma_{114}$	$\gamma \chi_{c2}$	$< 7.6$	$\times 10^{-6}$ CL=90%
$\Gamma_{115}$	$\gamma \chi_{c1}(3872)$	$< 5$	$\times 10^{-5}$ CL=90%
$\Gamma_{116}$	$\gamma \chi_{c1}(3872), \chi_{c1} \rightarrow \pi^+ \pi^- \pi^0 J/\psi$	$< 2.8$	$\times 10^{-6}$ CL=90%
$\Gamma_{117}$	$\gamma \chi_{c0}(3915) \rightarrow \omega J/\psi$	$< 3.0$	$\times 10^{-6}$ CL=90%
$\Gamma_{118}$	$\gamma \chi_{c1}(4140) \rightarrow \phi J/\psi$	$< 2.2$	$\times 10^{-6}$ CL=90%
$\Gamma_{119}$	$\gamma X \bar{X} (m_X < 3.1 \text{ GeV})$	[c] $< 1$	$\times 10^{-3}$ CL=90%
$\Gamma_{120}$	$\gamma X \bar{X} (m_X < 4.5 \text{ GeV})$	[d] $< 2.4$	$\times 10^{-4}$ CL=90%
$\Gamma_{121}$	$\gamma X \rightarrow \gamma + \geq 4 \text{ prongs}$	[e] $< 1.78$	$\times 10^{-4}$ CL=95%
$\Gamma_{122}$	$\gamma A^0$	[f]	
$\Gamma_{123}$	$\gamma A^0 \rightarrow \gamma \mu^+ \mu^-$	[g] $< 9$	$\times 10^{-6}$ CL=90%
$\Gamma_{124}$	$\gamma A^0 \rightarrow \gamma \tau^+ \tau^-$	[a] $< 1.30$	$\times 10^{-4}$ CL=90%
$\Gamma_{125}$	$\gamma A^0 \rightarrow \gamma g g$	[h] $< 1$	% CL=90%
$\Gamma_{126}$	$\gamma A^0 \rightarrow \gamma s \bar{s}$	[h] $< 1$	$\times 10^{-3}$ CL=90%

**Lepton Family number (LF) violating modes**

$\Gamma_{127}$	$e^\pm \mu^\mp$	LF	< 3.9	$\times 10^{-7}$	CL=90%
$\Gamma_{128}$	$\mu^\pm \tau^\mp$	LF	< 2.7	$\times 10^{-6}$	CL=90%
$\Gamma_{129}$	$e^\pm \tau^\mp$	LF	< 2.7	$\times 10^{-6}$	CL=90%
$\Gamma_{130}$	$\gamma e^\pm \mu^\mp$	LF	< 4.2	$\times 10^{-7}$	CL=90%
$\Gamma_{131}$	$\gamma \mu^\pm \tau^\mp$	LF	< 6.1	$\times 10^{-6}$	CL=90%
$\Gamma_{132}$	$\gamma e^\pm \tau^\mp$	LF	< 6.5	$\times 10^{-6}$	CL=90%

**Other decays**

$\Gamma_{133}$	invisible		< 3.0	$\times 10^{-4}$	CL=90%
$\Gamma_{134}$	hadrons		(96 ± 4)	%	

[a]  $2m_\tau < M(\tau^+ \tau^-) < 9.2$  GeV

[b]  $2$  GeV  $< m_{K^+ K^-} < 3$  GeV

[c]  $X \bar{X}$  = vectors with  $m < 3.1$  GeV

[d]  $X$  and  $\bar{X}$  = zero spin with  $m < 4.5$  GeV

[e]  $1.5$  GeV  $< m_X < 5.0$  GeV

[f]  $A^0$  = scalar with  $m < 8.0$  GeV

[g]  $201$  MeV  $< M(\mu^+ \mu^-) < 3565$  MeV

[h]  $0.5$  GeV  $< m_X < 9.0$  GeV, where  $m_X$  is the invariant mass of the hadronic final state.

**$\mathcal{R}(1S) \Gamma(i)\Gamma(e^+ e^-)/\Gamma(\text{total})$**

**$\Gamma(\mu^+ \mu^-) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$   $\Gamma_3 \Gamma_2/\Gamma$**

<u>VALUE (eV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>31.2±1.6±1.7</b>	KOBEL	92	CBAL $e^+ e^- \rightarrow \mu^+ \mu^-$

**$\Gamma(\text{hadrons}) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$   $\Gamma_{134} \Gamma_2/\Gamma$**

<u>VALUE (keV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1.240±0.016 OUR AVERAGE</b>			
1.252±0.004±0.019	<sup>1</sup> ROSNER	06	CLEO $9.5 e^+ e^- \rightarrow \text{hadrons}$
1.187±0.023±0.031	<sup>1</sup> BARU	92B	MD1 $e^+ e^- \rightarrow \text{hadrons}$
1.23 ±0.02 ±0.05	<sup>1</sup> JAKUBOWSKI	88	CBAL $e^+ e^- \rightarrow \text{hadrons}$
1.37 ±0.06 ±0.09	<sup>2</sup> GILES	84B	CLEO $e^+ e^- \rightarrow \text{hadrons}$
1.23 ±0.08 ±0.04	<sup>2</sup> ALBRECHT	82	DASP $e^+ e^- \rightarrow \text{hadrons}$
1.13 ±0.07 ±0.11	<sup>2</sup> NICZYPORUK	82	LENA $e^+ e^- \rightarrow \text{hadrons}$
1.09 ±0.25	<sup>2</sup> BOCK	80	CNTR $e^+ e^- \rightarrow \text{hadrons}$
1.35 ±0.14	<sup>3</sup> BERGER	79	PLUT $e^+ e^- \rightarrow \text{hadrons}$

<sup>1</sup> Radiative corrections evaluated following KURAEV 85.

<sup>2</sup> Radiative corrections reevaluated by BUCHMUELLER 88 following KURAEV 85.

<sup>3</sup> Radiative corrections reevaluated by ALEXANDER 89 using  $B(\mu\mu) = 0.026$ .

## $\Upsilon(1S)$ PARTIAL WIDTHS

$\Gamma(e^+e^-)$

$\Gamma_2$

VALUE (keV)

DOCUMENT ID

**1.340 ± 0.018 OUR EVALUATION**

## $\Upsilon(1S)$ BRANCHING RATIOS

$\Gamma(\tau^+\tau^-)/\Gamma_{\text{total}}$

$\Gamma_1/\Gamma$

VALUE (units  $10^{-2}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**2.60 ± 0.10 OUR AVERAGE**

2.53 ± 0.13 ± 0.04    60k    <sup>1</sup> BESSON    07    CLEO     $e^+e^- \rightarrow \Upsilon(1S) \rightarrow \tau^+\tau^-$

2.61 ± 0.12 <sup>+0.09</sup><sub>-0.13</sub>    25k    CINABRO    94B    CLE2     $e^+e^- \rightarrow \tau^+\tau^-$

2.7 ± 0.4 ± 0.2    <sup>2</sup> ALBRECHT    85C    ARG     $\Upsilon(2S) \rightarrow \pi^+\pi^-\tau^+\tau^-$

3.4 ± 0.4 ± 0.4    GILES    83    CLEO     $e^+e^- \rightarrow \tau^+\tau^-$

<sup>1</sup> BESSON 07 reports  $[\Gamma(\Upsilon(1S) \rightarrow \tau^+\tau^-)/\Gamma_{\text{total}}] / [B(\Upsilon(1S) \rightarrow \mu^+\mu^-)] = 1.02 \pm 0.02 \pm 0.05$  which we multiply by our best value  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.04) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Using  $B(\Upsilon(1S) \rightarrow ee) = B(\Upsilon(1S) \rightarrow \mu\mu) = 0.0256$ ; not used for width evaluations.

$\Gamma(e^+e^-)/\Gamma_{\text{total}}$

$\Gamma_2/\Gamma$

VALUE (units  $10^{-2}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**2.39 ± 0.08 OUR AVERAGE**

2.40 ± 0.01 ± 0.12    191k    PATRA    22    BELL     $\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$

2.29 ± 0.08 ± 0.11    ALEXANDER    98    CLE2     $\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$

2.42 ± 0.14 ± 0.14    307    ALBRECHT    87    ARG     $\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$

2.8 ± 0.3 ± 0.2    826    BESSON    84    CLEO     $\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$

5.1 ± 3.0    BERGER    80C    PLUT     $e^+e^- \rightarrow e^+e^-$

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

$\Gamma_3/\Gamma$

VALUE (units  $10^{-2}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**2.48 ± 0.04 OUR AVERAGE**

2.46 ± 0.01 ± 0.11    246k    PATRA    22    BELL     $\Upsilon(2S) \rightarrow$

$\pi^+\pi^-\mu^+\mu^-$

2.49 ± 0.02 ± 0.07    345k    ADAMS    05    CLEO     $e^+e^- \rightarrow \mu^+\mu^-$

2.49 ± 0.08 ± 0.13    ALEXANDER    98    CLE2     $\Upsilon(2S) \rightarrow$

$\pi^+\pi^-\mu^+\mu^-$

2.12 ± 0.20 ± 0.10    <sup>1</sup> BARU    92    MD1     $e^+e^- \rightarrow \mu^+\mu^-$

2.31 ± 0.12 ± 0.10    <sup>1</sup> KOBEL    92    CBAL     $e^+e^- \rightarrow \mu^+\mu^-$

2.52 ± 0.07 ± 0.07    CHEN    89B    CLEO     $e^+e^- \rightarrow \mu^+\mu^-$

2.61 ± 0.09 ± 0.11    KAARSBERG    89    CSB2     $e^+e^- \rightarrow \mu^+\mu^-$

2.30 ± 0.25 ± 0.13    86    ALBRECHT    87    ARG     $\Upsilon(2S) \rightarrow$

$\pi^+\pi^-\mu^+\mu^-$

2.9 ± 0.3 ± 0.2    864    BESSON    84    CLEO     $\Upsilon(2S) \rightarrow$

$\pi^+\pi^-\mu^+\mu^-$

2.7 ±0.3 ±0.3	ANDREWS	83	CLEO	$e^+ e^- \rightarrow \mu^+ \mu^-$
3.2 ±1.3 ±0.3	ALBRECHT	82	DASP	$e^+ e^- \rightarrow \mu^+ \mu^-$
3.8 ±1.5 ±0.2	NICZYPORUK	82	LENA	$e^+ e^- \rightarrow \mu^+ \mu^-$
1.4 <sup>+3.4</sup> <sub>-1.4</sub>	BOCK	80	CNTR	$e^+ e^- \rightarrow \mu^+ \mu^-$
2.2 ±2.0	BERGER	79	PLUT	$e^+ e^- \rightarrow \mu^+ \mu^-$

<sup>1</sup> Taking into account interference between the resonance and continuum.

