NODE=M047

$\Upsilon(4S)$

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

also known as $\Upsilon(10580)$

$\Upsilon(4S)$ MASS

NODE=M047M

NODE=M047M

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
10579.4±1.2 OUR AVERAGE				
10579.3±0.4±1.2	AUBERT	05Q	BABR	$e^+e^- \to$ hadrons
10580.0±3.5	[1] BEBEK	87	CLEO	$e^+e^- \to$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
10577.4±1.0	[2] LOVELOCK	85	CUSB	$e^+e^- \to$ hadrons

[1] Reanalysis of BESSON 85. NODE=M047M;LINKAGE=C

[2] No systematic error given. NODE=M047M;LINKAGE=B

$\Upsilon(4S)$ WIDTH

NODE=M047W

NODE=M047W

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
20.5±2.5 OUR AVERAGE				
20.7±1.6±2.5	AUBERT	05Q	BABR	$e^+e^- \to$ 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

$\Upsilon(4S)$ DECAY MODES

NODE=M047215;NODE=M047

	Mode	Fraction (Γ_i/Γ)	Confidence level	
Γ_1	$B\overline{B}$	> 96 %	95%	DESIG=8;OUR EST;→ UNCHECKED ←
Γ_2	B^+B^-	$(51.1 {+0.7 \atop -1.1})$ %		DESIG=10
Γ_3	D_s^+ anything + c.c.	(17.8 ± 2.6) %		DESIG=12
Γ_4	$B^0\overline{B}^0$	(48.6 ± 0.8) %		DESIG=11
Γ_5	$J/\psi K_S^0 + (J/\psi, \eta_c) K_S^0$	$< 4 \times 10^{-7}$	90%	DESIG=15
Γ_6	non-$B\overline{B}$	$(2.64 {+13.00 \atop -0.20}) \times 10^{-3}$		DESIG=6
Γ_7	e^+e^-	$(1.57 \pm 0.08) \times 10^{-5}$		DESIG=1
Γ_8	$\rho^+\rho^-$	$< 5.7 \times 10^{-6}$	90%	DESIG=16
Γ_9	$K^*(892)^0\overline{K}^0$	$< 2.0 \times 10^{-6}$	90%	DESIG=22
Γ_{10}	$J/\psi(1S)$ anything	$< 1.9 \times 10^{-4}$	95%	DESIG=2
Γ_{11}	D^{*+} anything + c.c.	< 7.4 %	90%	DESIG=3
Γ_{12}	ϕ anything	(7.1 ± 0.6) %		DESIG=4
Γ_{13}	$\phi\eta$	$< 1.8 \times 10^{-6}$	90%	DESIG=13
Γ_{14}	$\phi\eta'$	$< 4.3 \times 10^{-6}$	90%	DESIG=18
Γ_{15}	$\rho\eta$	$< 1.3 \times 10^{-6}$	90%	DESIG=19
Γ_{16}	$\rho\eta'$	$< 2.5 \times 10^{-6}$	90%	DESIG=20
Γ_{17}	$\Upsilon(1S)$ anything	$< 4 \times 10^{-3}$	90%	DESIG=5
Γ_{18}	$\Upsilon(1S)\pi^+\pi^-$	$(8.2 \pm 0.4) \times 10^{-5}$		DESIG=7
Γ_{19}	$\Upsilon(1S)\eta$	$(1.81 \pm 0.18) \times 10^{-4}$		DESIG=17
Γ_{20}	$\Upsilon(1S)\eta'$	$(3.4 \pm 0.9) \times 10^{-5}$		DESIG=26
Γ_{21}	$\Upsilon(2S)\pi^+\pi^-$	$(8.2 \pm 0.8) \times 10^{-5}$		DESIG=9
Γ_{22}	$h_b(1P)\pi^+\pi^-$	not seen		DESIG=21
Γ_{23}	$h_b(1P)\eta$	$(2.18 \pm 0.21) \times 10^{-3}$		DESIG=23
Γ_{24}	$\eta_b(1S)\omega$	$< 1.8 \times 10^{-4}$	90%	DESIG=27
Γ_{25}	${}^2H$ anything	$< 1.3 \times 10^{-5}$	90%	DESIG=14
	Double Radiative Decays			NODE=M047;CLUMP=B
Γ_{26}	$\gamma\gamma\Upsilon(\mathrm{D}) \to \gamma\gamma\eta\Upsilon(1S)$	$< 2.3 \times 10^{-5}$	90%	DESIG=24

