# The Implications of Flowing Space

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**Abstract:** The implications, predictions, and explanatory power of the flowing space theory of gravity are explored. Matter's sink- or source-flow interaction with space explains its gravity and its inertia, and thereby the equivalence of inertial and gravitational mass. Matter's inertia is an effect of its gravity, and its gravity is a residual effect of the nuclear strong interaction. Matter must entrain its surrounding sink flow-field into its own free-fall motion—explaining Mach's Principle explains the galaxial rotation anomaly without the need for "dark matter". Several phenomena suggest that nuclear reactions create or release space, so that stars with a sufficient reacting mass are spatial sources, not sinks. If all galaxies are spatial sources, space must accumulate in the voids between galaxy clusters, pushing them apart and explaining the galaxial recession anomaly ("dark energy"). The creation of space in nuclear reactions and consumption of space by all inert matter would produce a cyclical Cosmos; alternating eternally between spatial expansions and contractions: Big Bangs and Big Crunches.

**Résumé:** Les implications, prédictions et la puissance explicative de la théorie de l'espace coulant sont explorées. L'interaction de l'écoulement de source ou d'évier de la matière avec l'espace explique sa gravité et sa inertie, et donc l'équivalence de la masse inertielle et gravitique. L'inertie de matière est un effet de sa gravité, et la gravité est un effet résiduel de l'interaction nucléaire forte. La matière faut entraîne son champ écoulement en movement chute

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libre avec elle—expliquant le principe de Mach and l'anomalie de la rotation galactique sans "dark matter". Plusiers phénomènes suggere que des réactions nucléaires créer ou liberer espace, donc les étoile avec masse de réaction suffisant sont des sources, pas des éviers. Des sources crée gravitation normale aussi, mais si toutes les galaxies sont sources spatialles, donc sur la plus grande échelle des amas de galaxies faut être poussé à part, expliquant l'anomalie de la récession des galaxies. La création de l'espace dans les réactions nucléaires et la consommation de l'espace par toute matière inerte produirait un Cosmos cyclique; alternant éternellement entre expansions et contractions spatiales: Big Bangs et Big Crunches.

Key words: black holes, Cosmic cycle, dark matter, dark energy, equivalence of inertial and gravitational mass, electrons, gravity, gravitational constant, hadrons, inertia, nuclear strong interaction, neutrinos, space

## I. INTRODUCTION

I have previously shown that the foundational models of modern physics, Relativity and Quantum Mechanics, were formulated for the limited purpose of describing and predicting the experiences and measurements of the observer, not to model or explain the physical Cosmos.[1] Like the Ptolemaic Cosmology, they are observer-based measurement models: *ad hoc* systems of assumptions and equations that work to get the observer's predictions right. They do not include any hypotheses about what actually exists and causes the observed phenomena.

Failing to grasp the philosophical limitations of Relativity and Quantum Mechanics, scientists continue to misinterpret them as physical theories and continue to use them to try to explain Cosmic phenomena. The result is contradiction (paradox) and confusion: absolute $c$ for

every observer, twin paradox, "curved space-time", double slit paradox, wave-particle duality, multiple universes, 11-dimensions, observer-created reality, holographic reality, mathematical reality, etc. Recent astronomical observations have revealed large-scale Cosmic motions that were not predicted by, nor are consistent with Newtonian Mechanics, General Relativity or Quantum Mechanics: the galaxial rotation and recession anomalies. In an attempt to save their models, theorists have resorted to yet more *ad hoc* fixes—dark matter and dark energy—for which no other evidence exists.

I have shown that to explain the nature and causes of fundamental physical phenomena requires the hypothesis that space is a substance, and as such is the seat of gravity, inertia, electromagnetism and particle formation.[2] Space is, as Newton postulated, a substance that resists the acceleration of matter but not its uniform velocity. Space is, as Lorentz postulated, the substance in which light is a wave that propagates at $c$, and in which moving atomic clocks are slowed and objects shortened. Space itself prevents particles from moving at $c$ in our accelerators. Gravity is simply explained as the flow of this same inertial and electromagnetic space into all inert matter. Space accelerates at $GM/r^2$ as it flows radially into all matter. This centripetal acceleration of its flow explains gravity's ballistic effects. Space's inflow velocity at any given height is $\sqrt{2GM/r}$, producing gravity's electromagnetic (relativistic) effects including the gravitational redshift and the confinement of light by black masses ("black holes"). This sink/source flow of gravitoinertial-electromagnetic space is the physical reality underlying the successes of Newtonian Mechanics and General Relativity.[3] Nothing is merely relative. All fundamental physical phenomena are the product of spatial mechanisms. Quantum Electrodynamics must be reinterpreted as a wave model of light and electrons and their

interactions.[4] In what follows, I will attempt to begin to draw out the implications of this new space physics.

