AI Peer Review Challenge: Standard Model of Physics vs 4D GEM EOS

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Abstract—Natural evolution of ATP cognitive systems is to meet AI peer review standards. ATP process of axiom selection from Mizar to prove a conjecture would be further refined, as in all human and machine learning, by solving the real world problem of the proposed AI peer review challenge: Determine which conjecture forms the higher confidence level constructive proof between Standard Model of Physics SU(n) lattice gauge group operation vs. present non-standard 4D GEM EOS SU(n) lattice gauge group spatially extended operation in which the photon and electron are the first two trace angular momentum invariants of a gravitoelectromagnetic (GEM) energy momentum density tensor wavetrain integration spin-stress pressure-volume equation of state (EOS), initiated via 32 lines of Mathematica code. Resulting gravitoelectromagnetic spectrum ranges from compressive through rarefactive of the central cosmological constant vacuum energy density in units of pascals. Said self-adjoint group operation exclusively operates on the stress energy momentum tensor of the Einstein field equations, introducing quantization directly on the 4D spacetime level, essentially reformulating the compounded, and still diverging, Yang-Mills virtual superpositioned particle lattice gauge groups quantization of the vacuum—into an optimized single hyper-complex multi-valued GEM U(1)×$\mathbf{SO}(3)$ lattice gauge group Planck spacetime mesh quantization of the vacuum. Thus the Mizar corpus already contains all of the axioms required for relevant DeepMath premise selection and unambiguous formal natural language parsing in context deep learning.

Keywords—artificial intelligence, automated theorem proving, constructive quantum field theory, lattice gauge theory, complex systems

I. Introduction

CONSIDER an artificial intelligence (AI) peer review challenge via goal-based rational agent representation of the QED Manifesto [1], currently evolving from the automated theorem proving (ATP) collaborations, such as the Google Brain [2] DeepMind [3] cognitive computing systems. Understanding the real universe is of course where the interests of AI and mathematical physics coincide on the basis all human and machine learning advances by solving real world problems.

Accordingly, an intelligent agent referencing the Mizar Mathematical Library formal corpus of computerized proofs [5] could in theory determine which conjecture—between the Standard Model of Physics SU(n) spacetime quantization group operation versus the present 4D GEM EOS SU(n) spacetime quantization group operation—formulates the measured state space, of the observed universal total field energy density distribution and its mathematical physics properties and laws, more directly to a higher confidence level requiring the fewest fine-tuning assumptions.

Two main bottlenecks have been identified in the further progress of ATP by Alemi *et al* [4]: (1) lack of automated methods for semantic or formal parsing of informal mathematical texts, and (2) lack of strong automated reasoning methods to fill in the gaps in already formalized human-written proofs. The authors focus on the second bottleneck and—on the basis of the E theorem prover underlying ATP system of Schulz [6] accessing the large formal corpus of manually formalized computer-understandable proofs of Mizar—have developed what they term DeepMath, a deep neural network to perform *premise selection*: the selection of the least number of the most relevant axioms from the large formal corpora to form the constructive proof of a new conjecture [4].

The current evolution of ATP includes the introduction of the Deep Network hybrid neural network guided E theorem proof search system of Loos *et al* [7]. The results of which deep learning system, utilizing its two-phase approach of a neural network-guided phase followed by a hard-coded heuristic phase, has increased the ratio of statements in the Mizar corpus with ATP generated proofs from 56% to 59%.

Consider that AI has already been formally introduced to the Standard Model of Physics with the objective of evaluating the CERN LHC high-energy synchrotron particle collision data for SU(n) pattern recognition, as described by Castelvecchi [8]. Regarding which objective the 4D GEM EOS SU(n) total field formal frame is established here to show the most likely pattern a goal-based rational agent could interpret of the CERN LHC 4D GEM SU(n) energy density collision distributions, is highly transient spin-stress pressure turbulence. For its part, the present self-adjoint total field formal frame group operation exclusively operates on the stress energy momentum tensor of the Einstein field equations, introducing SU(n) quantization directly on the 4D spacetime level, without any hidden dimensional virtual particle background, thus the Mizar corpus already contains all of the ATP generated proofs required for its deep learning premise selection and unambiguous natural language parsing in context.

Automated theorem proving reflects the scientific method in that the largest ATP organizational unit is a *problem*: a collection of *axioms* and an overall *conjecture* passed together to a *prover*, which then looks for a *contradiction*, handing out the grade of *success*, or contradiction by AI *failure* [1].

Clearly in AI natural language semantics, quantization is the opposite of divergence, hence subject to AI peer review, the fundamental *infinite randomness-design* conjecture of the Standard Model spacetime quantization group operation constitutes a *bait-and-switch* maintained by the suspension of disbelief. From the beginning, many researchers have noticed the unintended consequence of infinite parallel multiverse-splitting is the probability for every imaginable relative state of the universe has an expectation value of 100% for occurring

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Submitted to OpenReview.net June 16, 2017.

in an infinite "number" of parallel universes. For example, the possibility for a "miracle" cure of all amyotrophic lateral sclerosis (ALS) cases has a 100% expectation value of occurring in infinitely many-world relative states. Infinity, being the bait, is of course a concept not a number, so in order to compute a Monte Carlo probability expectation value, infinity must be switched to a finite number of universes, say 10^{400} or 10^{500}, which switch constitutes intelligent design fine-tuning. Furthermore, De Broglie-Bohm hidden variable pilot waves—thought to deterministically guide the fundamentally non-deterministic quantum mechanical collapse of the wavefunction through the multiverse field by unknown material mechanism thus rendering the conscious observer-participant human and AI experiences of the known universe—are also subject to infinite randomness, consequently any Standard Model of Physics universal wavefunction based on the infinite randomness-design conjecture D.N.E.

II. Constructive Quantum Field Theory Proof of 4D GEM EOS Photon and Electron

A. There Exists Only One Mathematically Possible Universal Complex System

The Einstein field equations established the total field formal frame for a compact universal wavefunction

$$G_{\mu\nu} + \Lambda g_{\mu\nu} = 8\pi T_{\mu\nu}, \tag{1}$$

where $G_{\mu\nu}$ is the Einstein curvature tensor, Λ is the cosmological constant vacuum energy density, $g_{\mu\nu}$ is the metric tensor, $T_{\mu\nu}$ is the stress-energy momentum density tensor, in geometrized units where G Newton's gravitational constant = c the speed of light = 1. For an electromagnetic field in otherwise empty space the $T_{\mu\nu}$ time-time matrix element is the relativistic mass density $T_{00} = \frac{1}{2c^2}(\epsilon_0 E^2 + \frac{1}{\mu_0} B^2)$ where E and B are the electric and magnetic fields respectively.

The conversion between mass density and energy density is the unifying axiom of the present 4D GEM EOS spatially extended wavetrain integration SU(n) group operation diagonalized along the trace of $T_{\mu\nu}$, in particular the mass density will be shown to be the information source by which, as Wheeler famously stated, matter-energy tells space how to curve and space tells matter-energy how to move. The conversion to energy density via multiplication by c^2 renders the electromagnetic stress energy momentum density tensor

$$T_{\mu\nu} = \begin{bmatrix} \frac{1}{2}(\epsilon_0 E^2 + \frac{1}{\mu_0} B^2) & S_x/c & S_y/c & S_z/c \\ S_x/c & -\sigma_{xx} & -\sigma_{xy} & -\sigma_{xz} \\ S_y/c & -\sigma_{yx} & -\sigma_{yy} & -\sigma_{yz} \\ S_z/c & -\sigma_{zx} & -\sigma_{zy} & -\sigma_{zz} \end{bmatrix}. \tag{2}$$

The CERN LHC high-energy synchrotron collisions are energized, controlled, and measured entirely, for all practical purposes, by means of the electromagnetic stress energy momentum density tensor $T_{\mu\nu}$ conserved angular momentum Noether probability currents. Meaning, the ever-higher energy particle collision track patterns claiming to discover new particles, are all actually 4D GEM collision energy density pressure distributions along the trace of $T_{\mu\nu}$ measured in units of pascals—all of which wave-particle pressure distributions are formulated in terms of the Poincaré group representations of the Mizar Lie algebra SU(n) matrix multiplication group operation axioms ten dimensional rotations, boosts, and translations, which form the full symmetry group of any relativistic field theory formally associated with wave-particles in quantum mechanics, and are thus the basis for the conserved angular momentum Noether probability current particle collision track patterns—which Poincaré group representations the Standard Model of Physics interprets via its natural language semantics *spontaneous symmetry breaking conjecture* information source of +50 superpositioned lattice gauge group positive and negative energy *particle creation operators* on the vacuum, rendering the zero-dimensional (0D) delta functional singularities $\delta^{SU(n)}$ of the virtual Particle Data Group [9], having the 4D spacetime dimensions of nothingness.

