APRI-PH-2006-47a
1/19/2006

The symmetrical generation of quark and lepton, mass and charge

J. S. Markovitch

P.O. Box 2411, West Brattleboro, VT 05303
Email: jsmarkovitch@yahoo.com

Abstract

The symmetries of a cube are exploited to economically generate the masses and charges of the quarks and leptons. The mass formula employed succeeds in part by exploiting the first six Fibonacci numbers.

---

in the lower ring, while all heavy particles appear in the three remaining rings. The diagram produced is symmetrical about its *vertical axis*.

The diagram of Figure 2 is produced by placing precisely three quarks (Q) and three leptons (L) in each ring, in such a way that they are symmetrical about the diagram's dual *diagonal* axes.

The diagram of Figure 3 is produced by combining the conflicting symmetries (*vertical* and *diagonal*, respectively) of Figures 1 and 2, so that light quarks and leptons in the lower ring of Figure 3 appear in italicized lower case, while heavy quarks and leptons in the remaining rings all appear in uppercase. Note that although generated from Figures 1 and 2, Figure 3 has neither the vertical and diagonal symmetry of these figures.

The diagram of Figure 4a assigns the values of electric charge Q for all quarks and leptons, where the values assumed by Q are { 0, 1, 2, 3 } repeated three times. It is produced from Figure 3 by substituting a charge of 0 for the light leptons (l), and 3 for the heavy leptons (L), and either 1 or 2 for the heavy and light quarks (Q and q, respectively). Importantly, these 1s and 2s must be arranged so that, in groups of *four*, they sum to 6 in *nine* different ways, as is seen in Figure 4b. Note that if the midpoints of the 12 edges of a cube are similarly labeled, these nine sums would correlate with nine orthogonal "slices" of the cube, where each slice contains four such midpoints [1].

The diagram of Figure 5a assigns the values of of R^+ for all quarks and leptons. The values assumed by R^+ are { **0**, **1**, 1, 2, 3, 5 }, which are the first six Fibonacci numbers. These values are repeated twice. These values are arranged so that they are symmetrical about their diagonal axes, and so that, in groups of *three*, they sum to 6 in *eight* different ways, as is seen in Figure 5b. In this way, the 6-valued parameter R^+ is directly analogous to the 4-valued Q.

Note that the Fibonacci sequence extended in the reverse of its normal direction $R^- = \{ -3, 2, -1, 1, \mathbf{0}, \mathbf{1} \}$ can serve equally well in reproducing the particle masses [1,2]. Because this dual

References

[1] J. S. Markovitch, "An economical means of generating the mass ratios of the quarks and leptons (Rev.)," (APRI-PH-2003-40c, 2006). Available from Fermilab library.

[2] J. S. Markovitch, "Dual mass formulae that generate the quark and lepton masses," (APRI-PH-2003-22d, 2005). Available from Fermilab library.

[3] J. S. Markovitch, "A compact means of generating the fine structure constant, as well as three mass ratios," (APRI-PH-2003-34a, 2005). Available from Fermilab library.

[4] J. S. Markovitch, "A toroidal mass formula for heavy quarks and leptons," (APRI-PH-2005-38a, 2005). Available from Fermilab library.

[5] J. S. Markovitch, "A Precise, Particle Mass Formula Using Beta-Coefficients From a Higher-Dimensional, Nonsupersymmetric GUT," (APRI-PH-2003-11, 2003). Available at www.slac.stanford.edu/spires/find/hep/www?r=apri-ph-2003-11.

[6] J. S. Markovitch, "Coincidence, data compression, and Mach's concept of 'economy of thought'," (APRI-PH-2004-12b, 2004). Available at http://cogprints.ecs.soton.ac.uk/archive/00003667/01/APRI-PH-2004-12b.pdf.

