Dynamical 3-Space and the Earth's Black Hole: An Expanding Earth Mechanism

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During the last decade the existence of space as a quantum-dynamical system was discovered, being first indicated by the measured anisotropy of the speed of EM radiation. The dynamical theory for space has been under development during that period, and has now been successfully tested against experiment and astronomical observations, explaining, in particular, the observed characteristics of galactic black holes. The dynamics involves G and α - the fine structure constant. Applied to the earth this theory gives two observed predictions (i) the bore hole g anomaly, and the space-inflow effect. The bore hole anomaly is caused by a black hole (a dynamical space in-flow effect) at the centre of the earth. This black hole will be associated with space-flow turbulence, which, it is suggested, may lead to the generation of new matter, just as such turbulence created matter in the earliest moments of the universe.This process may offer a dynamical mechanism for the observed expanding earth.

1 Discovery of Dynamical Space

In remarkably prescient work Hilgenberg in the 1930's (Scalera and Braun, 2003) proposed that the expansion of the earth, driven by an increasing mass content, might be explained by a dynamical space that caused the generation of the new matter, and that the acceleration of gravity was nothing but the effect of an accelerated flow of that space. This was in direct conflict with the prevailing belief that space and time were inseparable aspects of a geometrical entity - spacetime, and that gravitational acceleration was a spacetime curvature effect. This Einstein worldview had its origin in the supposedly null results from the 1887 Michelson-Morley interferometer experiment designed to detect the anisotropy of the speed of light, which would otherwise have indicated that a dynamical space, or an ether in the terminology of that era, was flowing through the detector. Despite a few successes, the spacetime paradigm has faced an ever increasing list of inexplicable failures, including the need for dark matter and dark energy. However in 2002 (Cahill and Kitto, 2003) it was discovered that the Michelson-Morley experiment was not null, and the published 1887 data, using a new calibration theory for the device, showed a space speed up to 500km/s, see Fig.1. Miller's 1925/26 experiment showed even more detailed confirming results, see also Fig.1, and recently Doppler shifts from spacecraft earth-flybys have confirmed those early results (Cahill, 2009), revealing the galactic speed of the solar system to be some 490km/s in the direction RA=4.3h, Dec=-75deg, and within 5deg of the direction that Miller had determined. As well the flyby data also revealed an inflow of space into the earth, confirming the expected speed of some 11km/s at the surface, as well as the sun inflow speed at 1AU of 42km/s. The Sun's surface inflow of 615km/s now follows from a new account of the deflection of starlight by the Sun (Cahill, 2009b). These developments change all of physics, and now provide a mechanism to explain the expanding earth, exactly along the lines suggested by Hilgenberg, and in accord with later developments (Carey, 1989, Scalera, 2003, Maxlow, 2005).

Although probably apocryphal Galileo's Learning Tower of Pisa experiment, showing that objects of different mass have the same free-fall acceleration, was the first key experimental evidence about the nature of space and gravity. Galileo actually did other experi-

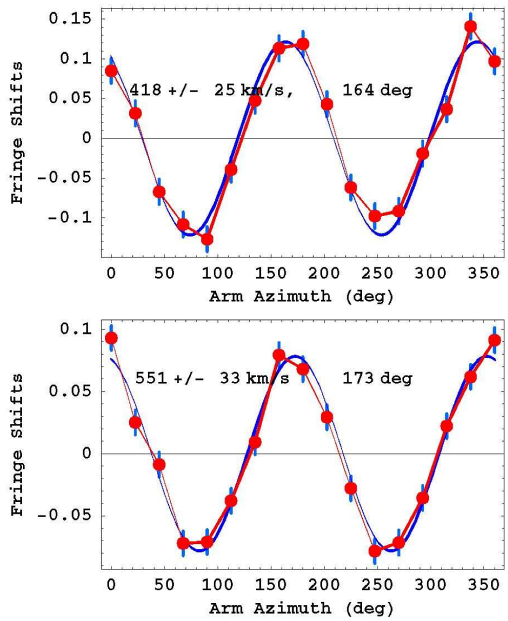

Fig. 1: A typical Miller averaged-data from September 16, 1925, $4^h40'$ Local Sidereal Time (LST) - an average of data from 20 turns of the gas-mode Michelson interferometer. Plot and data after fitting and then subtracting both the temperature drift and Hicks effects from both, leaving the expected sinusoidal form. (b) Best result from the Michelson-Morley 1887 data - an average of 6 turns, at 7^h LST on July 11, 1887. In both cases the indicated speed is v_P - the 3-space speed projected onto the plane of the interferometer. The angle is the azimuth of the 3-space speed projection at the particular LST. The speed fluctuations from day to day significantly exceed these errors, and reveal the existence of 3-space flow turbulence - i.e gravitational waves.

