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Self-organized computational rewrite language L predicating an optimal thermodynamic cosmic birth-order automorphic evolution of intelligent life, and consciousness, as nature's IT

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Abstract. This autonomous self-governed explanation of the cosmological thermodynamics of entirely novel states of matter (as in a renormalization group approach) includes the currently accepted fundamentals of physics, chemical valence, the periodic table and the basic neuroscience architecture/Nature's IT of the sentient evolution of intelligent life; with notably, the DNA/RNA molecular biology of the genetic code, Standard Model elementary particle quantum physics, non-standard mathematical analysis and consciousness. Automorphic representations demonstrably have a 'rest of the universe' phenomenology which features: the zitterbewegung; the U1 unitary geometry of Standard model/chemical valence Lamb shift; the Aharonov-Bohm and Casimir effects; the single RNA and double DNA helices of biomolecular chemistry; the neuron/glia/microtubule//brain/mind/self. This anticipates the rewrite computation both of Turing and of L itself, in addition to mathematical analysis, natural semantic language capabilities and consciousness, as all inherent in the human genome/self, creating a new starting point for more of Nature's IT wonders to come.

1. Nature's sentient 3+1 IT versus digital IT and the AI automation paradox

Experimentally proven 3+1 object image capture by any form of illumination, independent of any observer, is verifiable by one step reference beam 3+1 encoding that allows subsequent one step reference beam 3+1 image decoding. It also has 3+1 object/object image coincidence, where the sentient observer's sensor/eye/ear/etc supplies the necessary reference beam, and similarly any electron has its own 3+1 'rest of the universe' de Broglie 'radar and holography', from near cosmic time zero! [1-13] Clearly, only 3+1 object image/3+1 object coincidence makes life tenable. (A 'rest of the universe' criterion solves the conundrum of perception's subjectivity as it makes objective communication possible by allowing many observers to share different 3+1 images of the same external object and specifically of themselves even when they are by their selves.) And it makes sense that a sentient observer's sensor/eye/ear/etc should capture the entire 3+1 object image of the external 'reality manifold'/frame presented to it when this can be done in one step and then transferred directly to the brain for immediate associative memory storage and identification/recognition against past experience/ data starting from an empty brain!



2. The fundamental nilpotent criterion

Nilpotent Quantum Mechanics (NQM), as presented by Marcer and Rowlands (2017) [14], is grounded on Rowlands' extensively researched and well-referenced 2007 World Scientific book, *Zero to Infinity* [15] and some earlier publications [16-28]. It also follows from on and connects with earlier work by Rowlands on the foundations of physics and the Dirac equation [29-42]; by Marcer into the thermodynamic foundations of computing/IT [43-69], and Schempp, on quantum holography, neurocomputer architectures and magnetic resonance imaging [7-10]. Other contributing work includes that on DNA by Hill and Rowlands [70-72], and Dubois' concept of anticipatory computational systems [73]. NQM predicates the Logic of Self-Organised Systems [62] to include the sentient Evolution of Intelligence [58] as naturally biogenically manifest on Earth, where NQM is defined as the systemic unique birthorder automorphism of the NQM fermion X automorphisms ($ikE+ip+jm$) predicated by $L(X)$, Rowlands' universal rewrite language of computational productions [74-75]. Specifying the fundamental nilpotent criterion $X.X=E^2-\mathbf{p}^2-m^2=0$ (where $i=\sqrt{-1}$ and k,i,j are the quaternions) this concerns any NQM system's Energy E , momentum \mathbf{p} and mass m , in relation to the Nilpotent Dirac Group (NDG) of unique fermions $X \neq 0$. As research shows, the elementary particle physics of Standard Model QM and of the DNA/RNA molecular biology of the genetic code both exhibit NDG symmetries and symmetry breaking, in the form of its 64 part algebra as it relates to the Dirac group's 5-part gamma algebra. That is, it can be postulated that the A=T/U and C≡G regulating the valent connectivity of the entire biosphere/Gaia concerns $SU(2)$ and $SU(3)$ as in quantum physics. Thus, NDG is the fundamental physical nexus behind an endless automorphic evolution of all life, in a systemic near maximally thermodynamic self-organised cosmos where this takes place through an endless 'Russian Doll' hierarchy of autonomous self-governed units, as QM Carnot Engines [76]. In addition to physics and biology, neuroscience, computation and mathematical analysis, are all representations of the self-organized, autonomous, self-governed hierarchical automorphic rewrite Language system $L(X)$.

