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It from Qutrit: Braided Loop Metaheuristic

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Abstract

Cosmologies are developed by physicists and philosophers to explain our experiences of the evolving cosmos. Intelligent deep-learning metaheuristics provide original frameworks for cosmologies which are founded on quantum information. Mathematical standard models of physical cosmology and particle physics formalize an abundance of observations, yet there is no scientific consensus about how these models include our conscious experiences and fundamental philosophies of information. Furthermore, Naturalness in physics is coupled to the related problem of fine-tuning. To address these foundational problems, within the quantum information paradigm, whilst aligning with standard scientific models, I introduce a topological deep-learning cosmology metaheuristic. Braided, 3-coloured, world-strands are proposed to be the fundamental quantum information tracts (ethereal fibre bundles) of our evolving Triuniverse. This Braided Loop Metaheuristic comprises eternally evolving deep-learning feedback loops of superposed, braided, 3-coloured, quantum information world-strands, which process (in 3-level qutrit states) foundational properties coined Algebrus (labelled red), Algorithmus (labelled green) and Geometrus (labelled blue). Braids split from 1→2→3 (in knot representation respectively: closed loop→trefoil knot→Borromean loops) thence combine from 3→2→1 to form eternally evolving deep-learning loops. This cosmology metaheuristic simultaneously incorporates initial Laws of Form; Emergentism (from substrate Mathematics, through Quantum Physics to Life); Consciousness (as a superposed triunity of Implicate Order, Process Philosophy and Aesthetic Relationalism); Reductionism (from Life, through Quantum Physics to Pure Mathematics expressed as Logical Axioms, Laws of Parsimony and Ideal Form); and the Braided Loop Metaheuristic reboots its eternal cycle with the initial Laws of Form. An agent's personal anthropic Braided Loop Metaheuristic represents one of many-worlds, a meridional loop in a multiverse with horn-torus topology, where Nature's physical parameters vary equatorially. Fundamental information processing is driven by ψ-Epistemic Drive, the Natural appetite for information selected for advantageous knowledge. The meridional loops are ψ-Epistemic Field lines emanating

from an epistemic dipole at the horn-torus core. Equatorial parameter fine-tuning in many-worlds quantum physics and the many-species of Darwinian Life are similar deep-learning optimizations in the Braided Loop Metaheuristic.

1. Introduction

The topology of loops, knots and braids provides a foundational framework to describe the cosmos and all that it comprises; from its substrate logic and mathematics, quantum physics and biology, to intelligence and conscious experience. Our cosmos exists and evolves upon its conserved quantum information, and loops and knots (and their braid representations) explain quantization of field theories. The Jones polynomial is a knot polynomial in knot theory discovered by Jones [1], and Witten [2] provides a heuristic definition of the Jones polynomial in terms of a topological quantum field theory. Twenty years later, in 2009, Aharonov, Jones and Landau [3] presented a polynomial quantum algorithm for approximating the Jones polynomial. These three ideas, their geometry, algebra and algorithm, motivate us to explore for an overarching cosmology metaheuristic involving loops, knots and braids. These three ideas together provide an example of a quantum algorithm being a vital operational component in the solution of a big-picture problem, which seems otherwise incomplete via only geometry and algebra.

I propose algebraic algorithmic geometry, in the quantum information paradigm, is the crucial mathematical trio required to formalise the comprehensive cosmology metaheuristic which I present in this paper. Charles Darwin led with a similar approach, in his biological evolution metaheuristic of variational-selective-heredity. Mendelian understanding of algebraic variation with geometric heredity was in train, but it took Darwin's algorithm of Natural Selection to complete the big-picture of biological evolution. Likewise, upon algebraic quantum mechanics and geometric relativity, via the right metaheuristic we can discover the vital quantum algorithm to solve the century old problem of their unification.

The ideas presented in this paper extend the author's research programme [4] [5] [6] from the quantum intelligent cosmology of our quantum deep-learning Triuniverse, through the conscious agency and quantum physics of its emergent living beings, to the world and worldview elucidated by a Braided Loop Metaheuristic. This cosmology metaheuristic is philosophically and physically developed in the quantum information paradigm as a topological deep-learning me-

taheuristic wherein Logic, Mathematics, Physics, Life and Consciousness are looped in a superposition of 3-coloured, quantum foundational, braided properties of Nature, coined elemental Algebrus (labelled red), operational Algorithmus (labelled green) and structural Geometrus (labelled blue).

The Braided Loop Metaheuristic, topological deep-learning cosmology, begins with axiomatic Laws of Form [7] [8] and with foundational 3-colouration. I claim 3-colouration is the most fundamental self-defining characteristic of our Triuniverse. Such 3-colouration is figurative and has nothing to do with the hues we see in a rainbow, however it is at the root of consequently emergent 3-colour charge in Quantum Chromo-Dynamics. Here, 3-colouration is a foundational property expressed as 3 quantum information labels: red, green and blue. They relate to 3 species of quantum information [9]. It is proposed that hierarchical quantum information correspondence from Logic ⇔ Mathematics ⇔ Physics ⇔ Life ⇔ Consciousness is mapped and conserved within each colour label, such is the profundity and universality of elemental Algebrus (red), operational Algorithmus (green) and structural Geometrus (blue). Note correspondences are bidirectional (⇔). In this linear expression Emergentism flows to the right (⇒) whilst Reductionism flows to the left (⇐) and they coexist superposed symmetrically in the quantum conscious mind. Indeed, Enlightenment is proposed to be attained during simultaneous superposition of full Emergentism with full Reductionism in the Braided Loop Metaheuristic (Section 3).

Elemental Algebrus (red) comprises the algebraic characterization (*sensu lato*) of Logic, Mathematics, Physics, Life and Consciousness. Operational Algorithmus (green) comprises the algorithmic characterization (*sensu lato*) of Logic, Mathematics, Physics, Life and Consciousness. Structural Geometrus (blue) comprises the geometric characterization (*sensu lato*) of Logic, Mathematics, Physics, Life and Consciousness.

These definitions are formalized with symbols for Algebrus $|R\rangle$, Algorithmus $|G\rangle$ and Geometrus $|B\rangle$; Algebraic characterization (*sensu lato*) (R), Algorithmic characterization (*sensu lato*) (G) and Geometric characterization (*sensu lato*) (B); Logic ($\mathbb{A}$), Mathematics ($\mathbb{M}$), Physics ($\mathbb{L}$), Life ($\mathbb{L}$) and Consciousness ($\mathbb{Z}$) in Expression (1):

$$\text{Algebrus} \equiv |R\rangle = R\{\mathbb{A} \Leftrightarrow \mathbb{M} \Leftrightarrow \mathbb{Q} \Leftrightarrow \mathbb{L} \Leftrightarrow \mathbb{Z}\}$$
$$\text{Algorithmus} \equiv |G\rangle = G\{\mathbb{A} \Leftrightarrow \mathbb{M} \Leftrightarrow \mathbb{Q} \Leftrightarrow \mathbb{L} \Leftrightarrow \mathbb{Z}\} \quad (1)$$
$$\text{Geometrus} \equiv |B\rangle = B\{\mathbb{A} \Leftrightarrow \mathbb{M} \Leftrightarrow \mathbb{Q} \Leftrightarrow \mathbb{L} \Leftrightarrow \mathbb{Z}\}$$

where the mathematics of algebra (*sensu stricto*), algorithms (*sensu stricto*) and geometry (*sensu stricto*) are respectively subsets of ($\subseteq$) and conceptual frameworks for ($\lessdot$) the characterisation of elemental Algebrus $|R\rangle$, operational Algorithmus $|G\rangle$ and structural Geometrus $|B\rangle$ in Expressions (2) and (3) respectively:

$$\text{Algebra} \subseteq \text{Algebrus}$$
$$\text{Algorithims} \subseteq \text{Algorithmus} \quad (2)$$
$$\text{Geometry} \subseteq \text{Geometrus}$$

$$\begin{aligned} \text{Algebra} &\prec \text{Algebrus} \\ \text{Algorithims} &\prec \text{Algorithmus} \qquad\qquad (3) \\ \text{Geometry} &\prec \text{Geometrus} \end{aligned}$$

In contrast, a surreal binary "black and white" (again figurative) world with 2-colouration underlain by qubit (2-level) quantum computations is outperformed, in terms of computational efficiency, by a Natural one with the superposed properties of Algebrus $|R\rangle$, Algorithmus $|G\rangle$ and Geometrus $|B\rangle$, which elevate our world to a 3-coloured stable self-mutuality; a Triuniverse [4].

