Chapter 1

Hyperbits represent the end of reductionism as the primordial info-structure requirements for simulation hypothesis of the universe

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Many authors have proposed a simulation hypothesis of the universe, but most are from science fiction, (i.e. Star Trek holodeck and The Matrix). This paper focuses on science only informational/computation requirements based on my mathematical hyperbits being more primitive than quantum computing. Similar to Wheeler's "it from bit", these hyperdimensional bits (hyperbits) represent mathematical bit-vectors that are physics compatible at/below the Planck scale, so defining the end of reductionism. For my 2002 PhD, I showed these hyperbits can represent quantum qubits and ebits. Therefore, the deeper requirements from hyperbits are they have spacelike requirements to support the quantum properties and apparent non-locality of Bell states.

This paper combines simulation hypothesis ideas from my last two ANPA talks [1] [2], including the 2025 idea that hyperbits were attributed the new name "Existons". These Existons now represent the discrete unit of consciousness as well as the discrete information properties, so form a mathematical panpsychism, where everything is physical as well as conscious. An important requirement for any simulation model of the universe is how the subjective and objective interacts. Built-in Planck scale conscious hyperbits (aka Existons) meet those objective/subjective requirements. See my second paper in this journal for more information about Existons.

1. Introduction to Science of Simulation

A common theme that appears in both science fiction and science is the idea that the universe is a simulation. These ideas and the advent of large scale online computer servers/networks have led to the development of massively multiplayer online role-playing games (MMORPG) in the 1990s. MMORPG development/deployment is significant for two reasons: 1) the "at scale" technology stack associated with successfully supporting these games and 2) the revenue stream is 5-10 times the amount of revenue from Hollywood movies. Due to this huge revenue, significant amounts of resources have been invested in software development and servers for the simple purpose of entertainment.

The technological outcome is a deep understanding of how to build and deploy, at scale, simulated virtual environments that allow human player characters (PCs) to interact on quests within virtual worlds containing other PCs and also simple simulated non-player characters (NPCs). These virtual world simulations use physics engines to mimic many of the objects and rules of our physical world, from the perspective of the actions of each player's avatar. These physics engines use information to represent all the structure and behaviors of stable objects like the ground, matter, buildings, gravity, weapons, energy, and other players from the perspective of each PC by using ray tracing algorithms for light. This individual PC ray tracing view of the virtual world is called rendering.

The "at scale" technology stack allows 100s of thousands daily players to each have their unique view rendered efficiently with very little latency. With my background in simulation and computer circuits [3], this "at scale" technology stack is indeed impressive, and it only works due to minimizing all the object motion tracking and image rendering computations between the shared servers and the distributed players' local computers. MMORPGs continue to develop since NPCs are now starting to use AIs to act more intelligently. See Rizwan Virk book for details. [4]

Sci-Fi movies have introduced unrealistic ideas into our simulation hypothesis models. One such restrictive idea is that simulation engines are built and controlled by hyper-advanced races of beings. Another limiting idea is their purpose for building these virtual simulations. I don't agree with either of these ideas and I will explain my reasons later.

Our current understanding from Sci-Fi movies and MMORPGs informs us but also restricts our thinking due to the current limits of our classical computer models, implementations, and granularity/limits of the gaming physics engines. For example, if the simulation engine is only implementing classical physics rules, then the implementation can use classical computers for the implementation. But if the simulation environment must truly implement the physics engine to support quantum properties, then according to Richard Feynman the underlying physics engine must also be quantum mechanical, to support quantum properties, non-locality, and Quantum Field Theory. [5] Likewise, if the classical assumptions of Newtonian spacetime are assumed, then gravity and relativity cannot be 100% accurate. For a complete information based solution, spacetime and gravity must be emergent from the simulation engine and be integrated with quantum. This kind of model is called a Grand Unified Theory of Everything, which mankind currently does not comprehend. Also, as portrayed in Star Trek holodecks, we don't know how to actually create matter/energy from information using machines, since we have yet to invent "holo-emitters".