$\Upsilon(4S)$ PARTIAL WIDTHS

NODE=M047220

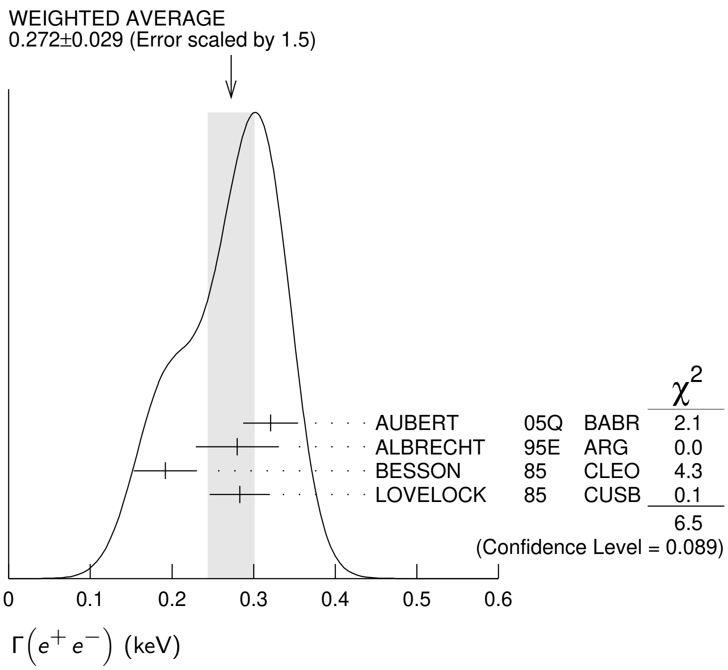
$\Gamma(e^+e^-)$ — Γ_7

NODE=M047W1
NODE=M047W1

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
0.272±0.029 OUR AVERAGE	Error includes scale factor of 1.5. See the ideogram below.			
$0.321\pm0.017\pm0.029$	AUBERT	05Q	BABR	$e^+e^- \to$ hadrons
$0.28\ \pm0.05\ \pm0.01$	[1] ALBRECHT	95E	ARG	$e^+e^- \to$ hadrons
$0.192\pm0.007\pm0.038$	BESSON	85	CLEO	$e^+e^- \to$ hadrons
0.283 ± 0.037	LOVELOCK	85	CUSB	$e^+e^- \to$ hadrons

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

NODE=M047W1;LINKAGE=A



$\Upsilon(4S)$ BRANCHING RATIOS

NODE=M047230

$B\overline{B}$ DECAYS

NODE=M047BBD

$\Gamma(B^+B^-)/\Gamma_{\text{total}}$ — Γ_2/Γ

NODE=M047R11
NODE=M047R11

VALUE	DOCUMENT ID		TECN
$\mathbf{0.5113^{+0.0073}_{-0.0108}}$	[1] BANERJEE	26	RVUE

[1] The quantities $\Gamma(B^+B^-)/\Gamma_{\text{total}}$, $\Gamma(B^0\overline{B}^0)/\Gamma_{\text{total}}$, $\Gamma(B^+B^-)/\Gamma(B^0\overline{B}^0)$ and Γ(non-$B\overline{B})/\Gamma_{\text{total}}$ produced by the Heavy Flavor Averaging Group (HFLAV) are correlated.

