

Article

Unbounded Continuum: Mesostratum & Physiostratum

Alex Vary*

Abstract

This paper is based on the argument that the cosmos is but an observable, measurable, material subset of the Universe which is an unbounded continuum beyond description or definition. There may be uncountable space-time-bounded cosmoses beyond the range of terrestrial observation. The Universe has no known history while the cosmos, a massive discontinuum filled with particles in motion, has a history. A plausible history of the cosmos is given by the hot big bang theory and chronology which posit its origin and rapid expansion from a point singularity. We propose an alternate chronology which assumes that the cosmos emerged from a universal energetic substratum, expanded, and agglomerated hierarchically; ultimately forming galaxies which subsequently spawned the stars that illuminate them. We reckon that the energetic substratum is an integral part of the mesostratum and identify the cosmos as the physiostratum. We argue that the mesostratum and its vast hyperspace energetic resources preexisted the physiostratum and that the cosmos sprang - quantum particle by quantum particle - from the mesostratum.

Keywords: Cosmos, universe, energetic substratum, mesostratum, physiostratum.

Introduction

Recent theoretical developments suggest there are entities in the mesostratum that can deliver elementary particles into the physiostratum. In string theory, 'strings' are such entities. Different vibrational states of strings are supposed to generate a variety of elementary quantum particles. According to the theory, a string is a continuum 'path' or 'loop' that propagates through the mesostratum hyperspace.

String theory, although unverified and incomplete, is an attempt to explain all the fundamental particles and forces of nature by modeling them as vibrations and extensions of one dimensional strings. The thought is that these fundamental entities vibrate at certain resonant frequencies. Elementary particles in the Standard Model of Particle Physics, such as electrons, are supposed to arise as vibration modes of these fundamental strings. In some versions of string theory, strings generate two dimensional extended objects called branes (an apocope of *membranes*). There are supposed multi-dimensional manifolds that occupy more than the four dimensions attributed to spacetime. The extra six or more dimensions are 'infinitesimal' which, according to string theory, are unobserved because they 'curl' up tightly upon themselves. We propose that the extra dimensions are unobservable because they reside entirely within the mesostratum continuum, and are for that reason unobservable and cannot be experienced in the physiostratum discontinuum.

This article explores the interrelation and interaction of the mesostratum and physiostratum. The underling idea is that only a granular discontinuous cosmos (physiostratum) may emerge from the

* Correspondence: Alex Vary, PhD, Retired NASA Scientist & Independent Researcher. Email: axelvary@wowway.com

energetic substratum continuum, the mesostratum. We adopt the notion that only discrete chunks of matter or quanta may be generated by the energetic substratum to occupy the physiostratum - otherwise infinite energy would be required to generate a massive physical continuum. Expending infinite energy to form just one cosmos completely negates the possibility of forming separate companion cosmoses.

We further argue that spacetime quanta emerge from the mesostratum and combine to initiate and produce the four-dimensional plenum of the physiostratum. The spacetime quanta - which we term 'voxels' - are envisioned as infinitesimal uniformly resonating cubes that are perfectly tessellated - forming what appears to be a vast macroscopic cosmic spacetime continuum.

Nature of the Mesostratum

We argue that the mesostratum is the transcendent base and source of the material world of our experience. It is perceptible only in its effect on physiostratum phenomena that we can sense, observe, and measure. We argue further that physiostratum spacetime is granular and that it consists of oceanic array of tessellated interacting spacetime parcels - depicted as voxels in Figure 1. The voxels are identical, uniformly dispersed, and form the cosmic physiostratum discontinuum. The mesostratum is conceived as an energetic substrate and source which generates the granular spacetime foundation of the physiostratum. Figure 1 represents the physiostratum as a subset of the mesostratum:

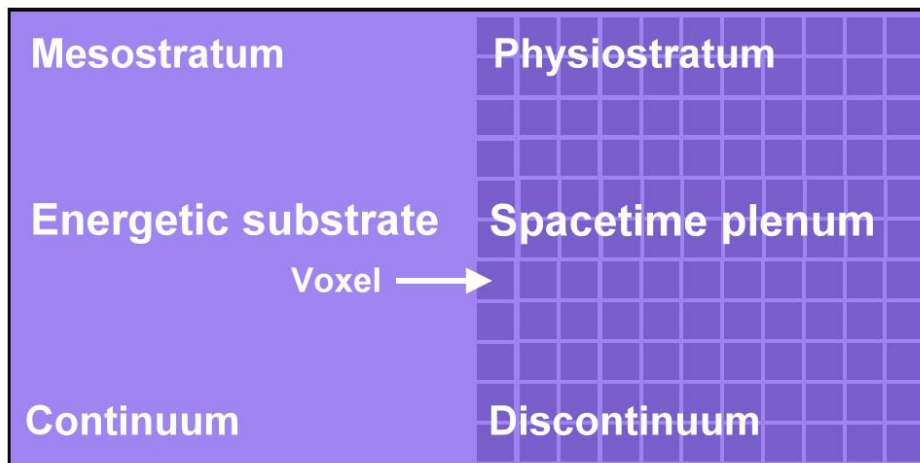


Figure 1 - Conceptual mesostratum and voxel array of the physiostratum.

The mesostratum hyperspace is a continuum in the mathematical sense. It is essentially equivalent to the 'aether' originally proposed as a hypothetical substance occupying all space. The aether was conceived as a background medium to account for the propagation of electromagnetic radiation through space. The concept assumes that the granular cosmic physiostratum is immersed in a universal hyperspace continuum - the aether. The notion of an all-pervasive aether substrate was abandoned after the Michelson–Morley interferometer experiment of 1887 which compared the speed of light in perpendicular directions, in an attempt to detect the relative motion of matter

through the stationary aether. In this paper, we assign properties of the aether to the mesostratum hyperspacetime substratum.

It can be demonstrated that photons, light waves, that is, electromagnetic waves and fields, transpire in the mesostratum. This has been long evident and demonstrated by Thomas Young's double slit experiment of 1801 and the Michelson–Morley interferometer experiment. Both revealed that light waves, electromagnetic waves, transpire transcendently within the mesostratum. Within the mesostratum continuum, photons traverse *decoupled* from the physiostratum material discontinuum, while *in transit* from a material source to a material detector. The decoupling from the material world is evident in the *constant velocity of light* which is *independent* of the velocity of the photon's physiostratum source/emitter which is a physiostratum gravitational agglomeration of quantumthings, where quantumthings are massive particles and entities resident exclusively in the physiostratum discontinuum, Figure 2.

A simple experiment reveals the reality of the mesostratum: Electromagnetic fields are continuumthings, intrinsically *mathematical continuum objects*, that exist exclusively in the mesostratum. Their presence and influence is clearly demonstrated by the alignment of iron filings originally randomly scattered on a cardboard sheet just before being placed over a magnet. The tiny particles of iron line up along so-called magnetic *lines of force*, which reside in the mesostratum hyperspace continuum, between the magnet's poles. Figure 2 identifies other continuumthings which reside in exclusively in the mesostratum.

Mesostratum	Physiostratum
Domain of energy & continuumthings	Material discontinuum of quantumthings
Hyperspace continuum	Spacetime voxels
Mathematical objects	Nucleons, atomic nuclei
Electromagnetic fields	Atomic agglomerations
Zero point energy & fields	Galaxies, stars, planets
Wave functions & signals	Living things & habitats
Superstrings & branes	Conscious beings

Figure 2 - Representative contents of mesostratum and physiostratum.

Provisionally recognizing the reality of the mesostratum can help explain many physical phenomena such as the spontaneous emergence and annihilation of electron-positron pairs and quantum entanglement - as explained later in this paper. Exploration of the mesostratum should reveal unexpected features, properties, and resources, particularly regarding modes of information storage and transfer. The mesostratum presumably has *wireless* signal origination, exchange, and transmission capabilities. Mesostratum signals and dynamic fields which transmit information and energy are not necessarily restricted to electromagnetic waves and fields. It is inadvisable to exclude the possibility of other kinds of signals; signals far stranger than the familiar electromagnetic waves that figure so pervasively in terrestrial technologies.