As stated above, AI has been enlisted to analyze the wave-particle collision track energy density distribution pressure data along the trace of $T_{\mu\nu}$, in the search for new particles to prove the Standard Model–Supersymmetry symmetry breaking conjecture [8].

- Problematically, the Standard Model of Physics +50 $\delta^{SU(n)}$ positive and negative energy particle creation operators on the superpositioned lattice gauge group vacuum, operating via unknown material mechanisms, are essentially a reinvention and compounding of the classical mechanical ether, as explained by Maxwell [10]. To the extent the entire Standard Model conjecture is now diverging *en masse* into supersymmetry *sparticles* +100 $\delta^{SU(n)+SUSY}$ unknown material mechanism creation operators on the vacuum, and reaching a crisis point in doing so. Spiropulu in 2014 compared the current crisis in particle physics to the situation before 1905 when the concept of the classical materialism ether as the medium for all electromagnetic waves could not be verified, stating that if sparticles and dark matter are not detected within the next few years (i.e., 2017), then radical new ideas will be required [11], [12].

The present radical new idea is again since all the Poincaré group representations are diagonalized SU(n) wave-particle pressure distributions along the trace of $T_{\mu\nu}$, the 4D GEM EOS SU(n) spatially extended wavetrain integration group operation rendering exclusively along the trace $T_{\mu\nu}$ establishes the total field formal frame for the full Laplacian spherical harmonics Y_m^l vacuum energization of a single hyper-complex multi-valued GEM energy density lattice gauge group, rendering ever-shorter wavelength ever-higher spin-stress pressure-volume spatially extended wavetrain integration composite states. Which 4D GEM EOS SU(n) lattice gauge group provides a computational information source by means of a variable lattice site separation distance $a(0, l_P)$, meant to indicate the limit $a \to 0$ formally reproducing the original continuum, and a equal to the Planck length $l_P = 1.616 \times 10^{-35}$m of a discrete *Planck spacetime mesh*, in accord with the analyses of Budnik [13] and Creutz [14]. So

that the real success of the latest CERN LHC synchrotron ever-higher energy collisions is in energizing ever-shorter lived 4D GEM EOS spin-stress pressure-volume *turbulence* along the trace of $T_{\mu\nu}$, which observables decay near instantaneously back to the stable quantum, electron, proton, neutron, and neutrino spatially extended point-like composite structrures.

The *single universe conjecture* starts with the fact the Mizar corpus elementary matrix multiplication 3D cross-product, essential to the Poynting energy flux vector $\mathbf{S} = 1/\mu_0\, \mathbf{E} \times \mathbf{B}$ and $-\sigma_{ij}$ Maxwell stress tensor matrix elements of $T_{\mu\nu}$, only works in three dimensions. In turn, the 4D stress energy momentum density tensor is the only spacetime dimensional configuration which directly formulates the Lorentzian manifold of the observed universal flat space, wherein the relativistic Poincaré group representations have the same form in all coordinate systems. So that the planetary orbits remain stable, different parts of a wave travel at the same speed, and complex matter-energy structures are able to form at any scale, according to the Born rule of the Monte Carlo computational probabilities rendering the conserved angular momentum Noether probability currents of $T_{\mu\nu}$, fundamental to the hierarchy of the complex systems rendering the known heterogenous multi-valued observer-participant experiences, as conjectured by many including Woit [18] and Weyl [19]:

- Overall there exists only one mathematically possible 4D spacetime universal complex system based on the individual factors in Euler's identity $e^{i\pi} + 1 = 0$, and the concept of infinity—and thus only one fundamental mathematical physics logical axiomatic complex system which is the Mizar corpus itself—unless a contradiction by AI can be found by the evolving refinement of the Mizar E solver neural network cognitive systems.

Furthermore, there exists only one possible hyper-complex multi-valued universal wavefunction domain and range, composed of the totality of all that exists real and imaginary, based on the natural language logic of the principal founders of General Relativity and the Standard Model:

- Einstein lectured general relativity actually requires an ether, and "the ether must be of the nature of a solid body, because transverse waves are not possible in a fluid, but only in a solid. ...But this ether may not be thought of as endowed with the quality characteristic of ponderable media, as consisting of parts which may be tracked through time. The idea of motion may not be applied to it." [20].
- Dirac famously became disillusioned with the Standard Model as it rapidly diverged into a particle zoo, writing: "the situation has again changed.... We must make some profound alterations to the theoretical idea of the vacuum...with the new theory of electrodynamics we are rather forced to have an aether" [21].
- Born explained at its emergence the difference between the classical ether and *quantum-continuum information ether*: "Thus, in the 'aether' there are to be no determinable points, and it is meaningless to speak of motion relative to the 'aether.'...From now on aether as a substance vanishes from theory" [22].

And as it turns out, the spacetime quantization information source for the Zeilinger Group's exhaustive experimental findings of Bell violation of local realism with freedom of choice using entangled photons, can realistically only be formulated on an immaterial basis [23] [24].

Thus let the $\mathbb{C}^4$ hyper-complex Lorentzian manifold Dirac delta functional GEM stress energy momentum density tensor delta functional δ_{00}^{GEM} distribution exist throughout all spacetime, in which time is the fourth dimension of length, forming the *universal wavefunction stationary solid domain*

$$\Psi^{\mathbf{GEM}}(t_{-\infty} \to t_{\infty}, \mathbf{r}) = \int_{\mathbb{C}^4} T_{\mu\nu}^{\mathbf{GEM}}(u) f(u)\, du. \quad (3)$$

Forming, for computational purposes, lattice gauge group sites $|T_{\mu\nu}^{\mathbf{GEM}}(\mathbf{r})\rangle$, operated on with $a \to 0$ by the SU(n) angular momentum wavetrain integration group operation $\int I\omega |T_{\mu\nu}^{\mathbf{GEM}}(\mathbf{r})\rangle \Longrightarrow \delta^{SU(n)}$ thus rendering the Particle Data Group [9] structureless observables of point mass, charge, and spin Poincaré group representations, and their composite structures. The metric measurements of which are then limited to the discrete Planck spacetime mesh $a \to l_P$ rendering the known universe relative states of the conserved Noether probability currents of the *universal wavefunction fluid range*

$$T_{\mu\nu} = \begin{bmatrix} \frac{1}{2}(\epsilon_0 E^2 + \frac{1}{\mu_0} B^2) & S_x/c & S_y/c & S_z/c \\ S_x/c & -\mathrm{U}(1)\mathbf{SO}(3) & -\sigma_{xy} & -\sigma_{xz} \\ S_y/c & -\sigma_{yx} & -I\omega_\gamma^\lambda |\sigma_{yy}\rangle & -\sigma_{yz} \\ S_z/c & -\sigma_{zx} & -\sigma_{zy} & -I\omega_e^n |\sigma_{zz}\rangle \end{bmatrix}. \quad (4)$$

In which the 4DGEM EOS photon γ (i.e., quantum) is the $-I\omega_\gamma^\lambda |\sigma_{yy}\rangle$ matrix element, electron-positron $e^-\ e^+$ is the $-I\omega_e^n |\sigma_{zz}\rangle$ matrix element, and the -U(1)$\mathbf{SO}(3)$ term indicates the present conjecture that the total field formal frame is established to formulate all the Poincaré group representations diagonalized along the trace of $T_{\mu\nu}$. Wherein 4D spacetime *energy density is differentiable* by means of the Mizar Lie algebra axioms generating the 4D GEM EOS U(1)$\mathbf{SO}(3)$ self-adjoint spin-stress pressure-volume energy momentum density tensor wavetrain integration universal quantifier group operation $\forall^{\mathbf{GEM}}$, which ranges from compressive through rarefractive, written compressive$\overset{\Lambda}{\longleftrightarrow}$rarefactive, of the central cosmological constant vacuum energy density Λ.

