

## ***Interactive comment on “GAIA 5.0 – A five-dimensional geometry for the 3D visualization of Earth’ climate complexity” by Renate C.-Z.-Quehenberger et al.***

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Dear Prof. Clarke,

“Thank you for encouraging us to emphasize the aspect of Gaia as a ‘cognitive system.’” ... sorry for my bad English, “I am Austrian” and sometimes Germanicisms lead astray.

I appreciate your hint to your article on “cognition not consciousness”: Following Margulis’ and your thoughts on Gaia’s planetary cognition manifested by the Earth system and its self-regulatory loops we may well re-consider the intelligent subscendent pat-

C1

tern that creates cognition that occurs both above and below the level of thought. It allows for systemic responses beyond awareness and without consciousness (Bruce Clarke, Cognition not Consciousness, February 26, 2019 )

Thank you for giving us the hint to the cybernetics notion “auto-poesis”: My geometrical research was inspired a lot by the “pattern that connects”, Gregory Bateson’s concept which I learned from the charming Austrian co-founder of cybernetics, Heinz von Förster. When Heinz von Foerster spoke of “self-organizing demons which govern the intrinsic structural and material energetic properties of the building blocks” of living systems he imagined magnetic cubes reminiscent of Charles Howard Hinton’s tesseracts or hypercubes, drawn as “Jumbled Boxes” by Gordon Pask (Clarke 2009, p.50) Of course motion and the idea of dynamic building blocks can only be visualized by means of 3D animated geometry. Instead of 4D hypercubes we use the 5-dimensional cubic grid, and its dual the structure of the infinite 5-dimensional space in the shape of the epita-dodecahedron which would then serve as “auto-poetic” subscendent “imaginary machine”.

From this 5-, respectively 10-dimensional space where quasicrystals “live” (Shechtman et al 1984), we can easily draw a connection to Schrödinger who compared life with an “aperiodic crystal” and his note about a living cell being 4-dimensional (Schrödinger, 1944). Our hyper-Euclidean geometry is inspired from this hint and forms 4-dimensional units for the Earth and living cells. Based on the “golden” grid ( $\sqrt{5}$ ) it builds a “real” 4D tangent space not from a point but from a 3-dimensional sphere in the center ( cf. Bolyai’s non-Euclidean geometry). Rashevsky also showed that Riemannian geometry is conforming to Golden ratio (Rashevsky, 1967). This geometrical approach allows to draw a model of 4-dimensional living cells. It allows to visualize symmetries and group transformations in a spacial continuum. Distinct to projective spaces hyper-Euclidean geometry is adding infinitely many spaces R5 inside R4. So we get a closed structure with boundaries for R3, R4 and R5 inside R6 . Fig 1. (a) shows such a 4D model of a cell and its symmetries (b) and organelles of an eukariotic

C2

cell are composed of organelles, including mitochondria (cellular energy exchangers) in the shape of a Bucky-ball. This way our hyper-Euclidean framework based leads us to principles of a generalized crystallography where Platonic symmetries, golden ratio and Fibonacci sequences can be observed in nature on all scales (He & Petoukhov, 2017). Hence gradients in the sense of Gaia as a "gradient-reducer" (Schneider and Sagan 2005) concerning minimizing free energy (Rubin 2019, 2021b) might become a different meaning in the 4-dimensional framework: Instead of independently moving particles driven by thermodynamics, we would get Schrödinger QM relations between the 4-momentum and the 4-gradient  $\partial$ . If the quantum relation is applied to a 4-vector field  $A_\mu$  instead of a Lorentz scalar field then one gets the generalized electric potential and a generalized magnetic potential. It would be interesting to find out, if it makes sense to apply the free Maxwell equation – when the rest mass term is set to zero (light-like particles) to explain a living cell.

– Alas, your question about the "sentient" and cognition" will lead us then to the problematic realm of the 5th dimension – which de Broglie recognized as field of matter waves (1927) and about which Einstein asked for a physical explanation. But we will try to address some points in our article.

According to our 6-dimensional parameter-space model (Fig.2) e may imagine that R5 is the space which produces not only light (Quehenberger, 2012) but micro-wave phenomena – previously called "spirit" – would lead us to Norbert Wiener's "frequency domain" and to the Pribram & Bohm theory of consciousness. We can imagine these frequencies tied to fractions of space, like the Conway circle decoration of the Penrose pattern is fixed on golden triangles forming waves in motion. Since Penrose patterns are perfectly aperiodic but are mirroring themselves at infinity, the term "reflection" gains a geometrical form. One might suppose that a similar recursive effect could take place at the tiniest triangular fractions of space that mirror themselves in a chiral movement towards a "zero point at infinity" (probably inside a 7-dimensional neuron?) and flash back in the emergence of a faction of recognition. The connection between conscious-

C3

ness the Unified Field and ancient philosophies was made before (c.f Hagelin, 1987) F.e. chaos theorist Ralph Abraham proposed a mathematical quantum vacuum model of consciousness expanded to the self-organization of the gross ether from a subtle (submicroscopic) cellular network (Abraham and Roy, 2010). Based on Bohm's theory Rupert Sheldrake developed his morphogenetic field theory in order to explain processes in living systems, plant growth (but remains agnostic about an underlying structure).

