

$b\bar{b}$ MESONS

$\Upsilon(1S)$

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

Mass $m = 9460.30 \pm 0.26$ MeV ($S = 3.3$)

Full width $\Gamma = 54.02 \pm 1.25$ keV

$\Gamma_{ee} = 1.340 \pm 0.018$ keV

$\Upsilon(1S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (MeV/c)
$\tau^+ \tau^-$	(2.60±0.10) %		4384
$e^+ e^-$	(2.48±0.07) %		4730
$\mu^+ \mu^-$	(2.48±0.05) %		4729

Hadronic decays

ggg	(81.7 ±0.7) %		—
$\gamma g g$	(2.21±0.22) %		—
$\eta'(958)$ anything	(2.94±0.24) %		—
$J/\psi(1S)$ anything	(6.5 ±0.7) × 10 ⁻⁴		4223
χ_{c0} anything	< 5 × 10 ⁻³	90%	—
χ_{c1} anything	(2.3 ±0.7) × 10 ⁻⁴		—
χ_{c2} anything	(3.4 ±1.0) × 10 ⁻⁴		—
$\psi(2S)$ anything	(2.7 ±0.9) × 10 ⁻⁴		—
$\rho\pi$	< 2 × 10 ⁻⁴	90%	4697
$\pi^+ \pi^-$	< 5 × 10 ⁻⁴	90%	4728
$K^+ K^-$	< 5 × 10 ⁻⁴	90%	4704
$p\bar{p}$	< 5 × 10 ⁻⁴	90%	4636
$\pi^0 \pi^+ \pi^-$	< 1.84 × 10 ⁻⁵	90%	4725
$D^*(2010)^\pm$ anything	(2.52±0.20) %		—
\bar{d} anything	(2.86±0.28) × 10 ⁻⁵		—

Radiative decays

$\gamma\pi^+ \pi^-$	(6.3 ±1.8) × 10 ⁻⁵		4728
$\gamma\pi^0 \pi^0$	(1.7 ±0.7) × 10 ⁻⁵		4728
$\gamma\pi^0 \eta$	< 2.4 × 10 ⁻⁶	90%	4713
$\gamma K^+ K^-$	[a] (1.14±0.13) × 10 ⁻⁵		4704
$\gamma p\bar{p}$	[b] < 6 × 10 ⁻⁶	90%	4636
$\gamma 2h^+ 2h^-$	(7.0 ±1.5) × 10 ⁻⁴		4720
$\gamma 3h^+ 3h^-$	(5.4 ±2.0) × 10 ⁻⁴		4703
$\gamma 4h^+ 4h^-$	(7.4 ±3.5) × 10 ⁻⁴		4679
$\gamma\pi^+ \pi^- K^+ K^-$	(2.9 ±0.9) × 10 ⁻⁴		4686
$\gamma 2\pi^+ 2\pi^-$	(2.5 ±0.9) × 10 ⁻⁴		4720
$\gamma 3\pi^+ 3\pi^-$	(2.5 ±1.2) × 10 ⁻⁴		4703

