

On the Nature and Origin of Matter, Dark Matter and Dark Energy: Part 1, Fundamentals

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Abstract

A theoretical model (Model OMG, Ongoing Mass Genesis) is presented that explains the nature and origin of matter, dark matter and dark energy and calculates energy densities matching the Planck mission data. The model is based on the FLRW cosmology but with continuing creation of equal amounts of positive and negative matter in a Null universe. Dark Energy is gravitational repulsion caused by negative matter, Dark matter is non-normal positive matter, including antimatter, in bosonic form but gravitationally attractive to normal matter

The model proposes a unified description of gravity and electric potential calculated using Bessel functions for the natural masses and electric charges of fermions, with mass quantisation correct to 2-4 significant figures. Apart from the mass of the electron there are no free parameters used in the theory which is essentially geometric. Matter is generated in a “chronoverse” containing eight orthogonal time-like directions, three describe the non-neutrino leptons residing on the surface of a unit radius “chronosphere”, and encode mass, gravity, charge and an electroweak force. The fourth dimension governs the strong force and defines the quarks. Photons and neutrinos involve an 8D chronoverse. Each “chronotype” of particle is the same matter, differing only in chronosphere coordinates, possibly representing background-independent, intrinsic timelike quantum signatures. The gravitational behaviour of matter is attributed to a preon-like quark-constituent of mass 0.5766 MeV. The Planck fine structure constant is calculated and evidences the tritoelectron and tritopreon. Quarks have a substructure of constituent preons each consisting of three tritopreons creating a superposition of a greater number of virtual preons. The Model embodies a descriptive unification of the 4 forces in an overall 11-D spacetime. The continuing creation of matter proceeds from tritopreons via compound bosons dubbed Careyons and is statistically-controlled. The mass creation model is supported by correct prediction of the primordial H:helium-4 ratio.

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1. Introduction

For a period in the latter half of the 20th century two theories competed to succeed the flawed theory of Continental Drift, the theory of the Expanding Earth and the theory of Plate Tectonics. Both theories accept the growth of oceanic plates by expansion at mid-ocean ridges; the first theory advocates that this is caused by earth expansion and drives the continents apart, the

second says it involves more random migration of continents on an earth of constant radius, necessitating a compensating subduction of the oldest oceanic plate material to make room for the new. The Expanding Earth failed to win acceptance largely on two grounds; the lack of any sensible cause for an expanding earth and the evidence offered for subduction. The latter issue is more related to defence of Plate Tectonics because without subduction, Earth Expansion is mandated. The Expanding Earth seemed to be an altogether better explanation for the disposition of the continents, relying on a rational process which can be traced in reverse to restore the continents to a single crustal entity on a smaller earth. Plate Tectonics proposes a random wandering of the continents, driven by e.g. mantle convection, which break up and recombine in chaotic fashion, and does not accord completely with the continental disposition of many geological features, nor the distribution of living and fossil lifeforms. Most “expansionists” come to the conclusion that only mass increase offers a plausible explanation for earth expansion. This inevitably means acceptance that the mass of the universe was also increasing. Thus the new paradigm of earth expansion diverges from Big Bang cosmology which demands that all the matter in the universe was created at one point in time. To overcome the objection that this violates conservation of energy, the BBT invoked negative gravitational energy to counter the positive mass energy. The new OMG (Ongoing Mass Genesis) theory enables an alternative justification and mechanism for Big Bang matter creation “out of nothing” but the intent is to justify continuous mass creation. This report is thus not a history nor a review of the pros and cons of the theory of earth expansion; rather, that theory is adopted as an axiom and the supporting theory of ongoing mass creation is given a generous investigation to see where it is possible to go; arguments about earth expansion will only be broached in the context of the present thesis. It will be found that this attitude leads us to new physics beyond the Standard Models of Cosmology and Particle Physics. It is accepted that some of the more speculative elements may not survive critical examination but may provoke and encourage fresh thinking.

The approach conforms to standard scientific practice; using available data to construct a theory that reproduces the data and seeks to validate the theory by making new, testable predictions.

In the interests of brevity this article does not detail the lengthy development, but presents the essential logic and present conclusions, of 20 years of independent research (“thought experiments”) into alternative approaches to the origins and nature of matter, driven by numerous unanswered questions in current theories. The result is a new theory that challenges three very strong, modern consensus positions, firstly Big Bang cosmology, secondly as a corollary, Plate Tectonics geology and thirdly as a further corollary, anthropogenic global warming. With respect to the second item, the heretical opposing view has several names but in honour of one of its leading exponents, Professor **Samuel Warren Carey**, whose life and works inspired this effort, I shall refer to it as he did; the **Expanding Earth** theory, Carey (1976). Maxlow (2014) has documented a thorough reverse engineering of the expansion, by sequentially removing the dated strips of oceanic plates extruded from the mid-ocean ridges, back to an earth with a monolithic, global, sialic crust without deep oceans, and further into the archaean. In effect playing the tape of earths’ expansion history in reverse. Maxlow (2014, chapter 13) also rebuts the constant paleoradius claims of McElhinny et al (1975, 1978). Hurrell (2020), reviewed the contributions and recollections of a number of modern expansionists. Regarding subduction, now deeply “entrenched” in Plate Tectonics and the prism by which all matters relating to earth science are viewed, Hurrell cites the contrary view expressed in an essay by Carey (1975) “The plate theory has fatal falsities. Africa and Antarctica are ringed by expanding rifts and each should have post-Paleozoic subduction zones to swallow more than 3000 km of crust. These do not exist.” Others such as Sudiro (2014) have argued against expansion theory, both its reality and the proposed mechanisms, and Plate Tectonics is the popular, consensus view, Neal (2018), see also section 7.2. A universal reason why the theory has not gained wider traction is the absence of a credible source for this mass increase of the earth. This paper proposes a theory of mass creation that provides such a source; how that might be applied in detail to the earth and universe is intended for a later publication. The theory is partly qualitative in explaining the origin and nature of normal matter, dark matter and dark energy but also quantitative, yielding estimates in excellent agreement with the conclusions of

the Planck Cosmic Microwave Background mission. The quantitation of gravity is derived from application of the model at the quantum level, identifying the fundamental gravitating particle and determining the critical parameters that govern gravitational behaviour. The theory is extended to a number of other predictions answering unresolved questions or offering alternative explanations regarding e.g. the zero energy universe, the initial low entropy of the universe; the mass quantisation of the fermions; the value of the Planck Fine Structure Constant; the substructure of the fermions including the quarks; the internal symmetry of the neutron (the strong CP problem); the primordial nucleosynthetic ratio of hydrogen to helium. A more speculative extension of the theory is presented to support the continued creation of matter ex nihilo, involving the creation and accumulation of pseudovirtual particles (at zero energy cost) and their "realisation" to fermions or bosons (including dark bosons) by collapse of the wave functions. The fermions generate matter, the dark bosons constitute dark matter. The creation of matter is statistically-controlled and correctly predicts the primordial ratio of hydrogen to helium-4.

With respect to global warming, if the theory of earth-mass increase is true then we are presently in ignorance of the fundamental driver of solar system physics, of Earth's geology and energy budget, consequently all current projections about future climate are invalid.

With such profound and widespread implications the new theory is presented as worthy of examination, criticism and further development.

The standard theory of cosmology (Λ Cold Dark Matter), has issues including: the apparent absence of antimatter, predicted to match the quantity of normal baryonic matter which is about 5% of the total matter energy; the presence of invisible ("dark") gravitational matter at about five times the amount of normal matter or about 25 percent of the total energy density of the universe; the presence of an unknown energy field ("dark energy") equivalent to about 70 percent of the total mass energy of the universe and driving the on-going and apparently accelerating expansion of the visible universe; the absurdly low entropy of the very early universe required by the second law of thermodynamics; the "horizon", "smoothness" and "flatness" problems attending the Big Bang cosmology, currently solved by the theory of cosmic inflation. Note that estimates of matter, dark matter and dark energy are derived from analysis of the cosmic microwave background (CMB) radiation assuming a Λ CDM interpretation based on Big Bang cosmology, so the CMB studies are not disputed but the details of the genesis of the pre-CMB universe are questioned.

2. Creation of Matter in a Null Universe

Every theory of the origin of matter and the universe faces the problem of conservation of energy if the universe is supposed to contain only positive matter energy.

The problem surfaces in another guise as the Standard Model of Cosmology posits only a positive mass universe, leading to the Standard Model of Particle Physics calculating, via quantum field theory, an enormous zero-point energy by summing up the fluctuations in the energy field; whereas the small value of the cosmological constant demonstrates a very low vacuum energy density. Both problems are resolved in a zero energy, Null universe.

Tryon (1973) proposed that the universe arose from a quantum fluctuation in the vacuum of a universe having zero net value for all conserved quantities, including the energy of the vacuum itself. The vacuum was proposed to be unstable in the presence of large scale fluctuations of the universal gravitational field. Model OMG is based on a similar zero energy universe.

Carey (1976) documented the geological studies that led him to his acceptance of an expanding earth. After reviewing the various explanations for an expanding earth (e.g. phase changes in an earth of constant mass; secular decrease in the gravitational constant G; secular increase in mass) he answered his own question "what causes the expansion" with an honest "I don't know". Paul Dirac had proposed that the value of G depended on cosmic time; this was adapted as an explanation of earth expansion by physicists Pascual Jordan (1971, fast expansion) and Robert Dicke (slow expansion) while geophysicist Egyed argued for slower expansion; these contributions have been reviewed by geophysicist Helge Kragh (2015). By 1988 in a second book, *Theories of the Earth and Universe*, Carey had accepted that secular mass increase could be enabled within a Null Universe with matter and energy cancelling "... the cosmos always was, is, and always will be in a state of zero. Philosophically, there is no other way the cosmos could come into being". Matter was created where the gravitational potential is low or zero e.g. between galaxies or at the centre of masses like the Earth. Carey suggested a version of the Steady State Universe proposed by Bondi, Gold and Hoyle where matter is continuously created but the density kept constant within

the observable universe by expansion. The BBT, e.g. Hawking (1988, 2002), Kraus (2012), depends critically on a zero energy universe where the positive energy of matter is exactly cancelled by negative energy in the form of gravity. They give simple thought experiments to support the otherwise “curious” idea, Gribbin (1996), that gravity has negative energy. Stephen Hawking explained, when you pull two objects apart, you need to expend energy to overcome the gravity that pulls them together. As it takes positive energy to separate them, gravity must be negative energy. This “free lunch”, “ a universe from nothing”, is “crucial” to the BBT according to Guth (1997) and he devotes a more elaborate argument in a specific appendix to proving that gravitational energy is negative. Johri (1995) concluded that in FRW cosmologies the total energy is zero and the energy for creation of matter during inflation is drawn from the energy of the gravitation field; in certain cosmologies which abandon adiabaticity to allow particle creation the gravitational energy is used directly as the energy source. Likewise, Christillin (2016) proposes a “black hole universe” with zero total energy wherein continuous particle creation is not merely permitted but necessary to counterbalance gravitational attraction; the theory is based on enforcing energy conservation while permitting photon and particle non-conservation... “ our causal Universe has evolved from a total zero energy quantum fluctuation at the Planck scale to the present dimensions, again with total zero energy, without any need to invoke inflation.”

Model OMG, hereafter the Model, is axiomatically based on the assumption of a Null universe where matter is continuously generated in more forms than the two currently recognised (matter and antimatter), with the inclusion of negative matter resulting in net zero mass energy at all times. Farnes (2018) pointed out Einstein did not pursue his original insight (that negative matter could provide an explanation of the cosmological constant), and also made a detailed case for a polarised universe containing both positive and negative matter; the existence of negative mass matter explaining dark energy as the gravitational repulsion of positive and negative matter. Farnes conducts a review of related cosmologies and the arguments for and against them. The model developed by Farnes differs from Model OMG in that while Farnes required the continuous creation of matter, only on-going negative matter creation was proposed.

Boyle, Finn and Turok (2022) devised another mirror universe model based on CPT symmetry, attributing dark matter to massive, sterile, right-handed neutrinos. Yi-Fang Chang (2021) proposed the existence of four types of matter; normal matter, antimatter, negative matter and negative antimatter, with an overall net zero mass energy budget. Mirror Universe models containing a dark sector that is the twin of the observable sector and contains the same particle content and gauge interactions as the standard model are well represented in the literature e.g. Cyr-Racine (2022) and leading references.

Note that Null models that only allow for matter and antimatter to be produced are false Null models because the net energy remains positive. The so-called annihilation of matter and antimatter does not result in true annihilation but rather the conversion of the mass energy of the particles to the equal positive energy of photons. In contrast the annihilation of a normal positive particle with a negative mass antipode would result in the total extinction of both matter and energy, the matter wave functions exactly cancel to zero. Hence we conceive that the universe was created ex nihilo by the generation of equal amounts of positive and negative matter giving a net zero mass energy content before and after. It is proposed that the creation of matter involves a time bifurcation with positive and negative matter separating in opposite time directions, a mirror universe with the sign of the matter determined by the sign of the time dimension. This supports both the BBT and Model OMG.

We then attribute dark energy to the presence of invisible negative matter that it is gravitationally repulsive to normal matter on the assumption that the signs of the masses manifests in the sign of the gravitational potential between two masses separated by distance d , i.e. by definition;
Gravitational Potential Energy (PE) = $-(M_a)(M_b)/d$
Negative PE is a consequence of attractive gravity between masses.
Hence the gravitational interaction of positive matter and positive matter is attractive.

The gravitational interaction of antimatter (assigned in Model OMG as positive matter because their mutual “annihilation” generates positive energy) with normal matter is thus predicted to be also attractive. This is an important test of Model OMG. Santilli (1999) and Villata (2011), based on extensions of general relativity, predict the opposite behaviour i.e. antimatter repulsion of normal matter. In particular Santilli’s isodual theory of antimatter requires that all characteristics of matter change sign for antimatter; Model OMG falsifies this principle as the two forms of matter have positive energy, demonstrated by matter/antimatter “annihilation” creating positive energy. The isodual theory does however apply to matter and negative matter. The Dirac-Milne universe of Benoit-Levy and Chardin (2012) likewise relies on a matter-antimatter symmetric universe with dark energy explained as negative active gravitational mass.

Experiments to determine the sign of the gravitational PE between matter (the Earth) and antimatter (neutral antihydrogen produced by the Antiproton Decelerator at CERN) continue e.g. Amole et al, (2013) and have recently achieved sufficient precision to determine it to be **attractive**, in accord with Model OMG.

For negative masses interacting with positive masses the PE is positive so the masses repel and this is proposed as the source of Dark Energy and the expansion of the universe. Negative masses will interact with negative masses attractively as the PE is negative. In the negative half of the universe physics will look exactly as it does in our positive half, upholding the cosmological principle.

The theory that dark matter is, at least in part, antimatter is an active area of research. For recent research see Sidhu et al (2020) who considered possible constraints, such as the effects on the CMB and BB nucleosynthesis, on the theory that antimatter constitutes macroscopic dark matter. The question arises that if antimatter is Dark Matter, why is the Dark Matter energy density, as determined by the microwave background missions (NASA WMAP, ESA Planck missions), about five times the normal matter energy density whereas both the Λ CDM theory and Model OMG predict equal amounts of matter and antimatter. Model OMG predicts that there are 3 types of dark matter, only one of which is anti(normal matter). The remaining anomaly will be quantitatively explained in Model OMG, as will the greater magnitude of the Dark Energy.

3. Continuous Mass Creation

3.1 Basis in General Relativity

The Friedmann-LeMaitre-Robertson-Walker (FLRW) solution to the Einstein field equations of general relativity applied to an homogenous, isotopic universe, treated as a perfect fluid, was used by Akinbo Ojo (2016) in a contrarian refutation of the Big Bang theory to derive equation (1);

$$M = rc^2/2G = c^3t/2G \quad (1)$$

Where M is the total mass energy of the universe, r is the radius, c is the speed of light, G is the gravitational constant and t is time, the age of the universe. This equation is recognisable as defining the Schwarzschild radius (r) of a gravitating mass (M) and the event horizon of a black hole. But the clear implication from Akinbo Ojo’s derivation, and vigorously promoted by him, that the mass energy of the universe is linearly increasing with time from an initial zero, has been otherwise universally avoided. The tacit rejection of this concept is based on the consensus adoption of the Big Bang interpretation of the FLRW cosmology wherein all the mass energy came into existence at a single moment in time. The alternative Steady State universe of Hoyle, modified to incorporate mass generation in order to explain the observed expansion of the universe, fell by the wayside with the triumph of Big Bang cosmology after the discovery of the cosmic microwave background radiation proved that the universe had a traceable beginning. Hoyle was one of the steady-state cosmologists who retreated in the face of this evidence.

Akinbo Ojo claims that a linear mass increase, starting with a very low (positive) mass e.g. 10^{-8} kg during the Planck epoch nevertheless goes through a radiation-dominated era due to the low radius ensuring a high energy density comparable to Big Bang scenarios and indeed more consistent than the latter in conforming to black body radiation laws. It will be demonstrated that acceptance of the this concept leads to a simple mathematical model that explains and quantitates the existence of dark matter and dark energy, both inexplicable in the Big Bang model. It is obvious that any new Model of creation, based on the cosmic microwave background data, needs to conform to the Big Bang scenario in respect to the CMB originating at the close of a radiation dominated era. Later (section 5.3.3) the energy released from the mass creation process will be estimated to be of similar order to stellar fusion processes, but much less than the near infinite energy of the BBT. Model OMG accepts the premise of matter starting from zero and increasing linearly at a rate that ensures the mass energy density always equals the critical

density, yielding a flat spacetime at all times. This critical rate of mass creation must be regulated by a balance of positive and negative feedback processes to maintain the critical value. Model OMG diverges from the Akinbo Ojo hypothesis where the latter postulates that the mass energy of the universe is compensated by a negative energy associated with increasing distance in the expanding universe; Model OMG proposes that the total mass energy of the universe is always zero due to the balance of positive and negative matter. Note that the title of Akinbo Ojo's book "Hypotheses Fingo" reverses Newton's statement "hypotheses non fingo" concerning the impossibility of the action-at-a-distance embodied in his theory of gravitation: in his day action-at-a-distance was only possible by mechanical means; poking something with a stick or throwing a rock at it. Leibniz was offended by the proposition and argued against it. Fortunately Newton did not resile from his theory but said "I feign no hypothesis". Newton's was a valid reaction when a new theory to explain previously unexplained data comes up against new consequences of that theory that are themselves inexplicable or considered impossible. Carey's admission in 1976, "I don't know", was the proper response, simply marking the new borderline between what we know and do not know. We take one step forward into the darkness but further darkness is always before us; we step back not because of the remaining darkness but when the last step is falsified.

3.2 Kinetics of mass creation.

Model OMG offers an alternative to inflation to solve the "horizon", "smoothness" and "flatness" problems of the original BBT by replacing the "all at once" creation of the entire matter energy budget of the universe with a slower, steady growth with time, allowing communication of distant regions and thermal equilibrium at all times. The universe thus begins not with a Big Bang but with a more leisurely Big Fizz or Big Fountain. This more extended process means that the universe is older than calculated from the BBT, explaining how the early galaxies detected by the James Webb telescope are more mature than thought possible in the BBT scenario, see section 7.10. According to equation (1) matter creation is a linear kinetic process, zero order with respect to

mass, first order with respect to time with a constant rate of mass creation $\frac{dm}{dt} = \frac{c^3}{2G}$. In fact it can be demonstrated that the process is dependent on mass density (to be addressed in Part 2 of this work). In the early stages with little matter this will be a stochastic process governed by random probability and of variable rate, contingent on the distribution of the initial masses. It is this initial "patchy" process that contributes to the slight density irregularities that evolve later into the matter clumps of galaxies and galaxy clusters. There must also be a some condition to be satisfied, e.g. a barrier to overcome, for mass creation to occur, otherwise in the absence of such a barrier the universe would immediately fill with matter as there is no net energy cost in creating equal negative and positive masses. In chemical reactions there is an "activation energy" barrier (Arrhenius activation energy), an energy hill that needs to be climbed with the energy returned as the system relaxes to a lower energy state of the products. As Model OMG imputes zero net energy cost to mass creation, neither net matter energy nor gravitational energy, there is no thermal energy barrier but it remains for entropy to be considered. One of the puzzles of the Big Bang model, given that the second law of thermodynamics requires entropy to always increase, is that the earliest (positive-matter) universe must have had extremely low entropy despite containing all the positive-matter energy of the current universe, with the expectation of many degrees of freedom and correspondingly high entropy. This conundrum evaporates in Model G where we propose that positive matter creation started with a only a few particles and only a handful of degrees of freedom and thus as close to zero entropy as it is possible to obtain. From the second law of thermodynamics as observed in our universe we expect that the creation of particles incurs a physical entropy burden which cannot be decreased nor reversed except by their total negation i.e. "decreation". Hence there is no useful way to recover the physical entropic cost of creation when considering our "positive time" universe alone. However the denizens of the negative time universe will also observe entropy to be ever increasing as their universe also evolves: from our view point it would appear to be increasing negative entropy in the negative universe. In other words in negative time all physical properties such as mass, gravity, enthalpy and entropy have the opposite sign relative to the same qualities in our positive time, resulting in a zero sum. This time reversal symmetry supports CPT conservation. The Cosmological Principle applied to the chronosphere means that the positive and negative mass hemispheres are entirely equivalent; physics is identical in both and denizens of either cannot distinguish which one they occupy; entropy is equivalent to energy in each hemisphere and must increase in each hemisphere **but in opposite directions and because the negative and positive particles are always created in equal numbers, the magnitude of the entropy increase in each**

hemisphere is identical. From this perspective the net entropy, like the net mass energy, will always be exactly zero and there is no overall entropy cost to mass genesis in a time-polarised universe.

The second law of thermodynamics states that entropy (in our half of the chronoverse) never decreases, which demands that our part of the early universe had a very low entropy. This conflicts with the low level of temperature anisotropy of the CMB soon after the Big Bang which means the universe was near equilibrium and therefore near maximum entropy not minimum (Lineweaver, Egan 2012). Initial low entropy of our half of the initial universe is inherent in Model OMG (4D version) as it posits the creation of just 8 positive mass subatomic particles.

A major problem with the early versions of the BBT was that if all the matter in the universe arose from a singularity, it would immediately recollapse under gravity into a black hole. This problem was solved by the concept of inflation.

