Diffusion Gravity: Attraction Mechanism

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Abstract

Previous research papers [1,2] introduced the Diffusion Gravity model which invokes the process of mass diffusion to explain gravity, motion, acceleration, energy and extensibility of the model to larger scales. This article is an elaboration of that introductory description of the DG model, with the objective to describe more thoroughly the gravitational attraction mechanism. It will show that the mechanisms of virtual particle flux and quantum mechanical annihilation together reduce the density of virtual particles in the stream between mass objects. Virtual particle streams act as *carriers* to transport *information* about mass and direction of the source masses, which dynamically interact with other virtual particle fluxes from distant objects to induce gravitational attraction. As a quasi-deterministic model, and as a hybrid of classical Newtonian and quantum mechanical principles, the Diffusion Gravity model represents a quantum physical process that manifests as gravity at the classical level, which reflects in the Poisson equation for gravity; essentially these two component models are combined into a quantum mechanical representation of the mass diffusion phenomenon as the causality for gravity.

Introduction

Theories invoking the ether and the "flow of space" have been part of science for hundreds of years. Newton, Maxwell, Lorentz and Poincare, and many others assumed an ether medium in their physics theories, and conducted thousands of experiments which resulted in our great pillar theories of physics. Whittaker [3] and Larmor [4] give a history of theories of the ether in the early twentieth century. But then "modern" physics was founded on the special theory of relativity, with consequent dismissal of the ether medium after the Michelson-Morley experiments did not show or "prove" its existence. Since then, physicists introduced various theories that were based on the existence of an ether-like medium, such as the Dirac "sea" of particles. In more modern context, theories that invoke ether are now more properly associated with and expressed as the structure and behavior of the quantum vacuum. Extensive efforts in research have been conducted on the quantum vacuum, resulting in further development of quantum electrodynamics and vacuum technology to engineer the quantum vacuum (e.g., Casimir effect) for practical application. From Feynman until now, QED has evolved and developed with investigations by researchers such as Milonni and Lamoreaux [5, 6] and Rafelski [7]. Contradictions that arise between relativity and quantum mechanics demonstrate clearly and cogently that the banishment of the ether led to the consequent failures to unify the two paradigms. Physics continues to wrestle and puzzle over this dilemma fully one hundred years later; this work proposes an alternative approach to that end.1

The Diffusion Gravity model stems from Dirac in 1930 [8,9], who postulated the "Dirac Sea" of electrons as the ambient quantum vacuum; more recently that concept may be illustrated by the modern interpretation where the Dirac spinor is a sum of creation operators and annihilation operators in the schema [10]:

$$\psi(x) = \sum a^{\dagger}(k)e^{ikx} + a(k)e^{-ikx} \qquad (1)$$

This representation of quantum mechanical operators is the basis within the DG model to depict creation and annihilation in the quantum vacuum of particles (or their harmonic oscillator counterparts), and in particular, virtual particle annihilation as the prime mover and underlying mechanism of diffusion gravity. The fundamental operations of creation and annihilation follow the conventional quantum mechanical commutation relation of

$$[a, a^{\dagger}] = 1 \qquad (2)$$

where $a^{\dagger}$ is the creation operator for virtual particles, and a is the annihilation operator in the standard notation of quantum mechanics. Physicists and mathematical physicists have worked toward linking the diffusion equation (Fick's Law), classical Brownian motion, and the Schrodinger equation of quantum mechanics. Nelson derived the Schrodinger equation from fundamental diffusion in 1966 [11] using stochastic mechanics and also Tsekov [12] more recently has derived the Schrodinger equation from Brownian motion, due to their analogous differential equation forms, and due to the quest to link quantum behaviors to classical physics and newtonian laws. This important linkage is integral to the DG model to explain gravitational attraction due to both classical and quantum mass diffusion.

The following sections of this paper will present the quantum interactions that produce the diffusion gravity effect. Then the annihilation operator will be applied to develop the quantum vacuum mechanics that evolve to the Poisson equation for gravity to show how a quantum mechanism of annihilation translates to a Poisson "*sink*" and diffusion gravity at the macro level. The creation of virtual particles is assumed to originate from the mass as the "source" of virtual particles, which then manifest as gravitational potential, $\Phi = GM/r$.

Section 1

This section discusses Diffusion Gravity with a brief overview of the conceptual model and progresses thence to the details as previewed in the introduction section.

