Exploration

Mesostratum & Cubic Lattice Nucleon Affinity Field

Alex Vary*

Abstract

We investigate the topology of cubic lattice atomic nuclei and the mesostratum nucleon affinity field. The cubic lattice model offers a solid-state-like concept of atomic nuclei having some properties of a liquid-drop, rather than a diffuse, chaotic gas of nucleons. Our nucleons *are not lattice points on the faces of cubes. Each cubic lattice nucleon is conceptually a cube* consisting of a substructure of even smaller cubes termed voxels. We argue that the cosmos cannot be understood unless it is recognized as the interaction of two adjacent realities: the mesostratum and physiostratum. The cubic lattice nucleon model incorporates the interaction of the adjacent realities and helps explain the instantiation and sustainment of atomic and inter-nucleon bonding.

Keywords: Mesostratum, physiostratum, cubic lattice nucleon, solid state nucleus, van der Waals bonds.

Introduction

Concepts of the nature of the atomic nucleus attempt to account for nuclear properties and the manner in which protons and neutrons coexist in the nucleus. The shell model proposes that nucleons exist in gaseous state. The liquid drop model proposes that nucleons are like molecules in liquid drop. The cluster model proposes that atomic nuclei consist of clusters of alpha particles. Each model accounts for selected properties of the nucleus but fails to account for other properties. A solid nucleus model has been considered as a viable alternative. The advent of quark theory and neutron star research permit the concept of solid-state nuclear structures. Solid-state models assume that individual nucleons have a spheroidal shape; that the protons and neutrons are the same size - that their radii differ only slightly; that the nucleons are arranged in a closely-packed crystalline structure

We elaborate upon the cubic lattice model proposed by Eugene Wigner in 1937. Wigner conjectured that the atomic nucleus is a face-centered cubic crystalline lattice of nucleons [1]. The model has been described as a dynamic lattice, an array of Gaussian probability clouds, a standing wave of nucleons, a condensate of correlated quarks or a lattice gas, but there is uncertainty concerning the physical interpretation of the crystalline lattice model. It was expected that the uncertainly was resolved by Wigner's face-centered-cubic lattice representation of the nuclear quantum space and coordinate-space structure of atomic nucleons [2].

Contrary to Wigner's idea of the cubic lattice geometry, quantum symmetries of the nucleus have been interpreted as abstract momentum-spaces rather than coordinate-spaces. Emphasis on momentum-space is consistent with the shell model and the chaotic movements of point-like or sphere-like nucleons. Both assumptions have remained problematic in nuclear structure theory,

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specifically due to the presumption of a long-range effective nuclear potential-well in contradiction to known short-range nuclear forces [3].

All observable properties of liquid-drop or spheroidal nucleon models (binding energies nuclear densities, vibrational states, etc.) including the independent-particle attributes of nucleons are retained in the cubic lattice model. We elaborate upon Wigner's model with a cubic lattice nucleon model which totally avoids the liquid drop description and provides a compact high-density atomic nucleus. In our model, nucleons are not lattice points on the facets of a cube, not arranged like atoms in crystals. The cubic lattice nucleon is conceptualized and modeled *as a cube consisting of a substructure of even smaller cubes termed voxels*.

We begin by discussing the profound differences between Wigner's idea of the crystalline lattice geometry and cubic lattice nucleon model. The discussion includes the rationale for depicting the nucleons as cubic entities with cubic substructures. We explain that both the crystalline lattice and cubic lattice nucleon model incorporate geometric features suggested by mesostratum mathematical objects. The cubic lattice nucleon conception of the alpha particle offers an appropriate foundation for the discussion.

Cubic Lattice Alpha Particle

After hydrogen, helium is the second lightest and second most abundant element in the observable universe, being present at about 24% of the total elemental mass, which is more than 12 times the mass of all the heavier elements combined. The nucleus of a helium atom (the alpha particle) has two protons with the same charge, which should strongly repel each other, but still stay together due to a stronger nuclear force. A stronger attractive force was postulated to explain how the atomic nucleus was bound despite mutual electromagnetic repulsion between protons. The stronger nuclear force theoretically holds nuclei together because it confines quarks into hadron particles such as the proton and neutron. The strong force field energy is putatively carried by gluons and holds quarks together to form protons, neutrons, and other hadron particles. Quantum chromodynamics describes the strong interaction between quarks and gluons. The interaction binds neutrons and protons to form helium nuclei (alpha particles) as depicted in Figure 1.

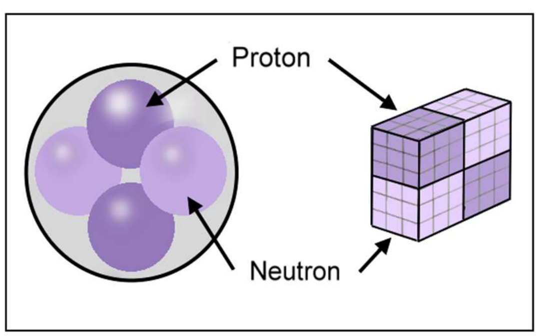

Figure 1 - Spherical and cubic lattice alpha particle.

We deduce that cubic lattice facet topology gives rise to Casimir - van der Waals forces and strong nucleon bonding in all atoms which are comprised of interfaced cubic lattice neutrons and protons: deuterons and alpha particle modules [4]. We propose a process by which primordial atoms form and nucleons bond without invoking quantum chromodynamics or 'color charge' interactions among quarks and gluons. The viability of inferred Casimir - van der Waals bonding is supported by the empirically observable stability of non-fissile atomic nuclei and also of fissionable nuclei which by a radioactive decay process split into smaller parts: two or more stable species with lower atomic weights.

Among the theories of the structures of atomic nuclei more massive than helium, the cluster model holds that they are combinations of alpha particles. There is evidence in favor of this structural theory but the concept that alpha particles are composed of spherical neutrons and protons in close proximity, as in Figure 1, requires an improbable shell structure and ad hoc quantum states based on the Pauli exclusion principle. In the nuclear shell model, a complicated potential describes forces on *each* nucleon. Nucleon and other properties are based on assumed harmonic oscillators and spin-orbit interactions.

The shell model presumes that nucleons move in an attractive potential well formed by all the other nucleons. Protons and neutrons in the shell model are independent of each other and are assumed to move about independently. In the cubic lattice model neutrons are paired with protons as fixed structural components of deuteron modules [4]. The cubic lattice model assumes that the voxel substructures of neutrons, protons, and their derivative nucleons are dynamic - rather than static topological entities - and that nucleons and their substructures exchange energy drawn from the mesostratum ZPF.

The alternative between the spherical or cubic lattice structure of the alpha particle as shown in Figure 1 depends essentially on the choice of mathematical objects (spheres, cubes, points, etc.) for describing the structure. An elegant quantum mechanics language based on choosing spheres has been devised to describe the structure and stability of alpha particles. This approach is an accepted employment of quantum theory, wave mechanical formulations, mathematical objects, and other resources found in the mesostratum.

Nature of Mesostratum Resources

We posit the mesostratum in place of aether, which early in the last century was considered a substance that carries light waves. This was disproved and abandoned. It can be demonstrated that light waves, indeed all electromagnetic waves and fields, transpirate in the mesostratum - which may be posited as a hyperspace continuum, not a substance, transcending gravitational physicality.