2. Natural Proclivity for the Integer 3

The underlying quantum computations of our evolving Triuniverse are proposed to be qutrit (3-level) computations [4]. Quantum computations at the foundations of our Triuniverse are performed with the integer base $\lceil e \rceil = 3$, which is the integer base with the lowest average radix economy [4] [10].

There is no computational speed advantage nor extra efficiency to be gained through any other integer radix of computations. The integer base 3 is manifest physically as follows:

- 3 is the least number of sides a polygon can have;
- 3 uncompactified spatial dimensions;
- 3 is the number of non-collinear points needed to determine a plane and a circle;
- 3-coloured Quantum Chromo Dynamics;
- 3 generations of leptons;
- 3 generations of quarks;
- 3 fundamental forces in Grand Unified Theory (where gravity is emergent and not a fourth force [5] [11] [12]);
- 3 voters in least participant majority voting for triple-modular-redundancy;
- 3-level qutrit solution to the Byzantine Agreement Problem for fault tolerance [13];
- 3-level qutrit is the smallest system where the contextual nature of quantum mechanics can be observed [14];
- 3 edges in triangles in quantum geometrodynamics or Machian shape dynamics [15];
- 3-string nodes in a trivalent string-net condensation physical mechanism for topological phases [16].

Furthermore, Natural 3-colouration is deeply self-labelled at the inception of the Braided Loop Metaheuristic, in the axiomatic Laws of Form, the cardinal characteristic of which is the "Mark". The Mark denotes the drawing of a Distinction and simultaneously signifies in superposition: (Red) the distinct entity within a boundary loop; (Green) the drawing of that boundary loop; and (Blue) the relationship between the distinct entity and its environment, across that boundary loop. There is no requirement in the Laws of Form for numbering these (1), (2) and (3), so we are free to use labels (Red), (Green) and (Blue), as I

do. Laws of Form simultaneously represent the simplest fundamental triunity superposition of Algebrus (red), Algorithmus (green) and Geometrus (blue).

The Braided Loop Metaheuristic comprises a deep-learning feedback loop of 3-coloured world-strands (fundamental quantum information tracts, or ethereal fibre bundles, of our evolving Triuniverse) with braid numbers splitting from 1→2→3 thence combining from 3→2→1 to form an endless cycle, illustrated in clockwise convention (**Figure 1**). All phase angles of the Braided Loop Metaheuristic coexist in simultaneous 3-coloured qutrit superposition and a time reversed anticlockwise experience (not commonly felt by biological, classically time rectified, conscious agents) is equally valid and superposed, however it is not illustrated in the figure below.

3. Braided Loop Metaheuristic

This section is an extended caption for **Figure 1** and its purpose is to further frame concepts and terminology. These concepts are discussed in more detail in subsequent sections, however a full picture is previewed here to assist the reader with perspectives across all its components.

The Braided Loop Metaheuristic comprises a deep-learning feedback loop of superposed, braided, 3-coloured, quantum information world-strands (ethereal fibre bundles), which process foundational qutrit properties: elemental Algebrus
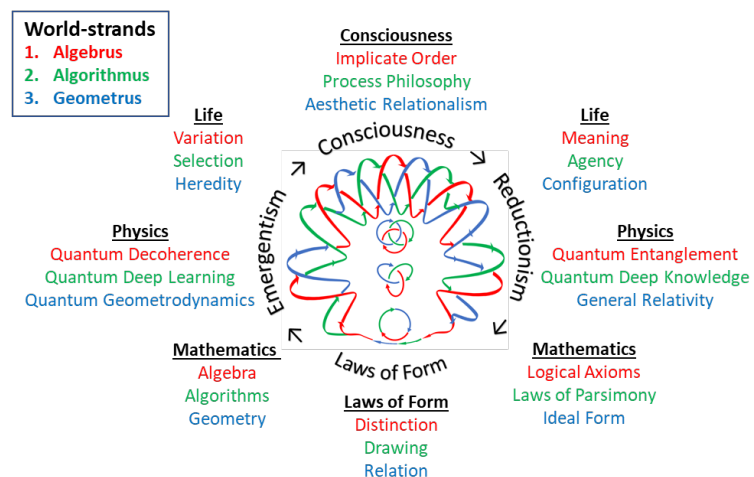

Figure 1. The Braided Loop Metaheuristic comprises a deep-learning feedback loop of 3-coloured world-strands with braid numbers splitting from 1→2→3 thence combining from 3→2→1 to form an endless cycle. In a clockwise convention, braided world-strands cycle endlessly: Elemental Algebrus (red), to operational Algorithmus (green), to structural Geometrus (blue) and from Laws of Form (1-strand braid, closed loop), to physical Emergentism (2-strand braid, trefoil knot), to Consciousness (3-strand braid, Borromean loops), to physical Reductionism (2-strand braid, trefoil knot) and back to Laws of Form (1-strand braid, closed loop). All phase angles of the Braided Loop Metaheuristic coexist in simultaneous 3-coloured qutrit superposition and a time reversed anticlockwise experience (not commonly felt by biological, classically time rectified, conscious agents) is equally valid and superposed, however it is not illustrated in the figure.

(red), operational Algorithmus (green) and structural Geometrus (blue). Braids split from 1→2→3 (in knot representation respectively: closed loop→trefoil knot→Borromean loops) thence combine from 3→2→1 (Borromean loops→trefoil knot→closed loop) to form an eternally evolving deep-learning Braided Loop Metaheuristic.

Referring to the symbols and Expressions (1) (2) (3) in the above introductory section, the Braided Loop Metaheuristic $|\mathfrak{L}\rangle$ is expressed as a 3-level qutrit state in terms of quantum foundational Algebrus $|R\rangle$, Algorithmus $|G\rangle$, and Geometrus $|B\rangle$ as follows:

$$|\mathfrak{L}\rangle = \alpha|R\rangle + \beta|G\rangle + \gamma|B\rangle \qquad (4)$$

where the left-hand side represents the deep-learning Braided Loop Metaheuristic $|\mathfrak{L}\rangle$ and the right-hand side is the 3-coloured qutrit state of superposed foundational properties and the coefficients are probability amplitudes with the sum of their squares being unity:

$$|\alpha|^2 + |\beta|^2 + |\gamma|^2 = 1 \qquad (5)$$

All phase angles of the Braided Loop Metaheuristic $|\mathfrak{L}\rangle$ coexist in simultaneous 3-coloured qutrit superposition.

The Braided Loop Metaheuristic begins with 1-braid closed loop Laws of Form wherein Algebrus is Distinction, Algorithmus is Drawing and Geometrus is Relation. Laws of Form evolve, splitting into the 2-braid trefoil knot of Emergentism, which untwines substrate Mathematics into Physics then Life [4]. In emergent Mathematics, Algebrus is Algebra, Algorithmus comprises Algorithms and Geometrus is Geometry. In emergent Physics, Algebrus is Quantum Decoherence, Algorithmus is Quantum Deep-Learning and Geometrus is Quantum Geometrodynamics. In emergent Darwinian Life, Algebrus is Variation, Algorithmus is Selection and Geometrus is Heredity.

Further Emergentism splits the 2-braid trefoil into 3-braid Borromean Loops of 3 superposed subconscious states, which in triunity create Full Consciousness, wherein the loop of Algebrus is an Implicate Order subconsciousness, the loop of Algorithmus is a Process Philosophy subconsciousness and the loop of Geometrus is an Aesthetic Relationalism subconsciousness. On attaining Enlightenment, 3-braid Borromean Full Consciousness combines into the 2-braid trefoil knot under Reductionism which entwines knowledge of Life, Physics thence Mathematics.

In conscious reductionist Life, Algebrus is Meaning, Algorithmus is Agency and Geometrus is Configuration. In the agents' (or correlated observers') reductionist Physics, Algebrus is Quantum Entanglement, Algorithmus is Quantum Deep Knowledge and Geometrus is General Relativity. In reductionist Mathematics, Algebrus comprises Logical Axioms, Algorithmus comprises Laws of Parsimony and Geometrus is Ideal Form.

On agents discovering and realising these pure states, Reductionism further combines world-strands into the 1-braid closed loop Laws of Form to complete

and superpose the entire deep-learning feedback loop of the Braided Loop Metaheuristic.