The main burden of this paper is to demonstrate the reality of the mesostratum and provisionally explain how a transcendent energetic substratum generates the physiostratum spacetime plenum and evolves its material content. A leap of blind faith is not needed for accepting the idea represented in Figure 3. One need simply observe that the cosmos/world exists and complements the mathematical objects such as wave functions, electromagnetic fields and signals, and other such *continuumthings* in the mesostratum [1]. It is axiomatic that mesostratum continuumthings like informational signals and mathematical objects transpire *outside* and *independently* the particulate physiostratum and its discontinuous granular spacetime. We shall explain how mesostratum continuumthings underlie the world and physiostratum quantumthing agglomerations.

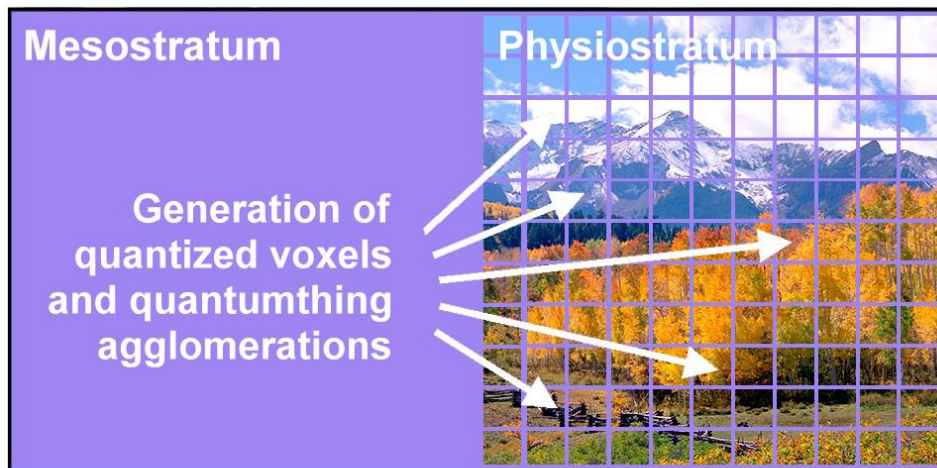


Figure 3 - Material world represented as emergent from the mesostratum.

Quantized Spacetime Voxels

In 1936, Einstein expressed the counter-intuitive notion that “perhaps we must give up, by principle, the spacetime continuum.” Current quantum gravity models assume that spacetime is discontinuous and particulate - that spacetime is a fractal *substance* and that the granularity of spacetime is on the scale of Planck length (10^{-33} centimeter) and Planck interval (10^{-43} second) [2]. In agreement, we postulate that spacetime consists of energetic ‘four-dimensional’ parcels - dynamic mathematical objects which consist of cubical volumes (voxels) of space that oscillate in time - and that spacetime is like a deformable substance consisting of tightly tessellated voxels. This corresponds to Einstein’s concept of a deformable spacetime, that is, a substantive material-like spacetime. The tensor calculus of his general theory of relativity demanded it. According to the theory, gravitational deformation of spacetime adjacent to the sun is analogous to the deformation of a trampoline surface by a heavy bowling ball tossed upon it.

Quantized spacetime voxels (energized cubic spacetime units) are also proposed as fundamental building blocks of subatomic quantum parcels such as neutrinos, electrons, positrons. Dimensional analysis of the equation, $E = mc^2$ indicates a profound relation between the ratio (E/m) and the space/time ratio $[L/T]^2$. The explicit meaning of the equation is that nuclear binding energies and

mass defects are related - that matter (mass) and energy are interchangeable and complementary. The implicit meaning of $E = mc^2$ is that energy and mass are essentially properties of space and time, that is, space-displacement $[\Delta L]^2$ and time-interval $[\Delta T]^2$. We postulate that spacetime parcels (voxels) have energy and mass and that select voxels contribute energy and mass when quantized as components of sub-atomic quantum parcels. This idea is applied in an abstract cubic representation of electrons according to the following *thought experiment* which models electrons as cubelike mathematical objects [3].

