QUARKS

The u-, d-, and s-quark masses are estimates of so-called "current-quark masses," in a mass-independent subtraction scheme such as $\overline{\text{MS}}$ at a scale $\mu \approx 2$ GeV. The c- and b-quark masses are the "running" masses in the $\overline{\text{MS}}$ scheme. For the b-quark we also quote the 1S mass. These can be different from the heavy quark masses obtained in potential models.

u

$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$

Mass $m = 1.5$ to 3.0 MeV [a] Charge $= \frac{2}{3}\ e$ $I_z = +\frac{1}{2}$

$m_u/m_d = 0.3$ to 0.6

d

$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$

Mass $m = 3$ to 7 MeV [a] Charge $= -\frac{1}{3}\ e$ $I_z = -\frac{1}{2}$

$m_s/m_d = 17$ to 22

$\overline{m} = (m_u + m_d)/2 = 2.5$ to 5.5 MeV

s

$I(J^P) = 0(\frac{1}{2}^+)$

Mass $m = 95 \pm 25$ MeV [a] Charge $= -\frac{1}{3}\ e$ Strangeness $= -1$

$(m_s - (m_u + m_d)/2)/(m_d - m_u) = 30$ to 50

c

$I(J^P) = 0(\frac{1}{2}^+)$

Mass $m = 1.25 \pm 0.09$ GeV Charge $= \frac{2}{3}\ e$ Charm $= +1$

b

$I(J^P) = 0(\frac{1}{2}^+)$

Charge $= -\frac{1}{3}\ e$ Bottom $= -1$

Mass $m = 4.20 \pm 0.07$ GeV ($\overline{\text{MS}}$ mass)

Mass $m = 4.70 \pm 0.07$ GeV (1S mass)

t

$I(J^P) = 0(\frac{1}{2}^+)$

Charge $= \frac{2}{3}\ e$ Top $= +1$

Mass $m = 174.2 \pm 3.3$ GeV [b] (direct observation of top events)
Mass $m = 172.3^{+10.2}_{-7.6}$ GeV (Standard Model electroweak fit)

t DECAY MODES		Fraction (Γ_i/Γ)		Confidence level	p (MeV/c)
$W\,q\,(q = b,\ s,\ d)$					–
$W\,b$					–
$\ell\,\nu_\ell$ anything	[c,d]	(9.4±2.4) %			–
$\tau\,\nu_\tau\,b$					–
$\gamma\,q\,(q{=}u,c)$	[e]	< 5.9	$\times 10^{-3}$	95%	–
$\Delta T = 1$ weak neutral current ($T1$) modes					
$Z\,q\,(q{=}u,c)$	$T1$	[f] < 13.7	%	95%	–

b' (4th Generation) Quark, Searches for

Mass $m >$ 190 GeV, CL = 95% ($p\overline{p}$, quasi-stable b')
Mass $m >$ 199 GeV, CL = 95% ($p\overline{p}$, neutral-current decays)
Mass $m >$ 128 GeV, CL = 95% ($p\overline{p}$, charged-current decays)
Mass $m >$ 46.0 GeV, CL = 95% (e^+e^-, all decays)

Free Quark Searches

All searches since 1977 have had negative results.

NOTES

[*a*] The ratios m_u/m_d and m_s/m_d are extracted from pion and kaon masses using chiral symmetry. The estimates of u and d masses are not without controversy and remain under active investigation. Within the literature there are even suggestions that the u quark could be essentially massless. The s-quark mass is estimated from SU(3) splittings in hadron masses.

[*b*] Based on published top mass measurements using data from Tevatron Run-I and Run-II. Including also the most recent unpublished results from Run-II, the Tevatron Electroweak Working Group reports a top mass of 172.5 $\pm$ 1.3 $\pm$ 1.9 GeV. See the note "The Top Quark" in the Quark Particle Listings of this *Review*.

[*c*] ℓ means e or μ decay mode, not the sum over them.

[*d*] Assumes lepton universality and W-decay acceptance.

[*e*] This limit is for $\Gamma(t \to \gamma q)/\Gamma(t \to W b)$.

[*f*] This limit is for $\Gamma(t \to Z q)/\Gamma(t \to W b)$.