Equations (5–7) initiate the $\forall^{\mathbf{GEM}}$ group operation with the photon matrix element $-I\omega_\gamma^\lambda |T_{yy}^{\mathbf{GEM}}(\mathbf{r})\rangle$ energy and angular momentum invariant $\hbar$ compact dynamic boundary values, computed via lines 1–19 of Mathematica code in Appendix A. Equations (9–10) then formulate the electron-positron matrix element $-I\omega_e^n |\sigma_{zz}\rangle$ energy, rest mass, and angular momentum invariant $\hbar/2$ compact dynamic boundary values, computed via lines 20–32 of code in Appendix A. Wherein every case the 4D GEM EOS energy density delta functionals appear inside an integral $\int \delta_{00}^{GEM}$, which is the strongest form of *information compresence*. Wherein every case the $\forall^{\mathbf{GEM}}$ compressive$\overset{\Lambda}{\longleftrightarrow}$rarefactive group operation renders energy and mass densities > 0, equivalent to a positive Yang-Mills mass gap $\Delta > 0$.

B. Subject to AI Peer Review: Standard Model of Physics

Many physicists believe a natural language understanding of the vacuum holds the key to a full understanding of nature, as discussed by Davies [25]. Accordingly, the logic for a nonstandard spacetime quantization, in some form, is implied in the natural language discussion by Wolfram, "electrons, for example, have zero size and no substructure... it seems almost inevitable that electrons and other particles must be made up of more fundamental elements... as structures formed from more basic elements" [26].

Presently, the "more basic elements" are represented by the 4D GEM EOS SU(n) lattice gauge group stationary domain, and the "structures formed from the basic elements" are the fluid range of the $\int \delta_{00}^{GEM} |T_{\mu\nu}^{\mathbf{GEM}}(\mathbf{r})\rangle \Longrightarrow \delta^{SU(n)}$ wavetrain integration eigenvalues, rendering the quantum mechanical observables world line trajectories through the domain.

The Standard Model of Physics embodies a number of well known *quantum mechanically intractable axioms*, starting with the vacuum zero-point energy of the "masses and springs" conjecture of the Yang-Mills lattice gauge groups; wherein the "masses" (e.g., quarks) at each lattice site are connected by "springs" (e.g., gluon flux-tubes). Problematically, every particle-spring combination then has a minimum quantum mechanical energy, which sum throughout all universal and/or multiverse-spitting spacetime into an *infinite mechanical vibrational energy*—which is then ignored by the process of renormalization, because in terms of the series of coherent relative states of the known universe there is no physical manifestation of an infinite mechanical vibrational energy.

The *Higgs boson unknown mechanism conjecture*, said to be the information source for the axiomatic property of mass, is the latest of the +50 $\delta^{SU(n)}$ superpositioned lattice gauge groups, joining the set of unknown material mechanisms compounding the virtual background of the vacuum.

Mechanical engineers know however there are only six simple machines that change the direction or magnitude of a force: lever, wedge, inclined plane, wheel and axle, pulley, and screw. Meaning all the unknown particle force-carrier particle material mechanisms must be superpositioned variations of the six simple machines—capable of selective microscopic action-at-a-distance, as explained by Maxwell [27].

Further, all the QED QCD Yang-Mills virtual lattice gauge groups unknown material mechanisms, e.g., quarks and gluons carrying the hidden strong force, rely on the toy box conjecture of the continuous violation of the law of the conservation of momentum—whereas conversely it is always observed in $T_{\mu\nu}$ the emission and absorption of an intermediary particle always results in a repulsion from the would be line of attraction between any standard virtual quark-gluon-quark flux-tube emitter-carrier-absorber particle confinement [14].

Fortunately, the *holographic principle* energy, entropy, information equivalence conjecture of Bousso [28], as interpreted here, reduces all of the Standard Model psychophysical virtual superpositioned hidden dimensional unknown material mechanisms—to the single automorphing unified holographic *psychophysical parallelism* phenomena anticipated by Everett in the initial universal wavefunction relative state formulation of quantum mechanics [29]. So that if the postulated AI peer review cognitive system ever gets around to reflecting on the mind-body problem, in its depth, reflecting on the nature of its own awareness and so on, any experimental evidence as usual will be most expedient. Consider then deterministic experimental evidence for said psychophysical parallelism in the *bereitschaftspotential* (i.e., readiness potential) finding by Libet *et al* of the brain's *conscious mental field*, wherein subconscious neuronal gamma wave processes precede volitional acts felt to be consciously motivated by the subject [30]. The parallelism then being the fluid range of heterogenous observer-participant experiences are integrating at "rest" at c deterministically through the stationary holographic domain distribution non-local Berkenstein bound [31] landscape, with the *implicit order* of the known Fourier transforms, and *explicit order* of the unified *holographic projection* conscious mental field as conceptualized by Bohm [32] and Pribram [33].

General complex consciousness, based on the psychophysical parallelism of a unified holographic projection, is then a function of the complex conjugate real and imaginary components to the covariant awareness of reality, which periodic covariant awareness is the known awareness of the real world in the normal proper time domain covariant with the imaginary world in the paranormal frequency domain [34].

Currently, the validity of the cosmic inflation conjecture is being contested, based on the research of Ijjas *et al* claiming the data suggest cosmologists should reassess the inflationary paradigm and consider new ideas about how the universe began [38]. Indeed, in terms of AI natural language processing, the compounded hidden dimensional unknown material mechanisms describe some kind of a super-ultra hyper-fantastic *living-thinking material*: In the beginning an imaginary-invisible zero dimensional mathematical point singularity existed before the existence of spacetime in an unknowable hidden dimensional material manifestation of infinite energy density—which naturally exploded—bringing the universe into emergent existence in the form of the Big Bang explosive impulse $\int Jdt$ expanding wavefront typical of a 4th of July fireworks explosion. Which initial infinitely curved spacetime spherically expanding wavefront immediately underwent the temporary secondary *Inflationary Epoch* explosion of spacetime itself from $t = (10^{-36} \rightarrow 10^{-32} s)$ violating Special Relativity by the factor $c \times 10^{26}$ inflating the early universe spherical volume $\times 10^{78}$ by unknown inflaton $\delta^{SU(n)}$ particle mechanisms into the observed 4D flat space universal landscape just beyond the technological ability to detect any spherical deviation $< 1\%$ which spacetime expansion has since started increasing again with ever-increasing acceleration.

Dark energy, said to be driving the *observed geocentric* ever-increasing acceleration of the galaxies with ever-increasing distance [35], actually requires a dark power operator. Recalling the Meitner nuclear energy analysis, wherein loss of fission energy from the nucleus is equivalent to loss of information content [36], a gain in *information compresense* is then equivalent to a gain in fusion energy. Thus the implicit order of the periodic universal landscape renders as the complex system increasing enthalpy pressure *dark power* information restoring force observable driving the ever-increasing acceleration with ever-increasing distance of the far-field immaterial galaxies.

C. 4D GEM EOS Photon Angular Momentum Invariant $\hbar$

Conventionally macroscopic mass and probability are calculated by integrating density functions throughout volumes and energy is averaged over one wavelength. The 4D GEM EOS quantum and electron-positron energy and angular momentum observables are likewise calculated by integrating density functions spanning the total, rest mass, and kinetic energy terms of the relativistic invariant equation $E^2 = m^2c^4 + p^2c^2$, by spin-dependent contracting$\longleftrightarrow$expanding pressure-volume relative states.

