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THE ORIGIN OF GRAVITY AND ITS EFFECTS: ACCORDING TO THE SUBQUANTUM KINETICS PARADIGM

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ABSTRACT

This overview explores the phenomenon of gravitation as represented in the novel physics methodology of subquantum kinetics (SQK). Model G of SQK is shown to spawn physically realistic particle-like structures having mass and charge which generate gravity potential fields capable of exerting forces on neighboring particles, but whose strength declines to zero beyond distances of 10 kpc, thus eliminating the need to assume the presence of dark matter. Gravity in this paradigm plays a far broader role than in standard physics. It creates subcritical conditions in intergalactic space that foster nonconservative photon energy damping, tired light redshifting, thus providing a static universe interpretation of the cosmological redshift. It also predicts the existence of supercritical conditions in gravity potential wells that allow spontaneous zero-point energy fluctuations to grow and continuously materialize subatomic particles. Furthermore, it predicts a mother-daughter particle nucleation process that allows matter creation to proceed at an exponential rate. Such supercritical regions induce nonconservative photon energy amplification which accounts for the anomalous blueshifts observed in galaxy cluster spectra, and also resolves the puzzling Kaiser effect and Fingers-of-God effect. Also gravity-potential-mediated photon energy amplification predicted within all celestial bodies is shown to account for the observed planetary-stellar mass-luminosity relation, to prevent the formation of black holes, to provide the energy powering supernova explosions, and to explain the tremendous outpouring of both matter and energy from galactic cores. All of these nonconservative energy effects are permissible since SQK conceives the material universe as an open system at the subquantum level. Other aspects of this physics covered here include the origin of the electrostatic, magnetic, and nuclear force, and the existence of a causal coupling between electric and gravitational potential fields. The gravity fields of SQK are also shown to account for the various general relativitistic effects.

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OVERVIEW

The concept of gravity that is explored here is different from anything one is likely to have encountered in the past. It emerges out of an approach to physics called *subquantum kinetics.* Before going specifically into an explanation for the origin of gravity and its effects, it is necessary to note a few things about subquantum kinetics.

• Subquantum kinetics was first published in 1985 (LaViolette, 1985a, b, c), and has been in development for more than 40 years, being most completely presented in LaViolette (2012).

• To date it has had eleven papers published in refereed journals, numerous others published in books and conference proceedings, as well as additional unpublished white papers. Many of these may be accessed at the Starburst Foundation internet archive (https://starburstfound.org/paper-archive/).

• Although not taught in physics classes and university curricula, subquantum kinetics has nevertheless developed a strong and enthusiastic following. More recently, especially since 2010, researchers have joined to help in its development, more particularly in performing computer simulation of the partial differential equation system that lies at its heart which has had such great success in generating verified predictions.

• Thus far subquantum kinetics, a.k.a. SQK, has had 13 a priori predictions confirmed. This exceeds by far general relativity which historically has had three confirmations. A theory's confirmations is generally recognized as a better indicator of its correctness than widespread acceptance of the theory by the scientific community, the latter being highly influenced by academic politics and by physicists' difficulty to break away from old familiar concepts to explore new ones. The reason why subquantum kinetics has had so many more confirmations than general relativity has to do with its scope. General relativity focuses mainly on celestial gravitational phenomena and has had its predictions verified entirely by means of astronomical observation. SQK, however, covers phenomena on a wide scale, ranging all the way from the subatomic to the cosmological. As a result, it has accumulated a far greater number of prediction confirmations. But it is important to keep in mind that due to its greater scope, it has been far more vulnerable to disproof than, for example, general relativity.

• Subquantum kinetics grew out of the author's basic belief that, at a very fundamental level, the physical Universe operates as an open system, rather than as a closed system as is the conventionally held view. The open system concept was a central idea that was being examined by a branch of science and philosophy called general system theory (GST), first developed in the 1930's by biologist Ludwig von Bertalanffy (1968). GST investigates the commonalties of physical systems, be they physical, chemical, biological, social, or psychological. It seeks to study the fundamental characteristics that systems have in common. The open system concept, for example, is found to apply to a wide variety of physical phenomena ranging from cellular convection, to morphogenesis in open chemical reaction systems, to the formation of social order in social systems, and even to the emergence of emotional-cognitive thought structures in the human mind. While the open system paradigm had been found to be fundamental to most types of systems around us, until the advent of SQK, it had never been applied to microphysics.

The formative ideas for SQK emerged at a time when the discovery of chemical wave phenomena in certain open chemical reaction systems was making news. Also at that time, in 1972, the work of the "Brussels school" on an interesting reaction-diffusion system called the Brusselator came to wide attention, e.g., see publications by Lefevre (1968), Prigogine, Nicolis, and Babloyantz (1972), and Nicolis and Prigogine (1977). The Brusselator is a nonlinear chemical reaction system described by four kinetic equations and two variables which, when simulated on the computer, is found to generate a variety of ordered structures from a simple initiating fluctuation. My initial insight at that time was that, the Brusselator reaction system could be properly modified into a reaction-diffusion model that would exhibit physically realistic behavior when simulated on the computer, the objective being to produce structural analogs of subatomic particles and fields. Inherent to this approach was the notion that all physical form emerges from an underlying stratum that functions as an open system.

• Subquantum kinetics is better thought of as an *approach* than a theory, one that differs radically from that used in standard physics. For example, it places modeling and theory antecedent to observation. It chooses a reasonable model to start with and then uses observations to check the model's validity and to fine tune it by making proper adjustments to the model's parameters. This approach differs from that of standard physics which puts observation first and theory second. In standard physics, theory serves as an after-the-fact attempt to explain existing observations. This approach is best depicted by the parable of the blind men and the elephant. Just as the blind men observe different parts of the elephant and form different theories of the whole, so too standard physics conducts numerous observations at various levels of Nature and this results in many and varied theories being devised. The theories that have resulted, though, fail to form a coherent and holistic explanation of physical reality, and in some cases contradict one another. In an attempt to "sew" them together into a coherent whole, the standard approach has relied on mathematical acrobatics and assumptions of higher dimensional spaces to create a so called "unified field theory." These attempts have tended to be highly mathematical, very complex, and to produce results more reminiscent of a patch-work quilt. String theory is an extreme example of the abstractness and complexity that this approach leads to.

The subquantum kinetics approach instead begins with a simple set of assumptions associated with a hypothetical Brusselator-like model that is expressed as three partial differential equations. These would then be computer simulated to produce particle-like structures, that are correlates of known subatomic particles, or energy waves. This core model, called "Model G", is devised to describe reaction processes occurring at a subquantum level. Its operation, then, generates phenomena that should be observable on a more macroscopic level, subatomic, astronomical, or even cosmological. So, SQK in a manner of speaking, begins with an educated guess for the "elephant's" genetic code, its genotype, and then simulates this to grow the elephant itself, the phenotype. When the code is properly engineered one gets a result that bears a good resemblance to what our observations tell us is out there. In this way, subquantum kinetics achieves simplicity and elegance right from the beginning. It has very few assumptions and, compared to quantum physics, it is mathematically far simpler and more commonsensical. It also avoids the many paradoxical results and pitfalls that standard physics suffers from.

• SQK postulates a "reaction-diffusion" ether pervading all of space. This differs from the nineteenth century mechanical ether theories, and instead resembles more the kind of multi-specie gaseous ether proposed by Dmitri Mendeleev (1904), or to the transmuting ether theory developed by the Chinese physicist T'an Ssu-t'ung (1865-1898), e.g., see Yu-Lan (1959). However, SQK has developed its approach in far greater detail and mathematical rigor than had these past theorists, partly because of the advent of the branch of physics and mathematics that deals with nonlinear chemical reaction systems and nonequilibrium thermodynamics. Significant also is our ability in modern times to carry out computer simulations of such nonlinear open reaction systems.

Similar to these early theories, SQK postulates an ether consisting of different types of etheron constituents, components labeled as A, B, C,… X, Y, Z, Ω, etc., and which react with one another or transform one into the other. SQK specifies a particular preferred set of reaction pathways as well as specific rates at which these constituents diffuse through space. More specifically, it uses concepts and techniques which previously were developed in the field of chemical kinetics to describe the behavior of open chemical systems and for the first time applies them to physics at the subquantum etheric level. Thus the SQK approach should be more easily understood by nuclear and chemical physicists, who typically deal with reaction processes, as compared to physicists who have been immersed in the mechanistic concepts of classical physics.

• SQK postulates that the physical universe is inherently processual at the etheric level with etherons entering our universe from "upstream" states and leaving our universe to transform to "downstream" states; see Figure 1. Hence SQK requires more than three dimensions for its description. This is a significant departure from standard physics which is based on the assumption that the universe should function as a *closed* system, there being assumed to be no existence "beyond" the observable universe. As such, just as nonlinear open systems are known to have spontaneous amplification modes or spontaneous damping modes, SQK allows that under certain conditions a photon's

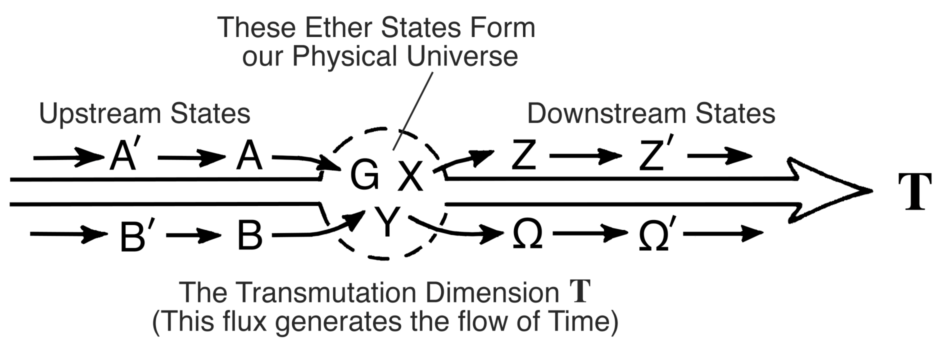

Figure 1 Depiction of the hyperdimensional transmuting ether.

energy may either progressively increase over time or progressively decrease over time. Perfect energy conservation in SQK appears only as a special case with energy nonconservation being the more common. Due to this flexibility, SQK has an advantage over standard physics in that it permits, rather than forbids, over-unity energy production. Hence it provides a fruitful paradigm within which to assess the many over-unity energy devices that have been developed in past decades. This flexibility also allows it to predict a cosmology of continuous matter creation which is able to serve as a viable alternative to the trouble-ridden big bang/expanding-universe cosmology. This continuous creation scenario blatantly violates both the first and second laws of thermodynamics, but becomes permissible in SQK with its open system paradigm. Although, such energy conservation violations occurring in the cosmological setting take place on a scale so small as to be virtually impossible to detect in the laboratory.

• In SQK it is possible to postulate a variety of reaction-diffusion systems as ether models. But it mainly focuses on exploring the physically relevant properties of one reaction system called *Model G*, which strongly resembles the Brusselator reaction-diffusion system. Model G is obtained by modifying the two-variable Brusselator reaction system by adding a third reaction variable G to the Brusselator's two variables X and Y; compare Figures 2 and 3. As a result, Model G is described by a total of five reaction steps, rather than four for the Brusselator. Figure 4 maps out the Model G reaction system specified in Figure 3. The Brusselator is unable to generate physically realistic structures since it spawns nonlocalized wave patterns, also termed dissipative space structures. That is, the wave pattern distributes itself at full amplitude throughout the entire space reaction-volume. The Model G alteration, on the other hand, is able to

$$A \xrightarrow{k_1} X, \qquad \text{a)}$$
$$B + X \xrightarrow{k_2} Y + Z, \qquad \text{b)}$$
$$2X + Y \xrightarrow{k_3} 3X, \qquad \text{c)}$$
$$X \xrightarrow{k_4} \Omega. \qquad \text{d)}$$

Figure 2. The Brusselator reaction scheme.

$$A \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} G, \qquad \text{a)}$$
$$G \underset{k_{-2}}{\overset{k_2}{\rightleftharpoons}} X, \qquad \text{b)}$$
$$B + X \underset{k_{-3}}{\overset{k_3}{\rightleftharpoons}} Y + Z, \qquad \text{c)}$$
$$2X + Y \underset{k_{-4}}{\overset{k_4}{\rightleftharpoons}} 3X, \qquad \text{d)}$$
$$X \underset{k_{-5}}{\overset{k_5}{\rightleftharpoons}} \Omega \qquad \text{e)}$$

Figure 3. The Model G reaction scheme.

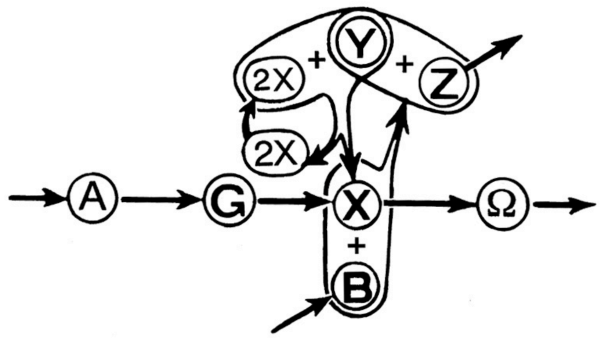

Figure 4. A schematic representation of the reaction kinetics of Model G

spawn localized wave patterns that are able to serve as analogs of subatomic particles. Model G not only spawns physically realistic soliton particles, but is both simple and, as will be seen, is able to account for a wide variety of physical phenomena, some not anticipated in the framework of standard physics.

Almost two decades after the first papers on SQK were published, the modeling approach that it was proposing as a new approach to physics was lauded by physicist Stephen Wolfram, founder of Wolfram Research and creator of the Mathematica computing software. Wolfram (2002) published a book entitled *A New Kind of Science* in which he proposed the hypothesis that the universe may follow simple rules that can be described and even solved by a computer program. He suggested that underneath all of the richness and complexity we see in physics there may just be simple rules operating at some lower level, and that all of physics would be found to emerge from these rules. He pointed out that incredibly simple programs can do extremely rich and complex things. On page 4 of his ebook, entitled *A Class of Models with the Potential to Represent Fundamental Physics* (Wolfram, 2004), he gives examples of what he calls such "rules," one being 1 → 2 → 3, and examines others that contain looping processes. Such rules bear some similarity to the idea of reaction kinetic processes. Although, they do not appear to incorporate concentration magnitudes or spatial diffusion coefficients. He believes he is getting closer to arriving at a workable set of rules for physics. If he eventually achieves that goal, the system of rules may turn out to look very much like Model G. He apparently was unaware of SQK, otherwise he would have mentioned this approach in his writings, and to be honest, I was not aware of his work until now while in the process of writing this present summary of SQK. Interestingly, in 2010, Wolfram's Mathematica computing platform was used by our group to solve the set of three partial differential equations that constitutes Model G. As is discussed in the next section, the results were quite successful and confirmed the reality of the particle-like structures that had been inferred in previous publications of SQK.

THE CREATION OF GRAVITATIONAL AND ELECTRIC FIELDS

The reactants specified in Model G are given values in terms of concentrations, all of which have positive magnitudes. However, in describing the evolution of physically realistic structures and fields, it is useful to define energy potentials which can take on either positive or negative values. If the analogy is made that etheron concentration is similar to ocean sea level, energy potentials would then refer to the waves on the ocean's surface. The amplitude of such waves could take on either positive or negative values relative to sea level. Let us say that initially prior to the emergence of physical form, the etheron concentrations are uniformly distributed, a condition representing the vacuum state of space. Values G_0, X_0, and Y_0 are assigned to Model G's three variables to represent this initial vacuum state which is called the ether's homogeneous steady state. Actually, these values are time averages since the etheron concentrations randomly fluctuate above and below these values due to the stochastic behavior of the etheron reaction processes. Gravity potential, then, could be referenced to the G_0 "zero-point value," and would be defined as $\varphi_g = G - G_0$. Gravity potential would be positive for $G > G_0$ and negative for $G < G_0$.