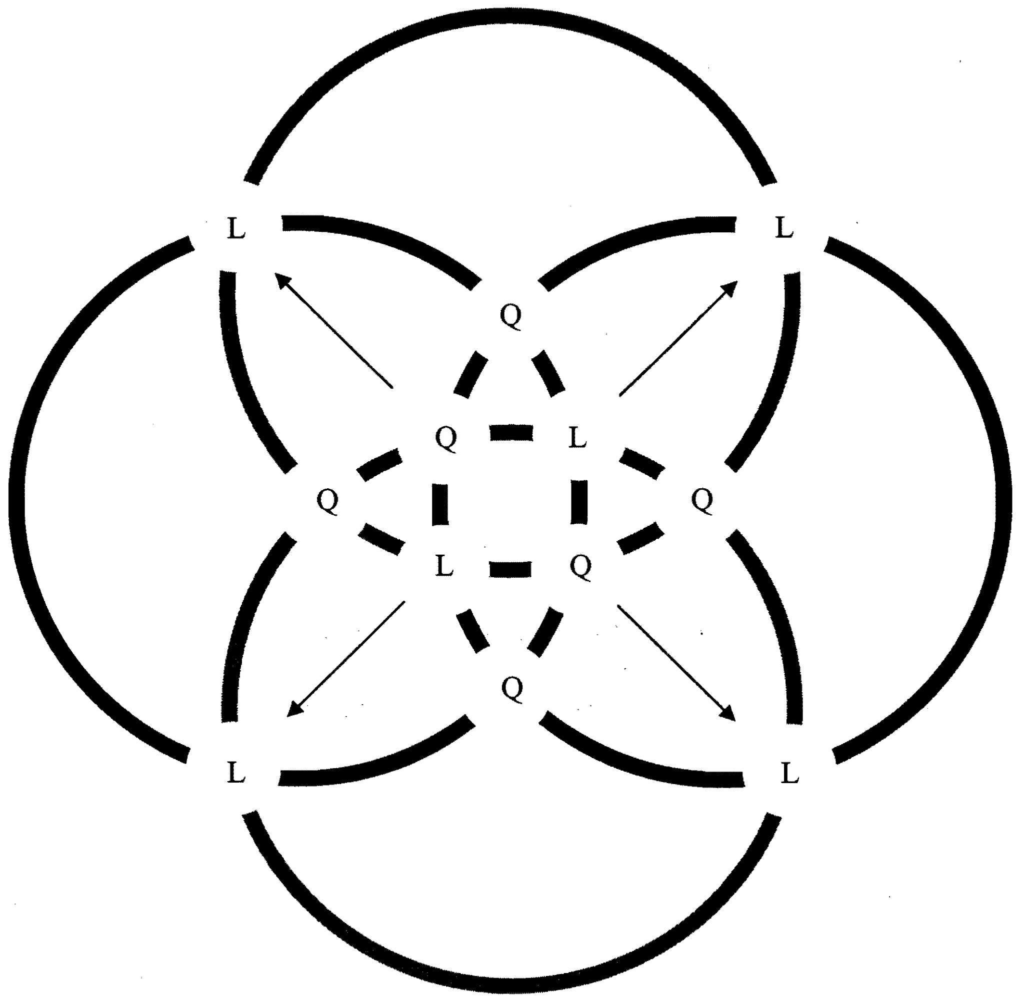

Figure 2. The above diagram is produced by placing precisely three quarks (Q) and three leptons (L) in each ring, so that they are symmetrical about the diagram's diagonal axes.