If Model OMG is to avoid such a “mass-catastrophe” where the (positive) universe immediately solidifies by the unrestrained creation of matter and collapses into the biggest black hole imaginable, we then need to propose some other impediment to mass creation and it is proposed that this is of a statistical nature rather than energetic i.e. requiring a relatively rare concatenation of events to initiate the generation of new matter. In other words matter creation is a stochastic process involving a relatively low-probability set of circumstances. Taking a cue from chemical kinetics, where reaction rates depend not on the absolute amounts of chemical matter but on their concentrations, we can postulate that matter creation requires (possibly among other things) particular concentrations (density) and/or configurations of pre-existing matter. The linear increase in positive matter with respect to time, imputed to equation (1), is supportive of this idea, which I intend to explore in a later report. The transfer of chemical principles to cosmology is validated by the “ideal gas” treatment of general relativity in the FLRW cosmology. The theory of General Relativity was a consequence of Einstein’s desire to give mathematical expression to what he termed Mach’s Principle (after the 19th-century Austrian physicist and philosopher Ernst Mach) that the inertial forces experienced by a body in nonuniform motion are determined by the quantity and distribution of matter in the universe. The success of the FLRW cosmology based on a uniform gas universe encouraged Hoyle (1955, 342-349) to see this large-scale uniformity as a natural law, demanding mass creation to fill any local deficiencies, “matter originates in response to the influence of other matter”.

The recent observation that the later expansion of the universe is accelerating exponentially is also kinetically explicable in terms of the self-catalysing activity of mass initiating more mass with more repulsion from more negative matter. In this case the FLRW equation may not be strictly valid in the long term, which is to be expected as it comes from a theory that does not include, nor contemplate, the existence of negative matter. Einstein included the arbitrary “cosmological constant” in his field equations to explain why the universe did not undergo gravitational collapse, and later removed it when Edwin Hubble showed him that galactic red-shifts proved the universe was not static but expanding. Accelerating expansion now requires the ad hoc re-inclusion of the constant but now as a driver of expansion rather than an inhibitor of gravitational collapse. The accelerating expansion of the universe is possibly reflected in the accelerating expansion of the earth proposed by earth expansionists; both are driven by mass increase; the former by cosmological negative mass, the latter by local positive mass.

Outside of Carey’s theory that matter creation occurs in the absence of a gravitational field, there is the problem of what triggered the very first matter creation event since there was no “environment” to start with. This is also a problem for the Big Bang. Retrocausality, that is backward-in-time causal influences, offers a solution and has been proposed as a foundation of quantum theory, beginning with idea of transactional retrocausality introduced by Wheeler and Feynman (1945,1949) and developed by Cramer (1988); the wave nature of quantum mechanics and the time reversibility of the wave equation allows a particle to be influenced by its **future** environment.

4. The 3D Chronoverse, a Universe with 3 Orthogonal Time-like Dimensions

An important clue to development of Model OMG was that it has long been thought that antimatter can be considered as just normal fermionic matter “going backwards in time” and is formally treated this way in particle physics e.g. Feynman diagrams, although e.g. CERN discourages this literal interpretation. This idea developed from Dirac’s prediction of the anti-electron (positron) which was reinterpreted by Feynman (1949) and Stueckelberg (1941) as an electron going backwards in time. In fact in Model OMG, antimatter is regarded as positive matter “going sideways in time”.

The concept of matter “going backwards in time” relative to us explains the origin of dark energy because seen in reverse time, gravitational attraction would appear to be gravitational repulsion. The large domination of repulsion over attraction needs to be explained, dark energy being estimated as about 70% of the matter/energy content of the universe; the proposed model logically and quantitatively explains this apparent anomaly.

The parameter on each of the three axes of the 3D chronosphere is timelike giving a universe with 3 space dimensions and the usual time dimension plus two extra time-like dimensions. Sparling (2007) developed a new spinorial theory based on general relativity with spacetime linked with two twistor spaces creating two extra time-like dimensions. Velez (2012) considered the motions of particles in multiple time and space dimensions and concluded that under certain conditions particles moving in multidimensional time are as stable as particles moving in one-dimensional time. It could be argued that the mathematics of Model OMG are also consistent with distance as the axis parameter but since Feynman and Stueckelberg the idea of negative time has at least been tolerated, while negative distance seems less acceptable. But if negative matter is just positive matter moving in negative time then negative distance is just distance traversed in negative time. However this rationale merely highlights the central theme that it is negative time that confers negativity on both mass and distance, so time is the choice of Occam’s Razor. The coordinate system of three axes defines a sphere centred on the origin and touching the coordinate point (1,1,1) and hence of radius $\sqrt{3}$. This constitutes the temporal universe, the “**chronoverse**”. Contained within that sphere is a smaller sphere of unit radius, the “**chronosphere**” (figure 1).

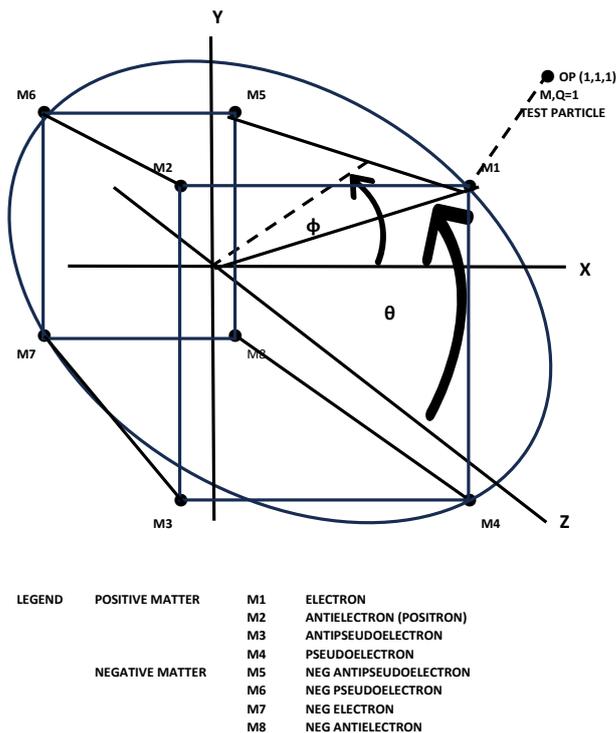


Figure 1. 3-D Chronoverse with 8 fermion chronotypes (exemplified by electron) in symmetric cubic array on surface of unit radius ($R=1$) Chronosphere represented by great circle through electron M1 and antipodal negative mass electron M7. θ and φ are the spherical polar angle and azimuthal angle respectively. A unit mass/ unit charge test particle resides at the Observation Point (OP) at $(x,y,z)=(1,1,1)$ or $(r, \theta, \varphi)=(\sqrt{3}, 0.9553, \pi/4)$.

The z axis is chosen as the time-like coordinate primarily responsible for gravity. The x coordinate is responsible for electrostatic potential and the y coordinate contributes to **both** gravity and electrostatic potential. The massive particles of the universe reside on the surface of the inner sphere. Gravitational and electrostatic potentials are calculated with respect to a unit mass/unit charge test-mass or reporter-particle located at the location (1,1,1), the “observation point” (OP), which can be considered as a scaled and eternal “now” in the chronoverse, possibly regarded as our co-moving temporal frame. Model OMG uses cylindrical or polar or Cartesian coordinates as required e.g. particle mass and electric charge are described by cylindrical or polar coordinates (r,θ,φ) while energy potentials such as gravity and electrostatic potential are described most simply in terms of cartesian coordinates. The time axes may be scaled to the age of the universe, set at unity, but note that the time-like coordinates are not “date stamps” for when the matter was created e.g. all electrons have the same coordinates irrespective of creation date. This is an aspect of the chronoverse, where certain features remain invariant with time. The coordinates are better considered as quantum numbers determining mass, charge, spin etc... What is this “time-like parameter” in the chronoverse? One possibility often used in cosmology is the red shift z since light that arrives from a distant source is stretched by a factor 1+z, giving a monotonic relationship between time of emission and z in an expanding universe. The preferred interpretation is from a quantum mechanical viewpoint; we are using **natural or geometrized units** where the physical quantities of length, time, mass and energy etc.. can all be expressed in terms of just one of them, e.g. time, viz section 4.1.

4.1 Correlation of the time-like parameter to gravitational energy.

The mass/gravity z axis parameter as a time-like parameter is based on the following assumptions and logic: returning to equation (1)

In natural units e.g Planck units, G and c are 1.

Hence in natural units, equation (2)

$$M = t/2 \tag{2}$$

Following Einstein’s apparent decision to ignore his own proposal that negative matter could explain the cosmological constant, the derived FLRW cosmology fails to take into consideration that equal amounts of positive and negative mass energy were generated at creation. It deals only with the general relativistic consequences for the positive mass energy and the masses and gravitational output are unsigned. If the co-created and equal negative mass energy is taken account then the equation is proposed to be equation (3)

$$|M| = rc^2/G = c^3t/G \tag{3}$$

Whence equation (4)

$$G|M|/c^3 = t \tag{4}$$

or in natural units equation (5)

$$|M| = t \tag{5}$$

where |M| is the sum of the absolute masses of both negative and positive matter. Using natural units hides the fact that the M here is actually GM, the standard gravitational parameter, divided by the cube of the speed of light.

Rearranging equation (3) we can recognise it, in equation (6), as describing the gravitational potential of a unit mass at a distance r=ct (with t being the time elapsed since the genesis event) from the hypothetical centre of mass of the universe. In more general terms we can multiply both sides of equation (4) by a test mass m leading to equation (7)

$$G|M|/r = c^2 \tag{6}$$

$$G|M|m/r = mc^2 \tag{7}$$

this gravitational potential now equated to the mass energy of the test mass, an interesting equivalence underlining the origin of the equation in relativity theory and agreeing with the BBT which relies on the equal magnitude (but opposite signs) of the gravitational energy and mass energy of the universe. However this relationship (or the simplified GM/r=c² applies exactly only at

the Planck scale thus with $M = \text{Planck mass } (2.176434 \times 10^{-8} \text{ kg})$, $G = 6.674 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$, $r = \text{Planck length } (1.616255 \times 10^{-35} \text{ m})$, $c = 2.99792458 \times 10^8 \text{ m s}^{-1}$ then $GM/r = c^2 = 8.987 \times 10^{16}$ to the same precision as value of G . At macro scales e.g. kg, m the value of c^2 is 27 orders of magnitude greater than GM/r . See section 5.4 for further discussion of this issue.

In terms of the standard gravitational parameter of mass M , equation (8)

$$GM = rc^2 = c^3(t) \quad (8)$$

This equality is intuitively extended by Model OMG to an important corollary; that the magnitude of the gravitational potential of a unit mass m separated by time Δt from mass M in the chronosphere is directly proportional to Δt with constant of proportionality c^3 , equation (9)

$$GM = c^3 \Delta t \quad (9)$$

Or in natural units equation (10)

$$M = \Delta t \quad (10)$$

but recognising that M is actually the gravitational potential per unit mass.

Hence, while Model OMG is based on the FLRW solution to the field equations of general relativity, it reinterprets it and enables the calculation of cosmological gravitational potentials in an extremely simple manner.

An alternative derivation of equation (5) starts by recasting the expression for Newtonian gravitational potential U , equation (11)

$$GMm/r = GMm/ct = U \quad (11)$$

Hence equation (12)

$$GMm/cU = t \quad (12)$$

So t represents the value of the function GMm/c per unit of gravitational potential, yielding equation (5) in natural units. It can be seen that equation (12) is equivalent to equation (8) by putting $U = mc^2$; i.e. the gravitational potential equals the mass energy of the unit mass, which is in accord with the first derivation. The author is therefore of the opinion that both derivations are valid.

The model accords with the geometrised units used in particle physics and cosmology wherein physical quantities like mass and electric charge can be identified with the magnitude of a timelike vector having the dimension of length. In geometric units a time interval is interpreted as the distance travelled by light in that time interval, so one second is interpreted as one light-second, ergo time has the geometric units of length.

Model OMG speculates that the positiveness or negativeness of matter is ultimately intrinsic and not actually referenced to any coordinate system, maintaining the cosmological principle and in agreement with Mach's principle that physics should be defined only in terms of the relation of one body to another, abandoning the idea of a reference background spacetime. The intrinsic quality is associated with "time signatures" for matter, in effect due to time-relevant quantum states possessed by normal baryonic matter rather than due to a unique "negative" baryonic matter. There is no exotic matter required in the Model, just fermionic matter with different time-signatures. Ultimately it is the matter wave function that carries all this information.

It is postulated that fermionic matter M could have time quantum numbers or signatures e.g. $M(+1,+1,+1)$ for normal matter and $M(-1,-1,-1)$ for the negative counterpart. The individual numbers are **Model quantum signatures**, given an arbitrary unit value but mainly encoding the signs of the three axes (x,y,z) in that model 3-D octant of the chronosphere. The Model signature signs only reflect the relationships of the signatures between the octants, thus a Model charge (x) signature of +1 in octant 1 may experimentally be either a positive or negative charge; however a Model mass (z) signature in octant 1 can only be a positive mass. When normal matter and its antipode meet the result is $M(0,0,0)$ or in Model OMG, a mass with no home in the chronosphere except the initial zero existence state at the origin.

The antimatter particles have positive z numbers like normal matter but negative x numbers. Thus a meeting of matter and antimatter, e.g. $M(+1,+1,+1)$ and $M(-1,+1,+1)$ results in $2M(0,+1,+1)$

equating to two massless photons in the yz plane ($x=0$), with energy in the y,z plane equal to the mass energy of the particles. A corollary is thus that the gauge bosons of the Standard Model are located on 2D planes of the chronosphere; photons on the y, z plane where $x=0$, an uncharged boson.

Time itself could then be a construct based on the intrinsic quantum behaviour of matter rather than a property caused by a universal coordinate system or directions.

Modern quantum physics accepts that space is filled with a sea of virtual particles created by the transient production of pairs of matter and anti-matter particles, which constantly form and collapse; the positive energy required to form the particles is temporarily “borrowed” from the universe (allowed by the uncertainty principle) but must be immediately paid back. In fact the 3D Model OMG predicts that this is only one quarter of the true process; in total eight different chronotypes of particles are produced (see below) but there is no net mass energy or entropy cost and no “borrowing” of energy via the uncertainty principle. In the 4D version there are 16 chronotypes, still summing to zero mass energy.

Model OMG now gives us a means to probe the gravitational effects of antimatter and negative matter on normal matter. Early models with gravity as a function of one dimension or two dimensions gave surprisingly encouraging results comparable to the WMAP outputs, but the models were not axiomatically coherent in the apportioning and distribution of matter, antimatter and negative matter.

4.2 Gravity as a function of two directions in a 3-dimensional chronoverse.

A satisfactory mathematical model was devised in a spherical universe (the “chronoverse”) of three orthogonal time-like directions requiring eight types of masses, one for each octant, to ensure symmetry between the positive and negative masses and preserve net zero mass energy content. Four of the mass types are negative matter ($z<0$), four are positive matter ($z>0$); normal matter and three types of “non-normal” positive matter consisting of antimatter, pseudomatter and pseudoantimatter.

The z and y axes are involved with the gravity calculations. That quantum gravity could be formulated in two dimensions rather than three is a feature of the “holographic principle”; noting that our universe and a black hole both have event horizons defined by the Schwarzschild radius and that properties like the entropy of a black hole are proportional to the two-dimensional area of its event horizon. In Model OMG the dimensions are time-like rather than spacial.

The x axis and y axes are involved in a similar treatment of electrostatic potential. This will be demonstrated by calculation of the Planck fine structure constant alpha from first principles, using no free parameters and only the electron mass as an input datum (section 6.3.1 below).

Particle mass is assumed to be a function of the coordinates. The natural mass M of the fundamental unit particle, $M=1$, can then be given by functions such as $\tan\theta$ or $\cot\theta$ when

$\theta = \pi/4$. If mass is given by $\tan\theta$ then the universe has infinite mass at $\theta=90$ degrees, when $t=0$ (Big Bang theory) but decreasing at later times (zero at $\theta=0$, when $t=1$ = running “now”). This is

not in accord with Big Bang nor with Model OMG. On the other hand if the mass is given by $\cot\theta$ then the universe starts at zero mass and increases to infinity with time in accord with Model G and the foundational relationship $|M|=kt$ with $k=c^3/G$. Hence we adopt $M=\cot\theta$ as an ansatz for both sign and magnitude of mass in natural units. Intuitive symmetry considerations then drive acceptance of an axiom that the angle $\theta = \pi/4$ is critically involved with defining the units of natural mass and/or a key fermion, further intuited to be the electron.

4.3 The location of the “Observation Point”. The Observation Point (OP) is defined as the coordinates of the location in the chronoverse where the unit natural mass and unit natural charge particle tests and reports on the gravitational and electrostatic properties of the particles on the surface of the chronosphere. The OP is placed at coordinates (1,1,1) at a distance $\sqrt{3}$ from the origin, outside the surface of the **fermion chronosphere, which is of unit radius**. The observation point must accept the presence of unit mass and charge. In spherical coordinates, the theta value of the OP is determined from $\cos\theta= z/(\text{radial distance})=1/\sqrt{3}$, giving theta= 0.9553... The φ value is $\pi/4$ as determined by $\tan\varphi=y/x=1$. Contrarily for the particles on the chronosphere we proposed in 4.2 an axiom that unit mass existed on the surface of the sphere at $\theta = \pi/4$ and might then be represented by the cotangent function. We can reconcile these requirements if mass is not solely dependent on the angular coordinates but also on the radial

distance. A suitable formula is $M_i = \sqrt{2}(r \cos \theta)(\cot \theta)$, thus $M=1$ for particles located at either the OP ($r=\sqrt{3}$, $\theta=0.9553\dots$) or the position on the chronosphere ($r=1$, $\theta = \pi/4$). For the fermionic particles on the surface of the unit radius chronosphere we can ignore this.

Mass creation generates 8 particles, one per octant, each on the surface of the unit radius 3D chronosphere. The coordinates of each mass therefore obey the spherical geometric condition $x^2 + y^2 + z^2 = 1$. The eight masses/matter types are designated M1 to M8 and are allocated to the octants in Figure (1). It is arbitrarily assigned that normal matter M1 resides in the octant with all positive values for the coordinates, designated octant 1, also containing the test particle location at coordinates (1,1,1).

The negative matter counterpart M7 is diametrically opposite in octant 7. The sign of the masses in Figure (1) is given by either the sign of the z Cartesian coordinate or equivalently by $\cot(\theta)$ where θ is the polar angle of the mass in spherical coordinates with the z axis as reference polar axis.

An important consequence of the final Model is that gravity only acts in the y and z direction in Figure (1), and the strength of the gravitational potential is determined only by the sum of the displacement of the masses from the OP (note that this is not a vector addition). Masses in negative z octants (octants 5,6,7,8) have negative mass and all masses in positive z octants (octants 1,2,3,4) have positive mass. Therefore all masses in negative octants, the negative z hemisphere of the chronosphere, are gravitationally repulsive to normal matter. Because antimatter (e.g. positron with + charge) reacts with normal matter (electron with - charge) to release positive energy it is assigned to positive z octant 2 with opposite charge to octant 1. Octants 3 and 4 are "other positive matter" designated as pseudo antimatter and pseudomatter respectively. Hence antimatter is in a 1:1 ratio with matter. Antimatter can be regarded as being positive matter that is backwards in x-time or "sideways in experiential time" to normal matter whereas the negative matter particles are to be regarded as "backwards in experiential time" (negative z time) with respect to normal matter. It can be considered that it is z-time that we experience phenomenologically as the flow of time. It is the crucial z-time reversal that causes the gravitational effects of negative matter on positive matter to appear repulsive. Denizens of the negative z time (antichronous) hemisphere would perceive gravity in their universe as attractive and gravitational forces would be experienced there exactly as in our positive mass (orthochronous) hemisphere i.e. the opposing hemispheres constituting experientially "mirror universes". *It is proposed that however there is only one universe and all eight matter types exist in the one physical 3D space but are separated in the temporal 3D chronosphere.* This is an essential feature of the chronoverse to explain the Planck findings, that all the matter chronotypes must co-exist and are in constant gravitational communication. Sakharov (1982) proposed full CPT invariance is achieved within a time polarised universe by balancing an excess of positive matter in the orthochronous sector by an equal excess of antimatter in the antichronous sector, but that is not proposed in Model OMG; the latter sector does not contain antimatter (which resides only in "our" hemisphere), along with matter) but contains negative antimatter, and both hemispheric time sectors are perfectly balanced wrt their local "matter" and "antimatter" chronotypes.

4.4 The gravitational equations

The gravitational outcomes of Model OMG are partitioned in the following way. The masses occupy positions on the surface of the chronosphere. The interaction of a normal, unit positive mass test particle positioned at the OP coordinates (1,1,1) with each mass is calculated as the simple sum (not vector sum) of the y and z separations (Δ values) of the test particle from the relevant mass and the interactions are summed for each mass type.

Normal matter is assigned to M1 in octant 1. M2 is antimatter, M3 and M4 are other positive matter and M5 to M8 are negative matter.

For the three positive masses, the separations are respectively, for M2: Δy is (1-y) and Δz is (1-z) while for M3: Δy is (1+y) and Δz is (1-z), and for M4: Δy is (1-y) and Δz is (1-z). The delta values for the Dark Energy masses, M5,M6,M7,M8 similarly follow. These delta values are entered in the gravitational equation for each mass type Table (1) and equated to the per cent mass energy density p for that mass type, with a conversion factor f . The conversion factor is derived from the sum of the gravity equations and converts the raw gravitational outputs to percentages of the total. The energy densities are represented by p_1 , p_2 and p_3 , the percentage of total energy

density contributed by each mass type to the total energy density of the universe, as in the Λ CDM model. Ignoring the tiny contribution of radiation to the energy density then obviously $p_1+p_2+p_3=100$.

Matter type		Displacement from test mass at (1,1,1)			Chronotype $\Sigma(\Delta z + \Delta y)$	Gravity
		$\Delta z.$	$\Delta y.$			
Positive.	M1 Normal.	1-z	1-y	2-z-y	=f(p1)	
	M2. Dark Matter.	1-z.	1-y			
	M3 Dark Matter.	1-z	1+y			
	M4. Dark Matter.	1-z	1+y	6-3z+y	=f(p2)	
Negative.	M5. Dark Energy.	1+z	1-y			
	M6. Dark Energy.	1+z	1-y			
	M7. Dark Energy.	1+z	1+y			
	M8. Dark Energy.	1+z	1+y	8+4z.	=f(p3)	
Sum all matter. 16.					=f(p1+p2+p3)=100f	

Table 1. Gravitational contributions of the 8 chronotypes in the 3D chronoverse with allocation to normal matter, dark matter and dark energy.