In SQK, the electric field is represented by two etheron species X and Y that are involved in a self-closing reaction kinetic cycle, graphically portrayed in Figure 4. While use of two variables to represent the electric field (X and Y) may seem strange to engineers and physicists who have grown accustom to using a single variable notation in practice, it nonetheless accounts for the origin of charge polarity, something that is inadequately explained in standard physics. A high-Y/ low-X concentration in a given locale would signify a positive charge whereas a low-Y/high-X concentration would signify a negative charge. In SQK, X and Y do not take values independent of one another; they co-depend in reciprocal fashion. As was done in defining gravity potential, electric potential would be defined as $\varphi_x = X - X_0$ and $\varphi_y = Y - Y_0$. Potentials φ_x and φ_y being understood to be co-dependent. If necessary, one could chart just one of these two variables, let us say φ_y, to track electric field magnitude.

The recursive X-Y loop transformation plays an important role in SQK. It is key to generating the emergent dissipative soliton wave pattern which can adopt two alternate polarities representing the matter and antimatter state of matter. This is examined in the next section. But, also significant, this bipolar character of the electric potential automatically leads to the creation of bipolar gravity potential. This is because the local value of the G-on concentration (gravitational mass) closely tracks the local value of the X-on concentration (electric charge) due to the presence of the reverse reaction $G \xleftarrow{k_{-2}} X$ in step (b) of Model G; see Figure 3. This is the only significant reverse reaction, the reverse reactions in the other reaction steps being assumed to be essentially zero. As will be described later, this reverse reaction plays an important role in allowing the emergence of self-stabilizing solitons (subatomic particles). As a result of this electrogravitic dependence, the φ_g potential at a given locale is able to adopt either a plus or minus polarity relative to the ambient ether concentration as it tracks the polarity of the φ_x component of the electric field. Consequently, in SQK gravity potential is bipolar. This departs radically from the general relativistic notion that gravity should be exclusively monopolar. More specifically, a localized positive electric charge potential in SQK will generate a gravity potential well whose field gradient is able to gravitationally attract material bodies, whereas a localized negative electric charge potential will instead generate a gravity potential hill whose field gradient is able to gravitationally repel material bodies.

This unique bipolar gravity prediction of SQK is consistent with the discovery by T.

Townsend Brown (Brown, 1929) that there is an *electrogravitic* coupling between electric and gravitational fields, or in other words between charge and gravity. This coupling becomes most evident at electric potentials exceeding 50 kV. This electrogravitic coupling phenomenon is unexplained by Einstein's general relativity theory. It was an issue of serious concern for him in his long attempt to find a way to somehow unify gravity with electromagnetism within his general relativistic framework. If it were not that the U.S. Navy had placed Brown under restrictions not to publish about his findings for national security reasons (see Brown, 1952), Brown, not Einstein, would today have been the revered icon in gravity theory. The history of the application of Brown's findings to the aerospace field is described in the aviation intelligence report known as *Electrogravitics Systems* (Aviation Studies, 1956), a copy of which is archived at the Wright Patterson Air Force base library. This document, together with an extensive review of electrogravitics may be found in the book *Secrets of Antigravity Propulsion* (LaViolette, 2008).

The point should be made here that in SQK electrically neutral matter produces a matter attracting gravity well, which is modest when compared to that of an isolated proton, because the proton's gravity well is slightly deeper than the electron's gravity hill. As for the demise of general relativity, physicists should not worry. For all the known general relativistic effects follow naturally from Model G. Relativistic effects are examined near the end of this chapter.

As in quantum mechanics, SQK postulates that field potentials are the real existents whereas forces are effects produced on particles by gradients of these potentials. This differs from classical physics which instead regards force as the real existent and energy as a more abstract attribute. SQK regards energy potentials as real scalar quantities that correlate with the concentration of specific ether species at specific points in space, G-ons for the gravity potential and X-ons and Y-ons for the electric potential. There is no separate magnetic field component in SQK. Magnetic forces are theorized to be electrodynamic effects produced by translating electric potentials, or X-on and Y-on ether vortices. In a manner analogous to how electric potential fields generate electrodynamic magnetic effects, the relative motion of a gravity potential field is expected to generate gravitodynamic forces. The existence of such a gravitodynamic force has been reported by Henry Wallace (1971).

THE IMPORTANCE OF GRAVITATIONAL POTENTIAL IN THE CREATION OF MATTER

In subquantum kinetics, G-on concentration, or alternatively gravity potential, serves as Model G's bifurcation parameter determining whether or not a subatomic particle is permitted to nucleate. The system's behavior depends on the value of the G-on concentration relative to the critical threshold concentration value G_c. Whether or not Model G allows a particle of matter to nucleate, depends on the prevailing steady state G-on concentration G_0 relative to the critical threshold concentration value G_c. If G_0 lies above the critical threshold, $G_0 > G_c$, Model G remains subcritical (infertile) and is unable to spawn matter; see Figure 5. If G_0 instead lies below this critical threshold, $G_0 < G_c$, Model G becomes supercritical (fertile) and a subatomic particle, for example, a neutron, is allowed to emerge.

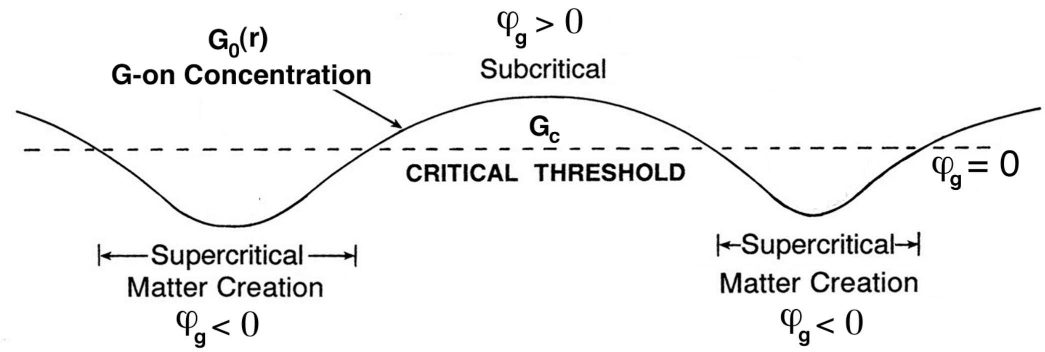

Figure 5. The ability for matter to nucleate in empty space depends on the ambient value of the gravity potential relative to the zero value which signifies critical threshold value, G_c.

Alternatively, it is useful to express this gravity bifurcation parameter in terms of a potential, referenced to some G concentration value. Earlier, the gravity potential was referenced relative to the steady state concentration value, G_0, with $\varphi_g = 0$ occurring when $G = G_0$. Here it is more useful to set the critical threshold G_c as the zero reference. Hence with $\varphi_g(r)$ defined as $G_0(r) - G_c$, a particle would be able to nucleate when $\varphi_g < 0$ and would be prevented from nucleating when $\varphi_g > 0$.

But in addition to requiring a preexisting supercritical region, an energy potential fluctuation is also needed to initiate particle morphogenesis in this region. As mentioned earlier, the ether concentrations continuously fluctuate above and below their steady state concentration values. This subquantum noise is theorized to have fluctuation amplitudes distributed as a Poission function and would be the analog of the zero-point energy field in quantum physics. However, unlike the standard quantum fluctuation concept, these fluctuations would normally have energies far smaller than that of a fully formed subatomic particle, and they would not emerge as paired plus-minus polarities. Instead, they would emerge in an uncorrelated white-noise fashion. These fluctuations play an important role in SQK since these are what nucleate particles in empty space.

But this nucleating fluctuation, say φ_x-φ_y, must be of *positive* polarity and also have a sufficiently large magnitude. The role of polarity will become clear shortly. Under prevailing supercritical conditions, such a positive electric potential fluctuation would be able to grow in size and eventually develop into a dissipative soliton, e.g., a neutron. This process by which a fluctuation can initiate an ordered pattern in a nonlinear nonequilibrium reaction system is well known in studies of the Brusselator system, and has been termed by Ilya Prigogine as “order-through-fluctuation”. Details of this have been extensively worked out by Nicolis, Prigogine and their Brussels group in a field of study called "fluctuation theory".

In the case of SQK, we may view this particle materialization process by simulating Model G on a computer. Beginning from the Model G reaction system, Figure 3, we may write the following set of three partial differential equations as a representation of Model G:

$$
\left.\begin{aligned}
\frac{\partial G}{\partial t} &= k_1 A - k_2 G + k_{-2} X + \mathcal{D}_g \nabla^2 G \\
\frac{\partial X}{\partial t} &= k_2 G + k_4 X^2 Y - k_3 B X - k_5 X + \mathcal{D}_x \nabla^2 X \\
\frac{\partial Y}{\partial t} &= k_3 B X - k_4 X^2 Y + \mathcal{D}_y \nabla^2 Y
\end{aligned}\right\} \qquad (1)
$$

Each partial differential equation here specifies the evolution of one of Model G's three variables, G, X, and Y over space and time. This equation system is more easily solved if the variables are expressed in terms of potentials rather than concentrations. Matt Pulver has expressed equation system (1) in terms of potentials and through the use of dimensionless counterparts has computer simulated this equation system (Pulver and LaViolette, 2013). Figure 6, taken from this paper, presents the results of one such computer simulation which shows a positive electric potential fluctuation evolving into a "dissipative soliton." This would represent the spontaneous nucleation of a neutron from "empty" space.

The initiating fluctuation must be positive, because this generates a corresponding local gravity well, negative φ_g potential, whose supercritical environment allows the emerging electric potential fluctuation to grow in size. A negative electric potential fluctuation, ultimately leading to the materialization of an *antineutron,* would fail to spontaneously self-amplify since it would generate a G-hill which would locally produce a subcritical environment, thereby snuffing its own growth. Because of this matter-antimatter bias, the SQK matter creation process leads to a universe filled mainly with matter, rather than antimatter. This is an advantage since to date there has been no detection of antimatter galaxies. The apparent lack of an equal amount of antimatter in the universe has been a major setback for the big bang theory of standard cosmology. This is not to say that negative polarity particles such as the antineutron cannot form. These can nucleate in an existing supercritical region when initiated by a sufficiently large energy impulse

Once the dissipative soliton has fully emerged, its growth ceases. Figure 7 depicts such a fully developed soliton representation of a neutron. The soliton maintains this final end state as an inhomogeneous steady-state condition, despite environmental perturbations that might attempt to destabilize it. It is important to note that the G-well present in the soliton's core, provides a supercritical environment that ensures the particle's continued survival. Thus in SQK such an emergent subatomic particle is both autonomous and autopoietic. That is, once formed it persists independently of environmental disturbances. This feature, whereby a particle becomes self-stabilizing by virtue of its own self-generated gravity well, is unique to Model G and gives this reaction-diffusion system the ability to produce physically realistic soliton structures.

This representation of a neutron's electric field differs substantially from previous representations that have come out of standard physics which show the neutron's electric field potential rising asymptotically to a peak at the particle's center, as in the model advanced by Schmieden (1999). However, particle scattering experiments subsequently conducted by Kelly (2002) show something very different. Compare Figure 6 to Figure 8-a which depicts the charge density profile of the neutron based on Kelly's observations.

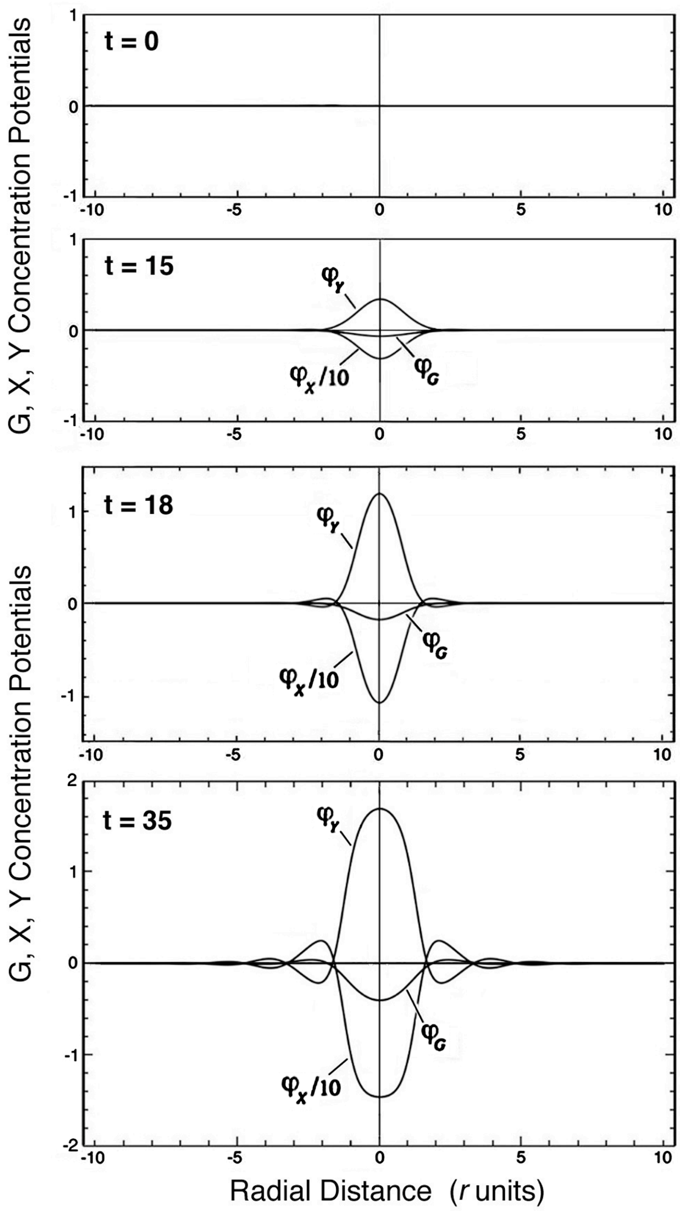

Fig. 6 . Sequential frames from a three-dimensional computer simulation of Model G showing the emergence of an autonomous dissipative soliton particle: t = 0 the initial steady state; t = 15 growth of the positively charged core as the X seed fluctuation fades; t = 18 deployment of the periodic electric field Turing wave pattern; and t = 35 the mature dissipative soliton particle maintaining its own supercritical core G-well. Simulation by M. Pulver. May be viewed at: https://tinyurl.com/ybfphshf.

Note that both show a rounded off central profile surrounded by a wave pattern that asymptotically declines in amplitude as it departs from the particle's center. The surrounding periodicity is made more evident when Kelly's data is plotted as a surface charge profile; see Figure 8-b. So Kelly's findings unequivocally confirm the SQK a priori

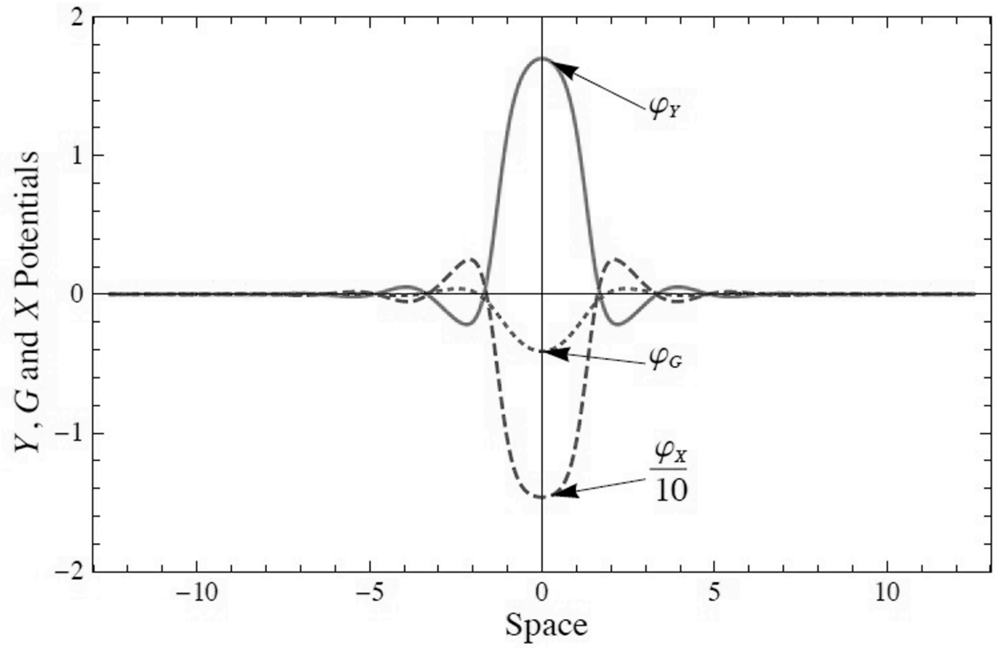

Fig. 7. Self-stabilizing soliton produced by a computer simulation of Model G which represents a neutron.