NODE=M047R11;LINKAGE=A

$\Gamma(D_s^+ \text{ anything} + \text{c.c.})/\Gamma_{\text{total}}$ — Γ_3/Γ

NODE=M047R13
NODE=M047R13

VALUE	DOCUMENT ID		TECN	COMMENT
0.178±0.021±0.016	[1] ARTUSO	05B	CLE3	$e^+e^- \to D_X X$

[1] ARTUSO 05B reports $[\Gamma(\Upsilon(4S) \to D_s^+ \text{ anything} + \text{ c.c.})/\Gamma_{\text{total}}] \times [B(D_s^+ \to \phi\pi^+)] = (8.0\pm0.2\pm0.9)\times10^{-3}$ which we divide by our best (shown rounded) value $B(D_s^+ \to \phi\pi^+) = (4.5 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

NODE=M047R13;LINKAGE=AR

$\Gamma(B^0\overline{B}^0)/\Gamma_{\text{total}}$ — Γ_4/Γ

NODE=M047R12
NODE=M047R12

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.4861^{+0.0074}_{-0.0080}}$	[1] BANERJEE	26	RVUE	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.487\ \pm0.010\ \pm0.008$	[2] AUBERT,B	05H	BABR	$\Upsilon(4S) \to \overline{B}B \to D^*\ell\nu_\ell$

[1] The quantities $\Gamma(B^+B^-)/\Gamma_{\text{total}}$, $\Gamma(B^0\overline{B}^0)/\Gamma_{\text{total}}$, $\Gamma(B^+B^-)/\Gamma(B^0\overline{B}^0)$ and Γ(non-$B\overline{B})/\Gamma_{\text{total}}$ produced by the Heavy Flavor Averaging Group (HFLAV) are correlated.

NODE=M047R12;LINKAGE=B

[2] Direct measurement. This value is averaged with the value extracted from the $\Gamma(B^+B^-)$ / $\Gamma(B^0\overline{B}^0)$ measurements.

NODE=M047R12;LINKAGE=AU

$\Gamma(B^+B^-)/\Gamma(B^0\overline{B}^0)$ — Γ_2/Γ_4

NODE=M047R10

VALUE	DOCUMENT ID	TECN	COMMENT
1.052±0.031 OUR AVERAGE [1.041 ± 0.028 OUR 2025 AVERAGE]			
1.052±0.031	[1] BANERJEE 26	RVUE	
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1.065±0.012±0.051	[2] CHOUDHURY 23	BELL	$\Upsilon(4S) \to B\overline{B} \to J/\psi K$
1.006±0.036±0.031	[3] AUBERT 04F	BABR	$\Upsilon(4S) \to B\overline{B} \to J/\psi K$
1.01 ±0.03 ±0.09	[3] HASTINGS 03	BELL	$\Upsilon(4S) \to B\overline{B} \to$ dileptons
1.058±0.084±0.136	[4] ATHAR 02	CLEO	$\Upsilon(4S) \to B\overline{B} \to D^*\ell\nu$
1.10 ±0.06 ±0.05	[5] AUBERT 02	BABR	$\Upsilon(4S) \to B\overline{B} \to (c\overline{c})K^*$
1.04 ±0.07 ±0.04	[6] ALEXANDER 01	CLEO	$\Upsilon(4S) \to B\overline{B} \to J/\psi K^*$

NEW

[1] The quantities $\Gamma(B^+B^-)/\Gamma_{total}$, $\Gamma(B^0\overline{B}^0)/\Gamma_{total}$, $\Gamma(B^+B^-)/\Gamma(B^0\overline{B}^0)$ and $\Gamma(\text{non-}B\overline{B})/\Gamma_{total}$ produced by the Heavy Flavor Averaging Group (HFLAV) are correlated. NODE=M047R10;LINKAGE=G

[2] CHOUDHURY 23 includes uncertainty due to the isospin symmetry assumption in $B \to J/\psi K$ decays. NODE=M047R10;LINKAGE=A

[3] HASTINGS 03 and AUBERT 04F assume $\tau(B^+)$ / $\tau(B^0)$ = 1.083 ± 0.017. NODE=M047R10;LINKAGE=F

[4] ATHAR 02 assumes $\tau(B^+)$ / $\tau(B^0)$ = 1.074 ± 0.028. Supersedes BARISH 95. NODE=M047R10;LINKAGE=D

[5] AUBERT 02 assumes $\tau(B^+)$ / $\tau(B^0)$ = 1.062 ± 0.029. NODE=M047R10;LINKAGE=E

[6] ALEXANDER 01 assumes $\tau(B^+)$ / $\tau(B^0)$ = 1.066 ± 0.024. NODE=M047R10;LINKAGE=C

$\left[\Gamma(J/\psi K^0_S) + \Gamma((J/\psi,\ \eta_c)K^0_S)\right]/\Gamma_{total}$ — Γ_5/Γ

NODE=M047R16

Forbidden by CP invariance.

