$\Upsilon(3S)$ or $\Upsilon(10355)$

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

Mass $m = 10.3553 \pm 0.0005$ GeV
Full width $\Gamma = 26.3 \pm 3.5$ keV

$\Upsilon(3S)$ DECAY MODES	Fraction (Γ_i/Γ)	Scale factor	p (MeV/c)
$\Upsilon(2S)$ anything	(10.6 $\pm$0.8) %		296
$\Upsilon(2S)\pi^+\pi^-$	(2.8 $\pm$0.6) %	2.2	177
$\Upsilon(2S)\pi^0\pi^0$	(2.00$\pm$0.32) %		190
$\Upsilon(2S)\gamma\gamma$	(5.0 $\pm$0.7) %		–
$\Upsilon(1S)\pi^+\pi^-$	(4.48$\pm$0.21) %		814
$\Upsilon(1S)\pi^0\pi^0$	(2.06$\pm$0.28) %		816
$\mu^+\mu^-$	(1.81$\pm$0.17) %		5177
e^+e^-	seen		5177
Radiative decays			
$\gamma\chi_{b2}(2P)$	(11.4 $\pm$0.8) %	1.3	87
$\gamma\chi_{b1}(2P)$	(11.3 $\pm$0.6) %		100
$\gamma\chi_{b0}(2P)$	(5.4 $\pm$0.6) %	1.1	123

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

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

Mass $m = 10.5800 \pm 0.0035$ GeV
Full width $\Gamma = 23.8 \pm 2.2$ MeV
$\Gamma_{ee} = 0.24 \pm 0.05$ keV (S = 1.7)

$\Upsilon(4S)$ DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
e^+e^-	$(1.01\pm0.21) \times 10^{-5}$		5290
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

$\Upsilon(10860)$

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

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)	p (MeV/c)
e^+e^-	$(2.8\pm0.7) \times 10^{-6}$	5432

$\Upsilon(11020)$

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

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^-	$(1.6\pm0.5) \times 10^{-6}$	5509

Searches for Top and Fourth Generation Hadrons

See the sections "Searches for t Quark" and "Searches for b' (4^{th} Generation) Quark" at the end of the QUARKS section.

NOTES

In this Summary Table:

When a quantity has "(S = ...)" to its right, the error on the quantity has been enlarged by the "scale factor" S, defined as S $= \sqrt{\chi^2/(N-1)}$, where N is the number of measurements used in calculating the quantity. We do this when S > 1, which often indicates that the measurements are inconsistent. When S > 1.25, we also show in the Full Listings an ideogram of the measurements. For more about S, see the Introduction.

A decay momentum p is given for each decay mode. For a 2-body decay, p is the momentum of each decay product in the rest frame of the decaying particle. For a 3-or-more-body decay, p is the largest momentum any of the products can have in this frame.

[a] The $\pi^\pm$ mass has increased by three (old) standard deviations since our 1992 edition, and the π^0 mass, which is determined using the mass difference ($m_{\pi^\pm} - m_{\pi^0}$), has increased accordingly. See the "Note on the Charged Pion Mass" in the $\pi^\pm$ Full Listings for a discussion.

[b] See the "Note on $\pi^\pm \to \ell^\pm\nu\gamma$ and $K^\pm \to \ell^\pm\nu\gamma$ Form Factors" in the $\pi^\pm$ Full Listings for definitions and details.

[c] Measurements of $\Gamma(e^+\nu_e)/\Gamma(\mu^+\nu_\mu)$ always include decays with γ's, and measurements of $\Gamma(e^+\nu_e\gamma)$ and $\Gamma(\mu^+\nu_\mu\gamma)$ never include low-energy γ's. Therefore, since no clean separation is possible, we consider the modes with γ's to be subreactions of the modes without them, and let $[\Gamma(e^+\nu_e) + \Gamma(\mu^+\nu_\mu)]/\Gamma_{\text{total}} = 100\%$.

[d] See the $\pi^\pm$ Full Listings for the energy limits used in this measurement; low-energy γ's are not included.

[e] Derived from an analysis of neutrino-oscillation experiments.

[f] Astrophysical and cosmological arguments give limits of order 10^{-13}; see the π^0 Full Listings.

[g] See the "Note on the Decay Width $\Gamma(\eta \to \gamma\gamma)$" in the η Full Listings.

[h] See the "Note on η Decay Parameters" in the η Full Listings.

[i] C parity forbids this to occur as a single-photon process.

[j] The e^+e^- branching fraction is from $e^+e^- \to \pi^+\pi^-$ experiments only. The $\omega\rho$ interference is then due to $\omega\rho$ mixing only, and is expected to be small. If $e\mu$ universality holds, $\Gamma(\rho^0 \to \mu^+\mu^-) = \Gamma(\rho^0 \to e^+e^-) \times 0.99785$.

[k] This is only an educated guess; the error given is larger than the error on the average of the published values. See the Full Listings for details.

[l] See the "Note on the $f_1(1420)$" in the $f_1(1420)$ Full Listings.

[m] See also the $\omega(1600)$ Full Listings.

[n] See the "Note on the $\eta(1440)$" in the $\eta(1440)$ Full Listings.

[o] See the "Note on the $\rho(1450)$ and the $\rho(1700)$" in the $\rho(1700)$ Full Listings.

[p] See also the $\omega(1420)$ Full Listings.

[q] The value is for the sum of the charge states indicated.

[r] The definition of the slope parameter g of the $K \to 3\pi$ Dalitz plot is as follows (see also "Note on Dalitz Plot Parameters for $K \to 3\pi$ Decays" in the $K^\pm$ Full Listings):

$$|M|^2 = 1 + g(s_3 - s_0)/m_{\pi^+}^2 + \cdots .$$

[s] For more details and definitions of parameters see the Full Listings.

[t] See the $K^\pm$ Full Listings for the energy limits used in this measurement.

[u] Most of this radiative mode, the low-momentum γ part, is also included in the parent mode listed without γ's.

[v] Direct-emission branching fraction.