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.

NODE=QXXX005

u

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

NODE=Q002

Mass $m = 1.5$ to 3.3 MeV [a] Charge $= \frac{2}{3}\ e$ $I_z = +\frac{1}{2}$

$m_u/m_d = 0.35$ to 0.60

NODE=Q002M;DTYPE=M;OUR EVAL; → NOT CHECKED ←
NODE=Q002MR;DTYPE=z;OUR EVAL; → NOT CHECKED ←

d

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

NODE=Q001

Mass $m = 3.5$ to 6.0 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 5.0 MeV

NODE=Q001M;DTYPE=M;OUR EVAL; → NOT CHECKED ←
NODE=Q001MR;DTYPE=z;OUR EVAL; → NOT CHECKED ←
NODE=Q001MR4;DTYPE=z;OUR EVAL; → NOT CHECKED ←

s

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

NODE=Q003

Mass $m = 104^{+26}_{-34}$ MeV [a] Charge $= -\frac{1}{3}\ e$ Strangeness $= -1$

$(m_s - (m_u + m_d)/2)/(m_d - m_u) = 30$ to 50

NODE=Q003M;DTYPE=M;OUR EVAL; → NOT CHECKED ←
NODE=Q003MR2;DTYPE=z;OUR EVAL; → NOT CHECKED ←

c

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

NODE=Q004

Mass $m = 1.27^{+0.07}_{-0.11}$ GeV Charge $= \frac{2}{3}\ e$ Charm $= +1$

NODE=Q004M;DTYPE=M;OUR EVAL; → NOT CHECKED ←

b

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

NODE=Q005

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

Mass $m = 4.20^{+0.17}_{-0.07}$ GeV ($\overline{\text{MS}}$ mass)

NODE=Q005MSB;DTYPE=M;OUR EVAL; → NOT CHECKED ←

t

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

NODE=Q007

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

Mass $m = 171.2 \pm 2.1$ GeV [b] (direct observation of top events)

NODE=Q007TP;DTYPE=M;CLUMP=A; OUR EVAL;→ NOT CHECKED ←

t DECAY MODES		Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)	
$W q (q = b, s, d)$				–	NODE=Q007240;DESIG=6;OUR EST; → NOT CHECKED ←
$W b$				–	DESIG=1;OUR EST;→ NOT CHECKED ←
$\ell \nu_\ell$ anything		[c,d] (9.4±2.4) %		–	DESIG=5
$\gamma q (q=u,c)$		[e] < 5.9 $\times 10^{-3}$	95%	–	DESIG=3
$\Delta T = 1$ weak neutral current ($T1$) modes					NODE=Q007;CLUMP=A
$Z q (q=u,c)$	$T1$	[f] < 13.7 %	95%	–	DESIG=2

b' (4[th] Generation) Quark, Searches for

NODE=Q008

Mass $m >$ 190 GeV, CL = 95% ($p\overline{p}$, quasi-stable b') NODE=Q008BP3;DTYPE=M;CLUMP=B; OUR LIM;→ NOT CHECKED ←

Mass $m >$ 199 GeV, CL = 95% ($p\overline{p}$, neutral-current decays) NODE=Q008BP1;DTYPE=M;CLUMP=B; OUR LIM;→ NOT CHECKED ←

Mass $m >$ 128 GeV, CL = 95% ($p\overline{p}$, charged-current decays) NODE=Q008BP2;DTYPE=M;CLUMP=B; OUR LIM;→ NOT CHECKED ←

Mass $m >$ 46.0 GeV, CL = 95% ($e^+ e^-$, all decays) NODE=Q008BPE;DTYPE=M;CLUMP=B

t' (4[th] Generation) Quark, Searches for

NODE=Q009

Mass $m >$ 256 GeV, CL = 95% ($p\overline{p}$, $t'\overline{t}'$ prod., $t' \rightarrow W q$) NODE=Q009TPP;DTYPE=M

Free Quark Searches

NODE=S027

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. LINKAGE=Q12

[b] Based on published top mass measurements using data from Tevatron Run-I and Run-II. Including also the most recent unpublished results from Run-II, the Tevatron Electroweak Working Group reports a top mass of 172.6 ± 0.8 ± 1.1 GeV. See the note "The Top Quark" in the Quark Particle Listings of this *Review*. LINKAGE=TPM

[c] ℓ means e or μ decay mode, not the sum over them. LINKAGE=LPE

[d] Assumes lepton universality and W-decay acceptance. LINKAGE=LPF

[e] This limit is for $\Gamma(t \rightarrow \gamma q)/\Gamma(t \rightarrow W b)$. LINKAGE=TD3

[f] This limit is for $\Gamma(t \rightarrow Z q)/\Gamma(t \rightarrow W b)$. LINKAGE=TD2