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A toroidal mass formula for heavy quarks and leptons

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Abstract

A toroidal mass formula that generates the mass ratios between heavy quarks, and between heavy leptons, is described.

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I. Introduction

A torus is uniquely specified by its outer radius R, and its inner radius r, measured from the torus's center point. Its surface area is then equal to

$$S(R,r)=\pi^2\left(R^2-r^2\right) \quad . \tag{1a}$$

We begin by defining the mass formula

$$R(j,k,L,U)=\frac{S\left(2\times 4.1^{\frac{j}{2}},\ 4.1^{\frac{j}{2}}\right)-S\left(2\times 0.1^{\frac{j}{2}},\ 0.1^{\frac{j}{2}}\right)\times L+2U}{-S\left(2\times 0.1^{\frac{5}{2}},\ 0.1^{\frac{k}{2}}\right)} \quad . \tag{1b}$$

This toroidal equation can precisely generate important particle mass ratios while following the general method the author has employed elsewhere [1,2,3,4,5]. .

We then let $L=1$ for ratios between pairs of lepton masses, and let $L=0$ otherwise (accordingly, in what follows, the variable L is a mere Boolean that tells whether the mass ratio to be generated is between leptons). The above definitions now allow the mass ratios

$\frac{M_{tau}}{M_{electron}}$	$\frac{M_{top}}{M_{charmed}}$
$\frac{M_{muon}}{M_{electron}}$	$\frac{M_{bottom}}{M_{charmed}}$

to be generated as follows:

$U = 0$	
$L = 1$	$L = 0$
$R(F_5, 0, L, U) = 3475.8250330 \ldots$	$R(F_1, 1, L, U) = 123.0492196 \ldots$
$R(F_4, 0, L, U) = 206.76827073 \ldots$	$R(F_0, 0, L, U) = 3.0001200 \ldots$

Note that the Fibonacci sequence includes the terms

$$\ldots \quad \underline{0} \quad \underline{1} \quad 1 \quad 2 \quad 3 \quad 5 \quad \ldots$$

where each term equals the sum of the preceding two, and where 0 and 1 are the sequence initiators (underlined above). In the equations above, the values for F_n are taken from the Fibonacci sequence's first six terms. Accordingly,

$$F_0 = 0,\ F_1 = 1,\ F_4 = 3, \text{ and } F_5 = 5\ .$$

In addition,

$$U = 0$$

for all four mass ratios.

Interestingly, an examination of Eq. (1b) reveals that because $U = 0$, the variable U is effectively unused by the above four equations; but if we let

$$U = S\left(10^{\frac{4}{2}}, 10^{\frac{3}{2}}\right) + S\left(10^{\frac{2}{2}}, 10^{\frac{1}{2}}\right) \quad , \tag{2a}$$

then the neutron-electron mass ratio can be generated with remarkable precision by

$$R(F_4, -1, L, U) = 1838.6836\,5473... \quad , \tag{2b}$$

where, because the neutron-electron mass ratio is *not* a ratio between lepton masses, $L = 0$. The reason for incorporating U in Eq. (1b) should now be evident: it is to show that the precise value of the neutron-electron mass ratio can be generated in this simple way.

Furthermore, the inverse of the fine structure constant also can be generated, simply and with precision, with the aid of powers of 10:

$$\frac{10^3 - 10^{-3}}{3^3} + \frac{10^{\frac{5}{2}} - 10^{-\frac{5}{2}}}{10^{\frac{1}{2}}} = \frac{999.999}{3^3} + 99.999 = 137.036 \quad . \tag{3}$$

II. Analysis of Results

The calculated values for $\frac{M_{top}}{M_{charmed}}$ and $\frac{M_{bottom}}{M_{charmed}}$ fit the roughly-known experimental quark mass ratios within, or close to, their broad limits of error. These experimental mass ratios are calculated below by choosing from the experimental values' upper or lower bounds, in an effort to fit the calculated values. Experimentally, the t-quark's mass equals 172,700 ± 2,900 MeV [6], while the b-quark's mass ranges from 4,100 to 4,400 MeV [7], and the c-quark's mass ranges from 1,150 to 1,350 MeV [7]; accordingly,

$$\frac{172{,}700\ \text{MeV} - 2{,}900\ \text{MeV}}{1350\ \text{MeV}} = 125.77...$$

and

$$\frac{4{,}100\ \text{MeV}}{1{,}350\ \text{MeV}} = 3.037... \ ,$$

which are close to their calculated values of 123.04... and 3.000... .

The calculated values for $\frac{M_{tau}}{M_{electron}}$ and $\frac{M_{muon}}{M_{electron}}$ fit their corresponding experimental values to roughly 1 part in 2,000, and 1 part in 16,000,000, respectively [7,8].

The calculated value for $\frac{M_{neutron}}{M_{electron}}$ fits its experimental value to about 1 part in 360,000,000 [8], while the calculated value for the fine structure inverse fits its experimental value to approximately 1 part in 150,000,000 [8].

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