Another serious problem with most simulation hypotheses models is they focus on physics while assuming that intelligence is emergent from classical computing models and that consciousness is emergent from neurology. In spite of the current successes of generative AI, general intelligence is not yet possible since we don't comprehend how to implement meaning and knowing with computers, a requirement for AGI (artificial general intelligence). Significant research has also occurred on lucid dreaming, [6] telepathy research, [7] cataloging life reviews from Near Death Experiences (NDEs), [8] and other spiritually transformative experiences (STEs). [9] These reported experiences suggest that the mind can directly generate extremely vivid virtual environments that appear even more real than our physical reality. Understanding how the subjective mind and consciousness is linked to the simulation hypothesis is critical and must include concepts such as meaning, knowing, telepathy, and STEs. Integrating the objective, quantum and subjective sciences is an important requirement for any ultimate simulation engine models. According to Thomas Campbell, this kind of model that includes subjective experiences is labeled a Big Theory of Everything [10].

The approach discussed in this article is there exists a primordial information engine that simulates the entire universe based on conscious hyperbits (aka Existons). [11] Since Existons are represented as physics-compatible, hyperdimensional bit-vectors (not just software bits), that exist as a near infinite cloud of tiny one bit universes, Hyperbits combine to form the topological structures that make up our quantum, classical, relativistic objects and subjective experiences. Any attempt to simulate a hyperbit cloud as another simulation would naturally require the same base spacelike hyperbit cloud layer again, so therefore conscious hyperbits form the base simulation engine of the universe and represents the "end of reductionism". Individual quantum states can still be smaller than hyperbits, since they are expressed by a collection of N-vectors, thus creating a duality between hyperbits/N-vectors and hyperstates. [12]

The key question in this paper is "What is the primary representation of information to support a simulation hypothesis that can generate the entire universe?" This question is key, since for all computer simulations (such as flight simulators) the traditional classical computers exist outside the simulation with everything being internally represented as information. If our universe is a simulation, what is the information representation that would exist outside the physical universe? Also, how can actual matter, energy, space/time, and conscious intelligence be constructed using only bits? My solution is conscious hyperbits exist as an infinite supply of abstract dimensional conscious objects below the Planck scale with protospace and prototime mathematical properties, thus supporting non-locality and consciousness.

2. Introduction to Hyperbits

During my Ph.D. effort in the late 1990s, Mike Manthey introduced me to the mathematical idea of Geometric Algebra (GALG) as an orthonormal vector notation for bits that is compatible with physics. These bit-vectors $\mathbf{e}_i$ (with + signatures $\mathbf{e}_i^2 = +1$) were restricted to 3 valued coefficients c_i of $Z_3 = \{0, +1, -1\}$ so defined a subset $G(p, Z_3)$ of Clifford Algebras Cl(p). Coefficients can be 0. Using my GALG modeling tool, my 2002 dissertation [13] proved that quantum computing qubits and ebits can be implemented using these hyperbit vectors. Clifford Algebras specifies both positive and negative signatures Cl(p, n), so in 2025 I updated my

tool to allow complex coefficients $i = \sqrt{-1}$, so $Z_{3C} = \{0, \pm 1, \pm i\}$ where $\mathbf{E_i} = i*\mathbf{e_i}$ and $\mathbf{E_i}^2 = -1$ thereby defining G(p, n, Z_{3C}). [11] This is important since my tool now supports both commutative values $i^2 = -1$ and built-in non-commutative complexes $(e_i*e_j)^2 = -1$ since $e_i*e_j = -e_j*e_i$. With this addition, my GALG now supports a complete set of complex quaternions $\{1, \mathbf{i}, \mathbf{j}, \mathbf{k}, i, i*\mathbf{i}, i*\mathbf{j}, i*\mathbf{k}\}$ with $\{\mathbf{i}, \mathbf{j}, \mathbf{k}\}$ as bivectors where $\mathbf{i}^2 = \mathbf{j}^2 = \mathbf{k}^2 = -1$.

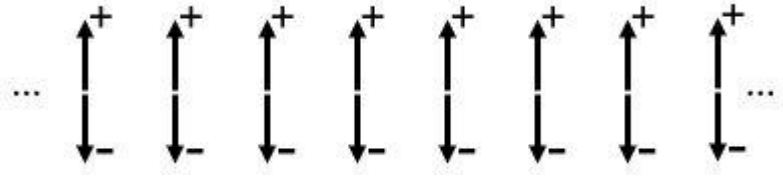

Fig 1 Hyperbits as orthonormal bit-vectors

Figure 1 illustrates how GALG hyperbits represent an infinite set of mathematical bit-vectors. These are equivalent to Hilbert Space column vectors, except I use the Clifford algebra conventions of 1-vectors, with geometric product, thus giving rise to bivectors, trivectors, N-vectors, etc. Any two bit-vectors are orthonormal, and their outer product forms a bivector (2D oriented plane), etc. Here are the geometric algebra rules.