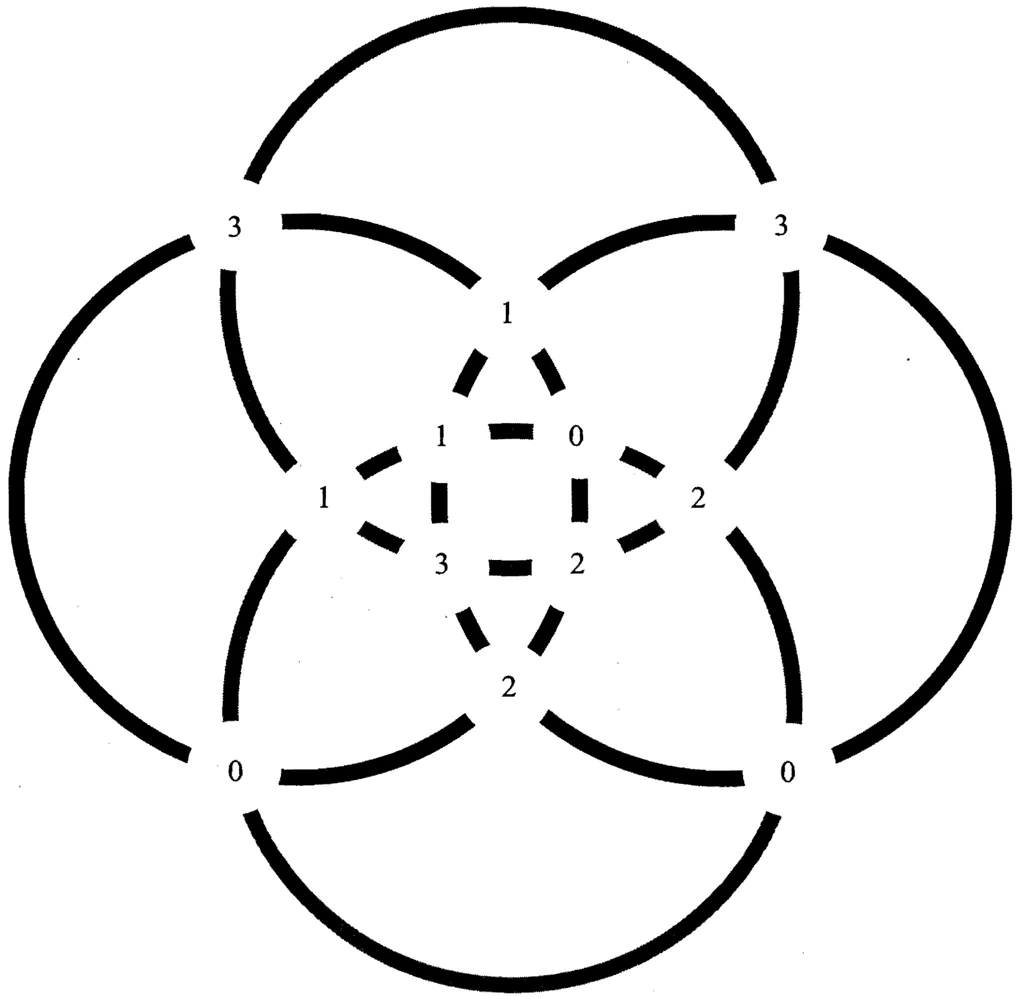

Figure 4a. The above diagram assigns the values of electric charge Q for all quarks and leptons. It is produced from Figure 3 by substituting a charge of 0 for the light leptons (l), and 3 for the heavy leptons (L), and either 1 or 2 for the remaining particles, the light and heavy quarks (q and Q). These 1s and 2s are arranged so that, in groups of four, they sum to 6 in nine different ways (see Figure 4b).