VALUE (units 10^{-7})	CL%	DOCUMENT ID	TECN	COMMENT
<4	90	[1] TAJIMA 07A	BELL	$\Upsilon(4S) \to B^0\overline{B}^0$

[1] $\Upsilon(4S)$ with $CP = +1$ decays to the final state with $CP = -1$. NODE=M047R16;LINKAGE=TA

non-$B\overline{B}$ DECAYS

NODE=M047NBB

$\Gamma(\text{non-}B\overline{B})/\Gamma_{total}$ — Γ_6/Γ

NODE=M047R6

VALUE (units 10^{-2})	CL%	DOCUMENT ID	TECN	COMMENT
$\mathbf{0.26^{+1.25}_{-0.02}}$		[1] BANERJEE 26	RVUE	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<4	95	BARISH 96B	CLEO	e^+e^-

[1] The quantities $\Gamma(B^+B^-)/\Gamma_{total}$, $\Gamma(B^0\overline{B}^0)/\Gamma_{total}$, $\Gamma(B^+B^-)/\Gamma(B^0\overline{B}^0)$ and $\Gamma(\text{non-}B\overline{B})/\Gamma_{total}$ produced by the Heavy Flavor Averaging Group (HFLAV) are correlated. NODE=M047R6;LINKAGE=A

$\Gamma(e^+e^-)/\Gamma_{total}$ — Γ_7/Γ

NODE=M047R5

VALUE (units 10^{-5})	DOCUMENT ID	TECN	COMMENT
1.57±0.08 OUR AVERAGE			
1.55±0.04±0.07	AUBERT 05Q	BABR	$e^+e^- \to$ hadrons
2.77±0.50±0.49	[1] ALBRECHT 95E	ARG	$e^+e^- \to$ hadrons

[1] Using LEYAOUANC 77 parametrization of $\Gamma(s)$. NODE=M047R5;LINKAGE=A

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

NODE=M047R17

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<5.7 × 10^{-6}	90	AUBERT 08BO	BABR	$e^+e^- \to \pi^+\pi^-2\pi^0$

$\Gamma(K^*(892)^0\overline{K}^0)/\Gamma_{total}$ — Γ_9/Γ

NODE=M047R02

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<2.0 × 10^{-6}	90	SHEN 13A	BELL	$e^+e^- \to K^*(892)^0\overline{K}^0$

$\Gamma(J/\psi(1S)\ \text{anything})/\Gamma_{total}$ — Γ_{10}/Γ

NODE=M047R1

VALUE (units 10^{-4})	CL%	DOCUMENT ID	TECN	COMMENT
<1.9	95	[1] ABE 02D	BELL	$e^+e^- \to J/\psi X \to \ell^+\ell^- X$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<4.7	90	[1] AUBERT 01C	BABR	$e^+e^- \to J/\psi X \to \ell^+\ell^- X$

[1] Uses B($J/\psi \to e^+e^-$) = 0.0593 ± 0.0010 and B($J/\psi \to \mu^+\mu^-$) = 0.0588 ± 0.0010. NODE=M047R;LINKAGE=AC

$\Gamma(D^{*+}\ \text{anything} + \text{c.c.})/\Gamma_{total}$ — Γ_{11}/Γ

NODE=M047R2

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.074	90	[1] ALEXANDER 90C	CLEO	e^+e^-

[1] For $x >$ 0.473. NODE=M047R2;LINKAGE=A

$\Gamma(\phi \text{ anything})/\Gamma_{total}$ Γ_{12}/Γ

NODE=M047R3
NODE=M047R3

VALUE (units 10^{-2})	CL%	DOCUMENT ID		TECN	COMMENT
7.1 ±0.1±0.6		HUANG	07	CLEO	$\Upsilon(4S) \to \phi X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.23	90	[1] ALEXANDER	90C	CLEO	$e^+ e^-$