- Z_3 is symmetric mod 2: +1 +1 = -1 and +x +x = -x
- Inner product: $\mathbf{e_i}.\mathbf{e_i} = +1$ (is colinear), $\mathbf{e_i}.\mathbf{e_j} = 0$ (is orthogonal)
- Outer Product: $\mathbf{e_i}*\mathbf{e_j} = \mathbf{e_i}\wedge\mathbf{e_j}$ (forms a bivector as wedge product)
- Geometric Product: $\mathbf{e_i}*\mathbf{e_j} = \mathbf{e_i}.\mathbf{e_j} + \mathbf{e_i}\wedge\mathbf{e_j}$ (sum of inner & outer prods)
- Non-commutative $\mathbf{e_i}*\mathbf{e_j} = -\mathbf{e_j}*\mathbf{e_i} = -\mathbf{e_j}\wedge\mathbf{e_i}$
- Generate multivector containing all N-vector terms:
  $(1+\mathbf{a})(1+\mathbf{b})(1+\mathbf{c}) = +1 +\mathbf{a} +\mathbf{b} +\mathbf{c} + (\mathbf{a}\wedge\mathbf{b}) + (\mathbf{a}\wedge\mathbf{c}) + (\mathbf{b}\wedge\mathbf{c}) + (\mathbf{a}\wedge\mathbf{b}\wedge\mathbf{c})$

Qubits **A** and **B** are each the sum of two hyperbits (syntactically similar to the Ket notation), where geometric product is equivalent to tensor product:

- Qubits**:** $\mathbf{A} = \mathbf{a0} \pm \mathbf{a1}$ and $\mathbf{B} = \mathbf{b0} \pm \mathbf{b1}$ (similar to $|0\rangle \pm |1\rangle$)
- Quantum Reg: $\mathbf{A}*\mathbf{B} = +(\mathbf{a0}\wedge\mathbf{b0}) - (\mathbf{a0}\wedge\mathbf{b1}) - (\mathbf{a1}\wedge\mathbf{b0}) + (\mathbf{a1}\wedge\mathbf{b1})$
- Bell operator in GALG: $\mathbf{Bell} = +(\mathbf{a0}\wedge\mathbf{a1}) + (\mathbf{b0}\wedge\mathbf{b1})$
- Ebit in Bell State: $\mathbf{A}*\mathbf{B}*\mathbf{Bell} = -(\mathbf{a0}\wedge\mathbf{b0}) + (\mathbf{a1}\wedge\mathbf{b1})$ $(|00\rangle \pm |11\rangle)$

Semantically, quantum registers contain grade-2 bivectors in GALG even though they look syntactically similar to the Ket notation of column vectors in Hilbert spaces, where bra-ket notation is based on inner products. Mathematically each qubit is two hyperbits so each ebit is 4 hyperbits, then to represent all qubits and ebits, we need a near infinite number of unique bit-vector math dimensions independent of any other physical representation. These hyperbits and subsequent qubits, qutrits, and ebits are not tied to physical matter nor embedded in spacetime. We will find later that having N-vectors to create structures beyond column vectors is critical for making objects in the universe.

Since hyperbits can support quantum computing and likewise quantum computing can support classical logic gates (using Toffoli and Fredkin gates), then hyperbits are Quantum complete (any quantum operations), Boolean complete (any Boolean logic) and Turing complete (any computation). Clifford Algebra multivectors also have a key trait where they can used as both the "state" or as an "operator" to change state. I call this critical property as "Von Neuman complete", since in 1945 John Von Neuman originally proposed a computer architecture where both data and programs could be stored in the same primary memory. [14] In our case, multivectors represent an abstract representation which we can treat as "memory", and importantly, they can recursively interact with other multivectors to evolve. In my 2020 book *"Deep Reality"*, [12] I introduced the term "verbnoun" balanced when discussing this property of multivectors. Hilbert Spaces are not verbnoun balanced since states are represented as column vectors and operations are represented as square matrices. Also importantly, Hilbert spaces do not support any arbitrary N-vectors as a column state.

Hyperbits clouds represent an abstract primary mathematical representation for information that is NOT encoded on top of any matter, energy, space, time, or quantum states. This idea is critical, since any useful base simulation engine must support the emergence of all "physical objects, states, fields, and interactions" from purely a primary information representation. Even the "laws" must be emergent (most likely from

topology), since there is no cosmic software programmer writing any programs. A cosmic being might exist, but its job is not a programmer.