4.5 Calculation of the Planck Dark Energy, Dark Matter and Normal Matter Content of the Universe

Sections 5.2.1.4 and 5.3.3 determine the fundamental gravitating particle to be a quark substituent (dubbed a preon) with $\theta = 0.724085304120635$ and $\phi = \pi/4$. Note that very similar but inferior results are obtained if φ has the same value as θ but there is no a priori reason for identical θ and φ values for the preon. The μ and τ leptons have the same charge as the electron despite widely differing masses. Using the usual formulas for conversion of spherical geometry coordinates to cartesian, with unit radius;

Thus $x = \cos\phi \sin\theta = 0.4962454412$

$y = \sin\phi \sin\theta = 0.4388406836n$

$z = \cos\theta = 0.7491056776$

The cartesian coordinates generate the **gravitational equations** (13) to (16):

Normal matter	$2-z-y = 0.8120536388 = f(p1)$	(13)
Dark matter.	$6-3z+y = 4.1915236508 = f(p2)$	(14)
Dark energy	$8+4z = 10.9964227104 = f(p3)$	(15)
SUM	$16 = f(p1+p2+p3) = f(100)$	(16)

Therefore from (16), $f = 0.16$ and the matter density fractions p_1 to p_3 can be calculated from (13)-(15). The model p_1 , p_2 and p_3 percentage gravitational masses are compared in Table (2) to the Planck mission outputs, Aghanin et al, Planck Collaboration (2020) which supercede the earlier WMAP results, Hinshaw et al (2013).

	Model OMG	Planck Collaboration
Normal matter.	4.89044419946	4.9.
Dark matter.	26.38191390015	26.6.
Dark energy.	68.72764190038	68.5.

Table 2. Comparison of Model OMG matter energy density calculations with Planck percentages.

Successful prediction of the Planck results from the Model mass and charge calculations for the preon is based on the foundational axiom that the electron occupies a privileged position in the chronosphere with θ and $\phi = \pi/4$ and validates the axiom.

Note that the ratios of the masses in the Model are matter/other positive matter (including antimatter)/ negative matter = 1/3/4 but the ratios of the gravitational masses are 1/5.4/14. The "other positive matter" and the negative matter both punch above their weight in terms of gravitational impact due to the greater delta time values.

In accord with the Λ CDM model, gravitational repulsion of the test mass by negative matter exceeds gravitational attraction by positive matter, explaining why the universe is characterised by expansion on the large temporal scale but not at the smaller, local temporal scale of gravitationally bound bodies. And note that by summing the internal displacements of the 8 chronotype masses the **total gravitational potential *within* the chronosphere is zero (likewise the total electrostatic potential).**

4.6 Reconciliation of the quantum and cosmological scales. In section 4.1 we established a foundational formula $GM/r = c^2$ which is only, and exactly, true at the Planck quantum scale and wildly untrue at macro scales; this morphed via $GM = c^3 t$ into an equation ultimately found to predict very accurately the gravitational properties of the cosmos, $GM = c^3 \Delta t$ or $M = \Delta t$ in natural units.

The intuitive leap from t as normal time to Δt as the difference between time-like coordinates in a chronoverse somehow transitioned from the quantum to the cosmological. The coordinates for any particle are identical for all particles of that type in universe, in other words independent of the particular spacetime coordinates of a particular particle: we interpreted this as the coordinates being particle-specific quantum signatures rather than spacetime grid coordinates, a form of background-free quantum entanglement or non-locality. The only dimensional measure determining gravitational potential is the differences between the particles' x and y coordinates and those of the unit mass/unit charge test particle: so if we were determined to retain locality in the model we could say that the test particle represents an average of all the other particles in the universe with the observation point as the average location of said particles. Using the model to calculate e.g. the gravitational potential of simple macro bodies is not obvious, nor is how to devolve the model into simple Newtonian gravity, so the two descriptions remain distinct. Beyond that, "Hypothesis non fingo"!

5. Particle coordinates on the Chronosphere are derived from Quantisation of Mass and Charge

5.1 Role of quarks, preons and electrons

It seemed obvious that the model should incorporate particle physics, in particular to predict the masses or at least the ratios of the magnitude of the masses of the elementary particles in the Standard Model, currently inexplicable. The coordinates, on the chronosphere, of the fundamental particles of the universe determine their quantum signatures and thence mass and charge and therefore gravitational and electrostatic behaviour. Therefore by deducing the quantisation formulae for mass and charge we can locate the fundamental particles of the universe on the chronosphere and use the coordinates to calculate fundamental gravitational and electrostatic properties of the material universe.

Two key intuitions were adopted as axioms:

1: Gravitational potential is determined by the up and down quarks, which in the form of atomic nuclei, comprise the bulk of the matter in the universe. As the quarks differ in mass and charge, a common subcomponent of the quarks is proposed as the basic gravitic and electrostatic unit. We shall refer to this particle as a preon, acknowledging many previous proposals for such a particle and noting that as a component of the quarks it is subject to quark confinement in the nucleus and hence not a free particle under normal circumstances. The fractional charge of the quarks supports their construction from smaller fractional charge components.

2: Fundamental particles will reside on the chronosphere at the spherical angles $\theta = \pi/4$ for mass and $\phi = \pi/4$ for charge. It is intuited that these particles are constituents of normal fermionic matter. The mass particle was assumed, and confirmed, to be the electron, a fermion with mass intermediate between the almost massless neutrinos and that of the up and down quarks, and free to exist outside the nucleus. The fundamental charge particle with spherical azimuthal angle $\varphi = \pi/4$ is also proposed to be the electron.

These axioms may appear to be contradictory but will be shown to reconcile and enable both free and confined fermions to define the basic properties of the universe.

In section 5.2.1.3 we first derive mass quantisation formulae for some of the leptons (electron, muon and tau particle) and deduce the existence of a preon-like particle. Section 5.2.1.4 derives the chronosphere coordinates for the fundamental gravitating particle of the universe. In section

4.5 we used this information to predict the gravitational properties of the universe from the chronosphere coordinates of the component of the quarks making up baryonic matter, assumed to be the aforementioned preon. In section 5.2.1.5 we extend the Model to quantisation formulae for the masses of the quarks and in Section 5.2.1.6 the same approach is applied to the neutrinos.

Finally in section 5.3 we extend the model to the quantisation of electric charge of leptons and the resulting electrostatic potential of charged particles in a similar way to the mass quantisation and gravitational potential of fundamental particles. This extension is applied to the calculation of the Planck fine structure constant and predicts the existence of the “tritoelectron” (mass= $1/3 m_e$; charge = $1/3 q_e$)

5.2 Mass Quantisation of the fermions (leptons and quarks):

5.2.1 The leptons ; electron, muon and tau particle.

Consider a particle n with mass M_n in natural units and mass m_n experimentally in SI units.

Assume there is a natural particle $n=0$ that embodies unit natural mass, $M_0=1$, with experimental mass m_0 thus $m_0 = m_0 M_0$; hence m_0 converts mass in natural units into SI units. For other masses $m_i = m_0 M_i$. We now propose that the natural mass M is a function of the particle coordinates in the chronoverse $M_i = F_m(r, \theta)$ and similarly the particle charge is $Q_i = F_q(r, \varphi)$. It was adopted as an ansatz that the theta and phi values of the electron on the chronosphere are $\pi/4$. Events will justify this intuition that the electron occupies a privileged place in the chronosphere and particle physics.

This fundamental axiom in the model enables the calculation of all the particle masses. Thus $m_e = m_0 M_e$ so $m_0 = m_e / M_e = m_e / F_m(r, \theta) = m_e / F_m(1, \pi/4)$ where we assume the particle resides on a chronosphere of natural unit radius. To determine all the particle masses we need just two more things: the nature of the function F_m and the quantisation scheme for the particle polar angle theta. Similar arguments apply for the charge calculations, where the charge is dependent on the azimuthal angle phi.

It is shown below that the fundamental particle defining natural unit mass is the electron with natural mass of one unit, $M_e = 1$, equating to SI mass $m_e=0.51099895$ MeV. This is expected because the unit mass and charge particle has to be at $\theta= \varphi= \pi/4$ in order for the gravity and electrostatic calculations to independent of the mass and charge of the test particle. The mass quantisation suggests another fundamental particle of slightly higher mass $M=1.283768842$ or $m =0.5765994030$ MeV, the particle primarily responsible for the gravitational properties of baryonic matter (of all 8 temporal types) because it is proposed as a fundamental quark constituent. The masses of the above leptons are calculated below.

5.2.1.1 Bessel function in cylindrical coordinates.

As in quantum field theory, the basis of the Standard Model, particles (fermions or bosons) are regarded as excitations or fluctuations in quantum fields; Model OMG differs from the Standard Model in that there is only one field necessary, the chronoverse field, not the individual fields for each particle. Application of wave mechanical analysis in three dimensions leads logically to the involvement of Bessel functions. The modified Bessel equation of the second type (AKA Basset function, Macdonald function, modified Bessel function of the third kind, modified Hankel function) is favoured as it behaves in the expected manner having real, positive values exponentially decreasing as the argument increases, rather than an oscillating function.

The modified Bessel Function of the Second Kind of order n , $K_n(\theta)$ is one of the two independent solutions of the Bessel equation with an imaginary argument, resulting from the process of separation of variables.

The function is conveniently available in excel worksheets under engineering functions.

Normally the Bessel equation describes oscillations of a wave function in a cylindrical coordinate system where there is symmetry around the cylindrical or longitudinal axis, with the argument of the function being the distance from the origin along the longitudinal axis; for example the amplitude of vibrations of a circular drum. In the case of the chronosphere the coordinates are time-like (but with the geometrised dimension of length as stated earlier), not physical distance along an axis, the argument of the function is just the polar angle theta, but alternatively the arc length $(r)\theta$, confounded with theta because the radius r is one unit. The radius r is involved in the mass calculation (see section 5.1 above) but is not relevant on the $r=1$ chronosphere. The

amplitudes of the oscillations describe masses. It will be shown that the longitudinal distance of the cylindrical coordinate systems referencing the z and x axes separately, translate satisfactorily into the Cartesian z and x axes and thence to the spherical coordinate system and that the cotangent function of the θ and φ angles can then replace the Bessel function to a good approximation.

The quantisation of the function is thought to be introduced via the imposition of appropriate boundary conditions during the solution of the modified Bessel equation, as occurs in the solution of the Schrodinger equation. The author cannot attempt this derivation in rigorous form and invites those more experienced in the matter to explore the challenge, however the following empirical relationships were found;

The fermion masses are given by equation (17)

$$M_i = \frac{K_1(\theta_i)}{K_1(\pi/4)} \quad (17)$$

where K_1 is the modified Bessel function of the second kind of order 1. **The fundamental particle of unit mass is the electron**, with $\theta_e = \pi/4$, $M_0 = M_e = \frac{K_1(\pi/4)}{K_1(\pi/4)} = 1$

The θ value for $K_1\theta = 1$ is assigned to a particle dubbed the preon, $\theta = 0.724085304120635$ rad. The mass in natural units M_p of this particle is, equation (18)

$$M_p = \frac{K_1(\theta_p)}{K_1(\pi/4)} = 1.1283768842 \quad (18)$$

The fermion masses are quantised at the level of the polar angle θ :

Quantisation of the polar angle:

$\theta_i = \frac{\pi}{2k_i}$ where k_i is the quantisation parameter.

Table 3 gives the empirical k values required to yield the experimental masses of the fermions (omitting neutrinos)

Fermion	Fermion index	Quantisation factor k
Electron.	4.	2
Up quark.	5.	6.283
Down quark.	6.	13
Strange quark.	7.	253
Muon.	8.	287.5
Charm quark.	9.	3461.5
Tau.	10.	4838.0
Beauty quark.	11.	11388.2
Top quark.	12.	470639.5

Table 3. Fermion indices for the non-neutrino fermions and the quantisation parameter values required by the experimental fermions masses (Particle Data Group values).

The Model quantisation parameter k for the non-neutrino leptons is determined by the Fermion indices i and l , equation (19)

$$k_i = \frac{l(i-2)!}{5^{l-1}} \quad (19)$$

The experimental mass of a fermion with fermion index i is m_i MeV, equation (20)

$$m_i = m_e M_i \quad (20)$$

where the mass m_e of the electron in MeV is the conversion factor for the ‘‘currency exchange’’ from natural units to human measured SI units, M_i is the natural mass of the fermion with the natural mass scale set by the electron, $M_e = 1$, and $m_e = 0.51099895$ MeV. Thus equation (21)

$$m_e = m_e \frac{K_1(\pi/4)}{K_1(\pi/4)} = m_e \quad (21)$$

The SI mass of the preon is, equation (22)

$$m_p = m_e M_p = 0.576599403 \text{ MeV} \quad (22)$$

Note in passing that the preon mass is close to the value of Euler's constant (AKA Euler-Mascheroni constant) 0.577215... which features in the solutions of the Bessel equation. It is also close to $\frac{1}{\sqrt{3}} = 0.577350...$ where $\sqrt{3}$ is the radial distance to the OP but these observations are purely coincidental.

θ_i is the angular position or azimuth in cylindrical coordinates, which will become the polar angle for the particle on the chronosphere in spherical coordinates (the Cartesian z axis being the reference axis in both cases).

k is the quantisation parameter made up from 2 quantum numbers i and l ;

i is the **fermion index number when the fermions (6 leptons and 6 quarks) are listed in order of ascending mass energy Table 4:**

i	1	2	3	4	5	6	7	8	9	10	11	12
lepton	ν_e	ν_μ	ν_τ	e				μ		τ		
quark					u	d	s		c		b	t

Table 4. Fermion index quantum number i for the fermions arranged in ascending mass energy.

Note that all three neutrinos are listed as lower energy than the electron: in the Standard Model of particle physics there is uncertainty as to the masses of the neutrinos but there is an upper limit on the heaviest neutrino ($\nu_\tau < 18.2 \text{ MeV}$) which lies well **above** the electron mass (circa 0.511 MeV). Listing the τ neutrino as **lighter** than the electron gives the neutrinos i indices of 1 to 3; these values are validated in the ensuing quantisation formulae for the e, μ, τ leptons. The Model thus insists that the masses of the neutrinos are all less than the electron mass.

5.2.1.2 Cotangent function in spherical coordinates

As postulated in the initial thoughts on the chronosphere, the cotangent function in spherical coordinates also yields a useful description of the masses (and charges) of the fermions. The cotangent function converges, at **low** values of the argument, with the modified Bessel function of the second type, order one, and offers an alternative function under those conditions. Usefully it delivers quite accurate lepton mass values but it is the Bessel function description that is based on wave-mechanics and draws attention to the preon, otherwise not discerned in the cotangent description.

Thus for small θ (e.g. $< \pi/4$) we can replace the Bessel function in equation (17) with the cotangent, giving the natural mass, equation (24)

$$M_i = \frac{\cot(\theta_i)}{K_1(\pi/4)} \quad (24)$$

and the SI mass, equation (25)

$$m_i = m_e \frac{\cot(\theta_i)}{K_1(\pi/4)} \quad (25)$$

Once again θ is quantised as described above.

Note that the value $\frac{1}{K_1(\pi/4)} = 1.1283768842$ is closely approximated by

$$\sqrt{\frac{1}{\pi/4}} = \frac{2}{\sqrt{\pi}} = 1.128379167, \text{ i.e. approximately, } K_1(\pi/4) = \frac{\sqrt{(\pi)}}{2}$$

5.2.1.3 Calculation of the Masses of the Electron, Muon and Tau Particle

Table 5 lists the 3 heavier leptons and their quantisation indices and compares their experimental masses with those calculated from both the Bessel and cotangent calculations. The only input parameter is the electron mass. The calculated mass for the electron using the Bessel function will be equal to the input value by definition; that from the cotan function is not accurate due to divergence of the Bessel and cotangent functions at high values of θ (or low values of k).

Fermion Index i .	Gen Index l	Lepton.	Quantisation parameter k .	Calculated mass (MeV)		PDG mass (MeV)
				Bessel.	Cotangent.	
4.	1.	Electron.	2.	= m_e	na.	0.51099895000
8.	2.	Muon.	288	105.7083162.	105.7164309.	105.6583755
10.	3.	Tau.	4838.4.	1776.053.	1776.053.	1776.86

Table 5. Calculated masses of the heavy leptons using Bessel function, $m_i = m_e \frac{K_1(\theta_i)}{K_1(\pi/4)}$ or

cotangent function, $m_i = m_e \frac{\cot(\theta_i)}{K_1(\pi/4)}$ where m_e is the mass of the electron and $\theta_i = \pi/2k_i$ and the quantisation parameter $k_i = \frac{l(i-2)!}{5^{(l-1)}}$

The Bessel function and quantisation parameters were developed starting with the axiom that the spherical angle θ for the electron is $\theta_e = \pi/2k_e = \pi/4$, hence $k_e = 2$.

The calculated masses agree in general with the experimental masses but not to the full precision of the experimental values. A possible reason for this is that the correct function could be the “**incomplete** Macdonald (AKA modified Bessel) function” rather than the modified Bessel function. These functions can be expressed in the form of integrals; the Macdonald function integrates from 0 to infinity whereas the incomplete Macdonald function has a variable endpoint of integration e.g. in dealing with electromagnetic problems in a truncated cylindrical structure. These incomplete functions “have a well-deserved reputation of being a computational challenge...” Shu (2020), and will not be further explored in this Model.

5.2.1.4 Calculation of the ratios of normal matter, dark matter and dark energy

Returning to the gravity equations for normal matter, dark matter and negative matter (dark energy)

A most important take-aways from mass and charge quantisation section are (a) the natural mass of the preon, M_p , the fundamental quark constituent proposed as the major contributor to the baryonic, gravitating masses of the universe and (b) the θ, φ angles for this particle on the chronosphere which determine the gravitational consequences, in particular yielding the energy density fractions for normal matter, dark matter and dark energy, in accordance with the Planck mission results.

Thus the fundamental gravitating particle, which we have referred to as a preon, acknowledging the various preons previously proposed as sub components of baryonic matter, is proposed to correspond to the unit value of $K(1)$, that is $K_1(\theta_p) = 1$. This corresponds to $\theta_p = 0.724085304120635$.

In section 5.3.1 on the Fine Structure Constant we determine that to obtain (approximately) the correct value, the angle φ for the preon is the same as the electron i.e. $\varphi_p = \pi/4$.

Thus we propose the preon, the fundamental gravitating particle, has $\theta = 0.724085304120635$ and $\varphi = \pi/4$

then the axis coordinates from spherical geometry with chronosphere radius 1 unit are;

$$x=0.4962454412$$

$$y=0.4388406836$$

$$z=0.7491056776$$

Inserting these values in the gravity equations gave the results presented in section 4.5 above.

5.2.1.5 Calculation of the Quark masses, indicating a quark substructure of preons and a superposition of virtual preons.

The application of the fermion index to the masses of the leptons encouraged the belief that a similar treatment of the quarks is possible even though we have already proposed that the up and down quarks are actually compound particles made from preons.

Thus the SI mass of a quark, m_q , is given by $m_q = m_e \frac{K_1(\theta_q)}{K_1(\pi/4)}$ where $\theta_q = \frac{\pi}{2k_q}$.

Table 3 above gave the values of the quantisation parameter k required to explain the known masses of the quarks.

Preliminary explorations found that approximate k values of the two lightest quarks could be calculated according to the following formulae, equations (26) and (27):

Up quark; $i=5$

$$k_u = \frac{5(24)}{19} = 6.315789474 = \frac{5(i-1)!}{(C_{3,3})} \quad (26)$$

Down quark; $i=6$

$$k_d = \frac{5(120)}{46} = 13.043478261 = \frac{5(i-1)!}{(C_{3,5})} \quad (27)$$

Here the quantisation parameter k involves the fermion index i and introduces **centered triangular numbers (CTN)**; the involvement of the latter offer clues to the substructure of the quarks as they initially suggest triangular arrangements of sub-components layered around a central particle. Particles such as the preons invoked in section 5.2.1.1, or even electrons, are good candidates for such sub components. For example four electron masses almost equate to one up quark and nine electrons to one down quark. Cziraki (2023) has published a theory of quark structure built up from electrons and positrons and neutrinos. We have already proposed the preon as the quark constituent, in which case four preons each of mass 0.5766 MeV give a total mass of 2.3064 MeV, exceeding the up quark mass of 2.16 MeV by 0.1464 MeV, which could be expressed as kinetic energy; it is far too small to be the binding energy of the preon cluster in view of the quark resistance to fragmentation. The CTN, $C_{3,n}$ are generated by

$C_{3,n} = (3n^2 + 3n + 2)/2$ so the first 6 numbers are $C_{3,0} = 1$, $C_{3,1} = 4$, $C_{3,2} = 10$, $C_{3,3} = 19$, $C_{3,4} = 31$, $C_{3,5} = 46$.

For the heavier quarks it was difficult to find a clear pattern in the higher centered triangular numbers required to deliver the quark masses but a satisfactory formula was found first for the up-type quarks, which established a pattern successfully extended to the even more obstinate (due to relatively low precision of the strange quark mass) down-type quarks.

The formulae now include the generation index, l . The only input physical parameter is the electron mass but the preon mass could equally be used with $m_e = m_p K_1(\pi/4)$. The CTN are free parameters in the sense that they are chosen to empirically fit the quark masses, a suitable general formula in terms of the quantum indices not yet developed but the following logic may offer a beginning; the CTN for the up quark is $C_{3,3} = 19$ which can be decomposed into the sum of three simple **triangular numbers** T_n , specifically $C_{3,3} = T_2 + T_3 + T_4 = 3 + 6 + 10 = 19$ Each T_n equates to the number of ways of choosing two numbers out of $n+1$, i.e. “ $(n+1)$ choose 2” or $\binom{n+1}{2} = n(n+1)/2$. Thus 19 is the sum of “3 choose 2”, “4 choose 2” and “5 choose 2”; the 3 and the 4 are $t(+)$ tritopreons for a total of $7t(+)$ and the 5 are the $5t(-)$ tritopreons, constituting the 12 tritopreons of the up quark. Choosing $2t(+)$ tritopreons out of n is equivalent to counting the number of ways to form a preon of type $2t(+)+t(-)$ by combining with a $t(-)$, so the total count of 19 is the total number of phantom preons that are possible from $7t(+)$ and $5t(-)$ tritopreons; implying that the up quark is not just an assembly of 4 real preons but a quantum superposition of 19 (pseudo)virtual or phantom preons.