[1] For $x >$ 0.52. NODE=M047R3;LINKAGE=A

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

NODE=M047R14
NODE=M047R14

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<1.8	90	[1] BELOUS	09	BELL	$e^+ e^- \to \phi\eta$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<2.5	90	AUBERT,BE	06F	BABR	$e^+ e^- \to \phi\eta$

[1] Using all intermedite branching fraction values from PDG 08. NODE=M047R14;LINKAGE=BE

$\Gamma(\phi\eta')/\Gamma_{total}$ Γ_{14}/Γ

NODE=M047R21
NODE=M047R21

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<4.3	90	[1] BELOUS	09	BELL	$e^+ e^- \to \phi\eta'$

[1] Using all intermedite branching fraction values from PDG 08. NODE=M047R21;LINKAGE=BE

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

NODE=M047R22
NODE=M047R22

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<1.3	90	[1] BELOUS	09	BELL	$e^+ e^- \to \rho\eta$

[1] Using all intermedite branching fraction values from PDG 08. NODE=M047R22;LINKAGE=BE

$\Gamma(\rho\eta')/\Gamma_{total}$ Γ_{16}/Γ

NODE=M047R23
NODE=M047R23

VALUE (units 10^{-6})	CL%	DOCUMENT ID		TECN	COMMENT
<2.5	90	[1] BELOUS	09	BELL	$e^+ e^- \to \rho\eta'$

[1] Using all intermedite branching fraction values from PDG 08. NODE=M047R23;LINKAGE=BE

$\Gamma(\Upsilon(1S) \text{ anything})/\Gamma_{total}$ Γ_{17}/Γ

NODE=M047R4
NODE=M047R4

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

$\Gamma(\Upsilon(1S)\pi^+\pi^-)/\Gamma_{total}$ Γ_{18}/Γ

NODE=M047R7
NODE=M047R7

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
8.2 ±0.4 OUR AVERAGE						
8.2 ±0.5 ±0.4		515	GUIDO	17	BELL	$\Upsilon(4S) \to \pi^+\pi^-\mu^+\mu^-$
8.5 ±1.3 ±0.1		113 ± 16	[1] SOKOLOV	09	BELL	$e^+ e^- \to \pi^+\pi^-\mu^+\mu^-$
8.00±0.64±0.27		430	[2] AUBERT	08BP	BABR	$\Upsilon(4S) \to \pi^+\pi^-\ell^+\ell^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
17.8 ±4.0 ±0.3			[3,4] SOKOLOV	07	BELL	$e^+ e^- \to \pi^+\pi^-\mu^+\mu^-$
9.0 ±1.5 ±0.2		167 ± 19	[5] AUBERT	06R	BABR	$e^+ e^- \to \pi^+\pi^-\mu^+\mu^-$
<12	90		GLENN	99	CLE2	$e^+ e^-$

[1] SOKOLOV 09 reports $[\Gamma(\Upsilon(4S) \to \Upsilon(1S)\pi^+\pi^-)/\Gamma_{total}] \times [B(\Upsilon(1S) \to \mu^+\mu^-)] = (0.211 \pm 0.030 \pm 0.014) \times 10^{-5}$ which we divide by our best (shown rounded) value $B(\Upsilon(1S) \to \mu^+\mu^-) = (2.48 \pm 0.04) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value. NODE=M047R7;LINKAGE=SK

[2] Using $B(\Upsilon(1S) \to e^+e^-) = (2.38 \pm 0.11)\%$ and $B(\Upsilon(1S) \to \mu^+\mu^-) = (2.48 \pm 0.05)\%$. NODE=M047R7;LINKAGE=UB

[3] SOKOLOV 07 reports $[\Gamma(\Upsilon(4S) \to \Upsilon(1S)\pi^+\pi^-)/\Gamma_{total}] \times [B(\Upsilon(1S) \to \mu^+\mu^-)] = (4.42 \pm 0.81 \pm 0.56) \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(1S) \to \mu^+\mu^-) = (2.48 \pm 0.04) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value. NODE=M047R7;LINKAGE=SO

[4] According to the authors, systematic errors were underestimated. NODE=M047R7;LINKAGE=US