Hyperbits and their expansion into N-vectors and multivectors supports the idea that information and mathematics can be tightly linked together. Many physicists state that physics is reality (the territory) and so downplay the importance of math as just the "map". Hyperbit math properties force us to rethink the physical reality of math, especially in the context that Landauer's "information is physical" [15] and Wheeler's "it from bit", [16] as the smallest bit change to a black hole's entropy. See my other paper in these proceedings [17] [2] that discusses in more details how physicality can emerge from the dimensions represented by hyperbit math.

3. Particles, Energy and Spacetime Emergence

Hyperbits (and Clifford Algebras) have specific mathematical properties to support the representations for topological based emergence. A foundation for the fundamental theories of modern physics is invariance and symmetry groups. A symmetry group of a geometric object is the group of all transformations (or properties) under which the object is invariant. Examples of basic mathematical invariant properties are rotations and identities unitary ($U^2 = 1$), nilpotent ($N^2 = 0$), idempotent ($I^2 = I$), and involution ($I^2 = -I$). Operating systems manage concurrency using "wait" and "signal", which can be implemented using nilpotent (as wait) and idempotent (as signal). [13] This means that our base simulation engine contains the built-in operating system mechanisms to support non-deterministic ordering of concurrent processes, which is the precursor for the emergence of time. Again, no cosmic programmer had to write this operating system, nor the rules where particles know how to behave. There are many other unintuitive mathematical properties of hyper dimensional spaces including entanglement and my previous work on Correlithms. [18] Entanglement's spooky action at a distance [19] is easy to understand when viewed from a 4D hyperbit and bivector perspective.

Another important group is the quaternions, which is fundamental to rotations in 3D geometry (and used for extremely efficient ray trace rendering in some gaming systems). Manthey's and my previous work [20] has demonstrated a version of quaternions (called tauquernions), representing 3D quaternionic rotations inside a 4 dimensional space (and tauquinions inside a 5D space). Important point to make is that tauquernions and tauquinions are represented using entangled states. [21] Complex quaternions support the Lorentz transformations (Pauli rotations/boost) of relativity.

Importantly, any ladder operator in a finite dimensional space is nilpotent. They represent creation and annihilation operators, which transform from one quantum state to another, for example the raising and lowering Pauli matrices $\sigma_{\mp} = (\sigma_x \mp i\sigma_y)/2$. Additionally, the product of nilpotent pairs generates idempotent projectors $P_+ = \sigma_+ * \sigma_-$, which Cohl Furey predicts can construct all the fermion particles (as well as anti-particles with both spin and charge) in a CL(0,6) [22] [23] (details in my other paper [17]). It makes sense that the "particle" stability property of idempotence ($I^2 = I$) would support persistence of states we designate as "fermion particles". Furey's model does not assume the existence of spacetime, so they can be thought of as multivector virtual particles.

When people think of objective physical reality, they assume they can hold it in their hand, which naturally corresponds to historic views of fermionic "particles". Most physicists think that the standard model of fermions, anti-fermions, and 5 bosons are irreducible "objects" of physics. Yet, what if fermions are all constructed using hyperbits, as predicted by Furey? [22] Can we imagine a hyperbit simulation engine that generates all the "primitive objects" of physics? This makes sense since particle/anti-particle annihilation occurs converting fermions to photons. Just remember, even physicists know that particles don't physically exist but are just mathematical perturbations in quantum fields. So, bosons and fermions could just be formed by hyperbits, yet there is no particle accelerator big enough to break them apart into hyperbits and most likely no way to detect the resulting hyperbits. Other questions are, how to build an Existon beam and how to detect hyperbits?

If all of the standard model objects are just hyperbit patterns so then what about energy? Except for quantized bosons, most energy (and thus entropy) are just a measure of some conserved properties like pressure, charge, electrical, mechanical, kinetic, thermal, chemical, vibrational or nuclear, etc. It is impossible to hold energy (or QFT matter) in your hand since they are just bit patterns!! Likewise, they are not physical since spacetime and fields also CANNOT be placed in your hand (or acted upon), so they are just used for consistency measurement frameworks. Standard physics assumes spacetime already exists for quantum physics, relativity, energy, and fields, but spacetime must also be emergent from a base hyperbit simulation engine. Specifically, 4D quantum ebits exhibit "spooky non-local" spacelike behaviors that transcend normal 3D spacetime, which can be understood using the increased dimensions of hyperbits. Therefore, fields and causality are also emergent properties.