The basic electron, as depicted in Figure 4, is essentially naked and may enjoy only a transitory existence. The naked electron is represented by the intersection of three mutually orthogonal strings and branes which carry mass, spin, and charge (a borrowing from string and M-theory). These properties are purely energetic potentialities and at this stage are undefined as physically measurable properties. According to our cubic electron model, after the naked electron is cloaked with a cubic spacetime voxel, its electric charge, spin, and mass appear as measurable properties. It then becomes a generation 1 electron with measurable mass of 0.511 MeV and also conforms with Standard Model electric charge (-1) and spin ($\frac{1}{2}$) properties.

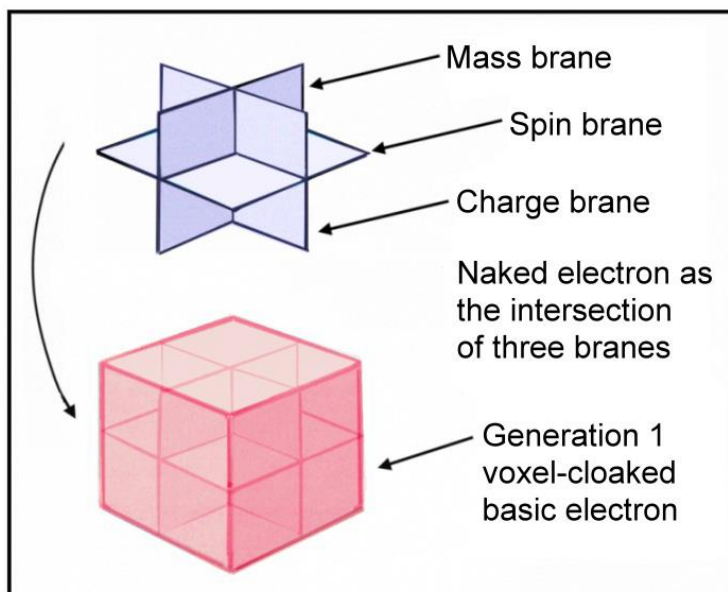


Figure 4 - Electron quantized cubic spacetime voxel.

The electron as represented in Figure 1 is stationary. The stationary electron occupies a voxel that has been quantized, that is, energized incrementally beyond its normal state of resonance - which is common to and identically shared by all spacetime voxels. In general, the electron has a trajectory in physiostratum spacetime which may be computed by Lagrangian mechanics. The trajectory of an electron is computed by applying the Lagrangian function for generalized coordinates and their time derivatives. The dynamics of the system involves the trajectory of the naked electron as it successively occupies a series of adjacent spacetime voxels, instant by instant. In the interim, between occupations of physiostratum voxels, the naked electron is a mesostratum continuumthing potentiality. The detection of electron trajectories and the inference of electron mass, spin, charge properties requires observation of voxel-cloaked basic electrons within the physiostratum spacetime plenum - as, for example, in cloud chamber experiments.

Substratum Energy Density

The generation and quantization of spacetime voxels and subatomic particles and ultimately quantumthing agglomerations and macroscopic matter requires an energetic substratum. We evaluate available mesostratum resources. Quantumthings such as protons, neutrons, and atomic nucleons require an energy source to be introduced into the physiostratum piecemeal - quantum by quantum from the energetic resources of the mesostratum. Max Planck showed that the very structure of nature is discontinuous and quantized. Although, quantization was a purely formal assumption in Planck's work at this time, and he never fully understood its radical implications. That had to await Albert Einstein's interpretations in 1905 to become to be regarded as the first essential stepping stone in the development of quantum theory, and the greatest intellectual accomplishment of Planck's career, for which he was awarded the Nobel Prize in Physics in 1918.

Einstein extended Planck's discovery by theorizing that energy itself (not just the process of energy absorption and emission) is quantized. He concluded, that light consists of tiny quanta of energy, now known as photons. Photons are massless quanta of energy - continuumthings in the mesostratum - which propagate spacetime voxel by voxel through the physiostratum. Photons are invisible during their propagation in the physiostratum. Photon velocity in the physiostratum is finite and governed by the photon transmission property of the voxels which is related to the Planck length/interval ratio ($\approx 10^{-33}$ cm)/($\approx 10^{-43}$ s) which is uniform throughout the physiostratum and yields a value $\approx 3 \cdot 10^{10}$ cm/s. Just as photons are emitted by quantumthings in quantumthing agglomerations; the detection and measurement of photon velocities requires their collision on quantumthing agglomerations, (e.g. photon-detector screens, light-sensitive grains).

