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

$m_u/m_d = 0.2$ to 0.7

d

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

Mass $m = 5$ to 8.5 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 $m = 80$ to 155 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 $m = 1.0$ to 1.4 GeV Charge $= \frac{2}{3}\ e$ Charm $= +1$

b

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

Mass $m = 4.0$ to 4.5 GeV Charge $= -\frac{1}{3}\ e$ Bottom $= -1$

t

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

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

Mass $m = 174.3 \pm 5.1$ GeV (direct observation of top events)
Mass $m = = 178.1^{+10.4}_{-8.3}$ GeV (Standard Model electroweak fit)

t DECAY MODES		Fraction (Γ_j/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]	< 3.2 %	95%	–
$\Delta T = 1$ weak neutral current (*T1*) modes				
$Z\,q(q{=}u,c)$	*T1* [e]	< 13.7 %	95%	–

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

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 $\Gamma(t \to Z\,q)/\Gamma(t \to W\,b)$.