Diffusion gravity depends on the the active quantum vacuum, and the virtual fermions therein that function as the *agents* and *carriers* for gravity and for electromagnetic energy quanta (photons). This conceptual model of the active vacuum and virtual fermions as *carriers* has also been applied to photons, by Urban[14] and Leuchs[13], with an integral linkage to the permittivity and permeability of the vacuum and the speed of light *c*. Virtual particles (virtual fermion pairs) within the DG model actually transport the "*information*" of gravity about the mass and direction of objects, via streams propagating radially outward from the center of masses. The virtual particles themselves persist only briefly due to the uncertainty principle, so they must propagate in relay fashion to transmit their information (about the mass and size of source) great distances, driven by primary diffusion from the source mass. To illustrate, please refer to the virtual fermions streaming agents of gravity shown in Figure 1.

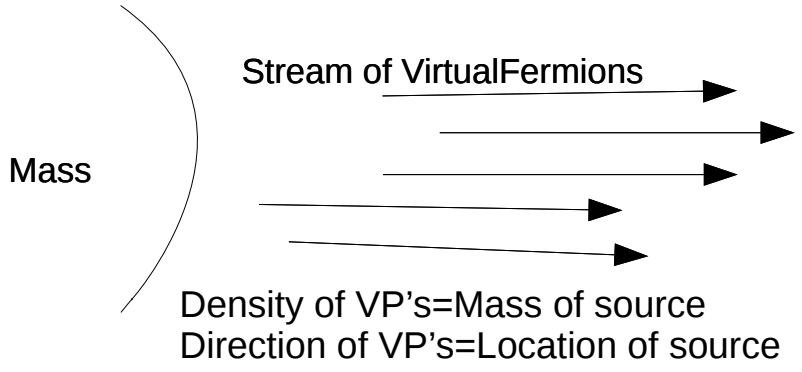

Figure 1: Virtual Particles Streaming from Source Mass

Streams from source masses may encounter streams from other masses; this produces an intersection zone that where the virtual fermions may annihilate between streams, due to opposite-directional cancellation (vector summation). When opposing flux streams converge, net reduction in virtual

particle pair density results from greater probability of collision and annihilation of VP's in both streams commensurate with their densities. A reduction in population of the virtual fermions between masses causes a *depletion* zone whose minimum density point is the null or balance point between masses. Figure 2 illustrates the diffusion gravity principle:

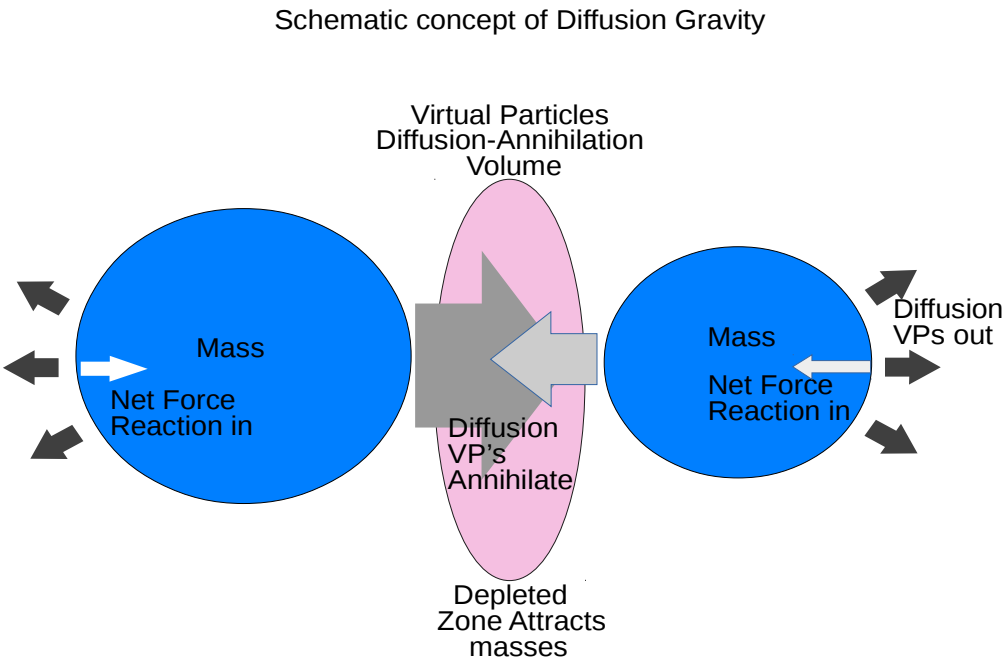

Figure 2: Concept Model of Diffusion Gravity Mechanism

Mass diffusion as the motive force of gravity can be shown in quantum mechanical terms as the annihilation of virtual particles between masses to produce a "depleted" volume of space. The creation and annihilation of virtual particles at the quantum level is intrinsic to the mass diffusion process as a quantum (probablistic) phenomenon. Pure diffusive behavior for non-quantum (macro diffusion) is shown in the quantum field theory form by the equation for diffusion annihilation [10] and summarized here:

$$\textit{define}: \quad a \,|\, n \rangle = n \,|n-1\rangle$$
$$a^{\dagger} \,|\, n \rangle = n \,|n+1\rangle \qquad (3)$$

$$\partial_t \,|\, \psi\rangle = -\alpha \sum \left(2a^{\dagger}_i a_i - a^{\dagger}_{i-1} a_i - a^{\dagger}_{i+1} a_i\right) |\psi\rangle$$

$$= -\alpha \sum \left(a^{\dagger}_{i} - a^{\dagger}_{i-1}\right)\left(a_i - a_{i-1}\right) |\psi\rangle \quad \textit{with sum over } i \qquad (4)$$

where the quantum field method signifies the creation and annihilation for the diffusion, and α is a probability density multiplier. Extensive research has been conducted to apply the quantum field methods for diffusion to the macroscopic level of diffusion; see Mikhailhov and Yashin (1984) [15], and Doi (1976a,b)[17], and more recently Mattis [18]. The annihilation term for this reaction can be obtained from the *n(n-1)* interactions possible, and developed as

$$\lambda \sum \left(a_i a_i - a^{\dagger}_{i}\, a^{\dagger}_{i}\, a_i\, a_i\right) \qquad (5)$$

which then adds as the evolution term to the previous equation 4,

$$-\alpha \sum \left(a^{\dagger}_{i} - a^{\dagger}_{i-1}\right)\left(a_i - a_{i-1}\right) |\psi\rangle + \lambda \sum \left(a_i^2 - a_i^{\dagger 2} a_i^2\right) |\psi\rangle \qquad (6)$$

This expression provides a quantum basis toward the macro diffusion phenomenon, and is repeated from [10] to substantiate the mass diffusion model for diffusion gravity. This approach postulates annihilation as the same phenomenon as the "*sink*" in the Poisson equation for a unit volume between masses in diffusion gravity:

$$\sum a_i^{\dagger} a_i = K\left\{\int J_{FM}\, dV + \int J_{RM}\, dV\right\} = \pm J_a \qquad (7)$$

where J_{FM} is the particle flux in one direction, and J_{RM} is the flux in the opposite direction, K is a diffusion constant for virtual fermions, and J_a is the resultant flux, which is equivalent to a gravitational acceleration. The resultant sign ± signifies that the *net* annihilation depends on the relative magnitudes (difference) between J_{FM} and J_{RM}.