ments that demonstrated that effect. However, starting with that observation, and building on Kepler's planetary discoveries, Newton went in a direction that we now know to be flawed, and which subsequently flawed the generalisation by Hilbert and Einstein. After some 300 years there is now a futile search for "dark matter" and "dark energy" - the epicycle fix-ups of these flawed theories. Newton's approach was to assume that Galileo's observations could be explained by assuming that the magnitude of a gravitational force acting on an object with inertial mass m, was proportional to m, in which case m also acted as a gravitational mass or charge. This entailed an equality of the inertial mass and the gravitational mass, which became known as the Weak Equivalence Principle. However, starting from Galileo's observations we can follow a different development, and one based on the following: that the equal gravitational acceleration of objects with different masses was caused by the flow of space, which had that acceleration at the location of the masses, and that low-mass matter acted as a probe of the space acceleration. This entails the idea that space exists, is dynamical and directly detectable. The derivation of the reaction of matter to the accelerating space had to await the development of the quantum theory of matter, and we find then that gravity is a refraction of the quantum waves, and is thus an emergent phenomenon. We also briefly show that this account of gravity resolves the above anomalies, and leads to new experimental phenomena and tests. We also discover that the dynamics of space has two parameters: (i) G describing the dissipative flow of space into matter, and which, for the case of the earth, has been directly detected by means of spacecraft earth-flyby Doppler shift data, and (ii) $\alpha \approx 1/137$ - the fine structure constant, which determines a self-interaction coupling constant of the dynamical space, and which bore hole g and black hole mass data reveals to be the fine structure constant. So the new theory of space and gravity not only provides a well tested theory, but also points to a new unification of space, gravity and the quantum theory. It was pointed out in [**?**, **?**] that this unification appears to arise from an information-theoretic approach to comprehending reality, leading to a quantum foam description of space. The new theory also explains various so-called relativistic effects, but in a way that does not involve "spacetime". Indeed the putative predictions of the "spacetime" formalism are falsified by experiments. Experiments confirm instead Lorentz's account of relativistic effects, as being caused by the absolute motion of objects wrt space, and for which the maximum speed is c. Experiments show that the speed of light, in vacuum, is anisotropic for an observer moving through space, as 1st detected by Michelson and Morley in 1887, and that the flowing space affects both quantum matter and electromagnetic waves, via its time dependence and/or its speed inhomogeneity. The dynamical space also exhibits wave/turbulence effects, usually called "gravitational waves", and again 1st detected in this experiment. We emphasise that the dynamical space is not a hydrodynamical theory, with some entity flowing through a non-dynamical geometrical space. Before reporting the evidence for a black hole at the centre of the earth, and its possible role in causing the formation of new matter, we must first firmly establish the dynamics of space, and in particular its successes in explaining the observed properties of galactic black holes, noting that these dynamical-space black holes have nothing to do with the General Relativity (GR) black holes.

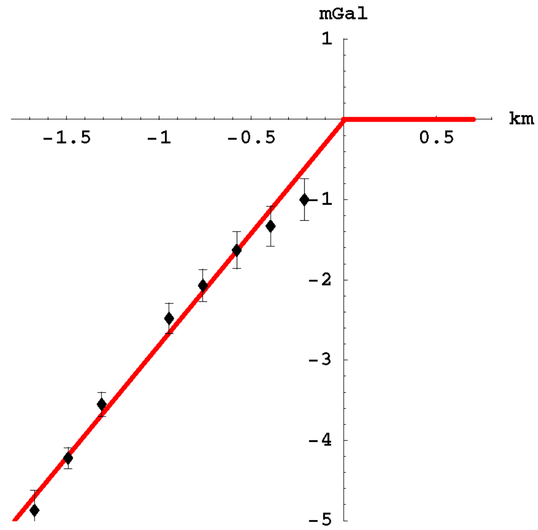

Fig. 2: small The data shows the gravity residuals for the Greenland Ice Shelf Airy measurements of the $g(r)$ profile, defined as $\Delta g(r) = g_{Newton} - g_{observed}$, and measured in mGal (1mGal $= 10^{-3}$ cm/s^2) and plotted against depth in km. The borehole effect is that Newtonian gravity and the new theory differ only beneath the surface. We obtain $\alpha^{-1} = 137.9 \pm 5$ from fitting the slope of the data.

2 Dynamics of Space

We begin the heuristic derivation of the dynamics of space, and the emergence of gravity as a quantum matter effect, by assuming that Galileo's observations suggest the existence of a dynamical space, whose acceleration will be shown to determine the same acceleration of matter, and whose time dependence and inhomogeneity of velocity determines the observed anisotropy of the speed of light, and causing light bending and gravity as refraction effects. Physics must employ a covariance formulation, in the sense that ultimately predictions are independent of observers, and that there must also be a relativity principle that relates observations by different observers. We assume then that space has a structure whose movement, wrt an observer, is described by a velocity field, $\mathbf{v}(\mathbf{r},t)$, at the classical physics level, at a location $\mathbf{r}$ and time t, as defined by the observer. In particular the space coordinates $\mathbf{r}$ define an embedding space, which herein we take to be Euclidean. At a deeper level space is probably a fractal quantum foam, which is only approximately embeddable in a 3-dimensional space at a coarse-grained level (Cahill, 2005, 2009a). This embedding space has no ontological existence - it is not real. Ironically Newton took this space to be real but unobservable, and so a different concept, and so excluding the possibility that gravity was caused by an accelerating space. It is assumed that different observers, in relative uniform motion, relate their description of the velocity field by means of the Galilean Relativity Transformation for positions and velocities. It is usually argued that the Galilean Relativity Transformations were made redundant and in error by the Special Relativity Transformations. However this is not so - there exist an exact linear mapping between Galilean Relativity and Special Relativity (SR), differing only by definitions of space and time coordinates (Cahill, 2008). This implies that the so-called Special Relativity (SR) relativistic effects are not actual dynamical effects - they are purely artifacts of a peculiar choice of space and time coordinates. In particular Lorentz symmetry is merely a consequence of this choice of space and time coordinates, and is equivalent to Galilean symmetry. Nevertheless Lorentz symmetry remains valid, even though a local preferred frame of reference exists. Lorentz Relativity, however, goes beyond Galilean Relativity in that the limiting speed of systems wrt to the local space causes various so-called relativist effects, such as length contractions and clock dilations.

