M-set hyperbolic components tuning the matter / dark matter / dark energy pie chart? Details

(F.J. Culetto and W. Culetto, Private Research-Associates, rev. Report, dated: Nov. 2016)

Mandelbrot set's universality/structural stability is pretty likely to play some role in case of a tentative description of all things / structures and the dynamics there are by using Julia set fractals and their control spaces/ connectedness loci (for the second order polynomials iterated the main and midget Mandelbrot M sets). According to A. Douady (in H.O. Peitgen and P.H. Richter: The Beauty of Fractals, 161-173 (1986)), all of M's combinatorial features are preserved if the (holomorphic) function F(z) iterated (properly rescaled, 0 trapped in a bounded region) just differs from $(z^2 + c)$ by < 1 for all values of z, and the complex parameter c does not exceed 4 in modulus.

As period $k = 2^0$ oscillations belong to c-values from the Mandelbrot set's big cardioid, and integer (el.)charge quantization most likely is linked to the cardioid cusp's external angles (0,1), conventional integer charged and neutral *matter's approximate pie chart share* from the ΛCDM-model could possibly emerge from an area-ratio involving the k = 1 hyperbolic component's area A_{2^0} which is $3\pi/8$ (from cardioid area ($3\pi a^2/2$, $2|a| = 1$, the cusp located at $c = 1/4 + 0i$)). Indeed, the area ratio of the doubly covered said cardioid and the difference area between the maximally permissible c-disc ($A_{c\text{-disc}} = 16\pi$) and twice the cardioid, i.e. $2A_{2^0}/(A_{c\text{-disc}} - 2A_{2^0})$, would be $0.049\underline{1}80\ldots$ compared with matter's 4.9% pie chart share.

And non-conventional, neutral matter's pie chart share from an integer charge quantization point of view also ought to be linked to a period-2^0 cardioid area, but this time to a variably inflated, "virtual" one. By stretching the matter-linked M cardioid's |a| from 1/2 to ($|c_D| - 1/4$), c_D being the main bifurcation series Myrberg-Feigenbaum point's coordinate $-1.401\,155\ldots + 0i$, the stretched area e.g. becomes $A_{2^0\text{infl}} = 3\pi(1/4 + c_D)^2/2$ and the cardioid's left end eventually is $-2.052\ldots$, slightly outside M set's real axis [– 2,1/4]. Accounting for fermion spin by doubly covering the original and the inflated cardioid areas, the following areas' ratio is

$$\frac{2(A_{2^0\text{infl}} - A_{2^0})}{A_{c\text{-disc}} - 2A_{2^0\text{infl}}} = 0.268\underline{2}41\ldots \quad , \qquad \text{Eq.(1)}$$

compared with the *dark matter's pie chart share* of 26.8%. And in the flat space-time case the still missing pie chart piece (or the sum of such pieces) is

$$1 - \frac{2A_{2^0}}{A_{c\text{-disc}} - 2A_{2^0}} - \frac{2(A_{2^0\text{infl}} - A_{2^0})}{A_{c\text{-disc}} - 2A_{2^0\text{infl}}} = 0.68\underline{2}578\ldots \quad , \qquad \text{Eq.(2)}$$

almost matching *dark energy's pie chart share* of 68.3%. Just lucky coincidences… ?
Component shares' time dependence may i.a. well come from c-disc's radii variation.

