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.

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u

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

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

$m_u/m_d = 0.38\text{–}0.58$

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d

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

$m_d = 4.8^{+0.7}_{-0.3}$ MeV $\qquad$ Charge $= -\tfrac{1}{3}\, e \quad I_z = -\tfrac{1}{2}$

$m_s/m_d = 17\text{–}22$

$\overline{m} = (m_u + m_d)/2 = 3.2\text{–}4.4$ MeV

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s

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

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

$m_s\, /\, ((m_u + m_d)/2) = 27 \pm 1$

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c

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

$m_c = 1.275 \pm 0.025$ GeV $\qquad$ Charge $= \tfrac{2}{3}\, e \quad$ Charm $= +1$

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b

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

Charge $= -\tfrac{1}{3}\, e \qquad\qquad$ Bottom $= -1$

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

$m_b(\text{1S}) \;= 4.65 \pm 0.03$ GeV

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t

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

Charge $= \tfrac{2}{3}\, e \qquad\qquad$ Top $= +1$

Mass (direct measurements) $m = 173.5 \pm 0.6 \pm 0.8$ GeV [a,b]

Mass ($\overline{\text{MS}}$ from cross-section measurements) $m = 160^{+5}_{-4}$ GeV [a]

$m_t - m_{\bar{t}} = -1.4 \pm 2.0$ GeV (S = 1.6)

Full width $\Gamma = 2.0^{+0.7}_{-0.6}$ GeV

$\Gamma(W\,b)/\Gamma(W\,q(q = b,\, s,\, d)) = 0.91 \pm 0.04$

t DECAY MODES		Fraction (Γ_i/Γ)		Confidence level	p (MeV/c)
$W\,q(q = b,\, s,\, d)$					−
$\quad W\,b$					−
$\quad\quad \ell\,\nu_\ell$ 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]	< 3.2	%	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)

t' (4th Generation) Quark, Searches for

Mass m ($p\overline{p}$, $t'\overline{t}'$ 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 ± 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 $\Gamma(t \to Z q)/\Gamma(t \to W b)$.