The mesostratum has been studiously explored, e.g., with Richard Feynman's path integral formulation and Edward Witten's M-theory. Theoreticians have found that the mesostratum contains a virtual infinitude of mathematical resources that seemingly have an independent existence of their own. We conclude that mesostratum dynamics, force fields, electromagnetic waves and fields, and mathematical objects instantiate the properties and interactions of quantumthings and quantumthing agglomerations in the physiostratum. An exception is that quantum entanglement and nonlocality prevail solely in mesostratum hyperspace [5].

The wave function and associated spin, charge, and momentum specify the state of subatomic entities during *transit* within the mesostratum continuum while their mass and particulate nature specify their specific *location* within physiostratum massive agglomerations, as for example on detector screens and in crystals. Wave functions, strings, branes, and similar 'mathematical objects' are mesostratum 'continuumthings'. Quantum 'particles' are physiostratum 'discontinuumthings' - material empirically-knowable aspects of discrete entities, for example, neutrons, protons, deuterons. The adjacent realities, mesostratum and physiostratum, interact and form the objective reality which is observed and measured in the physiostratum material discontinuum - which, in turn, originates in the mesostratum energetic continuum [5].

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 tesselated interacting spacetime parcels - depicted as voxels in Figure 2. The voxels are globally 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 - where the physiostratum is essentially a subset of the mesostratum.

Our fundament conjecture is that the mesostratum provides the framework 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 tesselated to form what appears to be a macroscopic continuum. Mesostratum hyperspace generates and interacts with the physiostratum.

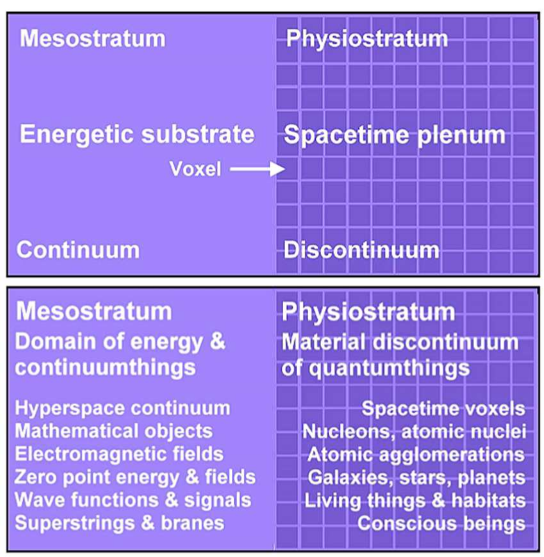

Figure 2 - Adjacent mesostratum/physiostratum realities.

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 like nuclides. A continuous, non-discrete, non-quantized flow and expenditure of energy from the mesostratum to the physiostratum would require a profligate and unsustainable expenditure of an infinite amount of energy. This essential quantization is epitomized by the Planck-Einstein relation E = hv.

Spacetime Voxel Substructure

The cubic lattice nucleon model employs a radical approach to visualizing the substructure of nucleons and the function of quarks [4]. Still, the model agrees with the essential properties of previous models - combining their strengths while not introducing paradoxical properties, contradictory ideas, or unrealistic parameters. Established concepts, such as quark containment and nuclear binding forces are used in a unique way in the cubic lattice nucleon model and these strengthen its underlying rationale and viability.

Lee Smolin, in Three Roads to Quantum Gravity, explains that according to loop quantum gravity theory, there is an atomic structure to space, describable in terms of the nodal spin networks devised by Roger Penrose (The Road to Reality). The most improbable and puzzling aspect of this atomized space is its apparent smooth and continuous nature. The apparent continuity or smoothness may be because the granularity of space and time are on the scale of Planck length (10^{-33} centimeter) and Planck interval (10^{-43} second). We are currently unable to detect or measure these infinitesimal quantities and therefore must rely on imaginative approaches to deal with Planck-scale spacetime voxels that the cubic nucleon model envisions for nucleons and nucleus architectures.

The cubic nucleon model assumes that spacetime is particulate - that spacetime is a fractal substance consisting of energetic four-dimensional spacetime parcels - cubical volumes (voxels) of space that oscillate in time. The voxel - the cubic unit spacetime parcel - is proposed as a fundamental unit cube common to all elementary particles (neutrinos, electrons, positrons) and nucleons (neutrons, protons, quarks). This is useful for developing the cubic nucleon model for nucleon substructures and nuclei architectures.

In 1936, Einstein expressed the rather contradictory, counter-intuitive notion that Aperhaps we must give up, by principle, the spacetime continuum.@ The cubic nucleon model adopts the principle of spacetime as a particulate discontinuum. Indeed, this corresponds to relativity theory treatment of spacetime as a deformable substance - like the gravitational deformation of adjacent spacetime by the sun. Einstein posited a deformable spacetime, a substantive material-like spacetime. The calculus of his theory demanded it.

Dimensional analysis of Einstein’s equation, $E = mc^2$ indicates a profound relation between the ratio (E/m) and the space/time ratio [L/T]. The explicit meaning of the equation is that nuclear binding energies and mass defects are related - that mass (matter) 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 [ΔL] and time-interval [ΔT]. Accordingly, we assume that select spacetime parcels (voxels) have energy and mass and contribute energy and mass - when combined as components of sub-atomic particles. This idea is applied in the abstract representations of nucleons and nucleus architectures. The genesis of cubic neutrons and protons is given in the section Emergence of Primordial Neutrons.

Adjacent Realities and the Cosmos

We argue that the cosmos cannot be understood unless it is recognized as the intertwining of two adjacent realities: the mesostratum and physiostratum. We suggest that further development of quantum theory depends on the understanding and recognizing the resources of the adjacent realities and we also advocate accepting a nucleon model consisting of *cubic lattice entities that possess topological properties, surface facets, and substructure*. This model is useful for illustrating the interaction of the adjacent realities and their role in forging the objective reality which is observed and measured in the physiostratum material discontinuum which originates in the mesostratum energetic continuum [5].

The reality of the physiostratum is obvious because we are conscious of it, we interact with it, we are immersed in it, we are objects in it along with other massive agglomerations of quantumthings like the atmosphere, oceans, lands, flora and fauna. We are certain of their permanence and that their objective reality continues existing even if unobserved. The reality of the mesostratum is enigmatic, ambiguous because we are only peripherally conscious of it, because in it are impalpable continuumthings that transcend discrete material things found in the physiostratum. Over two thousand years ago, Plato declared that 'perfect forms' like circles and spheres exist conceptually, although they cannot be found in the physical world. We contend that like circles, waveforms, electromagnetic fields/waves and ZPF energies exist conceptually as mesostratum entities but do not exist tangibly in the physiostratum. Cubic lattice nucleons are similarly mesostratum entities that appear as empirically measurable things in the physiostratum, e.g., as atomic nuclei components.