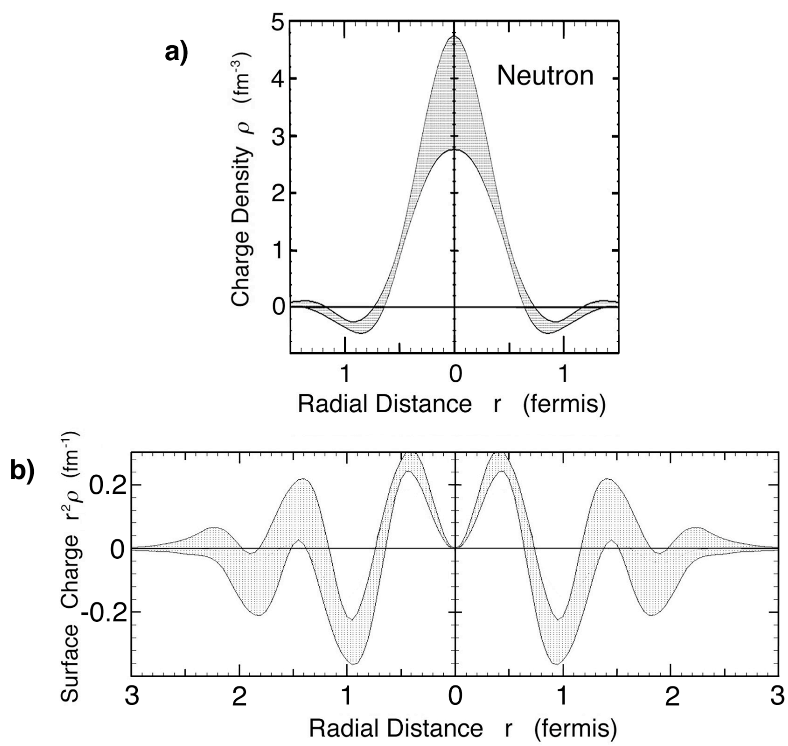

Figure 8. a) Charge density profile for the neutron predicted by Kelly's preferred Laguerre-Gaussian expansion models and b) the corresponding surface charge profile (after Kelly, 2002, Fig. 5 – 7, 18).

prediction of the electric field distribution in the neutron. This important finding is discussed in LaViolette (2006).

In SQK, the electric potential wave pattern in the core of a subatomic particle is termed its *Turing wave*, in honor of Alan Turing, the first to formulate a reaction-diffusion theory of morphogenesis. Similar wave patterns seen in chemical reaction-diffusion systems have been referred to as Turing patterns. SQK has predicted that the Turing wave should have a wavelength equal to a particle's Compton wavelength; i.e., the wavelength denoting one complete wave cycle (LaViolette, 1985b). Kelly's findings observationally confirm that the wavelength is indeed close to the Compton value.

The SQK model of subatomic particles resolves the wave-particle dualism that has long plagued standard physics. As seen here, the SQK dissipative soliton is both a particle and wave at the same time. So there is no need to assume that a wave packet tags along with a particle as the particle moves, the idea advanced by deBroglie and adopted by quantum theory. In fact, LaViolette (1985b, 2012) has shown that the SQK soliton with its Turing wave field modulation accounts for the same phenomena that standard wave mechanics attempts to explain, such as particle diffraction and orbital quantization. Thus SQK offers an effective replacement for quantum mechanics while avoiding paradoxical pitfalls of the standard view, such as the particle wavelength being dependent on the relative velocity of its observer. Nikolic (2007) discusses a large number of the assumptions of standard quantum theory which are either questionable or still unproved. We will not go into this further here since the purpose of this chapter is to focus on the topic of gravity.

SQK also theorizes that an ether vortex would develop in the particle's core and that this produces what physicists refer to as particle spin magnetic moment. In the neutron, for example, this vortex arises because Y-ons continually diffuse outward from the core, where the Y concentration is high, into the adjacent inner shell where the Y concentration is low. Simultaneously, X-ons and G-ons continually diffuse inward from this inner shell, where the X and G concentrations are high, into the central core where the X and G concentrations are low. Since the core and shell concentrations are maintained indefinitely by the underlying reaction processes, these fluxes also continue indefinitely. Furthermore, these radial fluxes are theorized to develop into a vortex similar to water going down a sink's drain. This vortex gives the particle a preferred spin axis. A particle's spin vortex is what gives the particle its ability to bind tightly to another particle when both come in close proximity. Hence according to SQK, the nuclear force is simply the attractive force produced by the mutual alignment and entrainment of two adjacent spin vortex fluxes. These vortices must be so aligned that the ether fluxes travel in the same direction. Hence the vortices (spins) must be aligned antiparallel when the particle vortices are entrained equatorially, and aligned parallel (same direction) when the vortices are axially aligned. This leads to the spin alignment rules studied in quantum mechanics. But, since this chapter is devoted to the subject of gravitation this subject will also not be dealt with further here; for more information see LaViolette (2012), Ch. 5.

Let us now examine the type of gravity field that a subatomic particle, e.g., a neutron, would generate as understood in the SQK approach. As discussed above, the φ_g potential of the neutron will have a periodic aspect, as do all subatomic particle field patterns in SQK. Since the negative amplitudes of the neutron's gravity field predominate over the positive amplitudes, the neutron produces a net consumption of G-ons in its core, and this in turn generates an extended gravity potential field which declines with distance from the particle's center as 1/r. SQK expresses this as:

$$\overline{\varphi}_g(r) = \overline{\varphi}_{g0}\left(\frac{r_0}{r}\right), \tag{2}$$

where $\overline{\varphi}_{g0}$ is the average value of the gravity potential $\overline{\varphi}_g$(r) at the particle core boundary $r = r_0$.

Indeed, in SQK, it is this net consumption of G-ons that determines the magnitude of the particle's gravity field. This is because the conversion of X-ons into Y-ons (reaction (c) in Figure 3) takes place more rapidly in the particle's core than it does in the particle's environment due to the presence of a higher concentration of Y-ons in the core. The resulting reduced X-on concentration, in turn, leads to X-ons being converted into G-ons at a slower rate (reaction (b) in Figure 3). The resulting deficit of G-ons in the core induces an inward G-on flux from the neutron's surroundings. It is this inward G-on flux that determines the 1/r contour of the neutron's gravity field. Hence the gravity field of the neutron is ultimately determined by this excess G-on consumption rate taking place in its core.

The potential $\overline{\varphi}_{g0}$ at the core boundary given in (2) is expressed as:

$$\overline{\varphi}_{g0} = M_g / 4\pi \mathcal{D}_g r_0 , \tag{3}$$

where $\mathcal{D}_g$ is the diffusion coefficient of G specified in equation (1) and M_g is the total G production rate balance accrued within the particle core, within a spherical boundary of radius r_0. In other words, M_g represents the total rate of G-on consumption within the neutron's core. This parameter is termed the particle's *active gravitational mass*; i.e., the gravitational mass that determines the neutron's extended gravity potential field. This gives an example of how known physically observed quantities may be expressed in terms of the SQK reaction-diffusion methodology. For a more detailed discussion of these mathematical expressions, one is referred to the main reference LaViolette (2012).

This reaction-diffusion characterization of the particle's gravitational mass and how it generates a surrounding gravity field may seem rather strange to the average physicist who is unfamiliar with SQK. But he should keep in mind that classical physics offers no explanation of the nature of gravitational mass or why it generates a gravity field; it merely quantifies these based on observation. Similarly, although general relativity claims that a mass creates its gravity field by warping space-time, it does not go into any specifics of how matter acts upon space-time to accomplish this. I tend to agree with the view of Nikola Tesla who said:

> "*I hold that space cannot be curved, for the simple reason that it can have no properties. ... To say that in the presence of large bodies space becomes curved, is equivalent to stating that something can act upon nothing. I, for one, refuse to subscribe to such a view.*"

At sufficient radial distances, the neutron should be found to produce a net G-on consumption. However, it should be recognized that close to the particle core the representation given in Eqns. (2) and (3) may be oversimplified. For, as is seen in Figure 7, the shell adjacent to the particle's core has a gravity potential that is slightly positive, hence a G-on production rate surplus (negative mass), and the shell beyond that has a slight G-on production rate deficit (positive mass), and so on. The idealized representation of the neutron's gravity field given in Eqn. (2) instead assumes that the G production rate balance outside of r_0 is zero. So, based on the Figure 7 soliton simulation, we should expect that there will be departures from this idealized state in the immediate vicinity of the neutron's core.

Moving onto the topic of gravitational force, we see that the 1/r gravity potential field is able to induce an attractive pull on neighboring particles that declines as $1/r^2$ with distance. This effect is expressed in terms of the *accelerating force intensity* $\bar{\mathbf{I}}_g(r)$ which depends on the gravity potential gradient as:

$$\bar{\mathbf{I}}_g(r) = k_g \nabla \bar{\varphi}_g(r) = \frac{k_g M_g}{4\pi \mathcal{D}_g r^2} \cdot \hat{\mathbf{r}} \qquad (4)$$

where k_g is a constant of proportionality. Hence SQK leads to gravitational field and force expressions that are consistent with classical theory.

This equation holds at large distances from the center of the particle. As one instead approaches the center of the particle where its gravity field flattens out, one finds that the gravity gradient approaches zero. This leads to the conclusion that black holes should be unable to form. That is, if a star were to collapse and compressing itself under the action of its own gravity field, the inward pulling gravitational force would eventually approach zero. This conclusion is backed up by Kelly's observations of the contour of the nucleon's electric charge density which accordingly flattens out at the particle's center. Kelly's data, of course, does not directly make predictions about the particle's gravity field. But, acknowledging the reality of a direct correspondence between the electric and gravitational fields, based on T. T. Brown's findings, one is led to conclude that the particle's gravity field should similarly plateau in the particle's core, just as SQK predicts. There is also another reason why black holes cannot form in SQK, which we defer to the section on photon blueshifting.

The manner in which a potential field causes a remote particle to move, due to the effect of its field gradient on the particle, differs substantially from the mechanistic explanations given in standard physics which rely on one's personal "hands-on" experience of force. Note that classical physics offers no explanation other than to quantify a particle's accelerating motion in the presence of a gravity field. Also general relativity, which relies on the concept of warped space-time, offers an understandable explanation of how a moving planet orbits its parent star. However, it falls short in offering an explanation of how an object initially at rest is caused to accelerate when subjected to a gravity field.

By comparison, SQK offers the following explanation. When subjected to a gravity potential gradient (G-on concentration gradient), the G concentration well that forms the core of the particle is caused to migrate toward the gravity field source, that is, in the direction where the gradient's G-on concentration is lowest. This is because the imposed gradient lowers the G-on concentration on the side of the particle's core nearest the gravity field source and raises it on the opposite side furthest from the gravity field source. In fact, this external gravity gradient distorts the particle's entire shell-like φ_g space structure, altering its former spherically symmetrical shape in the field gradient direction and perturbing the homeostatic condition that maintains the particle's entire space structure pattern. The particle consequently departs from its former stable attractor state and enters a condition of instability. It is through this stress, that the field gradient manifests its force on the particle. The magnitude of this force, would vary in direct proportion to the magnitude of the imposed gravitational field gradient.

The particle response to this stress follows in accordance with Le Chatlier's Principle which holds that a system in dynamic equilibrium that is subjected to a stress will change so as to relieve that stress. Although originally developed to explain the equilibration of chemical systems, this principle applies equally well to describe how concentration gradients present in a reaction-diffusion ether are able to induce particle acceleration. The particle relieves the imposed stress by readjusting its form so that its shell-like wave pattern adopts a more symmetrical configuration in a new reference frame that is in motion relative to its old frame. In so doing, the particle moves down the gravity gradient and, as a result, in the old frame its space structure will appear distorted, slightly compressed on its bow side and slightly extended on its lee side in accordance with the requirements of the relativistic Lorentz contraction effect discussed toward the end of this chapter.

As a demonstration that a gravity potential gradient in Model G is actually able to cause a soliton (neutron) to move, the reader is referred to the following youtube postings by M. Pulver which show the results of a computer simulation in 1D of a particle moving down a constant 2% φ_g slope.

normal view: https://tinyurl.com/y7s9m9xl

zoomed view: https://tinyurl.com/yc56t3oh

Figure 9 shows a frame taken from this simulation. Analysis of these simulations shows that the magnitude of this velocity scales in proportion to the steepness of the imposed G gradient; see Pulver and LaViolette (2013).

These simulations which were performed in only one dimension showed the soliton's velocity converging to a constant velocity along the x-axis. To be a correct representation,

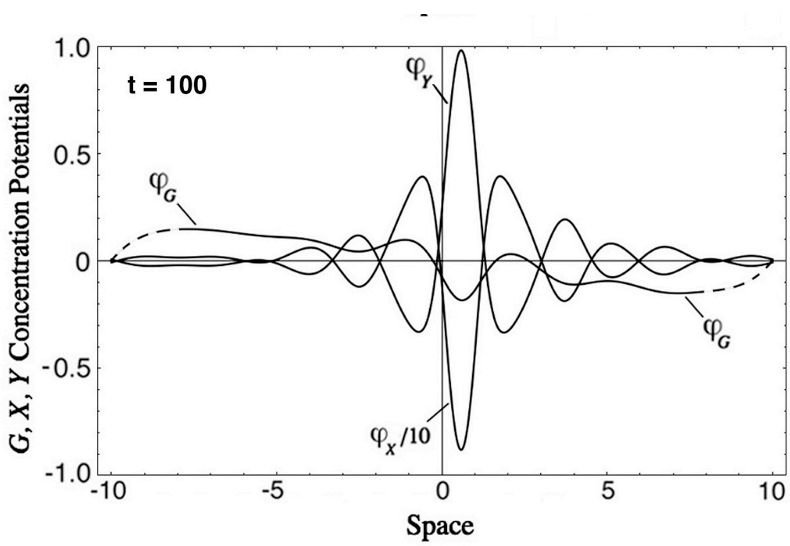

Figure 9. Computer simulation of a dissipative soliton particle moving in a 2% gravity potential gradient. Particle shown centered at position (x = +0.6). (Pulver and LaViolette, 2013).

the particle velocity should instead be found to continuously increase with distance traveled. More recent simulations of Model G, carried out in two dimensions by Brendan Darrer and the Model G/Vortical Motion Group, do show the soliton accelerating when placed in the presence of a G gradient; see video available at: https://youtu.be/1heLcC-xuiU. The two particles were nucleated on either side of the reaction volume each being subjected to a G concentration gradient (gravity potential gradient) that was inclined toward the volume's center, as shown in Figure 10 (a). Figure 10 (b) shows the positions of the particles after t = 10 seconds in the simulation and also after t = 45 seconds, having each accelerated down its respective G gradient and approached closer to one another. In the video the particles are seen to ultimately collide and circle one another slightly before the simulation finishes. The position x of the left soliton was determined at 14 points in time during the simulation and plotted to form a time-distance graph; see Figure 11. A polynomial fit of the graph showed that it fit the form $x = at^2 \;\; bt + c$, which corresponds to the formula exhibited by an accelerating body. This simulation was written in the TensorFlow/Python programming language and incorporated Navier Stokes equations in each of Model G's three partial differential equations.

