Citation: K. Hagiwara *et al.* (Particle Data Group), Phys. Rev. D **66**, 010001 (2002) and 2003 partial update for edition 2004 (URL: http://pdg.lbl.gov)

$\Upsilon(4S)$ or $\Upsilon(10580)$

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

$\Upsilon(4S)$ MASS

VALUE (GeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
10.5800±0.0035	[1] BEBEK	87	CLEO	$e^+e^- \to$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
10.5774±0.0010	[2] LOVELOCK	85	CUSB	$e^+e^- \to$ hadrons

[1] Reanalysis of BESSON 85.
[2] No systematic error given.

$\Upsilon(4S)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
14 ±5 OUR AVERAGE Error includes scale factor of 1.7.				
10.0±2.8±2.7	[3] ALBRECHT	95E	ARG	$e^+e^- \to$ hadrons
20 ±2 ±4	BESSON	85	CLEO	$e^+e^- \to$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
25 ±2.5	LOVELOCK	85	CUSB	$e^+e^- \to$ hadrons

[3] Using LEYAOUANC 77 parametrization of $\Gamma(s)$.

$\Upsilon(4S)$ DECAY MODES

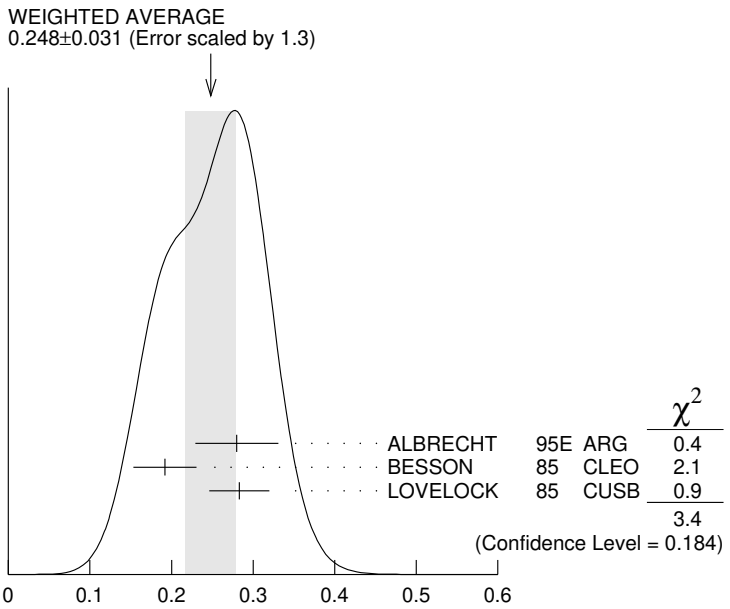
	Mode	Fraction (Γ_i/Γ)		Confidence level
Γ_1	$B\overline{B}$	> 96	%	95%
Γ_2	B^+B^-			
Γ_3	$B^0\overline{B}^0$			
Γ_4	non-$B\overline{B}$	< 4	%	95%
Γ_5	e^+e^-	$(2.8\pm0.7)\times10^{-5}$		
Γ_6	$J/\psi(1S)$anything	< 1.9	$\times10^{-4}$	95%
Γ_7	D^{*+}anything + c.c.	< 7.4	%	90%
Γ_8	ϕanything	< 2.3	$\times10^{-3}$	90%
Γ_9	$\Upsilon(1S)$anything	< 4	$\times10^{-3}$	90%
Γ_{10}	$\Upsilon(1S)\pi^+\pi^-$	< 1.2	$\times10^{-4}$	90%
Γ_{11}	$\Upsilon(2S)\pi^+\pi^-$	< 3.9	$\times10^{-4}$	90%

$\Upsilon(4S)$ PARTIAL WIDTHS

$\Gamma(e^+e^-)$ Γ_5

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.248±0.031 OUR AVERAGE	Error includes scale factor of 1.3. See the ideogram below.			
0.28 ±0.05 ±0.01	[4] ALBRECHT	95E	ARG	$e^+e^- \to$ hadrons
0.192±0.007±0.038	BESSON	85	CLEO	$e^+e^- \to$ hadrons
0.283±0.037	LOVELOCK	85	CUSB	$e^+e^- \to$ hadrons

[4] Using LEYAOUANC 77 parametrization of $\Gamma(s)$.