Neutron, Proton, Quark Plaque Structure

The cubic lattice nucleon model is a radical approach to visualizing the structure of nucleons. The model agrees with their essential properties as posited by the Standard Model of Particle Physics - a practical but ad hoc specification of elementary particles which are grouped in an arbitrary way, dependent on 24 numbers whose values cannot be deduced from first principles, but which have to be chosen to fit the observations. Established concepts, such as quark containment and strong (gluon) nuclear binding forces are adapted in a unique way in the cubic lattice nucleon model and these strengthen its underlying rationale

The most radical and innovative aspect of the cubic lattice nucleon/nucleus model is the appropriation of the quark model for containing electrons and positrons. When Murray Gell-Mann, George Zweig, and Yuval Ne'eman imagined a scheme for combining quarks to form hadrons, they succeeded in positing quarks as elementary particles and fundamental constituents of matter. When introduced as constituents of hadrons, there was little evidence for the existence of quarks. In 1968 scattering experiments at the Stanford Linear Accelerator Center provided indications of their existence. Due to the theoretical 'color confinement' quarks are never directly observed or found in isolation - they can be found only in hadrons.

As indicated in Figure 3, in the cubic lattice model for protons and neutrons, quarks are *structural* parts, called plaques (up and down quark plaques in protons and in neutrons). As envisioned in the cubic nucleon model, quarks have substructure, where each quark is a plaque consisting of nine energetic spacetime voxels. The cubic nucleon model assumes that up and down quark plaques have strong affinity for each other, while up quark plaques repel each other, just as do down quark plaques. Each of the 8 up quark voxels depicted in Figure 3 combines a +3/3 charge with a -1/3 charge to get the assigned +2/3 charge for up quark plaques. The gluon core voxels serve to form and hold the plaque arrangement of electron and positron voxels [4].

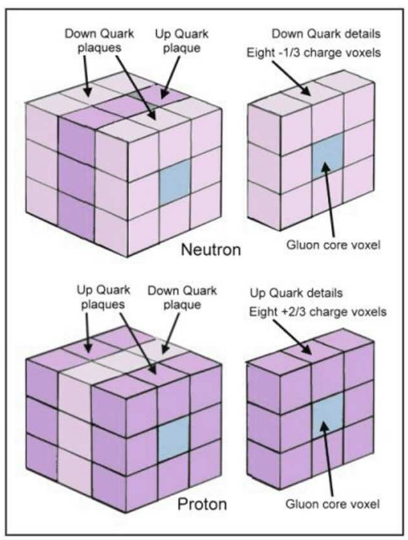

Figure 3 - Cubic lattice primordial nucleons.

Origin and Decay of Neutrons

We argue that neutrons were the first baryons that emerged in the nascent cosmos. Neutrons subsequently combined with protons, their beta decay products, to form the first population of deuterons, which in turn formed more massive atomic nuclei and isotopes: deuterium, helium, lithium, etc. Neutrons are needed specifically to confine and preserve electron-positron pairs in a non-volatile state.

The quantum foam of the mesostratum substratum produces the foundational fabric and precursor content of the physiostratum. Quantum foam roils within the Planck-scale particulate turbulence of the physiostratum spacetime fabric. The mesostratum energy density of the fluctuations and annihilations is likely to be quite sufficient to significantly alter spacetime voxels to generate the previously-described up and down quark plaques that combine to form neutrons that confine positron-electron pairs and preclude their annihilation.

Neutron beta decay is a transmutation process beginning with a primordial cubic lattice nucleon/neutron. When a free neutron β^s decays, the contained positron is isolated in the resultant proton while the contained electron is emitted. This explains why free electrons pervade the cosmos seemingly unbalanced and not annihilated by their antiparticles. Positrons which are housed in protons that pervade cosmic space commingle with the free electrons in virtually equal populations. Neutron beta decay also suggests the process by which primordial hydrogen atoms (protium) originated and formed as the expelled electrons simply began orbiting nascent protons. The emergence of the cubic lattice proton/neutron deuteron module is basic and essential. It appears twice in the helium-4 nucleus, Figure 1, and reappears regularly in nuclei of virtually all stable atoms and in meta-stable isotopes with excess neutrons.

Emergence of Primordial Neutrons

It is reasonable to surmise that the nascent cosmos was densely populated with spontaneously-generated primordial neutrons - a proportion of which beta decayed into protons. It is patent that a significant proportion of the new protons immediately fused with adjacent neutrons forming dense populations of deuterium modules which comprise all atomic nuclei in addition to isolated protons which captured an emitted electron to form protium atoms.

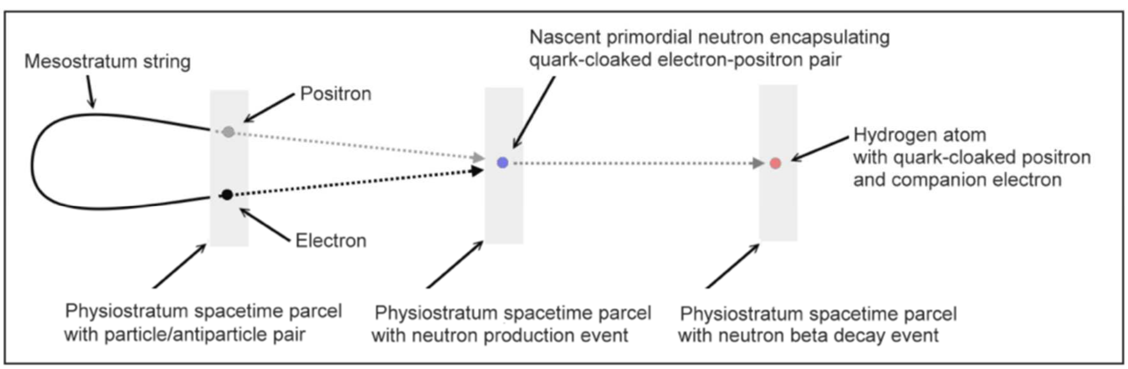

Figure 4 - Conceptual depiction of mesotratum-generated atomic particle emergence in physiostratum spacetime.

Figure 4 illustrates a conceptual spontaneous ZPF (zero-point field) generation of a particle antiparticle pair by a mesostratum string interacting with a slice of the physiostratum spacetime voxel fabric. The emergent pair typically consists of an electron and its anti-particle, a positron. Figure 4 shows a string loop intersecting with a spacetime parcel and the appearance of an electron-positron pair. As string loops interact with various physiostratum spacetime parcels, spacetime voxels are assembled into particles - as an electron in one voxel and as a positron in another voxel. Figure 4 depicts the particle pair being encapsulated in a primordial neutron - without annihilating and vanishing from the physiostratum.

The beta decay process as depicted is instructive: it indicates that primordial cosmic neutrons preexist electrons and protons. The spontaneous origin of neutrons and their encapsulation of nascent electron-positron pairs is somewhat enigmatic. The implied rule appears to be that a particular number of spacetime voxels will be energized and combine to form quark plaques that comprise the neutron structure depicted in Figure 3. A corollary rule appears to be that beta decay will always produce an electron and a positron-containing proton. This is observable and empirically evident. The enigma then reduces to the nature of mesostratum energetic fields and precursors which collectively generate primordial neutrons.