So we find that when simulated in two dimensions, Model G solitons accelerate in a gravitational gradient just as would real masses. Other 2D simulations have demonstrated that these neutral charged solitons exhibit mutual attraction as would two gravitating bodies, as well as elastic particle collisions. Currently, we are working on also simulating soliton tunneling across a thin boundary as well as diffraction of a soliton as it passes through a single slit.

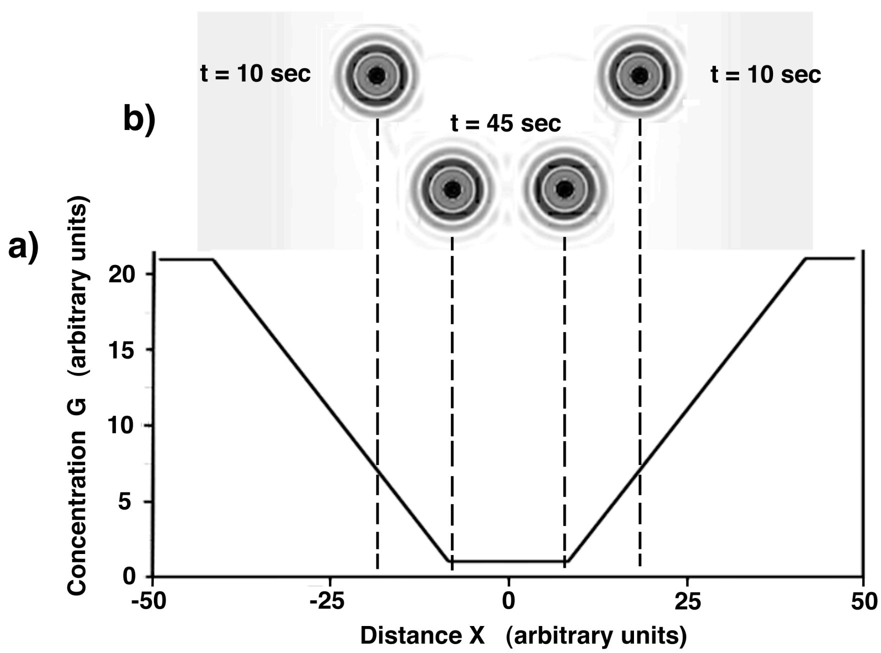

Figure 10. Illustration of movement of two Model G solitons down G gravity gradients toward one another. a) illustration of the G concentration contour imposed on the reaction volume, b) illustration of the relative positions of the two dissipative solitons at time t = 10 seconds and at t = 45 seconds into the simulation. Simulation by B. Darrer may be viewed at: https://youtu.be/1heLcC-xuiU.

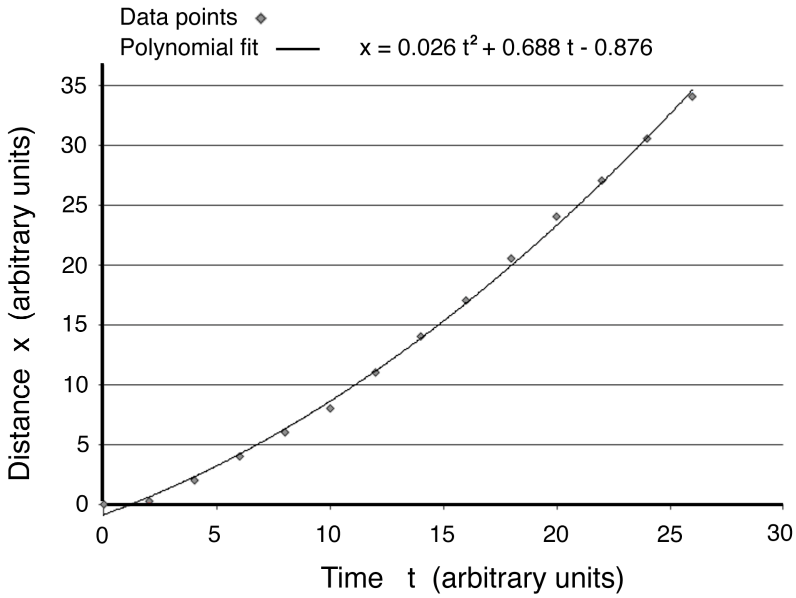

Figure 11. Illustration of the acceleration curve determined for the left soliton in the simulation illustrated in Figure 10. The soliton is found to accelerate down the G gravity gradient in a realistic fashion.

The proton, like the neutron, would generate a G-well in its core. The electron, though, would instead produce a G-hill and production rate surplus in its core. In the case of an electron, G-ons would diffuse radially outward to produce a gravity potential field that declined as 1/r from the electron's core. The electron then would generate a negative active gravitational mass and a field that was gravitationally repulsive rather than attractive. As mentioned earlier, this bipolarity of the gravity field, correlative with electric charge polarity, is supported by the experimental findings of electrogravitics. As mentioned earlier, G-ons are produced at a slightly lower rate in the electron's core than they are consumed in the proton's core. As a result, a neutral atom consisting of equal numbers of protons and electrons would be a net consumer of G-ons and would surround itself with a matter-attracting gravity well, consistent with observation.

Charged subatomic particles, such as the proton and antiproton, would appear as sketched in Figure 12. Note that the φ_y wave pattern of the proton is biased upward compared to what was shown for the neutron, and that the φ_y pattern for the antiproton is biased downward; see hatched region. The sketch of the φ_g field profile shown in Figure 12 is intended to represent the average value of the gravity potential Turing wave pattern. The φ_x field pattern, which is not shown here, would mirror the φ_y pattern. That is, φ_x would be most positive where φ_y would be most negative. For the proton, the φ_x Turing wave pattern would be biased downward relative to the φ_x zero reference value, and for the antiproton it would be biased upward.

Computer simulations producing these charged particle states have as yet not been performed, which is why SQK currently only offers a sketch of the expected appearance. Nevertheless, this a priori prediction (LaViolette, 1985b) was later confirmed by Kelly's

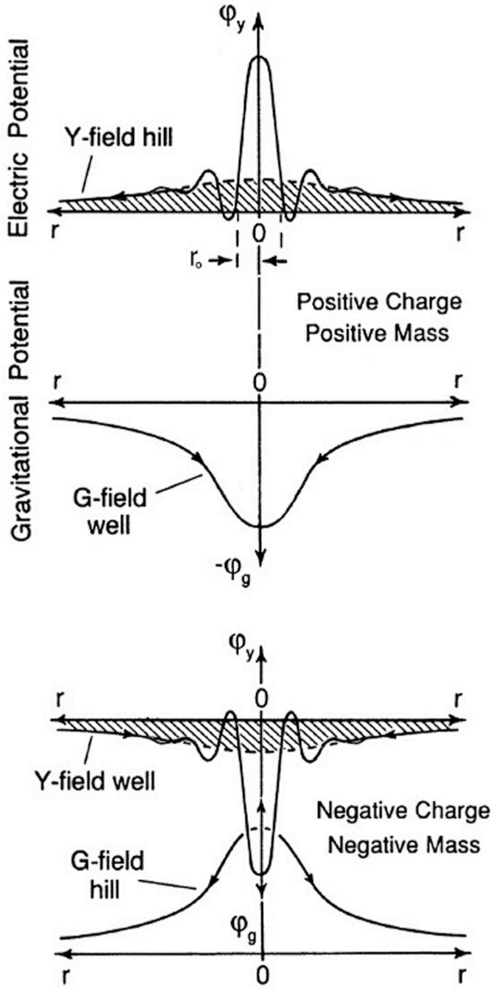

Figure 12. Hypothetical electrostatic and gravity potential field profiles (in radial cross-section) of a 3-D localized steady-state dissipative soliton. Top: matter state (proton) and Bottom: antimatter state (antiproton).

particle scattering results. Figure 13 (a) shows the charge density distribution and Figure 13 (b) the surface charge distribution as found by Kelly (2002) for the proton. The periodic aspect of the proton's charge distribution is more evident in the lower surface charge plot. Notice its upward bias, especially as the center of the particle is approached. Compare to Figure 12 (upper profile).

Such a biased ("charged") state is also observed for the dissipative structure pattern produced by the Brusselator. For example, Auchmuty and Nicolis (1975) have published a mathematical analysis of the Brusselator which examines circumstances in which the dissipative structure wave pattern is biased upward or downward relative to the homogeneous steady state concentration. Computer simulations performed on the Brusselator indicate that biasing of the dissipative space structure pattern occurs as a result of a secondary bifurcation of the first bifurcating branch, and emerges abruptly at

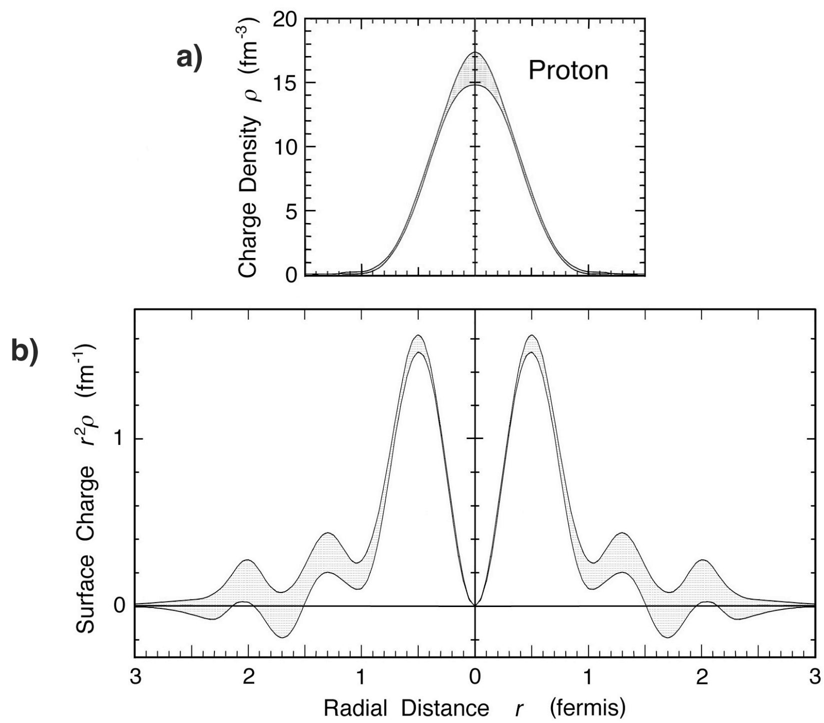

Figure 13. a) Charge density profile for the proton (upper plot) predicted by Kelly's preferred Gaussian models. b) Its corresponding surface charge profile (lower plot).

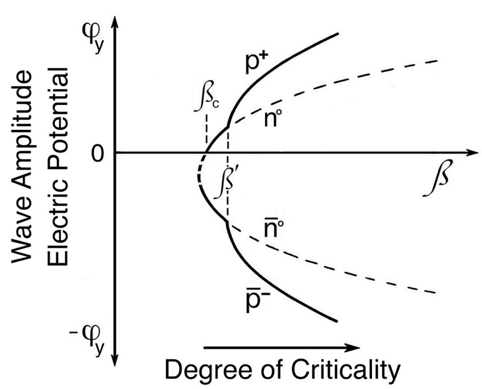

Figure 14. A hypothetical bifurcation diagram for nuclear particles showing the neutron and antineutron and the charged proton and antiproton states emerging as secondary bifurcations at criticality point β'.

some finite distance from the primary bifurcation point, at a point close to the next higher bifurcation (Herschkowitz-Kaufman, 1975). Since Model G is a modification of the Brusselator reaction system, the same phenomenon is expected for Model G.

A bifurcation diagram similar to that published for the Brusselator, can be used to describe the nucleon's transition to the charged state; see Figure 14. The neutron, which emerges spontaneously from a zero-point fluctuation, is shown to occupy the positive primary branch. The proton, which emerges as a secondary bifurcation of this primary bifurcation branch, occupies the new branch that splits off upward from the neutron's branch. In Model G, the emergence of this charged state is identified with the beta decay nuclear reaction which occurs when a neutron changes abruptly into a proton.

The excess production of Y (and consumption of X) in the proton's core would generate its extended positive polarity electric field. The antiproton, if it were formed through a particle scattering event, would accordingly generate a negative polarity electric field. In either case, these fields would disseminate as 1/r and their field gradients would exert electrostatic forces that declined as $1/r^2$, consistent with classical electrostatics. The generation of these fields and their exertion of force is similar to that described above for the gravity field. See LaViolette (2012) for more details on the mathematical description of this reaction-diffusion generation and deployment of the electric field.

The electron's φ_x, φ_y, space structure would look much like that of the antiproton, but would have a wavelength 2000 times larger. Feynman, Leighton, and Sands (1964) had proposed a reaction-diffusion concept of reality as a way of depicting the radial dependence of the electron's field pattern. Making an analogy to the diffusion of neutrons out of the core of a nuclear reactor, they postulated a substrate of "little X-ons" created in the electron's core and diffusing radially outward, to create a surrounding 1/r decrease in concentration. They note that the resulting mathematical relation is consistent with observation. They state that such a theory, where X-ons would be generated in distributed fashion within the electron's core, would avoid the infinite energy absurdity of current electrodynamics, but note that such a workable theory had not at that time been developed. We feel that SQK is the "workable theory" that Feynman et al. were intuiting.

THE COSMOLOGICAL IMPLICATIONS OF GRAVITY

As mentioned earlier, gravity potential serves as the bifurcation parameter controlling Model G's modes of operation, determining whether the ether operates in a subcritical or supercritical state. The same would be true for the energy behavior of photons. Adopting the generalized wave equation proposed by Gmitro and Scriven (1966) for the description of reaction diffusion waves consisting of small amplitude excursions [φ] from the steady-state, we may write:

$$[\varphi] = [\mathcal{A}_0]\, e^{i(\kappa_R r - \omega t)}\, e^{-\kappa_i r}, \tag{5}$$

where $\mathcal{A}_0 = |\varphi|_{max}$, and κ_R and κ_i are the real and imaginary parts of the wave number κ. The frequency and wavelength of the wave are given respectively as $f = \omega/2\pi$ and $\lambda = 2\pi/\kappa$. Here φ represents a generic field potential, be it electric ($\varphi_y(r, t)$) or gravitational ($\varphi_g(r, t)$).

The wave velocity relative to the ether rest frame is given as $c_0 = f\lambda = \omega/\kappa$, where the wave number κ and frequency ω must satisfy the determinental equation:

$$\det\{[\mathrm{K}] - \kappa^2[\mathcal{D}] + i\omega[\mathrm{I}]\} = 0, \tag{6}$$

determined by the values of the kinetic constants [K] and diffusion coefficients [$\mathcal{D}$] chosen for the reaction system, where [I] is the identity matrix (LaViolette, 2012, Ch. 2). These reaction system parameters would be chosen so that the derived velocity would equal the speed of light. The oscillatory real term in Eqn. (5), first exponent on the right, is consistent with energy wave behavior in standard physics. The imaginary term in Eqn. (5), second exponent on the right, though, is a term that is new to physics. It dictates nonconservative wave damping when $\kappa_i > 0$ (subcritical conditions) and nonconservative wave amplification when $\kappa_i < 0$ (supercritical conditions).