The Euler covariant constituent acceleration $\mathbf{a}(\mathbf{r},t)$ of space is then defined by

$$\mathbf{a} = \lim_{\Delta t \to 0} \frac{\mathbf{v}(\mathbf{r}+\mathbf{v}(\mathbf{r},t)\Delta t, t+\Delta t) - \mathbf{v}(\mathbf{r},t)}{\Delta t}$$

$$= \frac{\partial \mathbf{v}}{\partial t} + (\mathbf{v}\cdot\nabla)\mathbf{v}$$

which describes the acceleration of a constituent element of space by tracking its change in velocity. This means that space has a (quantum) structure that permits its velocity to be defined and detected, which experimentally has been done. We assume here that the flow has zero vorticity $\nabla \times \mathbf{v} = \mathbf{0}$, and then the flow is determined by a scalar function $\mathbf{v} = \nabla u$. We then need one scalar equation to determine the space dynamics, which we construct by forming the divergence of $\mathbf{a}$. The inhomogeneous term then determines a dissipative flow caused by matter, expressed as a matter density, and where the coefficient turns out to be Newton's gravitational constant,

$$\nabla \cdot \left(\frac{\partial \mathbf{v}}{\partial t} + (\mathbf{v} \cdot \nabla)\mathbf{v} \right) = -4\pi G \rho(\mathbf{r}, t)$$

Note that even a time independent matter density or even the absence of matter can be associated with a time-dependent flow. This equation follows essentially from covariance and dimensional analysis. For a spherically symmetric matter distribution, of total mass M, and a time-independent spherically symmetric flow we obtain from the above, and external to the sphere of matter, the acceleration of space

$$\mathbf{v}(\mathbf{r}) = -\sqrt{\frac{2GM}{r}}\hat{\mathbf{r}}, \text{ giving } \mathbf{a}(\mathbf{r}) = -\frac{GM}{r^2}\hat{\mathbf{r}}$$

which is the inverse square law. Newton applied such an acceleration to matter, not space, and which Newton invented directly by examining Kepler's planetary motion laws, but which makes no mention of what is causing the acceleration of matter, although in a letter in 1675 to Oldenburg, Secretary of the Royal Society, and later to Robert Boyle, he speculated that an undetectable ether flow through space may be responsible for gravity. Here, however, the inverse square law emerges from the Euler constituent acceleration, which imposes a space self-interaction. At the surface of the earth the in-flow speed is 11km/s, and the sun in-flow speed at 1AU is 42km/s, with both detected (Cahill, 2009b). If the sphere of matter is in motion, asymptotically wrt space, then the flow equation becomes non-trivial to solve, and no analytic solutions are known. Numerical solutions reveal non-trivial wave effects. Note that one cannot go from a flow of space associated with, say matter asymptotically stationary wrt to space, to the case where the matter is moving, asymptotically, wrt to space - these are very different dynamical situations. But in either case it is trivial to transform the velocity field, using Galilean Relativity, between different observers who are in relative motion.

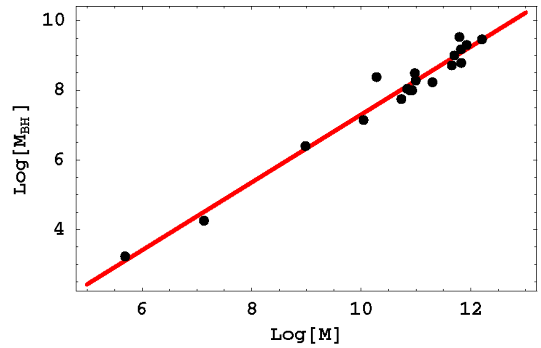

Fig. 3: The data shows black hole masses M_{BH} for a variety of spherical matter systems, from Milky Way globular clusters to spherical galaxies, with masses M, plotted against $\text{Log}_{10}[M]$, in solar masses M_0. The straight line is $M_{BH} = \frac{\alpha}{2}M$.