Nuclear physics reveals that great amounts of energy is released by the fission of tiny amounts of matter. Conversely, a large amount of energy is required to generate a small amount of matter. In nuclear physics and nuclear chemistry, nuclear fission is either a nuclear reaction or a radioactive decay process in which the nucleus of an atom splits into smaller parts (lighter nuclei). The fission process often produces free neutrons and gamma photons, and releases a very large amount of energy even by the energetic standards of radioactive decay. Typical fission events release about two hundred million eV (200 MeV) of energy for each fission event. The exact isotope which fissions, and whether or not it is fissionable or fissile, has only a small impact on the amount of energy released.

Current estimates of the spatial density of matter in the cosmos range from approximately $0.2 \cdot 10^{-28}$ to $1 \cdot 10^{-28}$ g/cm³. Attempts to measure the actual mass density of the cosmos have followed one of two methods: the accounting approach and the geometrical approach. Both methods return values for the mass density and which are consistent with the critical density, $\rho_0 \approx 10^{-28}$ g/cm³, suggesting that the cosmos is flat, balanced and stable. Flat geometry implies that parallel light rays remain parallel and that density is the critical density. Under critical density, infinite big bang expansion is halted after a finite time. The critical mass density of about 10 proton masses per cubic meter is assumed necessary to keep the cosmos stable and balanced on a 'knife edge' between high and low densities.

We hold that the material content of the cosmos sprang from the zero-point field - the energetic universal substratum which pre-exists the cosmos and any companion cosmoses - and that the ZPF

substratum is a component of the mesostratum. The ZPF energy density is taken as $\varepsilon = \rho_0 c^2 \approx 9 \cdot 10^{-8} \text{ g/cm}^2 \approx 9 \cdot 10^{-8} \text{ erg/cm}^3$, where c is light velocity = $2.998 \cdot 10^{10} \text{ cm/s}$. Proton mass equals 938.27231 MeV or 0.001503 erg. Accordingly, the ZPF can either support about 60 protons per cubic meter or provide for the kinetic energy density of protons and other particles that flow through cosmic space.

It was found that $mF = A = 10^{-18} \text{ gram per centimeter squared per second}$ represents the kinetic mass flux of all classes of objects in the cosmic hierarchy from the least to most massive, i.e., from electrons to galactic superclusters [4]. The quantity A , a cosmic constant, apparently equals the product of the mean density of matter in the cosmos, $\rho_0 \approx 10^{-28} \text{ gram per cubic centimeter}$, and the velocity of light, c , that is, $A \approx \rho_0 c \approx 10^{-18} \text{ gram per square centimeter per second}$. The energy density of the ZPF substratum is putatively available for generating massive particles such as protons or providing the kinetic energy which sustains the cosmic mass flux of $A = 10^{-18} \text{ gram per centimeter squared per second}$.

A kinetic energy density ε for each level of the cosmic hierarchy can be obtained from $A = mF = \rho_0 c v$ by setting $\varepsilon = Av = \rho_0 cv$, where, v is the mean velocity for a particular class of objects in the cosmic hierarchy. For interstellar protons v equals approximately 10^6 cm/s . Based on $mF = 10^{-18}$, $\varepsilon = 10^{-12} \text{ erg/cm}^3$ for protons. This kinetic energy density is comparable to the peak microwave background which equals roughly $6 \cdot 10^{-13} \text{ erg/cm}^3$. The mean random velocity of galaxies is 10^7 cm/s and this gives $\varepsilon = 10^{-11} \text{ erg/cm}^3$. This is comparable to the cosmic background radiation density when integrated over all wavelengths is $\leq 2 \cdot 10^{-11} \text{ erg/cm}^3$. This corresponds to the cosmic microwave background radiation or the cryogenic cosmos with a kinetic temperature of $\sim 3^\circ$ Kelvin. Since these energy densities are kinetic and not due to luminosity, they apparently manifest a dark energy density in the ZPF substratum.

