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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 4 MeV [a] Charge $= \frac{2}{3}\ e$ $I_z = +\frac{1}{2}$

$m_u/m_d = 0.3$ to 0.7

d

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

Mass $m = 4$ to 8 MeV [a] Charge $= -\frac{1}{3}\ e$ $I_z = -\frac{1}{2}$

$m_s/m_d = 17$ to 22

$\overline{m} = (m_u + m_d)/2 = 3.0$ to 5.5 MeV

s

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

Mass $m = 80$ to 130 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 $m = 1.15$ to 1.35 GeV Charge $= \frac{2}{3}\ e$ Charm $= +1$

b

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

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

Mass $m = 4.1$ to 4.4 GeV ($\overline{\text{MS}}$ mass)
Mass $m = 4.6$ to 4.9 GeV (1S mass)

t

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

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

Mass $m = 174.3 \pm 5.1$ GeV (direct observation of top events)
Mass $m = 178.1^{+10.4}_{-\ 8.3}$ 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		[b,c] (9.4±2.4) %		–
$\tau \nu_\tau b$				–
$\gamma q (q=u,c)$		[d] $< 5.9 \times 10^{-3}$	95%	–
$\Delta T = 1$ weak neutral current (*T1*) modes				
$Z q (q=u,c)$	*T1*	[e] < 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] ℓ means e or μ decay mode, not the sum over them.

[c] Assumes lepton universality and W-decay acceptance.

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

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