While the above 3-space dynamical equation followed from covariance and dimensional analysis, this derivation is not complete yet. One can add additional terms with the same order in speed and spatial derivatives, and which cannot be *a priori* neglected. There are two such terms, as in

$$\nabla \cdot \left(\frac{\partial \mathbf{v}}{\partial t} + (\mathbf{v} \cdot \nabla)\mathbf{v} \right) + \frac{\alpha}{8}\left((trD)^2 - tr(D^2)\right) + ... = -4\pi G \rho$$

where $D_{ij} = \partial v_i / \partial x_j$. However to preserve the inverse square law external to a sphere of matter, when the matter is stationary, asymptotically, wrt space, the two terms must have coefficients α and $-\alpha$, as shown. Here α is a dimensionless space self-interaction coupling constant. The ellipsis denotes higher order derivative terms with dimensioned coupling constants, which come into play when the flow speed changes rapidly wrt separation. However the observed dynamics of stars and gas clouds near the centre of the Milky Way galaxy has revealed the need for such a term, and we find that the space dynamics there requires an extra term

$$\nabla \cdot \left(\frac{\partial \mathbf{v}}{\partial t} + (\mathbf{v} \cdot \nabla)\mathbf{v} \right) + \frac{\alpha}{8}\left((trD)^2 - tr(D^2)\right) + + \frac{\delta^2}{8}\nabla^2\left((trD)^2 - tr(D^2)\right) + ... = -4\pi G \rho$$

where δ has the dimensions of length, and appears to be a very small Planck-like length (Cahill and Kerrigan, 2011c). This then gives us the dynamical theory of 3-space. It can be thought of as arising via a derivative expansion from a deeper theory, such as a quantum foam theory (Cahill, 2005). Note that the equation does not involve c, is non-linear and time-dependent, and involves non-local direct interactions. Its success implies that the universe is more connected than previously thought. Even in the absence of matter there can be time-dependent flows of space. To test this theory we need to determine how quantum matter and EM radiation respond to this dynamical space. We note immediately that this dynamics is very rich in that various new phenomena emerge, and which have been observed, and which do not occur in Newtonian gravity, which is a linear theory, nor in its relativistic generalisation, General Relativity (GR), with both being one-parameter theories, G: essentially GR is flawed by the assumption that GR must reduce to Newtonian gravity in the non-relativistic low-mass limit.

3 Quantum Matter and Emergent Gravity

We now derive, uniquely, how quantum matter responds to the dynamical 3-space. This gives the 1st derivation of the phenomenon of gravity, and reveals this to be a quantum matter wave refraction effect. For a free-fall quantum system with mass m the Schrödinger equation is uniquely generalised (Cahill, 2006), with the new terms required to maintain that the motion is intrinsically wrt the 3-space, and not wrt the embedding space, and that the time evolution is unitary

$$i\hbar\frac{\partial\psi(\mathbf{r},t)}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2\psi(\mathbf{r},t)$$
$$-i\hbar\left(\mathbf{v}.\nabla+\frac{1}{2}\nabla.\mathbf{v}\right)\psi(\mathbf{r},t).$$

The space and time coordinates $\{t,x,y,z\}$ ensure that the separation of a deeper and unified process into different classes of phenomena - here a dynamical 3-space (quantum foam) and a quantum matter system, is properly tracked and connected. As well the same coordinates may be used by an observer to also track the different phenomena. A quantum wave packet propagation analysis gives the matter acceleration $\mathbf{g}=d^2<\mathbf{r}>/dt^2$ induced by wave refraction to be

$$\mathbf{g}=\frac{\partial\mathbf{v}}{\partial t}+(\mathbf{v}.\nabla)\mathbf{v}+(\nabla\times\mathbf{v})\times\mathbf{v}_R+...$$
$$\mathbf{v}_R(\mathbf{r}_0(t),t)=\mathbf{v}_0(t)-\mathbf{v}(\mathbf{r}_0(t),t),$$

where $\mathbf{v}_R$ is the velocity of the wave packet relative to the 3-space, and where $\mathbf{v}_O$ and $\mathbf{r}_O$ are the velocity and position relative to the observer. The last term generates the Lense-Thirring effect as a vorticity driven effect. In the limit of zero vorticity we obtain that the quantum matter acceleration is the same as the 3-space acceleration: $\mathbf{g}=\mathbf{a}$. This confirms that the new physics is in agreement with Galileo's observations that all matter falls with the same acceleration. Using arcane language this amounts to a derivation of the Weak Equivalence Principle.

Significantly the quantum matter 3-space-induced 'gravitational' acceleration also follows from maximising the elapsed proper time wrt the quantum matter wave-packet trajectory $\mathbf{r}_o(t)$, (Cahill, 2005),

$$\tau=\int dt\sqrt{1-\frac{\mathbf{v}_R^2(\mathbf{r}_0(t),t)}{c^2}}$$

which entails that matter has a maximum speed of c wrt to space, and not wrt an observer. This maximisation ensures that quantum waves propagating along neighbouring paths are in phase - the condition for a classical trajectory. This gives

$$\mathbf{g}=\frac{\partial\mathbf{v}}{\partial t}+(\mathbf{v}\cdot\nabla)\mathbf{v}+(\nabla\times\mathbf{v})\times\mathbf{v}_R$$
$$-\frac{\mathbf{v}_R}{1-\dfrac{\mathbf{v}_R^2}{c^2}}\frac{1}{2}\frac{d}{dt}\left(\frac{\mathbf{v}_R^2}{c^2}\right)+...$$