[5] Superseded by AUBERT 08BP. AUBERT 06R reports $[\Gamma(\Upsilon(4S) \to \Upsilon(1S)\pi^+\pi^-)/\Gamma_{total}] \times [B(\Upsilon(1S) \to \mu^+\mu^-)] = (2.23 \pm 0.25 \pm 0.27) \times 10^{-6}$ which we divide by our best (shown rounded) value $B(\Upsilon(1S) \to \mu^+\mu^-) = (2.48 \pm 0.04) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value. NODE=M047R7;LINKAGE=AU

$\Gamma(\Upsilon(1S)\eta)/\Gamma_{total}$ — Γ_{19}/Γ

NODE=M047R18
NODE=M047R18

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
1.81±0.18 OUR AVERAGE						
1.70±0.23±0.08		49	GUIDO	17	BELL	$\Upsilon(4S) \to \pi^+\pi^-\pi^0\mu^+\mu^-$
1.96±0.26±0.09		56	[1] AUBERT	08BP	BABR	$\Upsilon(4S) \to \pi^+\pi^-\pi^0\ell^+\ell^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<2.7	90		[2] TAMPONI	15	BELL	$e^+e^- \to \gamma\eta +$ hadrons

[1] Using B($\Upsilon(1S) \to e^+e^-$) = (2.38 ± 0.11)% and B($\Upsilon(1S) \to \mu^+\mu^-$) = (2.48 ± 0.05)%.

NODE=M047R18;LINKAGE=UB

[2] Using B($\eta \to 2\gamma$) = (39.41 ± 0.20)%.

NODE=M047R18;LINKAGE=A

$\Gamma(\Upsilon(1S)\eta')/\Gamma_{total}$ — Γ_{20}/Γ

NODE=M047R03
NODE=M047R03

VALUE (units 10^{-5})	EVTS	DOCUMENT ID		TECN	COMMENT
3.43±0.88±0.21	27	GUIDO	18	BELL	$\Upsilon(4S) \to (\rho^0\gamma, \pi^+\pi^-\eta)\mu^+\mu^-$

$\Gamma(\Upsilon(1S)\eta)/\Gamma(\Upsilon(1S)\pi^+\pi^-)$ — Γ_{19}/Γ_{18}

NODE=M047R19
NODE=M047R19

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2.41±0.40±0.12	56	[1] AUBERT	08BP	BABR	$\Upsilon(4S) \to \pi^+\pi^-(\pi^0)\ell^+\ell^-$

[1] Not independent of other values reported by AUBERT 08BP.

NODE=M047R19;LINKAGE=UB

$\Gamma(\Upsilon(2S)\pi^+\pi^-)/\Gamma_{total}$ — Γ_{21}/Γ

NODE=M047R9
NODE=M047R9

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
8.2±0.8 OUR AVERAGE						
7.9±1.0±0.4		181	GUIDO	17	BELL	$\Upsilon(4S) \to \pi^+\pi^-\mu^+\mu^-$
8.6±1.1±0.7		220	[1] AUBERT	08BP	BABR	$\Upsilon(4S) \to \pi^+\pi^-\ell^+\ell^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
8.8±1.7±0.8		97 ± 15	[2] AUBERT	06R	BABR	$e^+e^- \to \pi^+\pi^-\mu^+\mu^-$
<3.9	90		GLENN	99	CLE2	e^+e^-

[1] Using B($\Upsilon(2S) \to e^+e^-$) = (1.91 ± 0.16)% and B($\Upsilon(2S) \to \mu^+\mu^-$) = (1.93 ± 0.17)%.

NODE=M047R9;LINKAGE=UB

[2] Superseded by AUBERT 08BP. AUBERT 06R reports [$\Gamma(\Upsilon(4S) \to \Upsilon(2S)\pi^+\pi^-)/\Gamma_{total}$] × [B($\Upsilon(2S) \to \mu^+\mu^-$)] = (1.69 ± 0.26 ± 0.20) × 10^{-6} which we divide by our best (shown rounded) value B($\Upsilon(2S) \to \mu^+\mu^-$) = (1.93 ± 0.17) × 10^{-2}. Our first error is their experiment's error and our second error is the systematic error from using our best (shown rounded) value.