It is also proposed that the Braided Loop Metaheuristic is scaled by the individual agent's present level of consciousness (Figure 2). The lowest mode of consciousness in this model is partial engagement (e.g. via the nervous system of a simple organism, or in the mind of a temporarily disinterested human). In this mode the agent endeavours to be fully present and non-judgemental but falls short of the threshold. Upon attaining that full engagement, the conscious agent enters a mode of partial connection with the environment of all things. Once fully connected, the agent enters the mode of partial unity with the environment of all things and only becomes fully unified with it upon attaining perfect enlightenment, without further desires and with all thoughts satisfied. Later, I explain that ultimate conscious enlightenment arises at the equator of a many-worlds horn-torus topology where Nature becomes maximally revealed, completely known and fully experienced (Section 7.4, Figure 3).

The living agent's level of consciousness is typically transient and interrupted by necessary acts of living and by the functional systems of Life. Thus it is probable that during its lifespan a conscious biological agent will complete its personal loop without attaining stable perfect enlightenment. However, the agent's mind will attain a certain maximum level of consciousness, which can be bettered through socio-environmental interaction, learning, reflexion, meditation and palingenesis during deep-learning iterations of the Braided Loop Metaheuristic.

Within the Braided Loop Metaheuristic, biological Life is generally experienced by its conscious agents in a clockwise conventional arrow-of-time direction, which I propose relates to the time-rectifying, time asymmetric, biochemical signalling cascades of emergent classical information bio-processing in simple nervous systems. Notwithstanding, a deeper quantum consciousness

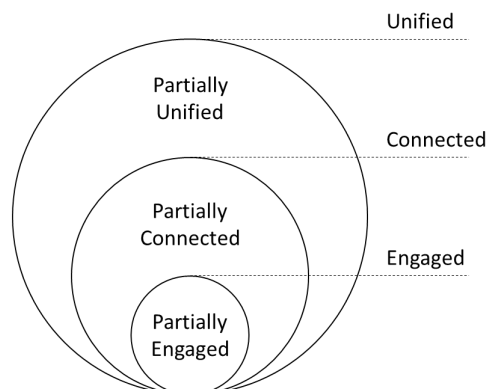**Schematic illustration of 3-levels of consciousness**

Figure 2. Schematic illustration of 3-levels of consciousness, successively: engaged, connected, thence unified with the environment of all things. The levels are transient conscious experiences and different living agents attain different maxima during their reflective palingenetic lifetimes.
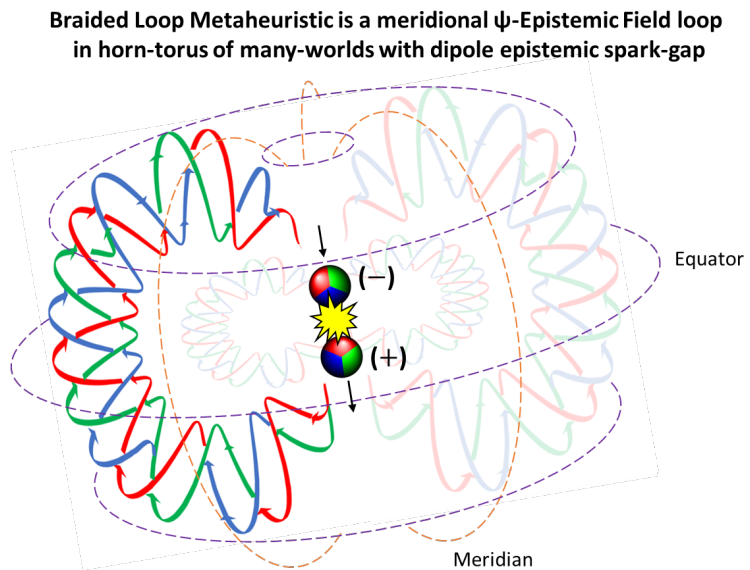
Braided Loop Metaheuristic is a meridional ψ-Epistemic Field loop in horn-torus of many-worlds with dipole epistemic spark-gap

Figure 3. Braided Loop Metaheuristic (boldly 3-coloured) depicted as one meridian of a horn-torus, where all possible meridional configurations of nature's physical parameters vary around its equator. The boldly highlighted meridional loop is anthropic, in that it has physical parameters conducive to the emergence and evolution of human life. The core of the horn-torus represents inception in Laws of Form, which in physical cosmology is equivalent to the singularly superposed Big Bang quantum state. An existential dipole epistemic spark-gap action occurs as Reductionism (negative sign) short-circuits, switching through with minimal information complexity, to Emergentism (positive sign) via the Laws of Form. The horn-torus equator is a contour of conscious enlightenment, from where entirely evolved, boundaryless, Nature becomes maximally revealed to the mind, completely known and fully experienced. Referring to **Figure 2** the diameter of the meridional loop correlates to levels of transient conscious experience and different living agents attain different maxima during their reflective palingenetic lifetimes (depicted in this figure as nested braided loops). ψ-Epistemic Drive is the Natural appetite for information selected for advantageous knowledge and is operationalised via the Braided Loop Metaheuristic, along meridional ψ-Epistemic Field lines.

operates within the quantum information paradigm [6]. Classical bio-processing with clockwise time asymmetry appears to have been Naturally Selected during the evolution of emergent Life because it bestows advantageous operational sequitur for adaptive algorithms in predictive learning. This confers anticipatory abilities in a cogent causal clockwise domain, and thus improves an agent's fitness to survive in that same emergent clockwise domain, to reproduce, accumulate memories and to communicate its beneficial knowledge. Just as matter and anti-matter co-exist in Majorana fermions, this clockwise domain, as experienced by the classically conscious, partially enlightened, biological mind, is proposed to have a complementary anticlockwise domain, where the process flows in the reverse direction, which cannot be commonly experienced by the simple, classically time-rectified, conscious biological mind, nonetheless, clockwise and anticlockwise domains coexist in the time-symmetric quantum cosmology of the

Braided Loop Metaheuristic.

Special Relativity informs us that the perception of "now" is illusory; past, present, future and all locations co-exist in a Minkowski spacetime block cosmos. Quantum retro-causality is conceivable in such a block cosmos, wherein past events persist and future events could affect them through spatiotemporal quantum non-locality [17] [18] [19]. I propose that whilst consciousness has quantum foundations [6] (through Lithium-6 spin-entanglement with topological spacetime instantons in the environmental vortical gluon field, via quantum chromodynamics) the emergent customary experiences of the partially enlightened biological brain result from time-rectifying biochemical signalling cascades of emergent classical information bio-processing. Such cascades are triggered by the deeper quantum chromodynamic (QCD) information processes and physiological controls, perception, cognition and intelligence arise (via hyperfine interactions) through parallel quantum electrodynamic (QED) information processing. This classical time-rectification by simple nervous system cascades from deep QCD to QED biochemical signalling bestows our entropic (clockwise arrow-of-time) and practical causal experience of the biologically perceivable and biologically inter-actionable world.

The Braided Loop Metaheuristic provides an original framework to describe a braided 3-colour version of the Minkowski spacetime block cosmos, comprising elemental Algebrus (red), operational Algorithmus (green) and structural Geometrus (blue). The Braided Loop Metaheuristic offers a way to characterise quantum spacetime non-locality. I propose elemental Algebrus (red) is innately manifest as an ordered quantum nodal spacetime lattice, which is information-rich but includes essential imperfections, flaws, glitches, random error spikes; seeded from the mathematical substrate of Gödel's incompleteness and emerging in quantum physics as Heisenberg's uncertainties. These vital flaws, existential noise, in the information-rich lattice, act as transient spatiotemporal reference points for instantaneous relative-identity and self-identity, and as random triggers for essential spontaneity and Natural variation. It is envisaged, later in this paper, that a random epistemic spark-gap action (not electric), in a ψ-Epistemic Field dipole, propagates this existential background noise (Section 7.4) throughout the quantum fields of our physical Triuniverse.

The lattice of innate elemental Algebrus is one part of the superposed triunity of foundational properties which together form the Minkowski spacetime block cosmos. Operational Algorithmus is the second of these three superposed foundational properties and is manifest as the algorithmic quantum computing of the information in the lattice. Structural Geometrus is the third of these superposed foundational properties and is manifest as the topological network of non-local spatiotemporal relations and interconnections between spacetime shapes (foundational to physical things) which coexist in the innate nodal lattice of Algebrus and which are drawn, traced, co-processed, coevolved and correlated by the deep-learning operations of Algorithmus.