and then taking the limit $v_R/c\to 0$ we recover the non-relativistic limit, above. This shows that (i) the matter 'gravitational' geodesic is a quantum wave refraction effect, with the trajectory determined by a Fermat maximum proper-time principle, and (ii) that quantum systems undergo a local time dilation effect. The last, relativistic, term generates the planetary precession effect. If clocks are forced to travel different trajectories then the above predicts different evolved times when they again meet - this is the Twin Effect, which now has a simple and explicit physical explanation - it is an absolute motion effect, meaning motion wrt space itself. This elapsed proper time expression invokes Lorentzian relativity, that the maximum speed is c wrt to space, and not wrt the observer, as in Einstein SR. The differential proper time has the form

$$c^2 d\tau^2 = c^2 dt^2 - (d\mathbf{r} - \mathbf{v}(\mathbf{r}, t)dt)^2 = g_{\mu\nu} dx^\mu dx^\nu$$

which defines an induced metric for a curved spacetime manifold. However this has no ontological significance, and the metric is not determined by GR.

4 Electromagnetic Radiation and Dynamical Space

We must generalise the Maxwell equations so that the electric and magnetic fields are excitations within the dynamical 3-space, and not of the embedding space. The minimal form in the absence of charges and currents is

$$\begin{aligned} \nabla \times \mathbf{E} &= -\mu_0 \left(\frac{\partial \mathbf{H}}{\partial t} + \mathbf{v}.\nabla \mathbf{H} \right), \quad \nabla . \mathbf{E} = \mathbf{0}, \\ \nabla \times \mathbf{H} &= \epsilon_0 \left(\frac{\partial \mathbf{E}}{\partial t} + \mathbf{v}.\nabla \mathbf{E} \right), \quad \nabla . \mathbf{H} = \mathbf{0} \end{aligned}$$

which was first suggested by Hertz in 1890, but with $\mathbf{v}$ then being only a constant vector field, and not interpreted as a moving space effect. As easily determined the speed of EM radiation is now $c = 1/\sqrt{\mu_0 \epsilon_0}$ with respect to the 3-space, and not wrt an observer in motion through the 3-space. The Michelson-Morley 1887 experiment 1st detected this anisotropy effect, as have numerous subsequent experiments. A time-dependent and/or inhomogeneous velocity field causes the refraction of EM radiation. This can be computed by using the Fermat least-time approximation - the opposite of that for quantum matter. This ensures that EM waves along neighbouring paths are in phase. Then an EM ray path $\mathbf{r}(t)$ is determined by minimising the elapsed travel time:

$$T = \int_{s_i}^{s_f} \frac{ds |\frac{d\mathbf{r}}{ds}|}{|c\hat{\mathbf{v}}_R(s) + \mathbf{v}(\mathbf{r}(s), \mathbf{t}(s)|},$$

with $\mathbf{v}_R = \frac{d\mathbf{r}}{dt} - \mathbf{v}(\mathbf{r}(\mathbf{t}), \mathbf{t})$, by varying both $\mathbf{r}(s)$ and $t(s)$, finally giving $\mathbf{r}(t)$. Here s is an arbitrary path parameter, and $\hat{cv}_R$ is the velocity of the EM radiation wrt the local 3-space, namely c. The denominator is the speed of the EM radiation wrt the observer's Euclidean spatial coordinates. This equation may also be used to calculate the gravitational lensing by black holes, filaments and by ordinary matter, using the appropriate 3-space velocity field. It produces the measured light bending by the sun. In particular galactic lensing agrees with observational data, and does not require "dark matter".

5 Dispensing with Dark Matter

Combining the 3-space zero-vorticity dynamics with the quantum matter acceleration, we obtain

$$\nabla \cdot \mathbf{g} = -4\pi G\rho - 4\pi G\rho_{DM}, \quad \nabla \times \mathbf{g} = \mathbf{0}$$

where we define

$$\rho_{DM} = \frac{\alpha + \delta \nabla^2}{32\pi G} \left((trD)^2 - tr(D^2) \right).$$

This is Newtonian gravity but with the extra dynamical term. The role of this expression is to reveal that if we analyse gravitational phenomena we will usually find that the matter density ρ is insufficient to account for the observed $\mathbf{g}$. Until recently this failure of Newtonian gravity has been explained away as being caused by some unknown and undetected but real "dark matter" density. This expression shows that to the contrary it is a dynamical property of 3-space itself. In deference to that language we call ρ_{DM} the 3-space induced effective dark matter density. From observed galactic EM lensing and galactic star trajectories ρ_{DM} may be determined and compared with the dynamical 3-space dynamics.