$\gamma 2\pi^+ 2\pi^- K^+ K^-$	$(2.4 \pm 1.2) \times 10^{-4}$		4658
$\gamma \pi^+ \pi^- p \bar{p}$	$(1.5 \pm 0.6) \times 10^{-4}$		4604
$\gamma 2\pi^+ 2\pi^- p \bar{p}$	$(4 \pm 6) \times 10^{-5}$		4563
$\gamma 2K^+ 2K^-$	$(2.0 \pm 2.0) \times 10^{-5}$		4601
$\gamma \eta'(958)$	$< 1.9 \times 10^{-6}$	90%	4682
$\gamma \eta$	$< 1.0 \times 10^{-6}$	90%	4714
$\gamma f_0(980)$	$< 3 \times 10^{-5}$	90%	4679
$\gamma f_2'(1525)$	$(3.7 \begin{smallmatrix} +1.2 \\ -1.1 \end{smallmatrix}) \times 10^{-5}$		4607
$\gamma f_2(1270)$	$(1.01 \pm 0.09) \times 10^{-4}$		4644
$\gamma \eta(1405)$	$< 8.2 \times 10^{-5}$	90%	4625
$\gamma f_0(1500)$	$< 1.5 \times 10^{-5}$	90%	4610
$\gamma f_0(1710)$	$< 2.6 \times 10^{-4}$	90%	4574
$\gamma f_0(1710) \rightarrow \gamma K^+ K^-$	$< 7 \times 10^{-6}$	90%	—
$\gamma f_0(1710) \rightarrow \gamma \pi^0 \pi^0$	$< 1.4 \times 10^{-6}$	90%	—
$\gamma f_0(1710) \rightarrow \gamma \eta \eta$	$< 1.8 \times 10^{-6}$	90%	—
$\gamma f_4(2050)$	$< 5.3 \times 10^{-5}$	90%	4515
$\gamma f_0(2200) \rightarrow \gamma K^+ K^-$	$< 2 \times 10^{-4}$	90%	4475
$\gamma f_J(2220) \rightarrow \gamma K^+ K^-$	$< 8 \times 10^{-7}$	90%	4469
$\gamma f_J(2220) \rightarrow \gamma \pi^+ \pi^-$	$< 6 \times 10^{-7}$	90%	—
$\gamma f_J(2220) \rightarrow \gamma p \bar{p}$	$< 1.1 \times 10^{-6}$	90%	—
$\gamma \eta(2225) \rightarrow \gamma \phi \phi$	$< 3 \times 10^{-3}$	90%	4469
γX	[c] $< 3 \times 10^{-5}$	90%	—
$\gamma X \bar{X}$	[d] $< 1 \times 10^{-3}$	90%	—
$\gamma X \rightarrow \gamma + \geq 4 \text{ prongs}$	[e] $< 1.78 \times 10^{-4}$	95%	—
$\gamma a_1^0 \rightarrow \gamma \mu^+ \mu^-$	[f] $< 9 \times 10^{-6}$	90%	—
$\gamma a_1^0 \rightarrow \gamma \tau^+ \tau^-$	[a] $< 5.0 \times 10^{-5}$	90%	—

Lepton Flavor (LF) violating or Invisible decays

$\mu^\pm \tau^\mp$	LF	$< 6.0 \times 10^{-6}$	95%	4563
invisible		$< 3.0 \times 10^{-4}$	90%	—

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

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

Mass $m = 9859.44 \pm 0.42 \pm 0.31$ MeV

$\chi_{b0}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (MeV/c)
$\gamma \Upsilon(1S)$	< 6 %	90%	391
$D^0 X$	< 10.4 %	90%	—
$\pi^+ \pi^- K^+ K^- \pi^0$	< 1.6 $\times 10^{-4}$	90%	4875
$2\pi^+ \pi^- K^- K_S^0$	< 5 $\times 10^{-5}$	90%	4875
$2\pi^+ \pi^- K^- K_S^0 2\pi^0$	< 5 $\times 10^{-4}$	90%	4846
$2\pi^+ 2\pi^- 2\pi^0$	< 2.1 $\times 10^{-4}$	90%	4905
$2\pi^+ 2\pi^- K^+ K^-$	(1.1 ± 0.6) $\times 10^{-4}$		4861
$2\pi^+ 2\pi^- K^+ K^- \pi^0$	< 2.7 $\times 10^{-4}$	90%	4846
$2\pi^+ 2\pi^- K^+ K^- 2\pi^0$	< 5 $\times 10^{-4}$	90%	4828
$3\pi^+ 2\pi^- K^- K_S^0 \pi^0$	< 1.6 $\times 10^{-4}$	90%	4827
$3\pi^+ 3\pi^-$	< 8 $\times 10^{-5}$	90%	4904
$3\pi^+ 3\pi^- 2\pi^0$	< 6 $\times 10^{-4}$	90%	4881
$3\pi^+ 3\pi^- K^+ K^-$	(2.4 ± 1.2) $\times 10^{-4}$		4827
$3\pi^+ 3\pi^- K^+ K^- \pi^0$	< 1.0 $\times 10^{-3}$	90%	4808
$4\pi^+ 4\pi^-$	< 8 $\times 10^{-5}$	90%	4880
$4\pi^+ 4\pi^- 2\pi^0$	< 2.1 $\times 10^{-3}$	90%	4850

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

$$J^{PC} = 0^+(1^{++})$$

J needs confirmation.