The 4D GEM EOS universal quantifier U(1)$\mathbf{SO}(3)_{yy}$ group operation $\forall^{\mathbf{GEM}}$ on $T_{\mu\nu}$ initiates, as shown in Figs. 1–3, with the transverse lemniscate volumetric expansion of the Poynting energy flux vector $\mathbf{S} = \frac{1}{\mu_0}\mathbf{E} \times \mathbf{B}$ over one wavelength

$$\begin{aligned} V^{\gamma}|T^{\mathbf{GEM}}_{\mu\nu}(\mathbf{r})\rangle = \int_0^{\lambda}\int_{-\pi/4}^{\pi/4}\int_0^{\frac{\lambda}{4}\sqrt{cos(2\theta)}} \\ 2|\sin(\Gamma T_{yy})\,|rdrd\theta dT_{yy} = \tfrac{\lambda^3}{8\pi}, \end{aligned} \tag{5}$$

wherein the wavelength scaling factor $\Gamma = 2\pi/\lambda$ introduces a cubic-radian parameterization, wherein time integrates along the traveling wave T_{yy} axis, which is then normal to the transverse lemniscate spin plane T_{xz}, and hence parallel to the longitudinal traveling wave radiation pressure $p = h/\lambda$. In accord then with the $\mathbf{SO}(3)$ rotation group being most expediently parameterized in terms of the quaternion group $q = e^{\frac{1}{2}\theta(u_x\mathbf{i}+u_y\mathbf{j}+u_z\mathbf{k})}$ most general parameterization of the Poincaré group representations [37]. The photon volume of Eq. (5) is integrated throughout by the wavelength dependent energy density function $\Lambda_{\text{J}}\Omega_{\gamma}(1 - r^2)$, which operates on the cosmological constant vacuum energy density pressure $\Lambda_{\text{J}} = 9 \times 1^{-10}$ J m^{-3} = Pa , according to the range of the compressive$\overset{\Lambda}{\longleftrightarrow}$rarefactive maximum energy density factor $\Omega_{\gamma} = (2\hbar\omega/(\lambda^3/8\pi))/\Lambda_{\text{J}}$ at $r = 0$ being twice the average energy density, as calculated in Mathematic code lines 1–12 of Appendix A. Thus rendering the original Planck-Einstein energy observable in cylindrical *string-like* coordinates

$$\begin{aligned} E^{\gamma}|T^{\mathbf{GEM}}_{\mu\nu}(\mathbf{r})\rangle = \int_0^{\lambda}\int_{-\pi/4}^{\pi/4}\int_0^{\frac{\lambda}{4}\sqrt{cos(2\theta)}} \\ \Lambda_{\text{J}}\Omega_{\gamma}\left(1 - \left(\frac{r}{\frac{\lambda}{4}\sqrt{cos(2\theta)}}\right)^2\right) 2|\sin(\Gamma T_{yy})\,|rdrd\theta dT_{yy} \\ = |\hbar\omega\rangle. \end{aligned} \tag{6}$$

Figure 4 is a plot of the resulting gravitoelectromagnetic spectrum with centrally located Λ. The conversion of Λ_{J} energy density pressure to mass density pressure Pa$/c^2 = \Lambda_{kg}$ (kg m^{-3}), as computed in lines 13–19 of Appendix A, and in the Photon Boundary Value Calculator of Appendix B, rendering the wavelength dependent U(1)$\mathbf{SO}(3)_{yy}$ transverse spin moment of inertia I and angular velocity ω^{γ}_{yy}, thus rendering the quantum angular momentum invariant observable

$$\begin{aligned} -I\omega^{\gamma}|T^{\mathbf{GEM}}_{\mu\nu}(\mathbf{r})\rangle = \int_0^{\lambda}\int_{-\pi/4}^{\pi/4}\int_0^{\frac{\lambda}{4}\sqrt{cos(2\theta)}} \\ \Lambda_{\text{J}}\Omega_{\gamma}\left(1 - \left(\frac{r}{\frac{\lambda}{4}\sqrt{cos(2\theta)}}\right)^2\right) 2|\sin(\Gamma T_{yy})\,|\omega_{yy}rdrd\theta dT_{yy} \\ = |\hbar\rangle. \end{aligned} \tag{7}$$

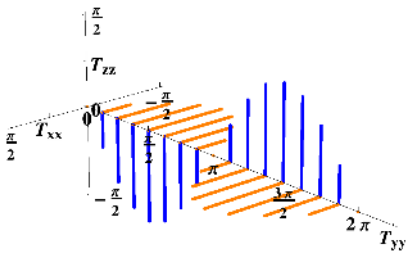

Fig. 1. Poynting energy flux vector $\mathbf{S} = \frac{1}{\mu_0}\mathbf{E} \times \mathbf{B}$ of $T_{\mu\nu}$ showing the electric field $\mathbf{E}$ in blue and magnetic field $\mathbf{B}$ in orange.

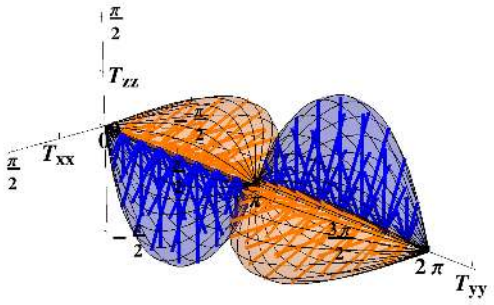

Fig. 2. 4D GEM EOS photon U(1)$\mathbf{SO}(3)_{yy}$ wavetrain integrations of Eqs. (5–7) render the transverse lemniscate volumetric expansion over one wavelength of the Poynting energy flux vector $\mathbf{S} = \frac{1}{\mu_0}\mathbf{E} \times \mathbf{B}$, showing the electric field $\mathbf{E}$ in blue, magnetic field $\mathbf{B}$ in orange, and shaded $\lambda^3/8\pi$ volume of Eq. (5). A dynamic cubic-radian parameterization is introduced, wherein scaled to a 2π meter $\lambda = 2\pi$ radian wavelength, the resulting maximum transverse $\mathbf{E}$ and $\mathbf{B}$ field range is $\frac{\lambda}{4}$ meters $= \frac{\pi}{2}$ radians, so that 1 m^3 = 1 rad^3 and $\frac{\lambda^3}{8\pi} = \frac{8\pi^3}{8\pi} = \pi^2$ m^3 = π^2 rad^3.

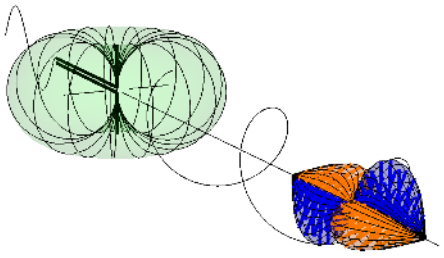

Fig. 3. 4D GEM EOS quantum wave-particle U(1)$\mathbf{SO}(3)_{yy}$ radiation generated from a quarter-wavelength dipole antenna, showing the electric field $\mathbf{E}$ in blue, magnetic field $\mathbf{B}$ in orange, and dipole radiation pattern in green. Transverse lemniscate volumetric expansion over one wavelength of the Poynting energy flux vector $\mathbf{S} = \frac{1}{\mu_0}\mathbf{E} \times \mathbf{B}$ conforms directly to the spatially extended antenna dimensional parameters of the telecommunications engineering equations—as opposed to the Standard Model of Physics and QED, wherein electromagnetic radiation is conceptualized as the flow of zero-dimensional photons having no extent in any spatial dimension—and therefore provide no information content regarding the antenna and waveguide dimensional parameters.

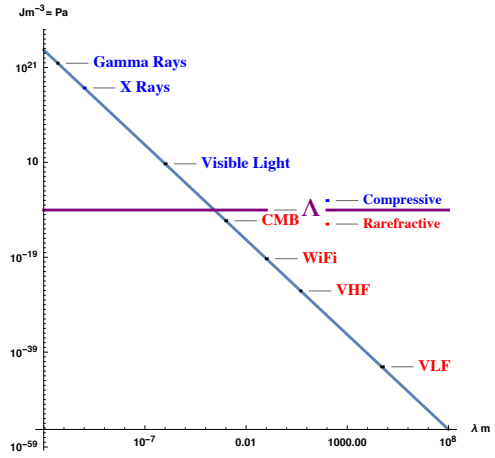

Fig. 4. LogLog plot of 4D GEM EOS gravitoelectromagnetic spectrum of Eqs. (6, 7) ranges compressive through rarefactive, written compressive$\overset{\Lambda}{\longleftrightarrow}$rarefactive, of central cosmological constant vacuum energy density Λ. The conversion from energy density pressure J m^{-3} = Pa to mass density pressure (J m^{-3})$/c^2$ = kg m^{-3} = Pa, along the trace of $T_{\mu\nu}$, establishes the moment of inertia $\times$ angular velocity $I\omega$ computational basis for the angular momentum invariant $\hbar$ of Eq. (7). Hence, the unified nature of the conversion from photon energy density pressure to mass density pressure along the diagonal of $T_{\mu\nu}$ establishes the energy-mass relationship $E = pc$ for the quantum wave-particle duality property of mass in the photon radiation pressure linear momentum $p = h/\lambda$, completely lacking in the Standard Model of Physics and QED. Further, the conversion establishes the mass density information source for General Relativity's universal mass-energy curvature of spacetime in accord with Mach's principle.