### $\Gamma(\tau^+ \tau^-) / \Gamma(\mu^+ \mu^-)$ $\Gamma_1 / \Gamma_3$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1.008 ± 0.023 OUR AVERAGE</b>				
1.005 ± 0.013 ± 0.022	0.7M	<sup>1</sup> DEL-AMO-SA..10c	BABR	$\Upsilon(3S) \rightarrow \pi^+ \pi^- \Upsilon(1S)$
1.02 ± 0.02 ± 0.05	60k	BESSON	07	CLEO $e^+ e^- \rightarrow \Upsilon(1S)$

<sup>1</sup> Allows any number of extra photons with total energy < 500 MeV.

### $\Gamma(g g g) / \Gamma_{\text{total}}$ $\Gamma_4 / \Gamma$

VALUE (units 10 <sup>-2</sup> )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>81.7 ± 0.7</b>	20M	<sup>1</sup> BESSON	06A	CLEO $\Upsilon(1S) \rightarrow \text{hadrons}$

<sup>1</sup> Calculated using the value  $\Gamma(\gamma g g) / \Gamma(g g g) = (2.70 \pm 0.01 \pm 0.13 \pm 0.24)\%$  from BESSON 06A and PDG 08 values of  $B(\mu^+ \mu^-) = (2.48 \pm 0.05)\%$  and  $R_{\text{hadrons}} = 3.51$ . The statistical error is negligible and the systematic error is partially correlated with that of  $\Gamma(\gamma g g) / \Gamma_{\text{total}}$  measurement of BESSON 06A.

### $\Gamma(\gamma g g) / \Gamma_{\text{total}}$ $\Gamma_5 / \Gamma$

VALUE (units 10 <sup>-2</sup> )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>2.20 ± 0.60</b>	400k	<sup>1</sup> BESSON	06A	CLEO $\Upsilon(1S) \rightarrow \gamma + \text{hadrons}$

<sup>1</sup> Calculated using BESSON 06A values of  $\Gamma(\gamma g g) / \Gamma(g g g) = (2.70 \pm 0.01 \pm 0.13 \pm 0.24)\%$  and  $\Gamma(g g g) / \Gamma_{\text{total}}$ . The statistical error is negligible and the systematic error is partially correlated with that of  $\Gamma(g g g) / \Gamma_{\text{total}}$  measurement of BESSON 06A.

### $\Gamma(\gamma g g) / \Gamma(g g g)$ $\Gamma_5 / \Gamma_4$

VALUE (units 10 <sup>-2</sup> )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>2.70 ± 0.01 ± 0.27</b>	20M	BESSON	06A	CLEO $\Upsilon(1S) \rightarrow (\gamma +) \text{hadrons}$

### $\Gamma(\eta'(958) \text{ anything}) / \Gamma_{\text{total}}$ $\Gamma_6 / \Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.0294 ± 0.0024 OUR AVERAGE</b>			
0.030 ± 0.002 ± 0.002	AQUINES	06A	CLE3 $\Upsilon(1S) \rightarrow \eta' \text{ anything}$
0.028 ± 0.004 ± 0.002	ARTUSO	03	CLE2 $\Upsilon(1S) \rightarrow \eta' \text{ anything}$

### $\Gamma(J/\psi(1S) \text{ anything}) / \Gamma_{\text{total}}$ $\Gamma_7 / \Gamma$

VALUE (units 10 <sup>-4</sup> )	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b>5.4 ± 0.4 OUR FIT</b> Error includes scale factor of 1.4.					
<b>5.4 ± 0.4 OUR AVERAGE</b> Error includes scale factor of 1.5.					
5.25 ± 0.13 ± 0.25		3k	SHEN	16	BELL $e^+ e^- \rightarrow J/\psi X$
6.4 ± 0.4 ± 0.6		730	BRIERE	04	CLEO $e^+ e^- \rightarrow J/\psi X$
11 ± 4 ± 2			<sup>1</sup> FULTON	89	CLEO $e^+ e^- \rightarrow \mu^+ \mu^- X$

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

<6.8	90	ALBRECHT	92J	ARG	$e^+ e^- \rightarrow e^+ e^- X,$ $\mu^+ \mu^- X$
<17	90	MASCHMANN	90	CBAL	$e^+ e^- \rightarrow \text{hadrons}$
<200	90	NICZYPORUK	83	LENA	

<sup>1</sup> Using  $B((J/\psi) \rightarrow \mu^+ \mu^-) = (6.9 \pm 0.9)\%$ .

**$\Gamma(J/\psi(1S)\eta_c)/\Gamma_{\text{total}}$   $\Gamma_8/\Gamma$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;2.2 × 10<sup>-6</sup></b>	90	YANG	14	BELL $e^+ e^- \rightarrow J/\psi X$

**$\Gamma(J/\psi(1S)\chi_{c0})/\Gamma_{\text{total}}$   $\Gamma_9/\Gamma$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;3.4 × 10<sup>-6</sup></b>	90	YANG	14	BELL $e^+ e^- \rightarrow J/\psi X$

**$\Gamma(J/\psi(1S)\chi_{c1})/\Gamma_{\text{total}}$   $\Gamma_{10}/\Gamma$**

VALUE (units 10 <sup>-6</sup> )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>3.90 ± 1.21 ± 0.23</b>	20	YANG	14	BELL $e^+ e^- \rightarrow J/\psi X$

**$\Gamma(J/\psi(1S)\chi_{c2})/\Gamma_{\text{total}}$   $\Gamma_{11}/\Gamma$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;1.4 × 10<sup>-6</sup></b>	90	YANG	14	BELL $e^+ e^- \rightarrow J/\psi X$

**$\Gamma(J/\psi(1S)\eta_c(2S))/\Gamma_{\text{total}}$   $\Gamma_{12}/\Gamma$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;2.2 × 10<sup>-6</sup></b>	90	YANG	14	BELL $e^+ e^- \rightarrow J/\psi X$

**$\Gamma(J/\psi(1S)\chi(3940))/\Gamma_{\text{total}}$   $\Gamma_{13}/\Gamma$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;5.4 × 10<sup>-6</sup></b>	90	YANG	14	BELL $e^+ e^- \rightarrow J/\psi X$

**$\Gamma(J/\psi(1S)\chi(4160))/\Gamma_{\text{total}}$   $\Gamma_{14}/\Gamma$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;5.4 × 10<sup>-6</sup></b>	90	YANG	14	BELL $e^+ e^- \rightarrow J/\psi X$

**$\Gamma(X(4350) \text{ anything, } X \rightarrow J/\psi(1S)\phi)/\Gamma_{\text{total}}$   $\Gamma_{15}/\Gamma$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;8.1 × 10<sup>-6</sup></b>	90	SHEN	16	BELL $\Upsilon(1S) \rightarrow J/\psi K^+ K^- X$

**$\Gamma(T_{c\bar{c}1}(3900)^\pm \text{ anything, } T_{c\bar{c}1} \rightarrow J/\psi(1S)\pi^\pm)/\Gamma_{\text{total}}$   $\Gamma_{16}/\Gamma$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;1.3 × 10<sup>-5</sup></b>	90	SHEN	16	BELL $\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$

**$\Gamma(T_{c\bar{c}1}(4200)^\pm \text{ anything, } Z_c \rightarrow J/\psi(1S)\pi^\pm)/\Gamma_{\text{total}}$   $\Gamma_{17}/\Gamma$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;6.0 × 10<sup>-5</sup></b>	90	SHEN	16	BELL $\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$



$\Gamma(T_{c\bar{c}1}(4430)^\pm \text{ anything}, T_{c\bar{c}1} \rightarrow J/\psi(1S)\pi^\pm)/\Gamma_{\text{total}}$					$\Gamma_{18}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<4.9 \times 10^{-5}$	90	SHEN	16	BELL	$\Upsilon(1S) \rightarrow J/\psi\pi^\pm X$

$\Gamma(\chi_{cs}^\pm \text{ anything}, X \rightarrow J/\psi K^\pm)/\Gamma_{\text{total}}$					$\Gamma_{19}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<5.7 \times 10^{-6}$	90	SHEN	16	BELL	$\Upsilon(1S) \rightarrow J/\psi K^- X$

$\Gamma(\psi(4230) \text{ anything}, \psi \rightarrow J/\psi(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$					$\Gamma_{20}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<3.8 \times 10^{-5}$	90	SHEN	16	BELL	$\Upsilon(1S) \rightarrow J/\psi\pi^+\pi^- X$

$\Gamma(\psi(4230) \text{ anything}, \psi \rightarrow J/\psi(1S)K^+K^-)/\Gamma_{\text{total}}$					$\Gamma_{21}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<7.5 \times 10^{-6}$	90	SHEN	16	BELL	$\Upsilon(1S) \rightarrow J/\psi K^+ K^- X$

$\Gamma(\chi_{c1}(4140) \text{ anything}, \chi_{c1} \rightarrow J/\psi(1S)\phi)/\Gamma_{\text{total}}$					$\Gamma_{22}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<5.2 \times 10^{-6}$	90	SHEN	16	BELL	$\Upsilon(1S) \rightarrow J/\psi K^+ K^- X$

$\Gamma(\chi_{c0} \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$					$\Gamma_{23}/\Gamma_7$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<7.4$	90	BRIERE	04	CLEO	$e^+e^- \rightarrow J/\psi X$