6 Earth Bore Holes Determine α

The value of the parameter α was first determined from earth bore hole g-anomaly data, which shows that gravity decreases more slowly down a bore hole than predicted by Newtonian gravity. Using the new theory of gravity we find the borehole gravity anomaly at radius $r = R + d$ to be, with $d < 0$, is (Cahill, 2006)

$$\Delta g = g_{NG}(d) - g(d) = 2\pi\alpha G\rho(R)d + O(\alpha^2)$$

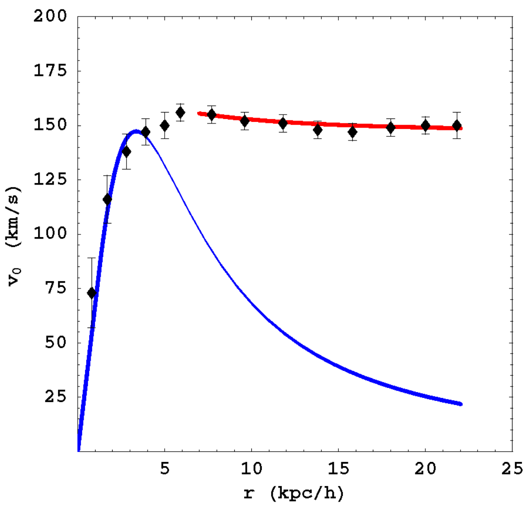

Fig. 4: Plots of the rotation speed data for the spiral galaxy NGC3198. Lower curve shows Newtonian gravity prediction, while upper curve shows asymptotic flat rotation speeds.

The experimental data then reveals α to be the fine structure constant, to within experimental errors.

7 G Measurement Anomalies

There has been a long history of anomalies in the laboratory measurements of Newton's gravitational constant G. The explanation is that the gravitational acceleration external to a piece of matter is only given by application of Newton's inverse square law for the case of an isolated spherically symmetric mass, and using an external small test mass. For other shapes, and with finite size test masses, the α-dependent interaction results in forces that differ from Newtonian gravity at $O(\alpha)$, as observed. This implies that laboratory measurements to determine G will also measure α.

8 Expanding Universe

The dynamical 3-space theory has a time dependent expanding universe solution of the Hubble form. In the absence of matter, $v(r,t) = H(t)r$ with $H(t) = 1/(1+\alpha/2)t$, giving a scale factor $a(t) = (t/t_0)^{4/(4+\alpha)}$,

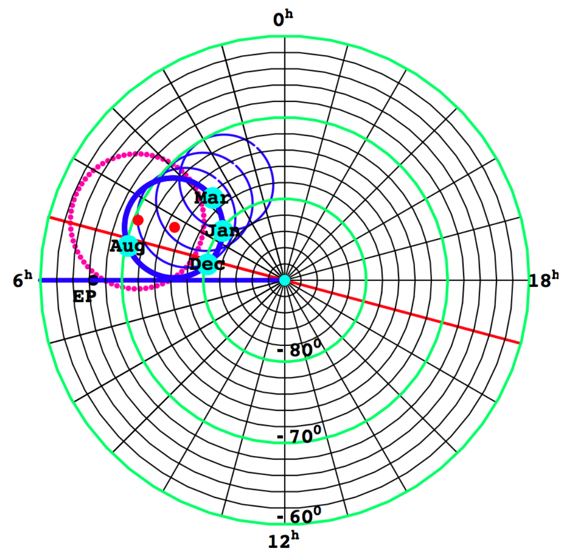

Fig. 5: South celestial sphere with RA and Dec shown. The red dotted circle shows the Miller aberration path discovered in 1925/26 (Cahill, 2005): The direction of maximum EM speed anisotropy changes during year because of (i) orbital speed of earth, and (ii) sun in-flow velocity. The red point at $\alpha = 4.52$hrs, $\delta = -70.5°$ shows the galactic flow direction determined by Miller, after removing earth-orbit aberration effect. The dark blue circle shows the aberration path from best-fitting the earth-flyby Doppler shift data and using the optical-fiber RA data point for November from Krisher (Cahill, 2009b). This corresponds to a best fit averaged earth inflow speed of 12.4 ± 5km/s.

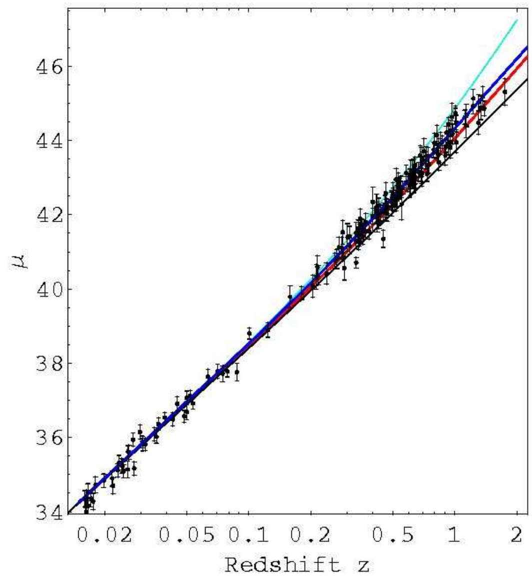

Fig. 6: Supernovae magnitude-redshift data. Upper curve (light blue) is "dark energy" only $\Omega_\Lambda = 1$. Next curve (blue) is best fit of "dark energy"-"dark-matter" $\Omega_\Lambda = 0.73$. Lowest curve (black) is "dark matter" only $\Omega_\Lambda = 0$. 2nd lowest curve (red) is generic uniformly expanding universe.