3. The 'rest of the Universe', " 5th force, dark matter" Feature of $L(X)$.

In $L(X)$, Rowlands' universal rewrite language, the most notable feature is that changes in each emergent fermion state X automatically leads to corresponding changes in its environment/vacuum state/**rest of the universe**, predicated here to concern geometric phase θ (Resta 1997 [77] The Berry Phase; Berry, 1984 Geometric Phases in Physics [78]) so that the parametric Hamiltonian $H(E;\mathbf{p};m)$ $E^2-\mathbf{p}^2-m^2=0$ is the fundamental nilpotent criterion predicated above. This allows each H to be dealt with as if it were isolated from any larger unity where, ultimately, $H(X)$ in an incomplete universe defines the First Law and Second Laws of Thermodynamics; and, as $L(X)$'s universal attractor, specifies its systemic birthorder automorphisms, additionally subject novel observable gauge invariant parametric effects predicating new novel states of matter $X(E,\mathbf{p},m)$. In Weyl (1929) [79], the units (identified by Galois) as of fundamental importance to the solution of algebraic equations, form a composition series composed of fundamental maximal invariant subgroups $g_0=g, g_1, g_2, g, \dots, g_{n-1}, g_n=1$, so that the factor groups g/g' are simple. Weyl quotes Millikan 'Never in the history of science has a subject (spectroscopy/valence) sprung so suddenly from a state of complete obscurity and unintelligibility to a condition of full illumination and predictability as has this field since the year 1913'. As he points out any electron/fermion in the shell structure of any atomic element/periodic table can be interchanged with any other, without changing the element's chemical valence properties and so this must also apply to $L(X)$ itself in relation to both NDG and the complete symmetry infinite linear permutation Galois Group of automorphisms hypothesized to constitute the linear quantum superposition of the $U1$ field prior to the change in the environment induced by the emergence of the next X . i.e. of normalized permutations (divided by $(n!)$) which then constitute a roll of the dice as the means by which evolution is proofread/advances.

4. NQM very briefly summarised

This summary postulates that Nilpotent Quantum Mechanics [14], including quantum physics, may be

best understood as the algebraic study of groups as the automorphisms of fields, i.e. as Galois theory. This is, for example, as used in Conway's non-standard mathematical analysis equivalent to Zermelo-Fraenkel set theory, where automorphisms (of the number/ordinal fields) are generated by means of the generalised Dedekind cut 'division algebra' and the system's unique birthorder automorphism provides the whole analysis of number/Turing computation, in the simplest possible way, as sums, products, inverses, groups, algebraic and transcendental extensions of successively more complicated well defined concepts of the analysis. Rowlands' universal computational rewrite language L shows, that $L(X)$ defines a quantum system's unique irreversible birthorder automorphism in terms of the splitting field of its fermion states X . That is, each X automatically leads to corresponding changes in its environment (vacuum state/**rest of the universe**) as governed by the nilpotent Dirac group algebra and nilpotent Dirac equation $(\pm kE \pm i\mathbf{p} + jm)A \exp(-i(Et - \mathbf{p} \cdot \mathbf{r})) = 0$. Here, $H = E^2 - \mathbf{p}^2 - m^2 = 0$ is the system's pointwise universal attractor, pole of poles and First Law of Thermodynamics of Energy E momentum \mathbf{p} and mass m , which factorizes into nilpotent Dirac group fermion solution space $X \neq 0$; $X \cdot X = 0 = (ikE + i\mathbf{p} + jm) \cdot (ikE + i\mathbf{p} + jm) = E^2 - \mathbf{p}^2 - m^2 = 0$; for all X (and each X must be proofread as compatible with each X before it). Here, $i = \sqrt{-1}$ and the quaternion units $\mathbf{k}, \mathbf{i}, \mathbf{j}$, are the (unit) projections of generalised charge in the Standard Model. That is, each unique $X = (ikE + i\mathbf{p} + jm)$ represents an automorphism in the nilpotent Dirac group algebra, that the Dirac equation says may apply. And the group g composition series $g_0 = g, g_1, g_2, g_3 \dots g_{n-1}, g_n = \mathbf{1}$, where each member is a maximal invariant subgroup of the preceding member, is of fundamental importance to the algebraic solution of the equations in question.