Solving the genesis of the $C_{3,n}$ for the quarks in general will shed further light on the detailed quark structure; e.g. the above up quark $C_{3,3}$ decomposition is suggestive of a shell model with the 12 tritopreons in 3 shells i.e. 3t(+),4t(+),5t(-). Similarly for the down quark with 13(t+) and 14(t-) we can postulate an inner core 2(t-),3(t+),4(t+) plus outer shells 5(t-),6(t+),7(t-); The inner core of 9 tritopreons is “closed” and does not contribute to the phantom preon count which depends on the outer shells of 5,6 and 7 tritopreons delivering phantom preons=

$\binom{2}{5} + \binom{2}{6} + \binom{2}{7} = 10 + 15 + 21 = 46 = C_{3,5}$. It is thus apparent that only the 3 outermost shells contribute to the phantom preon count.

Table 6 gives the completed quark quantisation formulae and compares the calculated and experimental (Particle Data Group) masses; data are divided into the 3 up-type quarks followed by the 3 down-type quarks in order to display their respective patterns. All calculated masses are within the experimental uncertainty. The “down-type” pattern does not progress as smoothly as the “up-type” pattern where the $C_{3,n}$ increase monotonically with the mass of the quark, and further, the down-type pattern for the beauty quark requires $C_{3,86} = 11,224$, an atypical, large value casting some doubt on this pattern.

Note that the PDG quark masses are not all on the same basis; the u,d and s masses are “current- quark masses, the c and b masses are “running masses” and the t mass is the “pole mass”.

Quark		i	l	Quantisation Parameter k	M(calc) MeV	M(exp) MeV	+	-
up	u	5	1	$\frac{3^{l-1}5^{l(l-1)}(i-1)!}{C_{3,3}}$	2.172	2.16	0.49	0.26
charm	c	9	2	$\frac{3^{l-1}5^{l(l-1)}(i-1)!}{(C_{3,3})(C_{3,5})}$	1270.0	1270	20	20
top	t	12	3	$\frac{3^{l-1}5^{l(l-1)}(i-1)!}{(C_{3,3})(C_{3,5})(C_{3,8})}$	173031	172760	300	300
down	d	6	1	$\frac{2^{2(l-1)}5^{2l-1}(i-1)!}{(C_{3,5})}$	4.692	4.67	0.48	0.17
strange	d	7	2	$\frac{2^{2(l-1)}5^{2l-1}(i-1)!}{(C_{3,5})(C_{3,4})}$	92.66	93	11	5
beauty	b	11	3	$\frac{2^{2(l-1)}5^{2l-1}(i-1)!}{(C_{3,5})(C_{3,4})(C_{3,86})}$	4161.2	4180	30	20

Table 6 Comparison of calculated and experimental (PDG) masses for the quarks, grouped into up-and down-type quarks. Fermion index i , Generation index l , derived quantisation parameter k and PDG experimental uncertainties are shown.

5.2.1.6 Extension to the neutrino masses

Debate continues as to whether neutrinos have mass: the Standard Model gives them zero mass, while neutrino oscillation indicates that they do have mass but this could be positive or negative as experimental data only gives access to the difference of the squares of the masses.

It is obvious that the lepton quantisation formula cannot apply to the neutrinos since, for example, the lightest has fermion index of 1 so the quantisation parameter would include the factorial of a negative number $(i-2)!$ If the neutrino quantisation parameters follow the quark pattern rather than that for the other leptons then the electron neutrino with $i=1$ will have an acceptable quantisation parameter incorporating $0!=1$. Uniquely for the neutrinos the fermion index i and the generation

index l are identical. In fact we will find a mass formula containing just the fermion/generation index, without factorial.

The neutrino flavours ν_e, ν_μ, ν_τ are linear combinations (superpositions) of the fundamental mass eigenstates m_1, m_2, m_3 . Neutrinos are emitted and absorbed by weak processes in flavour eigenstates but travel in mass eigenstates.

Experimentally we only have access to the difference of the squares of masses (e.g. Esteban et al (2019) equations (28) and (29). Subtracting (29) from (28) yields equation (30)

It is not known if the neutrino energies are ranked in normal order $m_1 < m_2 < m_3$ or reverse

$$m_3^2 - m_1^2 = 2.525(+0.33, - 0.31)exp(-3)eV^2 \quad (28)$$

$$m_2^2 - m_1^2 = 7.39(+0.21, - 0.20)exp(-5)eV^2 \quad (29)$$

$$m_3^2 - m_2^2 = 2.451exp(-3)eV^2 \quad (30)$$

order $m_1 > m_2 > m_3$ and because the squared mass terms are involved it cannot even be excluded that some masses are negative. The following assumptions are made: masses are positive: masses follow the normal order: the mass formula follows the examples of those for the leptons and quarks but may be simpler, befitting the smallest particle, normally presumed to be elemental, not composite; as a first approximation, the lightest neutrino mass state has mass very close to zero.

Hence with $m_1^2 = 0$, approximately $m_2^2 = 7.39exp(-5)eV^2$ and $m_2 = 0.00859eV$

and approximately $m_3^2 = 2.525exp(-3)eV^2$ with $m_3 = 0.05025eV$

The reference mass m_0 is the same as for the other 9 fermions, m_e the electron mass 0.5109 MeV, better expressed as $0.5109 \exp(6) eV$ at the neutrino scale.

By allowing m_1 to have a very small but non-zero mass the experimental results can be fitted:

$$m_1 \quad 0.00007 \text{ eV}$$

$$m_2 \quad 0.0085965 \text{ eV}$$

$$m_3 \quad 0.050249 \text{ eV}$$

meeting the requirements of equations (28) and (29).

An empirical formula for the neutrino masses was devised based on the same Bessel function used for the other fermions. To obtain the very small neutrino masses a high value of the argument of the Bessel function is required. Rather than have a very high angle θ , an expanded radius R of the chronosphere is employed with the Bessel argument as $R\theta$. For the other fermions the radius is 1, corresponding to a radial distance of the OP of $\sqrt{3}$. Thus we obtain satisfactory masses m_j for the mass states j using the empirical formulae, equation (31), Table (7)

$$m_j = m_e \frac{K_1(R_j\theta_j)}{K_1(\pi/4)} \quad (31)$$

Where $R_j = \sqrt{(8-j)}$ and $\theta_j = \pi/j$.

mass state $j = i = l$	Neutrino Mass	R	$R\theta$	Mass (eV)
1	m_1	$\sqrt{7}$	8.31187288	0.00006424
2	m_2	$\sqrt{6}$	3.84764949	0.00857249
3	m_3	$\sqrt{5}$	2.34160491	0.05195839

Table 7. Calculated masses for the normal order neutrino mass states. With $\theta_j = \pi/j$. The index j corresponds to both the neutrino fermion- and neutrino generation- indices.

The calculated mass-squared differences are:

$$m_3^2 - m_1^2 = 0.00269967eV^2$$

$$m_2^2 - m_1^2 = 0.00007348eV^2$$

$$m_3^2 - m_2^2 = 0.00262619eV^2$$

If this aspect of the Model is correct then the radius of the chronosphere is $\sqrt{1}$ for all the fermions except the neutrinos which have radii $\sqrt{5}$, $\sqrt{6}$, $\sqrt{7}$ suggesting a 7-levelled chronoverse with the lightest particles at the greatest radius.

The question arises, “is there a level of the chronosphere corresponding to the fermion index $j=0$?

The radius is then $\sqrt{8}$. According to the equation for neutrino mass, $\theta = \pi/j$ is then infinite, the Bessel function and the mass are zero: which would fit massless particles like photons.

With $R=\sqrt{8}$ this chronoverse has 4 more time-like dimensions ($t_3 - t_8$) than the 4-D case needed to describe the non-neutrino fermions and is governed by the invariant, equation (32):

$$x^2 + y^2 + z^2 + c^2 + t_5^2 + t_6^2 + t_7^2 + t_8^2 = R^2 = d \quad (32)$$

where d is the chronoverse dimension so the square of radius increases by one for each added dimension; with three dimensions the radial distance to the OP is $\sqrt{3}$ increasing to $\sqrt{8}$ for 8 dimensions. In the case of the heavier fermions (indices 4-12) which are defined by the unit radius 3-D chronosphere, with quite complex θ quantisation, the radius is 1 rather than the OP distance. For the neutrinos (and photon) with simpler θ quantisation and only one particle on the chronosphere, the radius is that of the OP, \sqrt{R} . Then 8 time-like dimensions, combine with the 3 space dimensions to form the 11-dimensional universe favoured in brane theory.

5.3 Extension to Electromagnetic Potential

5.3.1 Calculation of the Fine Structure Constant

The fine structure constant (FSC), α , represents the coupling constant for the electromagnetic force between an electron and a photon and is a key constant in quantum theory.

The magnitude of the fine structure constant has been experimentally determined but there is no theoretical calculation to account for it. The FSC is usually shown as the reciprocal value α^{-1} , or inverse alpha, with the most recent value, from Fan et al (2023) =137.035999166(15). In the SI system α^{-1} is a dimensionless number and a source of enduring mystery and fascination. Sorokowski (2019) claims that the dimensionless character of the FSC is an artifact of the SI system of units, which he also claims to be deficient because it delivers a value for the Planck charge, $Q_p=1.876e-18$ C which is $\sqrt{137}$ times larger than the elementary charge $e=1.602e-19$ C contradicting the experimental fact that “electric charge values have always been a whole number multiple of elementary charge” (at least for free charges, confined charges like quarks have fractional e charge). He proposes two fixes for this situation: using the “MS” (metre second) system of units, which results in the Planck charge having correct dimensions iff an additional term with dimensions $m^{1/2}_s$ is included in the expression; the square root of the FSC in the MS

system has these dimensions. Incorporating these changes in the expression for Q_p corrects the dimensions in the MS system and delivers a result equal to the elementary charge. Sorokowski's thesis has apparently not been published in a peer-reviewed journal. As a dimensioned constant it would be possible for the FSC to have other values in different units, in particular if natural units are used. Frino (2017) derives an expression for the Planck charge

$$Q_p = \sqrt{2\epsilon_0 \hbar c} \text{ and using this in place of } e \text{ in the formula for } \alpha = \frac{e^2}{2\epsilon_0 \hbar c} \text{ gives what he terms the}$$

Planck fine-structure constant α_p with **unit** value. Christillin (2023) derives the same formula for Q_p (but expressed as $Q_p = \sqrt{4\pi\epsilon_0 \hbar c}$) from which he also finds $\alpha_p=1$ (not surprising as his starting point is to **assume** the equality of the Planck electromagnetic and gravitational forces) in fact he claims to show that all the coupling constants of the fundamental interactions (strong, electromagnetic, weak and gravitational) devolve to unit value at the Planck scale, as generally expected for the unified force. Haug (2016) based on a new dimensional analysis lends support to Christillin's assumption and asserts that "the gravitational force and the Coulomb's electrostatic force are ultimately the same formula at the Planck scale and also have the same strength". Model OMG, based on natural units, accepted as an ansatz the thesis that at the Planck scale, the FSC has unit value, this assumption leading to a coherent sub-quark structure based on tritopreons.

By direct analogy to the foregoing treatment of gravitational potential the x and y axes represent electrostatic potential. Displacements of Δx and Δy between two particles are summed to give the potential. This will be used to determine the fine structure constant from the ratio of the magnitudes of the electrostatic and the gravitational potentials between two particular charged particles.

We can treat the electrostatic charge in the same manner as the gravitational mass i.e. as a modified Bessel function of the second kind but with the x axis now as the polar axis of the cylindrical coordinates and the spherical angle φ replacing θ . It is useful also to bring them together in the spherical coordinates of the chronosphere, recognising that there is no favoured direction and no timelike axis is given mathematical preference over the other two (however there is obviously seems to be an experiential difference between the z axis and the other two), so spherical symmetry is adopted. As with the mass function the cotangent of φ converges on the Bessel function for small φ but is invalid at higher φ .

With this qualification the mass and charge functions are found to be well represented by cotangent functions at low angles. The observation point of necessity corresponds to a particle of unit natural charge or unit natural mass, simplifying the quantification of the gravitic and electrostatic interactions of a test or reporter particle at these locations with other particles embedded in/on the surface of the unit radius chronosphere. It was a strong expectation that the unit mass/unit charge particles would eventually be identified as one of the particles in the Standard Model of Particle Physics or a constituent of such, and through symmetry of the chronosphere, would have θ and/or φ values of $\pi/4$. This turned out to be true for mass where the preon, a quark constituent, has unit natural mass if $M = K_1(\theta)$ where $\theta = 0.724085304120635$ but the electron has $\theta = \pi/4$ with natural mass 0.88622. Alternatively if we put $M = \frac{K_1(\theta)}{K_1(\pi/4)}$ then the

preon has natural mass = $\frac{K_1(0.7240...)}{K_1(\pi/4)} = 1.1283879849$ and the electron has natural mass 1. The

latter case is adopted, fitting the starting axiom and indeed delivering a consistent result: **the electron is the particle defining unit value on both natural mass and natural charge scales, with the angles θ and $\varphi=\pi/4$.**

The masses of the fermions can thus be expressed as $m_i = m_e M_i = m_e \frac{K_1(\theta_i)}{K_1(\pi/4)}$ so

$$M_e = \frac{K_1(\pi/4)}{K_1(\pi/4)} = 1. \text{ Thus the electron represents the unit mass referenced by all the other}$$

particles. It is important to keep the angle $\pi/4$ reserved for unit mass and charge at the OP (a

necessary condition for gravity and electric calculations). This is not crucial in most purposes here as we deal mainly with ratios of masses, where the constant factor $\frac{1}{K_1(\pi/4)}$ cancels.

By analogy with the gravity and mass functions of the chronosphere it is proposed that the electrostatic potential and charge functions involve the x- and y-axes. Electrostatic potential depends on the sum of the x- and y-axis separations of the particle and the unit test charge. The charge of the particle is solely a function of the azimuthal angle φ . As we have seen, the gravitational and electrostatic forces (and potentials) are identical in form at the Planck scale so the Modified Bessel Function of the Second Kind, Order 1 is applied identically to both. Let us define "Particle alpha" as the entity responsible for the value of the FSC.

The definition of α is

$$\alpha = \frac{e^2}{4\pi\epsilon_0\hbar c}$$

where ϵ_0 =electric constant, \hbar =reduced Planck constant, c =speed of light.

Putting $4\pi\epsilon_0 = \frac{1}{k_C}$ where k_C is the Coulomb constant then $\alpha = \frac{k_C e^2}{\hbar c}$.

We then note that the Planck mass $M_P = \sqrt{\frac{\hbar c}{G}}$ where G is Newton's gravitational constant

$$\text{Thus } \hbar c = GM_P^2 \text{ and } \alpha = \frac{k_C e^2}{2\hbar c} = \frac{k_C e^2}{GM_P^2}$$

Thus one physical interpretation of alpha states that "given two hypothetical particles each of Planck mass and elementary charge, separated by any distance, alpha is the ratio of their electrostatic repulsive force to their gravitational attractive force". In fact the sign of the potentials is irrelevant i.e. whether repulsive or attractive, only the magnitudes are relevant.

Here we will place a hypothetical, test unit mass/unit charge at the observation point (1,1,1) and consider the gravitational and electrostatic interaction with "particle alpha" at the M1 position in octant 1. The displacements of the test particle, natural mass M_t from the M1 particle, natural mass M_α at (x,y,z) determining the electrostatic potential are thus $\Delta x=1-x$ and $\Delta y=1-y$ and the sum of the displacements is $1-x+1-y$.

The displacements of the test particle and M1 determining the gravitational potential are $\Delta z=1-z$ and $\Delta y=1-y$. The gravitational potential U_G and electrostatic potential U_E in natural units are given in equations (33) and (34):

$$U_G = G(\Delta z + \Delta y)M_\alpha M_t = G(1 - z + 1 - y)M_\alpha M_t \quad (33)$$

$$U_E = k_C(\Delta x + \Delta y)Q_\alpha Q_t = \frac{1}{4\pi\epsilon_0}(1 - x + 1 - y)Q_\alpha Q_t \quad (34)$$

where Q_α and Q_t are the natural charges of particle alpha and the test particle.

Since $\alpha = \frac{U_E}{U_G}$ and $\alpha^{-1} = \frac{U_G}{U_E}$, reciprocal α is given by equation (35):

$$\alpha^{-1} = \frac{4\pi\epsilon_0 G(2 - z - y)}{(2 - x - y)} \frac{M_\alpha M_t}{Q_\alpha Q_t} \quad (35)$$

We now need to acknowledge that the natural units of mass and charge are on different scales and determine a conversion factor. Christillin (2023) asserted that "...gravitation, electromagnetism and the strong interactions unify at the Planck scale" and explicitly claimed that the Planck charge is derived by equating gravitational Planck force to the electric, equation (36):

$$\frac{GM_P^2}{L_P^2} = \frac{1}{4\pi\epsilon_0} \frac{Q_P^2}{L_P^2} \quad (36)$$

Where M_P , Q_P and L_P are the Planck mass, charge and length.

$$\text{Thus } \frac{M_P^2}{Q_P^2} = \frac{1}{G4\pi\epsilon_0} \text{ and } \frac{M_P}{Q_P} = \sqrt{\frac{1}{G4\pi\epsilon_0}}$$

To convert mass and charge units to a common footing, each mass/charge term is multiplied by this factor, for both the test particle and particle alpha.

The test particle is of unit mass and charge, $M(\text{test})=Q(\text{test})=1$, and equation (35) becomes equation (37):

$$\alpha^{-1} = \frac{4\pi\epsilon_0 G(2-z-y)}{(2-x-y)} \frac{M_\alpha M_t}{Q_\alpha Q_t} \frac{1}{4\pi\epsilon_0 G} = \frac{(2-z-y)}{(2-x-y)} \frac{M_\alpha}{Q_\alpha} \quad (37)$$

And as ansatz we assumed this has the value =1, i.e. equal gravitational and electrostatic potentials.

By inspection it is obvious that $\alpha^{-1}=1$ when $M_\alpha = Q_\alpha$ and $z=x$, i.e. $\cos\theta = \cos\varphi \sin\theta$ or $\cot\theta = \cos\varphi$. This condition is met exactly only when $\theta = \varphi = \pi/2$ and both terms =0, representing a massless, chargeless particle i.e. the photon: this conclusion is "trivial" in the sense that the photon is the gauge boson the electron is coupled with. Is there also a particle embodying the other half of the coupling relationship, the electron? If it is not the electron itself then a constituent with suitably small mass and charge. The fractional charges (e/3, e2/3) of the quarks point strongly to an e/3 constituent.

5.3.2 Tritoelectron determines the FSC

If we define "particle alpha" as **1/3 of an electron (dubbed a tritoelectron)** then its natural mass

$$\text{is } M_\alpha = 1/3 = \frac{K_1(\theta_\alpha)}{K_1(\pi/4)}, \text{ hence } \theta_\alpha = 1.456431666552$$

$$\text{Similarly for the natural charge } Q_\alpha = 1/3 = \frac{K_1(\varphi_\alpha)}{K_1(\pi/4)}, \text{ hence } \varphi_\alpha = 1.456431666552$$

$$\text{and obviously } \frac{M_\alpha}{Q_\alpha} = 1$$

The above values of θ_α and φ_α yield the x,y,z and α^{-1} values below:

$$x=0.1133651922$$

$$y=0.9869787811$$

$$z=0.1141105558$$

Thus x and z are nearly equal and the ratio $(1-z+1-y)/(1-x+1-y)=0.9991715016$

Hence the Model Planck $\alpha^{-1}=0.9991715016$, versus theoretical value=1

Note that any $\theta = \varphi > 1.45$ will deliver values $1 > \alpha^{-1} > 0.999$. Thus any particle that has mass and charge 1/3 of the electron or less will give a satisfactory result, but choosing the tritoelectron is the simplest and delivers a coherent model leading to the consequential tritopreon as the basic structural unit for the quarks.

5.3.3 Tritopreons assemble into Quarks, excess mass released as kinetic energy.

If we accept the logic of the FSC calculation then the existence of the **tritoelectron rationalises the occurrence of experimental charges in units of 1/3 electron as in the quarks. With the view that the preon is the "precursor" of the electron then the tritopreon is also indicated as a latent tritoelectron.**

To best fit the gravitational data and the FSC the charge on the preon is the same as the electron, (but strongly qualified below), 1 natural unit, and both have $\varphi=\pi/4$. Likewise the charge on the tritopreon is the same as that of the tritoelectron, e/3. If 4 preons (12 tritopreon) total mass 2.3064

MeV form one up quark, mass 2.16 MeV then the charge of $+2/3 e$ is accounted for by $7(+1/3 e) + 5(-1/3 e)$, = seven positive and 5 negative tritopreons. The excess mass of the tritopreons appearing as kinetic energy of the quark so mass creation is accompanied by thermal energy. Similarly if 9 preons (27 tritopreon) total mass 5.1894 MeV constitute one down quark, mass 4.67 MeV then the charge of $-1/3 e$ is accounted for by $14(-1/3 e) + 13(+1/3 e) = 14$ negative and 13 positive tritopreons. The excess mass energy is 0.0122 MeV per tritopreon for the up quark and 0.0192 MeV per tritopreon for the down quark. The construction of the 2 up quarks of the proton requires $2(4)=8$ preons or 24 tritopreons with excess mass energy $24(0.0122)=0.2928$ MeV and the construction of the down quark requires 9 preons or 27 tritopreons with excess mass energy $27(0.0192)= 0.5814$ MeV.

The excess tritopreon mass energy in assembling the valance quarks (ignoring the much greater mass energy of the virtual quark-gluon sea) of one H atom (2u,1d quark) is thus approximately 0.87 MeV, comparable to the excess mass energy (0.93 MeV) from fusing two protons to a deuteron. It is surmised that mass creation of quarks via tritopreons can produce sufficient energy to account for a high energy, ionisation era in an early small radius universe. Energy released by ongoing mass creation must also have a significant impact on stellar and planetary temperatures and evolution.

It is worth noting also that the mass energy of 9 preons = 5.1894 MeV and that of the product down quark is circa 4.67 MeV giving a mass energy excess of 0.5194 MeV, slightly more than an electron or positron (0.511 MeV) however these cannot be coproduced because the input and output electric charges will not balance, and there is no evidence for a neutral electron/positron.