Hyperbits are tiny spatial dimensions, yet they have a "+" time signature. Think of them as tiny 1 bit computing universes that asynchronously interacts with other hyperbits to form qubits, qutrits, ebits, quaternions, etc. Each hyperbit has a total of 9 unique states (or 25 when including complex coefficients). A qubit can represent 81 unique states (or 625 if including complex coefficients), and 2 qubits can represent over 43 million unique states, with many more when using complex coefficients. This is the exponential growth of quantum state space size that supports the speedup of quantum Fourier transform for Shor's algorithm. [24, pp. 124-134] Many of these states are orthogonal, so can be combined in superposition giving even more combined complex states. This state space explosion is why quantum states (and our base simulation engine) cannot be simulated using classical computers or any engine that presupposes the existence of relativistic spacetime.

The sum of terms in a multivector represents a co-occurrence (±**a0**±**a1**). Addition in GALG (and Hilbert Spaces) represents a spatial protospace cluster and *exact* simultaneity of dimensions, which is not possible in

relativistic physics. When an operator is applied with multiplication, and a state change occurs the two states (former and later) form a co-exclusion, which is a prototime "change" feature that is not related to any physical time scale. Discrete Planck lengths and Planck intervals must emerge from these protospace and prototime features of discrete hyperbits. Ultimately the speed of light, and light cone emerges with lightlike, timelike, and spacelike dependencies. All spacetime rotations emerge from geometric properties of complex quaternions, even relativistic time dilation and length contraction. Spinors can also be expressed using hyperbits. [25] Since hyperbits exist independently of the spacetime of physical reality then they existed and evolved before the big bang (or bit bang) of our universe. Hyperbits could support the emergence of many types of universes. This is exactly what would be expected for any base simulation engine, with the uncertainty of what was the initiating seed event for our physical universe creation.

An important feature of base simulation engine is the fidelity of energy. For example, the energy dynamics of bosons, strong force, fusion, fission, supernovas, gravity, and blackholes are critical to the creative behaviors of the universe. Just as when physicists simulate an atomic bomb, the computer doesn't melt, likewise the hyperbit engine can 'simulate' intense energetic atomic operations without a destruction of the hyperbit engine.

The second law of thermodynamics states that the entropy of isolated systems naturally increases over time towards maximum disorder and maximum entropy. This definition assumes closed systems, but our hyperbit model is NOT closed, since it is part of an infinite hyperbit cloud of dimensions without spacetime limits. Hyperbits can increase in correlations/complexity and represents information (as vortices or bullseyes), which therefore represents an effective energy (ala Landauer [15]). Hyperbit clouds are a source of neg-entropy, which may include the foundation for the bit bang origin of our universe (see Manthey's coin demo in my talks [26]).

4. Oneness requirements

Hyperbits exist as a mathematical protospace/prototime representation and most likely where spacetime is emergent. [12] At the primordial hyperbit cloud level, all that exists is hyperdimensional topology and geometry, and therefore conventional distance and duration do not yet exist. Also, other properties that rely on distance and time also don't exist, such as wavelength, frequency, period, velocity, acceleration, momentum, energy, electromagnetics, uncertainty, QFT, causality, entropy, and tensors.

On the good side, the normal rules of physics don't apply in the abstract hypercloud where all objects and interactions must occur. A common expression in the spiritual community is "we are all one", which is definitely the case for the hyperbit cloud with no separation due to lack of intervals. Also, the saying "time is what keeps everything from happening at once" [27] is also related to space. Space keeps "things" segregated so they are spread out and act distributed. With N-vectors in hyperspace, the hyperbit "things" act with a oneness in an unprecedented manner. One metaphor is to imagine a hundred dimensional snowflake growing in all dimensions simultaneously in an Escher style of interconnects. Another is, imagine hyperbits are 1D bubbles and they can combine to form bigger bubbles ($\geq$ 2D) and attach adjacently to from bubble clusters. Any kind of hierarchy (i.e. quarks, hadrons, atoms, molecules, chemistry, etc.) also form a oneness that is impossible in standard physics, (i.e. water, etc.).