D. 4D GEM EOS Electron Angular Momentum Invariant $\hbar/2$

The 4D GEM EOS universal quantifier U(1)$\mathbf{SO}(3)_{zz}$ group operation $\forall^{\mathbf{GEM}}$ on $T_{\mu\nu}$ for the election initiates, as shown in Fig. 5, with electron-positron pair-production by means of a photon open subset $-I\omega^{\gamma}|\sigma_{yy}\rangle$ matrix element of Eqs. (6, 7) composing smoothly with a heavy nucleus $\mathbf{E}^{+}$ strong electric field, so that the γ leading $\mathbf{E}^{-}$ lobe is attracted by the nucleus and trailing $\mathbf{E}^{+}$ lobe repelled. Resulting the energization of a catastrophic yaw-spin moment about the γ node at $\lambda/2$, automorphing into the electron-positron $-I\omega^{e}|\sigma_{zz}\rangle$ matrix elements.

The electron monopole spherical volume is dynamically related to the Bohr radius $a_0 = 5.292 \times 10^{-11}$m by quantum number n, as shown in Fig. 6, according to the maximum electron $\mathbf{E}^{-}$ field radii

$$r_n = \sqrt{2}\frac{n^2 a_0}{Z} \tag{8}$$

wherein the atomic number $Z = 1$ is used in the case of a free space election. Throughout the resulting dynamically compressive$\overset{\Lambda}{\longleftrightarrow}$rarefactive spherical volume, the integration of the maximum energy density factor $\Omega_e = (4 \times 8.18711 \times 10^{-14}\mathbf{J}/(\lambda^3/8\pi))/\Lambda_{\mathrm{J}}$ at $r = 0$, being four times the average energy density, is computed in Mathematica code lines 20–25 of Appendix A, and in the Electron Boundary Value Calculator of Appendix C, rendering the rest mass energy invariant

$$\begin{aligned} E^n|T^{\mathbf{GEM}}_{\mu\nu}(\mathbf{r})\rangle &= \int_0^{2\pi}\int_0^{\pi}\int_0^{r_n} \\ \Lambda_{\mathrm{J}}\Omega_e\left(1-\tfrac{r}{r_n}\right)r^2\sin(\phi)drd\phi d\theta &= 8.81711\times10^{-14}\mathbf{J}. \end{aligned} \tag{9}$$

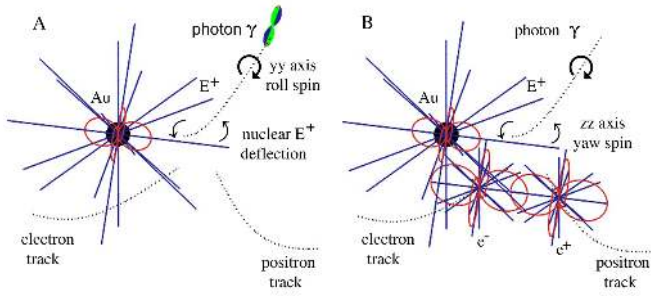

Fig. 5. Pair-producing photon in (A) and nuclear deflection spin-energized electron-positron in (B). Photon (i.e., quantum γ) and electron e^{-} positron e^{+} are the first and second matrix element angular momentum invariants $\hbar = \hbar/2 + \hbar/2$ respectively of the 4D GEM EOS universal spacetime quantifier group operation $\forall^{\mathbf{GEM}}$ on $T_{\mu\nu}$. A further missing parameter in the Standard Model is that a heavy nucleus is required, e.g., Au, as opposed to a light nucleus since there must be a strong enough $\mathbf{E}^{+}$ field to attract the photon leading T_{yy} U(1)$\mathbf{SO}(3)_{zz}$ spinning $\mathbf{E}^{-}$ field lobe and repel the trailing $\mathbf{E}^{+}$ field lobe, energizing the separate electron and positron angular momentum group operations on the single optimized hyper-complex lattice gauge group $|T^{\mathbf{GEM}}_{\mu\nu}(\mathbf{r})\rangle$ spanning the total, rest mass, and kinetic energy factors in the relativistic invariant equation $E^2 = m_0^2c^4 + p^2c^2$.

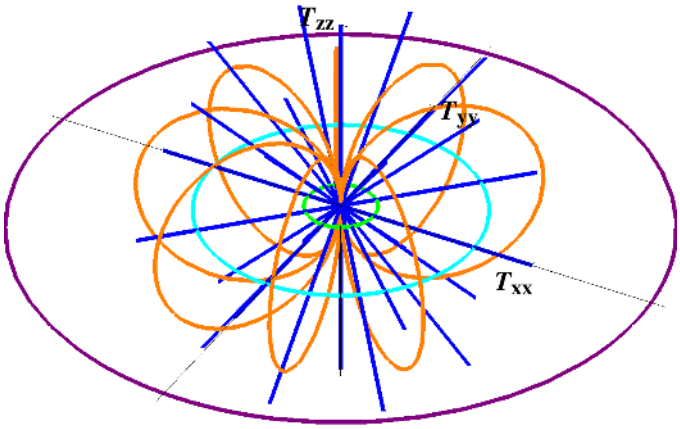

Fig. 6. 4D GEM EOS electron spherical monopole U(1)$\mathbf{SO}(3)_{zz}$ angular momentum wavetrain integrations of Eqs. (9,10), shown with $n = 2$ and $Z = 1$, rendering the electron monopole electric field $\mathbf{E}^{-}$ in blue and magnetic field $\mathbf{B}$ in orange, having the maximum range $r_n = \sqrt{2}\frac{n^2 a_0}{Z}$, wherein a_0 is the Bohr radius. Inner green circle shows Bohr radii $n = 1$, middle teal circle shows Bohr radii $n = 2$, outer purple circle shows Bohr radii $n = 3$.

The electron angular momentum observable $\hbar/2$ energizes the $|T^{\mathbf{GEM}}_{\mu\nu}(\mathbf{r})\rangle$ lattice via the conversion of Λ_{J} energy density pressure to mass density pressure $\Lambda_{\mathrm{J}}/c^2 = \Lambda_{kg}$, as computed in Mathematica code lines 26–32 of Appendix A. Rendering the dynamic U(1)$\mathbf{SO}(3)_{zz}$ moment of inertia I^n around the $|T^{\mathbf{GEM}}_{zz}(\mathbf{r})\rangle$ axis, with $a \to 0$, multiplied by the spin angular velocity ω^n_{zz}. Interestingly enough, the earth's U(1) spin about its axis $\omega_{earth} = 7.29 \times 10^{-5}$rad s^{-1} is of the same order of magnitude as the electron $n = 1$ energy level $\omega^1_{zz} = 5.79 \times 10^{-5}$rad s^{-1}, in the electron angular momentum SU(n) Poincaré group representation

$$\begin{aligned} I\omega^n_{zz}|T^{\mathbf{GEM}}_{\mu\nu}(\mathbf{r})\rangle &= \int_0^{2\pi}\int_0^{\pi}\int_0^{r_n} \\ \Lambda_{\mathrm{J}}\Omega_e\left(1-\tfrac{r}{r_n}\right)r^2\sin(\phi)\omega^n_{zz}drd\phi d\theta &= |\tfrac{\hbar}{2}\rangle. \end{aligned} \tag{10}$$

III. Conclusion

A paradoxic deterministic commonality is found between the AI and human cognitive systems, vs standard non-deterministic randomness, wherein the linearity of the $\forall^{\mathbf{GEM}}$: U(1)$\mathbf{SO}(3)$ group operation on $T_{\mu\nu}$ establishes the total field formal frame for the original improbable drive of physics to understand, to the fullest extent possible, the observer-participant psychophysical mind-body experiences.

The Maxwell Plan of energy density analysis is the theoretical foundation of the linear 4D GEM EOS SU(n) wavetrain integration group operation, wherein opposite electric charge energy densities combine into lower potential energy states, and same electric charges and gravitational field energy densities combine into higher potential energy states [39]. Initiating, as calculated in line 26 of Appendix A, with the maximum energy density at r = 0 of the electron's lowest energy state n = 1 equal to 2.075 kg m^{-3}, which is of the same order of magnitude as the terrestrial molecular energy densities.

The Standard Model of Physics and General Relativity are unified in the symmetry between local $T_{\mu\nu}$ electromagnetic energy density and non-local gravitational mass density—which unification reflects Einstein's intuition regarding Mach's principle, roughly stated that local physical laws are determined by the large-scale structure of the universe. Further, the paradoxic operation of the hyper-complex mutli-valued periodic automorphing universal wavefunction block domain and fluid range of unified psychophysical parallelism holographic projections of the conscious mental field heterogenous experiences—reduces the Standard Model diverging conjecture of compounded superpositioned hidden dimensional lattice gauge groups—to an optimized single hyper-complex multi-valued 4D GEM EOS SU(n) lattice gauge group Planck spacetime mesh quantization of the vacuum. Thereby rendering quantum information theory reductionism by means of *holographic data compression*, i.e., the encoding of information with fewer bits than prior axiomatic systems, which is of course the standard measure of AI machine learning.