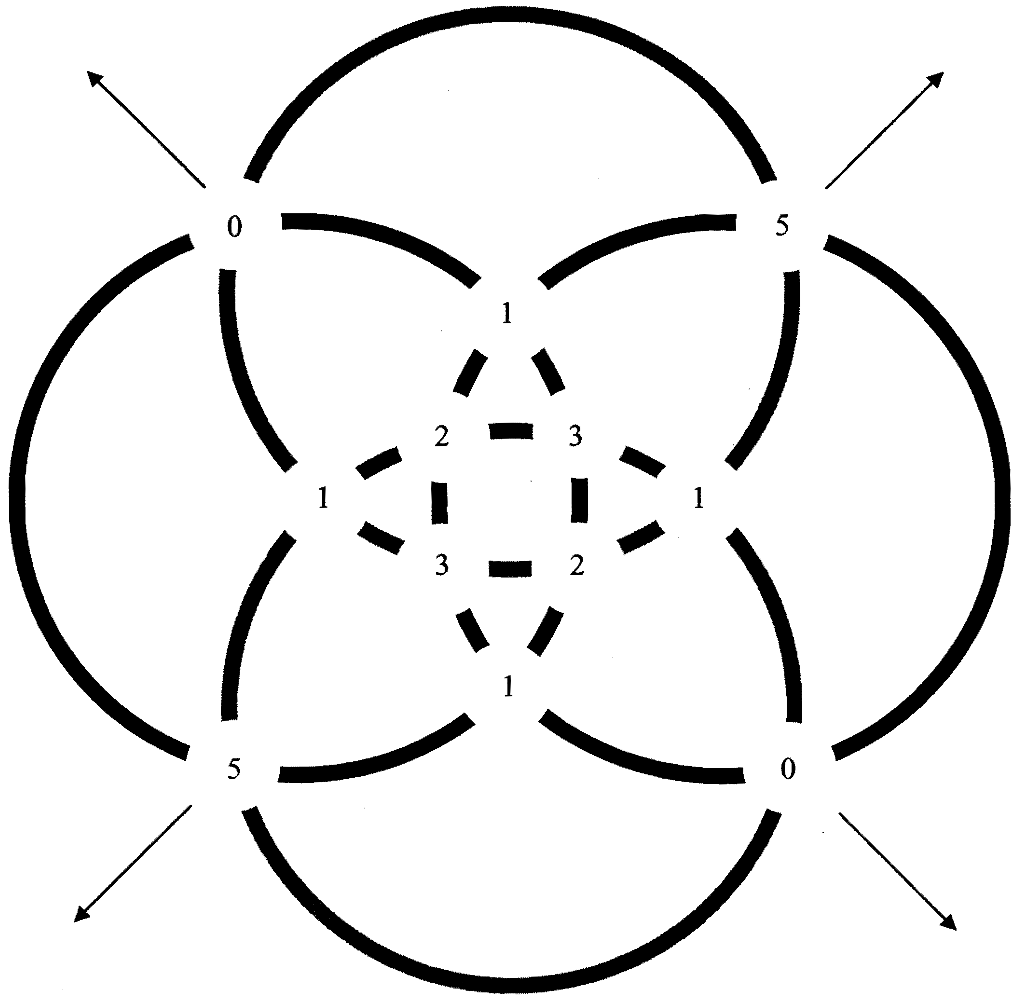

Figure 5a. The above diagram displays the values of R^+ for all quarks and leptons. The values assumed by R^+ are { **0**, **1**, 1, 2, 3, 5 }, which are the first six Fibonacci numbers. These values are repeated twice. These values are arranged so that they are symmetrical about their diagonal axes, and so that, in groups of three, they sum to 6 in eight different ways (see Figure 5b). In this way, the values of R^+ are analogous to those for electric charge Q in Figure 4b. Note that the Fibonacci sequence extended in the reverse of its normal direction $R^- = \{ -3, 2, -1, 1, \mathbf{0}, \mathbf{1} \}$ can serve equally well in reproducing the particle masses [1]. Because this dual solution cannot be extended to encompass 8 or more Fibonacci terms, it appears to impose a natural limit of three on the number of particle families [2].

