Citation: S. Eidelman *et al.* (Particle Data Group), Phys. Lett. B **592**, 1 (2004) (URL: http://pdg.lbl.gov)

$b\overline{b}$ MESONS

$\Upsilon(1S)$

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

Mass $m = 9460.30 \pm 0.26$ MeV (S = 3.3)
Full width $\Gamma = 53.0 \pm 1.5$ keV
$\Gamma_{ee} = 1.314 \pm 0.029$ keV

$\Upsilon(1S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\tau^+\tau^-$	$(2.67^{+0.14}_{-0.16})$ %		4384
e^+e^-	(2.38 ± 0.11) %		4730
$\mu^+\mu^-$	(2.48 ± 0.06) %		4729
Hadronic decays			
$\eta'(958)$anything	(2.8 ± 0.4) %		–
$J/\psi(1S)$anything	$(1.1 \pm0.4) \times 10^{-3}$		4223
$\rho\pi$	$< 2 \times 10^{-4}$	90%	4697
$\pi^+\pi^-$	$< 5 \times 10^{-4}$	90%	4728
K^+K^-	$< 5 \times 10^{-4}$	90%	4704
$p\overline{p}$	$< 5 \times 10^{-4}$	90%	4636
$\pi^0\pi^+\pi^-$	$< 1.84 \times 10^{-5}$	90%	4725
Radiative decays			
$\gamma\pi^+\pi^-$	$(6.3 \pm1.8) \times 10^{-5}$		4728
$\gamma\pi^0\pi^0$	$(1.7 \pm0.7) \times 10^{-5}$		4728
$\gamma 2h^+2h^-$	$(7.0 \pm1.5) \times 10^{-4}$		4720
$\gamma 3h^+3h^-$	$(5.4 \pm2.0) \times 10^{-4}$		4703
$\gamma 4h^+4h^-$	$(7.4 \pm3.5) \times 10^{-4}$		4679
$\gamma\pi^+\pi^-K^+K^-$	$(2.9 \pm0.9) \times 10^{-4}$		4686
$\gamma 2\pi^+2\pi^-$	$(2.5 \pm0.9) \times 10^{-4}$		4720
$\gamma 3\pi^+3\pi^-$	$(2.5 \pm1.2) \times 10^{-4}$		4703
$\gamma 2\pi^+2\pi^-K^+K^-$	$(2.4 \pm1.2) \times 10^{-4}$		4658
$\gamma\pi^+\pi^-p\overline{p}$	$(1.5 \pm0.6) \times 10^{-4}$		4604
$\gamma 2\pi^+2\pi^-p\overline{p}$	$(4 \pm6) \times 10^{-5}$		4563
$\gamma 2K^+2K^-$	$(2.0 \pm2.0) \times 10^{-5}$		4601
$\gamma\eta'(958)$	$< 1.6 \times 10^{-5}$	90%	4682
$\gamma\eta$	$< 2.1 \times 10^{-5}$	90%	4714
$\gamma f'_2(1525)$	$< 1.4 \times 10^{-4}$	90%	4607
$\gamma f_2(1270)$	$(8 \pm4) \times 10^{-5}$		4644
$\gamma\eta(1405)$	$< 8.2 \times 10^{-5}$	90%	4625
$\gamma f_0(1710) \to \gamma K\overline{K}$	$< 2.6 \times 10^{-4}$	90%	4576

$\gamma f_0(2200) \rightarrow \gamma K^+ K^-$	< 2	$\times 10^{-4}$	90%	4475
$\gamma f_J(2220) \rightarrow \gamma K^+ K^-$	< 1.5	$\times 10^{-5}$	90%	4469
$\gamma f_J(2220) \rightarrow \gamma \pi^+ \pi^-$	< 1.2	$\times 10^{-5}$	90%	–
$\gamma f_J(2220) \rightarrow \gamma p \overline{p}$	< 1.6	$\times 10^{-5}$	90%	–
$\gamma \eta(2225) \rightarrow \gamma \phi \phi$	< 3	$\times 10^{-3}$	90%	4469
γX (X = pseudoscalar with $m <$ 7.2 GeV)	< 3	$\times 10^{-5}$	90%	–
$\gamma X \overline{X}$ ($X \overline{X}$ = vectors with $m <$ 3.1 GeV)	< 1	$\times 10^{-3}$	90%	–

$\chi_{b0}(1P)$ [a]

$I^G(J^{PC}) = 0^+(0^{++})$
J needs confirmation.

Mass $m = 9859.9 \pm 1.0$ MeV

$\chi_{b0}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\gamma \Upsilon(1S)$	<6 %	90%	391

$\chi_{b1}(1P)$ [a]

$I^G(J^{PC}) = 0^+(1^{++})$
J needs confirmation.

Mass $m = 9892.7 \pm 0.6$ MeV (S = 1.1)

$\chi_{b1}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\gamma \Upsilon(1S)$	(35 ± 8) %	423

$\chi_{b2}(1P)$ [a]

$I^G(J^{PC}) = 0^+(2^{++})$
J needs confirmation.