Mesostratum Energy Density

We suggest that the energetic fields exist in the mesostratum and that the mesostratum fields influence and modulate neutrino voxels which preexist and ultimately assemble neutrons. Indeed, we assert that spacetime voxels are virtually indistinguishable from neutrinos, and that neutrinos meet the specifications of Einstein's concept of substantive spacetime parcels. Figure 5 summarizes the results of a previous study [6] which demonstrates that neutrinos fill and dominate the cosmos to the extent that the cumulate mass of neutrinos equals the cumulate mass of galaxies and their superclusters. We further assert that neutrinos and spacetime voxels are subject to and arise from energetic processes in the mesostratum [7].

The generation and quantization of spacetime voxels and subatomic particles and ultimately massive hadron agglomerations and macroscopic matter requires an energetic substratum. We argue that these emerge from mesostratum resources. Neutrons, protons, and atomic nucleons (deuterons) require quantized energy to emerge in the physiostratum - quantum by quantum from the energetic resources of the mesostratum [8].

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/cm^3. 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, $\rho_o = 10^{-28}$ g/cm^3, 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, the assumed big bang expansion is halted after a finite time. The critical mass density of about 10 neutron masses per cubic meter is assumed necessary to keep the cosmos stable and balanced on a 'knife edge' between high and low densities.

Our analysis suggests that nonluminous condensed matter is an extraordinary cryogenic phase of ordinary baryonic matter which formed and agglomerated during the nascency and evolution of the Cosmos. The cosmic mass flux parameter, $A = F_c\, m$ [10^{-18} g/cm^{2}sec], Figure 5, identifies and explains the abundance and nature of the cold dark matter which probably existed since the initial stage of evolution of the Cosmos. During nascency of the Cosmos, the original baryonic cold dark matter (atomic and molecular hydrogen and helium and their isotopes) may have consisted of an extraordinary cryogenic phase which has persisted to the current cosmic epoch. Cosmic microwave background blackbody radiation temperature of ~3 degrees Kelvin appears to be a relic indicator that the initial and persistent cryogenic phase of baryonic matter - a Bose-Einstein condensate - which fractionated, expanded, and agglomerated hierarchically; ultimately forming galaxies which subsequently spawned the stars that illuminate them [7].

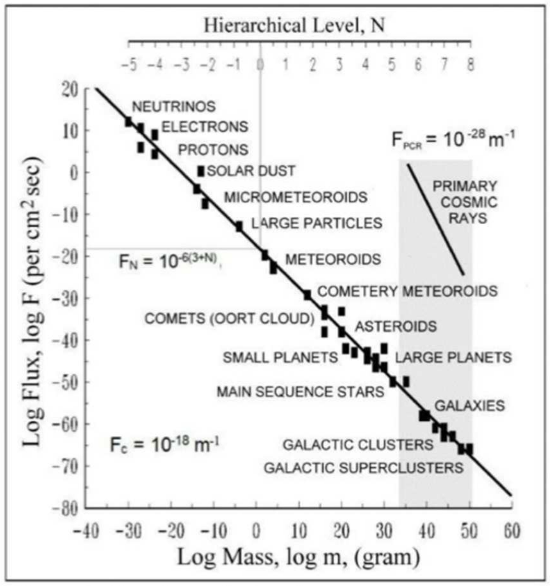

Figure 5 - Cosmic particulate flux versus mass.

A kinetic energy density ε for each level of the cosmic hierarchy can be obtained from $A = F_c m$ by applying the equation, $\varepsilon = Av = \rho_o cv$, 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 $A = F_c m = 10^{-18}$, $\varepsilon = 10^{-12}$ erg/cm^3 for protons. This kinetic energy density is comparable to the peak microwave background which equals roughly $6 \cdot 10^{-13}$ erg/cm^3. The mean random velocity of galaxies is 10^7 cm/s and this gives $\varepsilon = 10^{-11}$ erg/cm^3. This is comparable to the cosmic background radiation density which when integrated over all wavelengths is $2 \cdot 10^{-11}$ erg/cm^3. This appears sufficient to generate 10 neutron masses per cubic meter needed to maintain the critical density of the cosmos.

Particle-Antiparticle Asymmetry

Recent studies of high-energy cosmic ray electrons and positrons continue to show anomalies in the positron fraction. Seemingly, electrons dominate the cosmos with virtually no evidence of an equal complementary positron population. Theory and statistical analysis of the very early cosmos reckon that there were originally as many positrons as electrons. In the current epoch, there appears to be a lack of cosmic electron-positron symmetry or balance. The symmetry exists but is hidden.

The asymmetry is apparently essential to the formation of the material content of the observable cosmos. We suggest that primordial cosmic neutrons preexisted the electrons and protons which fill cosmic space - the physiostratum. The spontaneous origination of neutrons and their encapsulation of nascent electron-positron pairs is pivotal to the physical nature of the cosmos we observe. The subsequent emergence of protons, accompanied by electrons, comprise the foundation of the observable cosmos and the particulate aggregation of galaxies and the nucleosynthesis of their baryonic, dark matter, and stellar content.

Cubic Lattice Deuteron and Alpha Modules

The cubic lattice deuteron module is basic and appears regularly in nuclei of all stable atoms and in neutron-rich and neutron-poor isotopes. The quark triplet bond interlock depicted in Figure 6 requires the specific cubic lattice orientation shown: triplets of opposing up-down quark plaque edges [4]. Quark triplet interlock bonding scheme for protons coupled with neutrons (deuterons) occurs in all stable atomic nuclei no matter how great their atomic number or neutron richness. The triplet interface bond is the essential foundational aspect of all atomic nuclei and isotopes.

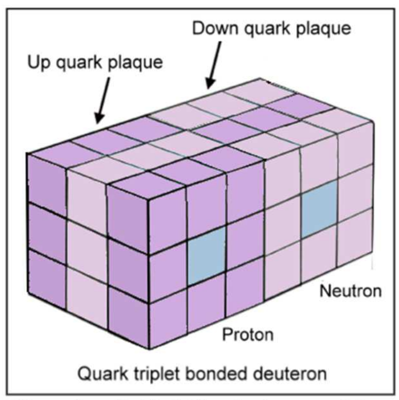

Figure 6 - Cubic lattice deuteron module.

Figure 7 depicts isotopes of iron, cobalt, and nickel that have neutron richness in which additional or excess neutrons are quark triplet bonded to deuterium modules. Isotopes like iron, cobalt, and nickel in Figure 7 may also be interpreted as consisting of alpha module clusters. The cubic lattice nucleon model makes it easy to explain the neutron-rich structures of isotopes that appear so frequently and prominently.

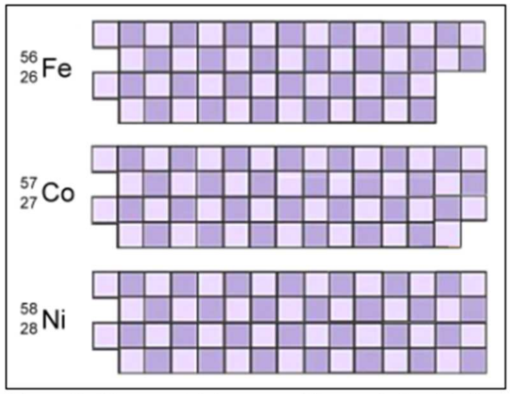

Figure 7 - Neutron rich isotopes of iron, cobalt, nickel.