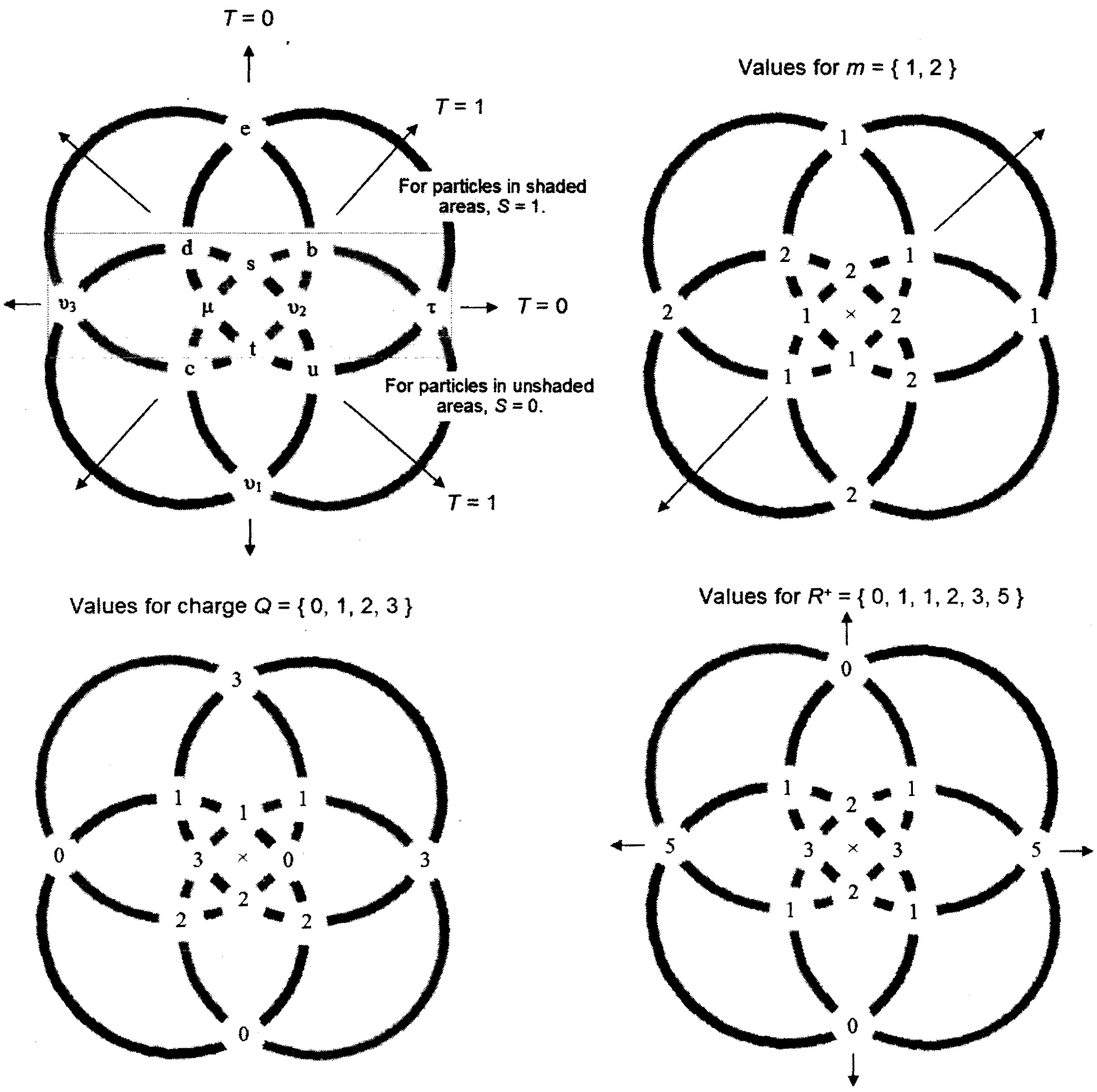

Figure 6. In the above diagrams, the parameters for the mass formula are assigned. The values for S and T are assigned in the upper left-hand corner. Continuing clockwise, we assign the values for m, R^+, and Q. The assignments follow Figures 1, 5a, and 4a, but with the diagrams for m, R^+, and Q rotated 45° clockwise.

Table IIa. The eight mass ratios produced by mass formula.

Light Particles	*Heavy Particles*	*Mass Ratio*
$\left(\frac{M(\nu_3)}{M(\nu_1)}\right)^2$	$\frac{M(\tau)}{M(e)}$	$4.1^5 \times 3$
$\left(\frac{M(\nu_2)}{M(\nu_1)}\right)^2$	$\frac{M(\mu)}{M(e)}$	$4.1^3 \times 3$
$\left(\frac{0.1 \times M(s)}{M(u)}\right)^2$	$\frac{0.1 \times M(t)}{M(c)}$	$4.1^1 \times 3$
$\left(\frac{M(d)}{M(u)}\right)^2$	$\frac{M(b)}{M(c)}$	$4.1^0 \times 3$

Table IIb. The eight mass ratios produced by mass formula.

Particles	*Mass Ratios*
Heavy leptons	$4.1^5 \times 3 \ : \ 4.1^3 \times 3 \ : 1$
Neutrino mass eigenstates	$\sqrt{4.1^5 \times 3} : \sqrt{4.1^3 \times 3} : \sqrt{1}$
Heavy quarks	$4.1 \times 10 \times 3 : 3 : 1$
Light quarks	$\sqrt{4.1} \times 10 \times \sqrt{3} : \sqrt{3} : \sqrt{1}$