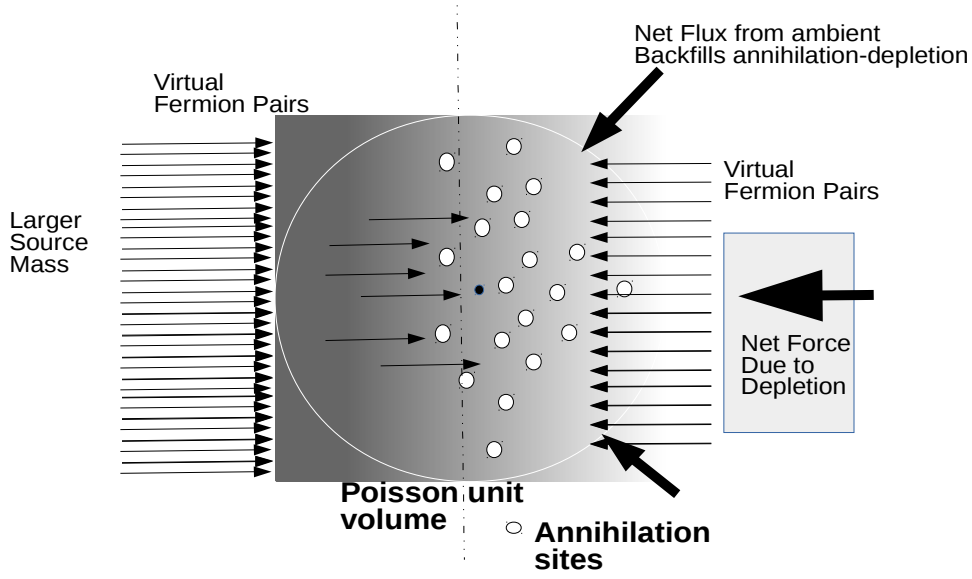

Figure 3 The Diffusion Gravity Mechanism Schematic

Now, as derived in the first paper on diffusion gravity [1,2], the diffusion sink expressed in the Poisson equation shows the negative potential (flux) depletion that results in acceleration (attraction) in either the J_{FM} *or* J_{RM} direction. The direction of J_a will determine the depletion net effect as depicted in Figure 4.

$$-J_a = \nabla^2\phi \qquad (8)$$

The resultant negative J signifies (as in newtonian) opposite gravitational force from the potential ϕ, whilst the net annihilation depends on the relative magnitudes (difference) between J_{FM} and J_{RM} . The Poisson equation applies for any unit volume not centered on the balance point between the masses. As the gradient increases, the point of equilibrium between the masses also moves towards the smaller mass along with the net acceleration. A similar argument applies as previously presented in the Laplace equation for the acceleration balance point, where annihilation of the virtual particle streams between the masses exactly cancelled to provide the zero net potential of that libration point.

$$\int J_{FM}\, dV \; + \int J_{FM}\, dV \; = \nabla^2\phi \; = 0 \qquad (9)$$

The Diffusion Gravity attraction mechanism reflects Gauss' law and Newtonian mechanics equations for gravity through the Poisson equation; the underlying quantum field diffusion processes show that Poisson's equation reflects the quantum virtual particle diffusion behavior, as the governing macroscopic expression of the quantum gravitational attraction mechanism.

In summary, virtual particle flows into and out of a given volume between massive objects will have a resultant inflow or outflow based upon annihilation between opposite flows. Virtual particle flows from masses are manifest and measurable via the gravitational potential generated by any mass object. The m/r potential relation suggests that the virtual particles follow that distribution proportionally. The causal mechanism of virtual particle flows as the mechanism for gravity is essentially a particle view, albeit in a *virtual* particle form rather than real microscopic particles. The quantum field method shown here reflects the second quantization and harmonic oscillator expressions for creation and annihilation operators at the quantum virtual particle level. When gravitation interactions occur, the conservation laws must hold for each object and its corresponding field for energy and potential. Conservation laws are maintained through the virtuality or temporal limitation of the Uncertainty Principle, when there are no gravitational interactions with other masses. Energy considerations of this model were covered in [2] on DG Dynamics.

Section 2

The referencing of action by mass objects to the ambient quantum vacuum is a critical tenet of the diffusion gravity model. In continuum mechanics, mass diffusion is a generic physical phenomenon, described by the differential equation $\boldsymbol{J = -D\, d\varphi/dx}$, which is independent of reference background. When the mass diffusion flux is superposed upon the ambient, therefore, the range can extend to the "negative" with respect to the average or ambient level of virtual particle activity in the vacuum. This will occur for depletion zones where annihilation results from the interaction of two mass objects. A comparison to the referencing in electromagnetism for positive and negative charges shows that the same reasoning and method can be applied to gravity if the ambient vacuum levels are taken as a neutral reference level (normal level of particle activity). Depletion zones would therefore be analogous to the cancellation of positive and negative charges in electromagnetism, where J_a is the flux, and is negative, indicating the net *sink* for virtual particles. This is the causal mechanism for the potential that arises from the cancellation mechanism, and the net depletion which results in attraction from higher mass densities (to lower mass densities) on either side of a unit reference volume. The independence of the diffusion equation from the reference background will allow for slight variations in the speed of light c. Such a basis for the attraction of gravity fits into the Dirac model of the "sea of fermions" of the active vacuum. Further work on this model will develop the hybrid model of quantum

and macroscopic equations into more detail, along with commensurate experiment design. A discussion that follows in the next section suggests further observation and possible work to validate the Diffusion Gravity model, and it may suggest review or analysis of available data to substantiate the DG concept application to existing observations.