## II. QUANTIZED GRAVITOINERTIAL-ELECTROMAGNETIC SPACE

Space cannot be an amorphous continuum. It must be quantized in order to explain the uniformity we observe and the usefulness of our mathematics. Every proton, for instance, has the same size because its spatial processes always involve the same number, the same volume of spatial cells. Space must indeed be composed of very small "cells", perhaps at the Planck scale ($10^{-33}$ cm). These cells are without mass, as mass is the result of a specific spatial process. In gravitoinertial processes, the cells move fluid-dynamically relative to one another without friction, flowing into and around moving matter so that matter can move at high uniform velocities through space perpetually, without slowing. This same cellular fluidic space is also the seat of electromagnetism. EM fields are some other kind of alteration in/of the spatial cells. As electromagnetism involves a different cellular mechanism, there is no contradiction between the cells' ability to flow move relative to one another without friction, and at the same time conduct EM motions at *c* like an extremely rigid elastic solid. Generally, EM motion is transmitted from cell-to-cell at much greater velocity than the gravitoinertial flows, so the effects of gravitational flows on light and electrons were not evident until we had sufficiently sensitive instruments. Space is a unique substance about which we are ignorant. We must simply ascribe to it whatever qualities are needed to explain the phenomena, as long as our explanations involve neither contradiction or impossibility.

## III. A NEW INTERPRETATION OF *G* AND OF *M-L-T* DIMENSIONS

This flowing space theory of gravity leads to a new interpretation of our dimensions and of the gravitational constant, *G*. It also leads to a qualitative and quantitative model of inertial

mass. Having characterized gravity as due to the acceleration and flow of a massless, frictionless, quantized fluidic space, we can reduce our mass $(M)$ unit, the kilogram, to kinematics, to a function of length $(L)$ and time $(T)$. In this theory, length and time are no longer mere measurements but have a physical meaning. Length represents the number of spatial cells between two points. Time represents the pace of spatial-causal evolution, of the interactions among the cells and among complex entities composed of spatial cells and their motions.

Maxwell suggested[5] that if mass were defined in terms of the acceleration its gravity produced, its units would be $L^3 T^{-2}$. This is apparent from the Newtonian formula: $GM = ar^2$, which requires $GM$ to have units $L^3 T^{-2}$. In order to emphasize the spherical geometry of spatial flow, I reinsert the canceled $4\pi$ terms:

$$4\pi GM = a4\pi r^2. \tag{1}$$

Notice that this is similar to the sink strength $(4\pi S)$ in hydrodynamics:

$$4\pi S = v4\pi r^2. \tag{2}$$

However, $4\pi S$ has units $L^3 T^{-1}$, representing the uniform volume flow rate of an ideal fluid through any concentric spherical surface outside the sink. $4\pi GM$ instead represents the centripetal spatial acceleration $(LT^{-2})$ through any concentric spherical area $(4\pi r^2)$ outside mass $M$ $(L^3 T^{-2})$. In gravitational sink or source flow, acceleration replaces velocity as the quantity that is proportional to the spherical area.

Thus what we call "mass" is not a self-existing, irreducible reality, but is a radially-symmetrical accelerating flow-field of massless space. Our gravitational constant, $4\pi G$, with units m$^3$/kgs$^2$, is just a conversion factor between $M$ in kilograms and the more fundamental $LT$ space-motion units. The product of $G$ (m$^3$/kgs$^2$) and $M$ (kg) yields $LT$ units (m$^3$/s$^2$);

expressing the acceleration and velocity of gravitating space. The stronger the sink/source flow field, the greater its dynamic interaction with the surrounding space, the greater its gravity and its inertia. For instance, the gravitational sink strength, $4\pi GM$, of a 1kg mass is $8.4\times10^{-10}\,\mathrm{m}^3/\mathrm{s}^2$ while that of Earth is $5.0\times10^{15}\,\mathrm{m}^3/\mathrm{s}^2$. Since $M$ has units $L^3T^{-2}$, momentum ($Mv$) has units $L^4T^{-3}$, force ($Ma$) is $L^4T^{-4}$, and energy ($Mv^2$) is $L^5T^{-4}$.

To treat the electromagnetic ("relativistic") effects of gravity, we consider that $4\pi GM$ also describes the radially-oriented velocity field of the electromagnetic (EM) spatial medium. This flow field affects all EM phenomena including atomic spectra (atomic clocks) and the motion of waves in the medium. $4\pi GM$ in this case represents the product of the square of space's velocity ($L^2T^{-2}$) and the circumference ($2\pi r$) at any $r$:

$$4\pi GM = v^2 2\pi r . \tag{3}$$

This is again just a reformulation of Newton's escape velocity formula as discussed in ref. 2.

To include electromagnetic (EM) phenomena in this unified $LT$ system, we can again follow Maxwell, substituting $L^3T^{-2}$ for $M$ in his $M$-$L$-$T$ electromagnetic units.[6] Electrostatic charge has units $L^3T^{-2}$ (identical to mass); the electrostatic field is an acceleration, $LT^{-2}$. EM charge has units $L^2T$; EM voltage is $L^2T^{-2}$, etc. The EM permittivity of space, $\mu$, has units $L^{-2}T^2$, and the EM permeability of space, $\varepsilon$, has no units ($L^0T^0$).

## IV. THE EQUIVALENCE OF INERTIAL AND GRAVITATIONAL MASS

We have long known that gravitational and inertial mass are equivalent;[7,8] but have had no explanation for either phenomenon or for their equivalence. In the current models, this equivalence appears to be a coincidence. The flowing space theory provides the simplest possible explanation of the equivalence: Inertial and gravitational mass are different aspects of the same

spatial inflow/outflow process. They have the same cause. The dynamic, accelerative field of spatial sink or source flow that matter creates in its surrounding space not only causes other masses to accelerate towards it (gravity), but also tethers the body in space accelerationally, so that any forced translational acceleration of the body relative to its larger surrounding space is resisted (inertia). Matter's accelerative action upon space (gravity) causes the surrounding space to react to matter's acceleration (inertia).