Mass $m = 9912.6 \pm 0.5$ MeV (S = 1.1)

$\chi_{b2}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\gamma \Upsilon(1S)$	(22 ± 4) %	442

$\Upsilon(2S)$

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

Mass $m = 10.02326 \pm 0.00031$ GeV
Full width $\Gamma = 43 \pm 6$ keV
$\Gamma_{ee} = 0.576 \pm 0.024$ keV

$\Upsilon(2S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\Upsilon(1S)\pi^+\pi^-$	(18.8 ± 0.6) %		475
$\Upsilon(1S)\pi^0\pi^0$	(9.0 ± 0.8) %		480
$\tau^+\tau^-$	(1.7 ± 1.6) %		4686
$\mu^+\mu^-$	(1.31 ± 0.21) %		5011
e^+e^-	(1.34 ± 0.20) %		5012
$\Upsilon(1S)\pi^0$	$< 1.1 \times 10^{-3}$	90%	531
$\Upsilon(1S)\eta$	$< 2 \times 10^{-3}$	90%	126
$J/\psi(1S)$anything	$< 6 \times 10^{-3}$	90%	4533
Radiative decays			
$\gamma\chi_{b1}(1P)$	(6.8 ± 0.7) %		130
$\gamma\chi_{b2}(1P)$	(7.0 ± 0.6) %		110
$\gamma\chi_{b0}(1P)$	(3.8 ± 0.6) %		162
$\gamma f_0(1710)$	$< 5.9 \times 10^{-4}$	90%	4865
$\gamma f'_2(1525)$	$< 5.3 \times 10^{-4}$	90%	4896
$\gamma f_2(1270)$	$< 2.41 \times 10^{-4}$	90%	4930

$\chi_{b0}(2P)$ [a]

$I^G(J^{PC}) = 0^+(0^{++})$
J needs confirmation.

Mass $m = 10.2321 \pm 0.0006$ GeV

$\chi_{b0}(2P)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\gamma\,\Upsilon(2S)$	(4.6 ± 2.1) %	207
$\gamma\,\Upsilon(1S)$	$(9 \pm 6) \times 10^{-3}$	743

$\chi_{b1}(2P)$ [a]

$I^G(J^{PC}) = 0^+(1^{++})$
J needs confirmation.

Mass $m = 10.2552 \pm 0.0005$ GeV
$m_{\chi_{b1}(2P)} - m_{\chi_{b0}(2P)} = 23.5 \pm 1.0$ MeV

$\chi_{b1}(2P)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor	p (MeV/c)
$\gamma\,\Upsilon(2S)$	(21 ± 4) %	1.5	229
$\gamma\,\Upsilon(1S)$	(8.5 ± 1.3) %	1.3	764

$\chi_{b2}(2P)$ [a]

$I^G(J^{PC}) = 0^+(2^{++})$
J needs confirmation.

Mass $m = 10.2685 \pm 0.0004$ GeV
$m_{\chi_{b2}(2P)} - m_{\chi_{b1}(2P)} = 13.5 \pm 0.6$ MeV

$\chi_{b2}(2P)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$\gamma\,\Upsilon(2S)$	(16.2 ± 2.4) %	242
$\gamma\,\Upsilon(1S)$	(7.1 ± 1.0) %	776

$\Upsilon(3S)$

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

Mass $m = 10.3552 \pm 0.0005$ GeV
Full width $\Gamma = 26.3 \pm 3.4$ keV

$\Upsilon(3S)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\Upsilon(2S)$anything	(10.6 ± 0.8) %		296
$\Upsilon(2S)\pi^+\pi^-$	(2.8 ± 0.6) %	S=2.2	177
$\Upsilon(2S)\pi^0\pi^0$	(2.00 ± 0.32) %		190
$\Upsilon(2S)\gamma\gamma$	(5.0 ± 0.7) %		327
$\Upsilon(1S)\pi^+\pi^-$	(4.48 ± 0.21) %		813
$\Upsilon(1S)\pi^0\pi^0$	(2.06 ± 0.28) %		816
$\Upsilon(1S)\eta$	$< 2.2 \times 10^{-3}$	CL=90%	677
$\mu^+\mu^-$	(1.81 ± 0.17) %		5177
e^+e^-	seen		5178
Radiative decays			
$\gamma\,\chi_{b2}(2P)$	(11.4 ± 0.8) %	S=1.3	86
$\gamma\,\chi_{b1}(2P)$	(11.3 ± 0.6) %		100
$\gamma\,\chi_{b0}(2P)$	(5.4 ± 0.6) %	S=1.1	122

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

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

Mass $m = 10.5800 \pm 0.0035$ GeV
Full width $\Gamma = 20 \pm 4$ MeV
$\Gamma_{ee} = 0.248 \pm 0.031$ keV (S = 1.3)

$\Upsilon(4S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$B\overline{B}$	> 96 %	95%	335
non-$B\overline{B}$	< 4 %	95%	–
e^+e^-	$(2.8\pm0.7) \times 10^{-5}$		5290

$J/\psi(1S)$ anything	$<$ 1.9	$\times 10^{-4}$	95%	–
D^{*+} anything + c.c.	$<$ 7.4	%	90%	5099
ϕ anything	$<$ 2.3	$\times 10^{-3}$	90%	5240
$\Upsilon(1S)$ anything	$<$ 4	$\times 10^{-3}$	90%	1053
$\Upsilon(1S)\pi^+\pi^-$	$<$ 1.2	$\times 10^{-4}$	90%	1027
$\Upsilon(2S)\pi^+\pi^-$	$<$ 3.9	$\times 10^{-4}$	90%	469

Υ(10860)

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

Mass $m = 10.865 \pm 0.008$ GeV (S = 1.1)
Full width $\Gamma = 110 \pm 13$ MeV
$\Gamma_{ee} = 0.31 \pm 0.07$ keV (S = 1.3)

Υ(10860) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
e^+e^-	$(2.8\pm0.7) \times 10^{-6}$	5432

Υ(11020)

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

Mass $m = 11.019 \pm 0.008$ GeV
Full width $\Gamma = 79 \pm 16$ MeV
$\Gamma_{ee} = 0.130 \pm 0.030$ keV

Υ(11020) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
e^+e^-	$(1.6\pm0.5) \times 10^{-6}$	5510

NOTES

[*a*] Spectroscopic labeling for these states is theoretical, pending experimental information.