Either neutron poorness or neutron richness of nuclei lead to instability and transmutation, typically by beta plus β+ or beta minus β- decay, respectively. Neutron poorness (neutron/proton ratios less than 1) means that there exist one or more orphan protons which lack deuteron companions, or which must share a neutron. This leads to β+ decay of the orphan protons and transmutations. The β+ transmutation results in an element with an atomic number decreased by one without changing its mass number, if the vanished proton has been replaced by a new neutron in place of the vanished proton.

Figure 7 also illustrates the space-filling tessellation realized with the cubic lattice nucleon concept. There is no doubt regarding the long-term stability of these isotopes of iron, cobalt, nickel, and other elements of the periodic table. The topological properties attributed to cubic lattice nucleons permit this visualization of compact solid-state-like atomic nuclei. This representation implies strong affinity between the deuterons and the alpha particle clusters that comprise atomic nuclei.

Deuteron Affinity Field

The cubic lattice nucleon model of the atom assumes an inter-atomic and intra-atomic deuteron affinity field that extends beyond the electron orbital envelope around the nucleus. We contend that the bonding of atoms that form molecules depends upon the mutual attraction or affinity between pairs of deuterons, as depicted in Figure 8 for the oxygen molecule O_2. The rationale is that deuteron attraction extends beyond the electron orbital envelopes of the oxygen atoms and overcomes the mutual repulsion of orbital envelopes [9]. The deuteron affinity field is conceptually a mesostratum entity, similar to the magnetic field that surrounds a bar magnet or the inter-polar field of a horseshoe magnet.

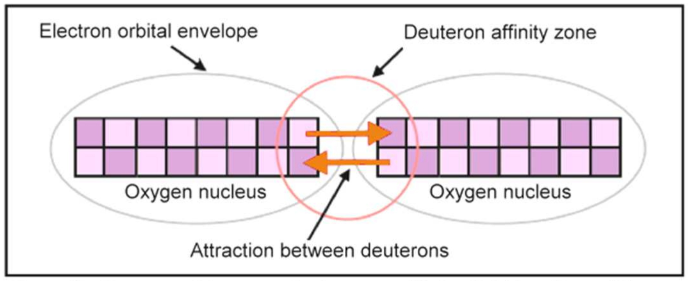

Figure 8 - Conceptual interatomic deuteron affinity field bonding of O_2.

The conceptual cubic architecture of the oxygen nucleus may be taken as the fusion of eight deuterons or four alpha particles. This represents the mutual affinity of deuterons. Experimental observation reveals an energy release (≈24 MeV) between deuteron pairs when they fuse to form alpha particles**.**

The carbon nuclei trifid bond depicted in Figure 9 elaborates upon the concept of the deuteron affinity field which is apparently fundamental to the formation, structure, and stability of the graphene allotrope of carbon. We can demonstrate the repeated appearance of the trifid bond in other cyclic molecules such as the benzene ring and in other instances where it explains the geometric arrangement of molecular atoms. In Figure 9 we assume that the three carbon nuclei are the same plane but allow that each defines its own plane as would be the case for graphene nanotubes or other buckminsterfullerenes [9].

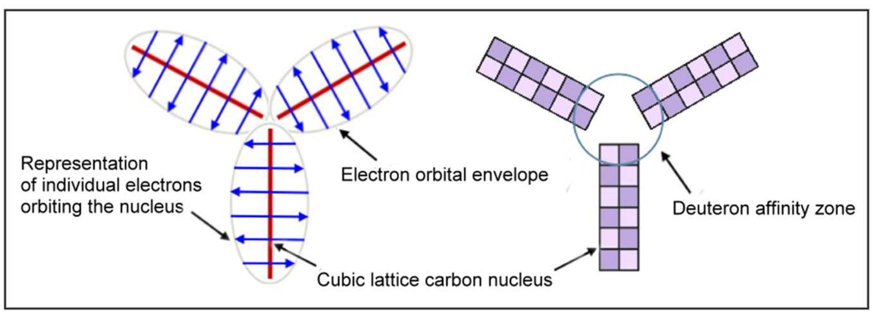

Figure 9 - Schematic trifid bonding of three carbon atoms by deuteron affinity field attraction.

Figure 9 suggests that the attraction between close deuterons of their nuclei results in trifid bonding of three carbon atoms, overriding the repulsion of their negatively-charged orbital envelopes. Our argument assumes the existence of a zone of attraction between deuterons which extends beyond the orbital envelope within which the carbon nuclei reside. Appendix A compares Lewis structures with the conjectured cubic lattice trifid bonding of four hydrocarbon molecules. Appendix B suggests that the deuteron affinity field may be a manifestation of the van der Waals force.

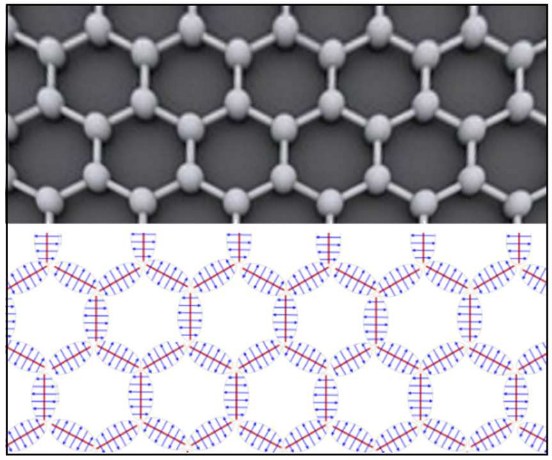

Figure 10 - Lewis structure and cubic lattice graphene matrix.

Figure 10 illustrates the standard visualization of graphene molecular structure in which bonding between atoms is represented by small rod-like connectors and a carbon atom occupies each hexagon vertex, where each atom is represented as a small sphere. The bond lengths represented by the rods are of the order of one angstrom or slightly greater. These typically represent lengths of single bonds (~1.5 angstroms) or double bonds (~1.3 angstroms) depending upon the orbital shells surrounding the assumed spheroidal nucleus of the carbon atom. This is the Lewis structure representation of graphene. We argue that, in the appropriate representation of the graphene array, the spheres and rods are reversed and that the bonding of the carbon atoms occurs where they meet (in trifid bonding) and that the atoms occupy the space attributed to rods.

Hamiltonian Applied to Deuteron Components

We apply the Hamiltonian operator to determine the total energy content of the neutron-proton-deuteron system. The Hamiltonian is usually expressed as the sum of the kinetic and potential energies of a system in the form H = T + V, where V is the potential energy operator and T is the kinetic energy operator which incorporates the mass of the particle. Applied to a quantum mechanical wavefunction the Hamiltonian operator produces the Schrodinger equation for the system. In the time independent Schrodinger equation, the operation produces specific values for the energy. This can be in the form $H_{opr}\ \psi_i = E_i\ \psi_i$ where the specific values of E_i are eigenvalues and the functions ψ_i are eigenfunctions. We assume that E_i represents a harmonic oscillator where the energy is due to cubic lattice voxel oscillations of the encapsulated electrons and positrons of the deuteron. This allows application of the Hamiltonian to systems described by a wavefunction with the energy E = hc/λ, where h is the Planck action quantum, c is the velocity of light, and λ is the wavelength of the oscillator.

