$\Upsilon(10860)$

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

$\Upsilon(10860)$ MASS

VALUE (GeV)	DOCUMENT ID		TECN	COMMENT
10.865±0.008 OUR AVERAGE	Error includes scale factor of 1.1.			
10.868±0.006±0.005	BESSON	85	CLEO	$e^+e^- \rightarrow$ hadrons
10.845±0.020	LOVELOCK	85	CUSB	$e^+e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
10.876±0.002	[1] AUBERT	09E	BABR	$e^+e^- \rightarrow$ hadrons
10.869±0.002	[2] AUBERT	09E	BABR	$e^+e^- \rightarrow$ hadrons

[1] In a model where a flat non-resonant $b\overline{b}$-continuum is incoherently added to a second flat component interfering with two Breit-Wigner resonances. Systematic uncertainties not estimated.

[2] In a model where a non-resonant $b\overline{b}$-continuum represented by a threshold function at $\sqrt{s}=2m_B$ is incoherently added to a flat component interfering with two Breit-Wigner resonances. Not independent of other AUBERT 09E results. Systematic uncertainties not estimated.

$\Upsilon(10860)$ WIDTH

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
110±13 OUR AVERAGE				
112±17±23	BESSON	85	CLEO	$e^+e^- \rightarrow$ hadrons
110±15	LOVELOCK	85	CUSB	$e^+e^- \rightarrow$ hadrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
43± 4	[3] AUBERT	09E	BABR	$e^+e^- \rightarrow$ hadrons
74± 4	[4] AUBERT	09E	BABR	$e^+e^- \rightarrow$ hadrons

[3] In a model where a flat non-resonant $b\overline{b}$-continuum is incoherently added to a second flat component interfering with two Breit-Wigner resonances. Systematic uncertainties not estimated.

[4] In a model where a non-resonant $b\overline{b}$-continuum represented by a threshold function at $\sqrt{s}=2m_B$ is incoherently added to a flat component interfering with two Breit-Wigner resonances. Not independent of other AUBERT 09E results. Systematic uncertainties not estimated.

$\Upsilon(10860)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	e^+e^-	(2.8 ± 0.7) × 10^{-6}	
Γ_2	$B\overline{B}X$	(59 ±14) %	
Γ_3	$B\overline{B}$	< 13.8 %	90%
Γ_4	$B\overline{B}^*$ + c.c.	(14 ± 6) %	
Γ_5	$B^*\overline{B}^*$	(44 ±11) %	
Γ_6	$B\overline{B}^{(*)}\pi$	< 19.7 %	90%
Γ_7	$B\overline{B}\pi\pi$	< 8.9 %	90%
Γ_8	$B_s^{(*)}\overline{B}_s^{(*)}(X)$	(19.3 ± 2.9) %	

Γ_9	$B_s^{(*)}\overline{B}_s^{(*)}$	
Γ_{10}	$B_s\overline{B}_s$	
Γ_{11}	$B_s\overline{B}_s^* +$ c.c.	
Γ_{12}	$B_s^*\overline{B}_s^*$	
Γ_{13}	$\Upsilon(1S)\pi^+\pi^-$	$(5.3 \pm 0.6) \times 10^{-3}$
Γ_{14}	$\Upsilon(2S)\pi^+\pi^-$	$(7.8 \pm 1.3) \times 10^{-3}$
Γ_{15}	$\Upsilon(3S)\pi^+\pi^-$	$(4.8 {}^{+1.9}_{-1.7}) \times 10^{-3}$
Γ_{16}	$\Upsilon(1S)K^+K^-$	$(6.1 \pm 1.8) \times 10^{-4}$

Inclusive Decays.

These decay modes are submodes of one or more of the decay modes above.