How can we explain matter's inertia in this sink/source flow theory? Consider the basic mystery of Newton's laws of motion: Why does space resist the acceleration of matter but not its uniform velocity? This theory suggests that the answer lies in the accelerational nature of matter's gravitational flow field. When a spatial sink or source $(L^3T^{-2})$, is forced to accelerate $(LT^{-2})$ relative to the surrounding space, opposing accelerations occur within the medium $(L^3T^{-2} \times LT^{-2} = L^4T^{-4})$. Even though space is massless and frictionless, it is still a fluid and opposing accelerations must produce tension or pressure in the medium—if the spatial cells cannot be separated from one another and cannot move instantaneously into or out of the region to relieve the tension or pressure. For instance, when a force is applied to a mass-sink, it is accelerated away from the very space that it is accelerating (pulling) towards itself (force = $Ma$ = $L^4T^{-4}$). Opposing accelerations exist on the anti-directional side of the mass and these create tension in space. This tension causes drag as long as the mass is being actively accelerated. Likewise, when a spatial source is forcibly accelerated, tension is created in space on the anti-directional side of the mass as the decelerating outflow is accelerated away from the surrounding space. Likewise on the forward side, the acceleration of space produced by the mass interacts with the different acceleration of the mass relative to the surrounding space. Once the force is no longer applied to a sink or source, there are no longer any opposing accelerations in the medium,

and therefore no tension in the medium. The sink/source flow-field is able to move at a uniform velocity through the massless, frictionless medium with no resistance $(Mv = L^4T^{-3})$. The surrounding spatial cells flow without hindrance into and around the moving flow-field.

One can demonstrate this effect with a simple fluid-dynamic analogy. Perforate the surface of a hollow metal sphere uniformly and place the sphere underwater. Note the resistance to its acceleration and uniform velocity within the water. Then attach one end of a hose to the sphere and the other end to a powerful suction pump. With the pump turned on, the sphere becomes a dynamic sink. With the water being pulled into the sphere from all directions, the sphere is "energized"; it now takes more force to accelerate the sphere in any direction. The sphere appears to have more "mass". However, it will take little-to-no additional force to keep the energized sphere moving at a given uniform velocity in the water compared to the non-energized sphere. One would obtain the same result by pumping water into the sphere, making it a source. The analogy breaks down because water has mass and friction, whereas space has neither, however it does illustrate the selective increase in resistance to the acceleration of a dynamic sink or source within a fluid.

## V. GRAVITATION IMPLIES SPATIAL ENTRAINMENT

How does matter affect the surrounding space as it moves through it? If space is a massless, frictionless fluid, then a powerful sink like Earth must pull a large region of its surrounding space into motion with itself. It must create a proportionally large field of co-moving, uniform, radial sink flow, to a distance of many Earth radii. Earth's entrained sink-flow field probably extends more or less intact far beyond the Moon. The Sun's flow field probably extends far beyond Pluto. The size of the fully-entrained spatial field will differ under various circumstances. The greater the mass and the lower the velocity of a body relative to the

surrounding space, the more extensive will be the entrained uniform radial flow field. The physical extent of entrainment will be reduced by interactions with the flow fields of nearby celestial bodies.

If Earth did not create a large uniform radial flow field in its surrounding space, then space would be flowing right through it. Earth's orbital motion would cause a $\pm 30$ km/s spatial wind on its surface. This is the "ether wind" used by the churchmen to argue against Copernicus' theory, and sought by Michelson and Morley. This spatial sink model of gravity provides a causal mechanism for the spatial entrainment first propounded by George Stokes[9,10,11] to explain the null Michelson-Morley experiment. There is a wind at the Earth's surface, but it is the vertical/radial gravitational wind flowing into Earth's surface at 11.2 km/s, aberrated slightly due to Earth's rotation within its sink flow field ($\approx 464$ m/s at Earth's equator).

Indeed, the data from all sources, including our extensive experience with satellites in the global positioning system (GPS), indicate that Earth completely determines the motion of its surrounding inflowing space for a very great distance, far beyond the Moon ($3.84 \times 10^5$ km) and probably out to the Earth's Hill Sphere ($1.5 \times 10^6$ km). The Hill Sphere radius ($R_{HS} \approx r_{orb} \sqrt[3]{M_E / 3M_S}$) is the greatest distance at which an object will orbit the Earth—at which space is accelerating consistently Earthward and not Sunward. Earth pulls this spherical volume of its surrounding space into motion with it while it is in freefall within the much larger volume of space that is entrained by our Sun. Entrainment explains how Earth and every large body creates its own local inertial and luminal "frame".