The Planck action quantum h is $4.135667662H10^{!15}$ eV·s, c is 299,792,458 meters per second (approximately $3.00\cdot10^{10}$ cm/s). The wavelength λ of the oscillator is usually assumed to be its radius. Nuclear radii are of the order $10^{!12}$ cm and are typically calculated as: $r = r_0\ A\ A^{1/3}$ where $r_0 = 1.2 \times 10^{-12}$ cm, and A is atomic mass number: the number of protons (Z) plus the number of neutrons (N). For separate nucleons, either protons or neutrons, Z = 1 and N = 1 and $A^{1/3} = 1$. We assign $r_0 = 1.2 \times 10^{-13}$ cm, assuming compact cubic lattice nucleons. If the wavelength is assumed to be the cubic lattice nucleon size: $E = hc/\lambda = (4.13\ 10^{-15}\ eV \cdot s)\ (3.00 \cdot 10^{10}\ cm/s) / (1.2 \cdot 10^{-13}\ cm)$ giving E = 1032.5 MeV. This (upper bound) estimate agrees with the derived masses: neutron = 939.56 MeV and proton = 938.27 MeV.

Conclusion

We trace the development of theoretical models of atomic nuclei from a diffuse chaotic gas of nucleons to a solid-state-like nucleus model where nucleons are points on facets of a cubical lattice structure. *In our cubic lattice model, nucleons are cubic entities that possess topological properties, surface facets, and substructure*. Cubic lattice nucleons tesselate perfectly in a checkerboard-like space-filling pattern providing an explicit way of visualizing compact solid-state-like nuclei. Nucleon affinity and bonding, empirically evident with all atoms and molecules, is readily explained by interfaced facets of cubic lattice neutrons, protons, deuterons, and alpha particle clusters. We describe a trifid bond structure for graphene and other compounds based on the cubic lattice model and redefine the nature of molecular bonds. We suggest that van der Waals affinity fields in trifid and derivative cubic lattice nucleon bonds supersede electron-sharing, covalent, and Lewis structure valence shell models.

We argue that the cosmos cannot be understood unless it is recognized as the intertwining of two adjacent realities: the mesostratum and physiostratum. We suggest that further development of quantum mechanics theory requires the sorting out and selection of the most practicable among the infinitude of mathematical-objects/concepts available in the mesostratum. Accordingly, we advocate accepting cubic lattice nucleon model which possess topological properties derivable from mesostratum resources. We argue that the cubic lattice nucleon model is useful for illustrating the interaction of the adjacent realities and their role in forging the objective reality that we experience. See Appendix A, B, C, D, E, F for further discussion of inter-nucleon affinity, electron orbitals, van der Waals bonding, adjacent realities, and wave-particle duality.

Appendix A - Hydrocarbon Inter-Nucleon Affinity

The hydrocarbon compound ethane has the chemical formula C_2H_6. Methane with the chemical formula CH_4 is the simplest alkane. In the Lewis structure depiction, Figure 1A, methane is assumed to be a tetrahedral molecule with four equivalent CBH bonds. Its electronic structure is described by four bonding molecular orbitals resulting from the overlap of the valence orbitals on C and H. Ethylene (ethene) is has the formula C_2H_4 or $H_2C{=}CH_2$. Acetylene (ethyne) the simplest alkyne has the chemical formula C_2H_2.

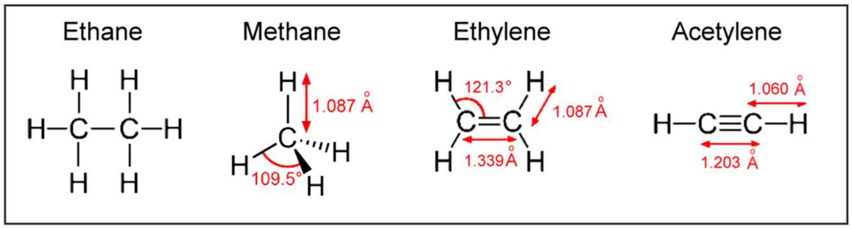

Figure 1A - Lewis structure representations and measurements of four hydrocarbon molecules.

Figure 2A depicts the conjectured cubic lattice nucleon-based structures of ethane, methane, ethylene, and acetylene molecules. In accordance with our argument, the bonding of carbon and hydrogen atoms is related to the affinity and attraction of terminal deuterons of adjacent cubic lattice nuclei. The deuteron-deuteron fields, as conceived here, adapt to a quadrifid as readily as a trifid configuration, as in the ethane molecule.

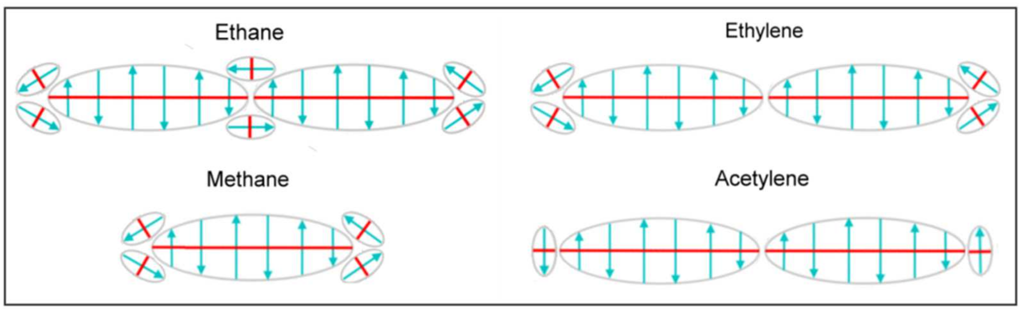

Figure 2A - Cubic lattice nucleon depictions of four hydrocarbon molecules.

Appendix B - Van der Waals Topological Affinity

We propose that the deuteron affinity field may be a manifestation of the van der Waals force which is a distance-dependent and topological interaction between atoms or molecules. Van der Waals forces play a fundamental role in diverse as supramolecular chemistry, structural biology, polymer science, nanotechnology, surface science, and condensed matter physics. The attractive strength of Van der Waals force between sub-microscopic surfaces may be represented as $F_{vdw} = -C/r^6$ where r is distance and C is a constant depending on the nature, topology, and environment of the particles.

Unlike the ionic or covalent bond, the van der Waals attraction is not a chemical-electronic bond but is a topological affinity between nucleons. Some theorists assign quantum gravity-like attributes to the van der Waals force which may vanish at long distances between interacting nucleons. Theoretical graphical representations of the interplay of van der Waals attractive and electrostatic repulsive forces abound but tend to disagree on details. Figure 1B adapts a version that we assume is representative of the variation of the inter-deuteron van der Waals attraction force which governs molecular bonds.

The combined curve in Figure 1B forms a repulsion barrier which prevents actual contact of nucleons with deceasing distance when the atoms combine as a molecule. Should the barrier be overcome, the nuclei of the atoms would fuse forming a new element. If, for example, the oxygen nuclei of Figure 8 fused, the product would be the nucleosynthesis of sulfur [7].