We have asserted that the natural charge of the preon $Q_p=1$, ($\varphi_p = \pi/4$) is the same as that of the electron $Q_e=1$, ($\varphi_e = \pi/4$). But the preon is comprised of 3 tritopreons, two of one charge and one of the opposite charge, all $\pm 1/3$, therefore summing to $\pm 1/3$, for which φ_p should be 1.4564...

The answer to this apparent contradiction is that the Bessel function calculates the unsigned modulus of the charge : all charges in octant 1 (our octant) have signature 1, but this represents both positive and negative experimental charges. So an angle $\varphi = \pi/4$ represents natural charges of 1 which can be $\pm e$ experimentally. For three tritopreons with $\varphi=1.4564...$ the Bessel functions deliver charges of $1/3$ which must be summed to give the apparent tritopreon charge of 1, equivalent to one charge of e and $\varphi = \pi/4$, i.e. the natural charge of the tritopreon

$$Q_{tp} = \frac{K_1(1.4564\dots)}{K_1(\pi/4)} = 1/3, \text{ translating to either plus or minus } e/3 \text{ experimentally.}$$

And formal natural preon charge= Q_p =sum of 3 tritopreon natural charges=

$$3Q_{tp} = 3 \frac{K_1(1.4564\dots)}{K_1(\pi/4)} = 3(1/3) = 1$$

The actual charge of the preon is the same as the tritopreon $\pm 1/3 e$, being a combination of 3 tritopreons, either $2(t+) + t(-)$ or $(t+) + 2(t-)$. The combinations $3(t+)$ and $3(t-)$ correspond to the charges of the three related tritoelectrons constituting the positron and electron respectively. Thus the 4 preons constituting an up quark have charges $3(+e/3)$ and $(-e/3)$ for a net charge of $+2/3 e$, while for the 9 preons of the down quark there are $4(+e/3)$ and $5(-e/3)$ for a net charge of $-e/3$. The preon/tritopreon model agrees with the inelastic scattering experiments that demonstrated the mean square charge of the quarks, for a target nucleus containing equal numbers of protons and neutrons, to have the value $5/18$.

Thus $p= uud$ and $n= udd$ so $p+n= uuudd$ and mean square charge $= (1/6)[3(2/3)^2 + 3(1/3)^2] = 5/18$. The fractional charges of the quarks are natural in the Model but not in the Standard Model of Particle physics where simple arithmetic demands it, but that is not a causal explanation (Khelashvili, 2017).

5.3.4 Tritopreons solve the strong CP problem and invalidate the need for axions.

The “strong CP problem” arises because neutrons are perfectly symmetrical. The neutron is neutral, comprised of one up quark (charge $+2/3$) and two down quarks (charge $2 \times -1/3 = -2/3$) and inexplicably, in terms of this structure, these charges are spread out incredibly uniformly, to within one part in a billion. Based on the quark structure the electric dipole moment of the neutron should be about $10^{-13} e \text{ cm}$, the measured value is about $10^{-27} e \text{ cm}$ (Hook, 2018). The neutron

is said to have charge-parity (CP) symmetry: it is unchanged by inverting all its charges from positive to negative, while also viewing it in a mirror. The question of why the particle has this arrangement became known as the “strong CP problem.” The symmetry is easily explained by the Model because the apparently unsymmetrical quark distribution hides a perfectly symmetrical arrangement of tritopreons; the up quark has 7 (t+) and 5 (t-) tritopreons while the two down quarks contribute 2x13 (t+) and 2x14 (t-) giving a total of 33 (t+) and 33(t-). There is no strong CP problem. As a consequence the motivation for the invention of the axion to explain the problem also evaporates, undermining the parsimonious advocacy of axion as a plausible dark matter candidate.

5.3.5 Tritopreons and beta decay suggest a neutrino substructure.

In the radioactive process of beta decay a free neutron or an unstable nucleus with an excess of neutrons is transformed to a stable state by conversion of a neutron into a proton by emission of a W- boson which decays into an electron, conserving charge, plus an electron antineutrino, overall:

$$n \rightarrow (p + W^-) \rightarrow (p + e + \bar{\nu}_e)$$

At the quark level a down quark transforms to an up quark:

$$uud \rightarrow (uud + W^-) \rightarrow (uud + e + \bar{\nu}_e)$$

At the preon level, $u = (3p^+, p^-)$ and $d = (4p^+, 5p^-)$ so the down quark transformation can be represented:

$$(4p^+, 5p^-) \rightarrow [(3p^+, p^-) + W^-] \rightarrow [(3p^+, p^-) + e + \bar{\nu}_e]$$

At the lowest, tritopreon, tp, level, $p^+ = 2tp^+, tp^-$ and $p^- = tp^+, 2tp^-$ giving overall:

$$13tp^+, 14tp^- \rightarrow [(7tp^+, 5tp^-) + W^-] \rightarrow [(7tp^+, 5tp^-) + e + \bar{\nu}_e]$$

The electron is 3 tritoelectrons 3te- derived from 3tp- [by loss of $3(0.5766-0.5110)=0.1968$ MeV of mass energy]. In the beta decay the strong force susceptibility of the tritopreons is lost so it is necessary to assume all the tritopreons convert to tritoelectrons in this process; this occurs via the intermediate W- which is not involved in the strong force.

From the above the W- boson is equivalent to $(p^+, 4p^-)$ or $(6tp^+, 9tp^-)$ or after transforming tritopreons to tritoelectrons, $(6te^+, 9te^-)$ to give a net charge in each case=e as expected.

Hence the transformation $W^- \rightarrow (e + \bar{\nu}_e)$ means $6te^+ + 9te^- \rightarrow 3te^- + \bar{\nu}_e$.

Thus the electron antineutrino on the right hand side is equated to 6te+, 6te- on the left hand side. This particle accounting can be carried further in two ways, Proposals A and B:

Proposal A. In the annihilation of an electron (3te-) and an antielectron (3te+) two massless photons are generated; by analogy we could propose that the 6te- are tritoelectrons composed of normal matter and pseudo normal matter (all charges -) and the 6te+ are tritoelectrons composed of antimatter or pseudoantimatter (all charges +) resulting in partial “annihilation” to generate a **single** near-massless particle akin to a “superphoton” with total energy equal to approx 12 tritoelectrons ($12 \times 0.511/3=2.044$ MeV) or, depending on the timing of the tritopreon to tritoelectron transformation, approximately 12 tritopreons ($12 \times 0.5766/3=2.3064$ MeV) which we identify as the electron antineutrino. The mass energy of the tritoelectrons contributing to the kinetic energy of the beta decay daughter particles. In terms of the model quantum signatures; $6(1,1,1,0) + 6(-1,1,1,0) \rightarrow (0,12,12,0)$ formally equivalent to the signature of 12 photons or Z0 bosons in section 7.4.2.

In this picture the neutrino is not an elemental particle of minimal character but a surprisingly complex compound particle containing more information and with potentially more capabilities.

Proposal B. Normally in annihilation of particles and antiparticles the photons are emitted in opposite directions to conserve momentum. If we adhere to this principle and generate **two neutrinos** then we could have: $3(1,1,1,0) + 3(-1,1,1,0) \rightarrow (0,3,3,0)$, e.g. $(\bar{\nu}_e)^{RH}$ a normal, right-handed electron antineutrino *plus* $3(1,1,1,0) + 3(-1,1,1,0) \rightarrow (0,3,3,0)$, e.g. $(\bar{\nu}_e)^{LH}$ a sterile, left-handed electron antineutrino. As the latter has weak isospin =0, weak isospin is still conserved in this beta decay scheme in the normal Fermi transition. The sterile neutrino does not feel the electroweak nor strong force but only interacts via gravity. When the neutrino was considered to be an elementary particle it was tolerable to accept that it might only exist with one helicity; but if the neutrino is a compound particle made up from the same subcomponents (tritoelectrons) as a fermion like the electron which comes in both left and right-handed forms, this is no longer reasonable. Left-handed antineutrinos and right-handed neutrinos are not observed and due to their sterility are probably not detectable, presumed to only respond to the force of gravity. Even

the low-energy neutrinos emitted by beta decay are virtually undetectable, and the sterile neutrinos are many orders of magnitude less detectable. Hence beta decay could be creating invisible sterile neutrinos as well as active neutrinos. It is proposed that neutrinos are Dirac particles (i.e. particles and antiparticles are distinct) rather than Majorana particles (which are their own antiparticles), which eliminates the “see-saw” mechanism for particle mass. Sterile Dirac neutrinos with right-handed spin enable Dirac neutrinos with left-handed spin to have mass by the Higgs mechanism, which requires them to have opposite spin, Romero (2020). From the foregoing we then propose that beta decay generates an electron antineutrino and a sterile electron antineutrino both with mass energy approximately 1 MeV, with the latter undetectable. By comparison, in the typical beta decay of Bi-210 the total energy of 1.16 MeV is variably partitioned between the electron, e.g. 0.4 MeV, and the electron antineutrino, e.g. 0.76 MeV; if the electron has null energy then the neutrino energy is maximised, 9.8 MeV. Proposal B accounts for the energetics of beta decay and also for the generation of neutrino mass by the Higgs mechanism and preserves weak isospin conservation. It also rectifies the discrepancy in the Standard Model where the neutrinos are apparently the only leptons without both helicities.

5.3.6 Neutrino as a Long Range Gauge Boson for the Weak Force

We know that neutrinos in the real state enable the weak force to act at long range in the sense of transmuting atoms and we have proposed above that their formation could be accompanied by sterile neutrinos as an explanation of real neutrino mass. We have also proposed the existence of a long range electroweak force, equivalent to and complementing both the gravitational force and electrostatic force. In section 5.3.5 we deduce that the neutrino is a surprisingly complex particle constructed from 12 tritopreons (6tp+,6tp-); indeed if present in virtual form it contains all the components required for a satisfactory gauge boson for transmitting a long range electroweak force. In section 6.4.1 we propose a supersymmetric equivalence principle that gauge bosons are constructed from fermions. It is now merely necessary to increase the number of tritopreon components by forming a boson as a pseudo virtual neutrino pair, doubling the tritopreon count. Perkins (see 6.2 below) has theorised that the photon is a neutrino-antineutrino pair. Hence we can imagine a ν_2 boson is (12tp+,12tp-) containing e.g. the equivalents of the W^- boson (6tp+,9tp-) and the W^+ boson (9tp+,6tp-). The weakness of this long range force relative to the short range weak force may be a result of the theoretically-postulated neutrino decoherence at long travel times, separating out the faster moving, low mass eigenstates and resulting in the weaker force from a lower mass gauge boson. Contrariwise, we must note that Ciuffoli (2021) states “decoherence has never been observed, there is still no solid theoretical description of such an effect.” Further extension (6.4.2) to pseudo virtual bosons in the 4-D chronosphere generates a host of new gauge bosons appropriate to a unified strong-gravito-electroweak force.

6 Interpretations and Speculative Extrapolations of the Model

6.1 Dark energy is due to Negative matter which is dark due to negative photons.

Given that half the universe exists in negative time, with negative matter and negative energy it is easy to rationalise why negative matter is “Dark” Energy i.e. not electromagnetically interactive with (positive photon) light. Transition of a negative matter atom from a higher to a lower negative energy state would emit negative energy photons which cannot be absorbed by a normal positive matter atom which can only occur with positive energy photons. Thus the negative matter universe remains invisible to us, and vice versa. It might be possible for negative energy photons of energy (-hv) to be absorbed by positive matter atoms if the latter are in an excited state of energy exactly +hv above a lower state i.e. returning the atom to that lower state; this might be experimentally detected as an unexpectedly short lifetime for the excited state. However, since current lifetime estimates will already be generated in an environment presumably flooded with negative photons we would need to do the test in an inverse manner; shield the matter in the excited state from the background negative photon flux and look for an increase in lifetime. But I can propose no way to achieve such shielding!

6.2 The Cosmological Quarantine of Antimatter and Other Positive Matter.

There are two major difficulties with identifying dark matter as “non-normal” positive matter, including antimatter, in the universe: why does it not interact with light nor interact (violently) with matter? Perkins (2014, 2015) examined the theory that the photon is not elementary but is a composite neutrino-antineutrino pair bound together; there are theoretical arguments for and

against this proposition, which also falsifies the idea that the photon is its own antiparticle, and he concludes: “An important test of these ideas will occur when the photons from anti-Hydrogen are examined. The composite photon theory predicts that the antiphotons from anti-Hydrogen will have the wrong helicity for interaction with electrons, and thus the antiphotons will not be detectable. Furthermore, ordinary photons have the wrong helicity for interaction with anti-hydrogen.” Thus explaining dark matter. However Perkin’s conclusion that dark matter was antimatter was disputed by Lehr Feng Low (2016). The later finding that antihydrogen interacts with light in the same way as normal hydrogen falsifies Perkin’s conclusion regarding antihydrogen, but his arguments are considered valid for pseudo hydrogen and antipseudohydrogen which the Model suggests do communicate via antiphotons (see 7.4.1) and are invisible in our octant where communications involve photons. It may be that cosmological antihydrogen is not detected because it is (a) mistaken for normal hydrogen due to identical behaviour with light, so not detected in interstellar space and (b) does not condense into antimatter stars i.e. is not radiant; if it did condense and was radiant then our estimates of the normal matter in the universe are grossly inflated.

Antimatter is routinely encountered and manipulated e.g by electromagnets, in physics. Antimatter atoms (antihydrogen) have been constructed and are being used to determine gravitational and other properties. The Standard Model based on CPT theory requires that hydrogen and antihydrogen have the same spectral properties and this was apparently confirmed by Ahmadi et al (2017) using magnetically trapped atoms of antihydrogen. The dark character of antimatter thus remained a mystery unsolved to this point by Model OMG. We can “see” it gravitationally but not electromagnetically. Primordial black holes made of normal matter have been proposed as dark matter candidates, Carr (2020, review), de Freitas Pacheco et al, (2023). One problem admitted for this scenario is the rapid evaporation of small black holes by Hawking radiation. In the case of Model OMG the black holes needed to explain invisible dark matter would need to be made from antimatter, pseudomatter and anti pseudomatter; in this Model Hawking radiation is not relevant as the black holes can grow without limit by creating matter at the event horizon, pulling in the positive matter and repelling the negative matter.

The Model seeks answers elsewhere. As we have proposed cosmological censorship to explain the invisibility of dark energy, so the Model requires a form of cosmological quarantine keeping dark matter (i.e. antimatter and the other two forms of non-normal positive matter) and normal matter apart; this must surely be a fundamental design requirement of a stable universe. Could the electrostatic attraction of e.g. a proton and an antiproton be reversed because the antiproton is “backward” in x time, by analogy with gravity where backward in z time reverses gravitational attraction? This is invalidated by the creation of positronium “atoms” from the electrostatic attraction of an electron and a positron, demonstrating that matter and antimatter charges interact exactly as matter. This reinforces the idea that it is only z time that is relevant to our experience of the “ flow of time”.

The invisibility of antimatter may be a collateral consequence of its cosmological quarantine; it is hidden in plain sight, sequestered in some manner yet to be defined, but more evidence for a fine-tuned universe. The Model assumes that all the matter and dark matter that existed in the universe after recombination is essentially still here, augmented by continuous creation since then. There has been no asymmetric annihilation of matter and antimatter. The effects of matter and the three chronotypes of dark matter are fully apparent gravitationally.

A copious literature exists concerning the nature of dark matter and where it exists in the universe. Searches for various particulate candidates (ranging from exotic particles such as WIMPs (with mass comparable to baryons) to macroscopic dark matter such as stellar masses (dark stars) and primordial black holes have all been unsuccessful. Gravitational lensing and galactic rotation curves demonstrate that dark matter is located within galaxies and may extend as a halo beyond them and has been advanced as evidence for axionic dark matter in a diffuse wavelike state (Amruth 2023). Axions (Chadha-Day, 2022), originally proposed as a solution to CP violation in quantum chromodynamics were later seen as good candidates for dark matter. The Model undercuts the axion theory by falsifying the need for axions to explain the Strong CP problem (see 5.3.4). The theory that dark matter may be made from quark or (particularly) antiquark “nuggets” i.e. compact composite objects of quark or antiquark matter, has been considered by Flambaum and Samsonov (2022) wrt possible means of detection. The nuggets are rendered electrically neutral by surrounding clouds of electrons or positrons and are astrophysically dark due to a small cross section to mass ratio. There is no significant evidence of

matter-antimatter annihilation radiation; Cohen and Sheldon Glashow et al (1998) concluded that this invalidated a universe consisting of distinct regions of matter and antimatter. Bauer (2018) proposed that this could be explained in a universe with local matter-antimatter asymmetry but a smooth transition through zero density between the domains reducing annihilation radiation below detectable levels; but this report does not seem to have been published in a peer-reviewed journal. One logical explanation of these observations (and lack of them) is that dark matter, though gravitationally attractive (part of which is a y axis aspect of the weak force) to both matter and dark matter, is not fermionic hence the effect on galactic rotation curves is preserved but dark matter does not condense into luminous stellar bodies and is quarantined from annihilation with fermionic matter. Bosonic dark matter generated from the collapse of Careyons and formation of Bose-Einstein condensates is thus a coherent option in the Model, see 6.4.3.1 below. The Model speculates that dark matter consists of the 3 variant chronotypes of positive matter and remains in a “fuzzy”, diffuse bosonic state, undetected and stable due to cosmological censorship and quarantine.

6.3 Unified Description of Gravity, Electromagnetism and Weak interaction?

It is speculated that the common gravity/electrostatic energetic component (y axis of the Model) involves the **weak nuclear force**. Since the two forces with which it is allied are both long range, mediated by massless bosons, it would be strange if it is not also a long range force and since electromagnetism is unified with the weak force in electroweak theory, conscripting the weak force is more economical than postulating an entirely unknown new force. This aspect of the weak force will only be apparent cosmologically and not at the level of particle physics. The correspondence of the proposed new bosons in section 6.4.1 with those in electroweak theory reinforces this view. The disparate short- and long-range behaviour of the weak force could be reconciled if it varied in the same way as the electrostatic and gravitational forces i.e. inversely proportional to the square of the distance.

Model OMG presents a unified description of gravitational and electrostatic potential but on the surface not much more than is afforded by the common form of these potentials as described by the laws of Newton and Coulomb. The novelty lies in the inclusion of the quantisation of mass and charge in terms of the same chromosphere coordinates that also determine the potentials. Unification of these forces is not unexpected and has been long sought: the unexpected feature of the Model is that the two potentials **share a common energy**, that represented by the y coordinate, proposed to be the weak interaction i.e. the **y and x axes of the chronosphere represent long range manifestations of the electroweak interaction**. The y axis then also quantifies the spin of the particles, spin being the quantum property recognised by the weak interaction.

By extension then the fact that the Model inserts the same y axis force into the gravity equations, equally weighted with the z axis gravity necessitates the conclusion that the z,y potential is a **gravitoweak interaction**.

The x,y,z axes of the chronosphere embody a united gravitoelectroweak theory. Not only are the three forces unified as inverse square law forces but they are mutually constrained by the invariant relationship $x^2 + y^2 + z^2 = 1$. In section 6.4.1 a scalar gravity-mediating boson is proposed that has charge and mass. These proposals imaginatively suggest that gravity might be manipulated by electrostatic energy via this shared weak interaction, possibly to enable antigravity, supporting the intuitions of various heretical experimenters over the years.

The existence of a common, weak force component to gravity and electromagnetic phenomena offers a meeting place for those who currently have opposing views on which force is the main agent in cosmology.

Later we will extend the chronoverse to 4 timelike dimensions to incorporate the strong force and propose a unified strong/electroweak/ gravitic force scenario with a number of gauge bosons of “mixed” types involved in mediating the various forces.

6.4 Composite Bosons in the Chronosphere.

6.4.1 Two-Fermion Composite Bosons and Boson/Fermion supersymmetry

Calculations in quantum field theories are beset by the problem that the quantum “corrections” create infinities. In Yang-Mills theory, the basis of the electroweak theory uniting electromagnetism and the weak force, and also of quantum electrodynamics which explains the strong force, the infinities are removed by the poorly rationalised and extremely tedious calculations of “renormalisation”. All attempts to develop a quantum field theory of gravity have failed due to the failure of renormalisation. However in supersymmetric string field theory the problem does not

arise; supersymmetry assumes that fermions and bosons are interchangeable and this results in the infinite quantum corrections of each exactly cancelling. Supersymmetry between fermions and bosons is speculated in Model OMG and indeed the following axioms are proposed:

- a) **bosons are fermions, i.e. bosons are composite particles made from combinations of fermions e.g. the composite photon model of Perkins. Bosons and fermions are thus interchangeable supersymmetric partners.**
- b) **bosons exist in two classes; the force-mediating virtual/pseudovirtual gauge bosons of the Standard Model and a new class of property-mediating bosons that carry properties such as mass, charge, spin that can be “realised” in bosonic matter.**
- c) **bosons can be negative or positive in energy.**
- d) **in the 3-D chronosphere bosons reside on the 2D planes or 1D axes.**
- e) **the properties of mass, charge and spin are determined by the z, x and y time axes values respectively; later we propose that the colour charge of the strong force is related to a fourth “c” time axis in the 4D chronoverse.**

Considering the positive matter hemisphere of the chronoverse, we can identify normal matter m_1 in octant 1, and antimatter m_2 in octant 2 but the two matter-types m_3 and m_4 in octants 3 and 4 require consideration.

We identify m_2 as antimatter by its reaction with normal matter:

$m_1(1,1,1) + m_2(-1,1,1) = (0,2,2) = 2(0,1,1)$ identified as two photons, with energy equal to the mass energy of the masses, on the z-axis (“mass axis”), with spin 1 on the y axis (“spin axis”) and zero charge on the x-axis (“charge axis”). Note that spin here is in model, not measured, units. The reversible annihilation/pair production interchange of fermions/anti fermions with photons supports the interchangeable equivalence of photons and fermions.

We have already concluded that fermions exist on the surface of the chronosphere and that bosons are usually constrained to 2D planes. The 4 positive chronotypes of a fermionic particle (of Model spin +/-1, measured spin +/-1/2) can be assembled into positive bosons (integral or zero spin) by combining two fermions to yield two composite bosons B represented by $B(x,y,z)$ where x,y,z are the net (model) quantum values for charge, spin and mass from the fermion combination. e.g. $M(1,1,1)+M(-1,1,1)=M(0,2,2)=2B(0,1,1)$

i.e. if the fermions are an electron and an anti electron, differing only in charge, the end result is two photons, in the y,z plane, with total energy=sum of mass energies of two electrons. This is the reverse of the pair-production of an electron and anti electron from two photons. Obviously negative mass electrons and negative antielectrons likewise generate negative energy photons.