NODE=M047R9;LINKAGE=AU

$\Gamma(\Upsilon(2S)\pi^+\pi^-)/\Gamma(\Upsilon(1S)\pi^+\pi^-)$ — Γ_{21}/Γ_{18}

NODE=M047R20
NODE=M047R20

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.16±0.16±0.14	220	[1] AUBERT	08BP	BABR	$\Upsilon(4S) \to \pi^+\pi^-\ell^+\ell^-$

[1] Using B($\Upsilon(1S) \to e^+e^-$) = (2.38 ± 0.11)%, B($\Upsilon(1S) \to \mu^+\mu^-$) = (2.48 ± 0.05)%, B($\Upsilon(2S) \to e^+e^-$) = (1.91 ± 0.16)%, and B($\Upsilon(2S) \to \mu^+\mu^-$) = (1.93 ± 0.17)%. Not independent of other values reported by AUBERT 08BP.

NODE=M047R20;LINKAGE=UB

$\Gamma(h_b(1P)\pi^+\pi^-)/\Gamma_{total}$ — Γ_{22}/Γ

NODE=M047R01
NODE=M047R01

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
not seen	(35^{+32}_{-26})k	[1] ADACHI	12	BELL	10.58 $e^+e^- \to h_b(1P)\pi^+\pi^-$

[1] From the upper limit on the ratio of $\sigma(e^+e^- \to h_b(1P)\pi^+\pi^-)$ at the $\Upsilon(4S)$ to that at the $\Upsilon(5S)$ of 0.27.

NODE=M047R01;LINKAGE=AD

$\Gamma(h_b(1P)\eta)/\Gamma_{total}$ — Γ_{23}/Γ

NODE=M047R00
NODE=M047R00

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
2.18±0.11±0.18	112k	[1] TAMPONI	15	BELL	$e^+e^- \to h_b(1P)\eta$

[1] Using B($\eta \to 2\gamma$) = (39.41 ± 0.20)%.

NODE=M047R00;LINKAGE=A

$\Gamma(\eta_b(1S)\omega)/\Gamma_{total}$ — Γ_{24}/Γ

NODE=M047R04
NODE=M047R04

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.8 × 10^{-4}	90	OSKIN	20	BELL	$e^+e^- \to \omega X$

$\Gamma(\eta_b(1S)\omega)/\Gamma(h_b(1P)\eta)$ — Γ_{24}/Γ_{23}

NODE=M047R05
NODE=M047R05

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<8.4 × 10^{-2}	90	[1] OSKIN	20	BELL	$e^+e^- \rightarrow \omega X$

[1] Using B($\Upsilon(4S) \rightarrow h_b(1P)\eta$) = $(2.18 \pm 0.11 \pm 0.18) \times 10^{-3}$ from TAMPONI 15.

NODE=M047R05;LINKAGE=A

$\Gamma(\overline{^2H}$ anything$)/\Gamma_{total}$ — Γ_{25}/Γ

NODE=M047R15
NODE=M047R15

VALUE (units 10^{-5})	CL%	DOCUMENT ID		TECN	COMMENT
<1.3	90	ASNER	07	CLEO	$e^+e^- \rightarrow \overline{d}X$

Double Radiative Decays

NODE=M047240

$\Gamma(\gamma\gamma\Upsilon(D) \rightarrow \gamma\gamma\eta\Upsilon(1S))/\Gamma_{total}$ — Γ_{26}/Γ

NODE=M047R24
NODE=M047R24

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<2.3 × 10^{-5}	90	GUIDO	17	BELL	$\Upsilon(4S) \rightarrow \gamma\gamma\pi^+\pi^-\pi^0\mu^+\mu^-$