$$\text{Mass } m = 9892.78 \pm 0.26 \pm 0.31 \text{ MeV}$$

$\chi_{b1}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (MeV/c)
$\gamma \Upsilon(1S)$	(35 \pm 8) %		423
$D^0 X$	(12.6 \pm 2.2) %		—
$\pi^+ \pi^- K^+ K^- \pi^0$	(2.0 \pm 0.6) $\times 10^{-4}$		4892
$2\pi^+ \pi^- K^- K_S^0$	(1.3 \pm 0.5) $\times 10^{-4}$		4892
$2\pi^+ \pi^- K^- K_S^0 2\pi^0$	< 6 $\times 10^{-4}$	90%	4863
$2\pi^+ 2\pi^- 2\pi^0$	(8.0 \pm 2.5) $\times 10^{-4}$		4921
$2\pi^+ 2\pi^- K^+ K^-$	(1.5 \pm 0.5) $\times 10^{-4}$		4878
$2\pi^+ 2\pi^- K^+ K^- \pi^0$	(3.5 \pm 1.2) $\times 10^{-4}$		4863
$2\pi^+ 2\pi^- K^+ K^- 2\pi^0$	(8.6 \pm 3.2) $\times 10^{-4}$		4845
$3\pi^+ 2\pi^- K^- K_S^0 \pi^0$	(9.3 \pm 3.3) $\times 10^{-4}$		4844
$3\pi^+ 3\pi^-$	(1.9 \pm 0.6) $\times 10^{-4}$		4921
$3\pi^+ 3\pi^- 2\pi^0$	(1.7 \pm 0.5) $\times 10^{-3}$		4898
$3\pi^+ 3\pi^- K^+ K^-$	(2.6 \pm 0.8) $\times 10^{-4}$		4844
$3\pi^+ 3\pi^- K^+ K^- \pi^0$	(7.5 \pm 2.6) $\times 10^{-4}$		4825
$4\pi^+ 4\pi^-$	(2.6 \pm 0.9) $\times 10^{-4}$		4897
$4\pi^+ 4\pi^- 2\pi^0$	(1.4 \pm 0.6) $\times 10^{-3}$		4867

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

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

Mass $m = 9912.21 \pm 0.26 \pm 0.31$ MeV

$\chi_{b2}(1P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\gamma \Upsilon(1S)$	(22 ± 4) %		442
$D^0 X$	< 7.9 %	90%	–
$\pi^+ \pi^- K^+ K^- \pi^0$	(8 ± 5) × 10 ⁻⁵		4902
$2\pi^+ \pi^- K^- K_S^0$	< 1.0 × 10 ⁻⁴	90%	4901
$2\pi^+ \pi^- K^- K_S^0 2\pi^0$	(5.3±2.4) × 10 ⁻⁴		4873
$2\pi^+ 2\pi^- 2\pi^0$	(3.5±1.4) × 10 ⁻⁴		4931
$2\pi^+ 2\pi^- K^+ K^-$	(1.1±0.4) × 10 ⁻⁴		4888
$2\pi^+ 2\pi^- K^+ K^- \pi^0$	(2.1±0.9) × 10 ⁻⁴		4872
$2\pi^+ 2\pi^- K^+ K^- 2\pi^0$	(3.9±1.8) × 10 ⁻⁴		4855
$3\pi^+ 2\pi^- K^- K_S^0 \pi^0$	< 5 × 10 ⁻⁴	90%	4854
$3\pi^+ 3\pi^-$	(7.0±3.1) × 10 ⁻⁵		4931
$3\pi^+ 3\pi^- 2\pi^0$	(1.0±0.4) × 10 ⁻³		4908
$3\pi^+ 3\pi^- K^+ K^-$	< 8 × 10 ⁻⁵	90%	4854
$3\pi^+ 3\pi^- K^+ K^- \pi^0$	(3.6±1.5) × 10 ⁻⁴		4835
$4\pi^+ 4\pi^-$	(8 ± 4) × 10 ⁻⁵		4907
$4\pi^+ 4\pi^- 2\pi^0$	(1.8±0.7) × 10 ⁻³		4877