Similarly the electroweak W^+ , W^- and Z^0 bosons decay to, and are hence equivalent to, a fermion/anti fermion pair.

Note the formalism assumed for the spin; that the “spin” is in model units which for fermions equate to experimental magnitude 1/2 but for gauge bosons equate to experimental magnitude 1.

The 6 possible chronotypes pairs in the positive hemisphere are shown in Table 8:

Chronotype pair	Model Quantum Signatures	Boson Interpretation
m_1+m_2	$(1,1,1) + (-1,1,1) \rightarrow (0,2,2) = 2(0,1,1)$	2 vector bosons, spin 1, y,z plane (x=0)
m_1+m_3	$(1,1,1) + (-1,-1,1) \rightarrow (0,0,2) = 2(0,0,1)$	2 uncharged scalar bosons, z axis
m_1+m_4	$(1,1,1) + (1,-1,1) \rightarrow (2,0,2) = 2(1,0,1)$	2 +charged scalar bosons, x,z plane
m_2+m_3	$(-1,1,1) + (-1,-1,1) \rightarrow (-2,0,2) = 2(-1,0,1)$	2 - charged scalar bosons, x,z plane
m_2+m_4	$(-1,1,1) + (1,-1,1) \rightarrow (0,0,2) = 2(0,0,1)$	2 uncharged scalar bosons, z axis
m_3+m_4	$(-1,-1,1) + (1,-1,1) \rightarrow (0,-2,2) = 2(0,-1,1)$	2 vector antibosons, spin -1, y,z plane

Table 8. Hypothetical combination of fermion chronotypes to form bosons in 3D chronoverse.

Note that all these bosons have positive energy ($z > 0$) but not necessarily mass, e.g. photon. The vector bosons can be massless photons of various energies $E = hv$ (e.g. gamma rays from annihilation of electron and positron, or greater energy from annihilation of heavier fermion/antifermion pairs). Massive bosons like the weak force Z^0 , W^+ and W^- bosons will result from annihilation of e.g. quark/antiquark pairs which are equivalent to the Z^0 as it decays into a quark/antiquark pair.

The existence of spin -1 anti photons in the positive hemisphere is predicted. This would explain some dark matter (m3 and m4) as an emitter/absorber of anti photons and unable to absorb or emit normal photons. For antiphotons the spin quantum number is negative, implying negative spin momentum and spin energy. In standard physics the photon is conventionally considered to be its own antiparticle because the possibility and consequences of negative time are ignored. In the chronoverse the true antiparticle of the photon is the negative photon; they sum to zero.

Since the antiphotons consist of pseudomatter and anti pseudomatter they interact electromagnetically with matter of those types, but not with matter nor antimatter. Conversely, normal photons, being matter/antimatter pairs, can interact with matter and antimatter. Hence pseudomatter and anti pseudomatter are “dark” to us but antimatter should not be.

The observation that antihydrogen atoms interacted with laser light in the same way as normal hydrogen supports this claim (except in the unlikely case that laser light contains both photons and antiphotons, in which case antimatter may not interact with photons).

In the negative hemisphere there will be negative energy photons and negative energy antiphotons, similarly with the other bosons, maintaining CPT invariance.

That bosons can be composites of fermions is well-established, except for gauge bosons which the Standard Model presumes to be elementary, but theories have been proposed where e.g. the photon is a composite of neutrino-antineutrino (Perkins 2014) or electron-positron (Clague 2022), while Technicolor theory posits Higgs bosons as composite of spin 1/2 techniquarks and the top quark condensate model has the Higgs as a composite of top- and antitop quarks.

For the assignment of all the boson quantum signatures we need to incorporate the gluons of the unified strong/electroweak/gravity force, see 6.4.2.

It is speculated that these bosons are equivalent to excitations in a unified strong/electroweak/gravity field. In unified field theory in the conventional 4D universe the symmetry is broken during the time-evolution of the universe to produce the gluons, W^+ , W^- and neutral Z bosons, and the photon, respectively governing the strong and weak interactions and electromagnetic interactions. But in the lower energy Model OMG it is proposed that the unified field interactions are constant in the chronosphere due to its necessary, “timeless” invariance. The phase transitions and symmetry-breaking of the BBT as the universe cools do not occur at the lower energies of the Model, so the BBT “top-down” process of boson evolution is not sensible in Model OMG. If time invariance is not critical to the Model it would be more consistent to propose a “bottom-up” process that creates heavier or more complex bosons (and thus the force fields) from the first simplest/lightest bosons at an early stage of the universe.

It is explicit in this scheme that both positive- and negative-energy photons and other bosons exist in their respective z -time-hemispheres and in our positive hemisphere photons and anti photons coexist, partly explaining dark matter.

6.4.2 Extension to the strong force in a 4-D chronoverse. The strong force must be included by adding another time dimension. The 4-D chronoverse then unites all 4 forces of the Standard Model. Thus a 7-D (overall) universe incorporating a 4-D chronoverse will provide another timelike axis to describe the colour charge/strong force properties. In a sense, compared to current theories in the normal 4-D universe, this gives us effectively the 11-D universe of brane theory; 3 space dimensions plus 4 timelike but with both positive and negative time so relative to the present 4-D theories, an additional 7 timelike dimensions or 11-D in total. In section 5.2.1.6 to accommodate neutrinos and photons the chronoverse was expanded to 8-D yielding a true 11-D spacetime.

Assuming the unit radius chronosphere remains pertinent then the 4 forces of nature are unified and co-governed under the symmetry of a 4-D chronoverse; $x^2 + y^2 + z^2 + c^2 = 1$ where the extra axis is labelled “c” for colour charge, the obvious choice of “w” for the new axis deemed inappropriate for the strong force! The invariant from the 3-D chronoverse, $x^2 + y^2 + z^2 = 1$

remains relevant for leptons which have no colour charge ($c=0$) and are not affected by the strong force. The 3-D chronoverse has $2^3=8$ sectors i.e. octants, and the 4-D chronoverse has $2^4=16$ sectors and 16 different chronotypes, 8 of which will be positive; these **8 positive fermion subtypes can pair up in 28 different ways to generate a possible 28 positive energy fermion-pair bosons.**

For example octant 1 fermion with positive colour charge is fermion1A, octant 1 fermion with negative colour charge is fermion 1B and the combination yields a boson assigned as a W^- with net zero colour charge. Similarly the negative, mirror hemisphere will have 28 negative fermion-pair bosons.

Note the terminology employed for bosons; gluons have positive colour charge, antigluons have negative colour charge, but zero colour charge gluons have positive spin while zero colour charge antigluons have negative spin; photons have positive spin, antiphotons have negative spin.

The model charge in octant 1 is positive but represents both positive and negative charges in our reality e.g. protons and electrons, hence the W boson with + charge (Model) can be either the W^- boson or the W^+ boson.

The photons/antiphotons are defined by their production via “annihilation” of matter/antimatter, as $(0,+/-1,1,0)$ particles. The other electroweak bosons (Z^0, W^+, W^-) are easily discerned from their charge and spin.

Bosons with with zero electric charge and non-zero spin and non-zero colour charge are gluons or antigluons mediating the strong force. Bosons with non-zero electric charge and non-zero colour charge cannot be gluons according to the Standard Model of particle physics and but can be tentatively included in a collection of strong gravitons or charged strong gravitons.

Bosons with zero charge, zero spin with zero colour charge are gravitons/antigravitons mediating the gravitational force, part of the gravitoelectroweak force.

All of these bosons exist in pseudovirtual form and are force-mediating gauge bosons. They can also be “realised” to form dark, bosonic matter existing in Bose-Einstein condensates, see 6.4.3.1.

Obviously this tentative picture involves a number of new bosons with unexpected gauge influences: it is presented as either a house-of-cards doomed to collapse or as an entry to a deeper understanding of the four fundamental forces. The proliferation of new bosons is coherent given the mixing of the forces proposed to underlay the Model due to the time-invariant nature of the unified force. Table 9 lists the tentative full assignment of fermion-pair bosons in the unified-force 4D chronoverse.

octants	2 Boson signature	Boson assignment	octants	2 Boson signature	Boson assignment
1A2A	0,2,2,2	gluon	3A1B	0,0,2,0	graviton
1A3A	0,0,2,2	strong graviton	3A2B	-2,0,2,0	charged (-) antigraviton
1A4A	2,0,2,2	charged (+) strong graviton	3A3B	-2,-2,2,0	W
1A1B	2,2,2,0	W	3A4B	0,-2,2,0	antiphoton or Z0
1A2B	0,2,2,0	photon or Z0	4A1B	2,0,2,0	charged (+) graviton
1A3B	0,0,2,0	graviton	4A2B	0,0,2,0	graviton
1A4B	2,0,2,0	charged (+) graviton	4A3B	0,-2,2,0	antiphoton or Z0
2A3A	-2,0,2,2	charged (-) strong graviton	4A4B	2,-2,2,0	W
2A4A	0,0,2,2	strong graviton	1B2B	0,2,2,-2	antigluon
2A1B	0,2,2,0	photon or Z0	1B3B	0,0,2,-2	strong antigraviton
2A2B	-2,2,2,0	W	1B4B	2,0,2,-2	charged (+) strong antigraviton
2A3B	-2,0,2,0	charged (-) antigraviton	2B3B	-2,0,2,-2	charged (-) strong antigraviton
2A4B	0,0,2,0	graviton	2B4B	0,0,2,-2	strong antigraviton
3A4A	0,-2,2,2	gluon	3B4B	0,-2,2,-2	antigluon

Table 9. Full list of fermion-pair bosons in the unified force, 4D chronoverse. Each boson assignment represents two bosons of that type i.e. each combination of two fermion chronotypes generates two bosons. The assignments are speculative and provisional.

The magnitude of each force is partly reflected in the number of bosons constructed from the fermions: the strong force, including contributions from gravitic and weak components, has a total of 8 bosons and 8 antibosons; the electroweak force has 6 bosons and 6 antibosons; the gravitoweak force has 4 bosons and 2 antibosons.

- Strong force = 2 gluon, 2 antigluon
- Gravitostrong force. = 2 strong gravitons, 2 strong antigravitons
- Electrostrong force. = 2 electrostrong gravitons, 2 electrostrong antigravitons
- Gravitoelectrostrong force. = 2 charged +/- strong gravitons, 2 charged +/- strong antigravitons
- Electroweak force = 2 photons or Z0; 2 antiphotons or Z0; 2W-, 2W+
- Gravity. = 2 gravitons
- Gravitoweak force. = 2 charged + gravitons, 2 charged - antigravitons

Note that the Z^0 is its own antiparticle and the W^+ and W^- are antiparticles. Also there is no simple antigraviton; gravitic repulsion, i.e. antigravity, is a result of the boson (0,0,-1,0) from the negative mass hemisphere. **This fundamental asymmetry of the gravitons is possibly responsible for the unique behaviour of gravity in the chronoverse where it is assumed as the only force acting between the mirror hemispheres, underlying the experiential flow of time in our hemisphere.**

It is further noted that the combination of 2Z bosons= (0,0,4,0) is equivalent to the Cm+ Careyons (see 6.4.3 below); the Higgs boson decays to 2Z bosons so the **Cm+ boson is proposed to be the Higgs**, which can also be created (along with a quark and antiquark) from 2Z bosons or 2W bosons.

6.4.3 Four-Fermion Composite Bosons

If we divide the 3D chronosphere into two equal hemispheres (3 dividing planes therefore 3 ways) and combining the 4 particles in each hemisphere we generate two bosons, one net positive and one net negative in mass, or charge or spin. These bosons are speculated to be force-mediating bosons and/or hypothetical property-mediating bosons. I propose to call the property-mediating bosons **Careyons**, in honour of S.Warren Carey, because they fulfil his quest for a mechanism for mass creation. We will represent them as C(x,y,z) where x,y,z are the net quantum numbers for charge, spin and mass from the fermion combination.

We have assigned the z coordinate to mass, the x coordinate to charge and now propose that the y coordinate is responsible for spin. **This is in accord with the hypothesis that the y axis is a long-range weak nuclear force component of the gravitic and electrostatic potentials ; the Standard Model, short range, weak force being a force that recognises spin.**

We can split the chronosphere along either the xy, yz or zx planes giving the results in Table 10:

Bisecting plane	octants.	Composite coordinates.	Careyon	
xy.	1,2,3,4.	(0,0,4).	Cm+.	mass positive
	5,6,7,8.	(0,0,-4).	Cm-	mass negative
xz.	1,2,5,6.	(0,4,0).	Cs+.	spin positive
	3,4,7,8.	(0,-4,0).	Cs-	spin negative
yz.	1,4,5,8.	(4,0,0).	Cc+.	charge positive
	2,3,6,7.	(-4,0,0).	Cc-	charge negative

Table 10. Careyons bosons from fermion tetrads via bisection of chronosphere.

As proposed above in 6.4.2 the property conferred by Cm+ , designated as the zero spin Higgs boson, is positive mass; negative mass in the mirror hemisphere is conferred by the negative Higgs boson Cm-. **Extending to the complete 4D chronoverse, there are an additional two Careyons, Ccc+ and Ccc-, the Careyons carrying the colour charges (cc+, cc-). The set of 8 Careyons then are Higgs-type bosons carrying either positive or negative mass, spin, charge and colour charge.**

6.4.3.1 Careyons as property-carrying bosons creating fermions and bosons

The creation of pseudovirtual fermions is cost-free but they are incapable of independent existence, being energy-locked into a zero sum whole. A measure of independence is gained when the full set of 16 pseudofermions are split into hemispheres in the four different ways to generate two sets of 8 Careyons, a positive set and a negative set. A pair of positive and negative Careyons are free to move independently of the other Careyons as there is no energetic consequences, but they are “energy locked” together i.e. cannot act independently of each other. This is the essential feature that bifurcates the experiential universe into our half and it’s mirror half. The statistically-controlled quantum superposition of 4 Careyons generates 4 real fermions. The virtue of bosons is that they are immune to the Pauli exclusion principle and can occupy the same quantum state, even en masse as e.g. the photons in a laser beam and helium-4 atoms in a Bose-Einstein condensate. Thus offers a way to store and accumulate the number of particles (Careyons) required to turn pseudovirtual preons, for example, into quarks, otherwise a puzzle and a roadblock to the nucleosynthesis proposed by the Model.

Thus the proposed process of positive mass creation involves the statistically-controlled combination of all 4 positive Careyons to regenerate four real, normal matter fermions; C(4,0,0,0) +C(0,4,0,0)+C(0,0,4,0)+C(0,0,0,4)=4M(1,1,1,1)

Because the positive and negative forms of the Careyons are bound by the energy-locking principle, the creation of positive mass fermions is necessarily accompanied by the co-creation of the equivalent negative mass fermions, which also maintains energy balance between the mass-polarised hemispheres.

Similarly for matter in each of the other sectors by combining four Careyons of appropriate type: e.g. C(4,0,0,0)+C(0,-4,0,0)+C(0,0,-4,0)+C(0,0,0,4)=4M(1,-1,-1,1) =four negative matter fermions.

The creation, accumulation and collapse of Careyons to regenerate real fermions is proposed to account for the initial and continuing generation of matter in the universe and the interior of the Earth.

To explain why mass creation occurs deep within the earth but not, apparently, at the surface crust we can propose a template effect where “observation” of the Careyons by surrounding real matter causes collapse of the Careyons to real fermions. This also creates a sink for pseudovirtual particles in the chronoverse and we can postulate a form of pseudovirtual particle pressure that maintains a continual flow of raw pseudovirtual particles towards the sinks where real mass creation occurs. Mass creation will then be dependent on the density and extent of real matter assemblies resulting in more within the earth than at the surface (crust). The quarantine of “incompatible” chronotype masses, e.g. negative masses and positive masses, and masses and their antimasses, is obviously an existential requirement for the universe; this will be partly supported by the forces between them but also if the matter chronotypes only act as templates for the catalysis of the creation of their own chronotype. Thus each chronotype reproduces strictly after its own kind. While a necessary feature of the universe, the segregation of matter, antimatter and negative matter chronotypes into chronotype ghettos will make interstellar and intergalactic travel extremely hazardous, if not impossible; explosive antimatter reefs in the galaxy, seas of extinguishing negative matter in the vast voids of the universe.

At this stage I offer no details as to the extent to which the various fermions engage in this behaviour other than the obvious case where the Careyon made from particular virtual fermion chronotypes can generate real fermions of that type. We will show (6.4.3.2) however that the primordial abundances of hydrogen and helium-4 implies a process using Careyons made from tritopreons.

As there is no energy cost in creating Careyons, there is no distinction between real and virtual Careyons so to distinguish them from real or virtual bosons, where there are energetic considerations, I propose to refer to them as “pseudo virtual”; there is a statistical process barrier between the pseudovirtual state and the real state. The Model process of mass creation in the positive sector is outlined below:

PSEUDOVIRTUAL	>Accumulation>	REAL
Fermion (ex nihilo)	& Collapse	
>>Fermion pairs= gauge bosons.		> Bosons
>>Fermion tetrads=Careyons.		>Fermions >> Normal Condensed Matter >Property Bosons >> Bose Einstein Condensates (Dark Matter)

In the same way that Careyons collapse to generate real fermions they can also **collapse in pairs to form real bosons** which can exist astrophysically as Bose-Einstein condensates, proposed to explain dark matter, see (6.4.3.3). Thus 4 real photons could be produced when the two positive Careyons Cs and Cm (derived inter alia from the genesis of the 16 chronotypes of the pseudovirtual photon), with opposite colour charge, collapse:

$$C(0,4,0,+/-4) + C(0,0,4,-/+4) > (0,4,4,0) = 4(0,1,1,0)$$

The generation of dark bosonic matter with appropriate characteristics can be imagined by the collapse of pairs of tritoelectron-derived Careyons e.g.

$$C(0,0,4,0) + C(0,0,0,4) > (0,0,4,4) = 4(0,0,1,1)$$

i.e. generating 4 tritopreon-type scalar bosons with mass and colour charge but no spin nor electric charge; thus they have mass energy and are confined in a “dark nugget” by the strong force but are blind to electromagnetic and weak interactions. This boson was identified in section 6.4.2 as the graviton, acting there in pseudovirtual form as a gauge boson but acting here as a realised boson in a dark Bose-Einstein condensate.

The zero energy cost puts no upper limit to the mass of the real fermions that can be created in this way but statistically the probability of constructing a complex, multi component baryon like a proton or neutron must be lower than that for a simpler fermion.

The barrier to mass creation for even simple particles is statistical in that the probability of four Careyons coinciding at any point is assumed to be very low. It seems likely that this process is facilitated by pre-existing matter by attracting and concentrating the Careyons and/or catalysing their collapse to real fermions. A stepwise rather than concerted process cannot be discounted. Assuming it is possible to create neutrons (4 at a time) in this way then it gives easy access to the accepted BB primordial nucleosynthesis mixture of hydrogen and helium-4; representing the Careyon tetrad in brackets and the realised fermions unbracketed:

(nnnn) >nnnn> 4H by weak decay

(nnnn) >nnpp >2D > He-4

(nnnn) >nnpp = He-4

The precise mixture of 75% H and 25% He-4 is not explicable in this scenario, but is quantitatively explicit in a more realistic genesis event (below) proceeding from virtual quarks via the smallest possible particle, the (pseudo)tritopreon. **The corollary and parsimonious conclusion is that the bosonic dark matter is also ultimately derived from pseudotritopreons.**

6.4.3.2 The Genesis Event and Primordial Nucleosynthesis from tritopreons

To challenge the BBT as an account of the origin of the universe Model OMG must not only rationalise the production of matter from nothing but also explain it's primordial composition and the co-production of considerable radiant energy in the form of photons; a radiation-dominated era ending eventually in recombination and the liberation of the CMB upon which both the BBT and Model OMG depend. The primordial composition is achieved via a purely statistical process. The energy production is free and comparable to hydrogen fusion (see 5.3.3).

The primordial "nucleosynthetic" mixture, Patrignani (2017), is approximately 75% hydrogen and 25% helium-4 by mass, which translates to 87.5% protons and 12.5% neutrons by mass and as they have closely similar nucleonic masses the ratio of protons to neutrons is 7:1.

Consider the chronoverse as a sea of pseudovirtual tritopreons with charge magnitude $e/3$, an equal mixture of positively-charged and negatively-charged, represented by $t+$ and $t-$. The tritopreons are fermions and cannot occupy the same quantum state, but by assembling the complete chronotype set, after generation, into Careyon bosons they are free to move and accumulate. At the focus of accumulation a coincidence of 4 appropriate Careyons will regenerate the tritopreon fermions $t(+)$ and $t(-)$. Recalling that up quarks consist of $7(t+)+5(t-)=$ net charge $+2/3$ while down quarks are $13(t+)+14(t-) =$ net charge $-1/3$, then we can draw the following statistical inferences:

Note that in the following discussion it is assumed that the "real" state is achieved post-collapse of the tritopreon Careyons.

The 12 tritopreons of the u quark exist in the combinatorial space of the chronoverse in 2^{12} permutations of the positive and negative forms. The 27 tritopreons of the d quark likewise exist in 2^{27} permutations. The particular up quark combinations of 7 positive and 5 negative tritopreons comprise $7!(5!)=792$ combinations. The combinations describing the d quark comprise $27!(13!14!) = 20058300$ combinations. We can then calculate statistical "concentrations", i.e. probabilities, of pseudovirtual u and d quarks in the chronoverse:

$$[u]=792/2^{12}= 0.1933$$

$$[d]=20058300/2^{27}= 0.1492$$

The ratio $[u]/[d]=1.2938 =(\text{approx } 9/7=1.2857)$

Hence for $[d]=7$ we expect $[u]=9$

The wave functions $[u]$ and $[d]$ contain complex variables; they are transformed into real-valued magnitudes (probability densities) via multiplication by their complex conjugates (equivalent to squaring the functions when these are real). We will assume that the ratio of real up quarks, u, to real down quarks, d, is given by squaring the pseudovirtual probability ratio:

$$u/d= [u]^2/[d]^2 = 1.6739= 15.0651/9= (\text{approx } 15/9=1.6667)$$

Therefore with 9 down quarks we calculate the cogeneration of 15.0651 up quarks (rounded to 15); assembled in quark triads gives uud, uud, uud, uud, uud, uud, uud, uud, udd =7 p, 1 n; this accords with the primordial ratio of 7 protons per neutron.