Virtual Particle Mechanism for Diffusion Gravity Observational Evidence

The most immediate effect of the virtual particle streams from masses is their effect on light photons which they carry. The virtual particle medium, i.e., active vacuum, is also the medium for photons as presented in Leuchs [13] and Urban [14]. If light is carried by fermion virtual pairs, then it is subject to the diffusion gravity effects that might be imposed upon the stream of virtual particles as the carrier. The best suggestion of evidence for this effect is the light arriving from distant sources that will naturally be carried to our observation point by our own local *outflowing* streams of virtual particles, which may retard, or *wavelengthen* the incoming photons, with the corresponding loss in energy absorbed by the active vacuum. Thus the background vacuum would have a consistently smooth energy level from the random photons arriving from all cosmic and local sources. That may be evidenced by what we have called the cosmic microwave background, or CMB, as a glow from the active virtual particle activity in the vacuum and the myriad of continuous creations and annihilations as described previously in this paper.

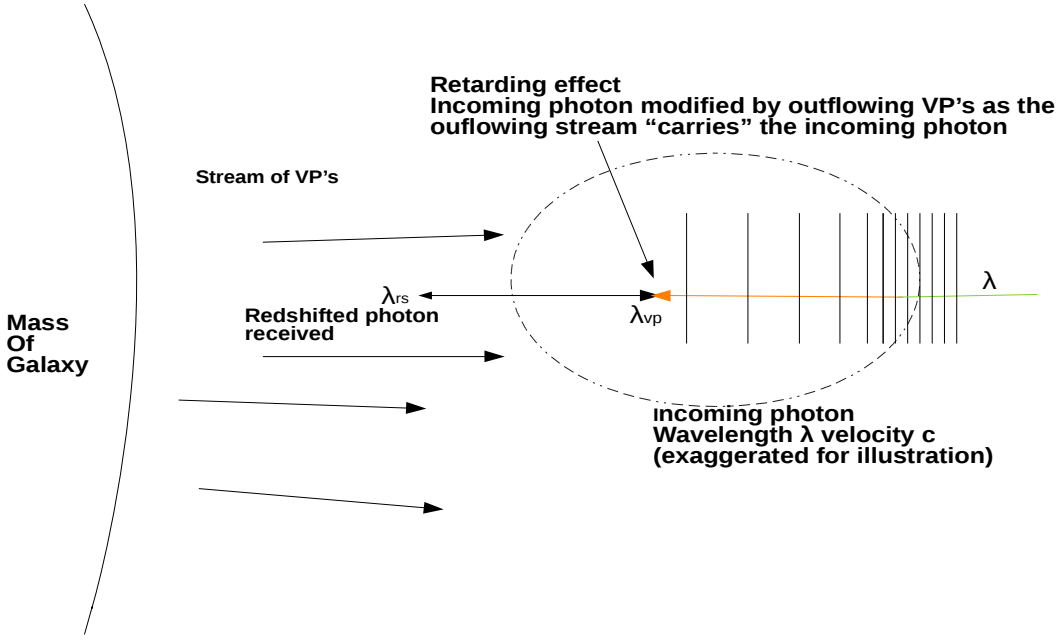

Figure 4 Local Wavelengthening by Virtual Particle Outflow

Direct observational evidence of the effects on received light from distant sources may be a *perceived* distance redshift. Outward flow of the virtual particle streams from massive objects may also redshift the light by a simple mechanism corresponding to the above alternative hypothesis for the CMB. The wavelengthening of incoming photons might be equivalent to the prevailing measurements of redshift of the distant sources by recession, expansion, or doppler shifting, except that it is *locally* -- not

remotely caused. The Milky Way galaxy therefore, with its enormous output of virtual particle streams due to its mass, may in and of itself redshift the incoming light from cosmic sources. Figure 4 shows how this might be possible.

This alternative hypothesis may call into question the current default standard of redshift metrics for distance measurement. It would seem more consistent and logical for the observed redshift to be primarily from local causality, rather than distant cosmos. Similarly, observations of our nearby galactic neighborhood show blueshifts of the nearby Local Group galaxies; the diffusion gravity theory suggests a reason for this other than the common assumption of movement towards (doppler shift) these nearest galaxies. Their proximity suggests that the virtual particle streams between members of the Local Group can and do interact as described by diffusion gravity, and would they would be close enough to experience the annihilation of virtual particles in the two converging virtual particle streams, with the resultant gravitational attraction and corresponding foreshortening of the wavelengths between the galaxies; this would be observable as a blueshift. Please see Figure 5 for this concept.