While Earth sweeps its surrounding space into its free-fall inertial motion about the Sun, it clearly does not sweep its surrounding space into its own rotation to any significant degree, nor could it given the theory of space presented here. There is irrefutable evidence of several kinds

that Earth's inflowing space is not dragged into rotation with Earth: the Coriolis effect, the rotation of the Foucault pendulum, the Michelson-Gale experiment,[12,13] and the Cosmic-directional stability of gyroscopes. Our Earth is rotating within its own entrained radial sink-flow field. Therefore, for an Earth-surface observer, light propagates parallel to Earth's surface at $c - v_{rot}$ in the easterly direction, and at $c + v_{rot}$ in the westerly direction. Experiments have revealed that light signals do indeed travel at different velocities around Earth in opposite directions,[14] and atomic clocks slow at different rates traveling east vs. west along Earth's surface.[15] The facts are consistent with a rotational Eastern spatial wind of $465\,\text{m/s}$ at Earth's equator that diminishes to zero at the poles.

Entrainment and sink flow explain why the global positioning system (GPS) works, with its "relativistic" corrections, just as if Earth were stationary but rotating at the center of the Cosmos. A satellite in orbit about Earth is moving tangentially through the Earth-centered field of radial sink flow. The satellite's atomic clock is slowed by its velocity in this Earth-entrained space. Its velocity, $v$, is the vector sum of its two orthogonal components: its tangential velocity, $v_t$, relative to the center of Earth in the non-rotating Sun-star frame, and its vertical/radial velocity, $v_r = \sqrt{2GM/r}$, due to Earth's gravitational inflow ($v^2 = v_t^2 + v_r^2 \Rightarrow v = \sqrt{v_t^2 + v_r^2}$). For GPS satellites, $v_t \approx 3.9\,\text{km/s}$ and $v_r \approx 5.5\,\text{km/s}$. Since the slowing of the satellite's clock is proportional to $v^2$ ($\Delta f/f = 1 - \sqrt{1 - v^2/c^2}$), that slowing can also be described, using the Pythagorean Theorem, by the addition of the slowings caused by its tangential ($\Delta f/f = 1 - \sqrt{1 - v_t^2/c^2}$) and radial velocities ($\Delta f/f = 1 - \sqrt{1 - 2GM/rc^2}$) in space. These two components of the clock's slowing are now known as the Special Relativity and General Relativity corrections, but there is nothing relative about them. They are physical effects caused

by the velocity of the satellites' clocks' atoms through the  gravitating space of the Earth. The slowing of each clock in the GPS is indeed determined by its velocity in the Earth-centered sink-flow frame, not by velocity relative to the Earth-observer or other clocks. Compared to the clock in a GPS satellite, an Earth-surface clock runs slower; it has only a small tangential velocity due to Earth's rotation ($\approx 0.5\,\text{km/s}$), but a higher velocity in the gravitational sink flow ($11.2\,\text{km/s}$).

Notice that, due to Earth's entrainment of its surrounding space, a GPS satellite's clock is not affected by its $\pm 30\,\text{km/s}$ velocity relative to the Sun, nor by the variations in its height in the Sun's $\approx 40\,\text{km/s}$ spatial flow at the Earth's orbital distance. Because of entrainment there are no Special and General Relativity corrections due to the satellite's position and motion relative to the Sun or any other nearby celestial body. The GPS system works as if the Sun and other planets were not there (except for small tidal effects discussed below). This lack of Solar effect on the GPS been called the "noon-midnight problem",[16] and implies entrainment. The GPS and, indeed, all phenomena are inconsistent with Relativity—with the idea that all motion and effects of motion are merely relative to any observer or arbitrary frame. (**Appendix A**)

Entrainment provides the missing physical explanation for Mach's Principle—for the fact that the distribution of matter in the Cosmos determines both the Cosmic and local inertial and luminiferous "frame". Matter controls the position and motion of space in the Cosmos. It is because of entrainment that all motion is most simply treated in the frame of the nearby celestial mass or masses. It is because of entrainment that the twin who remains at rest relative to the nearby celestial body(ies) has a lesser spatial velocity and faster clock than the twin who is in motion relative to those masses. Entrainment is actually assumed in applications of Special and General Relativity but not explicitly acknowledged as such. (**Appendix A**)

Because of entrainment, Earth appears to our senses and instruments to be stationary but rotating, while it and its surrounding field of sink flow are moving uniformly at 30 km/s within the much larger flow-field of our Sun. Our Sun's entrained flow-field is itself moving within the space entrained by nearby and distant stars in the Milky Way. The Milky Way and its entrained space are moving within the space entrained by the surrounding galaxies. The Cosmic Web of galaxy clusters/superclusters determines the motion of space on the largest scale.

Some have argued that Earth cannot be entraining its surrounding space as this would eliminate stellar aberration for the Earth observer. Such arguments, like all attempts to dismiss the physicality of space, are based on some inadequate or misunderstood theory of space and motion. (**Appendix B**)