$\Upsilon(4S)$ REFERENCES

NODE=M047

BANERJEE	26	PR D113 012008	Sw. Banerjee *et al.*	(HFLAV Collab.)	REFID=63789
CHOUDHURY	23	PR D107 L031102	S. Choudhury *et al.*	(BELLE Collab.)	REFID=62074
OSKIN	20	PR D102 092011	P. Oskin *et al.*	(BELLE Collab.)	REFID=60735
GUIDO	18	PRL 121 062001	E. Guido *et al.*	(BELLE Collab.)	REFID=58860
GUIDO	17	PR D96 052005	E. Guido *et al.*	(BELLE Collab.)	REFID=58218
TAMPONI	15	PRL 115 142001	U. Tamponi *et al.*	(BELLE Collab.)	REFID=56996
SHEN	13A	PR D88 052019	C.P. Shen *et al.*	(BELLE Collab.)	REFID=55591
ADACHI	12	PRL 108 032001	I. Adachi *et al.*	(BELLE Collab.)	REFID=53962
BELOUS	09	PL B681 400	K. Belous *et al.*	(BELLE Collab.)	REFID=53107
SOKOLOV	09	PR D79 051103	A. Sokolov *et al.*	(BELLE Collab.)	REFID=52760
AUBERT	08BO	PR D78 071103	B. Aubert *et al.*	(BABAR Collab.)	REFID=52659
AUBERT	08BP	PR D78 112002	B. Aubert *et al.*	(BABAR Collab.)	REFID=52660
PDG	08	PL B667 1	C. Amsler *et al.*	(PDG Collab.)	REFID=52166
ASNER	07	PR D75 012009	D.M. Asner *et al.*	(CLEO Collab.)	REFID=51617
HUANG	07	PR D75 012002	G.S. Huang *et al.*	(CLEO Collab.)	REFID=51624
SOKOLOV	07	PR D75 071103	A. Sokolov *et al.*	(BELLE Collab.)	REFID=51715
TAJIMA	07A	PRL 99 211601	O. Tajima *et al.*	(BELLE Collab.)	REFID=52066
AUBERT	06R	PRL 96 232001	B. Aubert *et al.*	(BABAR Collab.)	REFID=51143
AUBERT,BE	06F	PR D74 111103	B. Aubert *et al.*	(BABAR Collab.)	REFID=51563
ARTUSO	05B	PRL 95 261801	M. Artuso *et al.*	(CLEO Collab.)	REFID=50992
AUBERT	05Q	PR D72 032005	B. Aubert *et al.*	(BABAR Collab.)	REFID=50774
AUBERT,B	05H	PRL 95 042001	B. Aubert *et al.*	(BABAR Collab.)	REFID=50777
AUBERT	04F	PR D69 071101	B. Aubert *et al.*	(BABAR Collab.)	REFID=49748
HASTINGS	03	PR D67 052004	N.C. Hastings *et al.*	(BELLE Collab.)	REFID=49209
ABE	02D	PRL 88 052001	K. Abe *et al.*	(BELLE Collab.)	REFID=48557
ATHAR	02	PR D66 052003	S.B. Athar *et al.*	(CLEO Collab.)	REFID=48832
AUBERT	02	PR D65 032001	B. Aubert *et al.*	(BABAR Collab.)	REFID=48514
ALEXANDER	01	PRL 86 2737	J.P. Alexander *et al.*	(CLEO Collab.)	REFID=48316
AUBERT	01C	PRL 87 162002	B. Aubert *et al.*	(BABAR Collab.)	REFID=48346
GLENN	99	PR D59 052003	S. Glenn *et al.*		REFID=46890
BARISH	96B	PRL 76 1570	B.C. Barish *et al.*	(CLEO Collab.)	REFID=44693
ALBRECHT	95E	ZPHY C65 619	H. Albrecht *et al.*	(ARGUS Collab.)	REFID=44372
BARISH	95	PR D51 1014	B.C. Barish *et al.*	(CLEO Collab.)	REFID=44139
ALEXANDER	90C	PRL 64 2226	J. Alexander *et al.*	(CLEO Collab.)	REFID=41346
BEBEK	87	PR D36 1289	C. Bebek *et al.*	(CLEO Collab.)	REFID=40270
BESSON	85	PRL 54 381	D. Besson *et al.*	(CLEO Collab.)	REFID=22368
LOVELOCK	85	PRL 54 377	D.M.J. Lovelock *et al.*	(CUSB Collab.)	REFID=22369
LEYAOUANC	77	PL B71 397	A. Le Yaouanc *et al.*	(ORSAY)	REFID=44695