I highlight the fundamental importance of Algorithmus, in the quantum information paradigm, as the most often overlooked and yet most pivotal of these three superposed foundational properties. Union of quantum mechanics and relativity is typically attempted via 2-coloured algebraic geometry. Whereas trinity in the Braided Loop Metaheuristic provides a breakthrough approach, involving 3-coloured algebraic algorithmic geometry. Furthermore, in the Triuniverse model of cosmology [4] operational Algorithmus (green) performs the vital role of enabling things to out-compute (*sic*) each other, in a quantum information trophic web. The Triuniverse concept proposes that fundamental information processing is driven by ψ-Epistemic Drive, which is the Natural appetite for information selected for advantageous knowledge and it propels both Emergentism and Reductionism.

I propose in the Triuniverse concept [4]:

"That to out-compute (sic) alternatives is to prevail over them in terms of computational speed and algorithmic efficiency, quickly and accurately narrowing predictive model approximations, with codes continuously reoptimised through lex parsimoniae and the paring down of redundancies. Narrower predictive model approximations enable subsequent information processing to be more efficient and to bestow anticipatory advantage. Note, time is of the essence and is a valuable Natural resource in this quantum foundations concept."

Significantly, the economically-rationed processing time resource in operational Algorithmus, relates to conservation of energy through Noether's theorem as a consequence of continuous time translation symmetry (laws of physics do not change over time). Furthermore, through Szilárd's energy-information equivalence, conservation of information is thus also a consequence of continuous time translation symmetry. In Algorithmus, to out-compute (*sic*) alternatives (optimising quantum computational time whilst conserving energy and information) bestows selective advantage in the deep-learning Braided Loop Metaheuristic. Algorithmus thus performs the essential optimization to dynamically and computationally bridge the gap between quantum mechanics (Algebrus) and relativity (Geometrus), to establish a braided 3-colour Minkowski spacetime block cosmos, comprising a triunity of elemental Algebrus (red), operational Algorithmus (green) and structural Geometrus (blue).

An adjunct concept in this braided 3-colour Minkowski spacetime block cosmos interpretation pertains to time travel. The biochemical time-rectification of the human brain aside, it is proposed that time-reversible world-strands of Algorithmus, weaving shapes of Geometrus, through the error-spiked lattice of Algebrus, could explore past and future worlds with similar uncertainty. Whilst this is not surprising for time travel into the entropic future it is more bewildering for time travel into the relative past. The point I make, is that as a time-reversible world-strand of Algorithmus weaves into the past, it also encounters decision-altering random glitches, spikes in the lattice of Algebrus which are not

permanently memorised in the lattice. Information is conserved in the Triuniverse but (albeit essential) error glitches are not stored, they are spontaneous, transient and corrected, via triple modular redundancy and qutrit Byzantine agreement. Thus, just as the future can be influenced by the wilful conscious agent, history can also be influenced, provided a time-travelling quantum conscious agent can overcome its classical biochemical time-rectification.

Whilst human recollection errors and so-called false memories are most rationally explained in psychological and forensic science terms, and through consensus by many witnesses, there is scope for some open-mindedness when listening to accounts of the "beyond consensus" past as communicated by witnesses possessing other, altered, or impaired states of mind. In psychiatry, "confabulation" is a clinical term used to describe a disturbance of memory. Indeed we have all felt certain about our own recollections, whilst doubting some of others. A subset of those who confabulate are postulated to comprise agents less able to rectify time and if they could be distinguished from the population of those otherwise affected by confabulation, then they could provide data to test the idea of biochemical time-rectification in the human brain. Also note, no agent recollects absolute history, Einstein shows us that absolute simultaneity is negated by the relativity of simultaneity.

Furthermore, I suggest time-rectifying neural cascade circuitry is reinforced in babies' brains, as they develop in the same biological life-supporting arrow-of-time as their parents and contemporaries, because to do otherwise, to rely only on their deeper time-symmetric quantum consciousness, would lead to detrimental disconnection from their parents' metabolistic, classical, entropic, physical world of taking in essential water, food and heat, to reproduce. Might the undeveloped, unconditioned, new-born mind be time-symmetric, I suspect so (and perhaps permanently so in the simplest organisms). Indeed, might a mind's last thoughts also be time-symmetric, just as the mortal coil is shuffled off, when one's ultimate fate becomes apparent, when metabolic effort to rectify time is abandoned for higher and final mental priorities and does this offer a biological and physical window into the concept of palingenesis, in the eternal Braided Loop Metaheuristic? Time-symmetric jumps are thus possible between the beginnings and ends of living agents' conscious lives, *i.e.* where and when Emergentism at the beginning and Reductionism at the end of life coexist, in the initial Laws of Form and where and when a vital non-electric epistemic "spark" jumps the gap in the ψ-Epistemic Field dipole (Section 7.4, Figure 3) to reboot a quantum conscious state of mind in a new body.

There are also conceivable prospects in quantum consciousness research [6] to discover ways to tap deeper into the foundational quantum information processing substrate beneath the time-rectifying biochemical cascades of emergent classical information bio-processing in simple nervous systems. They could conceivably enable conscious experiences, beyond the familiar causal clockwise domain, which are temporally unrectified, time-symmetric, multi-directionally

motile in a Minkowski spacetime block cosmos, simultaneously clockwise and anticlockwise, around the Braided Loop Metaheuristic. Possible ways to achieve such transcendent full-spatiotemporal motility range from meditation and abstract mathematical, metaphysical and philosophical thinking, through pharmacological and non-pharmacological mind alteration, to brain quantum-computer interfacing. Random glitches, rooted in the incompleteness and emergent quantum uncertainties of Algebrus, cause error spikes in fault tolerant [13] operational Algorithmus, which could conceivably manifest themselves, in classically time-rectified conscious minds, as non-sequitur quantum spacetime short-circuits (e.g. experiences of déjà vu, or Jung-Pauli synchronicity in apparently meaningful coincidences etc.).

4. World-Strand of Algebrus

The ethereal world-strand of elemental Algebrus (red), in the context of the Braided Loop Metaheuristic, is all that is characterised as algebraic (*sensu lato*) and intrinsic to entities and to their numbers, variables, combinatorics, to registering of time, to their innate commutative, associative and distributive properties and likewise to their symbols, language, letters, words and word-strings, but it is neither operationally dynamic, nor relational (Table 1).

In the axiomatic Laws of Form, Algebrus is expressed as the implicit entity which becomes distinct from everything by drawing a boundary loop. Algebrus is neither the operational drawing of the boundary (that is Algorithmus), nor is it the relationship between the distinct entity and its environment across the boundary (that is Geometrus).

In the substrate of mathematics, Algebrus is expressed as Algebra (*sensu stricto*) and its evolution through creative mathematical discovery and conscious application. Gödel's incompleteness theorems are rooted in Algebrus, *i.e.* in any consistent formal system S within which a definite amount of arithmetic can be executed there are statements of the language of S which can neither be proved nor disproved in S, and such a formal system cannot prove that the system itself is consistent, assuming it is consistent. Put simply, using mathematics,

Table 1. Cyclic decomposition of the foundational property of elemental Algebrus within the Braided Loop Metaheuristic.

World Strand	Laws of Form	Mathematics	Physics	Life	Consciousness
Braid	1		2		3
Knot	Loop		Trefoil		Borromean
			→Emergentism→		
Algebrus (red)	Distinction	Algebra	Quantum Decoherence	Variation	Implicate Order
			←Reductionism←		
		Logical Axioms	Quantum Entanglement	Meaning	

mathematics cannot prove all of mathematics. This incompleteness is a logical source of essential Natural uncertainty and the algebraic seed of random variation, which pervades Algebrus.

In the Physics which emerges from this Mathematical substrate of Algebra (*sensu stricto*), Algebrus is expressed as Quantum Mechanics, specifically Quantum Decoherence [20] (the loss of information from a quantum system into the environment) which leads to classical emergent physics. Heisenberg's quantum mechanical uncertainty has roots in Algebrus, conceivably through Gödel's incompleteness and Natural algebraic random variation.

Upon that quantum physics, in emergent Life (and considering Natural variational-selective-heredity in Darwin's Theory of Evolution), Algebrus is manifest as biological Variation. Algebrus modified by Algorithmus (Sections 5 and 7.2) in evolutionary biology is the evolution of developmental interactions that modify the distribution of phenotypic variation, so-called "Evo-Devo" [21]. Life thence evolves emergent intelligence, including artificial intelligence in its tools and technologies, and Algebrus is manifest as componential intelligence, according to Sternberg's triarchic theory of intelligence [22]. Algebrus in triarchic intelligence is a composition of metacomponents.