$\Upsilon(2S)$

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

Mass $m = 10.02326 \pm 0.00031$ GeV

Full width $\Gamma = 31.98 \pm 2.63$ keV

$\Gamma_{ee} = 0.612 \pm 0.011$ keV

$\Upsilon(2S)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\Upsilon(1S) \pi^+ \pi^-$	(18.1 ± 0.4) %		475
$\Upsilon(1S) \pi^0 \pi^0$	(8.6 ± 0.4) %		480
$\tau^+ \tau^-$	(2.00± 0.21) %		4686
$\mu^+ \mu^-$	(1.93± 0.17) %	S=2.2	5011
$e^+ e^-$	(1.91± 0.16) %		5012
$\Upsilon(1S) \pi^0$	< 1.8 × 10 ⁻⁴	CL=90%	531
$\Upsilon(1S) \eta$	(2.1 ^{+0.8} _{-0.7}) × 10 ⁻⁴		126
$J/\psi(1S)$ anything	< 6 × 10 ⁻³	CL=90%	4533
\bar{d} anything	(3.4 ± 0.6) × 10 ⁻⁵		–
hadrons	(94 ± 11) %		–
$g g g$	(58.8 ± 1.2) %		–
$\gamma g g$	(1.87± 0.28) %		–

Radiative decays

$\gamma \chi_{b1}(1P)$	(6.9 ± 0.4) %	130
$\gamma \chi_{b2}(1P)$	(7.15 ± 0.35) %	110
$\gamma \chi_{b0}(1P)$	(3.8 ± 0.4) %	162
$\gamma f_0(1710)$	< 5.9 × 10 ⁻⁴ CL=90%	4864
$\gamma f'_2(1525)$	< 5.3 × 10 ⁻⁴ CL=90%	4896
$\gamma f_2(1270)$	< 2.41 × 10 ⁻⁴ CL=90%	4931
$\gamma \eta_b(1S)$	(3.9 ± 1.5) × 10 ⁻⁴	612
$\gamma X \rightarrow \gamma + \geq 4$ prongs	[h] < 1.95 × 10 ⁻⁴ CL=95%	—

Lepton Flavor (LF) violating decays

$\mu^\pm \tau^\mp$	LF < 1.44 × 10 ⁻⁵ CL=95%	4854
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$\chi_{b0}(2P)$ [g]

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

J needs confirmation.

$$\text{Mass } m = 10.2325 \pm 0.0004 \pm 0.0005 \text{ GeV}$$

$\chi_{b0}(2P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$\gamma \Upsilon(2S)$	(4.6 ± 2.1) %		207
$\gamma \Upsilon(1S)$	(9 ± 6) × 10 ⁻³		743
$D^0 X$	< 8.2 %	90%	—
$\pi^+ \pi^- K^+ K^- \pi^0$	< 3.4 × 10 ⁻⁵	90%	5064
$2\pi^+ \pi^- K^- K_S^0$	< 5 × 10 ⁻⁵	90%	5063
$2\pi^+ \pi^- K^- K_S^0 2\pi^0$	< 2.2 × 10 ⁻⁴	90%	5036
$2\pi^+ 2\pi^- 2\pi^0$	< 2.4 × 10 ⁻⁴	90%	5092
$2\pi^+ 2\pi^- K^+ K^-$	< 1.5 × 10 ⁻⁴	90%	5050
$2\pi^+ 2\pi^- K^+ K^- \pi^0$	< 2.2 × 10 ⁻⁴	90%	5035
$2\pi^+ 2\pi^- K^+ K^- 2\pi^0$	< 1.1 × 10 ⁻³	90%	5019
$3\pi^+ 2\pi^- K^- K_S^0 \pi^0$	< 7 × 10 ⁻⁴	90%	5018
$3\pi^+ 3\pi^-$	< 7 × 10 ⁻⁵	90%	5091
$3\pi^+ 3\pi^- 2\pi^0$	< 1.2 × 10 ⁻³	90%	5070
$3\pi^+ 3\pi^- K^+ K^-$	< 1.5 × 10 ⁻⁴	90%	5017
$3\pi^+ 3\pi^- K^+ K^- \pi^0$	< 7 × 10 ⁻⁴	90%	4999
$4\pi^+ 4\pi^-$	< 1.7 × 10 ⁻⁴	90%	5069
$4\pi^+ 4\pi^- 2\pi^0$	< 6 × 10 ⁻⁴	90%	5039

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

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

J needs confirmation.

