# Remark on fractional charge quantum numbers

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## Contents

Within our heuristic and tentative work in tracing the possible role of fractal geometry (this understood in a more general sense) in scaling electrodynamics' fundamentals, a relation between the *external angles* (1) $\xi(c_k)_{ms}$ of the Mandelbrot set's (2) main bifurcation series roots $c_k$ and *relative*[(3)] *(electric) charge* was seen (4, 5), which proved quantitative for the series' starting point and the 1st bifurcation. So, the external angle $\xi(c_1)=0$ ($n=0$, $k=2^n=1$), accessory to the cusp of the big Mandelbrot cardioid, coincides with the absolute values of lepton charge quantum numbers, specific angles being counted modulo 1. And $\xi_{u,l}(c_2)$, the values being 1/3 and 2/3, reproduce the absolute values of quark($k=2$) electric charge quantum numbers. If not merely accidental, this coincidence maybe were able to at least partially remove G. t'Hooft's (6) then difficulty in finding "one representation by itself, with integer charges for the leptons, and one completely different representation by itself, with only fractional charges for the quarks", where the charge operator in the theory has to be the same for both leptons and quarks. Indeed, a charge operator proportional to a sort of "external angle operator" (external angles being phase functionals $|g(f(\varphi))|$, $c_k$ & $c$  $f(\varphi)$) is capable of yielding the right integer *and* fractional quantum numbers. The corresponding (aggregated electric) charge quantum numbers $q_k$ for the leptons($n=0$, $k=1$), quarks($n=1$, $k=2$), quinks($n=2$, $k=4$), "teens"($n=3$, $k=8$) and "polies"($n=4$, $k=16$) to come apparently are

$$q_k = \frac{\left(\xi(c_k)_{ms} - \mathrm{sign}(c_k)_{ms}/2 - 1/2\right)\mathrm{sign}\left(\xi(c_k)_{ms} - 1/2\right)}{2^{(k-2)/2}\left(1 - \mathrm{sign}(c_k)_{ms}\right) - 1} \quad , \quad k=2^n,\ n=0,1,2,\ldots\ , \quad \text{Eq.(1)}$$

where fractional charge linked to *upper* external angles is negative and such linked to the *lower* ones positive. The $(\xi_{upper}(c_k), \xi_{lower}(c_k))_{ms}$ input values for $k=2,4,8,16$ are: (1/3, 2/3), (2/5, 3/5), (7/17, 10/17) and (106/257, 151/257). Finally, for quark composite of period-$2^0$ oscillation character a $q_1\mathrm{sign}(c_2)$ shape is likely. $(\mathrm{sign}(c_k)/2 + 1/2)$ of the Mandelbrot set main bifurcation series' $c_k$s is $\sin(k\pi/2)$, being $\Gamma(1/2)^2/(\Gamma(k/2)\Gamma(1-k/2))$ in terms of $\Gamma(x)$.

## References/Remarks

(1) Douady, A. Julia Sets and the Mandelbrot Set in: Peitgen, H.-O.& Richter, P.H. *The Beauty of Fractals*, 161–173 (Springer-Verlag, Berlin-Heidelberg-New York-Tokyo, 1986)

(2) Mandelbrot, B.B. Fractal aspects of the iteration of $z\to\lambda z(1-z)$ for complex $\lambda$ and z. *Annals New York Acad. Sciences*, 357, 249 – 259 (1980)

(3) The iterative $z \to z^2 + c$ map involved, z, c & $\xi(c)$ cannot be dimensional, so only *relative values* count.

(4) Culetto, F.J. and Culetto, W. Does fractal geometry tune electrodynamics' scales? http://culetto.at/private_research_associates/sciencephilosophy.pdf (2006)

(5) Culetto, F.J. and Culetto, W. Short note on a generalized $\alpha(0)$ (fine-structure constant) approximation. http://culetto.at/private_research_associates/sciencephilosophy4.pdf (2007)

(6) t'Hooft, G. Discussion statement following a paper by Harari, H. Quarks and Leptons: The Generation Puzzle. In: Ne'eman, Y. (ed.) *To Fulfill a Vision*. Jerusalem Einstein Centennial Symposium on Gauge Theories and Unification of Physical Forces, 184, (Addison-Wesley Publishing Company Inc., London-Amsterdam-Don Mills,Ontario-Sydney-Tokyo, 1981)