Addendum (dated Feb. 8, 2016)

In the previous section, the energy density linked to radiation (in our universe today) had been neglected, its share being orders of magnitude smaller than the mentioned pie chart pieces. Ω_{rad} is significant at small enough scale factor a(z) in a FRW-universe, thus $\Omega_{rad,0}$ cannot be neglected in this case. By projecting Mandelbrot set's real axis [–2, 1/4] onto its segment [0, 1/4] and keeping the cardioid's axis proportion 1: 2.25, the cardioid image's |a| becomes 1/18, hence the generating circles' radii 1/36 each. So the area of the *generating circles* which is $2\pi(1/36)^2$ (and accounts for two photon polarization degrees of freedom) over $(16\pi - 2\pi(1/36)^2)$ yields 9.646×10^{-5}. The present - day $\Omega_{rad,\,0}$ value estimated being of the same order of magnitude. For getting an impression of the richness of M's and of its cardioids' detail properties, e.g. see "Exploding the Dark Heart of Chaos", Chris King (rev. version 2015), www.dhushara.com/DarkHeart/DarkHeart.htm offering an "…investigation of the universality of the cardioid at the centre of the cyclone of chaotic discrete dynamics…"

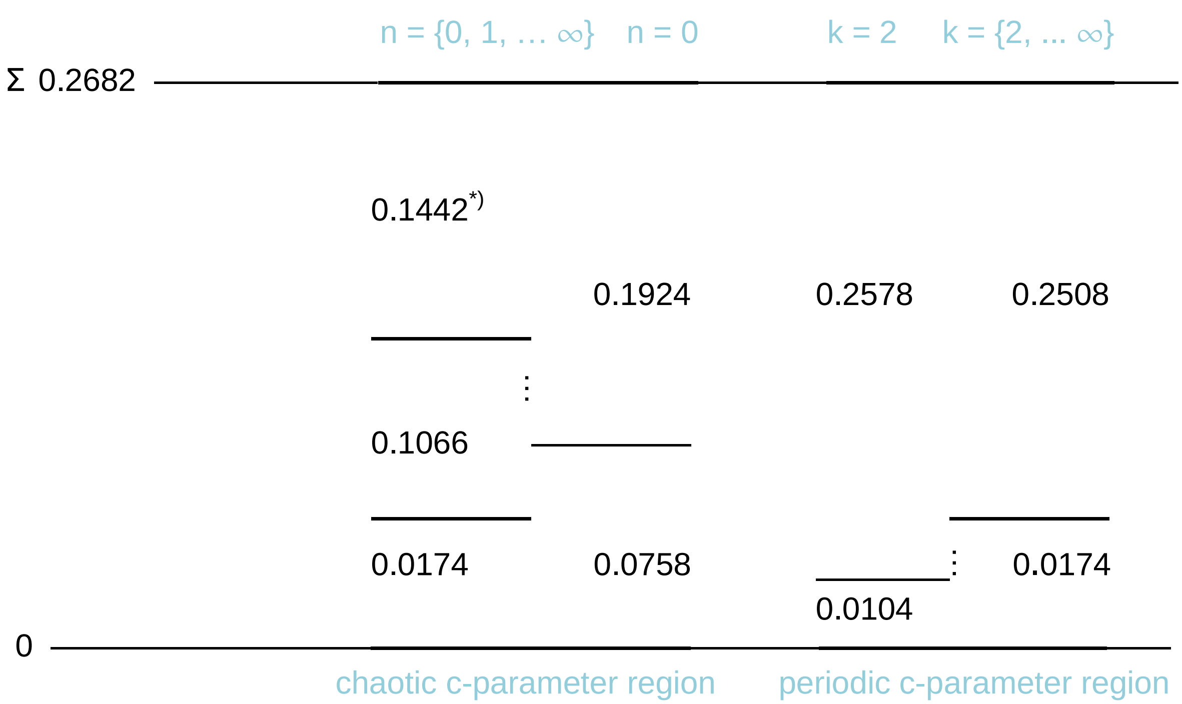
As far as the proper time dependence of the above mentioned pie chart pieces is concerned, in addition to their conventional scaling, a further variability from variation /oscillation of the permissible c - disc radius, i.e. for c values of modulus $(4 - \varepsilon)$, $\varepsilon > 0$, may occur in principle.