$$\text{Mass } m = 10.25546 \pm 0.00022 \pm 0.00050 \text{ GeV}$$

$$m_{\chi_{b1}(2P)} - m_{\chi_{b0}(2P)} = 23.5 \pm 1.0 \text{ MeV}$$

$\chi_{b1}(2P)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor	ρ (MeV/c)
$\omega \Upsilon(1S)$	$(1.63^{+0.40}_{-0.34})\%$		135
$\gamma \Upsilon(2S)$	$(21 \pm 4)\%$	1.5	230
$\gamma \Upsilon(1S)$	$(8.5 \pm 1.3)\%$	1.3	764
$\pi\pi \chi_{b1}(1P)$	$(8.6 \pm 3.1) \times 10^{-3}$		238
$D^0 X$	$(8.8 \pm 1.7)\%$		—
$\pi^+\pi^- K^+ K^- \pi^0$	$(3.1 \pm 1.0) \times 10^{-4}$		5075
$2\pi^+\pi^- K^- K_S^0$	$(1.1 \pm 0.5) \times 10^{-4}$		5075
$2\pi^+\pi^- K^- K_S^0 2\pi^0$	$(7.7 \pm 3.2) \times 10^{-4}$		5047
$2\pi^+ 2\pi^- 2\pi^0$	$(5.9 \pm 2.0) \times 10^{-4}$		5104
$2\pi^+ 2\pi^- K^+ K^-$	$(10 \pm 4) \times 10^{-5}$		5062
$2\pi^+ 2\pi^- K^+ K^- \pi^0$	$(5.5 \pm 1.8) \times 10^{-4}$		5047
$2\pi^+ 2\pi^- K^+ K^- 2\pi^0$	$(10 \pm 4) \times 10^{-4}$		5030
$3\pi^+ 2\pi^- K^- K_S^0 \pi^0$	$(6.7 \pm 2.6) \times 10^{-4}$		5029
$3\pi^+ 3\pi^-$	$(1.2 \pm 0.4) \times 10^{-4}$		5103
$3\pi^+ 3\pi^- 2\pi^0$	$(1.2 \pm 0.4) \times 10^{-3}$		5081
$3\pi^+ 3\pi^- K^+ K^-$	$(2.0 \pm 0.8) \times 10^{-4}$		5029
$3\pi^+ 3\pi^- K^+ K^- \pi^0$	$(6.1 \pm 2.2) \times 10^{-4}$		5011
$4\pi^+ 4\pi^-$	$(1.7 \pm 0.6) \times 10^{-4}$		5080
$4\pi^+ 4\pi^- 2\pi^0$	$(1.9 \pm 0.7) \times 10^{-3}$		5051

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

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

J needs confirmation.

$$\text{Mass } m = 10.26865 \pm 0.00022 \pm 0.00050 \text{ GeV}$$

$$m_{\chi_{b2}(2P)} - m_{\chi_{b1}(2P)} = 13.5 \pm 0.6 \text{ MeV}$$

$\chi_{b2}(2P)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	ρ (MeV/c)
$\omega \Upsilon(1S)$	$(1.10^{+0.34}_{-0.30})\%$		194
$\gamma \Upsilon(2S)$	$(16.2 \pm 2.4)\%$		242
$\gamma \Upsilon(1S)$	$(7.1 \pm 1.0)\%$		777
$\pi\pi \chi_{b2}(1P)$	$(6.0 \pm 2.1) \times 10^{-3}$		229
$D^0 X$	$< 2.4\%$	90%	—
$\pi^+\pi^- K^+ K^- \pi^0$	$< 1.1 \times 10^{-4}$	90%	5082
$2\pi^+\pi^- K^- K_S^0$	$< 9 \times 10^{-5}$	90%	5082
$2\pi^+\pi^- K^- K_S^0 2\pi^0$	$< 7 \times 10^{-4}$	90%	5054
$2\pi^+ 2\pi^- 2\pi^0$	$(3.9 \pm 1.6) \times 10^{-4}$		5110
$2\pi^+ 2\pi^- K^+ K^-$	$(9 \pm 4) \times 10^{-5}$		5068
$2\pi^+ 2\pi^- K^+ K^- \pi^0$	$(2.4 \pm 1.1) \times 10^{-4}$		5054