5. The Cosmos as a quantum coherent unity of its automorphisms

The theory predicates that the cosmos most likely has a quantum gauge coherent unity that holds at all 3+1 space-time scales, so that $L(X)$ represents the system's unique birthorder automorphism or Second Law of thermodynamics behaviour without time reversible symmetry. This is independently known to be the case: from the quantum thermodynamics of the quantum Carnot engine which leads to entirely new states of matter and includes the classical Second Law; from Berry's geometric/topological/tautologous phase θ , which also hypothesizes there exists a Hamiltonian without time reversal symmetry; and also from the parametric mapping of any Hamiltonian onto itself (as an attractor) to find its stable and unstable points, which, as the basis of the methodology of Wilson's renormalization group methodology, determines its material phases of matter, i.e. $H(X)$. Such material phase transitions of matter its stable and unstable critical points are found by mapping a Hamiltonian onto itself. [80-82]

Consequently these representations of the productions/machine order code of the universal computational rewrite language L and its unique infinite alphabet, with its formal system of four rules characterized by duality, self-similarity and holism, is one where the successive alphabets generated by the create process, i.e. (alphabet)(alphabet) \Rightarrow (new alphabet) leads to a regular series of identically closed anti-commutative cycles, each of which commutes with all the others (i.e. all the terms have a unique identity because they have a unique partner). As the proofreading process (subalphabet)(alphabet) \rightarrow (alphabet) confirms, the concatenation (AB)(AB) is commutative, $\rightarrow (R)$, or anticommutative, $\rightarrow (R^*)$, with only the anticommutative options lead to something new. That is, the generation process is a one-arm irreversible bifurcation, where this can be identified, quantum physically, with the fermions X as its sources. And in [14], L (which is Rowlands' self-organised universal nilpotent rewrite language with an infinite alphabet) then predicates a natural system/cosmology close to the thermodynamic ideal where the First Thermodynamic Conservation Law $H = E^2 - \mathbf{p}^2 - m^2 = 0$ of Energy E momentum \mathbf{p} and mass m is the system's universal attractor (that as above factorizes into the nilpotent Dirac Group fermion solution space $X \neq 0$; $X \cdot X = 0 = (ikE + i\mathbf{p} + jm) \cdot (ikE + i\mathbf{p} + jm) = E^2 - \mathbf{p}^2 - m^2 = 0$, with $i = \sqrt{-1}$ and $\mathbf{k}, \mathbf{i}, \mathbf{j}$ identified as the quaternion units onto which electromagnetic, strong and weak charge are projected. $L(X)$ also defines the irreversible Second Law of thermodynamics with a Dirac group unit element \mathbf{I} ; and 3. the nilpotent Dirac equation $(\pm kE \pm i\mathbf{p} + jm)A \exp(-i(Et - \mathbf{p} \cdot \mathbf{r})) = 0$ shows holds differently on different time (t) and space (\mathbf{r}) scales.

6. A computational context, where group theory supersedes apps.

In universal Turing digital representations, i.e. programs, apps, etc, each unique computational input ideally leads to a unique computable output, subject to cumulative error propagation, time limitations of exponential complexity, the Halting problem and the AI automation paradox. However, in the methodology of computational rewrite production system languages, a program rewritten as productions via an alphabet of unique symbols for hardware to interpret, not only ensures such a canonical ideal but the program's efficient tractable error free execution. Here, we have a methodology, by which digital algorithms are efficiently programmed/produced' using a finite alphabet, but also, as we have hypothesised, that is in use by the human brain, explaining how canonically a write/read associative memory of such productions might be sentiently compiled and accumulated, leading to semantic alphabetic language capabilities.