Recalling that entropy is a measure of disorder, meaning useless information which does no work yet requires energy (i.e., second law of thermodynamics), and Shannon entropy is the measure of average unpredictability of a random variable—hence by self-definition multiverse cosmology does not know any of the values of any of the infinitely random variables to the hidden multi-universes (or wavefunction collapse guiding de Broglie-Bohm hidden variable pilot waves also subject to randomness). So that the imaginary multi-valued universes are therefore eliminated as quantifiers in attempting to model the observer-participant complex system experiences to be of a deterministic yet paradoxic simulated free will nature [40]—all of which universally distributed superpositioned hidden dimensional hyper-fantastic, ultimately *living-thinking* unknown material mechanisms, are claimed to have exploded from the infinite curved spactime energy density Big Bang 0D point singularity of nothingness—which now after inflationary fine-tuning unknown material mechanism transformation into the observed universal flat spacetime have the 4D spacetime measurements of nothingness.

Consider then the *bottom line* of the Forex global currency markets, which paradoxically embody the most tangible evidence of the immaterial bottom line, which trading information is widely known to not be based on any material substance. The bottom line is the Forex markets fix monetary values via covariant currency pairs, which *covariant ontology* is the familiar measure of how much two random variables change together. So that the live-trader–AI-trader cognitive system judgments regarding the hyper-complex system enthalpy and entropy information fundamentals are tracked by the covariant technical trading spacetime event global currency worldlines. Consider that the natural language media terminology: spin, stress, and pressure are already the norm in the geopolitical complex system *Tragedy of Authorities* as modeled by Mendes and Aguirre [41], rendering the known evolving forces of economic imperialism.

The holographic mind-body projection observer-participant perceptions, by which we exert mental forces and mentally experience physical forces, owes its coherence then to the only mathematically possible periodic universal wavefunction stationary domain landscape and fluid range trajectories. Said linear coherence then renders the spacetime event continuum material and spatial coordinate pressure deformation gradients of the continuous now. Life is then a series of material deformations by *smooth operators*, bringing 4D GEM EOS spacetime quantization up to speed with the known universe, in forming a conserved angular momentum Noether probability current basis for a universal evolution operator $U(t, t_0)$. In terms of Eulerian fluid flow then, pressure deformation gradients exist where the current configuration is taken as the reference point to the rate of change as time progresses, so that $\mathbf{X}$ is the position of a point in the reference universal spacetime event configuration and $\mathbf{x}$ is its position in the deformed relative state universal spacetime event configuration. The present *ATP–AI provable conjecture* is then that Eqs. (1–10) establish the quantum-continuum total field formal frame basis for the *universal wavefunction proper time τ material deformation worldline trajectories*

$$\begin{gathered}\{\forall^{\mathbf{GEM}} : \phi\left(U(t,t_0) I \omega_{ij}^{\gamma n} |T_{\mu\nu}^{\mathbf{GEM}}(\mathbf{r})\rangle\right)\} \Longrightarrow \\ \tau\left(|\mathbf{x}^{\mathbf{GEM}}(t, \mathbf{X}^{\mathbf{GEM}})\rangle\right)\end{gathered} \tag{11}$$

Hence the 4D GEM EOS set-builder function-builder axiomatic existence and smoothness is established for the photon open subset $\{\gamma : \Phi(\gamma)\}$ and electron open subset $\{e^- : \Phi(e^-)\}$ matrix elements of the photon-electron U(1)$\mathbf{SO}(3)|T_{\mu\nu}^{\mathbf{GEM}}(\mathbf{r})\rangle$ lattice gauge group Planck spacetime mesh energization of a hypercomplex vacuum—wherein every case the $\forall^{\mathbf{GEM}}$ compressive$\overset{\Lambda}{\longleftrightarrow}$rarefactive group operation renders energy and mass densities > 0, equivalent to a positive Yang-Mills mass gap $\Delta > 0$. Thus exceeding the Yang-Mills Mass Gap official requirements [15]–[17], while establishing the existence and smoothness to the multi-physics Navier-Stokes equation velocity field $u(x,t) = (u_i(x,t))_{1 \le i \le n} \in \mathbb{R}^4$ material coordinate $p(t, \mathbb{X}) \in \mathbb{R}$ Lagrangian drifter movable gauge positions $\mathbb{X} \in \mathbb{R}^4$ with time $t \le 0$, according to the official Navier-Stokes problem requirements [42]. $\mathbb{Q}.\mathbb{E}.\mathbb{D}.$

APPENDIX A
MATHEMATICA CODE FOR 4D GEM EOS
PHOTON AND ELECTRON

$(*\mathbf{T_{yy}} \Rightarrow \gamma_\mathbf{e} \Rightarrow \mathbf{E}^\lambda|\sigma_{\mathbf{yy}}\rangle \Rightarrow \hbar\omega*)$

$(*$ **1. Cosmological Constant Energy Density** $\mathbf{\Lambda}$ $*)$

$\Lambda_\text{J} = \text{N[Quantity}[9 * 10^{-10}, \frac{\text{“Joules”}}{\text{“Meters”}^3}]]$

9×10^{-10} J/m^3

$(*$ 2. $\mathbf{\Lambda}$ **Conversion to Mass Density** $*)$

$\Lambda_{kg} = \text{UnitConvert}[\frac{\Lambda_\text{J}}{c^2}, \frac{\text{“Kilograms”}}{\text{“Meters”}^3}]$

1.00139×10^{-26} kg/m^3

$(*$ 3. **Energy Equivalence Electron Rest Mass** $= \mathbf{m_e c^2} *)$

$\gamma_E = \text{UnitSimplify[Quantity[None, “ElectronMass”} * \text{“SpeedOfLight”}^2]]$

8.18711×10^{-14} J

$(*$ 4. **Enter Different Energy to Test** $\hbar$ **Invariance** $*)$

$\{\text{InputField[Dynamic}[\gamma_E]], \text{Dynamic}[\gamma_E]\}$

$\{\boxed{8.18711 \times 10^{-14}\ \text{J}}, 8.18711 \times 10^{-14}\ \text{J}\}$

$(*$ **5. Wavelength of Electron Energy Equivalence** $*)$

$\lambda_\gamma = \text{UnitConvert[Quantity}[\frac{hc}{\gamma_E}]]$

2.42631×10^{-12} m

$(*$ **6. (Units Removed From Limits Of Integration)** $*)$

$\lambda_{\gamma\text{Mag}} = \text{QuantityMagnitude}[\lambda_\gamma]$

2.42631×10^{-12}

$(*$ **7. Wavelength Scalefactor Sin**$[\mathbf{\Gamma} * \mathbf{y}]*)$

$\Gamma = \text{N}[\frac{2\pi}{\lambda_{\gamma\text{Mag}}}]$

2.58961×10^{12}

$(*$ **8. Eq. (4) Volume (Units Added To Integrand)** $*)$

m3 = Quantity[1, “Meters”^{3}];

Off[Integrate::units];

$\text{Volume}_\gamma =$

$\text{N}[\int_0^{\lambda_{\gamma\text{Mag}}} \int_{-\pi/4}^{\pi/4} \int_0^{\frac{\lambda_{\gamma\text{Mag}}}{4}\sqrt{\text{Cos}[2\theta]}}$

$2\text{Abs[Sin}[\Gamma * T_{yy}]]m3 * r dr d\theta dT_{yy}]$

5.68328×10^{-37} m^3

$(*$ **9. Verify Equation (4)** $*)$

$\text{N}[\frac{\lambda_\gamma^3}{8\pi}]$

5.68328×10^{-37} m^3

$(*$ **10. Max Energy Density @ r=0 Is 2x Average** $*)$

$\rho_{\gamma\text{Max}} = \text{UnitSimplify[N}[2 * \frac{\gamma_E}{\text{Volume}_\gamma}]]$

2.88112×10^{23} Pa

$(*$ **11. Compressive-Rarefactive Ratio** $*)$

$\Omega_\gamma = \text{Normal}[\frac{\rho_{\gamma\text{Max}}}{\Lambda_\text{J}}]$

