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 estimated from charmonium, bottomonium, D, and B masses. They are the "running" masses in the $\overline{\text{MS}}$ scheme. 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 5 MeV [a] Charge $= \frac{2}{3}\ e$ $I_z = +\frac{1}{2}$

$m_u/m_d = 0.20$ to 0.70

d

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

Mass $m = 3$ to 9 MeV [a] Charge $= -\frac{1}{3}\ e$ $I_z = -\frac{1}{2}$

$m_s/m_d = 17$ to 25

$\overline{m} = (m_u + m_d)/2 = 2$ to 6 MeV

s

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

Mass $m = 60$ to 170 MeV [a] Charge $= -\frac{1}{3}\ e$ Strangeness $= -1$

$(m_s - (m_u + m_d)/2)/(m_d - m_u) = 34$ to 51

c

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

Mass $m = 1.1$ to 1.4 GeV Charge $= \frac{2}{3}\ e$ Charm $= +1$

b

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

Mass $m = 4.1$ to 4.4 GeV Charge $= -\frac{1}{3}\ e$ Bottom $= -1$

t

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

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

Mass $m = 173.8 \pm 5.2$ GeV (direct observation of top events)
Mass $m = 170 \pm 7\ (+14)$ GeV (Standard Model electroweak fit, assuming $M_H = M_Z$. Number in parentheses is shift from changing M_H to 300 GeV.

b′ (4*th* Generation) Quark, Searches for

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.