Symmetric equations that reproduce the fine structure constant and the muon-, neutron-, and proton-electron mass ratios

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Symmetric equations are introduced that reproduce the fine structure constant inverse and the muon-, neutron-, and proton-electron mass ratios near their experimental limits.

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The fine structure constant (FSC) and the muon-, neutron-, and proton-electron mass ratios can be accurately and economically reproduced as follows. Assume M and N are positive integers. Then define

$$l_0 = \frac{1}{M^2} \quad , \qquad\qquad q_0 = \frac{1}{M^3} \quad ,$$

$$l_1 = \frac{\left[M - l_0/3M^2\right]^2}{N^{-2}} \quad , \qquad\qquad q_1 = \frac{M^2 - q_0}{N^{-2}} \quad .$$

Similarly, define

$$l_2 = \frac{M^3 - l_0}{N} \quad , \qquad\qquad q_2 = \frac{M^3 - q_0}{N} \quad ,$$

$$l_3 = \frac{\left[M - l_0/3M^2\right]^3}{N} \quad , \qquad\qquad q_3 = \frac{\left[M - q_0/3M^2\right]^3}{N} \quad ,$$

which are symmetric under $l \leftrightarrow q$, so that for

$$M = 10 \qquad \text{and} \qquad N = 3$$

the FSC inverse can be approximated four ways

$$\frac{l_1 + l_2}{N^2} = 137.036\ 000\ 001\ 111 \quad , \qquad\qquad \frac{q_1 + q_2}{N^2} = 137.036 \quad ,$$

$$\frac{l_1 + l_3}{N^2} = 137.036\ 000\ 002\ 346 \quad , \qquad\qquad \frac{q_1 + q_3}{N^2} = 137.036\ 000\ 000\ 012 \quad ,$$

which are also symmetric under $l \leftrightarrow q$. Also define

$$L = \frac{4.1^3}{l_0 q_0} \quad , \qquad\qquad Q = \frac{6}{l_0 q_0} \quad ,$$

$$L' = \frac{L}{1 - l_0} \quad , \qquad\qquad Q' = \frac{Q}{\frac{1}{1+l_0}} \quad ,$$

$$L'' = \frac{L'}{1 - l_0} \quad , \qquad\qquad Q'' = \frac{Q'}{1 - l_0} \quad ,$$

so that

$$\frac{l_0 L - 1}{l_2 - l_0} = 206.768\ 270\ 731 \quad , \qquad\qquad \frac{q_0 L + Q'}{q_2 - q_0} = 1838.683\ 654\ 735 \quad ,$$

$$\frac{l_0 L - 1}{l_3 - l_0} = 206.768\ 270\ 724 \quad , \qquad\qquad \frac{q_0 L + Q'}{q_3 - q_0} = 1838.683\ 654\ 734 \quad ,$$

which are nearly symmetric under $l \leftrightarrow q$; also note that

$$l_0 q_0 N \left[\frac{Q''}{l_0} - q_0 L''\right] = 1836.152\ 675\ 237 \quad .$$

These reproduce, respectively, the muon-, neutron-, and proton-electron mass ratios and follow [1]. With the exception of the less precisely measured muon-electron mass ratio, which above is reproduced at its experimental limit, all of these values, including the FSC inverse, are within just a few parts per billion of their 2006 CODATA values [1, 2].

Analysis of the above definitions gives

$$(q_1 + q_2) - (l_1 + l_2) = \frac{\left(M - N^3/3 - 1\right) - N^3/9M^5}{NM^3} \quad . \tag{1}$$

It follows that if

$$M = N^3/3 + 1 \tag{2}$$

and

$$N^3/9M^5 \ll 1 \tag{3}$$

then $q_1 + q_2$ will closely approximate $l_1 + l_2$, making two of the above FSC approximations nearly equal. Inspection reveals that the smallest positive integers fulfilling Eq. (2) are $M = 10$ and $N = 3$. These, as already shown, actually bring all four FSC approximations into numerical alignment. Moreover, this alignment takes place at a value that (purely coincidentally?) is nearly an exact match for the experimental FSC. The economy with which the definitions of l_0, q_0, etc. unambiguously single out the precisely known FSC (via Eq. (2)) provides good evidence for a *non*-coincidental—i.e., physical—origin for l_0, q_0, etc. This evidence is stronger still when one also takes into account the efficiency with which these same definitions help to reproduce three precisely known mass ratios.

Further evidence for non-coincidence is supplied:

- by [3], which shows how a brute-force computer search for approximations of the FSC automatically finds $(q_1 + q_2)/N^2$.
- by [4], which accurately models the observed quark and lepton mixing angles with the aid of $(l_1 + l_3)/N^2$ (the *mixing model nexus*), while requiring no help from free variables "adjusted to fit experiment."
- by [5], which shows that the relation that $(q_1 + q_2)/N^2$ has with $(l_1 + l_3)/N^2$ derives from a general case involving the "broken symmetry" of simple algebraic identities.
- by [6], which exploits cuboctahedral symmetry, and 10, 3, and 4.1, to specify the quark and lepton masses, charges, and generations.

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