To maintain electrical neutrality the 7 protons require 7 electrons to be cogenerated from the tritopreon sea, provided ultimately by the collapse of 21 ($t-$) tritopreons. The total consumption of tritopreons from the pseudovirtual arena is thus;

$$\text{for } (t+) \text{ tritopreons} = 7(2*7+13)+(2*13+7)=222$$

$$\text{for } (t-) \text{ tritopreons} = 7(2*5+14) +(2*13+5)+7(3)=222$$

and the charge balance of the sea remains invariant, a critical necessity, enforced by the coproduction of t^+ and t^- tritopreons in equal numbers; if an excess of protons is created then the sea is locally depleted in t^+ tritopreons and neutron and electron creation will be favoured by the excess t^- . The balance of t^+ and t^- in the pseudovirtual, and of protons, neutrons and electrons in the real, is maintained by this feedback mechanism.

An alternative calculation of helium-4/H from the p/n ratio:

$$p/n = uud/udd = u/d = 1.6667$$

Hence in terms of number fractions for protons and neutrons:

$$p/(p+n) = 1.6667n/2.6667n = 0.625$$

$$n/(p+n) = n/2.6667n = 0.375$$

$$\text{Then the number ratio of helium-4 to hydrogen} = \text{helium-4}/H = ppnn/p = pnn \\ = 0.625(0.375)^2 = 0.08789 = 1/11.38$$

In terms of mass fraction

$$\text{helium-4}/H = 4 \text{ times number fraction} = 4/11.38 = 1/2.844$$

$$\text{then } H = 2.844(\text{helium-4})$$

$$\text{and since the total of the mass fractions} = H + \text{helium-4} = 3.844(\text{helium-4}) = 1$$

Hence helium-4 mass fraction = $1/3.844 = 0.26$ in accord with estimates of the primordial ratio.

This statistical method for primordial nucleosynthesis has not been successfully extended to other light elements at present.

An early high energy era needs to be explicit in the Model, in particular to create a period of ionisation with the universe in an opaque state to light and ending with the creation of the cosmic microwave background radiation surface at the "last scattering" at the end of this period with the release of photons after recombination of protons and electrons to neutral atoms, combined with the expansion of the universe extending the photon mean free path to the observable universe. While the Model embodies a primordial mass creation process that is a very much cooler process that does not need the extreme (almost infinite initial energy) conditions of the BBT, it might be supposed to produce this by the liberal production of "free" energy through the creation of a host of particles and antiparticles by the postulated mechanism; annihilation then creating the photon-rich environment. **This is contrary to the proposed cosmological quarantine theory so the energy byproduct of mass creation via tritopreons is the preferred explanation** (see 6.3.3). As a corollary of this decision, most or probably all of the antimatter ever created is still in existence i.e. no great annihilation of matter/antimatter has occurred; this is also implicit in equation (3) with matter creation as a uniform forward process without reverses.

Therefore ongoing mass increase, e.g. of the earth, although probably different in detail from the primordial case, should also be accompanied by internal heat production. Since the primordial process will also "refuel" stars burning hydrogen and helium the rate of creation must eventually be less than the rate of destruction otherwise stars would never run out of hydrogen and helium. Nucleosynthesis of higher elements in later times, such as at present, can occur by stellar processes (at high temperatures) as usual but the model proposes could also involve the in situ (nuclear) generation and fusion of quarks or even higher fermions including e.g. protons or neutrons by the Careyons route, enabling cold nucleosynthesis in the earth. This requires and supports the supposition that matter attracts Careyons, perhaps just by acting as a sink in the pressing pseudovirtual sea, and catalyses their collapse into real fermions; enabling increasing mass of astrophysical bodies. It is crucial that the incompatible matter chronotypes are quarantined from each other so the chronotype-specific catalysis of chronotype creation plays a key role in maintaining this. In Part 2 of this study it is intended to consider if the rate of mass creation of positive matter depends on the density of real positive matter, thus control of mass creation would be statistical not only for the creation and collapse of Careyons but also for the catalysis of the collapse by realised matter.

A key teleological requirement for our universe seems to be that it has a flat spacetime and this can be considered as an axiom for the model. The flatness requires that the density of the universe is always equal to the critical density and this will be achieved by feedback mechanisms (undefined at present) for regulating mass creation. The positive matter density and the identical critical density decrease with increasing time, or equivalently (since $t=r/c$) with increasing radius of the universe. Thus the rate of mass realisation would be higher in the early universe than in the

later universe. But this contradicts the invariance of the rate $\frac{dM}{dt} = \frac{c^3}{G}$, from differentiation of equation (3), where c as a constant is foundational in the relativistic basis of the universe; thus we

would need to postulate that the value of G changes with time, in particular that at early times it has a low value, giving a higher rate. We have previously assumed that all of the time-dependence of the relationship $GM = c^3 t$ is carried by M , with constant G ; however if the time variability is borne by the GM pair and G has a low value at early time then M will have a higher value than expected and the rate of mass creation will also be higher than expected versus the constant G scenario. This of course would have considerable consequences on the evolution of the universe, see section 7.10. Until the facts about the early universe are settled I would prefer to keep to the constant G model as it currently underpins the rationale for matter creation in the Model. This is supported by Mould and Uddin (2014) whose study of type 1a supernovae concluded that the value of $|\frac{dG/dt}{G}|$ has been $< e(-10)$ per year over the last 9Ga.

6.4.3.3 Bosonic Dark Matter?

The mystery concerning the invisibility and quarantine of dark matter can be solved if it is assumed that it exists in a diffuse or weakly-interacting state. Thus the focus of dark matter searches is on axions and WIMPs (Weakly Interacting Massive Particles). WIMP detection was claimed by the DAMA/LIBRA experiment based on annular modulation of the rate of event detection using sodium iodide, attributed to variation of earth's velocity relative to the Galactic dark matter halo, arising from Earth's solar orbit. This could not be replicated by the COSINE-100 collaboration (2018) and was later refuted by the ANAIS-112 experiment but experiments continue; see Amare et al (2021) for a detailed history and references for this ongoing search. On the other hand gravitational lensing studies have indicated support for dark matter being diffuse and wave-like, equivalent to particles (e.g. axions) with extremely low mass (\ll neutrinos) and self-interacting by quantum interference, manifested as waves within and around galaxies (Amruth et al 2023). Studies of this type explore the idea that dark matter is bosonic in character rather than fermionic (e.g. see Veltmaat et al 2018). Adopting that scenario it could be speculated that the dark "other positive matter", i.e. antimatter, pseudomatter and antipseudomatter, consist of dark bosons derived from Careyon pairs generated from pseudotritopreons. It can be imagined that at the genesis of the very first pseudovirtual chronotypes there was a "coin toss" to select the chronotype to collapse into real particles (fermions) and what we now call normal matter won that race and via a "template" effect catalysed future collapse and realisation to follow the same route, leaving the competing chronotypes to create bosonic dark matter. Thence arose a universe containing real fermionic normal matter and bosonic dark matter presumably collected into Bose-Einstein condensates. There is nothing special about the winning matter chronotype except that, naturally, we find ourselves constructed from it (the anthropic principle).

6.5 Quantum Field Theory Consequences of Model OMG; energy of the vacuum.

Quantum field theory calculates the energy of the vacuum as 60-120 orders of magnitude greater than is reasonable. This is based on the assumption that the vacuum is a sea of virtual positive mass-energy particles. Model OMG falsifies this picture; the vacuum is actually a sea of equal and opposite mass energy particles of both real and pseudovirtual nature, net mass energy always zero and net interaction energy with other particles also zero as gravitational and electrostatic effects also sum to zero. Zero vacuum energy also cancels the putative cosmological constant which the Model falsifies anyway.

The Model also potentially solves the "naturalness" problem of the Higgs boson; the Higgs gives mass to all the other particles and the other particles give mass to the Higgs, which should then have a much larger mass than is found. By existing in a net zero mass universe it should not acquire the problematic large mass theoretically attributed to it by the Standard Model.

6.6 Geological Consequences of Model OMG

The success of Model OMG in accounting for Dark Matter, Dark Energy and their gravitational effects supports a universe in which matter creation can be ongoing. This is of consequence not only to the evolution of the cosmos but also, closer to home, to the evolution and current state of the earth. In particular it supports the theory of the expanding earth, which is based on for example; wide geological evidence (Carey, 1976) of extension of the earth surface; geophysical evidence, from sea floor spreading at mid-ocean ridges, that the continents derive from the breakup of the monolithic crust of an earth with about half the present radius, with correlations to mass extinctions e.g. in particular the great end-Permian extinction (Maxlow, 2014, 351-3); and

paleontological evidence from the bio mechanical analysis of early life forms e.g. from the very earliest arthropods to the later dinosaurs (Hurrell 2011). This intriguing but very radical and heretical idea was previously too easily dismissed when the origin of the mass increase could not be imagined and was held to contravene conservation of energy. This automatic rejection or disengagement is no longer viable. Much of the argument against the expanding earth theory, apart from conservation of energy which is now theoretically defused by Model OMG, devolved into opposing positions on the reality of plate subduction processes. Carey considered them non-existent so that all the sea floor spreading from earth expansion was manifested, while the opposing plate tectonic view with no earth expansion is that all the new sea floor is balanced by equal subduction of old sea floor into the upper mantle. Model OMG favours the former without entirely discounting subduction of old sea floor but at a rate much less than the rate of new sea floor generation. This accords with the compromise offered by Edwards (2016) based on more recent geodetic surveys which may support earth expansion at a slower rate than proposed by Carey. However I agree with Carey that the evidence for subduction is weaker than advocated e.g. the absence of “subduction zones” to compensate for expansion at rifts around the African and Antarctic plates. The active zones around the Pacific Rim (the ring of fire) can be explained by the relaxation of the curvature of the Pacific plate and its neighbours as they accommodate to a wider globe, with the Hawaii hot-spot superplume near the centre of the plate as a possible related effect. The slow expansion scenario from recent geodetic studies may simply be evidence for episodic expansion rather than continuous. Condie (1998) explains episodic continental growth by supervolcanic events in the mantle attributed to catastrophic sinking of subduction plates; episodic earth expansion would achieve the same effect. An open-minded and curious scientist has no reason to ignore Carey’s theory nor to neglect its ramifications.

6.7 Global Climate consequences of Model OMG.

A corollary of the new paradigm is that we have been completely in ignorance of the most profound influence on the mass and dynamics of the galaxy and solar system, impacting the geological stability and thermodynamics of the earth, affecting everything from plate tectonics, earthquakes and volcanism, to climate, shedding new light on the issue of anthropogenic global warming inter alia. Ongoing linear or even exponential mass energy increase with time, of the galaxy, the solar system and the earth would have earth-climate consequences from several standpoints and deserves serious consideration in view of the implications for the “great crisis of our time”, global warming, currently blamed on anthropogenic factors and mooted as the next, and ongoing, mass extinction. We have given one mechanism for heat generation in the earth based on the primordial process, for a second example, cold neutron geofusion in the earth’s interior would release energy as the mass of the neutron plus the original nucleus would exceed the mass of the new nucleus, the difference being emitted as heat. At the very least if mass creation is real it renders invalid all current projections of Earth climate in the long term, but (alarmingly) also possibly in the short term if expansion is episodic and catastrophic. Conversely if global warming is as serious as publicised, the validity and implications of Model OMG deserve attention.

7 Is Model OMG falsifiable?

Any new hypothesis should pass two related tests: does it make correct predictions, particularly about phenomena not explicitly built into the theory, and is it falsifiable, i.e. are there tests which would invalidate the hypothesis if its predictions prove incorrect. If the hypothesis passes these tests it is promoted to a viable theory until falsified by new data.

7.1 The test of correct predictions

We have given evidence that the Model makes correct predictions for (1) the ratios of normal matter, dark matter and dark energy, (2) the ratio of the masses of the leptons (electron, muon and tau particle) and of the quarks, which when given the mass of the electron (the sole input parameter in the theory) gives their masses, (3) the Planck Fine Structure Constant. The term “correct” is used in a limited sense, in particular the calculated fermion masses do not match the full precision of the experimental values but comparable results in magnitude and ease of calculation are not available from other theories such as the Standard Models of particle physics and cosmology. Studies of the CMB may deliver more precise values for the amounts of normal matter, dark matter and dark energy for comparison to the Model. Greater precision from the Model may be obtained from a full theoretical derivation of the mass and charge functions, possibly defining incomplete Macdonald functions. The Model can also account accurately for the primordial abundance of hydrogen and helium-4.

The Model solves the Strong CP problem for the neutron.

In a more general sense the Model solves the original BBT problems; energy conservation, low entropy, and the horizon, smoothness and flatness problems, without inflation.

The prediction from the structure of the Model that all the neutrinos have masses less than the electron may be tested by increased precision of the experimental neutrino masses.

7.2 The prediction of the expanding earth

In terms of the postulated mass increase of the universe at the local level of the earth, space geodesic data will over time be decisive. Current measurements of the Earth are too lineball to convincingly distinguish between growth and dimensional stasis, resulting in arguments for a growing earth (Edwards 2016) and against (Sudiro (2014), Buis, Calvin, [NASA], 2011 citing Wu[JPL/NASA] et al 2011)). Edwards concluded "... that Sudiro's (2014) obituary of the expanding Earth theory as a whole must be considered premature at this time". Assuming growth is continuous the controversy will continue until unbiased data is available over a longer period. Some current measurements have been biased by the exclusion of data from earth stations judged to give results deemed unreliable because they are in unstable geological zones or otherwise out-of-trend, assuming constant earth dimensions (confirmation bias), Maxlow (2014, 371-373). There will remain the possibility that earth growth is not continuous but sporadic and may not currently be strongly operating. Some expansionists link sporadic or possibly even periodic spurts in growth to extinction-level events e.g. driving catastrophic sea-level changes Maxlow (2014, 344-357), who attributes the great end-Permian extinction to the break-up of the original monolithic crust (the Pangaea supercontinent) draining the shallow continental seas and initiating the deep, modern oceans.

7.3 The prediction that dark matter is antimatter inter alia.

Another prediction of the theory is that dark matter is, in part, antimatter and that the gravitational force between matter and dark matter is identical to that between matter and matter. This is under investigation already and recently confirmed. If antimatter was repulsive to matter then a central claim of the model is refuted and the Model is invalidated. The Model predicts that pseudomatter and pseudoantimatter could be dark as a consequence of the existence of antiphotons, but antimatter should be just as observable as normal matter, as found by recent experiments with antihydrogen. The darkness of antimatter may be due to its existence in non-radiant form but otherwise its darkness and that of the other two forms of non-normal positive matter can be attributed to their existence in the form of Bose-Einstein condensates of dark bosons from Careyon pair collapse.

7.4 The prediction of quark constituents with mass energy 0.5766 MeV (preon) and 0.1922 MeV (tritopreon).

The theory predicts a preon of mass 0.5766 MeV composed of three tritopreons. As quark components the preons will be subject to confinement in the nucleus and will only be detectable as an output of atom smashing in e.g the Large Hadron Collider. Such detection would support the theory but non-detection would not necessarily invalidate it as it is contingent on suitable experimental methodology and the absence of pathways that would permit only the most fleeting existence of free tritopreons.

7.5 The prediction of the Tritoelectron.

As with the preon, its detection is contingent on suitable experiments in the LHC. Since high-energy particle collisions generally create particle chains culminating in stable particles e.g. electrons, it may be that we will never see tritoelectrons or tritopreons.

7.6 The prediction of quark charges

With the tritopreon charge = $e/3$ the model for the quarks conforms to the standard model with the charges of the up-type quarks = $(+)2/3e$ and the down-type quarks = $(-)1/3 e$.

7.7 The prediction of in situ cold nucleosynthesis.

The Big Bang theory describes the nucleosynthesis of the universe's store of the lightest elements (hydrogen, deuterium, helium, lithium) in the the first few seconds of its history, after the high energy radiation-dominated era. In Model OMG a very small fraction of the current matter content of the universe is present during the early eras, compensated perhaps by a much greater span of time than the Big Bang. Energy density however could still be high due to the very small radius of the universe and nucleosynthesis might occur as in the Big Bang, but the amount generated is assumed to be much less. Model OMG therefore self-consistently requires not only ongoing mass creation but also ongoing extra-stellar nucleosynthesis. That is, we might envisage mass creation as simply generating free neutrons which rapidly decay to protons, electrons and neutrinos, leading to hydrogen and ultimately further nucleosynthesis via stellar processes; but this would not explain the assumed primordial abundances, which we have done by other means. It is

proposed possible that mass creation also involves in situ (that is, within existing matter) nucleosynthesis and there is some support for this; the kinetics of mass creation are at first glance, according to equation (1), dependent on time alone and independent of matter, but kinetic equations can be derived from the FLRW cosmology that do have dependence on the mass or equivalently on the mass density of the universe [details to be reported in Part 2 of this report]. Thus matter creation is in a sense autocatalytic, and deeply involved in the growth of galaxies and stellar planetary systems. This provides the trigger for mass creation; matter induces the creation of matter. Nucleosynthesis e.g. by incorporation of newly created neutrons into existing atoms, must also accompany mass creation if this is involved in ongoing expansion of the earth for example, although the existence of geohydrogen sources (Hand E., 2023) could also indicate hydrogen generation within the earth from decay of newly generated neutrons. Fusion reactions of this type have been observed in Lattice Confinement Fusion (Pines V. et al, 2020, Steinetz B.M., et al, 2020) where the high electron density of a conductive metal reduces the Coulomb repulsion of the fusing particles (e.g. a nucleus with a neutron or even a proton), enabling processes like the Oppenheimer-Phillips stripping reaction even at room temperature. The solid iron core and molten iron outer core of the earth seem plausible sites for such physics.

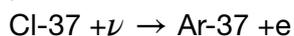
The claims that the Earth is expanding and that the expansion is driven by mass increase, in particular the speculation that this involves nucleosynthesis in the inner earth, have been partly tested by close examination of the tritium emitted by volcanoes. Tritium from within the Earth cannot be primordial due to its very short half-life, its presence in volcanic emissions is credited to “geo-fusion”, “cold” nucleosynthesis within the Earth. It is elevated in hot-spot volcanoes like Kilauea, where the magma originates in plumes from the deep core-mantle boundary, usually accompanied by elevated ratios of helium-3/helium-4, another indication of geo-fusion (Jones and Ellsworth, 2003). Shallow sources of magma like “subduction zone” volcanoes do not show such indicators proving that the tritium cannot come from subducted oceanic material contaminated by tritium originating in space or the atmosphere e.g. from nuclear testing. Geofusion should also enhance the heat flow from the inner earth, currently attributed to chains of radioactive decay from primordial radioactive elements. Note that the proposed geofusion processes would also create radioactive isotopes within the earth. The net heat flow out of the earth is difficult to measure accurately and earth surface temperature is mainly determined by solar energy absorption, but could be used to support or falsify the Model which predicts that heat flow exceeds that expected from radioactive decay of isotopes present in the earth since its formation.

The Model proposes that mass creation requires a specific conditions so the ultimate question is what factor in the environment initiates or catalyses mass creation. It also proposes that this specific trigger requires a low probability of occurrence in order to avoid “mass-catastrophe” i.e. run-away mass creation. It is intended to show in Part 2 of this research that the kinetics of mass creation is a process that is dependent on pre-existing matter i.e. mass begets more mass. We have proposed that the accumulation and collapse of bosonic Careyons wave functions can account for mass creation. It has a low statistical probability because a large number of Careyons are needed to coincide and collapse in order to generate a stable proton or neutron e.g. a large number of preons are needed to construct the 3 valence quarks plus the “virtual quark-antiquark-gluon sea” in a stable nucleus. It could be speculated that Careyons are everywhere, perhaps existing atoms act as a “template” for their collapse into nucleons. The wave functions of the pseudovirtual Careyons collapse to real particles when exposed to real particles? This has been offered as an explanation for dark matter (7.4.3.3) as mass remaining in bosonic (axion) form due to the “first past the post” victory of normal matter in collapsing first at the origin of the universe establishing an eternal template for future Careyons collapse to fermions, leaving other chronotypes to collapse in dark bosonic limbo.

As above we can postulate mass creation as some process operating within massive bodies and contingent only on conditions within those bodies, and/or alternatively a process triggered by other massive bodies and involving some kind of messenger other than Careyons. If such a messenger operates within a massive body like the inner Earth it must be something capable of deep penetration of the earth and not sufficiently potent to promote significant mass increase in shallower bodies like the continents and crust at the surface. Gravity waves have been postulated as a source of energy for inner Earth changes but the author leans towards the continuous and copious flux of neutrinos from various sources, mainly astrophysical; possibly providing mass themselves as suggested above but also interacting with atoms within the Earth to promote the

genesis of new matter, e.g. “cold” neutrons which will rapidly decay to hydrogen atoms and/or transform atoms to heavier atoms such as tritium and helium-3 inter alia, by the s-process. To avoid the “5- and 8-nucleon gaps” there needs to exist atoms with more than 5 nucleons to enable neutron capture to construct atoms heavier than helium; not a problem within the earth, but limiting nucleosynthesis in deep space.

Neutrinos have manifestly little interaction with matter, meeting the requirement for a low probability process. The mass creation process involving either neutrinos or Careyons could be testable by looking for the products of nucleosynthesis when large, heavy objects of suitable material (i.e. a lot of mass with high neutrino cross-section to enhance neutrino interaction with the material), are exposed to neutrino beams from nuclear reactors. Obviously very sensitive detectors and shielding from radio-contamination will be critical but the neutrino physics community is experienced in these matters. Neutrinos interact feebly with nuclei via the weak interaction converting a neutron into a proton, transmuting the atom into an isotope of the next atom in the periodic table with essentially the same mass as the initial atom. Thus the classic Homestake gold mine, solar neutrino experiment (Davis Jr., 1996) detected the radioactive argon produced from chlorine in a tank of tetrachloroethylene



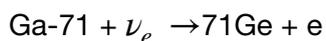
The detection of radioactive nuclei produced by Careyon or neutrino-induced nucleosynthesis may thus be problematic unless very specific radiation energies are produced and can be detected. An alternative, at least for neutrinos, is to look for A+1 nuclei (where A is the atomic mass of the substrate) by mass spectroscopy. For this we desire a substrate with atomic mass A that is naturally devoid of the A+1 isotope, preferably a gas or liquid to facilitate continuous monitoring by MS. Of the elements in the periodic table only 21 are monotopic i.e. occur naturally as essentially one isotope.