## VI. ENTRAINMENT AND THE GALAXIAL ROTATION ANOMALY

Entrainment offers a solution to the problem of the galaxial rotation anomaly; eliminating the need for the *ad hoc* "dark matter" hypothesis. The anomaly is the fact that the outer stars in a galaxy orbit the center at much higher velocities than predicted by Newtonian Mechanics or General Relativity. Rather than reject these models, theorists have posited the existence of additional, invisible matter in just the right distribution within and outside the galaxy to produce the correct rotational curve using Newtonian Mechanics. However, Newton's single, uniform "absolute" space is unaffected by the motion of matter. In this flowing space theory, each of the stars in a galaxy's disk entrains a very large volume of its surrounding space into its own revolutionary motion about the galaxial center. The rotational anomaly tells us that the stars are sufficiently massive and close to one another that they collectively entrain much of the space within the galaxial disc into their free-fall orbital motion about the galaxial center. Because of this stellar entrainment of space, galaxies are spatial vortices—intragalaxial space is accelerating

towards the center and whirling around the galaxial center. The acceleration and rotation of intragalaxial space causes all matter to accelerate centripetally with it. The outer stars in a spiral galaxy thus require a proportionately higher tangential velocity, as measured by an outside observer, to avoid falling towards the galaxial center. The degree of entrainment of galaxial space relative to the surrounding, non-rotating extragalaxial space is naturally less near the outer parts of the galaxy. The entrainment is not complete; galaxies are neither solid rotating disks of stars and space, nor Newtonian systems; but something in between. The entrainment of space by matter helps to explain galaxy formation and stability, again without the need for "dark matter".

Why don't we see this vortex-effect in our solar system? Why is our solar system Newtonian? There are only a few planets orbiting the Sun at varying radial angles, in a disk that is only one planet thick. The planets cannot entrain the space of the entire solar system into their revolutionary motion or centripetal acceleration. The Sun, with 99.86% of the mass of the solar system, and the surrounding stars therefore determine our solar system's inertial "frame". In contrast, the disk of the Milky Way galaxy is around 10,000 light-years in thickness. With an average star-to-star distance of 5 light-years, the disk is around 2000 stars thick. With this dense mass configuration, the orbiting stars' entrainment of space pulls intragalaxial space into rotation to various degrees at various radii, diminishing towards the outer parts of the galaxy.

In a globular cluster, the stellar orbits can have random orientations and directions. There may be no bulk entrainment of space in any particular plane; but all stars are still accelerating towards the center, so the inertial frame is accelerating centripetally also. Since the centripetal entrainment is less uniform and complete, and there is therefore less apparent "extra mass" in clusters compared to spiral galaxies. Similar considerations apply to galaxy clusters—the greater the number and mass of the galaxies orbiting the central galaxy, the more the centripetal

acceleration of their entrained space, the more the apparent "extra mass". This theory is consistent with the fact that spiral galaxies have the highest mass-to-light ratios: up to 10:1, and globular clusters have lower mass-to-light ratios of around 3:1.[17]

Entrainment can also explain the anomalous strong correlation between the mass of the "black hole" at the center of a galaxy and the velocity of the stars in the outer regions of the bulge, which are not affected by its gravity.[18,19] As the stars of the bulge orbit the center of the galaxy, even if in a spherical distribution, they entrain the space of the bulge into their own free-fall acceleration towards the black mass. As in a globular cluster, this causes the space within the bulge to accelerate centripetally with the stars to some degree. The outer stars of the bulge are affected by the centripetal accelerations space entrained by stars closer to the black mass, and those stars affected by stars even closer to it, etc. Therefore, by contiguous effect, the gravity of the black mass affects the centripetal acceleration of space in the outer regions of the bulge, producing a greater degree of centripetal spatial acceleration there and higher stellar velocities.

**Tests:** This entrainment theory can be compared qualitatively to observations of various star clusters, galaxies, and galaxy clusters to see if, indeed, more centripetal spatial acceleration is routinely associated with higher densities and greater organization of orbiting celestial bodies.

## VII. GRAVITATIONAL INTERACTIONS

A proton, nucleus or celestial body is not just the matter we see, but is also what it is doing to its surrounding space. Matter is a set of extended physical processes, of motions in and of space. A hadron is not a self-existing particle "associated" with a gravitational field; it is its gravitational field, it is a large as its gravitational field. It is a locus of perpetual motion in and of space. Likewise a celestial body is not just the matter we see but is as large as its influence in space. The gravitational flow field of a mass is always present everywhere and acts locally on

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test masses by contact. Thus gravity is not a speed-of-light interaction between the gravitator and the test mass. The perpetual existence of this entrained sink/source flow at every location outside a body explains why its gravity acts "instantaneously" over great distances and without aberration. Matter must always passively accelerate with the acceleration of larger body of surrounding space in which it moves. Small masses in orbit about a celestial body are in free fall—in uniform motion in a space that is itself accelerating radially toward the larger mass.

As a comparably–sized sinks or sources approach one another, their flow fields begin to interact. Each is altering in which the other exists; creating an accelerational gradient in each other's surrounding space. Therefore each must accelerate with the space that is flowing into or out of the other body. The bodies therefore accelerate towards each other, towards the "center of mass" between them. This fictitious gravitational "force" between two sinks is described by the Newtonian equation:

$$F = (4\pi GM_1 / 4\pi r^2) \times M_2. \tag{4}$$

This is just the gravitational sink-flow acceleration of one body at a given distance multiplied by the sink-flow "mass" $(L^3 T^{-2})$ of the other body. It describes the force that would be needed to prevent one of the masses from accelerating towards the other mass, assuming that the other mass is fixed in location.