$\Gamma(\chi_{c1} \text{ anything})/\Gamma_{\text{total}}$					$\Gamma_{24}/\Gamma$
VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT	
<b><math>1.90 \pm 0.35</math> OUR FIT</b>					
<b><math>1.90 \pm 0.43 \pm 0.14</math></b>	215	JIA	17	BELL	$\Upsilon(1S) \rightarrow \gamma J/\psi(1S)$

$\Gamma(\chi_{c1} \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$					$\Gamma_{24}/\Gamma_7$
VALUE	EVTS	DOCUMENT ID	TECN	COMMENT	
<b><math>0.35 \pm 0.07</math> OUR FIT</b>					
<b><math>0.35 \pm 0.08 \pm 0.06</math></b>	$52 \pm 12$	BRIERE	04	CLEO	$e^+e^- \rightarrow J/\psi X$

$\Gamma(\chi_{c1}(1P)\chi_{tetra})/\Gamma_{\text{total}}$					$\Gamma_{25}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<37.8 \times 10^{-6}$	90	<sup>1</sup> JIA	17A	BELL	$e^+e^- \rightarrow \text{hadrons}$

<sup>1</sup> For a tetraquark state  $\chi_{tetra}$ , with mass in the range 1.16–2.46 GeV and width in the range 0–0.3 GeV. Measured 90% CL limits as a function of  $\chi_{tetra}$  mass and width range from  $4.4 \times 10^{-6}$  to  $37.8 \times 10^{-6}$ .

$\Gamma(\chi_{c2} \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$					$\Gamma_{26}/\Gamma_7$
VALUE	EVTS	DOCUMENT ID	TECN	COMMENT	
<b><math>0.52 \pm 0.12 \pm 0.09</math></b>	$47 \pm 11$	BRIERE	04	CLEO	$e^+e^- \rightarrow J/\psi X$

$\Gamma(\psi(2S) \text{ anything})/\Gamma_{\text{total}}$					$\Gamma_{27}/\Gamma$
VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT	
<b><math>1.23 \pm 0.17 \pm 0.11</math></b>	215	SHEN	16	BELL	$e^+e^- \rightarrow \psi(2S) X$

$\Gamma(\psi(2S) \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$					$\Gamma_{27}/\Gamma_7$
<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$0.41 \pm 0.11 \pm 0.08$	$42 \pm 11$	BRIERE	04	CLEO	$e^+ e^- \rightarrow J/\psi \pi^+ \pi^- X$
$\Gamma(\psi(2S)\eta_c)/\Gamma_{\text{total}}$					$\Gamma_{28}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$< 3.6 \times 10^{-6}$	90	YANG	14	BELL	$e^+ e^- \rightarrow \psi(2S) X$
$\Gamma(\psi(2S)\chi_{c0})/\Gamma_{\text{total}}$					$\Gamma_{29}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$< 6.5 \times 10^{-6}$	90	YANG	14	BELL	$e^+ e^- \rightarrow \psi(2S) X$
$\Gamma(\psi(2S)\chi_{c1})/\Gamma_{\text{total}}$					$\Gamma_{30}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$< 4.5 \times 10^{-6}$	90	YANG	14	BELL	$e^+ e^- \rightarrow \psi(2S) X$
$\Gamma(\psi(2S)\chi_{c2})/\Gamma_{\text{total}}$					$\Gamma_{31}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$< 2.1 \times 10^{-6}$	90	YANG	14	BELL	$e^+ e^- \rightarrow \psi(2S) X$
$\Gamma(\psi(2S)\eta_c(2S))/\Gamma_{\text{total}}$					$\Gamma_{32}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$< 3.2 \times 10^{-6}$	90	YANG	14	BELL	$e^+ e^- \rightarrow \psi(2S) X$
$\Gamma(\psi(2S)X(3940))/\Gamma_{\text{total}}$					$\Gamma_{33}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$< 2.9 \times 10^{-6}$	90	YANG	14	BELL	$e^+ e^- \rightarrow \psi(2S) X$
$\Gamma(\psi(2S)X(4160))/\Gamma_{\text{total}}$					$\Gamma_{34}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$< 2.9 \times 10^{-6}$	90	YANG	14	BELL	$e^+ e^- \rightarrow \psi(2S) X$
$\Gamma(\psi(4230) \text{ anything}, \psi \rightarrow \psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$					$\Gamma_{35}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$< 7.9 \times 10^{-5}$	90	SHEN	16	BELL	$\Upsilon(1S) \rightarrow \psi(2S)\pi^+\pi^- X$
$\Gamma(\psi(4360) \text{ anything}, \psi \rightarrow \psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$					$\Gamma_{36}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$< 5.2 \times 10^{-5}$	90	SHEN	16	BELL	$\Upsilon(1S) \rightarrow \psi(2S)\pi^+\pi^- X$
$\Gamma(\psi(4660) \text{ anything}, \psi \rightarrow \psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$					$\Gamma_{37}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$< 2.2 \times 10^{-5}$	90	SHEN	16	BELL	$\Upsilon(1S) \rightarrow \psi(2S)\pi^+\pi^- X$
$\Gamma(T_{c\bar{c}}(4050)^\pm \text{ anything}, X \rightarrow \psi(2S)\pi^\pm)/\Gamma_{\text{total}}$					$\Gamma_{38}/\Gamma$
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
$< 8.8 \times 10^{-5}$	90	SHEN	16	BELL	$\Upsilon(1S) \rightarrow \psi(2S)\pi^\pm X$

$\Gamma(T_{c\bar{c}1}(4430)^\pm \text{ anything}, T_{c\bar{c}1} \rightarrow \psi(2S)\pi^\pm)/\Gamma_{\text{total}}$					$\Gamma_{39}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<6.7 \times 10^{-5}$	90	SHEN	16	BELL	$\Upsilon(1S) \rightarrow \psi(2S)\pi^\pm X$

$\Gamma(\chi_{c1}(3872)\text{ anything})/\Gamma_{\text{total}}$					$\Gamma_{40}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<2.7 \times 10^{-4}$	90	<sup>1</sup> SHEN	16	BELL	$\Upsilon(1S) \rightarrow J/\psi \pi^+ \pi^- X$

<sup>1</sup> SHEN 16 reports  $[\Gamma(\Upsilon(1S) \rightarrow \chi_{c1}(3872)\text{ anything})/\Gamma_{\text{total}}] \times [B(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi(1S))] < 9.5 \times 10^{-6}$  which we divide by our best value  $B(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi(1S)) = 3.5 \times 10^{-2}$ .

$\Gamma(T_{c\bar{c}1}(4200)^+ T_{c\bar{c}1}(4200)^-)/\Gamma_{\text{total}}$					$\Gamma_{41}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<22.3 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL	$\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$

<sup>1</sup> Assuming  $B(T_{c\bar{c}1}(4200)^\pm \rightarrow J/\psi \pi^\pm) = 1$ .

$\Gamma(T_{c\bar{c}1}(3900)^\pm T_{c\bar{c}1}(4200)^\mp)/\Gamma_{\text{total}}$					$\Gamma_{42}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<8.1 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL	$\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$

<sup>1</sup> Assuming  $B(T_{c\bar{c}1}(4200)^\pm \rightarrow J/\psi \pi^\pm) = 1 = B(T_{c\bar{c}1}(3900)^\pm \rightarrow J/\psi \pi^\pm)$ .

$\Gamma(T_{c\bar{c}1}(3900)^+ T_{c\bar{c}1}(3900)^-)/\Gamma_{\text{total}}$					$\Gamma_{43}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<1.8 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL	$\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$

<sup>1</sup> Assuming  $B(T_{c\bar{c}1}(3900)^\pm \rightarrow J/\psi \pi^\pm) = 1$

$\Gamma(T_{c\bar{c}}(4050)^+ T_{c\bar{c}}(4050)^-)/\Gamma_{\text{total}}$					$\Gamma_{44}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<15.8 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL	$\Upsilon(1S) \rightarrow \chi_{c1}(1P)\pi^\pm X$

<sup>1</sup> Assuming  $B(T_{c\bar{c}}(4050)^\pm \rightarrow \chi_{c1}(1P)\pi^\pm) = 1$

$\Gamma(T_{c\bar{c}}(4250)^+ T_{c\bar{c}}(4250)^-)/\Gamma_{\text{total}}$					$\Gamma_{45}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<26.6 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL	$\Upsilon(1S) \rightarrow \chi_{c1}(1P)\pi^\pm X$

<sup>1</sup> Assuming  $B(T_{c\bar{c}}(4250)^\pm \rightarrow \chi_{c1}(1P)\pi^\pm) = 1$

$\Gamma(T_{c\bar{c}}(4050)^\pm T_{c\bar{c}}(4250)^\mp)/\Gamma_{\text{total}}$					$\Gamma_{46}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<44.2 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL	$\Upsilon(1S) \rightarrow \chi_{c1}(1P)\pi^\pm X$

<sup>1</sup> Assuming  $B(T_{c\bar{c}}(4050)^\pm \rightarrow \chi_{c1}(1P)\pi^\pm) = 1 = B(T_{c\bar{c}}(4250)^\pm \rightarrow \chi_{c1}(1P)\pi^\pm)$

$\Gamma(T_{c\bar{c}1}(4430)^+ T_{c\bar{c}1}(4430)^-)/\Gamma_{\text{total}}$					$\Gamma_{47}/\Gamma$
VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
$<20.3 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL	$\Upsilon(2S) \rightarrow \psi(2S)\pi^\pm X$

<sup>1</sup> Assuming  $B(T_{c\bar{c}1}(4430)^\pm \rightarrow \psi(2S)\pi^\pm) = 1$

$\Gamma(T_{c\bar{c}}(4055)^\pm T_{c\bar{c}}(4055)^\mp)/\Gamma_{\text{total}}$   $\Gamma_{48}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<23.3 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL $\Upsilon(1S) \rightarrow \psi(2S)\pi^\pm X$