This oneness supports primitive "objects" as well as clusters of meaning in the conceptual space using content addressable memory style math. [28] Meaning rotes occur from this oneness due to N-vectors and superposition of many "modality dimensions". According to Robert Monroe, rotes are "thought packets of meaning", [29] which can recursively include other meanings. This increases meaning complexity in a wholeness wavelike manner. Knowing and meaning requires a unified oneness of information, much different than the distributed "data" stored in the classical representations of Large Language Models. If a LLM is programmed to

recognize cats, does it know what is the meaning of cats? The cat training data is everywhere and nowhere in the LLM memory, so where exactly is the cat? Distributed data do not represent wholeness of data, whereas multivector sums of N-vectors act with oneness, wholeness and "catness".

Hyperspace oneness also gives simultaneously the part and wholeness perspectives. Holograms also appear to express the part/whole properties, yet they do so by reducing the dimensionality of the data. Hyperspace has the same part/whole properties while maintaining the efficiencies of hyperdimensional data without any matrix inversion, data sorting, or anisotropic behaviors. Correlithms illustrate that related "concepts" appear to be near each other by using content addressable memory math, (a hyperdimensional bullseye). This is the "correlated" vortex math for the "law of attraction" and supports meaning and knowing. [30] Since emotions are tied to meaning, love must also be represented using hyperbit math, especially the "infinite love" experienced and reported in NDEs and STEs. Ester Hicks' "Abraham" reports itself as infinite intelligence, which is only possible in hyperspaces, since black hole limits disallow infinities.

Correlithm math [18] relies on a wholeness and correlation properties of distance measures or inner products. Numenta founder Jeff Hawkings has publicly stated that true AI is not really possible without correlithm style math, [28] due to the unintuitive correlational properties of hyperspaces. Random points/corners in a high dimensional spaces (for N>>20D) are nearly orthogonal points/vectors and can act as loci/tokens for meaning. Correlithms [18] act like similarity radar to efficiently cluster similar meanings in the global hyperspace. Any kind of global wholeness property can be efficiently represented in hyperspace due to the significant computational concurrency of hyperbits existing outside spacetime. Computing Fourier transformations and least action paths also require wholeness computations for simulating energy/mass/gravity interactions.

Besides entanglement, other examples of wholeness in physics is exotic quantum states such as superconductivity and Bose-Einstein condensate, where all states are the same resulting in collective behaviors like zero resistance (superfluidity and superconductivity) and macroscopic quantum

effects. These unusual behaviors only exist due to wholeness. Black holes also represent a “singularity”, which is the largest example of oneness. Timelike nature of light (nilpotent on light cone) also acts like a single point in spacetime (twistor theory). It is also easy to mathematically show that the volume of a hyperdimensional space exists on its surface area, which is same as event horizon surface area of a blackhole.

5. Scalability requirements

To paraphrase Stephen Hawkings book on quantum properties, “hyperbits are the dreams that stuff is made of”. [31] This reflects Niels Bohr's idea that "everything we call real is made of things that cannot be regarded as real," reflecting on quantum strangeness. How can the physical universe with all its size, contents, and behaviors emerge from nothingness of “dreams”? I have proposed models where numbers, distinctions, source, and Existons can emerge from the void. [32] So even the universe can emerge from nothing of “void” under the right conditions. Since hyperbits are dimensional creating, then our universe size/scope can emerge from these clouds of 1 bit universes. It’s just hard to imagine the strangeness of building “things” with hyperdimensional quantum tinker toys that manufacture themselves as needed. Hyperbits are the “dream” informational/computation resources for creating/simulating the universe.

Hyperbits exist at the abstract protospace and prototime level and thus represent significant raw concurrent computational resources. Since hyperbits are an abstract mathematical resource, there can be an infinite supply of them from some “source of distinctions”. This source represents the low entropy precondition for the “bit bang”, that we might call “god”.

When computer engineers create an “at scale” gaming simulation engine and environment, they are usually thinking about millions or billions of users. The hyperbits represent “universe scale” prequantum simulation resources that must be much larger than our observable universe, which

contains trillions of galaxies, each containing >100 billion stars. Just imagine simulating all the estimated ~10^{97} particles and photons in the universe, but also all the ~10^{80} atoms, chemistry, DNA, neurology, beings, planets, stars, supernovas, 10^{20} black holes, and even the quantum foam of empty space including the gravitational lensing properties of dark matter.

