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

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

$m_u = 2.3^{+0.7}_{-0.5}$ MeV Charge $= \frac{2}{3}\ e$ $I_z = +\frac{1}{2}$

$m_u/m_d = 0.38$–0.58

d

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

$m_d = 4.8^{+0.5}_{-0.3}$ MeV Charge $= -\frac{1}{3}\ e$ $I_z = -\frac{1}{2}$

$m_s/m_d = 17$–22

$\overline{m} = (m_u+m_d)/2 = 3.5^{+0.7}_{-0.2}$ MeV

s

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

$m_s = 95 \pm 5$ MeV Charge $= -\frac{1}{3}\ e$ Strangeness $= -1$

$m_s\ /\ ((m_u + m_d)/2) = 27.5 \pm 1.0$

c

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

$m_c = 1.275 \pm 0.025$ GeV Charge $= \frac{2}{3}\ e$ Charm $= +1$

b

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

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

$m_b(\overline{\text{MS}}) = 4.18 \pm 0.03$ GeV

$m_b(1\text{S}) = 4.66 \pm 0.03$ GeV

t

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

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

Mass (direct measurements) $m = 173.07 \pm 0.52 \pm 0.72$ GeV [a,b]
Mass ($\overline{\text{MS}}$ from cross-section measurements) $m = 160^{+5}_{-4}$ GeV [a]
$m_t - m_{\overline{t}} = -0.6 \pm 0.6$ GeV (S = 1.2)
Full width $\Gamma = 2.0 \pm 0.5$ GeV
$\Gamma(W\,b)/\Gamma(W\,q(q = b,\ s,\ d)) = 0.91 \pm 0.04$

t-quark EW Couplings

$F_0 = 0.70 \pm 0.05$
$F_- = 0.32 \pm 0.04$
$F_+ = -0.017 \pm 0.028$
$F_{V+A} < 0.29$, CL = 95%

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) %		–
$\gamma\,q(q{=}u,c)$	[e]	$< 5.9 \times 10^{-3}$	95%	–
$\Delta T = 1$ weak neutral current (*T1*) modes				
$Z\,q(q{=}u,c)$	*T1* [f]	$< 2.1 \times 10^{-3}$	95%	–

b′ (4*th* 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)

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

Mass $m >$ 685 GeV, CL = 95% ($p\overline{p}$, $t'\overline{t}'$ prod., $t' \to W\,q$)
Mass m

Free Quark Searches

All searches since 1977 have had negative results.

NOTES

[*a*] A discussion of the definition of the top quark mass in these measurements can be found in the review "The Top Quark."

[*b*] Based on published top mass measurements using data from Tevatron Run-I and Run-II and LHC at $\sqrt{s} = 7$ TeV. Including the most recent unpublished results from Tevatron Run-II, the Tevatron Electroweak Working Group reports a top mass of 173.2 $\pm$ 0.9 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 $\Gamma(t \to Z q)/\Gamma(t \to W b)$.