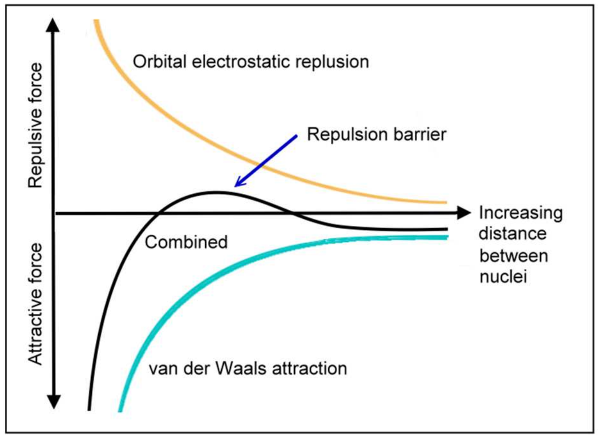

Figure 1B - Van der Waals interactrion with electron orbital envelope.

Appendix C - Cubic Lattice Nucleus Orbitals

The election shell model is a visualization of the electron configuration surrounding the atomic nucleus. The spherical nuclear shell model is a model of the atomic nucleus which uses the Pauli exclusion principle to describe the structure of the nucleus in terms of energy levels. The nuclear shell model is analogous to the electron orbital shell model which describes the arrangement of electron orbitals.

Protons and neutrons in the nuclear shell model are independent of each other and unlike the cubic lattice nucleus model protons and neutrons are not paired as deuterons. Indeed, neutrons in the spherical nucleus move about independently while in the cubic lattice model neutrons are fixed structural components. Because neutron-proton pairs form deuteron substructure modules of atomic nuclei, as in Figure 1, it is possible to assign a separate orbit to each electron associated with each deuteron with no orbital commingling, as is indicated schematically in Figure 2A and Figure 9.

The spherical shell model must provide a way to overcome mutual repulsive forces of electrons commingling in orbitals surrounding the atomic nucleus. The model invokes the Pauli exclusion principle which states that two or more identical fermions (electrons in orbit around the atom nucleus) cannot occupy the same quantum state within a quantum system simultaneously. Quantum mechanics theory resolves the electron charge repulsion problem with rules associated with four quantum numbers. It is impossible for two commingled electron orbitals to have the same values of the four quantum numbers: n, the principal quantum number, P, the angular momentum quantum number, m_P, the magnetic quantum number, and m_s, the spin quantum number. If two electrons reside in the same orbital, and if their n, P, and m_P values are the same, then their m_s must be different, and the electrons must have opposite half-integer spins of +2 and !2. No two electrons can share the same allowed combinations of the four quantum numbers.

Elaborate quantum mechanics rules are unnecessary with the cubic lattice nucleus where each electron assumes a distinct, separate orbit, as depicted in Figure 1C. Each electron orbits a specific deuterium module. The disc-like representation of electron orbitals is meant to suggest a Parson magneton [10]. Alternate orbitals are assumed to rotate in opposite directions in accordance with their associated deuteron orientations. The cubic lattice nucleus model assigns periodic interactions of orbital electrons with specific deuteron modules.

Orbital electrons may be considered to be essentially mesostratum entities encircling physiostratum objects (atomic nuclei) thus profoundly combining key aspects of the two adjacent realities. Alternatively, free electrons may be considered as cubic lattice physiostratum objects [11].

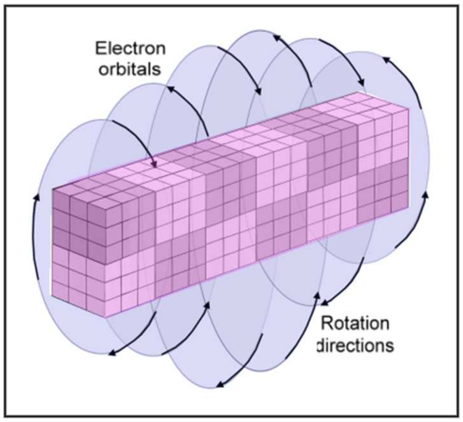

Figure 1C - Cubic lattice carbon nucleus orbitals.

Appendix D - Inter-Nucleon Attraction-Repulsion Zones

The cubic lattice nucleon model readily explains why some elements are inert and form no compounds while other elements are highly interactive and compound-forming. This makes it unnecessary to invoke the notion of electron-sharing to complete orbital shells. We illustrate with fluorine and neon:

Fluorine with atomic number 9 is the most electronegative element, it is extremely reactive. Almost all other elements, including some noble gases, form compounds with fluorine. Neon with atomic number 10 is a noble gas. Neon is chemically inert and forms no uncharged chemical compounds. Some compounds of neon may include ionic molecules, molecules held together by van der Waals forces and clathrates (substances in which a molecule of one compound fills a cavity within the crystal lattice of another compound).

Assuming the shell model: The fluorine atom has 2 and 7 electrons per shell while the neon atom has 2 and 8 electrons per shell. The complete octet of eight electrons in the outer atomic shell makes neon stable and resistant to bonding with other elements while fluorine with only seven electron in the outer atomic shell makes fluorine prone to compound-forming by ‘borrowing’ the electron needed for completing the outer shell, and is therefore highly reactive.

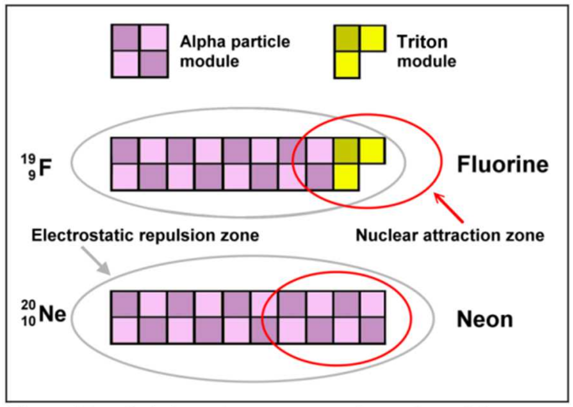

Figure 1D - Imbalance between attraction and repulsion zones.

Figure 1D shows a conceptual imbalance between attraction and repulsion which according to the cubic lattice nucleon model explains the chemical activity of fluorine and the inertness of neon. The underlying rationale is that fluorine's neutron-rich triton module and orbital electron envelope allow the nuclear attraction zone to extend beyond the electrostatic repulsion zone. Apparently, the five alpha particle modular structure of the neon nucleus is such that the nuclear attraction zone is drawn within the repulsion zone.

A similar rationale may be applied to chlorine and argon: Chlorine with atomic number 17 is an extremely reactive element and a strong oxidizing agent. Among the elements, chlorine has the highest electron affinity and the third-highest electronegativity, behind only oxygen and fluorine. Argon with atomic number 18 is a noble gas and undergoes almost no chemical reactions. The chlorine atom has 2, 8, 7 electrons per shell while the argon atom has 2, 8, 8 electrons per shell. The complete octet of eight electrons in the outer atomic shell makes argon stable and resistant to bonding while chlorine with only seven electrons in the outer atomic shell makes chlorine prone to completing the outer shell and therefore highly reactive. As in the case of fluorine-19, the cubic lattice model chlorine-35 has a neutron-rich triton module which distorts the repulsion-attraction balance while argon-36 with a complete set of alpha particle modules draws the nuclear attraction zone within the repulsion zone.