Equation (5) may be restated as Eqn (7) to portray the manner in which photon energy changes as a function of photon travel distance:

$$E(r) = E_0 e^{-(\alpha \varphi_g / c) r}. \tag{7}$$

The term E(r) here signifies the wave's maximum electric potential or energy over a wave cycle. Its initial energy E_0 represents the wave amplitude at time t = 0 and is equivalent to the wave amplitude term $\mathcal{A}_0$ in equation (5). The exponent $e^{-(\alpha \varphi_g / c) r}$ would signify the second exponent in (5) where $\kappa_i = \alpha\varphi_g/c$. Here α is a constant of proportionality given in units of s/cm^2; φ_g is the ambient gravity potential as noted in Figure 5; and c is the velocity of light. Negative values of $\varphi_g(r)$ would dictate supercritical conditions and photon energy amplification. Positive values of $\varphi_g(r)$ would dictate subcritical conditions and photon energy damping.

Intergalactic regions of space which are largely devoid of matter would be subcritical ($\varphi_g > 0$). Hence photons traveling through such regions would experience energy damping, or redshifting; see Figure 15. Regions in the vicinity of galaxies and galaxy clusters, on the other hand, would be supercritical ($\varphi_g < 0$), and photons present in such regions would experience energy amplification, or blueshifting. Such supercritical regions would often span close clusters and even could include an entire galaxy supercluster.

To be physically realistic, the degree of subcriticality or supercriticality affecting a photon's energy must be sufficiently small that the photon's departure from perfect energy conservation is unobservable in the laboratory. For energy nonconservation to be detected, an individual photon would need to be observed over a great length of time or

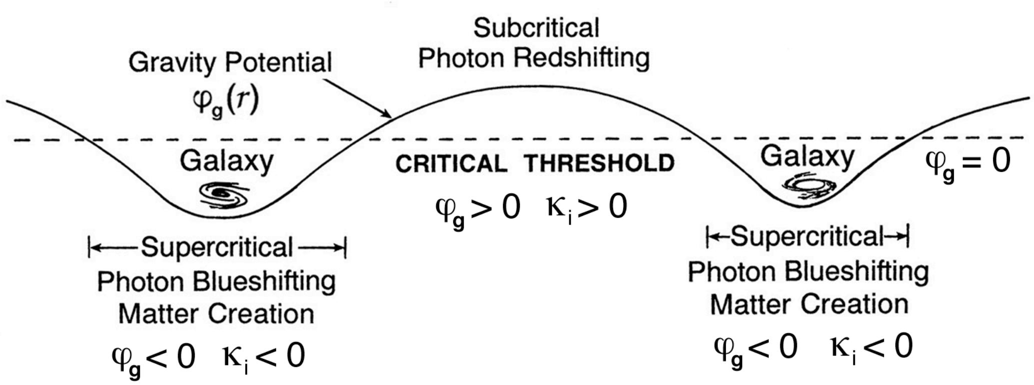

Figure 15. Photon behavior depends on the ambient value of the gravity potential relative to the critical threshold value, $\varphi_g = 0$. Photons progressively increase their energy within supercritical gravity wells surrounding galaxies and galaxy clusters (where $\varphi_g(r) < 0$). Photons progressively decrease their energy in intergalactic space (where $\varphi_g(r) > 0$).

over a great propagation distance. Hence such effects would become important only at the astronomical and cosmological scale.

Photons traveling from distant galaxies will spend more time passing through subcritical void regions, than galaxy rich supercritical regions, and so would exhibit a net redshift. SQK then offers a way to account for the observed cosmological redshift of distant galaxies without adding in any extra assumptions about cosmic expansion. Equation (7) may be written as follows to express the average attenuation rate that a photon would experience over the course of its flight:

$$E(r) = E_0 e^{-\beta r}. \tag{8}$$

where β, the attenuation coefficient is equivalent to term $\alpha\varphi_0/c$ in Eqn. (7). Expressed in terms of photon wavelength, λ, this would be rewritten as:

$$\lambda(r) = \lambda_0 e^{\beta r} \tag{9}$$

This is essentially the "tired-light" relation which was first proposed in 1929 by Fritz Zwicky to explain Hubble's redshift-distance observations as an alternative to the expanding universe hypothesis. For his theory, Zwicky made the ad hoc hypothesis that photons have a non-zero rest mass and lose energy through an energy-conserving gravitational drag effect. In SQK, on the other hand, no such ad hoc photon interactions are needed since photons lose energy non-conservatively due to the fact that the open reaction-diffusion ether operates in a subcritical state.

The value of attenuation coefficient β is given by the Hubble constant, i.e., $\beta = H_0/c$. Sandage, et al. (2006) have estimated the Hubble constant using Cepheid stars in nearby galaxies as redshift-distance-indicators, and find that it has the value $H_0 = 62.3 \pm 1.3$ km/s/Mpc. Higher values are also quoted in the literature such as 70 km/s/Mpc and 74 km/s/Mpc of Freedman, et al. (2019 and Riess, et al. (2019). But these are based on redshift calibrators found in the Large Magellenic Cloud which lies about 400 fold closer to us than the galaxies Sandage used and which along with the Milky Way resides on the edge of a void, hence in a region of space that is likely more subcritical than average (LaViolette, 2020). Also the value quoted by Sandage, et al. is substantiated by Marosi (2014) who finds a similar Hubble constant value of 62.6 km/s/Mpc by fitting magnitude-redshift data of supernovae out to a redshift of z = 8.1. Adopting the H_0 value of Sandage, et al. yields a tired-light photon energy decline rate of $\beta = 6.4 \pm 0.1\%$ per billion light years (bly). This may instead be expressed in units of time by multiplying β by the factor $c = 3.17 \times 10^{-17}$ bly/s, which yields an energy loss rate $\mu = -\beta c = -2.03 \times 10^{-18}$/s. This is about 10 orders of magnitude smaller than the smallest change observable in the laboratory.

To test this SQK prediction, the stationary universe, tired-light prediction of SQK and the prevailing expanding universe big bang hypothesis were compared against observational data on four different cosmology tests (LaViolette, 1986). There it was shown that the tired-light model fit the data better than the standard expanding universe model on all four tests. This result presented a coup against standard cosmology since the tired-light model made its good fit without requiring the addition of any evolutionary corrections.

In the past, big bang cosmologists would typically add evolutionary corrections to make their expanding universe model fit the observational data trend. The four-test approach published in 1986 (LaViolette, 1986), however, blocked this cunning practice. For it was shown that any attempt to add evolutionary corrections to make the big bang prediction fit the data better on one test, would make its prediction depart from the data trend on one or more of the other tests. This multi-test approach traps the big bang theory much like a Chinese handcuff. So the judgment against standard cosmology is final.

One cosmology test taken from this multi-test study is a version of the angular-size-redshift test that plots the harmonic mean angular separations of bright galaxies in a galaxy cluster against the cluster's redshift, where the mean galaxy angular separations are used as a measure of distance; see Figure 16. Three cosmologies are plotted against the θ–z data set of Hickson and Adams (1979), which include the simple linear Hubble relation, the no-evolution tired light model (static universe), and the no-evolution, $q_0 = 0$ Friedmann model (expanding universe). There is no question that the static universe, tired light cosmology falls closer to the data trend. The fit of these three models was assessed by comparing the variances between the θ data points and the prediction that each model makes. The variances for the three models (linear $\theta \propto 1/z$, tired light, and $q_0 = 0$ expanding universe) were respectively in the ratio 1:1.2:5.0. Repeating the calculation

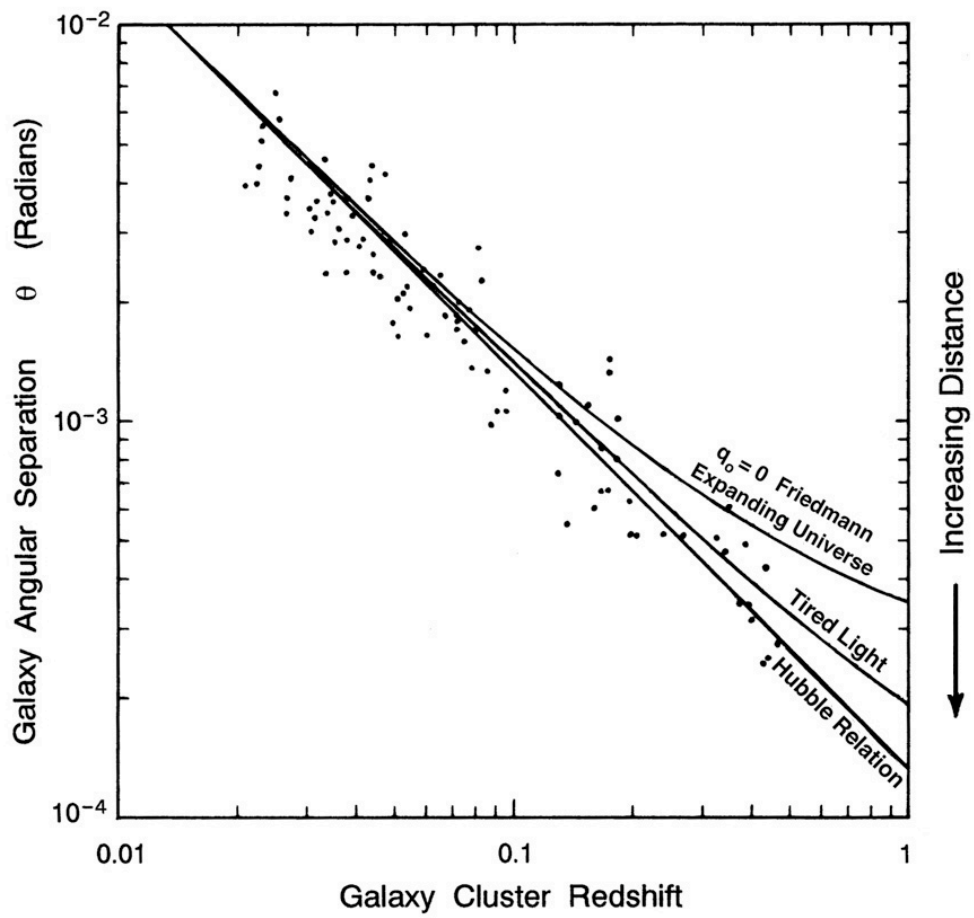

Figure 16. Log normalized galaxy angular separation vs. log galaxy cluster redshift.

for the 31 most distant clusters ($z > 0.1$) gives relative variance ratios of 1 : 1.4 : 10. Thus the static, Euclidean tired light cosmology is seen to be significantly favored over the $q_0 = 0$ expanding universe model. The $q_0 = 0.5$ Friedmann model, which many cosmologists have favored which incorporates the assumption of hidden mass plots above the $q_0 = 0$ prediction and makes an even worse fit.

Actually, the initial purpose in conducting the 1986 study was to check whether the SQK energy attenuation relation could present a valid explanation of the cosmological redshift. In fact, it was only in the course of doing background research for this test that I had found that the tired-light model had been known for some time, and had been originally conceived as an alternate explanation for the cosmological redshift. The outcome of the 1986 study was that cosmological test data confirmed the SQK prediction and showed that it offered a new theoretical explanation for tired-light behavior. Over the intervening years, many other studies have been published also showing that the tired-light model makes the better fit. A number of these more recent studies have been included in an updated multi-test evaluation of the expanding and static universe cosmologies; see LaViolette (2021a).

MATTER CREATION

With the big bang theory and its underlying expanding universe hypothesis disproved, a new theory of cosmic creation must be sought, one that allows matter to emerge spontaneously in a cosmologically static universe. Hence a cosmology must be sought that proposes repeated minor materialization events taking place in distributed fashion throughout all visible space rather than relying on the occurrence of a singular materialization event of unbelievable magnitude, as the big bang theory had suggested. One such hypothesis is the theory of continuous creation as advanced by astronomers such as Sir James Jeans (1928) or William McCrea (1964), both of whom were led to the idea on the basis of astronomical observation. SQK, though, is the first theory to explain in detail how such materialization might occur.

By its nature, a theory of continuous creation would involve a violation of energy conservation on a cosmological scale, the appearance of matter being a negentropic event. But the spontaneous formation of ordered structures is a phenomenon frequently observed in open systems. So, the demise of the big bang theory automatically leads to the idea that our universe likely functions as an open system. Indeed, if the big bang theory is invalid and continuous creation is the only remaining alternative, there appears to be no choice but to arduously embrace the open system view of physical reality.

So there is hope that the physics community as a whole is now ready to seriously consider the paradigm of subquantum kinetics. As was discussed above, Model G allows the spontaneous creation of matter wherever the initially subcritical ether has its G-on concentration sufficiently close to the critical threshold as to allow a zero-point energy fluctuation of critical size to nucleate a neutron. Such conditions would likely present themselves over large stretches of space throughout the cosmos. In SQK, this matter creation process is called *parthenogenesis*, which signifies the spontaneous self-formation or birth of matter.

However, there is another matter creation feature of SQK, namely, the ability of existing particles of matter to create fertile environments in their immediate vicinity in which "progeny" particles may spawn themselves. That is, once a particle has formed, the G-well present in the particle's core forms a supercritical environment that nurtures any emerging seed fluctuation, allowing it to rapidly grow into a new particle. Thus in the SQK cosmology, matter spawns more matter (LaViolette, 1985c, 1994, 2012). This process of exponential growth much resembles biological reproduction. Projected to a very late stage of matter evolution, after star filled galaxies have developed, SQK predicts that the supermassive core positioned at the galaxy's center, with its very deep gravity well, should spawn matter at a prodigious rate.

Computer simulations of Model G in 1D have verified this maternal birth process by showing a nascent neutron coming into being within the supercritical gravity well of an already existing nucleon. A randomly emerging zero-point energy fluctuation is found to spawn a progeny neutron most effectively if it emerges in one of the two inner most gravity well shells that surround the core of an existing nucleon the supercritical conditions in these shells providing fertile environments where these fluctuations are able to self-amplify (Pulver and LaViolette, 2013).

Also simulations have shown that a neutron is able to self-materialize in the supercritical region located between two pre-existing nucleons; see Figure 17 taken from LaViolette (2012), also discussed in Pulver and LaViolette (2013). Actually, maternal nucleation would take place more commonly from "mother protons" rather than from "mother neutrons" since once it had emerged a neutron would subsequently decay into a proton and electron through the beta decay process. So hydrogen nuclei would more commonly be present in interstellar space than lone neutrons. Also due to their positive charge, isolated protons would have a much deeper G-well than isolated neutrons, this being because in the positive charge state, the nucleon's core φ_x well is biased downward, which in turn downwardly biases its φ_g well, making it more supercritical. This is essentially the electrogravitic field coupling feature discussed earlier.

So materialization would proceed in a mother-daughter fashion in which a daughter proton acts as a nucleation center which spawns a daughter neutron which then decays into a daughter proton which itself acts as a nucleation center to spawn a daughter neutron. Consequently, one nucleon becomes two, which become four, which become eight, and so on in an exponential growth process.

The continuous materialization of neutrons and their subsequent beta decay produces a diffuse interstellar hydrogen gas throughout the universe which becomes heated into an ionized state by the 0.78 Mev beta particles produced as a result of neutron decay. Through collisional energy transfer, this gas consequently becomes heated into an X-ray emitting plasma, thereby explaining the observed diffuse X-ray emission that is observed coming from all directions of the sky. This X-ray emitting intergalactic gas has been referred to as the Warm Hot Intergalactic Medium, or WHIM. Its presence is also indicated by the so called Lyman alpha forest, diffuse Lyman alpha emission radiated by the ionized portion of this gas. These observations have led astronomers to conclude that there may be as much matter in the universe residing in the "voids" between galaxies as resides in the galaxies themselves. This has posed a problem for the big bang theory because it indicates that there is far more ordinary matter in the universe than big bang models predict. Also the big bang theory cannot account for its temperature because it predicts that the gas of the initially hot fireball should have long ago cooled down.

