$\eta_b(1S)$

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

OMITTED FROM SUMMARY TABLE

Quantum numbers shown are quark-model predictions. Observed in radiative decay of the $\Upsilon(3S)$, therefore $C = +$.

$\eta_b(1S)$ MASS

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
9390.9± 2.8 OUR AVERAGE					
9391.8± 6.6± 2.0	2.3 ± 0.5k	[1] BONVICINI	10	CLEO	$\Upsilon(3S) \to \gamma X$
9394 $^{+4.8}_{-4.9}$ ± 2.0	13 ± 5k	[1] AUBERT	09AQ	BABR	$\Upsilon(2S) \to \gamma X$
9388.9 $^{+3.1}_{-2.3}$ ± 2.7	19 ± 3k	[1] AUBERT	08V	BABR	$\Upsilon(3S) \to \gamma X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
9300 ±20 ±20		HEISTER	02D	ALEP	181–209 e^+e^-

[1] Assuming $\Gamma_{\eta_b(1S)}$ = 10 MeV. Not independent of the corresponding γ energy or mass difference measurements.

$m_{\Upsilon(1S)} - m_{\eta_b}$

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
69.3±2.8 OUR AVERAGE					
68.5±6.6±2.0	2.3 ± 0.5k	[2] BONVICINI	10	CLEO	$\Upsilon(3S) \to \gamma X$
66.1 $^{+4.8}_{-4.9}$ ±2.0	13 ± 5k	[2] AUBERT	09AQ	BABR	$\Upsilon(2S) \to \gamma X$
71.4 $^{+2.3}_{-3.1}$ ±2.7	19 ± 3k	[2] AUBERT	08V	BABR	$\Upsilon(3S) \to \gamma X$

[2] Assuming $\Gamma_{\eta_b(1S)}$ = 10 MeV. Not independent of the corresponding γ energy or mass measurements.

γ ENERGY IN $\Upsilon(3S)$ DECAY

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
920.6 $^{+2.8}_{-3.2}$ OUR AVERAGE					
918.6±6.0±1.9	2.3 ± 0.5k	[3] BONVICINI	10	CLEO	$\Upsilon(3S) \to \gamma X$
921.2 $^{+2.1}_{-2.8}$ ±2.4	19 ± 3k	[3] AUBERT	08V	BABR	$\Upsilon(3S) \to \gamma X$

[3] Assuming $\Gamma_{\eta_b(1S)}$ = 10 MeV. Not independent of the corresponding mass or mass difference measurements.

γ ENERGY IN $\Upsilon(2S)$ DECAY

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
609.3 $^{+4.6}_{-4.5}$ ±1.9	13 ± 5k	[4] AUBERT	09AQ	BABR	$\Upsilon(2S) \to \gamma X$

[4] Assuming $\Gamma_{\eta_b(1S)}$ = 10 MeV. Not independent of the corresponding mass or mass difference measurements.

$\eta_b(1S)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$3h^+ 3h^-$	not seen	
Γ_2	$2h^+ 2h^-$	not seen	
Γ_3	$4h^+ 4h^-$		
Γ_4	$\gamma\gamma$	not seen	
Γ_5	$\mu^+ \mu^-$	$<9 \times 10^{-3}$	90%
Γ_6	$\tau^+ \tau^-$	<8 %	90%

$\eta_b(1S)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(3h^+ 3h^-) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_1\Gamma_4/\Gamma$

VALUE (eV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<470	95	ABDALLAH	06	DLPH	161–209 $e^+ e^-$
<132	95	HEISTER	02D	ALEP	181–209 $e^+ e^-$

$\Gamma(2h^+ 2h^-) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_2\Gamma_4/\Gamma$

VALUE (eV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<190	95	ABDALLAH	06	DLPH	161–209 $e^+ e^-$
< 48	95	HEISTER	02D	ALEP	181–209 $e^+ e^-$

$\Gamma(4h^+ 4h^-) \times \Gamma(\gamma\gamma)/\Gamma_{total}$ — $\Gamma_3\Gamma_4/\Gamma$

VALUE (eV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<660	95	ABDALLAH	06	DLPH	161–209 $e^+ e^-$

$\eta_b(1S)$ BRANCHING RATIOS

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

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$<9 \times 10^{-3}$	90	[5] AUBERT	09Z	BABR	$e^+ e^- \rightarrow \Upsilon(2S,3S) \rightarrow \gamma\eta_b$

[5] Obtained using B($\Upsilon(2S) \rightarrow \gamma\eta_b$) = $(4.2^{+1.1}_{-1.0} \pm 0.9) \times 10^{-4}$ and B($\Upsilon(3S) \rightarrow \gamma\eta_b$) = $(4.8 \pm 0.5 \pm 0.6) \times 10^{-4}$. This limit is equivalent to B($\eta_b \rightarrow \mu^+\mu^-$) = $(-0.25 \pm 0.51 \pm 0.33)$% measurement.

$\Gamma(\tau^+ \tau^-)/\Gamma_{total}$ — Γ_6/Γ

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$<8 \times 10^{-2}$	90	AUBERT	09P	BABR	$e^+ e^- \rightarrow \gamma\tau^+\tau^-$

$\eta_b(1S)$ REFERENCES

BONVICINI	10	PR D81 031104R	G. Bonvicini *et al.*	(CLEO Collab.)
AUBERT	09AQ	PRL 103 161801	B. Aubert *et al.*	(BABAR Collab.)
AUBERT	09P	PRL 103 181801	B. Aubert *et al.*	(BABAR Collab.)
AUBERT	09Z	PRL 103 081803	B. Aubert *et al.*	(BABAR Collab.)
AUBERT	08V	PRL 101 071801	B. Aubert *et al.*	(BABAR Collab.)
ABDALLAH	06	PL B634 340	J.M. Abdallah *et al.*	(DELPHI Collab.)
HEISTER	02D	PL B530 56	A. Heister *et al.*	(ALEPH Collab.)