These are in agreement with the experimentally confirmed thermodynamics of a Quantum Carnot Engine (a generalization of its classical counterpart) that leads to entirely new states of matter and perhaps hot running [78]). For quantum phase coherence θ alters ideal Carnot heat engine action from $\eta = 1 - T_c/T_h$ where T_c and T_h are the low and high temperature entropy sink and source (as required by the classical Second Law of Thermodynamics) to $\eta_\theta = \eta - \theta \cos \theta$ when $T_c = T_h$. So such heat engine action is even possible in a single heat bath hypothesized self-governed autonomous cosmology where each unit I_x similarly can be an autonomous self-governed DNA/RNA biogenetic life form/QCE leading to entirely new/novel states of matter/alphabetic signals of thought, i.e. the emergence of new material phase transitions. Furthermore this now normalized unit group formalization itself may be given a universal computational rewrite language L' with an alphabet of just 4 symbols representing the axioms of group theory (in place of L 's rewrite four fixed rules of an alphabet, a start 'axiom', rewrite productions and a stopping criteria used by Rowlands and Diaz) i.e. closure, associative law, unit element and inverse element. These lead to those of the 64 triples of DNA/RNA genetic code as the symmetries and symmetry breaking of the nilpotent Dirac Group. And, clearly in this case, L' which we today label group theory says, will 'in the passage of time' bootstrap itself into existence as a nature language capability of a DNA life form (of which we ourselves as the human genome constitute an experimental validation) together with the universal computational rewrite language L (including Turing computation!) and that of the DNA/RNA genetic code itself! This tells us that these languages are tautologous, and concern the quantum geometric phase θ as a tautological one form θ . In this structure, there is now an even more compact mathematical formal language, category theory represented by object labelled arrows corresponding to the 'passage of time' i.e. signal inputs followed by signal outputs, the result of a labelled computational process, which here concerns a self-adjoint commutative Lie diagram representing the known fundamental spectral theorem of Hilbert and Von Neumann on the Hilbert space. (As in Wittgenstein's semantic principle [83], 'there is necessarily only one proposition for each fact that answers to it and that the sense of a proposition cannot be expressed except by repeating it, i.e. each individual is a unique, quantum automaton [84].) And since the passage of time is a dissipative process governed by the Hamiltonian H then there exists a Liouvillian $L[H,] = H \otimes \mathbf{1} - \mathbf{1} \otimes H$ & $[L, t] = 0$ & $[T, L] = i$ where t is time and T an 'internal' clock/time may exist. i.e. $\theta \cdot \mathbf{1} = \theta$ is the canonical one form, and $d\theta$ the 2 form on the associated symplectic manifold, such that $dd\theta = 0$, represents the physical principle of least action, as is implicit in the existence of H .

Galois theory is the algebraic study of groups of automorphisms of a field in which one associates an extension field with a given algebraic equation and there always exists a unique birthing automorphism of the field; so that potentially (as shown above) $H(X)$ provides a basis for the First, Second and Third laws of Thermodynamics and probability theory in the same universal quantum mechanical group theoretic explanation! Galois theory thus tells us that there exists a universal theory of everything computational, described below, in which each unique canonical input-output, is one (of an infinity) of tractable roots/solutions of a single mathematical group (currently scientifically largely unrecognised in this computational context), where parallelism across all its computational processes is quantum linear superposition so that this group takes the form of the general linear complete group of permutations.

7. Some applications (reread Introduction)

The conundrum of perception's objectivity/subjectivity is resolved in this self-governed system by the fact the object image of an object is a phase conjugate dynamic '3+1 holographic' one that coincides external to the observer (or outer automorphism) with that of the 3+1 unique object itself i.e. **'a rest of the universe'** geometric phase objectivity, the 3+1 basis of which is common to the perception of all sentient observers. This is one that makes communication between different observers possible. Just a snap of ones fingers demonstrates this; listen where do you hear the snap?