The source of ionizing radiation for the WHIM has puzzled astronomers since no

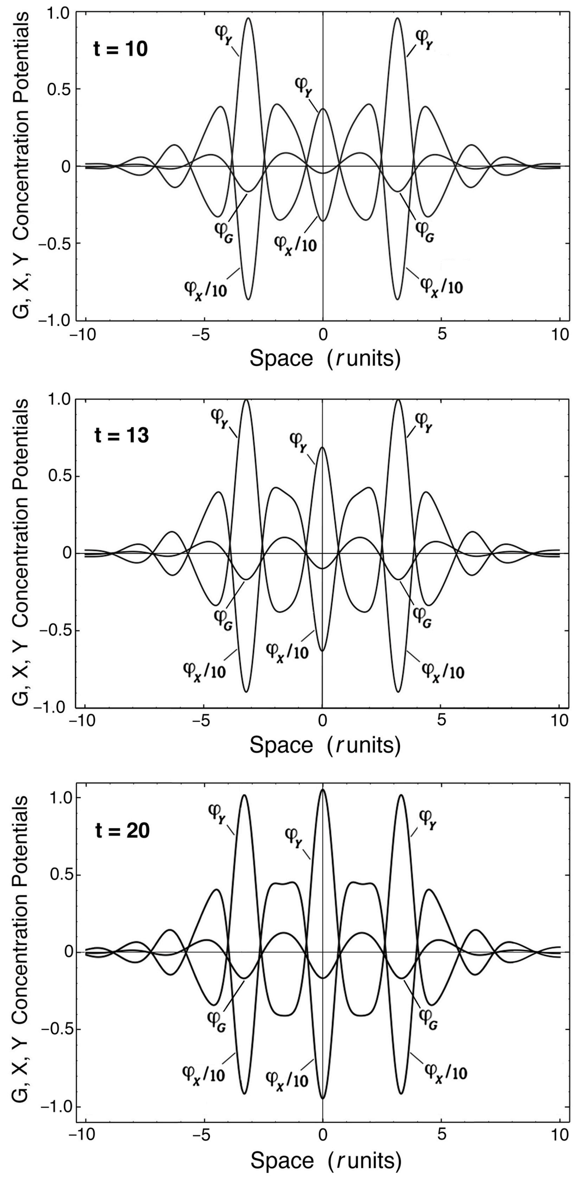

Figure 17. Sequential frames from a one-dimensional computer simulation of Model G showing the spontaneous emergence of a third soliton from between two pre-existing Turing wave parents.
Simulation by M. Pulver may be viewed at: https://tinyurl.com/y6vunl7a.

stars are visible in these clouds and radiation from active galactic cores falls short of the energy requirements. LaViolette (2012), however, has shown that beta decay of parthenogenic neutrons would supply more than enough energy to power this emission. Crawford (1987, 2011) has shown that the electrons in such a heated X-ray emitting plasma have a temperature and density sufficient to generate the observed 2.73° K cosmic microwave background radiation (CMBR). Moreover Arp, et al. (1990) have argued that iron whiskers present in intergalactic space could thermalize the 3°K radiation field while allowing transparency at other wavelengths. So with the theory that the WHIM is the source of the CMBR, we still retain the idea that the microwave background is of cosmic origin. The only difference is that instead of the emission arising all at once from a single big bang event, it is now understood as being continuously generated by beta decay electrons associated with the ongoing creation of matter.

Once the WHIM had formed, some regions could cool sufficiently to allow neutral hydrogen gas to form and to condense into droplets of liquid hydrogen. These would eventually coalesce to form comet sized bodies which would grow both through accretion and through internal matter creation. This preliminary phase of creation could have transpired over as much as a few trillion years. Note that the SQK continuous matter creation cosmology has no 13.8 billion year restriction in which to generate the cosmos as does the big bang theory. This early phase and subsequent phases of cosmic evolution are depicted in Figure 18. Continuing the sequence, a comet sized body would eventually grow into a brown dwarf, then into a primordial star, whose stellar wind would spawn gaseous planets. The daughter planets of this solar system would themselves evolve into stars and eventually a star cluster would form. As a given stellar body grew in mass, so would its surface gravity potential and degree of supercriticality. As a result, its rate of matter creation and rate of energy output due to spontaneously generated energy would both progressively increase. The phenomenon of spontaneous energy production due to photon blueshifting that would take place in these bodies is discussed in the next section.

The primordial "Mother star', the first star to have formed, would be the most massive star in the star cluster, having had a head start over its daughter stars. It would reside at the cluster's center with the other less massive stars orbiting around it. By this point, it would have grown to a mass of hundreds to thousands of solar masses. As the star cluster continued to proliferate and grow in size, it eventually would turn into a dwarf elliptical galaxy. As it grew in mass and became increasingly supercritical, the Mother star would begin to produce energetic outbursts. Upon reaching a mass of a hundred thousand solar masses or more, its outbursts would become increasingly violent

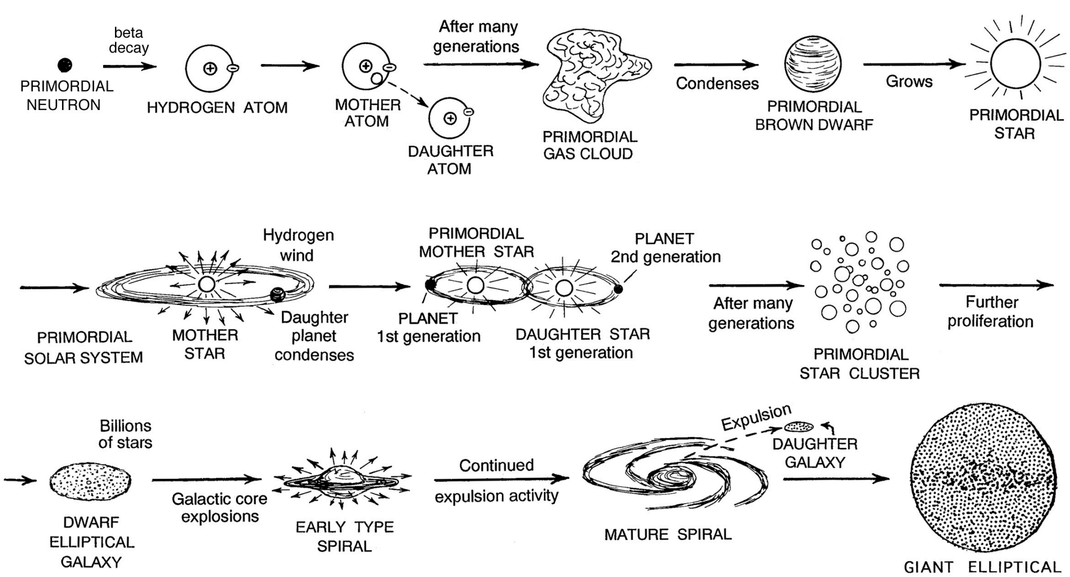

Figure 18. Cosmogenic evolution: Sequential development from primordial self-nucleating particles to mature galaxies.

similar to the outbursts seen to come from the cores of Seyfert galaxies. These outbursts would propel stars and gas outward to gravitate toward the evolving galaxy's orbital plane causing the dwarf elliptical to evolve into a compact spiral galaxy and then into a mature spiral galaxy.

The Mother star core would at this time produce a gravity well so deep and so supercritical that its matter creation rate would far outstrip the combined matter creation rate of all the stars in its galaxy. In fact, this cosmology predicts that 99% of the matter in our own galaxy has originated from our core Mother star, Sagittarius A-star (Sgr A*). Some of the more violent outbursts would cause the Mother star to fission and spew out a part of itself as a star cluster or even a dwarf daughter galaxy. Astronomer Halton Arp has catalogued many cases of such core ejections. These daughter bodies would orbit the spiral galaxy, forming a star cluster halo around the galaxy as well as spawning nearby galaxy progeny. Such is seen happening in our own Milky Way. Eventually, as a result of continued core ejections, the spiral galaxy would evolve into a giant elliptical galaxy.

A number of prominent astronomers, such as Jeans, Ambartsumian, Sérsic, Arp, Hoyle, Narlikar and McCrea, have voiced the opinion that galaxy evolution involves a kind of continuous matter/energy creation that is most evident in galactic cores and that likely involves some sort of new physics. We might also add Edwin Hubble to this list of sympathizers. Hubble (1926) proposed an evolutionary galaxy classification sequence that had the shape of a tuning fork, which indicated that as an elliptical galaxy evolved from compact to lenticular morphology it would subsequently evolve into either of two spiral galaxy morphologies. In studying galaxies of a fixed total magnitude ($m_T = 10$), he found that as one proceeded through the morphology sequence from compact E0 elliptical on the left to mature Sc spiral on the right, the major axis diameter of a galaxy progressively increased. Also a number of recent observations of how galaxies evolve as redshift decreases are compatible with the SQK matter creation prediction. For example, the data of Buitrago, et al. (2013) shows that massive galaxies exhibit an average 5.2 billion year doubling time over the past 18 billion years (here using the tired-light distance metric for converting redshift). Attempts to save the standard big bang cosmology paradigm by hypothesizing that galaxies merge with one another, however, fail to explain these galaxy growth findings (LaViolette, 2012, Ch. 8). Lopez-Corredoira (2010) has also concluded that galaxy merger theories fail to explain observation. More about how SQK and its continuous matter creation prediction is able to account for astronomical and cosmological observation can be found in chapters 7 and 8 of LaViolette (2012).

Another benefit of SQK is that it has no need of adding dark matter assumptions as is done in standard astrophysics. Earlier we had noted that the gravity field behaved as a Newtonian field, having a 1/r potential decrease. However, a different situation presents itself at astronomical scales. The gravity field ultimately must taper off to a zero gradient outside a galaxy as the G-on concentration approaches the ambient steady-state concentration value present in intergalactic space. Thus gravity does not have an infinite reach as it does in standard physics. The departure of a star's gravity field from Newtonian expectations would begin to become noticeable beyond a distance of 3 kpc, where its field gradient would begin a more rapid decline (LaViolette, 2012, Ch. 8). For this reason there would be no long-range force influencing distant galaxies that might cause an initially static universe to collapse. So SQK resolves the gravitational potential summation problem that has been an area of difficulty for Euclidean static universe cosmologies.

The gravity field tapering prediction of SQK parallels ideas presented in Milgrom's modified Newtonian dynamics theory (MOND). Whereas the MOND theory emerged from the standpoint of observing stellar orbits in galaxies, the SQK gravity field tapering outcome emerges as a theoretical prediction of the Model G model. Various studies have shown that MOND is able to explain the rotation velocity profiles of spiral galaxies without the need of introducing assumptions about the presence of dark matter, one such study being that of McGaugh (2011). The gravity prediction of Model G should yield similar results.

THE PHOTON BLUESHIFTING EFFECT

When the ether is supercritical, that is in regions where $\varphi_g(r) < \varphi_{gc}$, photon energy will progressively increase where Eqn (7) now becomes expressed as:

$$E(r) = E_0 e^{\beta r} \qquad (10)$$

Here $\beta = -\alpha\varphi_g/c$ takes on the role of an amplification coefficient for the case where $\varphi_g < 0$. In effect, β now acts as a negative Hubble constant, dictating photon energy amplification, rather than photon energy damping.

Such blueshifting would occur when a photon passes through a galaxy cluster where the gravity potential would adopt a negative value (LaViolette, 2012, 2021b). One example of this can be seen in studying the Virgo cluster. Being 16.5 Mpc away, it is the closest massive galaxy cluster to our own Local Group (LG) galaxy cluster. This blueshift effect is apparent in Figure 19, which plots the data of Mei et al. (2007). Following the redshift distance relation (heavy black line) outward from a distance of 7 Mpc, the nearest graphed distance value, we see that initially this relation on their graph proceeds outward with a slope of 78 km/s/Mpc. Then around 4 Mpc from the cluster's center, this redshifting trend reverses and turns into a blueshifting trend, with a slope of approximately -115 km/s/Mpc. Then, going further out, around 4 Mpc from the cluster's center on its far side, this blueshifting trend tapers off and reverses to pursue the same redshifting trend of 78 km/s/Mpc. The vertical displacement of the two redshift-distance trend lines relative to one another, due to this intervening blueshifting, amounts to 850 km/s. Consequently, the total energy gain for the blueshifted photons in their passage through the cluster amounts to 0.28%. The fact that the extra cluster Hubble flow has an H_0 value considerably greater than the 62 km/s/Mpc adopted over cosmological distances does not affect the present discussion.

This cluster photon blueshifting can also alter the shape of galaxy clusters when they are plotted in redshift-distance space. For example, due to moderate blueshifting experienced by photons originating from peripheral galaxies, the cluster at its periphery will appear to be flattened or pancaked along the line-of-sight when plotted in redshift space; see Figure 20. This has been called the Kaiser effect. In addition, the significant blueshifting experienced by photons coming from galaxies located on the far side of the cluster and passing through the cluster center as they travel toward the Earth observer, causes the cluster at its center to appear elongated toward the observer when its redshift-distance values are plotted in redshift space. That is, galaxies in this region will be highly blueshifted which will reduce their overall redshift value relative to the cluster average,

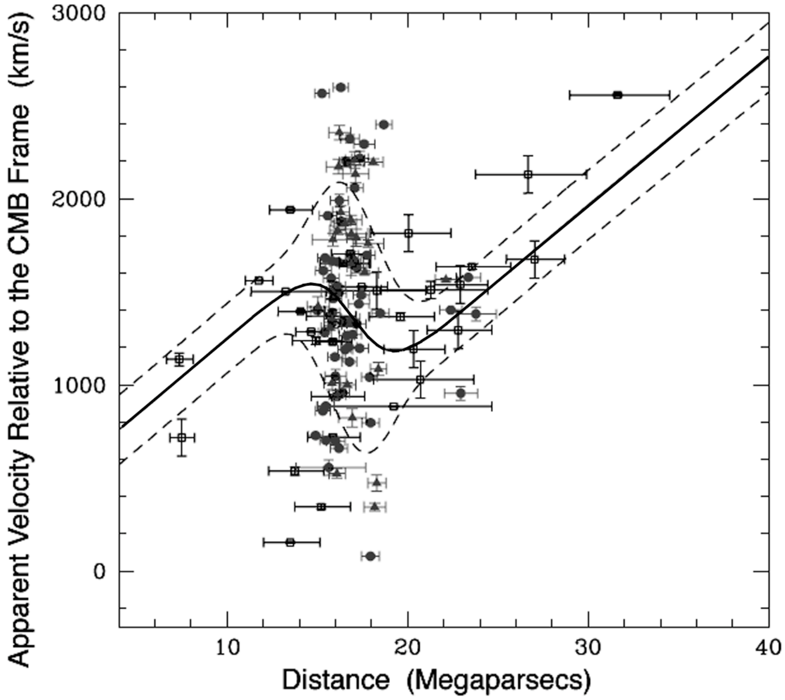

Figure 19. Redshift-distance trend lines for galaxies in the vicinity of the Virgo cluster. The circle, triangle and square data points indicate the redshifts and distances of various galaxies in the Virgo cluster that have been transformed from the heliocentric frame into the cosmic microwave background frame. The vertical scatter of the sample is due to the peculiar velocities of the galaxies in the cluster. Tired-light photon redshifting temporarily changes to progressive photon blueshifting when photons traverse the Virgo cluster (diagram after S. Mei, et al.).

