Citation: D.E. Groom *et al.* (Particle Data Group), Eur. Phys. Jour. **C15**, 1 (2000) (URL: http://pdg.lbl.gov)

Index for Quarks Summary Table

Navigating PDF files: use CTRL-N to go to the desired page.

QUARKS

The u-, d-, and s-quark masses are estimates of so-called "current-quark masses," in a mass-independent subtraction scheme such as $\overline{\mathrm{MS}}$ 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 $\overline{\mathrm{MS}}$ 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 $m = 1$ to 5 MeV [a] Charge $= \frac{2}{3}\,e$ $I_z = +\frac{1}{2}$

$m_u/m_d = 0.2$ to 0.8

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

$\overline{m} = (m_u + m_d)/2 = 2.5$ to 6 MeV

s

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

Mass $m = 75$ 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 $m = 1.15$ to 1.35 GeV Charge $= \frac{2}{3}\,e$ Charm $= +1$

b

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

Mass $m = 4.0$ 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 $m = 174.3 \pm 5.1$ GeV (direct observation of top events)
Mass $m = = 168.2^{+9.6}_{-7.4}$ GeV (Standard Model electroweak fit)

t DECAY MODES			Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)
$W b$					–
$\ell \nu_\ell$ 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]	< 33 %	95%	–

b′ (4th 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 $\Gamma(t \to Z q)/\Gamma(t \to W b)$.