Appendix E - Cubic Lattice versus Spheroidal Shell Nucleus

The Aristotelian and Ptolemaic geocentric model of the cosmos - in which the Sun, the Moon, stars, and planets all revolve around the Earth - prevailed until replaced by the Copernican heliocentric model. Until Kepler demonstrated that the Earth and planets follow elliptical orbits around the Sun, theorists imagined cycles and epicycles to explain the erratic periodic retrograde motions of the planets based on the geocentric model. It has been determined that the Copernican, Ptolemaic and even the Tychonic models provided identical results to identical inputs. They are *computationally* equivalent, though Kepler showed that physical observations reveal heliocentricity and that the Sun is one of the foci of elliptical planetary orbits.

We are confronted with a comparable quandary with the currently accepted model of the atom in which the nucleus, nucleons, and electron shells are assumed to be essentially spheroidal as opposed the cubic lattice model depiction. Sophisticated application of theoretical mathematics and quantum mechanics stratagems provide a *computationally consistent* base for accepting the spheroidal model of the nucleus and surrounding electron shells. The model is applied in modified forms wherein electron orbitals are depicted as teardrop-shaped, doughnut-shaped, or as electron clouds.

Modifications of the spheroidal shell model arose because ongoing studies show that electrons behave in ways that defy classical physics. In the electron cloud model, electrons are no longer depicted as particles moving around a central nucleus in fixed orbits. Instead, their instant locations are described as being loci in clouds around the nucleus where the electrons are likely to be found.

In *Fashion, Faith, and Fantasy in the New Physics of the Universe*, Roger Penrose contemplates models adopted by theoreticians in their pursuit of truths about the nature of atoms and other physical entities. Penrose acknowledges the remarkable effectiveness of mathematics in describing and predicting their nature and properties. However, Penrose cautions that discovering mathematical truths is not the same as discovering physical truths: ". . . we need a change in the physics, not just some clever mathematics, brought in to cover the ontological cracks!" Indeed, we need to reexamine the models that represent atoms.

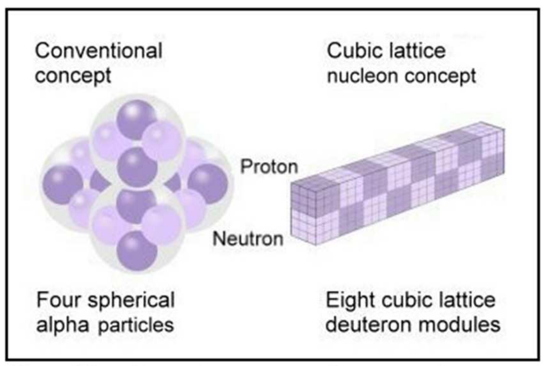

Figure 1E - Alternative concepts of oxygen nucleus.

The cubic lattice nucleus model is offered as a rational approach for depicting the atom nucleus and for depicting the nature electron orbitals in a way which avoids the esoterica of electron clouds. We are in effect obliged to imagine a structure for the nucleus and to discover the nature and arrangement of orbital electrons associated with that structure. Figure 1E compares the conventional and the cubic lattice structures for the oxygen nucleus. In the conventional depiction, protons which would mutually repel are held tightly together by the strong force between quarks. The cubic lattice nucleon affinity model adopts the essence of the chromodynamics of quark 'asymptotic freedom' wherein attraction prevails even as deuterons are widely separated. Figure 1B accounts for nucleon affinity that extends beyond the electron orbital envelope.

Appendix F - Wave-Particle Duality and Hidden Variables

The wave-particle duality myth begins with the double-slit experiment in which light passing through two precisely cut parallel slits in a thin opaque plate is collected on a photo-sensitive detector screen. After the photons pass through the slits, the image produced on the detector screen consists of fringes, an interference pattern, with light and dark regions corresponding to where light waves have apparently constructively and destructively interfered. The myth is sustained by failure to recognize that an interplay of adjacent realities (the mesostratum and physiostratum) is involved in the process and in explaining the observations.

The interference pattern is taken as evidence of wave-particle duality, it is inferred from the application of wave-function calculations. When photons or other quantum particles pass through the double slit, a calculation which *assumes* that the photons behave as wave*s is needed* - to predict the interference pattern. When the fringe pattern is examined, it is evident that the pattern was built piecemeal - quantum by quantum - not by continuous wave fronts - forming fringes composed of a patterned accumulation of random spots.

During transit, each photon, from the source to detector screen through one or the other double slit evolves according to the Schrödinger wave-function and spreads out in space as an assumed wave front. But the actual measurement on the detector screen finds each photon deposited as a quantum parcel at a particular spot on the detector surface. This is unanticipated by the wave-function - it is called wave-function collapse. This is explained by assuming wave-particle duality, that photons in transit are waves which become particles as they impinge the detector screen.

It is better to admit that photons are *photons* and remain photons throughout the physiostratum. We may imagine protons as pure waves in the mesostratum continuum as a means of explaining and describing their behavior while in transit, applying the infinitude of mathematical resources of the mesostratum reality. For example, the WheelerBFeynman path integral avoids describing *photons* as either waves or particles and replaces the classical notion of a single unique trajectory with a functional integral over all quantum-mechanically possible trajectories to compute an infinity of possible (mesostratum) trajectories.

Cylindrical wave fronts, mesostratum mathematical continuum objects, are conjured to describe photons in transit because they effectively predict the *probable* fringe pattern of illumination and photo-excitation of *actual* particles that comprise the detector screen photo-sensitive granules. The enigma remains because the fringe pattern is built piecemeal, quantum by quantum, and not by the diffuse spreading and constructive/destructive interference of continuous wave fronts.

An alternative way to describe the transit of photons - or other quantum particles - is based on a Louis de Broglie concept adopted and developed by David Bohm. Bohm postulated that photons travel through both slits, but that each photon has a well-defined trajectory and passes through exactly one of the slits. According to Bohm, photon interactions govern the trajectory of each photon instant by instant. This implies an inter-mesostratum/physiostratum hidden 'configuration space' which modifies spacetime voxels and guides photons to their destinations.

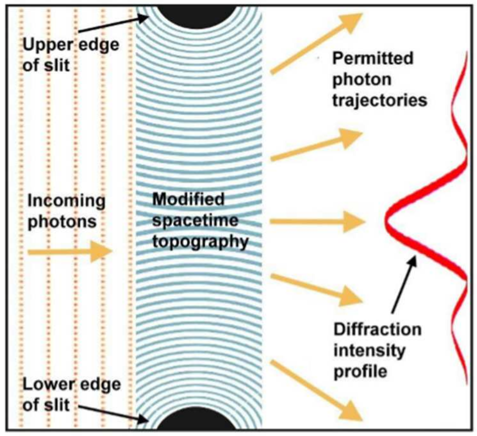

Figure 1F - Conjectured spacetime topology configuration.

Figure 1F depicts a conjectural configuration space for single slit diffraction. In the case of double slits it is likely that the proximity of a second slit will alter adjacent voxel spacetime topology and produce the observed double slit diffraction pattern. We suggest that the hidden variable in diffraction is due to micro-modification of the spacetime topology very near massive quantumthing agglomerations [12].

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