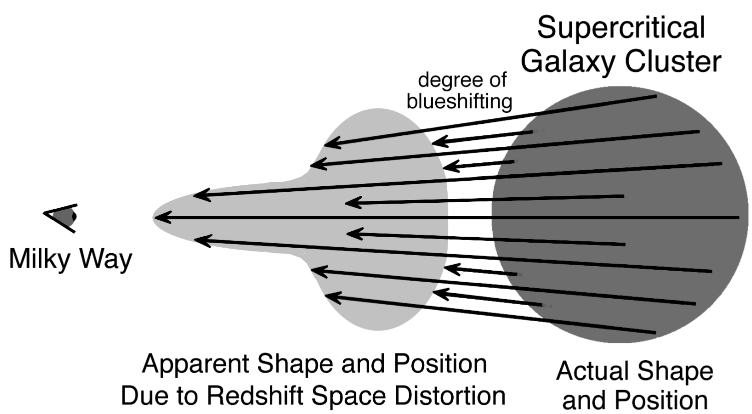

Figure 20. The Kaiser effect and Fingers-of-God effect created when photons coming from the far side of a galaxy cluster blueshift during their passage through the cluster's supercritical region.

causing them to appear to be positioned much closer to the observer. This has been called the Fingers-of-God effect because it gives the impression that the central portions of these galactic clusters are pointing towards the Earth (in redshift-distance space). Clusters redshift space diagrams appear to point toward us regardless of which cluster in the sky they are located in. This phenomenon appears surreal to astronomers who have no good explanation in standard physics.

In both the Kaiser effect and the Fingers-of-God effect, when the galaxy positions are mapped out in redshift space, this blueshift distortion will cause galaxies on the far side of the cluster to appear to be positioned on the cluster's near side and vice versa. Thus the positions of the galaxies in the cluster will have the false appearance of being flipped front-to-back and back-to-front along the line of sight. While standard astronomy regards both of these effects as an unexplained mystery, they have a natural explanation in the paradigm of SQK. More about how SQK accounts for these phenomena with its photon blueshifting prediction can be found in LaViolette (2012) Ch. 7 and LaViolette (2021b).

GENIC ENERGY

SQK predicts that photons should blueshift their wavelengths in supercritical regions such as that surrounding the Milky Way and those surrounding all other galaxies as well. This blueshifting prediction then should dramatically impact our understanding of all stellar astronomical phenomena. In this respect, it is useful to calculate the excess energy, $\Delta E = E(t) - E_0$, produced as a result of photon energy amplification. This may be regarded as a new source of energy, previously unrecognized by physics, but just as important as the energy released from chemical reactions or nuclear fusion. SQK calls this spontaneously generated energy: *genic energy*. To calculate it, the spontaneous progressive increase of photon energy is best expressed as a function of time rather than distance. Hence Eqn. 10 would be changed to the equivalent form given as:

$$E(t) = E_0\, e^{\mu t}, = E_0\, e^{-\alpha\varphi_g t}, \tag{11}$$

Here $\mu = -\alpha\varphi_g$ signifies the amplification coefficient where α is the proportionality constant, and where the c denominator has been absorbed in converting r to t. Differentiating Eqn. (11) yields the genic energy luminosity L_g:

$$L_g = \frac{dE(t)}{dt} = \mu E(t) = -\alpha\varphi_g E(t). \tag{12}$$

That is, as a result of its continuous increase in energy, a photon would produce genic energy at rate L_g. By assigning a value of 7×10^{-33} s/cm^2 to α, Eqn. (12) is able to account for the intrinsic luminosities of jovian planets and lower main sequence stars. At the surface of the Earth, where $\varphi_g \sim -2.1 \times 10^{14}$ cm^2/s^2, this value for α yields a photon amplification rate of $\mu = 1.48 \times 10^{-18}$/s, which is equivalent to a 4.7% increase in energy every billion years. This is about 73% as large as the observed cosmological redshift attenuation rate, but of opposite sign. Also, it is less than half of the -115 km/s/Mpc blueshifting rate described earlier for the Virgo cluster which calculates to be $\mu = -3.7 \times 10^{-18}$/s.

This created genic energy ultimately arises as a result of the continuous operation of the underlying subquantum reactions specified by the Model G equation system (Fig. 3). Whereas the nineteenth century mechanical ether was an inert and inactive substance, the subquantum kinetics ether continuously transforms. Its reactions operate in a continuous state of flux, continuously building up the G, X, and Y concentrations that compose the physical universe. Although these unobservable ether reactions are assumed to behave in a conservative manner, the physically observable field amplitudes which they produce can behave nonconservatively as was shown above.

One consequence of relation (12) is that the energy stored in a celestial body will evolve genic energy at the rate:

$$L_g = \mu H \approx -\alpha \bar{\varphi}_g \bar{C} M \bar{T}, \tag{13}$$

where H represents the body's total heat capacity, given by the product of the body's mass M, its average specific heat $\bar{C}$, and average internal temperature $\bar{T}$. As before, the parameter $\bar{\varphi}_g$, represents the body's average internal gravity potential, the variable determining the prevailing degree of supercriticality.

Based on Eqn. (13) one may conclude that all celestial bodies must produce genic energy and that the amount of their genic energy luminosity should vary in direct proportion to their mass. This in turn leads to the prediction that planets and red dwarf stars alike should generate genic energy and hence that their mass and luminosity values should lie along a common mass-luminosity relation. A test of this prediction, confirmed it (LaViolette, 1992, 2012, Ch. 9). Mass and luminosity values for a sample of red dwarf stars belonging to the lower main sequence stars were plotted on a log-log plot along with the least squares fit performed by Harris et al. (1963); see Figure 21. That fit indicated an M-L dependence of $L \alpha M^{2.76 \pm 0.15}$. In addition, as a test of the SQK prediction, the mass and luminosity values for the jovian planets, Jupiter, Saturn, Neptune, and Uranus obtained from satellite IR data were plotted on the same graph. As is apparent, these were found to lie along this same M-L relation. This new result indicated that a common energy process must operate in both planets and stars. It could not be nuclear since jovian planets have insufficient mass to support nuclear reactions. It could not be stored heat acquired during primordial mass accretion because such heat should long ago have been radiated away due to the high luminosity of red dwarf stars. Genic energy, however, would be a viable candidate since the mass exponent for genic luminosity has an estimated value of 2.7 ± 0.9, conforming to the M-L exponent observed by Harris, et al. (LaViolette, 2012, Ch. 9). As a result, the planetary-stellar mass-luminosity relation presents an important confirmation of SQK. Sometime later, mass-luminosity values for a number of brown dwarfs were published, and these also were found to fall close to this same relation, further strengthening this SQK prediction; see again Figure 21.

The presence of genic energy leads one to conclude that nuclear burning begins to occur in red dwarf stars at a higher mass than previously supposed, that is above about 0.45 $M_\odot$ rather than above 0.08 $M_\odot$ (LaViolette, 1992). Note that at this same mass of 0.45 $M_\odot$, the M-L relation takes an upward bend to form the steeper upper main sequence relation where it follows a power aw of $L \propto M^4$. Standard theoretical models place the convective-to-radiative core transition for stars at around 0.35 $M_\odot$ Now with the assumption of two energy sources being present, genic energy plus nuclear, this transition is expected to be pushed to a higher mass range (0.4 - 0.5 $M_\odot$.). Hence this

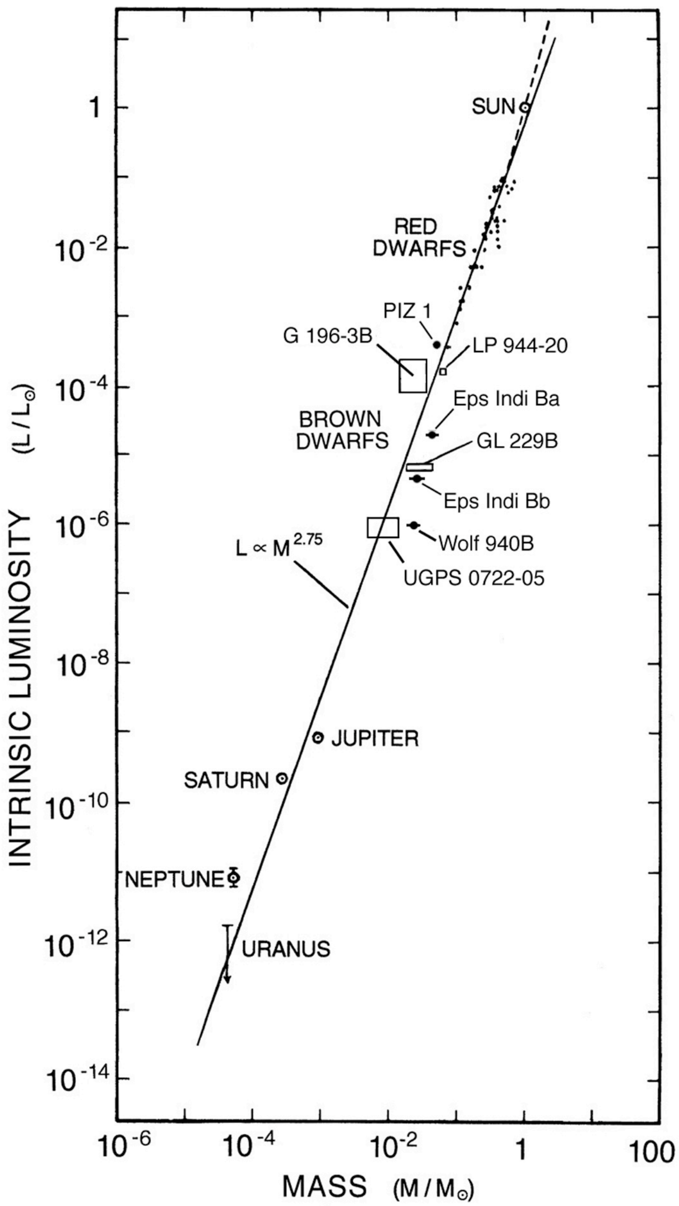

Figure 21. The position of the jovian planets and several brown dwarfs shown in relation to an extension of the lower main sequence stellar mass-luminosity relation.

leads to the conclusion that the onset of the transition to a radiative core and steeper M-L slope is associated with the onset of nuclear burning. The luminosity difference between the upper and lower M-L relations indicates the added contribution of nuclear energy. Projecting this curve upward predicts that 16 ± 6 percent of the Sun's energy should be of genic energy origin, with the other 84% being due to nuclear fusion.

It is also noteworthy that this higher mass nuclear onset coincides with an inflection point in the stellar luminosity function. Thus the luminosity function is actually bimodal. Its lower mass main lobe would be populated by stars powered only by genic energy, while its higher mass, more minor lobe would be populated by stars powered by both genic and nuclear energy (LaViolette, 1992). This indicates that most of the stars populating the Galaxy (the main lobe) are powered by genic energy and that nuclear burning is present only in the rarer more massive mature stars occupying the minor lobe.

The SQK continuous creation cosmology requires that lower mass red dwarf stars eventually grow to become sun-like stars, then giant stars, and finally supergiant stars. This turns standard astronomy's assumption about the ages of stars on its head. According to SQK, blue supergiant stars would be among the oldest and red dwarf stars among the youngest, just the opposite of what is conventionally assumed (LaViolette, 2012, Ch. 10). The assumption that a blue giant star would burn itself out after just a few million years becomes an absurdity since it continually materializes new hydrogen in its interior at a rate faster than it can be burned through nuclear fusion. As a result, in spite of its very high luminosity, a blue supergiant would keep growing and increasing its luminosity until it ultimately ejected its atmosphere, leaving behind a hot core, commonly called a white dwarf. White dwarfs would not be dead stars cooling off as astronomy conventionally believes. Instead, they would be stars that were almost entirely powered by genic energy. Their energy output would be so great that they would be unable to maintain an atmosphere. Nevertheless, they would continue to grow in mass and energy, eventually turning into X-ray stars, and finally into supermassive X-ray and gamma-ray-emitting stellar cores. These stellar cores need not be electron degenerate, as standard physics teaches, since the star's genic energy output would sufficient to support the weight of the star's entire mass.

As for neutron stars, there is a big question as to whether they even exist. Astrophysicist Sorin Cosofret (2019) has raised serious questions about the standard pulsar model and the existence of neutron stars. He has pointed out that if pulsars are neutron stars, their extreme mass and density should gravitationally bend starlight and gravitationally lens stellar images as they travel through space. However, no such stellar aberration phenomena have been reported around pulsars. Also it is theorized that there should be a vast pool of dead neutron stars, perhaps on the order of a billion, wandering through space invisible to telescopes which also should be deflecting starlight. But not a single instance of this has been reported.

The neutron star concept, first proposed in 1934 by Baade and Zwicky, was not taken seriously by the astrophysical community until 1968 when Thomas Gold proposed the neutron star light house model to explain the pulses produced by the newly discovered Crab pulsar. Gold proposed that the Crab pulsar's signals, which pulsed at 30 Hz, were produced by a radiation beam coming from the pole of a spinning neutron star. Only a star as compact as a neutron star (20 km) would make such a model sensible. For example, if an electron degenerate stellar core such as a white dwarf, were spinning at 30 Hz, its surface rotational velocity would exceed the speed of light, an unacceptable outcome for most physicists. Cosofret (2019) has effectively disproved the validity of the lighthouse model. Also in earlier publications, I have presented multiple reasons why the pulsar lighthouse model is invalid (LaViolette, 2000, 2005, 2016). There I show that the signals are better explained if the radio pulsar synchrotron radiation is directed towards us as a stationary beam and *artificially* modulated to produce the observed complex signal patterns. With stellar rotation no longer required, there is no need to assume their beams originate from cosmic-ray-emitting neutron stars. In their stead, X-ray emitting stellar cores serve as adequate cosmic ray sources powering the beams.

In the case of supernova explosions, SQK again offers a ready explanation for their source of energy. Namely, the enormous amount of energy that is released in a supernova explosion would be primarily genic energy. With the genic energy mechanism present, a stellar collapse phase may not be necessary. It may just be an issue of how fast a star is able to discharge energy from its core through radiation and convection. If the energy is unable to discharge fast enough, the amount of heat in the core would build up exponentially producing a rapid rise of temperature. As noted in Eqn (13), the rate of genic energy production is directly related to temperature. Thus if heat were not able to be convected or radiated outward sufficiently rapidly, a star would at some point enter an unstable feedback mode in which increased core temperature leads to increased genic energy output, which leads to increased core temperature, and so on in an ever increasing spiral. This nonlinear energy increase becomes ultimately relieved in the supernova outburst. Genic energy also offers a reasonable explanation for hypernova, extremely energetic supernova releasing energies greater than 10^{52} ergs. At such high energies, standard theory is hard pressed to offer a reasonable explanation.

The type-II supernova SN 1987A, which was observed in the Magellenic Cloud in 1987, has demonstrated the inadequacy of the conventional explanation. According to conventional astrophysics, a type-II supernova occurs when a star is in its red supergiant phase and is assumed to have totally exhausted its supply of nuclear fuel. However, the progenitor star for SN 1987A was not found to be a red supergiant as expected, but an unusually luminous type B3 blue supergiant known as Sandulek $-69°$ 202. Instead of being a star that was about to exhaust its energy supply and flicker out, it was seen to be a star emitting energy at a prodigious rate. Since this is the only supernova in which the nature of the precursor star was known to astronomers, we must assume, until proven otherwise, that this supernova progenitor was typical. As mentioned above, the conventional idea of a stellar collapse may not be required to explain Sandulek's explosion. But in the possibility that its supernova was initiated by an inward collapse, radiation pressure produced by the sky rocketing temperature and genic energy luminosity would likely bring the collapse to a halt prior to the supernova.

Black hole singularities, then, should be unable to form in SQK. Genic energy radiation pressure should increase according to $1/R^4$ during a collapse, whereas the inward pull of gravity causing collapse should increase only according to $1/R^2$ (LaViolette, 2012, Ch. 9). Hence because outward genic energy radiation pressure rises faster than the inward pull of gravity, a point is eventually reached as radius decreases where genic energy dominates and halts the collapse.

Moreover even if one were to suppose that a collapsing stellar core were somehow able to become compressed to the point that subatomic particles became closely pressed to within half a Compton wavelength of one another, at such high densities the inward pull of gravity would vanish. This is because the gravity potential field contour at the center of a subatomic particle would plateau to a finite value (recall Figure 7), this "haystack" shape being backed by particle scattering data. So the classical physics notion that the energy potential gradient and force of attraction should approach infinity at the particle's center is no longer tenable, neither in subquantum kinetics nor in recent determinations of nuclear structure. So a collapsing stellar core would theoretically be unable to attain the singularity state.