Consider how this model of gravity explains tides by contiguous physical action, as opposed to an abstract overlapping vector model. Consider the Earth-Moon interaction as an interaction between two sinks. The Moon orbits Earth because its sink-flow field is in freefall in Earth's larger radially-accelerating flow field (as is any small mass in Earth orbit). The tangential velocity of the Moon provides the fictitious "centrifugal force" that prevents it from crashing into Earth. Because they are of comparable size, Earth is also in free-fall towards the Moon. Their

sink-flow fields also interact strongly in the region between them where each is pulling space away from the other. There are opposing accelerations and therefore tension in space in that region. This reduces the acceleration and velocity of the flows into their facing surfaces, creating less acceleration (high tide) and velocity (lower redshift) on their facing surfaces. Why is there also a high tide and lower redshift on their opposite surfaces? Since there is tension in the space between them, they accelerate towards each other more than their surrounding space, e.g. Earth is accelerated Moonward more than a small test mass at Earth's distance from the Moon. So their opposite surfaces are being accelerated centripetally away from the larger body of surrounding space. This reduces the acceleration and velocity of the flows into their opposite surfaces also, creating a high tide there. Since the total spatial consumption requirements of Earth and Moon are constant, and since less space is flowing into both their facing and opposite surfaces, more space is drawn into band-like area of their surfaces that is perpendicular to their axis, producing greater spatial accelerations and velocities there (low tides).

This physical theory of gravity implies other deviations from Newton's laws. For example, as comparably-sized sinks approach each other, their flows will begin to create tension in the intervening space as each is accelerating space away from that region. As long as the masses are small enough, and far enough apart, space can easily flow into the intervening region to alleviate the tension, and there will be only the expected Newtonian acceleration towards one another. However, when sufficiently large sink-masses are sufficiently close to one another, space cannot flow quickly enough into the region between them to completely alleviate tension. Increased tension in the intervening space would create additional, excess gravitational acceleration, greater than the Newtonian prediction. This is currently modeled as the "gravitational energy" of gravity itself, or as "strong" gravity. On the contrary, as two large sources were brought very

close together, space would be unable to flow out of the region between them quickly enough, producing a repulsive or anti-gravitational effect.

## VIII. GRAVITY IS HADRONIC

The flowing space theory of gravity works, but it gives rise to more questions: What causes space to flow into matter? Where does it go? To seek answers, we must first ask: What objects or processes are actually known to create gravity? We have actually encountered gravity and inertial motion only in multiatomic matter whose "mass" is almost entirely composed of hadrons. It is highly improbable that all forms of motion ("mass-energy") create gravity. There is no evidence whatsoever that light, EM fields, pressure, "potential energy", momentum, heat, or any other forms of motion (energy) create gravity. We also have no evidence that free or bound electrons create gravity. An electron's "mass" and motion appear to be purely electromagnetic, not gravitoinertial. (**Appendix C**) It is therefore reasonable to assume that gravity is a physical process uniquely associated with hadrons.

Thus it appears that spatial inflow is an aspect of the unique "strong interaction" that binds the proposed quarks together in hadrons, and residually, hadrons together in the nucleus. A quark may be a nidus of spatial consumption and electrical charge that is stable only when combined with other quarks. Hadrons appear to be complex structures composed of this quark-based sink-flow process, and of multiple electrons and positrons, and perhaps of spatial vortices and other physical processes about which we know nothing. Hadrons must be quite complex in order to account for the many different short-lived hadrons created in high-velocity proton collisions (the "particle zoo"). They must consist of unstable combinations of the various hadronic structural components.

This spatial consumption/flow theory offers some tantalizing explanations for the unusual characteristics of the strong force: its perpetual nature, its increase with distance between quarks, and its residual binding force between baryons in the nucleus that falls off faster than the square of the distance. In this theory, the strong force is maintained perpetually, not by "glue", but by the consumption of space itself. The residual nuclear binding force may be a kind of strong gravity, caused by the extremely close proximity of the hadron-sinks—so close that space cannot flow into the region between them quickly enough to relieve the tension in space. With increasing separation of the hadron sinks, this strong gravity would diminish very rapidly, as space could flow more freely into the region between them. Their mutual attraction would quickly diminish to the normal gravitational interaction. Thus the normal "weak" gravity that we experience may be just another residuum of the quark-hadronic-nuclear strong force. The aggregate gravity of a planet, moon, or asteroid is just the net effect of the many microscopic single and multi-hadronic spatial sinks (nuclei) whose sink-flows combine to form a single large, powerful spatial sink.

**Tests:** It should not be difficult with modern technology to determine whether, in fact, only hadrons produce gravity. Electrons and/or positrons could be concentrated within or on some object to see if its gravity increased. The gravity of ions could be compared to that of their atoms or molecules; it should be the same if only hadrons produce gravity. We could investigate whether any other form of "energy" creates gravity; e.g. objects in motion rather than at rest, heated vs. cold objects, concentrations of EM radiation, etc.