Consciousness is thereafter emergent in the minds of sentient beings and Algebrus in consciousness is expressed as a subconsciousness of non-commutative algebra known as Bohm-Hiley Implicate Order [23]. Mind and matter are related projections into our explicate order from the underlying reality of the implicate order in the Bohm-Hiley model [24]. Consciousness requires alphanumeric characterisation for algebra and language, through Algebrus, to express Natural variation in Nature's innately ordered patterns. A perfect information lattice bestows no identity, thus no existence, and therefore variation in Algebrus is existential. The Implicate Order of Algebrus within consciousness is one of three superposed states of subconsciousness, which in Borromean triunity establish the 3-coloured state of Full Consciousness.

The conscious state of mind thence attains enlightenment (as and when it occurs, to different and personal levels, intermittently and spontaneously, through genius, insight, reflexion, intuition and serendipity) which enables Reductionism (Table 1), whereupon Life finds its Meaning. Life is thence also able to fathom Physics and its substrate of Mathematics. Figure 2 illustrates the 3-levels of an agent's consciousness which, upon attaining enlightenment, ultimately becomes fully unified with the environment of all things. Note, the 3-levels of consciousness: engaged, connected and unified, are experienced by minds operating in the superposed 3-coloured state of Full Consciousness, *i.e.* where minds have superposed subconsciousness of Algebrus (Implicate Order), subconsciousness of Algorithmus (Process Philosophy) and subconsciousness of Geometrus (Aesthetic Relationalism) (Figure 1).

Schrödinger discovered a linear partial differential equation, which describes wave-particle duality evolution over time [25]. This duality, quantum non-locality and entanglement are Natural physical facets of Algebrus. Quantum Mechanics

is thus reduced to Quantum Entanglement as set out in Bell's Theorem (wherein no physical theory of local hidden variables can ever reproduce all the predictions of quantum mechanics) and Mathematics is ultimately reduced to its Logical Axioms.

In summary, elemental Algebrus is a foundational property with Algebraic characterisation (*sensu lato*) which, with its intrinsic uncertainty, transcends from its mathematical substrate, through the emergent physics of quantum decoherence to emergent Life, evolving thereafter through innate phenotypic variation to gain componential intelligence and thence attain subconscious algebraic Implicate Order via sentient beings. Enlightened conscious minds perform Reductionism and Algebrus is thence manifest through Life finding Meaning, through quantum physics being maximally entangled and through Mathematics reducing to its Logical Axioms.

Recall, this foundational property of Algebrus is inseparable from the triunity of Algebrus, Algorithmus and Geometrus, just as Variation is inseparable from Natural variational-selective-heredity in Darwin's Theory of Evolution. Algebrus alone is incomplete, so this definition above is only valid in the context of the triunity of 3-colouration, see Equation (4).

5. World-Strand of Algorithmus

The ethereal world-strand of operational Algorithmus (green), in the context of the Braided Loop Metaheuristic, is all that is characterised as algorithmic (*sensu lato*), dynamic, involving process, action, change and the passage (neither registering, nor relativity) of time and it is neither intrinsic to entities, nor relational (Table 2). I assign the elemental registering of time to Algebrus (Section 4, above) and the relativity of time to structural Geometrus (Section 6, below).

In the axiomatic Laws of Form, Algorithmus is expressed as the act of drawing a boundary around an entity, thus separating it from everything else in the environment.

In the substrate of Mathematics, Algorithmus is expressed as Algorithms (*sensu stricto*) and their emergent evolution through deep-learning. Operational

Table 2. Cyclic decomposition of the foundational property of operational Algorithmus within the Braided Loop Metaheuristic.

World Strand	Laws of Form	Mathematics	Physics	Life	Consciousness
Braid	1		2		3
Knot	Loop		Trefoil		Borromean
		→Emergentism→			
Algorithmus (green)	Drawing	Algorithms	Quantum Deep Learning	Selection	Process Philosophy
		←Reductionism←			
		Laws of Parsimony	Quantum Deep Knowledge	Agency	

switching and computing are also rooted in Algorithmus, as are looped feedback processes which learn, including adaptive algorithms for predictive learning. This is the logical source of clockwise causality and entropy, the algorithmic basis of time-rectified agents' choices and the passage of events leading to consequences which pervade via Algorithmus.

In the Physics which emerges from the mathematical substrate of Algorithms (*sensu stricto*), Algorithmus is expressed as Natural Quantum Deep-Learning [4]. Qutrit information processing in Natural physical systems, with error tolerant Byzantine agreements [13] and triple-modular-redundancy majority-voting [4] in complex quantum systems, are emergent physical and computational facets of Algorithmus.

Upon that quantum physics, in emergent Life (and considering Natural variational-selective-heredity in Darwin's Theory of Evolution), Algorithmus is manifest as Natural Selection. Algorithmus in evolutionary biology is the evolution of ecological interactions that modify the form of selective pressures, so-called "Evo-Eco" [21]. Life thence evolves emergent intelligence, including artificial intelligence in its tools and technologies, and Algorithmus is manifest as experiential intelligence, according to Sternberg's triarchic theory of intelligence [22]. Algorithmus in triarchic intelligence is deep-learning creative automation.

Consciousness is thereafter emergent in the minds of sentient beings and Algorithmus in consciousness is expressed as the deep-learning algorithm characterised by Whitehead's Process Philosophy (or Processism) [26]. In Algorithmus, being is rather thought of as becoming, and Process Philosophy regards change as the essence of reality. Algorithmus within consciousness is one of three superposed states of subconsciousness, which in Borromean triunity establish the 3-coloured state of Full Consciousness.

The enlightened conscious mind embarks on Reductionism (Table 2) through Algorithmus expressed as Agency. Conscious change is thence brought about through the living agent's will. In Physics the physical records and memories acquired and the knowledge gained through Emergentism in Quantum Deep-Learning are put to work during Reductionism and manifest as Quantum Deep Knowledge. Further Reductionism into the Mathematical substrate of that Physics, condenses Algorithmus to Laws of Parsimony, through Nature's deep-learning self-application of Occam's razor and the Principle of Least Action. In their ultimately reduced algorithmic representation, the Laws of Parsimony condense to the Drawing of a boundary which forms a distinction in the Laws of Form (Figure 1).

In summary, operational Algorithmus is a foundational property with Algorithmic characterisation (*sensu lato*) which, with intrinsic feedback processes, transcends from its mathematical substrate, through emergent physical quantum deep-learning to emergent Life, evolving thereafter through Natural Selection with changing selective pressures to gain experiential intelligence and thence at-

tain conscious algorithmic processism in sentient beings. Enlightened conscious minds perform Reductionism and Algorithmus is thence manifest through Life acting with Agency, through quantum physics harnessing its deep knowledge and through Mathematics reducing to its Laws of Parsimony.

Recall, this foundational property of Algorithmus is inseparable from the triunity of Algebrus, Algorithmus and Geometrus, just as Selection is inseparable from Natural variational-selective-heredity in Darwin's Theory of Evolution. Algorithmus alone is incomplete, so this definition above is only valid in the context of the triunity of 3-colouration, see Equation (4).

6. World-Strand of Geometrus

The ethereal world-strand of structural Geometrus (blue), in the context of the Braided Loop Metaheuristic, is all that is characterised as relational (*sensu lato*), including spatiotemporal, but it is neither intrinsic to entities, nor dynamic (Table 3).

In the axiomatic Laws of Form, Geometrus is expressed as the Relation between the distinct entity and its environment, across the boundary.

In the substrate of Mathematics, Geometrus is expressed as Geometry (*sensu stricto*). This is the logical source of Natural symmetries, sequences, replication, repetition, shapes and patterns which pervade via Geometrus.

In the Physics which emerges from this mathematical substrate of Geometry (*sensu stricto*), Geometrus is expressed as Machian Quantum Geometrodynamics [15]. Patterns in the complex systems of Nature, from atomic lattices of minerals, through desiccation cracks, to the cosmic web are further Emergent manifestations of Geometrus pervading all scales.

Upon that physics, in emergent Life (and considering Natural variational-selective-heredity in Darwin's Theory of Evolution), Geometrus is manifest as Heredity. Geometrus modified by Algorithmus (Sections 5 and 7.3) in evolutionary biology is the evolution of reproductive interactions that modify evolutionary individuality by changing mechanisms of heredity, so-called "Evo-Ego" [21]. Life thence evolves intelligence, including artificial intelligence

Table 3. Cyclic decomposition of the foundational property of structural Geometrus within the Braided Loop Metaheuristic.