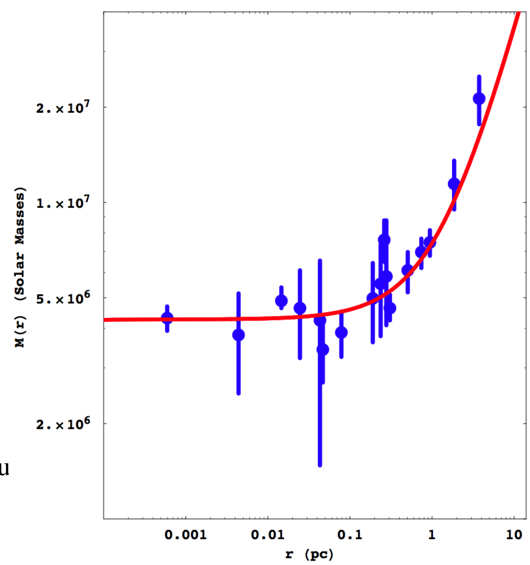

Fig. 7: The $M(r)$ data for the Milky Way SgrA* black hole, showing the flat regime, that mimics a point-like mass, and the rising form beyond $r_s = 1.33$pc. Here M_0 and r_s parametrise a quantum foam soliton, and involves no actual matter. The data gives $M_0 = 4.5 \pm 0.4 \times 10^6$ solar masses.

predicting essentially a uniform expansion rate. This gives a parameter free account of the supernovae magnitu redshift data (Cahill, 2009a, Cahill and Rothall, 2012). That data reveals a uniformly expanding universe. However the Friedmann equations from GR do not have such a uniformly expanding solution, and *ad hoc* "dark matter" and "dark energy" terms are added to "save the theory", giving the current standard cosmological model. Best fitting the Ω_Λ and Ω_{DM} ΛCDM composition parameters to the above solution gives $\Omega_\Lambda = 0.73$ and $\Omega_{DM} = 0.27$, the same values as determined by fitting the ΛCDM to the supernova data. This demonstrates that "dark matter" and "dark energy" are epicycles of GR. Extending that model into the future leads to the spurious claim that the universe will undergo an exponential rate of expansion.

9 Black Holes

In the absence of matter the dynamical 3-space equation has black hole solutions of the asymptotic form $v(r)^2 \approx A\frac{\delta}{r} + B\left(\frac{\delta}{r}\right)^{\alpha/2}$, when $r \gg \delta$, giving $g(r) =$

$GM(r)/r^2$ where

$$M(r) = M_0 + M_0 \left(\frac{r}{r_s}\right)^{1-\alpha/2}$$

This is precisely the form observed for the black ho at the centre of the Milky Way, Fig.7 (Cahill and K rigan, 2011).. For $r > r_s$ these black holes produc $1/r$ gravitational acceleration, and not a $1/r^2$ form assumed in the usual Newtonian-gravity based anal sis. This then produces flat rotation curves, as show in Fig.4. NG and GR required the invention of da matter to "explain" this effect.

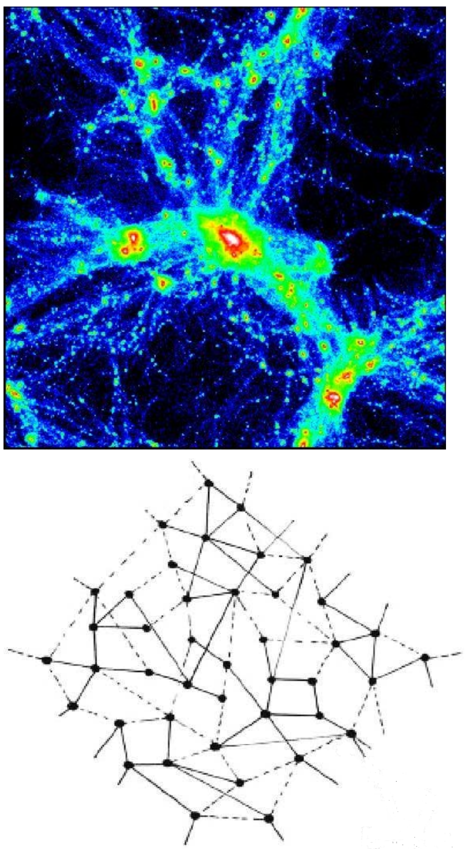

Fig. 8: Top: Cosmic filaments as revealed by gravitational lensing statistical tomography. From J.A. Tyson and G. Bernstein, Bell Laboratories, Physical Sciences Research, http://www.bell-labs.com/org/physicalsciences/projects/darkmatter/darkmatter.html. Bottom: Cosmic network of primordial filaments and primordial black holes.

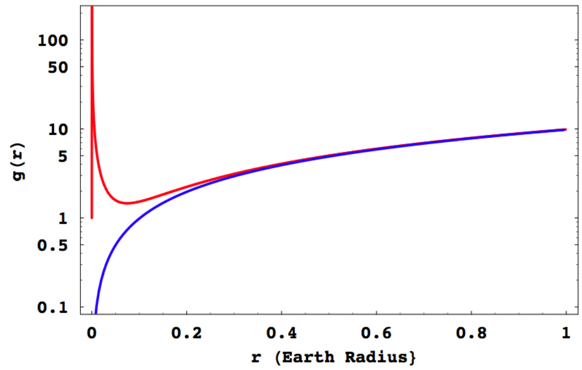

Fig. 9: Gravitational acceleration $g(r)$ for the earth from solving dynamical space in-flow speed $v(r)$, and then computing $g(r)$: red plot. The blue plot shows $g(r)$ from Newtonian gravity. The sharp rise in red plot at centre is the black hole effect induced by the matter in the earth. The small difference in these two plots just within the earth's surface is observed as the bore hole g anomaly, see Fig.2. The in-flow speed of space outside the earth, $v \sim 11$km/s, was first detected using NASA spacecraft earth-flyby Doppler shift data, see Fig.5.