Except for stars, proto-stars, and luminous nebula that populate galaxies, the cosmos is demonstrably a dark cryogenic entity comparable to a Bose-Einstein condensate [5]. The cosmos overall is at the lowest possible energy that a quantum oscillator or system may have; however, even at this 'ground state' there is a measurable quantum zero-point energy. This zero-point energy appears in the mesostratum as the ZPF energy density which is putatively the foundation of the material content and mass flux ($A = mF$) of the cosmos.

ZPF Generated Attractors

Stochastic electrodynamic (SED) theory is based on the concept that the universal ZPF substratum is a fundamental, all-pervasive stochastic energetic field which may be viewed as an ocean of energy that permeates the mesostratum. Joachim Kepler argues that stochastic modifications of the ZPF produce local states of order in the inherently chaotic disordered ZPF [6]. The quiescent ZPF exhibits no correlations between stochastic individual modes, while the locally coherent ZPF exhibits a phase-locked coupling of certain sets of modes. Such a phase-locking occurs whenever a mesostratum dynamic system reaches a coherent stable state - an *attractor* - whenever a system is in dynamic equilibrium with the ZPF. These attractors are fractal structures and are also called 'strange attractors' as exemplified by $A = mF$ [5].

The set of correlated modes depends on the resonance frequencies of the given system, so that the generated modifications (signals or wavefunctions) in the ZPF are system-specific information states peculiar to the physiostratum voxel states. Accordingly, specific voxels or groups of voxels undergo periodic transitions from a disordered chaotic to ordered phase - induced by appropriate stimuli such as mathematical objects, strings, wave functions, etc. in the mesostratum.

In the ordered phase, the dynamics of loci in the physiostratum plenum assembly become attractors, i.e., the dynamics of an assembly reflects a state of synchronized activity and high coherence. Such patterns manifest as quantumthings and quantumthing agglomerations. In the background locus, due to the interaction with the ZPF, these activity patterns coalesce to populate the physiostratum milieu. The ZPF substrate is thus an essential component of the mesostratum and fundamental to orchestrating the content of the cosmos.

Somethingness from Nothingness

The mesostratum presumably contains an infinitude of superstring entities. These include incredibly insubstantial soap-bubble-like manifolds and spider-web-like networks that string and quantum theorists extrapolate and exploit. These hyperspace inventions supposedly produce palpable forces and forge quantum particles that emerge as gravitationally massive quantumthing agglomerations in the physiostratum. Whether these mathematical hyperspace objects be taken as one dimensional strings or ten dimensional Calabi-Yau manifolds, all are just mathematical continuum figures that are infinitely less substantial than soap bubbles or spider webs. Nevertheless, they theoretically produce ponderous mass and objective reality when they spill out of the mesostratum into the physiostratum.

Hypothesized strings, loops, branes, like perfect Platonic forms such as lines, circles, ellipses, spheres, are essentially one dimensional curved lines or surfaces that reside only in the mesostratum hyperspace. Yet, they suffice as bases for generating physiostratum quantized entities like electrons, protons and atomic nuclei. Mesostratum waveforms and Schrödinger wave functions, while having no finite bounds or heft, wash quantum sand grains onto physical shores. Indeed, at their most basic level, all material things consist of nothingness derived from nothingness - exemplified by the *nothingness* of energy. An electron exemplifies this nothingness as we attempt to describe its physical form, location and motion. Yet the electrons and positrons easily emerge from the ZPF fog of quantum froth, exist tentatively in the physiostratum voxel spacetime, and annihilate mutually - disappearing from the spacetime milieu - as depicted in Figure 5.