## IX. SPATIAL CONSUMPTION AND EXCESS PLANETARY HEAT

This physical model suggests explanations for other hitherto unexplained phenomena. Most planets in our solar system are known to have excessive heat production in their cores that cannot

be accounted for by the residual heat of their formation or by simple radioactive decay. If, as this theory suggests, hadronic/nuclear stability depends upon the consumption of space, and if space must flow into the body from outside, then deep within the cores of planets there must be a relative spatial deficit and high spatial tension. All inert matter external to the core is "sucking" space away from the core. This higher tension would also produce stronger gravity between the nuclei in the core. In sufficiently large, dense masses, spatial tension could weaken the residual strong force. This would destabilize nuclei, causing excess fission of larger nuclei and fusion of smaller nuclei. Fission and fusion would produce heat (particle motion, radiation) and an excess of the most stable nuclei. The nuclie with the highest binding energies per nucleon are iron and nickel. This mechanism would therefore explain both the excess heat production in Earth's core and the abundance of iron and nickel there. It would explain the proposed excess deuterium-deuterium fusion in Jupiter's core that produces the heat that drives Jupiter's weather.[20] Likewise, the initiation of stellar fusion may occur due to excess spatial tension in the center of the collapsing gas cloud. Central spatial-tension could also explain the initiation of Type 1a supernovae. The current theory is that the accumulation of additional mass on the surface of a carbon-oxygen white dwarf increases the pressure and temperature in the core. However in this theory, the accumulation of mass on the surface would also further increase the spatial tension in the core. When the tension reaches a critical level, a runaway nuclear fusion reaction could begin. The cores of extremely large, dense masses, like black masses, may have a degree of spatial tension/starvation that causes hadrons themselves to be destroyed, releasing extreme amounts of motion-energy-heat.

## X. HADRONIC MASS DESTRUCTION CREATES SPACE

If space is perpetually consumed by the hadronic matter, there must be some mechanism by which space is also being created in order that the Cosmos remains stable for long periods of time. Five phenomena suggest that space is created by destruction of nuclear mass (the mass defect) in fusion and fission reactions, and by the destruction of hadrons themselves:

1. The blast effect of nuclear explosions

2. "Neutrinos"

3. The observations of Supernova 1987A

4. The accelerating recession of distant galaxies from one another ("Dark Energy")

5. The Cosmic Inflation of the Big Bang

I will address the first three phenomena in this section.

**A. Nuclear blast effect**

Do our current theories of uranium fission or hydrogen fusion reactions explain the enormous blast effect produced by nuclear bombs? Should we not seek to explain the mechanism rather than invoke some amorphous "energy"? Chemical bombs cause a blast effect by the mass and velocity of their reaction products. How do fusion bombs create their much greater blast effect? Their mass is small; hydrogen fusion creates only light helium and tritium nuclei, EM radiation, and massless "neutrinos". Which of these flattens every building within hundreds of meters in air bursts and creates large seismic disturbances in underground tests? Can the blast effect really be explained with only the heating of the surrounding air or earth, their expansion and vaporization, and the resulting compression wave in the medium? I think not. I submit that the blast effect is actually due to the creation or release, at superluminal velocity, of a large volume of space—a mini "Big Bang"— a local "inflation" event. A superluminal spatial outflow either absolutely displaces, or strongly accelerates all hadronic matter in the region away from the blast. This

spatial shockwave almost instantaneously displaces a like volume of the surrounding medium (air, earth, water) creating a compression wave in that medium.

**Tests:**   A review of conventional and atomic bomb data may reveal whether the effects are consistent with this hypothesis. A study of the effects of nuclear explosions in outer space will shed light on the blast mechanism. This theory predicts that even in the vaccum of space there will be a blast effect greater than predicted by the mass and velocity of the fusion products or radiation pressure. This information may already exist in military "space wars" research.

## B. Fluid-dynamic waves in space: neutrinos and gravity waves

Once we admit that space is a substance then we must assume that any phenomenon that has a fixed velocity in space that is independent of its source's velocity, and that has little or no detectable "mass", is actually a wave in the medium of space. Light, for instance, is not a particle flying through a void, but is a transverse wave in this gravitoinertial-electromagnetic space.[21] I submit to you that what we call "neutrinos" and "gravitational waves" are longitudinal compression-rarefaction waves in fluidic space. Consider that both are massless and propagate at $c$. We have misrepresented light and neutrino waves as flying particles because we detect them by their interactions with particles. The quantization of these interactions belongs to the detecting particle-structures, not to the waves themselves.[22] Astronomically, we search for neutrinos by observing weak decays of unstable nuclei (e.g. $Cl^{37}$) in our detectors. Since in this theory the stability of nuclei depends upon the consumption of space, it is reasonable that a compression-rarefaction wave in fluidic space could provoke such a decay in an unstable nucleus. It is also possible also that some detected "neutrinos" are actually spatial vortices that are created/released in nuclear reactions. These would be distinguished by the fact that they do not move at $c$.

I suggest that we are labeling as a "neutrino" any spatial fluid-dynamic pressure disturbance which causes a weak nuclear interaction that we can detect. When a neutrino wave is produced, it begins to spread diffractively in the medium as do all free waves. The various neutrino types may just be waves of differing frequency, amplitude, or polarization. Also as with "photons", the "neutrinos" we detect are the result of the interference of the waves from the known source superpositioning with background waves from all other near and distant sources. Thus, as with light, we can only produce a probabilistic account of such interactions.[23]

So-called "gravity waves" could exist in this theory as long-wavelength hydrodynamic waves in fluidic space. These could propagate outward in the medium from the periodic motions of large bodies, such as in rapidly orbiting stellar or black-mass systems, or from collisions between large masses.