Two of these are halogens: F-19 and I-127, the former exists as a diatomic gas and the latter a relatively volatile solid at room temperature, facilitating monitoring for the products of s-process nucleosynthesis. These reactive halogens could generate the next element up in the periodic table, the inert gases neon and xenon respectively. The disparity in chemical reactivity could permit efficient chemical separation of iodine and its inert gas product, or enrichment of the product, before analysis, improving the signal-to-noise ratio. Neon does form compounds with fluorine, NeF_n with n=1,2,3. Of the 18 known isotopes of fluorine and the 37 for iodine, only F-19 and I-127 are stable and remain in natural samples. The products expected from F-19 will be initially F-20 or Ne-20 (depending on whether the final particle generated in the nucleus is a neutron or a proton) however F-20 is unstable with a half-life of 11 seconds and decays by beta elimination to Ne-20, in both cases the Ne-20 atoms will then create a mixture of free Ne-20 and its spectrum of fluorine compounds, losing some signal-to-noise sensitivity. Unfortunately few researchers will be eager to work with tons of very hazardous fluorine for long periods of time. Natural iodine is monotopic I-127: but nuclear testing and accidental releases has resulted in I-128 contamination, which decays with a half-life of 25 minutes mainly by beta emission to Xe-128, which is the species sought from A+1 nucleosynthesis, perhaps disqualifying iodine as a good substrate. Iodine e.g. as sodium iodide, has been used in dark matter searches and also proposed for solar neutrino experiments (Lutostansky, 2022) and could simultaneously explore the generation of Xe-128. Using fluoride or iodide salts is safer and more convenient than using the molecular halogens.

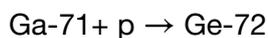
If nucleosynthesis in situ does not result in the absorption of the new neutron by the nucleus it may be released as a free neutron, which has a half-life of about 14 minutes, decaying to a proton by beta emission of an electron (and an electron antineutrino), in effect generating a hydrogen atom. The persistent presence of hydrogen in evacuated steel containers might already be evidence of free neutron genesis in steel although the current position is that this is just a contamination problem. As the core of the earth is thought to be mainly iron, and if this is the probable substrate for nucleosynthesis by neutrinos (and yes I have seen the movie “2012”!) then further studies of this observation are called for but must overcome any persistent hydrogen contamination if this is generated chemically during manufacture or processing of the iron. The existence of geological stores and emissions of hydrogen is becoming important as significant sources of “green” energy (Zgonnik 2020). It is also an important energy source for deep sea bacteria for whom photosynthesis is unavailable. It is suggested to be of varied origin, including buried organic matter within the earth and a by-product of nitrogen fixation in the seas, but also from deep geological sources which Model OMG suggests could include de novo neutron genesis.

Sodium is monoisotopic Na-23, transmutation by a proton will give Mg-24, which is the stable major isotope. Transformation by a neutron will give Na-24, which is unstable, decaying with a half-life of 20 hours by beta emission to also result in Mg-24. Molten sodium is safely used in very large amounts for cooling in sodium-cooled fast reactors, where it can also absorb reactor neutrons to form Mg-24. Molten sodium (but not from nuclear reactor coolant) could be a suitable material, if devoid of natural Mg, to monitor for nucleosynthetic Mg-24 from neutrino bombardment or Careyon-mediated transmutation. Alternatively, aqueous sodium salt solutions might be used as in the Gallex experiments, below, but molten sodium may be a better mimic of deep earth conditions e.g molten iron, if these are critical as suggested by the lattice confined fusion scenario. Sodium fluoride or iodide solutions would provide safe targets with the advantage of two A+1 nucleosynthetic products in each case. Sodium iodide is in use in experiments to detect dark matter WIMPs (COSINE -100 Collaboration, 2018).

Ga-71 has been used in solar neutrino detection experiments; Gallex (Anselmann, 1994,1995; Hampel, 1996) and the Gallium Neutrino Observatory (Altmann, 2005 using Ga-71 trichloride solutions, and the Russian-American Gallium experiment, SAGE, using liquid gallium-71).



In the Gallex experiments the germanium was chemically extracted, converted to Germane GeH_4 and the decay of the radioactive Ge-71 detected by counters. These experiments could have been used to detect transmutation by neutrino- or Careyon-driven neutron/proton generation in the nucleus:



Transmutation by either neutron or proton produces stable Ge-72. This could have been detected in the Gallex/GNO germane by mass spectroscopy of the germane.

Natural gallium is 39.9% Ga-71 and 60.2% Ga-69. The latter would generate Ge-70 (stable) so both Ge-70 and Ge-72 could be sought as nucleosynthetic products from natural gallium.

Negative results from such experiments may simply demonstrate that we have failed to duplicate the high pressures and temperatures of the deep inner earth; suggesting that we should also be looking more closely for evidence of nucleosynthesis products from those regions e.g. hot spot volcanic emissions from deep mantle plumes.

7.7.1 What rate of nucleosynthesis is required to explain earth expansion?

Typical estimates of earth growth require a doubling in radius over the last 245 Ma (e.g. radius 0.52 of current earth radius in Triassic, Maxlow 2014, p447) an 8-fold increase in volume and thus also of mass, assuming constant density. This represents 3 doubling times for mass increase. If we consider the nuclei, then each nucleon must create 7 more over this interval, which is about 7.7×10^{15} seconds. The time required per nucleon to make another nucleon is thus of the order of 10^{15} sec. Conversely an assembly of 10^{15} nucleons will generate one new nucleon every second, or 86,400 per day, or circa 30 million per year. The analytical method will thus need to detect the new matter at a level of about 30 ppb after one year. Combined with sample enrichment methods this analysis seems feasible. Experiments of the type proposed could readily be included in the various neutrino monitoring studies underway or otherwise possible.

7.8 A predicted outflow of negative matter from black holes.

Stephen Hawking proposed black holes emit black body radiation due to relativistic quantum effects. Model OMG (3D) predicts that "octet production" of eight particle chronotypes in the vicinity of a black hole will result in net destruction of matter outside the event horizon. Whether the particles are considered real or virtual is moot, there is no energetic cost, and in either case the black hole will very efficiently separate the positive and negative masses; 4 positive mass particles are pulled into the black hole while the 4 negative mass particles are just as powerfully repelled from the black hole. In the Hawking picture matter escaping the black results in a "quantum glow". Hawking predicted that black holes, after consuming all the matter in their vicinity, could thus evaporate over vast periods of time. Model OMG predicts the opposite; the black hole continues growing, by creating and devouring positive matter while the co-created negative matter is violently but invisibly expelled. Incoming positive matter meets this outgoing stream resulting in the quiet disappearance of both. However the net effect of matter creation near the event horizon when other matter is near the black hole is nil, the black hole consumes the same amount of positive

matter as it destroys. It is unlikely that the different behaviour of black holes predicted by the Model will be detectable with current technology; we are looking at small differences in the very violent environment around a black hole. We would be seeking an unexpected deficiency of luminous normal matter (plasma, gas and dust) just outside the event horizon; surely an imposing if not impossible task. Once again there must be factors inhibiting mass creation or black holes would experience run-away mass growth.

7.9 The prediction of accelerating expansion of the universe.

Ongoing autocatalysed mass creation produces more negative matter inter alia and creating more gravitational repulsion and accelerating expansion. Already observed. Long term consequences unknown apart from the fact that the density of the universe will continue decreasing with the expansion because the increasing radius (volume) of the universe outpaces the mass increase. Speculatively, as the Model suggests that mass creation is tied to density then the rate of mass creation should decrease, slowing the rate of expansion and possibly constituting the feedback mechanism that keeps the density always equal to the critical density. The fine-tuning of the universe to support life implies a long term purpose to achieve a quasi-steady state in an evolving universe. The never-ending mass increase but decreasing density in our positive part of the universe creates the teleological puzzle regarding the end-fate of such a universe. A universe with mass “decreation” enabling an eventual kinetic equilibrium between creation and destruction might evolve into a system with true eternal stability. One route to this would be quantum tunneling between positive matter black holes in our hemisphere and negative matter black holes in the negative hemisphere, resulting in matter drains in both hemispheres. I hope to consider some of these aspects in Part 2 of this article.

7.10 The prediction that the universe is older than the Big Bang theory estimates.

The “slow fizz” model indicates a much more leisurely process of spacetime-and mass- creation than the Big Bang, allowing more time between “time zero” and “first light” era for the gravitational concentration of matter and the production of galaxy seeds. According to BBT there is insufficient time post-Big Bang to account for the maturity of the young galaxies observed by the Webb telescope, Labbe (2023). To resolve this contradiction Gupta (2023) developed a hybrid Λ CDM cosmology incorporating tired light to stretch the age of the universe to 26.7 Ga with 3.5 Ga at $z=2$, giving enough time to form massive galaxies. The kinetics of mass creation in Model OMG deserves more scrutiny than possible here but a simplified analysis is presented: according to the interpretation of the FLRW universe in section 4.1 the mass growth is linear with time, so we can define a doubling time t_2 in which a mass M increases to $2M$. If we assume Earth expansion follows the same kinetics and assume constant earth density then we can relate mass increase

(M_1 to M_2) to radial increase (R_1 to R_2) and it is easy to show: $\frac{R_1}{R_2} = \left(\frac{M_1}{M_2}\right)^{\frac{1}{3}} = (0.5)^{\frac{1}{3}} = 0.7937$

The current radius of the earth is 6370.8 km so it would have half the current mass at a radius of $6370.8 \times 0.7937 = 5056.5$ km. From estimates in Maxlow (2014, p69) we can interpolate that the earth had this radius approximately 76 Ma ago, and this will be assumed as the invariant universal doubling time. This agrees roughly with the 245 Ma for 3 doubling times estimated in section 7.7.1 also based on other presentations of Maxlow’s data, i.e. a doubling time of about 82 Ma. If we assume the initial genesis event was the creation of the full set of 4 positive matter hydrogen chronotypes with total mass $4 \times 1.6735 \times 10^{-24} \text{ g} = 6.694 \times 10^{-24} \text{ g}$ and that the current modulus of the mass of all positive mass chronotypes in the universe is $4 \times (\text{visible matter}) = 4 \times 1.5 \times 10^{53} \text{ kg} = 6 \times 10^{56} \text{ g}$ then $6 \times 10^{56} \text{ g} = 6.694 \times 10^{-24} \text{ g} \times 2^n$ where n is the number of doubling times, whence $n=265.6$.

This makes the **age of the universe = (76-82)*265.6 Ma = 20.2-21.8 Ga** which may accommodate the Webb observations, lending a measure of credence to both the congruency of earth and universe mass creation and to Maxlow’s estimates for the former.

As expected, a long, apparent “induction period” occurs where mass increase in absolute terms is very small for a substantial period, e.g. after the first 5 billion years of approx 66 doublings the

mass is only about 1.25×10^{40} kg, less than 1% of the current mass of the Milky Way galaxy (estimated by Watkins (2019) including dark matter to be 3×10^{42} kg). So, while there appears to be sufficient time for the first galaxies to mature, there must be concern as to whether there is sufficient mass to form those first galaxies as seen by the Webb telescope! Section 7.4.3.2 offered a qualitative solution to this concern: with a variable G and the relationship $G |M| = c^3 t$ then the early universe (with low G) has a higher than expected mass and rate of mass creation. The cosmological picture is then almost a hybrid of the Big Bang and the Continuous Steady Creation (G=constant) scenarios; rather than a Slow Fizz at constant G, a faster Big Fizz of matter creation initially at low G, decreasing as G increases. In this scenario it is possible that the early universe observations by the Webb telescope, mature galaxies at very high redshift, are explicable.

Alternatively, and more consistent with Model OMG and with the favoured constant G scenario, if the rates of mass increase and expansion are not linear but increasing, possibly exponentially, then the current rate of earth expansion is greater than in earlier epochs, so the doubling time would be longer in previous epochs and the age of the universe is correspondingly greater than estimated above.

8 Questions

The Model raises a host of further questions, many have been considered in the development of the theory, but many remain and many more will surface with time. A few of the more obvious ones are addressed here.

8.1 Where is all the dark matter and dark energy? Dark matter is identified as what we call “other positive matter” which consists of antimatter, pseudomatter and pseudo antimatter. It is located where we presently believe dark matter to reside; in haloes gravitationally bound to the normal matter galaxies. Dark energy is identified as the repulsive gravitational impact of negative matter. It could be proposed to reside spatially in, and create, the great voids of the universe. But does this not conflict with the cosmological principle that the negative- and positive-mass universes are indistinguishable? Not at all, the denizens of the negative universe, will like us, live in galaxies held in the great filaments through their universe and wonder about what is in the voids. Their universe developed exactly in the manner of ours but in negative time. Spatially a difference develops between the positive and negative universes, but they are equivalent “mirror images” in time. We do not and cannot observe negative matter (positive matter travelling backwards in the z time direction) due to the inability of negative energy photons to interact with our positive energy matter. Cosmic censorship.

We, as normal matter, coexist in this universe with both dark matter and negative matter. We experience the effects of both through their gravitational effects. We may not “see” pseudomatter nor pseudoantimatter, positive matter travelling backward in the y or x time directions because that requires us to detect antiphotons. The inability to see cosmological antimatter is less explicable in terms of recent physical experiments that prove it interacts with light in the same way as normal matter and should not be dark; the Model allows that it and the other positive matter chronotypes could exist in dark bosonic form. Chronotype-specific catalysis of fermion and boson formation supports continued spacial quarantine. Cosmic censorship and quarantine.

8.2 Do I have a mirror image negative version of myself in the negative time universe?

Not likely. The two antipode universes are equivalent in the gross scale but not in the detail; from the moment the first 16 particles are formed in the 4-D chronoverse, 8 positive mass and 8 negative, the particles will go their separate ways, perhaps with initial and opposite, position and momentum vectors equal to many decimal places but ultimately differing due to the uncertainty principle. The histories of the two universes start to diverge from the very beginning and evolve through chaos and contingencies as proposed in biological systems. In a near infinite universe there may be a negative version of me but equally there could be at some time or place another positive version of me in the positive universe.

8.3 Have we simply kicked “the impossible” a bit further down the road? By invoking mass creation to explain the universe and then involving cold nucleosynthesis to explain the detail of local mass creation have we just moved the barrier to credibility downstream? This is true! But this is how science progresses. One advance in understanding the universe does not immediately reveal the chain of causality all the way to the complete and ultimate Theory of Everything. “I formulate no hypothesis” concerning nucleosynthesis should be an acceptable position but as imaginative scientists we usually have further outrageous speculations on how the new roadblocks may be overcome!

Accepting mass creation according to the Model, then pseudovirtual up and down quarks must become “realised” in sets of three to create stable nucleons which go on to transmute atoms into higher mass/atomic number atoms.

8.4 Does the Neutrino have a role in gravity or mass creation?

From the gravitational analysis we have posited the existence of a gravitic contribution from a long-range manifestation of the weak force presumably mediated by a zero-mass gauge boson. From the “bosons as fermion pairs” theory we have posited the graviton as (inter alia) a composite of fermions from octants 1A and 1B (constituting our octant) wherein the colour charges cancel to zero. The graviton 1A1B has the same characteristics (quantum signatures) as the scalar W-boson 1A4B but with the addition of spin, and thus has a close connection to the weak force. These considerations of gauge bosons in a gravitoelectroweak theory potentially intersect at the neutrino.

Neutrinos have zero mass in the Standard Model of particle physics, supported by quasiluminal travel at or near the speed of light (within experimental error). In section 5.2.1.6 we admitted the possibility of a zero mass electron neutrino if the neutrino mass quantisation parameter contains the factor (i-1). The zero mass neutrino is denied by other behaviour such as neutrino oscillation which implies mass but, being at the forefront of physics, remains controversial. Neutrino oscillation may explain how the weak force could become an inverse distance force at cosmological distances as the spacial separation of the wave packets of neutrino mass eigenstates leads to decoherence and damping of neutrino oscillations, so at short range the heavy mass eigenstates contribute (giving a moderate force) but at longer ranges the low mass state has “outrun” the heavier states and a weaker force results. Decoherence can also result from neutrino interaction with the environment.

Electron neutrinos and antineutrinos are intimately involved in weak force interactions; in the beta decay of neutrons to protons a W- boson is emitted and decays into an electron and an electron antineutrino, while in the electron capture process a proton is converted to a neutron and an electron neutrino is emitted. The gravito-electroweak gauge boson might then be a bosonic pair of electron neutrinos in a pseudo virtual state as common to gauge bosons.

Against these speculations are the facts that neutrinos and gravitons should be uncharged while the proposed bosonic-pair gravitons are charged (non-zero x component). In partial defence of this vulnerable speculation it seems reasonable that a TOE including a gravitoelectroweak interaction should feature force-mediating bosons that have charge, spin and mass.

A comprehensive theory exists, energy wave theory, where the neutrino is the fundamental particle, from which all other particles are constructed (Yee J. 2011, 2018). As such it is a plausible candidate for mass increase of the universe and nucleosynthesis by accumulation of neutrinos in existing matter and further transmutation by the weak interaction. Thus if the neutrino is unlikely to be the graviton, it might possibly be a mass carrier.

Matter reproduction would then have analogies to biological reproduction with a massive “egg” (nucleus or atom) interacting productively with a stream of small, mobile “spermatocytes” (neutrinos) both of which contain and transmit “genetic” information of a wave mechanical nature critical to the creation of the new quantum body. This picture resolves a philosophical/teleological puzzle concerning matter and the universe: if I accept, like Stephen C. Meyer (2021), that the universe has meaning and purpose, what is the purpose of neutrinos? The other fermions are key elements in the baryonic structure of the building blocks of nature, while the bosons are force-mediating messengers governing their behaviour and interactions, but the neutrino, while possibly having mass does not seem to contribute meaningfully to the mass of the universe (merely transmuting existing atoms) and while looking like a fast and mobile, ubiquitous, and extremely penetrating messenger had only the bosonic message of transmutation ascribed to it until now. The deduction in the Model that the neutrino is a composite particle creates scope for it to contain genetic information for particle creation.

However on the balance of the model evidence, the Careyon picture of fermionic mass creation is the favoured route to nucleosynthesis and is supported by prediction of the primordial abundances of H and He-4. The economical explanation for dark matter as Bose-Einstein condensates of collapsed pairs of pseudovirtual Careyons of the other positive chronotypes, otherwise an intractable puzzle, offers the advantage of parsimony.

9 Conclusions

Model OMG delivers, albeit at a descriptive level, a unification of areas in physics previously separated by gulfs in our understanding:

(a) the physics of the very large (cosmology, gravity) and the very small (fermion masses), bridging the gap between the Standard Model of Cosmology and the Standard Model of Particle Physics. The Model starts with the FLRW solution to the field equations of General Relativity, derives the existence of the 3-D chronosphere which, for the non-neutrino fermions, dictates the quantisation of mass and charge and the force potentials resulting from them; general relativity and quantum mechanics meet in the chronosphere;

(b) Gravity and electromagnetic potentials described under a common protocol and sharing a common energy component speculated to originate in a long range weak force derived from the weak interaction. Extension to a 4-D chronosphere enables the strong force to be accommodated, also the Higgs boson. The Carey model for statistically-controlled creation of mass (fermions) successfully predicts the primordial ratio of hydrogen and helium-4, lending support for the allied speculations, less verifiable, of the existence of a host of novel gauge bosons describing a unified gravito-weak-electromagnetic-strong force and their appearance in realised form as dark matter. Supersymmetry of the fermions and bosons is implied by their interconversion and shared description under a simple geometric scheme. Extension to an 8-D chronoverse encompasses neutrinos and massless particles like photons. Supersymmetry with string field theory in ten dimensions, or M theory in 11 dimensions, implies that Model OMG with 11 dimensions (3 space+8 time-like) could be completed to include the missing details with grand unification of the 4 forces. Model OMG provides a theoretical basis for continuing mass creation in the universe, locally realised by an expanding Earth. The Webb telescope observations of surprisingly mature galaxies at high red shift may be accommodated by an older universe postulated in the Model. A template or "observer" effect, wherein existing fermionic matter catalyses the collapse of Careyons is proposed to explain the growth of normal matter bodies in the visible universe while leaving in a dark, diffuse, bosonic state the antimatter and the other two forms of positive matter.

Model OMG, while coherent, is incomplete in the present form, quantitative in some aspects and only speculative and descriptive in others but offers a new route to a Grand Unification Theory of Everything.

In particular it emphasises that the theory of General Relativity is also incomplete, it needs to incorporate negative matter (a consequence of negative time) as originally considered by Einstein. Further, by including eight time dimensions, in a resulting 11 dimensional spacetime, it is anticipated that quantisation of gravity could ensue with the eventual characterisation of a range of new bosons as mediators of the unified force; wave mechanical calculations usually produce quantisation through the imposition of critical boundary conditions that enforce integer numbers of wavelengths and past attempts to develop a quantum field theory of gravitation have omitted the key time-boundaries and negative-time symmetries proposed in Model OMG. The model is contrary to, or well beyond, the Standard Model of particle physics e.g. by speculating that some variant forms of gravitons and gluons can have electric charge.

The optimism engendered by string/brane theory encourages solution of a wave equation in a 11-dimensional relativistic supersymmetric universe where mass (the wave function) tells spacetime how to bend, while spacetime tells mass (the wave function) how to move.

A mathematical dance happily left for the next Einstein to choreograph!

I trust that the more contentious proposals in the Model do not dissuade researchers from exploring it's explanatory virtues and correcting it's deficiencies.

Carey had an ascerbic view regarding the stultifying influence of monopolistic tradition i.e. censorious consensus, both scientific and religious, on the acceptance of new ideas. In particular he was always careful to specify that the mass creation he was looking for was a secular process, a mechanistic process bereft of purpose, in other words illustrating the very attributes he decried. While honouring his research I need to contrast our different philosophies; my position is as an open-minded theist and that mass creation in the Model is a consequence of design and purpose. Model OMG completes a new depiction of matter and the universe as a living, eternally growing, self-reproducing system with meaning and purpose rather than a mechanical, one-off construction of the Big Bang, the latter explicable only by extraordinary devices (inflation and the multiverse), doomed to ever- increasing isolation of its islands of life in a cold and gathering darkness, waning over countless eons to an inevitable end by heat death. Life versus death. Heaven versus Hell. A scientific choice but with deep philosophical outcomes.

I think modern society is in dire need of a) a more optimistic philosophy than that derived from the current consensuses, b) a more challenging approach to existing consensuses, and c) more open

attitude to new theories, particularly from multidisciplinary sources outside the established discipline.

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