World Strand	Laws of Form	Mathematics	Physics	Life	Consciousness
Braid	1		2		3
Knot	Loop		Trefoil		Borromean
Geometrus (blue)	Relation	Geometry	→Emergentism→	Heredity	Aesthetic Relationalism
			Quantum Geo-metro-dynamics		
			←Reductionism←		
		Ideal Form	General Relativity	Configuration	

in its tools and technologies, and Geometrus is manifest as contextual intelligence, according to Sternberg's triarchic theory of intelligence [22]. Geometrus in triarchic intelligence is contextual and involves relational shaping.

Consciousness is thereafter emergent in the minds of sentient beings and Geometrus in consciousness is expressed geometrically (*sensu lato*) in what I term Aesthetic Relationalism. Principles of comparative beauty and the relational nature of things, as being relational entities in reality, lies at the heart of this subconscious facet of consciousness. I submit that Japanese aesthetics provide a suitable framework which lends itself to formalization, as for example Maheux sets out in his paper on Wabi-Sabi mathematics [27]. Geometrus bestows relational awareness beyond self-reference (including empathy) and, within consciousness, Geometrus is one of three superposed states of subconsciousness, which in Borromean triunity establish the 3-coloured state of Full Consciousness.

The enlightened conscious mind embarks on Reductionism (Table 3) through Geometrus expressed as an agent's capacity for Configuration. Discovered through subsequent Reductionism, in the intelligent conscious minds of two renowned geniuses, Einstein and Noether; General Relativity, symmetries and corresponding physical conservations [28], are Natural physical facets of Geometrus. Further Reductionism into the Mathematical substrate of that Physics, condenses Geometrus to Platonic Ideal Form. In its ultimately reduced geometric representation, Ideal Form condenses to the Relation across a boundary which forms a distinction in the Laws of Form (Figure 1).

In summary, structural Geometrus is a foundational property with Geometric characterisation (*sensu lato*) which, with its intrinsic relationalism, transcends from its mathematical substrate, through the emergent physics of quantum geometrodynamics to emergent Life, evolving and reproducing thereafter through Heredity to gain contextual intelligence and thence attain conscious Aesthetic Relationalism in sentient beings. Enlightened conscious minds perform Reductionism and Geometrus is thence manifest through Life finding perspectives via Configuration, through quantum spacetime being an ideal continuum of General Relativity and through Mathematics reducing to its Ideal Forms.

Recall, this foundational property of Geometrus is inseparable from the triunity of Algebrus, Algorithmus and Geometrus, just as Heredity is inseparable from Natural variational-selective-heredity in Darwin's Theory of Evolution. Geometrus alone is incomplete, so this definition above is only valid in the context of the triunity of 3-colouration, see Equation (4).

7. Combined World-Strands

We now consider the Nature of combined world-strands. Firstly, in coupled 2/3-coloured pairs: Geometrus-Algebrus (Section 7.1, Table 4), Algebrus-Algorithmus (Section 7.2, Table 5) and Algorithmus-Geometrus (Section 7.3, Table 6) and then as all three combined: Algebrus-Algorithmus-Geometrus

Table 4. Facets of the combined foundational properties of structural Geometrus and elemental Algebrus.

World Strand	Laws of Form	Mathematics	Physics	Life	Consciousness
			→Emergentism→		
Geometrus Algebrus (magenta)	Relational Distinction	Algebraic Geometry	Geometrodynamic Decoherence	Heritable Variation	Relational Order
			←Reductionism←		
		Ideal Singularity	Relativistic Entanglement	Meaningful Configuration	

Table 5. Facets of the combined foundational properties of elemental Algebrus and operational Algorithmus.

World Strand	Laws of Form	Mathematics	Physics	Life	Consciousness
			→Emergentism→		
Algebrus Algorithmus (yellow)	Distinction Drawing	Algebraic Algorithms	Decoherent Deep Learning	Variational Selection	Order Process
			←Reductionism←		
		Singular Parsimony	Entangled Deep Knowledge	Meaningful Agency	

Table 6. Facets of the combined foundational properties of operational Algorithmus and structural Geometrus.

World Strand	Laws of Form	Mathematics	Physics	Life	Consciousness
			→Emergentism→		
Algorithmus Geometrus (cyan)	Drawing Relation	Algorithmic Geometry	Deep Learning Geometrodynamics	Selective Heredity	Process Relationalism
			←Reductionism←		
		Parsimonious Form	Deep Knowledge Relativity	Configured Agency	

(Section 7.4, Table 7). This section pertains to the combining and splitting of world-strands in the Braided Loop Metaheuristic as illustrated in Figure 1.

Above I state that neither Algebrus, nor Algorithmus, nor Geometrus exists in 1/3-coloured isolation, they are integral components of a fully 3-coloured tri-unity. Likewise, neither can they completely exist pairwise (2/3-coloured). Whist the combined pairs below are incomplete; they nonetheless have pedagogic utility. Their pairing helps us understand the world, but can only provide fractional 2/3-coloured solutions and limited effective explanations of reality. 2/3-coloured fractional consciousness, involving coupled pairs Geometrus-Algebrus (blue + red = magenta), Algebrus-Algorithmus (red + green = yellow) and Algorithmus-

Table 7. Facets of the combined foundational properties of elemental Algebrus, operational Algorithmus and structural Geometrus.

World Strand	Laws of Form	Mathematics	Physics	Life	Consciousness
Braid	1		2		3
Knot	Loop		Trefoil		Borromean
			→Emergentism→		
Algebrus Algorithmus Geometrus (white)	Existence	Algebraic Algorithmic Geometry	Quantum Intelligent Geometrodynamics	Variational Selective Heredity	Enlightenment
			←Reductionism←		
		Pure State	Quantum Conscious Cosmology	Free Will	

Geometrus (green + blue = cyan) is temporally and somewhat mysteriously experienced by incompletely conscious agents (due to 2-colouration, instead of complete 3-colouration). For example, certain psychedelic drugs may act on the conscious mind by dampening Algebrus, causing the world to not add up in an orderly fashion, suspending the mind's commutative, associative and distributive abilities, whilst vivid dynamic shapes of Algorithmus-Geometrus flourish and become embellished.

Illusory phenomena arise from incomplete fractional 2/3-coloured pictures of the world due to the respective absences of Algorithmus (green), Geometrus (blue) and Algebrus (red) from the above three pairs. Only when all three world strands are combined together do we get the full 3-coloured conscious picture of reality. When reading the following three sections (Sections 7.1, 7.2 and 7.3) about 2/3-coloured fractional surrealisations of full 3-coloured reality, one may be reminded of the literary nonsense of logician and mathematician Charles Lutwidge Dodgson (1832-1898), better known by his *nom de plume* Lewis Carroll, author of Alice in Wonderland. The surreal madness of Carroll's wonderland conceivably came about through his incomplete pictures of the significant mathematical advances of his era, which he turned on satirically, being unable to complete a fully 3-coloured overview. I call these incomplete fractional pictures of reality, Dodgson surrealities.

7.1. World-Strands of Geometrus-Algebrus

Two of three world-strands, when combined, lead to fractional descriptions of reality, Dodgson surrealities, and can only support effective theories at best. Such fractional descriptions ultimately lead to tensions which can only be resolved at the foundational level by incorporating the omitted world-strand. In the case of combined Geometrus-Algebrus, the lack of Algorithmus leads to tensions and gaps which thwart complete understanding, as we will see in this section.

The most prominent example of this in physics is the lack of scientific con-

sensus for a reconciliation between the Geometrus of General Relativity and the Algebrus of Quantum Mechanics. The missing Algorithmus world-strand of Quantum Deep-Learning, in the Triuniverse metaheuristic [4], algorithmically completes the picture of reality by establishing an essential triunity with General Relativity and Quantum Mechanics.

In a similar way, Gregor Mendel's Principles of Inheritance, established through diligent studies of Heredity and Variation in pea plants, are an effective theory also based on Geometrus-Algebrus. The genius Charles Darwin included the algorithmic process of Natural Selection, in his theory of evolution and a major puzzle of Life was substantially solved through a triunity of Mendelian Geometrus-Algebrus with Darwin's inclusion of Algorithmus.

Combined world-strands of structural Geometrus (blue) and elemental Algebrus (red) (Table 4) combine and include those of algebraic geometry in mathematics (e.g. sheaves), joining geometries to make new composite shapes in mathematics (e.g. triangles assembling polygons), pure particle-space in physics (e.g. cores of neutron stars), geometrodynamic decoherence (e.g. soliton physics and twistor theory [29]), and variational heredity in biology (e.g. DNA mutation).