<sup>1</sup> Assuming  $B(T_{c\bar{c}}(4055)^\pm \rightarrow \psi(2S)\pi^\pm) = 1$

$\Gamma(T_{c\bar{c}}(4055)^\pm T_{c\bar{c}1}(4430)^\mp)/\Gamma_{\text{total}}$   $\Gamma_{49}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<45.5 \times 10^{-6}$	90	<sup>1</sup> JIA	18	BELL $\Upsilon(1S) \rightarrow \psi(2S)\pi^\pm X$

<sup>1</sup> Assuming  $B(T_{c\bar{c}}(4055)^\pm \rightarrow \psi(2S)\pi^\pm) = 1 = B(T_{c\bar{c}1}(4430)^\pm \rightarrow \psi(2S)\pi^\pm)$

$\Gamma(\rho\pi)/\Gamma_{\text{total}}$   $\Gamma_{50}/\Gamma$

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;3.68</b>	90	SHEN	13	BELL $\Upsilon(1S) \rightarrow \pi^+\pi^-\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<1 \times 10^3$	90	BLINOV	90	MD1 $\Upsilon(1S) \rightarrow \rho^0\pi^0$
$<2 \times 10^2$	90	FULTON	90B	$\Upsilon(1S) \rightarrow \rho^0\pi^0$
$<2.1 \times 10^3$	90	NICZYPORUK	83	LENA $\Upsilon(1S) \rightarrow \rho^0\pi^0$

$\Gamma(\omega\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{51}/\Gamma$

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;3.90</b>	90	SHEN	13	BELL $\Upsilon(1S) \rightarrow \pi^+\pi^-\pi^0\pi^0$

$\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{52}/\Gamma$

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;5</b>	90	BARU	92	MD1 $\Upsilon(1S) \rightarrow \pi^+\pi^-$

$\Gamma(K^+K^-)/\Gamma_{\text{total}}$   $\Gamma_{53}/\Gamma$

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;5</b>	90	BARU	92	MD1 $\Upsilon(1S) \rightarrow K^+K^-$

$\Gamma(\rho\bar{\rho})/\Gamma_{\text{total}}$   $\Gamma_{54}/\Gamma$

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;5</b>	90	<sup>1</sup> BARU	96	MD1 $\Upsilon(1S) \rightarrow \rho\bar{\rho}$

<sup>1</sup> Supersedes BARU 92 in this node.

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{55}/\Gamma$

VALUE (units $10^{-6}$ )	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>2.14 \pm 0.72 \pm 0.34</math></b>		$26 \pm 9$	SHEN	13	BELL $\Upsilon(1S) \rightarrow \pi^+\pi^-\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<18.4$	90		ANASTASSOV	99	CLE2 $e^+e^- \rightarrow \text{hadrons}$

$\Gamma(\phi K^+K^-)/\Gamma_{\text{total}}$   $\Gamma_{56}/\Gamma$

VALUE (units $10^{-6}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>2.36 \pm 0.37 \pm 0.29</math></b>	56	SHEN	12A	BELL $\Upsilon(1S) \rightarrow 2(K^+K^-)$

$\Gamma(\omega\pi^+\pi^-)/\Gamma_{\text{total}}$					$\Gamma_{57}/\Gamma$
<u>VALUE (units <math>10^{-6}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>4.46±0.67±0.72</b>	64	SHEN	12A BELL	$\Upsilon(1S) \rightarrow 2(\pi^+\pi^-)\pi^0$	
$\Gamma(K^*(892)^0 K^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}$					$\Gamma_{58}/\Gamma$
<u>VALUE (units <math>10^{-6}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>4.42±0.50±0.58</b>	173	SHEN	12A BELL	$\Upsilon(1S) \rightarrow K^+ K^- \pi^+ \pi^-$	
$\Gamma(\phi f'_2(1525))/\Gamma_{\text{total}}$					$\Gamma_{59}/\Gamma$
<u>VALUE (units <math>10^{-6}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>&lt;1.63</b>	90	SHEN	12A BELL	$\Upsilon(1S) \rightarrow 2(K^+ K^-)$	
$\Gamma(\omega f_2(1270))/\Gamma_{\text{total}}$					$\Gamma_{60}/\Gamma$
<u>VALUE (units <math>10^{-6}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>&lt;1.79</b>	90	SHEN	12A BELL	$\Upsilon(1S) \rightarrow 2(\pi^+\pi^-)\pi^0$	
$\Gamma(\rho(770) a_2(1320))/\Gamma_{\text{total}}$					$\Gamma_{61}/\Gamma$
<u>VALUE (units <math>10^{-6}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>&lt;2.24</b>	90	SHEN	12A BELL	$\Upsilon(1S) \rightarrow 2(\pi^+\pi^-)\pi^0$	
$\Gamma(K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.})/\Gamma_{\text{total}}$					$\Gamma_{62}/\Gamma$
<u>VALUE (units <math>10^{-6}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>3.02±0.68±0.34</b>	42	SHEN	12A BELL	$\Upsilon(1S) \rightarrow K^+ K^- \pi^+ \pi^-$	
$\Gamma(K_1(1270)^\pm K^\mp)/\Gamma_{\text{total}}$					$\Gamma_{63}/\Gamma$
<u>VALUE (units <math>10^{-6}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>&lt;2.41</b>	90	SHEN	12A BELL	$\Upsilon(1S) \rightarrow K^+ K^- \pi^+ \pi^-$	
$\Gamma(K_1(1400)^\pm K^\mp)/\Gamma_{\text{total}}$					$\Gamma_{64}/\Gamma$
<u>VALUE (units <math>10^{-6}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>1.02±0.35±0.22</b>	24	SHEN	12A BELL	$\Upsilon(1S) \rightarrow K^+ K^- \pi^+ \pi^-$	
$\Gamma(b_1(1235)^\pm \pi^\mp)/\Gamma_{\text{total}}$					$\Gamma_{65}/\Gamma$
<u>VALUE (units <math>10^{-6}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>&lt;1.25</b>	90	SHEN	12A BELL	$\Upsilon(1S) \rightarrow 2(\pi^+\pi^-)\pi^0$	
$\Gamma(\pi^+\pi^-\pi^0\pi^0)/\Gamma_{\text{total}}$					$\Gamma_{66}/\Gamma$
<u>VALUE (units <math>10^{-6}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	
<b>12.8±2.0±2.3</b>	143 ± 22	SHEN	13 BELL	$\Upsilon(1S) \rightarrow \pi^+\pi^-\pi^0\pi^0$	
$\Gamma(K_S^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$					$\Gamma_{67}/\Gamma$
<u>VALUE (units <math>10^{-6}</math>)</u>	<u>CL%</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1.59±0.33±0.18</b>	37 ± 8	SHEN	13 BELL	$\Upsilon(1S) \rightarrow K_S^0 K^- \pi^+$	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<b>&lt;3.4</b>	90	<sup>1</sup> DOBBS	12A	$\Upsilon(1S) \rightarrow K_S^0 K^- \pi^+$	

<sup>1</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

$\Gamma(K^*(892)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{68}/\Gamma$

VALUE (units $10^{-6}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>2.92 \pm 0.85 \pm 0.37</math></b>	$16 \pm 5$	SHEN	13	BELL $\Upsilon(1S) \rightarrow K_S^0 K^- \pi^+$

$\Gamma(K^*(892)^- K^+ + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{69}/\Gamma$

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;1.11</b>	90	SHEN	13	BELL $\Upsilon(1S) \rightarrow K_S^0 K^- \pi^+$

$\Gamma(f_1(1285) \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{70}/\Gamma$

VALUE (units $10^{-3}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>4.6 \pm 2.8 \pm 1.3</math></b>	3.1k	JIA	17A	BELL $e^+ e^- \rightarrow \text{hadrons}$

$\Gamma(D^*(2010)^\pm \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{71}/\Gamma$

VALUE (units $10^{-3}$ )	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>25.2 \pm 1.3 \pm 1.5</math></b>	$\approx 2k$	<sup>1</sup>	AUBERT	10C	BABR $\Upsilon(2S) \rightarrow \pi^+ \pi^- \Upsilon(1S)$

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

<19	90	<sup>2</sup>	ALBRECHT	92J	ARG $e^+ e^- \rightarrow D^0 \pi^\pm X$
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<sup>1</sup> For  $x_p > 0.1$ .

<sup>2</sup> For  $x_p > 0.2$ .

$\Gamma(f_1(1285) X_{tetra})/\Gamma_{\text{total}}$   $\Gamma_{72}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT	
<b>&lt;62.4 <math>\times 10^{-6}</math></b>	90	<sup>1</sup>	JIA	17A	BELL $e^+ e^- \rightarrow \text{hadrons}$

<sup>1</sup> For a tetraquark state  $X_{tetra}$ , with mass in the range 1.16–2.46 GeV and width in the range 0–0.3 GeV. Measured 90% CL limits as a function of  $X_{tetra}$  mass and width range from  $4.6 \times 10^{-6}$  to  $62.4 \times 10^{-6}$ .

$\Gamma(\bar{2}H \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{73}/\Gamma$

VALUE (units $10^{-5}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>2.85 \pm 0.25</math> OUR AVERAGE</b>				
$2.81 \pm 0.49^{+0.20}_{-0.24}$		LEES	14G	BABR $e^+ e^- \rightarrow \bar{2}H X$
$2.86 \pm 0.19 \pm 0.21$	455	ASNER	07	CLEO $e^+ e^- \rightarrow \bar{2}H X$

$\Gamma(\text{Sum of 100 exclusive modes})/\Gamma_{\text{total}}$   $\Gamma_{74}/\Gamma$

VALUE (units $10^{-2}$ )	DOCUMENT ID	COMMENT
<b><math>1.200 \pm 0.017</math></b>	<sup>1,2</sup> DOBBS	12A $\Upsilon(1S) \rightarrow \text{hadrons}$

<sup>1</sup> DOBBS 12A presents individual exclusive branching fractions or upper limits for 100 modes of four to ten pions, kaons, or protons.