Γ_{17}	ϕ anything	$(13.8 {}^{+2.4}_{-1.7})$ %
Γ_{18}	D^0 anything + c.c.	(108 ± 8) %
Γ_{19}	D_s anything + c.c.	(46 ± 6) %
Γ_{20}	J/ψ anything	(2.06 ± 0.21) %

Υ(10860) PARTIAL WIDTHS

$\Gamma(e^+e^-)$ — Γ_1

VALUE (keV)	DOCUMENT ID		TECN	COMMENT
0.31 ±0.07 OUR AVERAGE	Error includes scale factor of 1.3.			
0.22 ±0.05 ±0.07	BESSON	85	CLEO	$e^+e^- \to$ hadrons
0.365±0.070	LOVELOCK	85	CUSB	$e^+e^- \to$ hadrons

Υ(10860) BRANCHING RATIOS

$\Gamma(B\overline{B}X)/\Gamma_{total}$ — Γ_2/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.589±0.100±0.092	[5] HUANG	07	CLEO	$\Upsilon(5S) \to$ hadrons

$\Gamma(B\overline{B})/\Gamma_{total}$ — Γ_3/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.138	90	[5] HUANG	07	CLEO	$\Upsilon(5S) \to$ hadrons

$\Gamma(B\overline{B})/\Gamma(B\overline{B}X)$ — Γ_3/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.22	90	AQUINES	06	CLE3	$\Upsilon(5S) \to$ hadrons

$\Gamma(B\overline{B}^* + \text{c.c.})/\Gamma_{total}$ — Γ_4/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.143±0.053±0.027	[5] HUANG	07	CLEO	$\Upsilon(5S) \to$ hadrons

$\Gamma(B\overline{B}^* + \text{c.c.})/\Gamma(B\overline{B}X)$ — Γ_4/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.24±0.09±0.03	10	AQUINES	06	CLE3	$\Upsilon(5S) \to$ hadrons

$\Gamma(B^* \overline{B}^*)/\Gamma_{total}$ — Γ_5/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.436±0.083±0.072	[5] HUANG	07	CLEO	$\Upsilon(5S) \to$ hadrons

$\Gamma(B^* \overline{B}^*)/\Gamma(B \overline{B} X)$ — Γ_5/Γ_2

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.74±0.15±0.08	31	AQUINES	06	CLE3	$\Upsilon(5S) \to$ hadrons

$\Gamma(B \overline{B}^{(*)} \pi)/\Gamma_{total}$ — Γ_6/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.197	90	[5] HUANG	07	CLEO	$\Upsilon(5S) \to$ hadrons

$\Gamma(B \overline{B}^{(*)} \pi)/\Gamma(B \overline{B} X)$ — Γ_6/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.32	90	AQUINES	06	CLE3	$\Upsilon(5S) \to$ hadrons

$\Gamma(B \overline{B} \pi \pi)/\Gamma_{total}$ — Γ_7/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.089	90	[5] HUANG	07	CLEO	$\Upsilon(5S) \to$ hadrons

$\Gamma(B \overline{B} \pi \pi)/\Gamma(B \overline{B} X)$ — Γ_7/Γ_2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.14	90	AQUINES	06	CLE3	$\Upsilon(5S) \to$ hadrons

$\Gamma(B_s^{(*)} \overline{B}_s^{(*)} (X))/\Gamma_{total}$ — Γ_8/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.193±0.029 OUR EVALUATION	Taking into account common systematics.			
$0.195^{+0.030}_{-0.023}$ OUR AVERAGE				
0.180±0.013±0.032	[6] DRUTSKOY	07	BELL	$\Upsilon(5S) \to D^0 X$, $D_s X$
$0.21\ ^{+0.06}_{-0.03}$	[7] HUANG	07	CLEO	$\Upsilon(5S) \to D_s X$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.160±0.026±0.058	[8] ARTUSO	05B	CLEO	$e^+ e^- \to D_x X$

$\Gamma(B_s^* \overline{B}_s^*)/\Gamma(B_s^{(*)} \overline{B}_s^{(*)})$ — $\Gamma_{12}/\Gamma_9 = \Gamma_{12}/(\Gamma_{10}+\Gamma_{11}+\Gamma_{12})$

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
$93^{+7}_{-9}\pm1$	[9] DRUTSKOY	07A	BELL	10.86 $e^+ e^- \to B_s^{(*)} \overline{B}_s^{(*)}$

$\Gamma(B_s \overline{B}_s)/\Gamma(B_s^* \overline{B}_s^*)$ — Γ_{10}/Γ_{12}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.16	90	BONVICINI	06	CLE3	$e^+ e^-$