2/3-coloured fractional consciousness is manifest as a combination of two of the three necessary subconscious facets of consciousness, namely Relational Order (e.g. intuition; circumvention of endless Algorithmus to bypass the halting problem of computability theory; innate order-space including values and morals such as good versus evil). Patterns and symmetry in language including prose, rhymes and poetry and reflective and juxtapositional humour come about through Geometrus-Algebrus.

Static bistable optical illusions such as the Necker cube derive from Geometrus-Algebrus because there is no Algorithmus operating to uniquely compute the subjective dichotomy. Tiling hexagons additively to infinity, whilst intuitively possible in Geometrus-Algebrus, lacks Algorithmus and is non-computable [30]. This incomplete consciousness, lacking Algorithmus, enables partial Reductionism via meaningful configurations by conscious living agents (e.g. judging when to halt sculpting a statue, when an artistic subjective ideal is perceived to have been reached).

Meaningful coincidences in Jung-Pauli synchronicity, whilst scientifically problematic to verify, could arise in this incomplete fractional 2/3-coloured consciousness. Agents in Geometrus-Algebrus cause relativistic entanglement (e.g. Dark Matter phenomena from consciousness [5]) in the physical world and (non-parsimoniously) approach an ideal singularity in Mathematics and Logic. The Laws of Form cannot be completed as a full superposition of all 3 components because Algorithmus is missing, but Relational Distinction is conceivable (e.g. ER = EPR connected ideal singularities, or wormholes) and can be dreamt up, though cannot be realised without associated quantum Algorithmus.

Colour labelling for this pair is blue + red = magenta.

7.2. World-Strands of Algebrus-Algorithmus

Two of three world-strands, when combined, lead to fractional descriptions of reality, Dodgson surrealities, and can only support effective theories at best. Such fractional descriptions ultimately lead to tensions which can only be resolved at the foundational level by incorporating the omitted world-strand. In the case of combined Algebrus-Algorithmus, the lack of Geometrus leads to tensions and gaps which thwart complete understanding, as we will see in this section.

Combined world-strands of elemental Algebrus (red) and operational Algorithmus (green) (Table 5) combine and include properties of algebraic algorithms in mathematics (e.g. Fourier decompositions and numerical calculus), statistical mechanics in physics (e.g. heat), order-disorder cycles, Lotka-Volterra cycles and variational selection in biology (e.g. chance predator-prey encounters). Intelligence emerges in deep-learning experiential metacomponents (e.g. cellular automata and insect swarms).

2/3-coloured fractional consciousness is manifest as a combination of two of the three necessary subconscious facets of consciousness, namely Order Process (e.g. cognition, parametric feedback and random quale generation). Instructions through language, language loops, mantras, cultural procedures, scriptures and humorous puns come about through Algebrus-Algorithmus. This incomplete consciousness, lacking Geometrus, enables partial Reductionism via the meaningful agency of conscious living agents. Such agents leverage entangled deep knowledge from the physical world and can therefore approach (non-ideal) singular parsimony in Mathematics and Logic. The Laws of Form cannot be completed as a full superposition of all 3 components because Geometrus is missing, but drawing a distinct unrelatable entity is conceivable (e.g. imagining the content of an infinite area loop), but is not realistic.

Colour labelling for this pair is red + green = yellow.

7.3. World-Strands of Algorithmus-Geometrus

Two of three world-strands, when combined, lead to fractional descriptions of reality, Dodgson surrealities, and can only support effective theories at best. Such fractional descriptions ultimately lead to tensions which can only be resolved at the foundational level by incorporating the omitted world-strand. In the case of combined Algorithmus-Geometrus, the lack of Algebrus leads to tensions and gaps which thwart complete understanding, as we will see in this section.

Combined world-strands of operational Algorithmus (green) and structural Geometrus (blue) (Table 6) combine and include those of algorithmic geometry in mathematics (e.g. animated shape drawing), spacetime evolution in physics (e.g. general relativistic precession displayed by the planet Mercury) and selection mechanisms for heredity in biology (e.g. DNA transcription).

Kinetic bistable optical illusions (e.g. Nobuyuki Kayahara silhouettes of spin-

ning 3D dancers) in Algorithmus-Geometrus derive from the lack of visual cues for depth (*i.e.* there are hidden variables, due to the omission of Algebrus). In quantum physics, the bistable illusion represented by Schrodinger's cat (simultaneously alive and dead) similarly prompts search for omitted extradimensional Algebrus. The Penrose triangle and related paradoxical optical illusions also derive from Geometrus-Algorithmus, wherein the missing Algebrus provides neither variation nor randomness to break its loop.

2/3-coloured fractional consciousness is manifest as a combination of two of the three necessary subconscious facets of consciousness, namely Process Relationalism. Psychedelic drugs may induce this state of mind (Section 3). This incomplete consciousness, lacking Algebrus, enables partial Reductionism via configured agency of conscious living agents (e.g. perception, will, ill-will, or bias which is operationally directed by aesthetics). Such agents leverage deep knowledge relativity (e.g. learning continua) from the physical world and can therefore approach (non-singular) parsimonious form in Mathematics and Logic. Laws of Form cannot be completed as a superposition of all 3 components because Algebrus is missing, but drawing a relationship is conceivable (e.g. infinitely long parallel lines) but not realizable.

Colour labelling for this pair is green + blue = cyan.

7.4. World-Strands of Algebrus-Algorithmus-Geometrus

Combined world-strands of elemental Algebrus (red), operational Algorithmus (green) and structural Geometrus (blue) (Table 7) combine and include those of algebraic algorithmic geometry (*sensu stricto*) in Mathematics (I conjecture that the entirety of Mathematics can be discovered through algebraic algorithmic geometry) and quantum intelligent geometrodynamics in fully 3-coloured physics.

Modern physical laboratory tests confirm Bell's Theorem and validate entanglement as a fundamental feature of quantum mechanics, without hidden variables, because the successful tests universally involve all three of the foundational properties of the Braided Loop Metaheuristic: 1) random number generation, *i.e.* they tap into the fundamental uncertainty innate in Algebrus; 2) a logical experimental process, running in time, *i.e.* Algorithmus; and 3) spatially configured apparatuses, *i.e.* Geometrus. It is my conjecture that omission of any one of either Algebrus, Algorithmus or Geometrus, from a laboratory test of Bell's Theorem, would result in experimental bias and thus a failure of the test.

Furthermore, in this emergent and fully 3-coloured physics, the Naturalness of emergent quantum intelligent geometrodynamics and the evolving horizon of spacetime are both readily framed within the Braided Loop Metaheuristic. The Triuniverse is genetically composed of Algebrus, with its inherent quantum information and innate glitches, imperfections, bestowing character-forming identities to all things and agents therein; operating under naturally intelligent evolutionary Algorithmus, with Natural Selection of physical phenomena, optimised

by way of quantum information feedback, quantum deep-learning, via iterations of the Braided Loop Metaheuristic; and involving complex and defining relationships, characterised by Geometrus and all referenced relatively within the spacetime of Geometrus. Agents' experiences of the evolving horizon of spacetime have no beginning and no end in the Braided Loop Metaheuristic, as in a no-boundary Hartle-Hawking model. Beyond its palingenetic perspective on Life, the Braided Loop Metaheuristic involves endless quantum deep-learning cosmological cycles; the boundary condition is there is no spacetime boundary. Palingenesis, in this quantum deep-learning cosmology, involves reboots of consciousness (into an agent's next life) which add to the Triuniverse's evolving ψ-Epistemic Field of accumulating knowledge. In other (and optimistic) words, the quantum consciousness of a mortal agent can expect to epistemically spark across to a subsequent living body which hosts more evolved and more knowledgeable capabilities of quantum consciousness. Knowledge builds in the Triuniverse and palingenetic Life, its quantum consciousness and its wilful agency, purposefully modifies the evolution of the quantum deep-learning cosmos, counteracting entropy.