$2\pi^+ 2\pi^- K^+ K^- 2\pi^0$	$(4.7 \pm 2.3) \times 10^{-4}$		5037
$3\pi^+ 2\pi^- K^- K_S^0 \pi^0$	$< 4 \times 10^{-4}$	90%	5036
$3\pi^+ 3\pi^-$	$(9 \pm 4) \times 10^{-5}$		5110
$3\pi^+ 3\pi^- 2\pi^0$	$(1.2 \pm 0.4) \times 10^{-3}$		5088
$3\pi^+ 3\pi^- K^+ K^-$	$(1.4 \pm 0.7) \times 10^{-4}$		5036
$3\pi^+ 3\pi^- K^+ K^- \pi^0$	$(4.2 \pm 1.7) \times 10^{-4}$		5017
$4\pi^+ 4\pi^-$	$(9 \pm 5) \times 10^{-5}$		5087
$4\pi^+ 4\pi^- 2\pi^0$	$(1.3 \pm 0.5) \times 10^{-3}$		5058

$\Upsilon(3S)$

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

Mass $m = 10.3552 \pm 0.0005$ GeV

Full width $\Gamma = 20.32 \pm 1.85$ keV

$\Gamma_{ee} = 0.443 \pm 0.008$ keV

$\Upsilon(3S)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)
$\Upsilon(2S)$ anything	$(10.6 \pm 0.8) \%$		296
$\Upsilon(2S) \pi^+ \pi^-$	$(2.45 \pm 0.23) \%$	S=1.1	177
$\Upsilon(2S) \pi^0 \pi^0$	$(1.85 \pm 0.14) \%$		190
$\Upsilon(2S) \gamma \gamma$	$(5.0 \pm 0.7) \%$		327
$\Upsilon(2S) \pi^0$	$< 5.1 \times 10^{-4}$	CL=90%	298
$\Upsilon(1S) \pi^+ \pi^-$	$(4.40 \pm 0.10) \%$		813
$\Upsilon(1S) \pi^0 \pi^0$	$(2.20 \pm 0.13) \%$		816
$\Upsilon(1S) \eta$	$< 1.8 \times 10^{-4}$	CL=90%	677
$\Upsilon(1S) \pi^0$	$< 7 \times 10^{-5}$	CL=90%	846
$\tau^+ \tau^-$	$(2.29 \pm 0.30) \%$		4863
$\mu^+ \mu^-$	$(2.18 \pm 0.21) \%$	S=2.1	5177
$e^+ e^-$	seen		5178
$g g g$	$(35.7 \pm 2.6) \%$		-
$\gamma g g$	$(9.7 \pm 1.8) \times 10^{-3}$		-

Radiative decays

$\gamma \chi_{b2}(2P)$	$(13.1 \pm 1.6) \%$	S=3.4	86
$\gamma \chi_{b1}(2P)$	$(12.6 \pm 1.2) \%$	S=2.4	99
$\gamma \chi_{b0}(2P)$	$(5.9 \pm 0.6) \%$	S=1.4	122
$\gamma \chi_{b2}(1P)$	$< 1.9 \%$	CL=90%	434
$\gamma \chi_{b1}(1P)$	$< 1.7 \times 10^{-3}$	CL=90%	452
$\gamma \chi_{b0}(1P)$	$(3.0 \pm 1.1) \times 10^{-3}$		484
$\gamma \eta_b(2S)$	$< 6.2 \times 10^{-4}$	CL=90%	-
$\gamma \eta_b(1S)$	$(5.1 \pm 0.7) \times 10^{-4}$		919
$\gamma X \rightarrow \gamma + \geq 4$ prongs	$[i] < 2.2 \times 10^{-4}$	CL=95%	-
$\gamma a_1^0 \rightarrow \gamma \tau^+ \tau^-$	$[j] < 1.6 \times 10^{-4}$	CL=90%	-

Lepton Flavor (LF) violating decays

$\mu^\pm \tau^\mp$ LF < 2.03 $\times 10^{-5}$ $CL=95\%$ 5025

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

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

Mass $m = 10.5794 \pm 0.0012$ GeV
 Full width $\Gamma = 20.5 \pm 2.5$ MeV
 $\Gamma_{ee} = 0.272 \pm 0.029$ keV ($S = 1.5$)