We are suggesting that the reader should realise that if a theory of everything computable is an algebraic equation then we will all know two ways to solve it!! That is, $i=+\sqrt{-1}$ and $-\sqrt{-1}$ because these make the factorization of any algebraic equation into all its roots/solutions possible! And as Galois theory tells us all such roots forms a mathematical group, which in the case of quantum mechanics, one can postulate concerns quantum linear superposition, i.e. the complete linear group Gl_{\square} of permutations, which needs no independent basis for probability theory & has a complete Lie algebra gl_{\square} of potential solutions in terms of the Lie group germ Gl_{\square} ; i.e. Lie brackets $[a,b]$ where a,b commute (i.e. is Abelian) which together with $\{c,d\}$ the Clifford bracket/group germ and c,d anti-commute, define the entire quantum solution space, of bosons and fermions X respectively. (Such Lie and Clifford group germs are a means to tractable solutions to problems because the notation $(,)$ signifies a control process that always returns control to the interval $(,)$, i.e. to the group/one of its members and in particular the group unit **1** (signifying normalization) – a safety critical means which returns control to the control interval. [85]) And so, as is experimentally validated currently, quantum mechanics consists solely of the unique fermions (Pauli exclusion) and their bosons interactions.

Moreover, Lie $[a,b]$ s are a diffeomorphic generalization of the classical differential operator, i.e. such group germs concern an exponential differentiable operator with a differentiable (logarithmic) inverse. It says that Heisenberg uncertainty and exponential complexity can both be overcome, by means of the 3D unipotent Heisenberg Lie Group and its 3D nilpotent Lie algebra \mathfrak{g} , in the form of the Heisenberg sphere/geometric qubit [7, 8, 10]. That is, $[i, -i]$ determines all such solutions, using the 3D Heisenberg Lie group G nilpotent Lie algebra \mathfrak{g} , as used by Schempp as the fundamental mathematical basis for the optimal control of Magnetic Resonance Imaging machines; a neural architecture of brains working by non-degenerate quantum holography; and black hole astrophysics (e.g. published in *Acta Systematica* 2018). Thus the Lie and Clifford bracket and Lie diffeomorphism determine a quantum mechanical system of solutions where the indeterminate units i become determinate and do so quantum mechanically in what is known as geometric/Berry phase θ where $\exp(i(\theta=\pi)) = -1$ & only relative phases can be measured (the initial fixed phase itself is known to be indeterminate). Such computation is thus characterized by π , as Deutsch (1985) [86] shows in his Royal Society paper on the universal quantum computer, where the Church Turing Hypothesis is replaced by the Church Turing Principle that one QM system may perfectly simulate another; and, as found experimentally in mammals, ' π = visual cortex' by Miller [87]. (This is explained as due to Berry phase in [63] and in a letter to *Science*, dated 6 December 2010, published in [63].)

Such Lie and Clifford group germs are the means to tractable solutions to problems because the notation $(,)$ signifies a tractable control process that always returns control to the interval $(,)$, i.e. to the group/one of its members and in particular the group unit **1** (signifying normalization) and as such is a solution/root as represented by its Lie algebra. An example can be found in U1 electromagnetism where an electron is the source of photons which also act as clocks, i.e. quanta $h\nu$ having frequency ν , and the **1** tells us electromagnetic phenomenon are calculable over the whole cosmos unit **1**. Time, therefore, is not just a scalar where special relativity holds with respect to clocks. It has a direction and so is irreversible. Again, in respect to the Dirac delta function δ in the Dirac bra/ket formalism, where $(,)$ is written as $\langle | \rangle$, and δ acts as a Heaviside operator equivalent to the singular Green's function G (Schwartz distribution) that permits the corresponding description by means of an integral formula, as in Feynman's sum of histories approach to quantum mechanics, i.e. $G(r,t,r',t') = \delta(t-t' -|r-r'|/c)/4\pi|r-r'|$ (a description interpreted as arising from the field bosons in question) implies that the fermion (re) source $S_{or} = OPF$ has an inverse $F=(OP)^{-1}S_{or}$ exists and is calculable. And the normalized group unit **1**

tell us that such units corresponding probabilistically to autonomous self-governed systems within an autonomous -governing cosmos, must also be represented by some form of division algebra, where that of the following continued fraction suggests itself, because every irrational number may be so represented, for $1 + 1/(1 + 1/(1 + 1/(1 + \dots))) = (1 + \sqrt{5})/2$, the golden mean, is the finite limit/birthorder automorphism of field of continued fractions such that 1 is modulus $|1|$ and so this field automorphism is that of solutions of group of units $|1|=1$ and with respect to δ where $\mathbf{r}-\mathbf{r}'$ is represented by its modulus. That is, they both concern the modular groups consisting of all Mobius transformations and have modular representations over a field of prime characteristic, which concerns a rational invertible transformation of the complex plane $w=(az+b)/(cz+d)$ and are conformal mappings where $ad \neq bc$, i.e. meriphormic where the poles are the fermions.