<sup>2</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

$\Gamma(ggg, \gamma gg \rightarrow \bar{d} \text{ anything})/\Gamma(ggg, \gamma gg \rightarrow \text{anything})$

VALUE (units $10^{-5}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>3.36 \pm 0.23 \pm 0.25</math></b>	455	ASNER	07	CLEO $e^+ e^- \rightarrow \bar{d} X$

$\Gamma(\gamma\pi^+\pi^-)/\Gamma_{\text{total}}$		$\Gamma_{75}/\Gamma$		
<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>6.3 \pm 1.2 \pm 1.3</math></b>		<sup>1</sup> ANASTASSOV 99	CLE2	$e^+e^- \rightarrow$ hadrons
<sup>1</sup> For $m_{\pi\pi} > 1$ GeV.				
$\Gamma(\gamma\pi^0\pi^0)/\Gamma_{\text{total}}$		$\Gamma_{76}/\Gamma$		
<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>1.7 \pm 0.6 \pm 0.3</math></b>		<sup>1</sup> ANASTASSOV 99	CLE2	$e^+e^- \rightarrow$ hadrons
<sup>1</sup> For $m_{\pi\pi} > 1$ GeV.				
$\Gamma(\gamma\pi\pi(\text{S-wave}))/\Gamma_{\text{total}}$		$\Gamma_{77}/\Gamma$		
<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>4.63 \pm 0.56 \pm 0.48</math></b>		LEES 18A	BABR	$\Upsilon(1S) \rightarrow \gamma\pi^+\pi^-$
$\Gamma(\gamma\pi^0\eta)/\Gamma_{\text{total}}$		$\Gamma_{78}/\Gamma$		
<u>VALUE (units <math>10^{-6}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>&lt; 2.4</math></b>	90	<sup>1</sup> BESSON 07A	CLEO	$e^+e^- \rightarrow \Upsilon(1S)$
<sup>1</sup> BESSON 07A obtained this limit for $0.7 < m_{\pi^0\eta} < 3$ GeV.				
$\Gamma(\gamma K^+K^-)/\Gamma_{\text{total}}$ ( $2 < m_{K^+K^-} < 3$ GeV)		$\Gamma_{79}/\Gamma$		
<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>1.14 \pm 0.08 \pm 0.10</math></b>	90	ATHAR 06	CLE3	$\Upsilon(1S) \rightarrow \gamma K^+K^-$
$\Gamma(\gamma p\bar{p})/\Gamma_{\text{total}}$ ( $2 < m_{p\bar{p}} < 3$ GeV)		$\Gamma_{80}/\Gamma$		
<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>&lt; 0.6</math></b>	90	ATHAR 06	CLE3	$\Upsilon(1S) \rightarrow \gamma p\bar{p}$
$\Gamma(\gamma 2h^+2h^-)/\Gamma_{\text{total}}$		$\Gamma_{81}/\Gamma$		
<u>VALUE (units <math>10^{-4}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>7.0 \pm 1.1 \pm 1.0</math></b>	$80 \pm 12$	FULTON 90B	CLEO	$e^+e^- \rightarrow$ hadrons
$\Gamma(\gamma 3h^+3h^-)/\Gamma_{\text{total}}$		$\Gamma_{82}/\Gamma$		
<u>VALUE (units <math>10^{-4}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>5.4 \pm 1.5 \pm 1.3</math></b>	$39 \pm 11$	FULTON 90B	CLEO	$e^+e^- \rightarrow$ hadrons
$\Gamma(\gamma 4h^+4h^-)/\Gamma_{\text{total}}$		$\Gamma_{83}/\Gamma$		
<u>VALUE (units <math>10^{-4}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>7.4 \pm 2.5 \pm 2.5</math></b>	$36 \pm 12$	FULTON 90B	CLEO	$e^+e^- \rightarrow$ hadrons
$\Gamma(\gamma\pi^+\pi^-K^+K^-)/\Gamma_{\text{total}}$		$\Gamma_{84}/\Gamma$		
<u>VALUE (units <math>10^{-4}</math>)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>2.9 \pm 0.7 \pm 0.6</math></b>	$29 \pm 8$	FULTON 90B	CLEO	$e^+e^- \rightarrow$ hadrons

$\Gamma(\gamma 2\pi^+ 2\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{85}/\Gamma$

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>2.5 \pm 0.7 \pm 0.5</math></b>	$26 \pm 7$	FULTON	90B CLEO	$e^+ e^- \rightarrow$ hadrons

$\Gamma(\gamma 3\pi^+ 3\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{86}/\Gamma$

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>2.5 \pm 0.9 \pm 0.8</math></b>	$17 \pm 5$	FULTON	90B CLEO	$e^+ e^- \rightarrow$ hadrons

$\Gamma(\gamma 2\pi^+ 2\pi^- K^+ K^-)/\Gamma_{\text{total}}$   $\Gamma_{87}/\Gamma$

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>2.4 \pm 0.9 \pm 0.8</math></b>	$18 \pm 7$	FULTON	90B CLEO	$e^+ e^- \rightarrow$ hadrons

$\Gamma(\gamma \pi^+ \pi^- \rho \bar{\rho})/\Gamma_{\text{total}}$   $\Gamma_{88}/\Gamma$

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>1.5 \pm 0.5 \pm 0.3</math></b>	$22 \pm 6$	FULTON	90B CLEO	$e^+ e^- \rightarrow$ hadrons

$\Gamma(\gamma 2\pi^+ 2\pi^- \rho \bar{\rho})/\Gamma_{\text{total}}$   $\Gamma_{89}/\Gamma$

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>0.4 \pm 0.4 \pm 0.4</math></b>	$7 \pm 6$	FULTON	90B CLEO	$e^+ e^- \rightarrow$ hadrons

$\Gamma(\gamma 2K^+ 2K^-)/\Gamma_{\text{total}}$   $\Gamma_{90}/\Gamma$

VALUE (units $10^{-4}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>0.2 \pm 0.2</math></b>	$2 \pm 2$	FULTON	90B CLEO	$e^+ e^- \rightarrow$ hadrons

$\Gamma(\gamma \eta'(958))/\Gamma_{\text{total}}$   $\Gamma_{91}/\Gamma$

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 1.9</math></b>	90	ATHAR 07A	CLEO	$\Upsilon(1S) \rightarrow \gamma \eta' \rightarrow \gamma \pi^+ \pi^- \eta, \gamma \rho$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$< 16$	90	RICHICHI 01B	CLE2	$\Upsilon(1S) \rightarrow \gamma \eta' \rightarrow \gamma \eta \pi^+ \pi^-$

$\Gamma(\gamma \eta)/\Gamma_{\text{total}}$   $\Gamma_{92}/\Gamma$

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 1.0</math></b>	90	ATHAR 07A	CLEO	$\Upsilon(1S) \rightarrow \gamma \eta \rightarrow \gamma \gamma \gamma, \gamma \pi^+ \pi^- \pi^0, \gamma 3\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$< 21$	90	MASEK 02	CLEO	$\Upsilon(1S) \rightarrow \gamma \eta$

$\Gamma(\gamma f_0(980))/\Gamma_{\text{total}}$   $\Gamma_{93}/\Gamma$

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 3</math></b>	90	<sup>1</sup> ATHAR 06	CLE3	$\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$

<sup>1</sup> Assuming  $B(f_0(980) \rightarrow \pi \pi) = 1$ .



**$\Gamma(\gamma f'_2(1525))/\Gamma_{\text{total}}$**   **$\Gamma_{94}/\Gamma$**

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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**2.9 ± 0.6 OUR AVERAGE**

2.13 ± 0.28 ± 0.72			<sup>1</sup> LEES	18A BABR	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
4.0 ± 1.4 ± 0.1		17	<sup>2</sup> BESSON	11 CLEO	$\Upsilon(1S) \rightarrow K_S^0 K_S^0$
3.7 $^{+0.9}_{-0.7}$ ± 0.8			ATHAR	06 CLE3	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$

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

<14	90		<sup>3</sup> FULTON	90B CLEO	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
<19.4	90		<sup>3</sup> ALBRECHT	89 ARG	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$

<sup>1</sup> Using  $B(f'_2(1525) \rightarrow K\bar{K}) = 0.887 \pm 0.022$  and  $B(K^0\bar{K}^0) = 1/2 B(K\bar{K})$ .

<sup>2</sup> BESSON 11 reports  $(4.0 \pm 1.3 \pm 0.6) \times 10^{-5}$  from a measurement of  $[\Gamma(\Upsilon(1S) \rightarrow \gamma f'_2(1525))/\Gamma_{\text{total}}] \times [B(f'_2(1525) \rightarrow K\bar{K})]$  assuming  $B(f'_2(1525) \rightarrow K\bar{K}) = (88.8 \pm 3.1) \times 10^{-2}$ , which we rescale to our best value  $B(f'_2(1525) \rightarrow K\bar{K}) = (88.8 \pm 2.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. The result also assumes  $B(K_S^0 \rightarrow \pi^+\pi^-) = (69.20 \pm 0.05)\%$  and  $B(f'_2(1525) \rightarrow K\bar{K}) = 4 B(f'_2(1525) \rightarrow K_S^0 K_S^0)$ .

<sup>3</sup> Assuming  $B(f'_2(1525) \rightarrow K\bar{K}) = 0.71$ .

**$\Gamma(\gamma f_2(1270))/\Gamma_{\text{total}}$**   **$\Gamma_{95}/\Gamma$**

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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**10.1 ± 0.6 OUR AVERAGE**

10.15 ± 0.59 $^{+0.54}_{-0.43}$			<sup>1</sup> LEES	18A BABR	$\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$
10.5 ± 1.6 $^{+1.9}_{-1.8}$			<sup>2</sup> BESSON	07A CLE3	$\Upsilon(1S) \rightarrow \gamma \pi^0 \pi^0$
10.2 ± 0.8 ± 0.7			ATHAR	06 CLE3	$\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$
8.1 ± 2.3 $^{+2.9}_{-2.7}$			<sup>3</sup> ANASTASSOV	99 CLE2	$e^+ e^- \rightarrow \text{hadrons}$

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

<21	90		<sup>3</sup> FULTON	90B CLEO	$\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$
<13	90		<sup>3</sup> ALBRECHT	89 ARG	$\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$
<81	90		SCHMITT	88 CBAL	$\Upsilon(1S) \rightarrow \gamma X$

<sup>1</sup> Using  $B(f_2(1270) \rightarrow \pi^0 \pi^0) = 1/3 B(f_2(1270) \rightarrow \pi\pi)$  and  $B(f_2(1270) \rightarrow \pi\pi) = (84.2  $^{+2.9}_{-0.9}$ )\%$ .

