$\Upsilon(11020)$

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

$\Upsilon(11020)$ MASS

VALUE (GeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
11.019±0.008 OUR AVERAGE				
11.019±0.005±0.007	BESSON	85	CLEO	$e^+e^- \rightarrow$ hadrons
11.020±0.030	LOVELOCK	85	CUSB	$e^+e^- \rightarrow$ hadrons

$\Upsilon(11020)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
79 ±16 OUR AVERAGE				
61.0±13 ±22	BESSON	85	CLEO	$e^+e^- \rightarrow$ hadrons
90.0±20.0	LOVELOCK	85	CUSB	$e^+e^- \rightarrow$ hadrons

$\Upsilon(11020)$ DECAY MODES

	Mode	Fraction (Γ_i/Γ)
Γ_1	e^+e^-	$(1.6\pm0.5)\times10^{-6}$

$\Upsilon(11020)$ PARTIAL WIDTHS

$\Gamma(e^+e^-)$ Γ_1

VALUE (keV)	*DOCUMENT ID*		*TECN*	*COMMENT*
0.130±0.030 OUR AVERAGE				
0.095±0.03 ±0.035	BESSON	85	CLEO	$e^+e^- \rightarrow$ hadrons
0.156±0.040	LOVELOCK	85	CUSB	$e^+e^- \rightarrow$ hadrons

$\Upsilon(11020)$ REFERENCES

BESSON	85	PRL 54 381	+Green, Namjoshi, Sannes+	(CLEO Collab.)
LOVELOCK	85	PRL 54 377	+Horstkotte, Klopfenstein+	(CUSB Collab.)

NON-$q\overline{q}$ CANDIDATES

We include here mini-reviews and reference lists on gluonium and other non-$q\overline{q}$ candidates. See also $N\overline{N}$(1100–3600) for possible bound states.

NOTE ON NON-$q\overline{q}$ MESONS

The existence of a gluon self coupling in QCD suggests that, in addition to conventional $q\overline{q}$ meson states, there may exist bound states including gluons: gluonia or glueballs, and hybrids ($q\overline{q}g$). Another example of non-$q\overline{q}$ mesons is multi-quark states. For detailed reviews, see, *e.g.*, HEUSCH 86, CLOSE 87, TOKI 88, GODFREY 89, BURNETT 90. Theoretical guidance for the properties of these states is somewhat contradictory, and models often differ in detailed predictions.

Among the signatures naively expected for glueballs are:

(i) No place in $q\overline{q}$ nonets;
(ii) Flavor-singlet couplings;
(iii) Enhanced production in gluon-rich channels such as $J/\psi(1S)$ decay;
(iv) Reduced $\gamma\gamma$ coupling;
(v) Exotic quantum numbers not allowed for $q\overline{q}$ (in some cases).

However, mixing effects, and other dynamical effects such as form factors, may obscure these simple signatures. If the mixing is large, only overpopulation of the spectrum relative to the number of states predicted by the $q\overline{q}$ quark model remains as a clear signal for non-exotic non-$q\overline{q}$ states. Exotic quantum numbers ($J^{PC} = 0^{--}, 0^{+-}, 1^{-+}, 2^{+-}\cdots$) would be the best signature for non-$q\overline{q}$ states.

Lattice gauge theory calculations in the quenched approximation (without quark loops) predict the lightest glueball to be a scalar with a mass of typically 1550±50 MeV (BALI 93). The same calculation finds a tensor glueball mass of 2270±100 MeV, and glueballs with other spin parities, which include the J^{PC}-exotics, are predicted to be still heavier. The inclusion of dynamical quarks will change the predicted masses through couplings to decay channels. Very little is known about the expected widths, which may conceivably be very large.

Hybrid mesons are $q\overline{q}$ states combined with a gluonic excitation (BARNES 82, CHANOWITZ 83, ISGUR 85). Experimentally, these are more attractive than glueballs because they span flavor nonets, and are predicted to have characteristic decay modes (LEYAOUANC 85), and a $J^{PC} = 1^{-+}$ exotic hybrid is expected in all models. The masses of the lightest hybrids are typically predicted to be in the range 1500–2000 MeV.

The third class of non-$q\overline{q}$ states are the multiquark states, which can be either baglike or clusters of mesons (VOLOSHIN 76, JAFFE 77, GUTBROD 79). A subclass of the latter are the deuteronlike meson-meson bound states, or deusons, where the long-range pion exchange is the major source of binding (TORNQVIST 91 and 94, ERICSON 93, MANOHAR 93). Many of the best non-$q\overline{q}$ candidates discussed below lie close to