Furthermore, Berry postulates that there is a (now known) quantum system with an unknown Hamiltonian operator without time reversal symmetry in the form of the Zeta function where, by Riemann's Hypothesis all Zeta's zeros lie on the line $x=1/2$ in the upper half complex plane (x,y) . Can it therefore be coincidence that quantum mechanics defined by Lie commutator $[,]$ and Clifford anti-commutative bracket $\{ , \}$ group germs, has a universal self-governed rewrite language L with an infinite alphabet that Rowlands finds determines a Hamiltonian $H=0$ that is that of the First Thermodynamic Conservation Law, while also satisfying the Second Law of Thermodynamics in the form of H 's fermion Hamiltonian path in the quantum cosmology postulated here, and additionally concerning the Standard Model elementary particle physics described by the $U(1)$, $SU(2)$ and $SU(3)$ Lie Group and its Lie algebras defining the electromagnetic, weak and strong force fields respectively.

Amazingly, too, we are all aware of group theory use with respect to our own human biology, in relation to blood groups where the 4 basic types are O, A, B and AB, and O is indeterminate, that is, it can be transfused by anyone. That is, we ourselves are a living proof of its Galois correctness. In addition, the Blue Planet Earth/Biosphere/Gaia also perfectly stimulates the Heisenberg sphere/universal qubit which both acts as a quantum cosmological clock for the emergence of autonomous, self-governed life forms, and allows us to understand the mystery of time, as the gauge invariant cosmological phenomenon of geometric phase θ . This is the exact feature of how analogue clocks on Earth endlessly display the passage of relative time, such that time is irreversible, with a fixed past, an ever changing present, and an uncertain and largely indeterminate future.

We can also postulate that the heart is a quantum clock/engine, i.e. a qubit/Heisenberg sphere/(4-chambered) pump that optimally controls the flow of blood throughout the body by quantum linear superposition, so that in whatever activity the living being is engaged, there is optimal control and each subunit/organ inputs the oxygenated blood supply it needs and outputs/recycles the used blood supply at ideally the clock frequency each organ/body part and its current activity demand. And this even includes immune system self-repair and the fighting of disease/harmful bacteria/viruses including their detection. It may even include sexual attraction when two hearts, as we say, beat as one, i.e. become a quantum Cooper pair so as to change each individual's behaviour entirely. For quantum hearts have now solitonic properties and so may even interact with themselves, as probably happens in the self-repair of the body and mind, because they have a well-defined holographic trace transform/cranial sacral system as the basis of sentient self-governance as well a holographic transform shown to be the quantum basis of sentient/sensory perception and the brain's holographic optimally controlled associative filter bank memory.

8. Appendix: General relativity and quantum mechanics are compatible

The discovery/algebraic formalization of a First Law of Thermodynamics of matter predicating the nilpotent Dirac equation as autonomous self-governance set out herein, says that 'matter tells 3D+1 space-time how to curve and that 3D+1 space-time tells matter how to move', the central essential feature of Einstein's General Relativity (EGR) in this predicated quantum cosmology. Here, the self-adjointness of the Fundamental Spectral Theorem of Hilbert and Von Neumann expressed as Lie commutative diagram/Lie group germ already referred to above, defines the covariance necessary to EGR. It concerns by two commutative vector spaces in NQM, i.e. the dualistic geometry of manifolds,

where Amari [88] explains the geodesic behaviour in terms of two Riemannian metrics coupled one to the other such that there is a dually flat manifold having two different criteria of linearity or flatness; implying the existence of mutually dual/conjugate bases in their tangent space. One has tangent vectors along the co-ordinate curves θ_a so that $g_{ab}(\theta)$ defines the metric while the second has its exponential dual z_a concerns $g^{ab}(z)$ such that δ_a^b is the Kronecker delta, so θ is a linear coordinate system with exponential derivatives/flatness and z is its flatness dual. Amari demonstrates a Pythagorean/orthogonal relationship between the two duals, and the two coordinate systems are connected by a Legendre transform.

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