$\Gamma(B_s \overline{B}_s^* + \text{c.c.})/\Gamma(B_s^* \overline{B}_s^*)$ — Γ_{11}/Γ_{12}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.16	90	BONVICINI	06	CLE3	$e^+ e^-$

$\Gamma(\Upsilon(1S)\pi^+\pi^-)/\Gamma_{total}$ — Γ_{13}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
5.3±0.3±0.5	325	[10] CHEN	08	BELL	10.87 $e^+e^- \to \Upsilon(1S)\pi^+\pi^-$

$\Gamma(\Upsilon(2S)\pi^+\pi^-)/\Gamma_{total}$ — Γ_{14}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
7.8±0.6±1.1	186	[10] CHEN	08	BELL	10.87 $e^+e^- \to \Upsilon(2S)\pi^+\pi^-$

$\Gamma(\Upsilon(3S)\pi^+\pi^-)/\Gamma_{total}$ — Γ_{15}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
$4.8^{+1.8}_{-1.5}\pm0.7$	10	[10] CHEN	08	BELL	10.87 $e^+e^- \to \Upsilon(3S)\pi^+\pi^-$

$\Gamma(\Upsilon(1S)K^+K^-)/\Gamma_{total}$ — Γ_{16}/Γ

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
$6.1^{+1.6}_{-1.4}\pm1.0$	20	[10] CHEN	08	BELL	10.87 $e^+e^- \to \Upsilon(1S)K^+K^-$

$\Gamma(\phi\text{ anything})/\Gamma_{total}$ — Γ_{17}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$0.138\pm0.007^{+0.023}_{-0.015}$	HUANG	07	CLEO	$\Upsilon(5S) \to \phi X$

$\Gamma(D^0\text{ anything} + \text{c.c.})/\Gamma_{total}$ — Γ_{18}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
1.076±0.040±0.068	DRUTSKOY	07	BELL	$\Upsilon(5S) \to D^0 X$

$\Gamma(D_s\text{ anything} + \text{c.c.})/\Gamma_{total}$ — Γ_{19}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.46 ±0.06 OUR AVERAGE				
0.472±0.024±0.072	[6] DRUTSKOY	07	BELL	$\Upsilon(5S) \to D_s X$
0.45 ±0.10 ±0.04	[11] ARTUSO	05B	CLE3	$e^+e^- \to D_x X$

$\Gamma(J/\psi\text{ anything})/\Gamma_{total}$ — Γ_{20}/Γ

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
2.060±0.160±0.134	DRUTSKOY	07	BELL	$\Upsilon(5S) \to J/\psi X$

[5] Using measurements or limits from AQUINES 06.

[6] Using B($D_s^+ \to \phi\pi^+$) = (4.4 ± 0.6)% from PDG 06.

[7] Supersedes ARTUSO 05B. Combining inclusive ϕ, D_s, and B measurements. Using B($D_s^+ \to \phi\pi^+$) = 4.4 ± 0.6% from PDG 06.

[8] Uses a model-dependent estimate B($B_s \to D_s X$) = (92 ± 11)%.

[9] From a measurement of $\sigma(e^+e^- \to B_s^*\overline{B}_s^*)$ / $\sigma(e^+e^- \to B_s^{(*)}\overline{B}_s^{(*)})$ at $\sqrt{s} = 10.86$ GeV.

[10] Assuming that the observed events are solely due to the $\Upsilon(5S)$ resonance.

[11] ARTUSO 05B reports [$\Gamma(\Upsilon(10860) \to D_s$ anything + c.c.$)/\Gamma_{total}$] × [B($D_s^+ \to \phi\pi^+$)] = 0.0198 ± 0.0019 ± 0.0038. We divide by our best value B($D_s^+ \to \phi\pi^+$) = (4.39 ± 0.34) × 10^{-2}. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Upsilon(10860)$ REFERENCES

AUBERT	09E	PRL 102 012001	B. Aubert *et al.*	(BABAR Collab.)
CHEN	08	PRL 100 112001	K.-F. Chen *et al.*	(BELLE Collab.)
DRUTSKOY	07	PRL 98 052001	A. Drutskoy *et al.*	(BELLE Collab.)
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