<sup>2</sup> Using  $B(f_2(1270) \rightarrow \pi^0 \pi^0) = B(f_2(1270) \rightarrow \pi\pi)/3$  and  $B(f_2(1270) \rightarrow \pi\pi) = (84.7  $^{+2.5}_{-1.2}$ )\%$ .

<sup>3</sup> Using  $B(f_2(1270) \rightarrow \pi\pi) = 0.84$ .

**$\Gamma(\gamma \eta(1405))/\Gamma_{\text{total}}$**   **$\Gamma_{96}/\Gamma$**

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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**<8.2** 90 <sup>1</sup> FULTON 90B CLEO  $\Upsilon(1S) \rightarrow \gamma K^\pm \pi^\mp K_S^0$

<sup>1</sup> Includes unknown branching ratio of  $\eta(1405) \rightarrow K^\pm \pi^\mp K_S^0$ .

**$\Gamma(\gamma f_0(1500))/\Gamma_{\text{total}}$**   **$\Gamma_{97}/\Gamma$**

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;1.5</b>	90	<sup>1</sup> BESSON	07A CLEO	$e^+e^- \rightarrow \Upsilon(1S) \rightarrow \gamma\pi^0\pi^0$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<6.1	90	<sup>2</sup> BESSON	07A CLEO	$e^+e^- \rightarrow \Upsilon(1S) \rightarrow \gamma\eta\eta$
<sup>1</sup> Using $B(f_0(1500) \rightarrow \pi^0\pi^0) = B(f_0(1500) \rightarrow \pi\pi)/3$ and $B(f_0(1500) \rightarrow \pi\pi) = (0.349 \pm 0.023)\%$ .				
<sup>2</sup> Calculated by us using $B(f_0(1500) \rightarrow \eta\eta) = (5.1 \pm 0.9)\%$ .				

**$\Gamma(\gamma f_0(1500) \rightarrow \gamma K^+ K^-)/\Gamma_{\text{total}}$**   **$\Gamma_{98}/\Gamma$**

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>1.04 \pm 0.14 \pm 0.33</math></b>	<sup>1</sup> LEES	18A BABR	$e^+e^- \rightarrow \Upsilon(1S) \rightarrow \gamma K^+ K^-$
<sup>1</sup> LEES 18A quotes $B(\Upsilon(1S) \rightarrow \gamma f_0(1500) \rightarrow \gamma K\bar{K}) = (2.08 \pm 0.27 \pm 0.65) \times 10^{-5}$ assuming $B(K^0\bar{K}^0) = 1/2 B(K\bar{K})$ .			

**$\Gamma(\gamma f_0(1710))/\Gamma_{\text{total}}$**   **$\Gamma_{99}/\Gamma$**

<u>VALUE (units <math>10^{-4}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt; 2.6</b>	90	<sup>1</sup> ALBRECHT	89 ARG	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 6.3	90	<sup>1</sup> FULTON	90B CLEO	$\Upsilon(1S) \rightarrow \gamma K^+ K^-$
<19	90	<sup>1</sup> FULTON	90B CLEO	$\Upsilon(1S) \rightarrow \gamma K_S^0 K_S^0$
< 8	90	<sup>2</sup> ALBRECHT	89 ARG	$\Upsilon(1S) \rightarrow \gamma\pi^+\pi^-$
<24	90	<sup>3</sup> SCHMITT	88 CBAL	$\Upsilon(1S) \rightarrow \gamma X$
<sup>1</sup> Assuming $B(f_0(1710) \rightarrow K\bar{K}) = 0.38$ .				
<sup>2</sup> Assuming $B(f_0(1710) \rightarrow \pi\pi) = 0.04$ .				
<sup>3</sup> Assuming $B(f_0(1710) \rightarrow \eta\eta) = 0.18$ .				

**$\Gamma(\gamma f_0(1710) \rightarrow \gamma K^+ K^-)/\Gamma_{\text{total}}$**   **$\Gamma_{100}/\Gamma$**

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>1.01 \pm 0.26 \pm 0.18</math></b>		<sup>1</sup> LEES	18A BABR	$e^+e^- \rightarrow \Upsilon(1S) \rightarrow \gamma K^+ K^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.7	90	ATHAR	06 CLEO	$e^+e^- \rightarrow \Upsilon(1S) \rightarrow \gamma K^+ K^-$
<sup>1</sup> LEES 18A quotes $B(\Upsilon(1S) \rightarrow \gamma f_0(1710) \rightarrow \gamma K\bar{K}) = (2.02 \pm 0.51 \pm 0.35) \times 10^{-5}$ assuming $B(K^0\bar{K}^0) = 1/2 B(K\bar{K})$ .				

**$\Gamma(\gamma f_0(1710) \rightarrow \gamma\pi^+\pi^-)/\Gamma_{\text{total}}$**   **$\Gamma_{101}/\Gamma$**

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>0.53 \pm 0.17 \pm 0.11</math></b>	<sup>1</sup> LEES	18A BABR	$\Upsilon(1S) \rightarrow \gamma\pi^+\pi^-$
<sup>1</sup> LEES 18A quotes $B(\Upsilon(1S) \rightarrow \gamma f_0(1710) \rightarrow \gamma\pi\pi) = (0.79 \pm 0.26 \pm 0.17) \times 10^{-5}$ assuming $B(\pi^0\pi^0) = 1/3 B(\pi\pi)$ .			

**$\Gamma(\gamma f_0(1710) \rightarrow \gamma\pi^0\pi^0)/\Gamma_{\text{total}}$**   **$\Gamma_{102}/\Gamma$**

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt;1.4</b>	90	BESSON	07A CLEO	$e^+e^- \rightarrow \Upsilon(1S) \rightarrow \gamma\pi^0\pi^0$

$\Gamma(\gamma f_0(1710) \rightarrow \gamma \eta \eta) / \Gamma_{\text{total}}$   $\Gamma_{103} / \Gamma$

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<1.8	90	BESSON	07A	CLEO $e^+ e^- \rightarrow \Upsilon(1S) \rightarrow \gamma \eta \eta$

$\Gamma(\gamma f_4(2050)) / \Gamma_{\text{total}}$   $\Gamma_{104} / \Gamma$

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<5.3	90	<sup>1</sup> ATHAR	06	CLE3 $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$

<sup>1</sup> Assuming  $B(f_4(2050) \rightarrow \pi \pi) = 0.17$ .

$\Gamma(\gamma f_0(2200) \rightarrow \gamma K^+ K^-) / \Gamma_{\text{total}}$   $\Gamma_{105} / \Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.0002	90	BARU	89	MD1 $\Upsilon(1S) \rightarrow \gamma K^+ K^-$

$\Gamma(\gamma f_J(2220) \rightarrow \gamma K^+ K^-) / \Gamma_{\text{total}}$   $\Gamma_{106} / \Gamma$

VALUE (units $10^{-7}$ )	CL%	DOCUMENT ID	TECN	COMMENT
< 8	90	ATHAR	06	CLE3 $\Upsilon(1S) \rightarrow \gamma K^+ K^-$

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

< 160	90	MASEK	02	CLEO $\Upsilon(1S) \rightarrow \gamma K^+ K^-$
< 150	90	FULTON	90B	CLEO $\Upsilon(1S) \rightarrow \gamma K^+ K^-$
< 290	90	ALBRECHT	89	ARG $\Upsilon(1S) \rightarrow \gamma K^+ K^-$
<2000	90	BARU	89	MD1 $\Upsilon(1S) \rightarrow \gamma K^+ K^-$

$\Gamma(\gamma f_J(2220) \rightarrow \gamma \pi^+ \pi^-) / \Gamma_{\text{total}}$   $\Gamma_{107} / \Gamma$

VALUE (units $10^{-7}$ )	CL%	DOCUMENT ID	TECN	COMMENT
< 6	90	ATHAR	06	CLE3 $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$

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

<120	90	MASEK	02	CLEO $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$
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$\Gamma(\gamma f_J(2220) \rightarrow \gamma p \bar{p}) / \Gamma_{\text{total}}$   $\Gamma_{108} / \Gamma$

VALUE (units $10^{-7}$ )	CL%	DOCUMENT ID	TECN	COMMENT
< 11	90	ATHAR	06	CLE3 $\Upsilon(1S) \rightarrow \gamma p \bar{p}$

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

<160	90	MASEK	02	CLEO $\Upsilon(1S) \rightarrow \gamma p \bar{p}$
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$\Gamma(\gamma \eta(2225) \rightarrow \gamma \phi \phi) / \Gamma_{\text{total}}$   $\Gamma_{109} / \Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.003	90	BARU	89	MD1 $\Upsilon(1S) \rightarrow \gamma K^+ K^- K^+ K^-$

$\Gamma(\gamma \eta_c(1S)) / \Gamma_{\text{total}}$   $\Gamma_{110} / \Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<2.9 $\times 10^{-5}$	90	<sup>1</sup> KATRENKO	20	BELL $e^+ e^- \rightarrow \gamma + \text{hadrons}$

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

<5.7 $\times 10^{-5}$	90	SHEN	10A	BELL $\Upsilon(1S) \rightarrow \gamma X$
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<sup>1</sup> Using  $\Upsilon(2S) \rightarrow \Upsilon(1S) \pi^+ \pi^-$  decays.

**$\Gamma(\gamma\eta_c(2S))/\Gamma_{\text{total}}$   $\Gamma_{111}/\Gamma$**

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$<4 \times 10^{-4}$	90	<sup>1</sup> KATRENKO 20	BELL	$e^+e^- \rightarrow \gamma + \text{hadrons}$

<sup>1</sup> Using  $\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-$  decays.