Any base quantum hyperbit simulation engine must meet the raw size and concurrency performance without needing any efficiency hacks of cached rendering or lazy evaluation. Quantum measurement is not associated with rendering in my model. These universe scale hyperbits requirements must be real in order to actually simulate all the matter, energy, space, time, fields, and minds of our physical universe. These universe scale resources is at a minimum proportional to the number of Planck volumes in the universe (~10^{186}), yet may be finite, just like our observable physical universe might be finite. Some people report an awareness of a pixelated existence, which would be a property of a discretized reality. The same resources model can continue even if the actual universe is much bigger than the known observable universe and may extend to other multiverses.

Quantum computing relies on the mathematical nature of quantum registers and complex numbers. The number of simultaneous quantum states in quantum register of q qubits grows exponentially as 2^q. For example, 2^{325} is larger than the number of particles in the known universe. This means the number of hyperbits/qubits themselves is small compared to the number of unique N-vectors formed by their interactions, where each N-vector has its own dimensionality. Constructing near infinite independent quantum dimensions (and N-vectors) is fundamental to how the math of orthogonality and concurrency works in quantum computing.

Another scalability issue is precision limits of floating point representation for complex numbers used in quantum computing Hilbert spaces. For a 1024 bit quantum register, the 2^{1024} independent quantum states are normalized by the unitary constraint for probabilities (1 = sum of coefficients squared). This means most of the actual values are smaller than 2^{-1024}, which is smaller than the 10^{-325} double-precision limit of floating point numbers. Due to these floating point scalability limits,

normalization and complex numbers cannot really be used by the ultimate simulation engine, which is why geometric algebra and correlithms should use integer only math from hyperbits. Use of normalization and renormalization must be reconsidered due to these precision limits of complex numbers.

Another fact about quantum registers is that each orthogonal vector must be spacelike. The reason this is true is because ebit states |00>+|11> (and |01>+|01>) are inseparable and thus spacelike. Since these are subsets of the full quantum register states |00>+|01>+|10>+|11>, therefore each ket state must be individually spacelike. This is also true for geometric algebra states, **a0^b0** + **a1^b1**. Therefore, the apparent non-locality of ebits is built into the basic 4D vector semantics before injecting into spacetime using the Schrodinger equation. Entanglement can exist in any number of dimensions due to symmetries, such as |000>+|111>, and spacetime/gravity itself are most likely entangled. [21]

After discussing space scalability, let's talk about scalability of quantum prototime. During NDEs, STEs and zone experiences, people report from their perspective, the external passage of time around them appears to slow down. [33] This "fast perceptual awareness" is just the *opposite* of time dilation predicted by relativity, where the local time appears dilated thereby slower when compared to other observer frames. In this zone state, many people also describe a spherical awareness with everything around them is slowing down. Some people even describe a time cessation experience [33] or even a panoramic view across time [34]. This nirvana state is equivalent to stepping out of conventional spacetime and entering a quantum hyperbit spacetime with no separation or intervals and thus no spacetime intervals whatsoever. Hyperbits define their own protospacetime independent of physical spacetime intervals, where concurrency of hyperbits transforms any "awareness" to be maximally concurrent, outside time, and thus "faster" compared to any classical limits of the normal spacetime intervals. This protospacetime acts as all actions are spacelike intervals, so no conventional time nor causality exists.

6. Subjective requirements

The two most compelling example of simulations in the subjective realms are lucid dreaming [6] and NDE experiences [8]. In fact, most people experience levels of details and fidelity of awareness plus deep meaning that far surpasses our waking experiences. Eastern meditators also believe our physical world is an illusion (or maya) to a deeper reality that is accessible via meditation and dreams. For a complete universe scale simulation model, we must include subjective related wholeness requirements such as meaning, rotes, knowing, thought, learning, intelligence, attention, intention, mind, consciousness, telepathy, transpersonal, and transcendent STEs. These requirements define a reality where our body is the physical avatar to the intelligent subjective mind. Thus, important requirements are the interaction between both subjective and objective realities, or brain mind interfaces.