$\Upsilon(4S)$ BRANCHING RATIOS

$\Gamma(B^+B^-)/\Gamma(B^0\overline{B}^0)$ Γ_2/Γ_3

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
1.04 ±0.07 OUR NEW AVERAGE	[1.02 ± 0.14 OUR 2002 AVERAGE]			
1.041±0.054±0.050	[5] ATHAR	02	CLEO	$e^+e^- \to B\overline{B}$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.02 ±0.14	[6] ALEXANDER	01	CLEO	$e^+e^- \to B\overline{B}$

[5] Using also results from ALEXANDER 01 and assuming $\tau_{B^+}/\tau_{B^0} = 1.074 \pm 0.028$.

[6] Assuming isospin conservation with $(\tau_{B^+})/(\tau_{B^0}) = 1.09^{+0.11}_{-0.10} \pm 0.08$. Superseded by ATHAR 02;

$\Gamma(e^+ e^-)/\Gamma_{total}$ Γ_5/Γ

VALUE (units 10^{-5})		DOCUMENT ID		TECN	COMMENT
2.77±0.50±0.49	[7]	ALBRECHT	95E	ARG	$e^+ e^- \rightarrow$ hadrons

[7] Using LEYAOUANC 77 parametrization of $\Gamma(s)$.

$[\Gamma(D^{*+}\text{anything}) + \Gamma(\text{c.c.})]/\Gamma_{total}$ Γ_7/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.074	90	[8] ALEXANDER	90C	CLEO	$e^+ e^-$

[8] For $x > 0.473$.

$\Gamma(\phi\text{anything})/\Gamma_{total}$ Γ_8/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.0023	90	[9] ALEXANDER	90C	CLEO	$e^+ e^-$

[9] For $x > 0.52$.

$\Gamma(J/\psi(1S)\text{anything})/\Gamma_{total}$ Γ_6/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<1.9	95	[10] ABE	02D	BELL	$e^+ e^- \rightarrow J/\psi X \rightarrow \ell^+ \ell^- X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<4.7	90	[10] AUBERT	01C	BABR	$e^+ e^- \rightarrow J/\psi X \rightarrow \ell^+ \ell^- X$

[10] Uses $B(J/\psi \rightarrow e^+ e^-) = 0.0593 \pm 0.0010$ and $B(J/\psi \rightarrow \mu^+ \mu^-) = 0.0588 \pm 0.0010$.

$\Gamma(\Upsilon(1S)\text{anything})/\Gamma_{total}$ Γ_9/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.004	90	ALEXANDER	90C	CLEO	$e^+ e^-$

$\Gamma(\Upsilon(1S)\pi^+\pi^-)/\Gamma_{total}$ Γ_{10}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<1.2	90	GLENN	99	CLE2	$e^+ e^-$

$\Gamma(\Upsilon(2S)\pi^+\pi^-)/\Gamma_{total}$ Γ_{11}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<3.9	90	GLENN	99	CLE2	$e^+ e^-$

$\Gamma(\text{non-}B\overline{B})/\Gamma_{total}$ Γ_4/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.04	95	BARISH	96B	CLEO	$e^+ e^-$

$\Upsilon(4S)$ REFERENCES

ABE	02D	PRL 88 052001	K. Abe *et al.*	(BELLE Collab.)
ATHAR	02	PR D66 052003	S.B. Athar *et al.*	(CLEO Collab.)
ALEXANDER	01	PRL 86 2737	J.P. Alexander *et al.*	(CLEO Collab.)
AUBERT	01C	PRL 87 162002	B. Aubert *et al.*	(BaBar Collab.)
GLENN	99	PR D59 052003	S. Glenn *et al.*	
BARISH	96B	PRL 76 1570	B.C. Barish *et al.*	(CLEO Collab.)
ALBRECHT	95E	ZPHY C65 619	H. Albrecht *et al.*	(ARGUS Collab.)
ALEXANDER	90C	PRL 64 2226	J. Alexander *et al.*	(CLEO Collab.)
BEBEK	87	PR D36 1289	C. Bebek *et al.*	(CLEO Collab.)
BESSON	85	PRL 54 381	D. Besson *et al.*	(CLEO Collab.)
LOVELOCK	85	PRL 54 377	D.M.J. Lovelock *et al.*	(CUSB Collab.)
LEYAOUANC	77	PL B71 397	A. Le Yaouanc *et al.*	(ORSAY)

OTHER RELATED PAPERS

ABE	01J	PR D64 072001	K. Abe *et al.*	(BELLE Collab.)
HENDERSON	92	PR D45 2212	S. Henderson *et al.*	(CLEO Collab.)
ANDREWS	80B	PRL 45 219	D. Andrews *et al.*	(CLEO Collab.)
FINOCCHI...	80	PRL 45 222	G. Finocchiaro *et al.*	(CUSB Collab.)