**$\Gamma(\gamma\chi_{c0})/\Gamma_{\text{total}}$   $\Gamma_{112}/\Gamma$**

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$<6.6 \times 10^{-5}$	90	<sup>1</sup> KATRENKO 20	BELL	$\Upsilon(1S) \rightarrow \gamma + \text{hadrons}$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<6.5 \times 10^{-4}$	90	SHEN 10A	BELL	$\Upsilon(1S) \rightarrow \gamma X$

<sup>1</sup> Using  $\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-$  decays.

**$\Gamma(\gamma\chi_{c1})/\Gamma_{\text{total}}$   $\Gamma_{113}/\Gamma$**

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>CL%</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$4.7^{+2.4+0.4}_{-1.8-0.5}$	5		<sup>1</sup> KATRENKO 20	BELL	$\Upsilon(1S) \rightarrow \gamma + \text{hadrons}$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<2.3$	90		SHEN 10A	BELL	$\Upsilon(1S) \rightarrow \gamma X$

<sup>1</sup> Using  $\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-$  decays.

**$\Gamma(\gamma\chi_{c2})/\Gamma_{\text{total}}$   $\Gamma_{114}/\Gamma$**

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$<7.6 \times 10^{-6}$	90	SHEN 10A	BELL	$\Upsilon(1S) \rightarrow \gamma X$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<3.3 \times 10^{-5}$	90	<sup>1</sup> KATRENKO 20	BELL	$\Upsilon(1S) \rightarrow \gamma + \text{hadrons}$

<sup>1</sup> Using  $\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-$  decays.

**$\Gamma(\gamma\chi_{c1}(3872))/\Gamma_{\text{total}}$   $\Gamma_{115}/\Gamma$**

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$<5 \times 10^{-5}$	90	<sup>1</sup> SHEN 10A	BELL	$\Upsilon(1S) \rightarrow \gamma X$

<sup>1</sup> SHEN 10A reports  $[\Gamma(\Upsilon(1S) \rightarrow \gamma\chi_{c1}(3872))/\Gamma_{\text{total}}] \times [B(\chi_{c1}(3872) \rightarrow \pi^+\pi^- J/\psi(1S))] < 1.6 \times 10^{-6}$  which we divide by our best value  $B(\chi_{c1}(3872) \rightarrow \pi^+\pi^- J/\psi(1S)) = 3.5 \times 10^{-2}$ .

**$\Gamma(\gamma\chi_{c1}(3872), \chi_{c1} \rightarrow \pi^+\pi^-\pi^0 J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{116}/\Gamma$**

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$<2.8 \times 10^{-6}$	90	SHEN 10A	BELL	$\Upsilon(1S) \rightarrow \gamma X$

**$\Gamma(\gamma\chi_{c0}(3915) \rightarrow \omega J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{117}/\Gamma$**

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$<3.0$	90	SHEN 10A	BELL	$\Upsilon(1S) \rightarrow \gamma X$

**$\Gamma(\gamma\chi_{c1}(4140) \rightarrow \phi J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{118}/\Gamma$**

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$<2.2$	90	SHEN 10A	BELL	$\Upsilon(1S) \rightarrow \gamma X$

**$\Gamma(\gamma X \bar{X}(m_X < 3.1 \text{ GeV}))/\Gamma_{\text{total}}$**   **$\Gamma_{119}/\Gamma$**   
 ( $X \bar{X}$  = vectors with  $m < 3.1 \text{ GeV}$ )

VALUE (units $10^{-3}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;1</b>	90	<sup>1</sup> BALEST 95	CLEO	$e^+ e^- \rightarrow \gamma + X \bar{X}$

<sup>1</sup> For a noninteracting vector  $X$  with mass  $< 3.1 \text{ GeV}$ .

**$\Gamma(\gamma X \bar{X}(m_X < 4.5 \text{ GeV}))/\Gamma_{\text{total}}$**   **$\Gamma_{120}/\Gamma$**   
 ( $X$  and  $\bar{X}$  = zero spin with  $m < 4.5 \text{ GeV}$ )

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;24</b>	90	<sup>1</sup> DEL-AMO-SA..11J	BABR	$e^+ e^- \rightarrow \gamma + X \bar{X}$

<sup>1</sup> For a noninteracting scalar  $X$  with mass  $m < 4.5 \text{ GeV}$ .

**$\Gamma(\gamma X \rightarrow \gamma + \geq 4 \text{ prongs})/\Gamma_{\text{total}}$**   **$\Gamma_{121}/\Gamma$**   
 ( $1.5 \text{ GeV} < m_X < 5.0 \text{ GeV}$ )

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;1.78</b>	95	ROSNER 07A	CLEO	$e^+ e^- \rightarrow \gamma X$

**$\Gamma(\gamma A^0)/\Gamma_{\text{total}}$**   **$\Gamma_{122}/\Gamma$**   
 ( $A^0$  = scalar with  $m < 8.0 \text{ GeV}$ )

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<4.5 \times 10^{-6}$	90	<sup>1</sup> DEL-AMO-SA..11J	BABR	$e^+ e^- \rightarrow \gamma + X$
$<3 \times 10^{-5}$	90	<sup>2</sup> BALEST 95	CLEO	$e^+ e^- \rightarrow \gamma + X$
$<5.6 \times 10^{-5}$	90	<sup>2</sup> ANTREASYAN 90C	CBAL	$e^+ e^- \rightarrow \gamma + X$

<sup>1</sup> For a non-interacting scalar or pseudoscalar,  $A^0$ , with mass  $m_{A^0} < 8.0 \text{ GeV}$ . 90% CL upper limits range from  $1.9 \times 10^{-6}$  to  $4.5 \times 10^{-6}$ .

<sup>2</sup> For any non-interacting long-lived particle with mass  $< 7.2 \text{ GeV}$ .

**$\Gamma(\gamma A^0 \rightarrow \gamma \mu^+ \mu^-)/\Gamma_{\text{total}}$**   **$\Gamma_{123}/\Gamma$**   
 ( $201 < M(\mu^+ \mu^-) < 3565 \text{ MeV}$ )

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt; 9</b>	90	<sup>1</sup> LOVE 08	CLEO	$e^+ e^- \rightarrow \gamma A^0 \rightarrow \gamma \mu^+ \mu^-$

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

$<16$	90	<sup>2</sup> JIA 22	BELL	$\Upsilon(2S) \rightarrow \gamma \mu^+ \mu^- \pi^+ \pi^-$
$< 9.7$	90	<sup>3</sup> LEES 13C	BABR	$e^+ e^- \rightarrow \gamma A^0 \rightarrow \gamma \mu^+ \mu^-$

<sup>1</sup> For a narrow scalar or pseudoscalar,  $A^0$ , with  $201 < M(\mu^+ \mu^-) < 3565 \text{ MeV}$ , excluding  $J/\psi$ . Measured 90% CL limits as a function of  $M(\mu^+ \mu^-)$  range from  $1-9 \times 10^{-6}$ .

<sup>2</sup> For a narrow scalar or pseudoscalar,  $A^0$ , with  $0.22 < M(A^0) < 9.2 \text{ GeV}$ , resulting in 90% CL upper limits ranging from  $3.1 \times 10^{-7}$  at  $M(A^0) = 0.22 \text{ GeV}$  to  $1.6 \times 10^{-5}$  at  $M(A^0) = 9.2 \text{ GeV}$ .

<sup>3</sup> For a narrow scalar or pseudoscalar,  $A^0$ , with mass in the range  $0.212-9.2 \text{ GeV}$ , excluding  $J/\psi$  and  $\psi(2S)$ . Measured 90% CL limits as a function of  $m_{A^0}$  are in the range  $0.28-9.7 \times 10^{-6}$ .

$\Gamma(\gamma A^0 \rightarrow \gamma \tau^+ \tau^-) / \Gamma_{\text{total}}$   $\Gamma_{124} / \Gamma$   
 ( $2m_\tau < M(\tau^+ \tau^-) < 9.2 \text{ GeV}$ )

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;130</b>	90	<sup>1</sup> LEES	13R BABR	$\Upsilon(2S) \rightarrow \gamma \tau^+ \tau^- \pi^+ \pi^-$
<150	90	<sup>2</sup> JIA	22 BELL	$\Upsilon(2S) \rightarrow \gamma \tau^+ \tau^- \pi^+ \pi^-$
< 50	90	<sup>3</sup> LOVE	08 CLEO	$e^+ e^- \rightarrow \gamma A^0 \rightarrow \gamma \tau^+ \tau^-$

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

<sup>1</sup> For a narrow scalar or pseudoscalar,  $A^0$ , with  $2m_\tau < M(A^0) < 9.2 \text{ GeV}$ , resulting in 90% CL upper limits of  $0.9 \times 10^{-5}$  at  $M(A^0) = 2m_\tau$ ,  $\approx 1.5 \times 10^{-5}$  at  $M(A^0) = 7.5 \text{ GeV}$ , and  $13 \times 10^{-5}$  at  $M(A^0) = 9.2 \text{ GeV}$ .

<sup>2</sup> For a narrow scalar or pseudoscalar,  $A^0$ , with  $2m_\tau < M(A^0) < 9.2 \text{ GeV}$ , resulting in 90% CL upper limits ranging from  $3.8 \times 10^{-6}$  at  $M(A^0) = 2m_\tau$  to  $1.5 \times 10^{-4}$  at  $M(A^0) = 9.2 \text{ GeV}$ .

<sup>3</sup> For a narrow scalar or pseudoscalar,  $A^0$ , with  $2m_\tau < M(A^0) < 7.5 \text{ GeV}$ , resulting in 90% CL limits ranging from  $1 \times 10^{-5}$  at  $M(A^0) = 2m_\tau$  to  $5 \times 10^{-5}$  at  $M(A^0) = 7.5 \text{ GeV}$ .