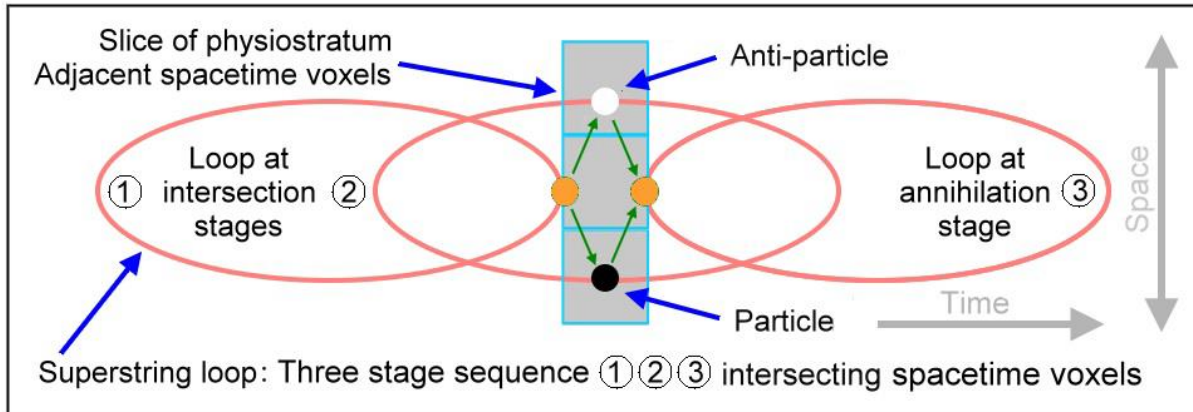


Figure 5 - Particle and anti-particle from ZPF form, separate, recombine and annihilate .

Figure 5 illustrates a concept of the spontaneous ZPF generation of a particle-antiparticle pair by an energetic superstring loop 'interacting' with a 'slice' of the physiostratum spacetime voxel fabric. The resultant pair typically consists of an electron and its anti-particle, a positron. The Figure 5 shows three stages of a superstring loop intersecting spacetime where an electron-positron pair appears, separates and self-annihilates in an arbitrary slice of physiostratum spacetime, here represented as three adjacent voxels. As the superstring loop interacts with the physiostratum spacetime parcels, voxels are converted into particles - as an electron in one voxel and as a positron in another voxel - stage (2). Figure 5 shows the particle pair, still associated with their shared superstring loop, brought into close proximity in stage (3), annihilating and vanishing from the physiostratum.

Quantum Entanglement

We examine quantum entanglement to illustrate that the mesostratum hyperspace continuum is devoid of the time dimension which is a facet of the physiostratum four-dimensional spacetime voxel. It is notable that the fifth dimension introduced in Kaluza-Kline unified field theory and the extra ten or more curled-up dimensions in string and M-theory, are all space-like dimensions. The mesostratum continuum is populated with potential energies, mathematical objects, strings and manifolds, informational signals which are conceptually instantaneous, tachyonic, perpetual and not referable to physiostratum time or light-velocity measurements or limitations.

Quantum entanglement is a phenomenon in which the quantum states of two or more quantum things have to be described with reference to each other, even though the individual objects may be widely separated. Measurements of physical properties, such as spin, performed on entangled particles are found to be correlated by Euler's identity. For example, if a pair of particles is simultaneously generated in such a way that their total spin is zero, and one particle has a spin-vector 'up', then the spin-vector of the other particle is 'down', or a -180° flip measured on the same coordinates axes. The entanglement paradox makes it appear that one particle of an entangled pair 'knows' the spin measured on the other, even though there is no known means for such information to be communicated between the particles, which at the time of measurement may be separated by arbitrarily large distances [7].

For example, it is possible to separate two particles originally in a single quantum state such that when one is observed to be spin-up, the other one will always be observed to be spin-down and vice versa. This happens despite the fact that, using quantum mechanics methods, it is impossible to predict which spin measurements will be observed at any given time. Measurements performed on one object seem to instantaneously influence the object entangled with it. Quantum entangled pairs (such as electrons and positrons) arise at superstring intersections with physiostratum spacetime parcels (voxels). Instant communication between these quantumthings apparently occurs along a shared superstring, as illustrated in Figure 6. Quantum entanglement obviously involves speedy transmission of information, but it cannot be ascribed to spacetime information transfer at light velocity. Cosmic spacetime quantumthing pairs are apparently instantaneously entangled with each other through strings in the mesostratum hyperspace.