$\Upsilon(4S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	P (MeV/c)
$B\bar{B}$	> 96 %	95%	328
B^+B^-	(51.6 ± 0.6) %		334
D_S^+ anything + c.c.	(17.8 ± 2.6) %		—
$B^0\bar{B}^0$	(48.4 ± 0.6) %		328
$J/\psi K_S^0 (J/\psi, \eta_c) K_S^0$	< 4 $\times 10^{-7}$	90%	—
non- $B\bar{B}$	< 4 %	95%	—
e^+e^-	$(1.57 \pm 0.08) \times 10^{-5}$		5290
$\rho^+\rho^-$	< 5.7 $\times 10^{-6}$	90%	5233
$J/\psi(1S)$ anything	< 1.9 $\times 10^{-4}$	95%	—
D^{*+} anything + c.c.	< 7.4 %	90%	5099
ϕ anything	(7.1 ± 0.6) %		5240
$\phi\eta$	< 1.8 $\times 10^{-6}$	90%	5226
$\phi\eta'$	< 4.3 $\times 10^{-6}$	90%	5196
$\rho\eta$	< 1.3 $\times 10^{-6}$	90%	5247
$\rho\eta'$	< 2.5 $\times 10^{-6}$	90%	5217
$\Upsilon(1S)$ anything	< 4 $\times 10^{-3}$	90%	1053
$\Upsilon(1S)\pi^+\pi^-$	$(8.1 \pm 0.6) \times 10^{-5}$		1026
$\Upsilon(1S)\eta$	$(1.96 \pm 0.11) \times 10^{-4}$		924
$\Upsilon(2S)\pi^+\pi^-$	$(8.6 \pm 1.3) \times 10^{-5}$		468
\bar{d} anything	< 1.3 $\times 10^{-5}$	90%	—

$\Upsilon(10860)$

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

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 ($S = 1.3$)

$\Upsilon(10860)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$e^+ e^-$	$(2.8 \pm 0.7) \times 10^{-6}$		5432
$B\bar{B}X$	$(59 \pm 14) \%$		—
$B\bar{B}$	< 13.8	%	90% 1280
$B\bar{B}^* + \text{c.c.}$	$(14 \pm 6) \%$		—
$B^*\bar{B}^*$	$(44 \pm 11) \%$		—
$B\bar{B}^{(*)}\pi$	< 19.7	%	90% —
$B\bar{B}\pi\pi$	< 8.9	%	90% 442
$B_s^{(*)}\bar{B}_s^{(*)}$	$(19.3 \pm 2.9) \%$		—
$B_s\bar{B}_s$	$(5 \pm 5) \times 10^{-3}$		—
$B_s\bar{B}_s^* + \text{c.c.}$	$(1.4 \pm 0.6) \%$		—
$B_s^*\bar{B}_s^*$	$(17.4 \pm 2.7) \%$		—
$\Upsilon(1S)\pi^+\pi^-$	$(5.3 \pm 0.6) \times 10^{-3}$		1288
$\Upsilon(2S)\pi^+\pi^-$	$(7.8 \pm 1.3) \times 10^{-3}$		763
$\Upsilon(3S)\pi^+\pi^-$	$(4.8 \pm_{-1.7}^{+1.9}) \times 10^{-3}$		416
$\Upsilon(1S)K^+K^-$	$(6.1 \pm 1.8) \times 10^{-4}$		933

Inclusive Decays.

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

ϕ anything	$(13.8 \pm_{-1.7}^{+2.4}) \%$	—
D^0 anything + c.c.	$(108 \pm 8) \%$	—
D_s anything + c.c.	$(46 \pm 6) \%$	—
J/ψ anything	$(2.06 \pm 0.21) \%$	—

$\Upsilon(11020)$

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

Mass $m = 11.019 \pm 0.008$ GeV

Full width $\Gamma = 79 \pm 16$ MeV

$\Gamma_{ee} = 0.130 \pm 0.030$ keV

$\Upsilon(11020)$ DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)
$e^+ e^-$	$(1.6 \pm 0.5) \times 10^{-6}$	5510

NOTES

- [a] $2m_\tau < M(\tau^+\tau^-) < 7500$ MeV.
- [b] $2 < m_{K^+K^-} < 3$ GeV.
- [c] X = pseudoscalar with $m < 7.2$ GeV
- [d] $X\bar{X}$ = vectors with $m < 3.1$ GeV
- [e] 1.5 GeV $< m_X < 5.0$ GeV
- [f] $201 < M(\mu^+\mu^-) < 3565$ MeV.
- [g] Spectroscopic labeling for these states is theoretical, pending experimental information.
- [h] 1.5 GeV $< m_X < 5.0$ GeV
- [i] 1.5 GeV $< m_X < 5.0$ GeV
- [j] For $m_{\tau^+\tau^-}$ in the ranges 4.03–9.52 and 9.61–10.10 GeV.