Addendum (dated Oct. 7, 2016)

There are a few details to be added to the ideas/data given before. The fact that all of the main M's period k ≥ 2 hyperbolic components' areas are subsets of $(A_{2^0 infl} - A_{2^0})$, and still part of the connectedness locus, suggests non-uniformity of dark matter as far as the Julia set fractals' connectivity is concerned. One has a mixture of at least on average connected ones and of Cantor-dust ones. Thus the situation might tend towards destroying the hope that dark matter could be some mono-componential stuff. If the whole Mandelbrot M set's area (A_M = 1.50659…) is taken instead of A_{2^0} in the $2(A_{2^0 infl} - A_{2^0}) / (A_{c\text{-}disc} - 2A_{2^0 infl})$ ratio, then the resulting dark matter density parameter would be 0.2508… versus 0.2682… as started from. The latter parameter would thus be a composite (0.2508 + 0.0174) one. Its smaller sum-term could well get composite again, the major contribution to from the k = 2 hyperbolic component's role in the game. At best, the bifurcation series is terminating at relatively small $k = 2^n$, for whatever reasons. When searching for a proton to electron rest mass ratio approximation formula (see the corresponding articles of our www.culetto.at website), stopping the bifurcation process after n = 4 (period -16 oscillation) proved really helpful in achieving the necessary fine-tuning. By so taking the corresponding bifurcation root $c_4 = -1.3940462\ldots + 0i$ (from K.T. Alligood et al. (1997)) instead of c_D – the infinite k limit – in the area formula for $A_{2^0 infl}$, the resulting dark matter density parameter would be 0.2630… and a better fit to the Planck Collaboration's 2015 corresponding cosmological parameter (arXiv:1502.01589). In addition to the connectivity's (maybe) impact, explicit / implicit k - dependence, if such, could get dark matter's complexity efficiently enhanced.

Addendum (dated Nov. 19, 2016)

As far as dark matter's possible complexity is concerned, in addition to the said, maybe relevant factors mentioned right before, there could be one further complication lurking around the corner: *explicit or implicit k - dependence* again, but this time referring to the *chaotic bands* $\mathbf{B}_n$ (see G. Pastor et al., 2004) of M's chaotic c - parameter region. As the period - 2^0 chaotic band $\mathbf{B}_0$ is located between the Misiurewicz points (– 1.54368…, 0i) and (– 2, 0i), and the areas of the *secondary Mandelbrot set* with cardioid cusp at (– 1.75, 0i) and of the other hyperbolic components on M's antenna slice are small compared with A_M, there is hope that one could assume the possible impact by the chaotic bands being small /negligible. But this needn't be so. Then the common area of $A_{2^0 \text{infl}}$ and the circular ring area 1.54368…≤ |c| ≤ 2, the outer circle through (– 2, 0i), has to get calculated. After numerical integrations yielding A_{com} – this as $2(A_{2^0 \text{infl}} – A_{2^0} – A_{com})/(A_{c\text{-disc}} – 2A_{2^0 \text{infl}})$ altering the area ratio – the chaotic band $\mathbf{B}_0$'s effect could be partitioning of the total dark matter density parameter into ≈ (0.192 + 0.076) in case of all other effects absent. And further partitioning of the leading term by bands $\mathbf{B}_n$, n ≥ 1, the said term ending up as ≈ 0.144 in the infinite n limit, is likely if such for n = 0. Thus concluding, the dark matter's complexity could get much bigger than initially anticipated. And Occam's razor (the exact term of Sir-William-Hamilton origin) may indeed have been a pretty suitable tool in the Mr. Occam's hairstyle context, but doesn't seem to lead anywhere in the dark-matter-complexity field.



*) Circular ring $|c_D| \le |c| \le 2$ used in A_{com} - calc. for $2(A_{2^0 \text{infl}} – A_M – A_{com}) /(A_{c\text{-disc}} – 2A_{2^0 \text{infl}})$ ratio

Fig.: Potential partitioning of the dark matter density parameter $\Omega_{dm,0}$ by impact of *Julia set connectivity* and of *period-k sensitivity* in M's periodic / chaotic c-parameter regions