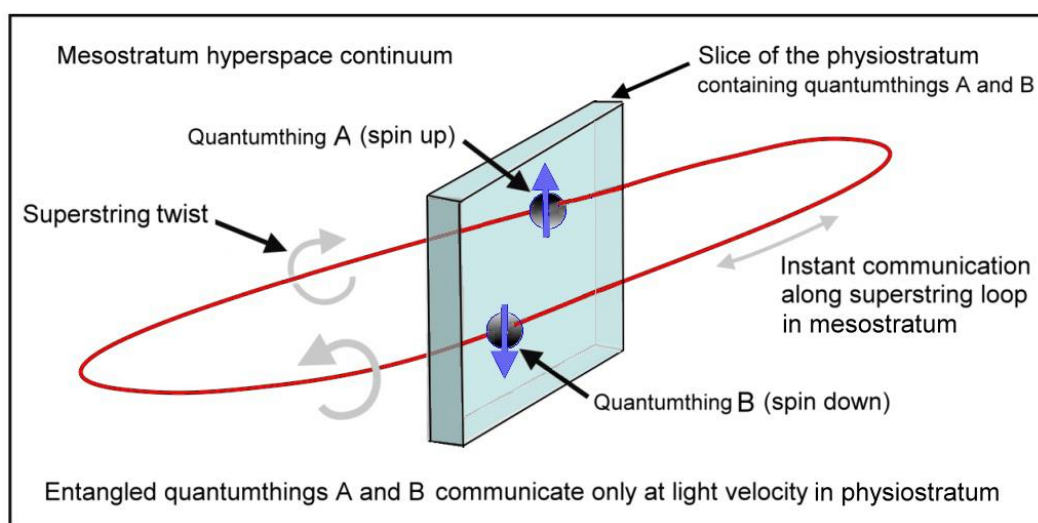


Figure 6 - Hypothetical instantaneous communication along mesostratum superstring.

Roger Penrose in *The Road to Reality* [8] declares that quantum entanglement is a most extraordinary experimentally proven phenomenon. He cites David Bohm's example of entanglement: Assume one has a particle that splits into two particles, say an electron and positron, going off in opposite directions. We then measure the spins of the particles A and B after they become widely separated. Yet, measurements performed on A will seem to be instantaneously influencing measurements performed on B. When the particles are widely separated, we cannot account for this unless we assume that A sends signals to B at superluminal speed, which is impossible in the physiostratum.

Mesostratum hyperspace is by our definition devoid of time as we measure it in the material physiostratum. Communication along hyperspace fields and strings is instantaneous and reversible. Moreover, spatial distances and measurements in hyperspace are undefined by and unrelated to physical spacetime. In addition to their putative 'vibrations', superstring loops may have 'twist' and other abstract attributes. Since superstring properties regulate the properties of the quantum particles that they generate, it is to be expected that measurements and manipulations applied to particle A will be concordantly exhibited by particle B which shares the same superstring and its properties, as illustrated in Figure 6.

Conclusion

Our fundament conjecture is that the mesostratum provides the latticework and matrix which sustains the physiostratum and that the mesostratum continuum preexists the physiostratum and that the physiostratum spacetime discontinuum needs to preexist the objects that occupy it. Physiostratum spacetime parcels are envisioned as energetic resonant subatomic voxels that are perfectly tessellated to form what appears to be a macroscopic continuum. Our conjecture holds that the mesostratum hyperspace generates and interacts with the physiostratum. The nature of this interaction is the transfer of energy quanta from the mesostratum to the physiostratum involving the formation of quantum ‘particles’ namely, quantumthings. Mesostratum dynamics, force fields, electromagnetic waves and fields, and mathematical object regulate the interaction and properties of quantumthings and quantumthing agglomerations in the physiostratum. In this quantized mode, continuumthings of the mesostratum and quantumthings of the physiostratum comprise the cosmos, the vast tangible material entity that we experience, observe, measure, and contemplate. The assignment for theoretical physicists is to explore the mesostratum and discover its mathematical treasures. Arguably, the mind is the best instrument for the exploration - as advocated by Roger Penrose [8, 9] in his quest to unravel the mathematical foundations of the universe. Theoreticians may find as Heinrich Hertz did, “One cannot escape the feeling that these mathematical formulas have an independent existence of their own, and they are wiser than even their discoverers, that we get more out of them than was originally put into them.”

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