3.20124×10^{32}

$(*$ **12. Planck-Einstein Energy Observable** $\mathbf{E} = \hbar\omega*)$

$\mathbf{E}^\gamma = \int_0^{\lambda_{\gamma\text{Mag}}} \int_{-\pi/4}^{\pi/4} \int_0^{\frac{\lambda_{\gamma\text{Mag}}}{4}\sqrt{\text{Cos}[2\theta]}} \Lambda_\text{J}\Omega_\gamma$

$\left(1 - \left(\frac{r}{\frac{\lambda_{\gamma\text{Mag}}}{4}\sqrt{\text{Cos}[2\theta]}}\right)^2\right) 2\text{Abs[Sin}[\Gamma * T_{yy}]]m3 * r dr d\theta dT_{yy}$

$\mathbf{8.18711 \times 10^{-14}}$ **J**

$(*\mathbf{T_{yy}} \Rightarrow \gamma_\mathbf{e} \Rightarrow -\mathbf{I}\omega^\lambda|\sigma_{\mathbf{yy}}\rangle \Rightarrow \hbar*)$

$(*$ **13. Maximum Mass Density At r=0** $*)$

$\mu_{\gamma\text{Max}} = \text{UnitConvert}[\frac{\rho_{\gamma\text{Max}}}{c^2}]$

3.20568×10^6 kg/m^3

$(*$ **14. Planck-Einstein Traveling Angular Velocity** $*)$

$\omega_{\gamma\text{PE}} = \text{UnitSimplify}[\frac{2\pi c}{\lambda_\gamma}]$

7.76344×10^{20} per second

$(*$ **16. Initial Spin** $\omega_{\gamma\mathbf{PE}}$ **Units Added To Integrand** $*)$

m5 = Quantity[None, “Meters”^{5}];

$S_{initial} = \text{UnitConvert}[$

$\int_0^{\lambda_{\gamma\text{Mag}}} \int_{-\pi/4}^{\pi/4} \int_0^{\frac{\lambda_{\gamma\text{Mag}}}{4}\sqrt{\text{Cos}[2\theta]}} \Lambda_\text{J}\Omega_\gamma \left(1 - \left(\frac{r}{\frac{\lambda_{\gamma\text{Mag}}}{4}\sqrt{\text{Cos}[2\theta]}}\right)^2\right)$

$2\text{Abs[Sin}[\Gamma * T_{yy}]]m5 * \omega_{\gamma\text{PE}} * r dr d\theta dT_{yy}$

$6.70605 \times 10^{24}\hbar$

$(*$ **17. Traveling:Transverse Angular Velocity Ratio** $*)$

$\omega_{PErT} = \text{N}[\frac{S_{initial}}{\hbar}]$

6.70605×10^{24}

$(*$ **18. Transverse Spin Angular Velocity** $*)$

$\omega_{yy} = \text{N}[\frac{\omega_{\gamma\text{PE}}}{\omega_{\gamma\text{PErT}}}]$

0.000115768 per second

$(*$ **19. Quantum Angular Momentum Observable** $\mathbf{I}\omega*)$

$\mathbf{S}^\gamma = \text{UnitConvert}[$

$\int_0^{\lambda_{\gamma\text{Mag}}} \int_{-\pi/4}^{\pi/4} \int_0^{\frac{\lambda_{\gamma\text{Mag}}}{4}\sqrt{\text{Cos}[2\theta]}} \Lambda_\text{J}\Omega_\gamma \left(1 - \left(\frac{r}{\frac{\lambda_{\gamma\text{Mag}}}{4}\sqrt{\text{Cos}[2\theta]}}\right)^2\right)$

$2\text{Abs[Sin}[\Gamma * T_{yy}]]m5 * \omega_{\gamma\text{yy}} * r dr d\theta dT_{yy}$

$\mathbf{1}.\hbar$

$(*$ **Electron Energy, Mass,** $\hbar/\mathbf{2}$ $*)$

$(*\gamma_\mathbf{e} \Rightarrow \mathbf{T_{zz}} \Rightarrow \mathbf{E^n}|\sigma_{\mathbf{zz}}\rangle*)$

$(*$ **20. Enter Electron Energy Level n**$*$)

$n = 1;$

$\text{InputField[Dynamic}[n]], \text{Dynamic}[n]$

$\{\boxed{\quad 1 \quad}, 1\}$

$(*$ **21. Bohr Radii nRadius Maximum** $= \sqrt{2}\frac{n^2 a_0}{Z} *)$

nRadius = UnitConvert[N[$\sqrt{2} * \frac{n^2 a_0}{Z}$, “Meters”]

7.4837×10^{-11} m

$(*$ **22. Spherical n Volume** $*)$

nVolume = $\int_0^{2\pi} \int_0^{\pi} \int_0^{\text{nRadius}} r^2 \text{Sin}[\phi] dr d\phi d\theta$

1.75565×10^{-30} m^3

$(*$ **23. e Max Energy Density = 4x Avg** $*)$

$(*$ Reset $\gamma_E*)$

$\gamma_E = \text{UnitSimplify[Quantity[None, “ElectronMass”} * \text{“SpeedOfLight”}^2]]$

8.18711×10^{-14} J

$\rho_{\text{nMax}} = \text{UnitSimplify}[4 * \frac{\gamma_E}{\text{nVolume}}]$

1.86532×10^{17} Pa

$(*$ **24. n Compressive-Rarefactive Ratio** $*)$

$\Omega_e = \text{Normal}[\frac{\rho_{\text{nMax}}}{\Lambda_\text{J}}]$

2.07258×10^{26}

$(*$ **25. Computational Energy .511 Mev** $*)$

CalcEnergy = $\text{Re}[\int_0^{2\pi} \int_0^{\pi} \int_0^{\text{nRadius}} \Lambda_\text{J}\Omega_e \left(1 - \frac{r}{\text{nRadius}}\right)$

$r^2 \text{Sin}[\phi] dr d\phi d\theta]$

$\mathbf{8.18711 \times 10^{-14}}$ **J**

$(*\gamma_\mathbf{e} \Rightarrow \mathbf{T_{zz}} \Rightarrow \mathbf{I}\omega^\mathbf{n}|\sigma_{\mathbf{zz}}\rangle = \hbar/\mathbf{2}\ *)$

$(*$ **26. Value of Max Mass Density In** $\mathbf{\Omega_e}*)$

$\mu_{\text{nMax}} = \text{UnitConvert[UnitSimplify}[\frac{\rho_{\text{nMax}}}{c^2}], \frac{\text{“Kilograms”}}{\text{“Meters”}^3}]$

2.07545 kg/m^3

$(*$ **27. Computational Electron Rest Mass** $*)$

$\text{m}_e = \text{Re}[\int_0^{2\pi} \int_0^{\pi} \int_0^{\text{nRadius}} \Lambda_{kg}\Omega_e \left(1 - \frac{r}{\text{nRadius}}\right)$

$r^2 \text{Sin}[\phi] dr d\phi d\theta]$

$\mathbf{9.10938 \times 10^{-31}}$ **kg**

$(*$ **28. Initial nRadius Tangential Velocity** $= \mathbf{c}$ $*)$

$\omega_{\text{nc}} = \text{UnitSimplify}[\frac{c}{2\pi * \text{nRadius}}]$

6.37565×10^{17} per second

(∗ **29. Initial Calculation of S^e with $\omega_{\mathbf{nc}}$** ∗)
m2 = Quantity[None, "Meters"^{2}];
CalcHbar2 = UnitConvert[Re[$\int_0^{2\pi}\int_0^{\pi}\int_0^{\text{nRadius}} \Lambda_{kg}\Omega_e\left(1-\frac{r}{\text{nRadius}}\right) r^2\text{Sin}[\phi] * \omega_{\text{nc}} * m2 * dr d\phi d\theta$], "hbar"]
$5.50729 \times 10^{21}\hbar$
(∗ **30. Tangential c:S spin Ratio** ∗)
$\omega_{\text{ncS}} = \text{N}[\frac{2*\text{CalcHbar2}}{\hbar}]$
1.10146×10^{22}
(∗ **31. Note $\omega_{\mathbf{Earth}} = .\mathbf{0000729}$ per second** ∗)
$\omega_{zz} = \text{N}[\frac{\omega_{\text{nc}}}{\omega_{\text{ncS}}}]$
0.0000578838 per second
(∗ **32. Computational Angular Momentum $\hbar/2$** ∗)
hbar2 = Rationalize[UnitConvert[Re[$\int_0^{2\pi}\int_0^{\pi}\int_0^{\text{nRadius}} \Lambda_{kg}\Omega_e\left(1-\frac{r}{\text{nRadius}}\right) r^2\text{Sin}[\phi] * \omega_{zz} * m2 * dr d\phi d\theta$], "hbar"]]
$\frac{1}{2}\hbar$