The 3-coloured Braided Loop Metaheuristic (Figure 1) can be viewed as a meridian of a topological horn-torus (Figure 3) multiverse. An enlightened agent may ultimately explore (in its mind) its entire meridional loop where the core of the horn-torus represents the inception of the Laws of Form and the equator of the horn-torus represents conscious enlightenment. The diameter of the meridional loop varies according to the level of consciousness (Figure 2). Note, there are an infinite number of meridians, each with a different meridional longitude. Around the equator, each meridional loop is proposed to have a different set of physical parameters (physical "constants" of Nature) in this Braided Loop Metaheuristic horn-torus multiverse. At one specific meridional longitude we arise from the anthropic physical parameters, which enable biological Life, as humans experience and know it. At any another meridional longitude Life, if possible, would exist in unfamiliar physics. This 3-coloured, no-boundary, multi-meridional, Braided Loop Metaheuristic horn-torus multiverse concept provides an alternative to eternally expanding bubble-like multiverse theories. In this Braided Loop Metaheuristic horn-torus multiverse of many-worlds, the infinite possible determinations of Nature's physical parameters co-exist and vary equatorially, in a population of meridional loops which vary in diameter according to levels of consciousness (Figure 3).

Fundamental information processing is driven by ψ-Epistemic Drive [4], the Natural appetite for information selected for advantageous knowledge. The meridional loops in the Braided Loop Metaheuristic horn-torus multiverse are ψ-Epistemic Field lines emanating from a dipole at the core of the horn-torus multi-verse. It is envisaged that a random epistemic spark-gap action, across the ψ-Epistemic Field dipole at the core of the horn-torus multi-verse, propagates existential background noise (Figure 3, Section 3) through the physical Triuni-

verse. The Triuniverse's self-error-corrected signal-to-noise ratio is however ample for physics to be very precisely law abiding, though the consequences of inherent ψ-Epistemic Field dipole spark-gap randomness do become more apparent transcending from the classical to quantum realms. I propose that the existential epistemic spark-gap action happens as Reductionism (negative sign in Figure 3) spontaneously short-circuits, switching with minimal information complexity, to Emergentism (positive sign in Figure 3) through the Laws of Form (Figure 1, Table 7). Hertz demonstrated Maxwell's waves emanating from an electric dipole spark-gap; here the Braided Loop Metaheuristic horn-torus multiverse is essentially a more magnificent quantum field of knowledge emanating from a ψ-Epistemic Field dipole and existential epistemic spark-gap at its core. In physical cosmology the epistemic spark is equivalent to the singularly superposed Big Bang quantum state. For our artistic readers, Michelangelo's Sistine chapel ceiling masterpiece of creation, triggered by near-touching hands, humbly serves to complement the epistemic spark gap in Figure 3.

A formalisation of the equatorial function, which governs the selection of physical parameters in each meridional loop, around the horn-torus multiverse is possibly found in the work of Arkani-Hamed et al [31] on "Nnaturalness". In this concept, N copies of the Standard Model are defined with varying values of the Higgs mass parameter, *i.e.* a different Higgs vacuum expectation value. Multiple copies of the Standard Model could thus solve the hierarchy problem. I propose the equatorial function, operating around the Braided Loop Metaheuristic horn-torus-multiverse, involves Algorithmus via quantum-deep-learning operating on the Higgs mass parameter, with an optimized solution corresponding to our anthropic meridional loop. Our anthropic meridional loop is the one with the smallest non-zero Higgs vacuum expectation value, which in this Braided Loop Metaheuristic would be naturally selected by out-computing (*sic*) alternatives (optimising quantum computational time whilst conserving energy and information). Meridional parameter fine-tuning in emergent physics and speciation in Darwinian Life are similar deep-learning optimizations in the Braided Loop Metaheuristic.

In the Braided Loop Metaheuristic horn-torus multiverse, the braided loops corresponding to correlated agents and all things in our anthropic world are all co-meridional, *i.e.* sharing the same physics, with its particular discrete set of physical parameters. Considering "parallel" worlds, each with different physical parameters, we should envisage such quantum physical many-worlds as occupying other meridional loops, within the one Triuniverse, framed in a multi-meridional Braided Loop Metaheuristic horn-torus multiverse.

Moving on, to emergent Life, variational selective heredity in Darwinian evolutionary biology is also a 3-coloured combination of Algebrus (Variation), Algorithmus (Natural Selection) and Geometrus (Heredity). Biological phenomena and structures also exhibit foundational 3-colouration, e.g. a spider's web has radial and concentric geometric elements, woven via an operational construction algo-

rithm, and rendered distinct from another by its inherent algebraic variation and glitches. Componential-experiential-contextual triarchic intelligence comes about in the completely intelligent brain through combining the three world-strands and full 3-coloured consciousness in sentient beings arises through the superposed Borromean triunity of Implicate Order subconsciousness, Process Philosophy subconsciousness and Aesthetic Relationalism subconsciousness.

This Borromean triunity enables enlightenment, albeit experienced at different levels by different individuals and at different times during the lifetimes of the reflective palingenetic agents (Figure 2). Enlightened agents gain Free Will which they leverage to bring about the physics of quantum conscious cosmology, wherein the observer's measurement problem is manifest and solved through entangled agency and the Dark Matter phenomena which are caused [5]. Through continued reductionism and via the mathematical Pure State of superposition of Logical Axioms, Laws of Parsimony and Ideal Form; Existence is thence brought about with the superposition of the 3-coloured components of the Laws of Form; Distinction, Drawing and Relation.

Colour labelling for this triunity is red + green + blue = white.

8. Conclusions

I have introduced a topological deep-learning cosmology by way of a Braided Loop Metaheuristic. Braided, 3-coloured, world-strands are proposed to be the fundamental quantum information tracts (ethereal fibre bundles) of our evolving cosmos. The Braided Loop Metaheuristic comprises eternally evolving deep-learning feedback loops of superposed, braided, 3-coloured, quantum information world-strands, which process (in 3-level qutrit states) foundational properties coined Algebrus (labelled red), Algorithmus (labelled green) and Geometrus (labelled blue). The loops are the meridional loops of a topological horn-torus multiverse. Around its equator, each meridional longitude is proposed to have a different set of physical parameters (physical "constants" of Nature) manifest as many-worlds. At one specific meridional longitude we arise from the anthropic physical parameters, which enable biological Life, as humans experience and know it. The meridional loops are ψ-Epistemic Field lines emanating from an epistemic dipole at the horn-torus core.

Elemental Algebrus has profound Algebraic characterisation (*sensu lato*) which, with its intrinsic uncertainty, transcends from its mathematical substrate, through the emergent physics of quantum decoherence to emergent Life, evolving thereafter through innate phenotypic variation to gain componential intelligence and thence attain subconscious algebraic Implicate Order in sentient beings. Enlightened conscious minds perform Reductionism and Algebrus is thence manifest through Life finding Meaning, through quantum physics being maximally entangled and through Mathematics reducing to its Logical Axioms.

Operational Algorithmus has profound Algorithmic characterisation (*sensu lato*) which, with its intrinsic feedback processes, transcends from its mathe-

matical substrate, through emergent physical quantum deep-learning to emergent Life, evolving thereafter through changing selective pressures to gain experiential intelligence and thence attain conscious algorithmic processism in sentient beings. Enlightened conscious minds perform Reductionism and Algorithmus is thence manifest through Life acting with Agency, through quantum physics harnessing its deep knowledge and through Mathematics reducing to its Laws of Parsimony.

Structural Geometrus has profound Geometric characterisation (*sensu lato)* which, with its intrinsic relationalism, transcends from its mathematical substrate, through the emergent physics of quantum geometrodynamics to emergent Life, evolving thereafter through heredity to gain contextual intelligence and thence attain conscious Aesthetic Relationalism in sentient beings. Enlightened conscious minds perform Reductionism and Geometrus is thence manifest through Life finding perspectives via Configuration, through quantum spacetime being a continuum of General Relativity and through Mathematics reducing to its Ideal Forms.

Braids split from 1→2→3 (in knot representation respectively: closed loop→trefoil knot→Borromean loops) thence combine from 3→2→1 (Borromean loops→trefoil knot→closed loop) to form an eternally evolving deep-learning Braided Loop Metaheuristic. This cosmology metaheuristic incorporates initial Laws of Form; Emergentism (from substrate Mathematics, through Quantum Physics to Life); Consciousness (as a superposed Borromean triunity of Implicate Order, Process Philosophy and Aesthetic Relationalism); Reductionism (from Life, through Quantum Physics to Pure Mathematics expressed as Logical Axioms, Laws of Parsimony and Ideal Form); and the Braided Loop Metaheuristic reboots its eternal cycle with the initial Laws of Form.

Whilst not a *Theory of Everything*, the Braided Loop Metaheuristic presents a common algebraic algorithmic geometric framework (*sensu lato*) in the quantum information paradigm, open to all disciplines, offering potential as a *Metaheuristic of Everything*.

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