$\Gamma(\gamma A^0 \rightarrow \gamma g g) / \Gamma_{\text{total}}$   $\Gamma_{125} / \Gamma$   
 ( $0.5 \text{ GeV} < m < 9.0 \text{ GeV}$ )

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;1 × 10<sup>-2</sup></b>	90	<sup>1</sup> LEES	13L BABR	$\Upsilon(1S) \rightarrow \gamma X$

<sup>1</sup> For a narrow,  $CP$ -odd pseudoscalar,  $A^0$ , searched for in 26 hadronic decay modes with invariant mass  $0.5 \text{ GeV} < m_{A^0} < 9.0 \text{ GeV}$ . Measured 90% CL limits as a function of  $m_{A^0}$  range from  $10^{-6}$  to  $10^{-2}$ .

$\Gamma(\gamma A^0 \rightarrow \gamma s \bar{s}) / \Gamma_{\text{total}}$   $\Gamma_{126} / \Gamma$   
 ( $0.5 \text{ GeV} < m < 9.0 \text{ GeV}$ )

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;1 × 10<sup>-3</sup></b>	90	<sup>1</sup> LEES	13L BABR	$\Upsilon(1S) \rightarrow \gamma X$

<sup>1</sup> For a narrow,  $CP$ -odd pseudoscalar,  $A^0$ , searched for in 14 hadronic decay modes with invariant mass  $1.5 \text{ GeV} < m_{A^0} < 9.0 \text{ GeV}$ . Measured 90% CL limits as a function of  $m_{A^0}$  range from  $10^{-5}$  to  $10^{-3}$ .

———— LEPTON FAMILY NUMBER ( $LF$ ) VIOLATING MODES ————

$\Gamma(e^\pm \mu^\mp) / \Gamma_{\text{total}}$   $\Gamma_{127} / \Gamma$

VALUE (units $10^{-7}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;3.9</b>	90	PATRA	22 BELL	$\Upsilon(2S) \rightarrow \pi^+ \pi^- e^\pm \mu^\mp$

$\Gamma(\mu^\pm \tau^\mp) / \Gamma_{\text{total}}$   $\Gamma_{128} / \Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;2.7 × 10<sup>-6</sup></b>	90	PATRA	22 BELL	$\Upsilon(2S) \rightarrow \pi^+ \pi^- \mu^\pm \tau^\mp$

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

<6.0 × 10 <sup>-6</sup>	95	LOVE	08A CLEO	$e^+ e^- \rightarrow \mu^\pm \tau^\mp$
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$\Gamma(e^\pm \tau^\mp) / \Gamma_{\text{total}}$   $\Gamma_{129} / \Gamma$

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;2.7</b>	90	PATRA	22 BELL	$\Upsilon(2S) \rightarrow \pi^+ \pi^- e^\pm \tau^\mp$

$\Gamma(\gamma e^\pm \mu^\mp)/\Gamma_{\text{total}}$   $\Gamma_{130}/\Gamma$

VALUE (units $10^{-7}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<4.2	90	PATRA 22	BELL	$\Upsilon(2S) \rightarrow \pi^+ \pi^- \gamma e^\pm \mu^\mp$

$\Gamma(\gamma \mu^\pm \tau^\mp)/\Gamma_{\text{total}}$   $\Gamma_{131}/\Gamma$

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<6.1	90	PATRA 22	BELL	$\Upsilon(2S) \rightarrow \pi^+ \pi^- \gamma \mu^\pm \tau^\mp$

$\Gamma(\gamma e^\pm \tau^\mp)/\Gamma_{\text{total}}$   $\Gamma_{132}/\Gamma$

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<6.5	90	PATRA 22	BELL	$\Upsilon(2S) \rightarrow \pi^+ \pi^- \gamma e^\pm \tau^\mp$

OTHER DECAYS

$\Gamma(\text{invisible})/\Gamma_{\text{total}}$   $\Gamma_{133}/\Gamma$

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
< 3.0	90	AUBERT 09AX	BABR	$\Upsilon(3S) \rightarrow \pi^+ \pi^- \Upsilon(1S)$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
<39	90	RUBIN 07	CLEO	$\Upsilon(2S) \rightarrow \pi^+ \pi^- \Upsilon(1S)$
<25	90	TAJIMA 07	BELL	$\Upsilon(3S) \rightarrow \pi^+ \pi^- \Upsilon(1S)$

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TAJIMA 07	PRL 98 132001	O. Tajima <i>et al.</i>	(BELLE Collab.)
AQUINES 06A	PR D74 092006	O. Aquines <i>et al.</i>	(CLEO Collab.)
ATHAR 06	PR D73 032001	S.B. Athar <i>et al.</i>	(CLEO Collab.)
BESSON 06A	PR D74 012003	D. Besson <i>et al.</i>	(CLEO Collab.)

ROSNER	06	PRL 96 092003	J.L. Rosner <i>et al.</i>	(CLEO Collab.)
ADAMS	05	PRL 94 012001	G.S. Adams <i>et al.</i>	(CLEO Collab.)
BRIERE	04	PR D70 072001	R.A. Briere <i>et al.</i>	(CLEO Collab.)
ARTUSO	03	PR D67 052003	M. Artuso <i>et al.</i>	(CLEO Collab.)
MASEK	02	PR D65 072002	G. Masek <i>et al.</i>	(CLEO Collab.)
RICHICHI	01B	PRL 87 141801	S.J. Richichi <i>et al.</i>	(CLEO Collab.)
ARTAMONOV	00	PL B474 427	A.S. Artamonov <i>et al.</i>	
ANASTASSOV	99	PRL 82 286	A. Anastassov <i>et al.</i>	(CLEO Collab.)
ALEXANDER	98	PR D58 052004	J.P. Alexander <i>et al.</i>	(CLEO Collab.)
BARU	96	PRPL 267 71	S.E. Baru <i>et al.</i>	(NOVO)
BALEST	95	PR D51 2053	R. Balest <i>et al.</i>	(CLEO Collab.)
CINABRO	94B	PL B340 129	D. Cinabro <i>et al.</i>	(CLEO Collab.)
ALBRECHT	92J	ZPHY C55 25	H. Albrecht <i>et al.</i>	(ARGUS Collab.)
BARU	92	ZPHY C54 229	S.E. Baru <i>et al.</i>	(NOVO)
BARU	92B	ZPHY C56 547	S.E. Baru <i>et al.</i>	(NOVO)
KOBEL	92	ZPHY C53 193	M. Kobel <i>et al.</i>	(Crystal Ball Collab.)
ANTREASYAN	90C	PL B251 204	D. Antreasyan <i>et al.</i>	(Crystal Ball Collab.)
BLINOV	90	PL B245 311	A.E. Blinov <i>et al.</i>	(NOVO)
FULTON	90B	PR D41 1401	R. Fulton <i>et al.</i>	(CLEO Collab.)
MASCHMANN	90	ZPHY C46 555	W.S. Maschmann <i>et al.</i>	(Crystal Ball Collab.)
ALBRECHT	89	ZPHY C42 349	H. Albrecht <i>et al.</i>	(ARGUS Collab.)
ALEXANDER	89	NP B320 45	J.P. Alexander <i>et al.</i>	(LBL, MICH, SLAC)
BARU	89	ZPHY C42 505	S.E. Baru <i>et al.</i>	(NOVO)
CHEN	89B	PR D39 3528	W.Y. Chen <i>et al.</i>	(CLEO Collab.)
FULTON	89	PL B224 445	R. Fulton <i>et al.</i>	(CLEO Collab.)
KAARSBERG	89	PRL 62 2077	T.M. Kaarsberg <i>et al.</i>	(CUSB Collab.)
BUCHMUEL...	88	HE $e^+e^-$ Physics 412	W. Buchmueller, S. Cooper	(HANN, DESY, MIT)
Editors: A. Ali and P. Soeding, World Scientific, Singapore				
JAKUBOWSKI	88	ZPHY C40 49	Z. Jakubowski <i>et al.</i>	(Crystal Ball Collab.) IGJPC
SCHMITT	88	ZPHY C40 199	P. Schmitt <i>et al.</i>	(Crystal Ball Collab.)
ALBRECHT	87	ZPHY C35 283	H. Albrecht <i>et al.</i>	(ARGUS Collab.)
COHEN	87	RMP 59 1121	E.R. Cohen, B.N. Taylor	(RISC, NBS)
BARU	86	ZPHY C30 551	S.E. Baru <i>et al.</i>	(NOVO)
ALBRECHT	85C	PL 154B 452	H. Albrecht <i>et al.</i>	(ARGUS Collab.)
KURAEV	85	SJNP 41 466	E.A. Kuraev, V.S. Fadin	(NOVO)
Translated from YAF 41 733.				
ARTAMONOV	84	PL 137B 272	A.S. Artamonov <i>et al.</i>	(NOVO)
BESSON	84	PR D30 1433	D. Besson <i>et al.</i>	(CLEO Collab.)
GILES	84B	PR D29 1285	R. Giles <i>et al.</i>	(CLEO Collab.)
MACKAY	84	PR D29 2483	W.W. MacKay <i>et al.</i>	(CUSB Collab.)
ANDREWS	83	PRL 50 807	D.E. Andrews <i>et al.</i>	(CLEO Collab.)
GILES	83	PRL 50 877	R. Giles <i>et al.</i>	(HARV, OSU, ROCH, RUTG+)
NICZYPORUK	83	ZPHY C17 197	B. Niczyporuk <i>et al.</i>	(LENA Collab.)
ALBRECHT	82	PL 116B 383	H. Albrecht <i>et al.</i>	(DESY, DORT, HEIDH+)
ARTAMONOV	82	PL 118B 225	A.S. Artamonov <i>et al.</i>	(NOVO)
NICZYPORUK	82	ZPHY C15 299	B. Niczyporuk <i>et al.</i>	(LENA Collab.)
BERGER	80C	PL 93B 497	C. Berger <i>et al.</i>	(PLUTO Collab.)
BOCK	80	ZPHY C6 125	P. Bock <i>et al.</i>	(HEIDP, MPIM, DESY, HAMB)
BERGER	79	ZPHY C1 343	C. Berger <i>et al.</i>	(PLUTO Collab.)