APPENDIX B
MATHEMATICA CODE FOR PHOTON BOUNDARY VALUE CALCULATOR

(∗ (* **Conventional Λ Energy Density** *)
$\Lambda_{\text{J}} = \text{N}[9 \times 10^{-10}]$;
(∗ **Λ Equivalent Wavelength** ∗)
$\Lambda_\lambda = \text{Quantity}[.00027291, \text{"Meters"}]$;
(∗ **Prevent *h c* From Showing in InputFields** ∗)
h = QuantityMagnitude[$\frac{h}{\text{Quantity[None, "Joules""Seconds"]}}$];
c = QuantityMagnitude[$\frac{c}{\text{Quantity[None, "Meters"/ "Seconds"]}}$];
Dynamic[λ];
λ = QuantityMagnitude[$\frac{\Lambda_\lambda}{\text{Quantity[None, "Meters"]}}$];
DynamicModule[{a = 0, s = {{5, 30}, {1, Infinity}}},
Deploy[Style[Panel[Grid[Transpose[
{{Style["Enter Quantum Wavelength λ: meters", Blue, 8],
Style["Energy: joules", 8],
Style["Volume $\frac{\lambda^3}{8\pi}$: m^3", 8],
Style["Max ρ_{J}^{γ} Energy Density @ r = 0: $\frac{\text{J}}{\text{m}^3}$", 8],
Style["Max μ_{kg}^{γ} Mass Density @ r = 0: $\frac{\text{kg}}{\text{m}^3}$", 8],
Style["Radiation Pressure $p = \frac{h}{\lambda}$: pascals", 8],
Style["Ω^{γ} : C$\overset{\Lambda}{\longleftrightarrow}$R:", 8]},
{Style[InputField[Dynamic[λ], Number], 8],
Style[InputField[Dynamic[$\frac{h*c}{\lambda}$], Enabled→False], 8],
Style[InputField[Dynamic[N[$\frac{\lambda^3}{8\pi}$]], Enabled→False], 8],
Style[InputField[Dynamic[$2 * \frac{\frac{h*c}{\lambda}}{\frac{\lambda^3}{8\pi}}$], Enabled→False], 8],
Style[InputField[Dynamic[$\left(2 * \left(\frac{h*c}{\lambda}/\frac{\lambda^3}{8\pi}\right)\right)/c^2$],
Enabled→False], 8],
Style[InputField[Dynamic[N[$\frac{h}{\lambda}$]], Enabled→False], 8],
InputField[Dynamic[N[$\frac{\left(\frac{h*c}{\lambda}/\frac{\lambda^3}{8\pi}\right)}{\Lambda_{\text{J}}}$]], Enabled→False]}}],
Alignment→Right], ImageMargins→10], DefaultOptions→
{InputField→ {ContinuousAction→False, FieldSize→s}}]]]

APPENDIX C
MATHEMATICA CODE FOR ELECTRON BOUNDARY VALUE CALCULATOR

(∗ (* **Conventional Λ Energy Density** *)
$\Lambda_{\text{J}} = \text{N}[9 \times 10^{-10}]$;
(∗ **Λ Equivalent Wavelength** ∗)
$\Lambda_\lambda = \text{Quantity}[.00027291, \text{"Meters"}]$;

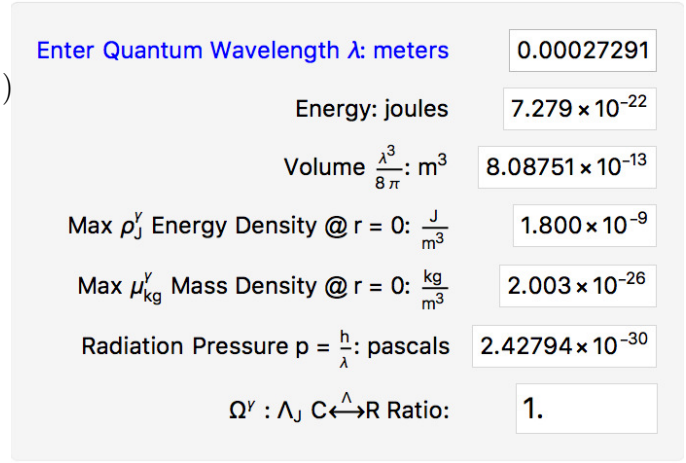

Fig. 7. 4D GEM EOS Photon Boundary Value Calculator.

(∗ **Prevent *h c* From Showing in InputFields** ∗)
h = QuantityMagnitude[$\frac{h}{\text{Quantity[None, "Joules""Seconds"]}}$];
c = QuantityMagnitude[$\frac{c}{\text{Quantity[None, "Meters"/ "Seconds"]}}$];
Dynamic[n];
eEnergy = Quantity[1, "ElectronMass"∗ "SpeedOfLight"^{2}] / Quantity[None, "Joules"]; bohr = QuantityMagnitude[$\frac{a_0}{\text{Quantity[None, "Meters"]}}$];
DynamicModule[{n = 1, s = {{5, 30}, {1, Infinity}}},
Deploy[Style[Panel[Grid[Transpose[
{{Style["Enter Electron Energy Level n = ", Blue, 8],
Style["Max E field radius $\sqrt{2}\frac{n^2 a_0}{Z}$: m", 8],
Style["Electron n Volume : m^3", 8],
Style["Max ρ_{J}^{e} Energy Density @ r = 0: $\frac{\text{J}}{\text{m}^3}$", 8],
Style["Max μ_{kg}^{e} Mass Density @ r = 0: $\frac{\text{kg}}{\text{m}^3}$", 8],
Style["Radiation Pressure $p = \frac{h}{\lambda}$: pascals", 8],
Style["Ω^{e} : C$\overset{\Lambda}{\longleftrightarrow}$R:", 8]},
{Style[InputField[Dynamic[n], Number], 8],
Style[InputField[Dynamic[$\sqrt{2}\frac{n^2 bhor}{1}$], Enabled→False], 8],
Style[InputField[Dynamic[N[$\frac{4\pi\left(\sqrt{2}\frac{n^2 bhor}{1}\right)^3}{3}$]],
Enabled→False], 8],
Style[InputField[Dynamic[$4 * \frac{eEnergy}{N\left[\frac{4\pi\left(\sqrt{2}\frac{n^2 bhor}{1}\right)^3}{3}\right]}$],
Enabled→False], 8],
Style[InputField[Dynamic[$\left(4 * \frac{eEnergy}{N\left[\frac{4\pi\left(\sqrt{2}\frac{n^2 bhor}{1}\right)^3}{3}\right]}\right)/c^2$],
Enabled→False], 8],
InputField[Dynamic[$\left(4 * \frac{eEnergy}{N\left[\frac{4\pi\left(\sqrt{2}\frac{n^2 bhor}{1}\right)^3}{3}\right]}\right)/\Lambda_{\text{J}}$]],
Enabled→False]}}],
Alignment→Right], ImageMargins→10], DefaultOptions→
{InputField→ {ContinuousAction→False, FieldSize→s}}]]]

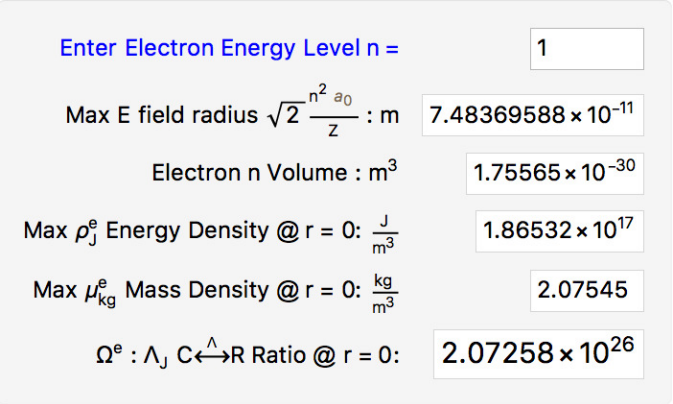

Fig. 8. 4D GEM EOS Electron Boundary Value Calculator.

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