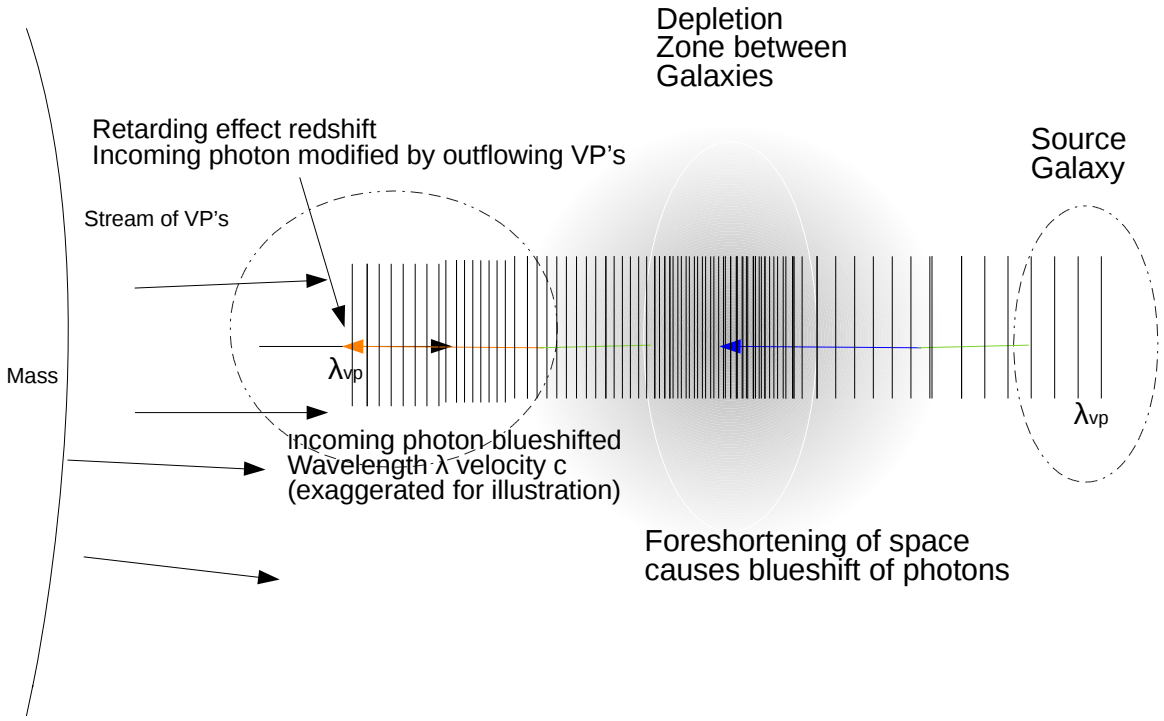

Figure 5 Blueshift Model for Diffusion Gravity

Discussion

The observational analysis of the wavelengthening or shortening as a distance and motion measuring method has been a challenge for astronomy until the present day. Astronomical measurements in many cases do not have sufficient redundancy or verifiability to validate their accuracy, methods or models.

Diffusion Gravity offers alternative models of physics for gravity and its affect on light transmission by quantum virtual particles as carriers, and their corresponding measurement effects on cosmology and astronomy. In fact, redshift may not necessarily be caused by distance, recession, or expansion as believed, but it may have local origin at the receiving end. Re-factoring of the prevailing assumption of redshift from the perspective of occam's razor might more correctly characterize metric tools for cosmology. The fundamental source of ambiguity in this area of physics is the extrapolation of local physics to the entire cosmos, when there is not sufficient evidence to support the assumption that such metrics are valid. The alternative presented herein uses local known physics to explain the observations, rather than current remote and unverifiable theories.

Summary and Conclusion

The integration of the fundamental physical phenomenon of diffusion as the motive force for gravity uses a bottom-up approach from the principles of quantum mechanics to build a model of macroscopic behavior in Poisson's equation for gravity. The known models and laws of diffusion were combined with the quantum mechanical models of probablistic behavior to postulate a precise mechanism for gravitational attraction. This model of Diffusion Gravity was then applied to a practical observation for wavelengthening (redshift) and waveshortening (blueshift) local causality, and proposed as an alternative explanation for observations that heretofore were explained by expansion and recession redshift in the distant cosmos. Further observational analysis will continue with the objective of further application of these effects, including supportive diffusion gravity experiment design in association with related gravitational phenomena.

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