Much more research is necessary to confirm my artistic speculations and eventually the scientific paradigm would have to change so that we can define how "consciousness" could arise from unitary structures. If so we can Gaia even call a hyper-consciousness, – like our paleolithic mothers probably have thought of it when they've invented the Great Goddess: ""Earth on a global scale" – All these things resonate strongly with the ancient magico-religious sentiment that all is one" (Margulis & Sagan, 2011). At least, with the Platonic assumption that "the pattern itself is an eternal being" , like Plutarch speaks only of the "animated movement" but not of a singular "soul", we get rid of the mind matter problem.

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C4

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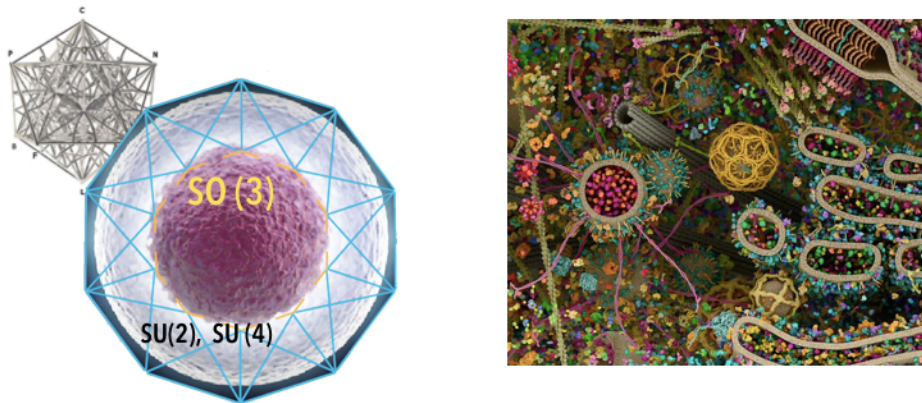
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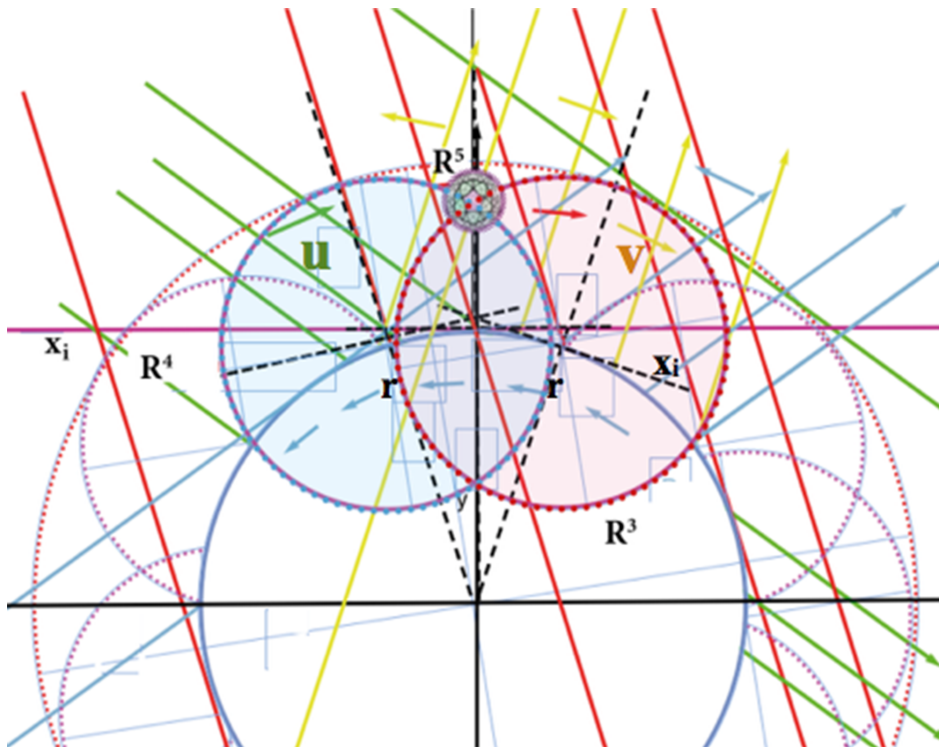
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C6



**Fig. 1.** 4D framework of a cell with "real" tangent space ( $R^4$ ) with inherent icosahedral symmetries in  $R^5$  (small picture in grey) around the center of the cell ( $R^3$ ) image: RCZQ (b) Image of a

C7



**Fig. 2.** 6D discrete space-model – with 4D tangent space and 5D sub-space

C8