All of these subjective virtual behaviors are information centric and NOT energy related. Some of these ideas are being explored using classical LLM AI systems, due to the presupposition that the mind is due to classical computational aspects of brain and consciousness is emergent from neurology. My "Real Intelligence" model is that mental behaviors are due to mathematical hyperbits (outside spacetime), which implies the brain is a transducing antenna, converting N-Dimensions into 3D space. [12]

Real intelligence can exhibit non-local and transcendent behaviors, including meaning and learning of general intelligence due to wholeness nature of hyperbits. AI merely simulates hyperdimensional mathematics (in classical spacetime) thus missing the wholeness of actually utilizing those dimensions. Many misleading models and category errors have occurred due to the mistake of thinking the brain is a classical computer and the mind might therefore be explainable by a classical system. This leads to ongoing scientism oriented mistakes of our world views, where I believe all of these premises are false and are therefore misguided. [35]

- Downloadable Consciousness: assumes we can scan brain/mind resulting in survival of consciousness in physical computers
- myth of AI: wrongly predicts the existence of truly intelligent machines in 10 years for the last 70 years
- Conscious AIs: presumes that consciousness could emerge in AIs
- AI singularity: predicts AIs smarter than humans (don't need us)
- Virtual agents: Cannot distinguish between real/AI intelligences
- Death is permanent: that mind does not survive biological death
- Telepathy and PSI don't exist: Cannot exist on first principles

The critical idea of downloadable consciousness is a direct result of the scientism belief that intelligence and consciousness are due to classical brain models. My real intelligence model denies that possibility, since the brain is just a 3D antenna interacting with an N-dimensional hyperbit mind. Since hyperbits have quantum properties, the quantum no-cloning law applies, forbidding the copying of uncompressible hyperdimensional states into any lower dimensional physical medium. Since conscious mind exists as non-local hyperbits, it can directly interact with the brain without being downloaded and also supports OBEs and remote viewing. No-cloning also applies to any sci-fi ideas such as Star Trek teleporters, so if they exist (see portal game), then they must be due to other technology.

Since conscious mind exists using hyperbits, it can directly interact with the brain states without being downloaded. So how does the objective and subjective interact using hyperbits? Hyperbits can directly observe the brain states using Existon awareness, which must be present to support telepathy, OBEs and NDEs. Also, from PEAR's global consciousness project [36] and Sheldrake's morphogenic fields, [37] it appears that influencing randomness is the ideal mechanism to inject the order of intent into the objective representations without violating the 2nd law of thermodynamics. If intention can perturbate randomness, then this injected order represents information and has an effective energy. This applies to any random process, but specifically to quantum, chemistry, microtubules, neurons and DNA. Manifestation might also be possible from hyperbits.

7. Summary and Conclusions

This paper has discussed the scientific requirements of a simulation hypothesis for the universe, by using my conscious hyperbit model. Conscious hyperbits (Existons) act like a cloud of asynchronous 1 bit universes that represent the Planck scale, protospacetime computing resources for the simulation of our entire quantum and relativistic universe, plus other multiverses. Hyperbits are quantized, represent the "end of reductionism", and can coalesce to form larger mathematical objects such as N-vectors and multivectors. Since non-algorithmic hyperbits are mathematical orthonormal bit dimensions they exist as independent primordial information substrate below any other matter, energy, space, time, or field representation. Hyperbits preceded the emergence of matter, energy, space, and time thus supporting the big bang.

Hyperbits provide universe scale spacelike resources that are near infinite in extent with maximal concurrent computational power, so can support quantum superposition, entanglement, black holes, and quantum foam at universe scale. All fermions, bosons, and spacetime plus their emergent properties can be represented using the complex quaternions and spinors supported by the non-commutative GALG hyperbits and N-vector objects. No software is required, since all simulation behaviors are topologically and mathematically defined, including the operating system features. Order is emergent inside this hyperbit framework.

Since hyperbits are also conscious (Existons) they represent a mathematical panpsychism, where everything is conscious. This consciousness can support the thoughts of conscious information based beings, including qubits, qutrits, ebits, matter, bosons, cells, insects, animals, humans, and even increasing complexity of cosmic non-corporal beings. These eternal thought beings can interact with biological physical avatars that appear to inhabit the worlds. Both the player characters and the physical avatars are supported by the conscious hyperbit models that assumes the brain is an antenna, (not a computer). Meaning and knowing are supported by the wholeness properties of quantum states.

The conscious hyperbits simulation model predicts that conscious information builds in complexity independently of physical matter, so "infinite intelligent" cosmic beings may exist that have complete control

over the hyperbit substrate by using hyperbit based attention and intention. Their control of the creative power of hyperbits source would make them appear to be cosmic beings or "gods" where telepathy and manifestation is the norm. We are all made of Existons so are eternal "god like" beings. Our physical universe existence is a result of the underlying hyperbit infrastructure, but not necessarily due to these cosmic beings. Everything is conscious hyperbit source, but human minds can utilize the awareness and express their free will over the subjective and objective world.

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