10 Cosmic Filaments

The 3-space dynamics also has cosmic filament solutions, asymptotically, $v(r) = -\mu/r^{\alpha/8}$, where r is here the perpendicular distance from the filament, for arbitrary μ. The gravitational acceleration is long-range and attractive to matter, i.e. $\mathbf{g}$ is directed inwards towards the filament, $g(r) = -\alpha\mu^2/8r^{1+\alpha/4}$. This is for a single infinite-length filament. It is conjectured that more complex solutions involving a network of filaments and black holes exist, and which explain the observed cosmic web.

11 Earth Black Hole

The recent discovery that space exists and has a now-known dynamics changes all of physics: from Galileo and Newton to the modern era the existence of space was missed, and even denied. Amazingly the experimental evidence for space first appeared in 1887 when, despite the oft-repeated claims, Michelson and Morley discovered the anisotropy of the speed of light. The dynamical theory for space has been heuristically determined, and it is suggested that it will be derivable via a derivative expansion of a deeper quantum-theoretic theory within the new physics - Process Physics As briefly shown herein there are many experimental and observational tests of the dynamical theory of space, from laboratory G measurements, to geophysical, galactic rotations, galactic black holes, and ultimately the measured uniform expansion rate of the universe. In particular when applied to the earth we discover that the dynamics predicts a central black hole, as shown in Fig.9, where $g(r)$ becomes very large. The causative in-flow of space then becomes very large and also very turbulent. The space in-flow above the earth's surface has been from NASA spacecraft earth-flyby Doppler shift data, see Fig.5, and the presence of the black hole manifests as the bore hole g anomaly, see Fig.2. So we expect new effects to be present within the earth due to turbulent space dynamics. One such effect could be the generation of new matter. Within Process Physics quantum matter is a form of space, but possessing topological properties that preserve such mater, while space itself is a complex fractal quantum foam system, that is not conserved, and indeed is dissipated by matter. So it is not unreasonable to speculate that a turbulent in-flow of space could generate matter, and that the same process occurred in the very early moments of the big bang formation of the universe. The generation of new matter in the earth would result in its ongoing and accelerating expansion, along the line suggested by Hilgenberg in the 1930's (Scalera and Braun, 2003). That matter is forming at the centre of the earth has received yet another confirmation, namely that the geoneutrino flux from the decay of uranium-238 and thorium-232 can explain only about 50% of the heat production of the earth of some 44.2±1.0 TW (KamLAND Collaboration, 2011). So another heat production process is ocuring, and this could be a side-effect of matter production.

12 Conclusions

Physics failed to discover the existence of a dynamical 3-space until very recently. This discovery changes all of physics. The dynamics has been revealed, and extensive direct and indirect evidence, from laboratory G measuring experiments, to the expansion of the universe, is now explained. Only some of that evidence has been cited herein. The nature of the theory suggests that space is a quantum phenomenon, and the occurrence of the fine structure constant in both quantum matter and space phenomena suggest that a new grand unification of, until now, disparate phenomena is emerging. As well the experimental data shows that it is Lorentzian relativity that explains relativistic effects, as absolute motion effects, and that Newtonian gravity and its successor, General Relativity, fail as theories of gravity and, for GR, a theory of the universe. The observations that implied an expanding earth may now be explained as a consequence of this dynamical space, and so the expanding earth, and a necessary expansion of other planetary and stellar objects, was an indication of fundamental new physics that had been missed by mainstream physics, mislead as it was by the spurious notion of spacetime and the denial of space itself as a real and observable dynamical system.

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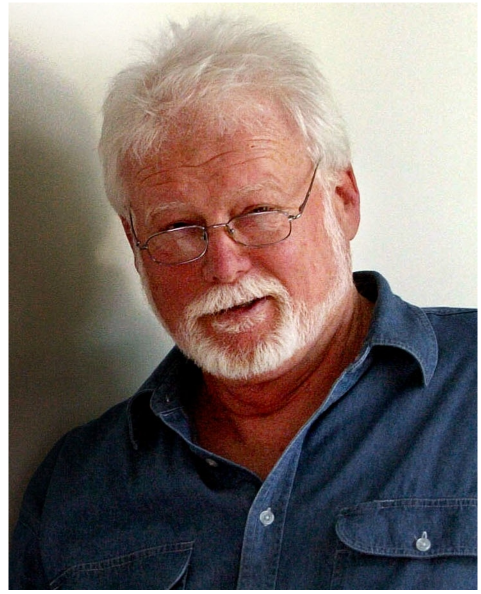

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