Discoveries have recently been reported of stellar mass black holes having masses in the range of 3 $M_{\odot}$ to 10 $M_{\odot}$ which have no detectable X-ray emission. However, SQK interprets these as being low temperature stripped stellar cores which are kept from collapse by internal genic energy production. With improved astronomical measurements in the future, these objects should be found to produce low luminosity emission in the far UV to soft X-ray bands.

Probably one of the best disproofs of the black hole theory comes from recent observations of the core of our galaxy, Sgr A*. Observations of Sgr A* at a wavelength of 1.3 mm made by Doeleman, et al. (2008) using long baseline interferometry show Sgr A* to be a luminous region having a diameter of 37 (+16, -10) microarcseconds. Adopting a distance to Sgr A* of 7.86 kpc, this luminous region would measure 0.29 AU in size. If Sgr A* were a black hole, it should have a gravitationally lensed Schwarzschild diameter of 0.42 AU given that it has a mass of 4.0 X 10^6 $M_{\odot}$. However, the observation of Doeleman, et al. shows a luminous region, not a black hole, and this luminous region turns out to be smaller than the event horizon diameter, about 70% of its calculated size. Standard black hole theory would hold this to be impossible since observation suggests that radiation is coming out from a region smaller than the size of Sgr A*'s assumed event horizon. The authors of the study attempt to circumvent the problem by claiming that this luminous region is a jet of material aimed towards us that lies outside of the event horizon in our direct line of site. The problem with this is that material in this central region is rotating very rapidly around the Galactic core, and no motion has been detected for this emission. Hence the radiation we are seeing coming from Sgr A* must be coming from the surface of a star-like body and not from a black hole's event horizon.

Based on the measurement of Doelman et al., an upper limit measurement of the radius of the Sgr A* celestial body would be 0.145 AU, or ~32 $R_{\odot}$. As a lower limit radius, Sgr A* must have a radius greater than 4.3 $R_{\odot}$, otherwise its radio emission would be so concentrated as to be self-absorbed. So the true radial size of Sgr A* must lie in the range 4.3 $R_{\odot} < R < 32$ $R_{\odot}$. Let us suppose, then, that Sgr A* has a radius of about 21 $R_{\odot}$. Given that it has a mass of 4.0 X 10^6 $M_{\odot}$, its density would calculate to be 600 g/cm^3, much less than that of a low density white dwarf. More details about Sgr A* according to the SQK paradigm are given in LaViolette (2012), Ch. 8.

Based on our observations of our own nearby core, Sgr A*, we may conclude that the supermassive objects observed at the centers of other galaxies in the heavens would not be black holes, but non-electron-degenerate stellar cores of extremely high mass and density. As mentioned earlier, SQK refers to such celestial bodies as *mother stars*. This name highlights the trait that a mother star would serve as the primary matter and energy birthing site in a galaxy, being the galaxy's most supercritical region. That is, rather than being matter consumers, as astronomers typically characterize black holes, supermassive galactic cores would be matter and energy producers. They would tend to both grow in mass and to continually expel a portion of their continuously created matter to their surroundings. Here, the significant suggestion of Sir James Jeans (1928) comes to mind:

> 'The type of conjecture which presents itself, somewhat insistently, is that the centres of the extragalactic nebulae [galaxies] are of the nature of 'singular points,' at which matter is poured into our universe from some other, and entirely extraneous, spatial dimension, so that, to a denizen of our universe, they appear as points at which matter is being continually created."

Jeans comes very close to the idea that our universe functions as an open system, something that becomes most obvious when one considers the type of phenomena that take place in galactic cores.

The tendency for mother stars to increase in mass as a result of their ongoing matter creation process would drive them to states of increasing supercriticality. As a result, the genic energy process would at times become very unstable and there would be instances in which the mother star would "explode", that is, go into an active state where its energy output might abruptly jump 6 orders of magnitude or more. As in its quiescent state, in the active state it would be creating and discharging primarily genic energy. It is apparent that such objects would display some of the most egregious violations of physicist's cherished First Law. Thus the genic energy hypothesis offers a ready means to explain not only extreme supernova, but also extremely energetic outbursts coming from galactic cores, which standard physics is at a loss to explain. Only, in this case, the celestial body would be much more massive and the outburst would take place on a much more energetic scale.

Some physicists may feel that it is cheating to introduce such dramatic violations of the First Law to explain astronomical phenomena. But keep in mind this blueshifting phenomenon is not an ad hoc assumption. Rather it follows naturally from Model G which has had its predictions verified in many areas of physics. When so much that is otherwise puzzling to standard theory becomes explained in such a unified manner, there should be no reason to be concerned. Things become much simpler to understand when one realizes that we live in a universe that functions as an open system.

SPECIAL RELATIVISTIC EFFECTS

Subquantum kinetics adopts the Lorentz transformations of standard physics, however, it interprets the effects of moving frames differently. Its interpretation conforms with that offered by the rod-contraction-clock-retardation ether theory. For example, subquantum kinetics predicts that when a reference frame is moving relative to the ether rest frame, clocks in the moving frame will slow down, an interpretation that accords with the view that Lorentz expressed in 1909. It does not accept the special relativistic idea that the time dimension itself dilates in the moving frame. According to SQK, clocks and all physical processes proceeding in the moving frame should slow down because of the effect of the ether wind on reactions taking place in the moving frame. That is, such motion would increase the average relative velocity between etherons in the moving frame which would have an effect similar to reducing the values of the ether reaction rate constants. Such reduced reaction rates would cause clocks and oscillations to slow down, as if time had slowed down.

Subquantum kinetics also predicts that the soliton wave pattern that makes up a subatomic particle should become compressed on the upwind side (on the side facing the direction of travel), and should become expanded on the oppositely facing downwind side. Although, this has not yet been demonstrated through computer simulation of Model G, it is expected that this will soon be shown. While the space structure of each individual subatomic particle would become skewed in this fashion, the distances separating adjacent particles in a molecular structure should not be expected to change much. In fact, experiments conducted at CERN which accelerate ions to relativistic velocities appear to substantiate this. It has been reported that the pancaking of the ions, expected on the basis of special relativity, has not been observed (Rak, 2019). While this result has not yet formally been announced, when eventually published, it should deliver a serious blow to special relativity theory.

But special relativity has already been disproved based on findings which indicate that the speed of light can be surpassed. For example, Podkletnov and Modenese (2001) report sending a collimated scalar longitudinal gravity impulse across their laboratory at a speed of 64c. The electrogravitic impulse was generated by discharging a 2 Mv pulse from a Marx bank through a 10 cm diameter superconducting electrode that was magnetized such that magnetic field lines were oriented along the direction of beam propagation. In a later experiment, using an improved apparatus that discharged 10 Mv pulses Podkletnov (2007) reported that aided by atomic clocks he had determined the speed of these gravity impulses to be *thousands* of times the speed of light.

Experiments that I had conducted with Guy Obolensky at his laboratory in 2005 and 2006 used 200 kv discharges to produce scalar longitudinal coulomb waves (electric field shocks) that propagated from the cathode at speeds as high as 6.5c (LaViolette, 2008, Ch. 6). Another example of superluminal propagation may be found in the work of Gasser (2016). He found that a 10 kv spark discharge between two spheres would produce a Coulomb shock that traveled at speeds ranging from 1.4 c to 5 c. LaViolette (2008) has reasoned that, in such pulse discharge experiments, the electric and gravity potential pulse, attains its superluminal velocity because it is riding an ether wind that propagates with the pulse in its direction of travel. Hence the observed pulse velocity may be expressed as $v' = c + v$, where c is the velocity of light and v is the velocity of the forward propagating ether wind that it surfs upon.

According to SQK, such pulses are scalar reaction-diffusion waves that move forward because their concentration gradients produce a forward etheric diffusion flux vector that raises the concentration of X, Y, or G in the forward direction, thereby causing the wave to shift forward. Such waves, termed scalar longitudinal waves, differ from Hertzian waves in that they have no transverse magnetic field component, i.e., no curl terms. A Hertzian wave would be created when a reaction-diffusion wave is modulated or polarized to have an oscillating transverse reaction-diffusion component (LaViolette, 2012, Ch. 6). NonHertzian scalar longitudinal waves are not predicted by classical Maxwellian electrodynamics as modified by Heaviside. But they are predicted when classical electrodynamics is modified into a new version called Extended Electrodynamics (EED); see Hively and Loebl (2019) and Reed (2019). EED is an improvement in that it resolves many of the flaws inherent in the classical version. Moreover, it is completely compatible with the gradient-driven scalar and Hertzian waves that SQK predicts. For a discussion of some of the flaws of Maxwell's equations, see LaViolette (2012), Ch. 6 and references therein.

GENERAL RELATIVISTIC EFFECTS: EFFECTS DUE TO GRAVITY

Gravitational Length Contraction, Mass Dilation, and Orbital Precession

Dicke (1961) and Clube (1977, 1980) have shown that the standard tests of general relativity may be reproduced using Lorentz invariant laws of mechanics in flat space-time provided that inertial mass is allowed to increase and the speed of light is allowed to decrease with increasing gravitational potential according to certain specified relations. They propose the following variation:

$$m \propto m_0^{(3\varphi_g/c_0^2)}$$
$$c \propto c_0^{(-2\varphi_g/c_0^2)}, \tag{14}$$

where φ_g = MG/r is the gravity potential expressed as a positive quantity and where m_0 and c_0 indicate the values of mass and the speed of light at a point remote from visible matter. In terms of subquantum kinetics we might define m_0 and c_0 as representing m and c in intergalactic space.

The above gravity potential expression effectively replaces that of general relativity which attributes orbital precession and the bending of light to a gravitational "warping" of space-time. Hence any (e.g., pulsar) test claiming to confirm the predictions of general relativity will also confirm this variable m and c theory. Such alterations of mass, length and temporal period are predicted by Model G. As the value of the bifurcation parameter G is decreased (i.e., as gravitational potential is made more negative), the Turing wave wavelength of a subatomic particle should become shorter and hence its inertial and gravitational mass should become greater. Accordingly, if a body were to move deeper into a gravitational potential well, its inertial and gravitational mass would correspondingly increase. If a planet such as Mercury, which has a highly elliptical orbit about the Sun, were to vary in mass, becoming most massive at perihelion and least massive at aphelion, its orbit should be found to precess as is observed. Future computer simulation of Model G hopefully will show quantitatively how soliton wavelength and velocity vary with gravitational potential.

Gravitational Clock Retardation

According to SQK, a light clock in a gravity potential well would slow down, thus reproducing the effect known in physics as gravitational time dilation. The lower G concentration prevailing in the potential well would reduce the reaction rate in the X-Y ether reaction loop which, in turn, would cause a photon's field potential to oscillate at a slower rate. By the same token, a photon traveling inside a gravity potential well would be expected to travel slower than normal. General relativity secures these related effects by maintaining that gravity in some unexplained way dilates the time dimension. In SQK the time dimension remains unchanged, the effect instead arising because the altered ether reaction rates reduce the photon's frequency and velocity.

Gravitational Redshifting

The gravitational redshift phenomenon, which is most evident in the spectra of white dwarfs, is related to the gravitational clock retardation effect. Since light clocks situated deep in the central part of a gravity potential well would run slower than clocks residing at more peripheral locations, spectral line photons emitted at the surface of a star would have lower frequencies, be redshifted, relative to the frequency that they would have if those same spectral line photons had been emitted at a point distant from this gravity well. As these redshifted photons leave the surface of the star, their frequency and velocity would both increase, preserving their original emitted wavelength to be seen as a redshift.

Gravitational Bending of Light

As mentioned above, as G is decreased, φ_g becoming more negative, the frequency and wavelength of a propagating photon (reaction-diffusion wave) will decrease and its propagation velocity will be slowed. From this it follows that if a photon were to encounter a gravitational potential well, these effects would cause its trajectory to bend inward as if the photon were being pulled inward toward the center of the well. Hayden (1990) has shown that such light refraction by a gravitational potential field is able to completely account for the gravitational bending of light. General relativity, on the other hand, explains this same effect by assuming that the space-time fabric in the vicinity of a star is warped by the star's gravity field, and thereby causes the photon's space-time trajectory to bend. But how a gravity field causes space-time to warp is not explained.

It is important to note that the Model G cosmology resolves the gravitational potential summation problem that has been an area of difficulty for Euclidean cosmologies such as those proposed by Dicke and Clube. This problem may be stated as follows. Namely, if gravitational potential fields extend to infinity, as is assumed in classical field theory, then it can be shown that the gravitational potential at any given point in space would approach infinity as the potential contributions were summed up over an infinitely large region of the universe. This in turn would lead to the absurdity that in all regions of space particle masses should be infinitely large and photon velocities infinitely small. This problem does not emerge in SQK. The finite extension of gravitational potential fields emerges as a natural corollary of the methodology. As mentioned earlier, the gravitational field of a celestial body would be expected to terminate at a substantial distance from the body as the prevailing G-on concentration plateaus to the steady-state local intergalactic value, G_0, determined by the homeostatic equilibrium established by input and output reaction kinetic processes.

TECHNOLOGICAL APPLICATIONS OF SUBQUANTUM KINETICS

Subquantum kinetics has been usefully applied to explain several propulsion and over-unity energy production technologies which standard physics has been at a loss to explain (LaViolette, 2007, 2008, 2012). Propulsion technologies that have a direct relevance to the subquantum kinetics theory of electro-gravity include Townsend Brown's electrogravitic thruster, the Podkletnov gravity impulse beam, and the Searl disc. The operation of other devices such as T.T. Brown's asymmetrical capacitor thruster and the Nassikas superconducting thruster (Nassikas, 2012) may be understood in the SQK framework when it is realized that the electric field (potential gradient) and magnetic field (vortical ether currents) are not attached to their field sources but instead are seated in the ether. Hence their fields are able to exert unbalanced forces on the devices that produce them, allowing these devices to achieve propulsion without the action of outside forces. Both of these technologies, of course, violate Newton's third law. One version of Brown's asymmetrical electrokinetic thruster has been reported to have a thrust-to-power ratio of 70,000 Nwt/kw, over 4000 times that of the jet engine. Since a jet engine is known to have an efficiency of 15%, this projects an efficiency of over 26,000 percent for Brown's thruster. So his technology in addition violates the First Law of Thermodynamics, something that is permissible in the SQK paradigm. SQK is also able to explain the operation of the Sun cell invented by Randal Mills of Brilliant Light Corp., which produces 1 MW of power by inducing the electron in the hydrogen atom to jump to orbits below the recognized ground state. Such transitions, thought to be impossible in standard physics, become highly probable when one substitutes the SQK Turing wave model of the electron in place of the trouble-ridden wave packet model of standard quantum mechanics.

More broadly speaking, SQK provides a new paradigm for viewing the world, one in which over-unity energy generation and violations of Newton's third law becomes the new norm rather than the enemy to be suppressed. Energy technologies such as Kim Zorzi's over-unity Shauberger vortex air turbine, Walt Jenkins' water gas combustion engine, and many others that are ready to change our way of life are even now waiting to be implemented. Field propulsion technologies such as those developed by Townsend Brown have been already implemented by the military but have been locked in secrecy since the late 1950's. Meanwhile standard physics has frozen physicist's thinking in a paradigm that has yet to produce any major breakthroughs in the last century other than nuclear power. It is time to realize that physics should not be left to university professors who sit in their armchairs spinning abstract string theories. Our daily lives are directly impacted by the unworkable theories sanctioned by physics that have failed to solve society's mounting problems. It is time that we awaken to the fact that the physical world around us does not behave in the way physicists and astronomers have long taught us and to open ourselves to new possibilities such as the perspective offered by subquantum kinetics.

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