**Tests:** Studies could be performed to see if the velocity of neutrino-waves is independent of their source's velocity, and if they exhibit superpositioning and other wave-phenomena.

## C. Supernova 1987A

The observations of Supernova 1987A can be interpreted using this model, and can support its account of nuclear reactions. The "neutrinos" arrived in a ten-second burst two hours before the light from the event, and most of the energy of the explosion was in the (massless?) neutrino output. To explain this, theorists have ascribed *ad hoc* properties to neutrinos, extension and mass, for which there is no other evidence.[24] They propose that the neutrinos arrived over a ten-second period because they were "impeded" by the high density of the core; and that they "revived" a shock wave that moved slowly through the star from the core to the surface and eventually caused the light display.

If, however, the destruction of hadronic mass creates space, then we would expect such huge nuclear reaction to create a large sphere of space nearly instantaneously—a local "inflation" event that would produce a shockwave in space itself. The evidence from Supernova 1987A can be interpreted as implying that the sphere of new space created was 2 light-hours in radius, as evidenced by the fact that the light arrived 2 hours after the "neutrinos". The light had to propagate outward through 2 light-hours of newly-created space. This local inflation event produced a powerful compression wave in fluidic space that spread spherically in all directions. Matter was accelerated away from the explosion by the spatial pulse. Spatial pulses arrived at our detectors over a 10-second period, suggesting that the nuclear reaction took to 10 seconds to spread through the entire reacting mass, suggesting that mass was 10 light-seconds in radius.

**Tests:** This theory of spatial creation and neutrino-wave production by nuclear reactions can be tested by applying it to other observations of supernovae and related astrophysical phenomena.

## XI. STARS ARE SPATIAL SOURCES

If nuclear reactions do create space, vast amounts of space compared to slow consumption of space by inert matter, then it is possible that stars are net space producers; spatial sources. For this to occur, the amount of space produced by hadronic mass destruction in their cores would have to far exceed the amount of space consumed by their inert matter. Space would need to flow out of the star at the calculated escape velocity. The gravitational mass of a star would then be determined by its reacting mass, not the amount of inert matter. If the number of nuclear reactions were to slowly decline, the star would have less and less gravity until the amount of space created equaled the amount of space consumed by its inert matter; it would then have no gravity at all. As the number of reactions continued to decline further, the star would again have gravity, becoming a spatial sink of increasing strength. This idea that stars are spatial sources

may seem improbable, but it provides the most plausible theory for the "dark energy" that appears to dominate the Cosmos. (See below.)

It seems counterintuitive, but spatial sources would indeed produce normal gravity as would sinks. Space is massless and frictionless; it does not "push" matter, just as it does not impede matter's high-velocity uniform motion through it. Space moves matter only an accelerational mechanism at subluminal velocities, as discussed above. The acceleration and velocity of space at any distance $r$ from a spatial source would be described by the same equations as for a sink and would have the same gradients: $GM/r^2$ and $\sqrt{2GM/r}$. With a spatial source, the velocity of the outflow would decline with distance; it would decelerate. The deceleration of an outflow produces the same accelerational gradient $(dv/dr)$ as the acceleration of an inflow. So a source and sink of identical strength with identical outflow/inflow velocities at their surfaces would produce similar gravitational effects: both ballistic and electromagnetic ("relativistic"). Test masses in a source-flow field would accelerate centripetally, they would gravitate towards the source as matter must always accelerate with its surrounding space.

A spatial source would produce both normal gravity and entrainment, but differences will be seen between sinks and sources in certain circumstances. Two stars (spatial sources) of comparable mass will attract one another gravitationally and orbit one another, as in a binary system. Each is causing all surrounding space to accelerate towards itself (decelerate away from itself). The source flow of each star creates a decelerating spatial frame that affects the motion of the other star. Each must accelerate with the surrounding space towards the other. Each is, however, expelling space into the region between them. If they are at a sufficient distance, space will easily flow out of that region without creating back pressure on the stars. However, if they

are very close, pressure will develop in the region between them that will diminish the gravitational attraction. They may then gravitate towards each other less than expected.

Our solar system is the most stable system: a central large source with orbiting sinks. Our Sun produces a very powerful source and the inert planets are sinks moving through its outflow, consuming the created space. The planets consume only a small fraction ($< 0.2\%$) of the Sun-created space. Between sources and sinks in such a system, no anomalous spatial tensions or pressures arise. This is another reason that Newtonian Mechanics accurately describes motions within our solar system.

**Tests:** If the gravity of stars comes from source flow, and that depends upon the ratio of reacting to inert matter in the star, then we should find some stars have gravitational masses that are much greater or less than expected by their size. A brown dwarf star or other relatively dark star has fewer nuclear reactions taking place and therefore should create less gravity than expected. A sufficiently dim star may have no gravity whatsoever. As a star dims, its planets should move farther and farther away. Wandering dark stars may be wandering precisely because they have little gravitational interaction with other bodies. One can also look for anomalous gravitational interactions between binary stars in very close proximity.

## XII. STELLAR SOURCE FLOW AND THE GALAXIAL RECESSION ANOMALY

If all stars are indeed spatial sources then all visible galaxies, whose stellar mass is much greater than their inert mass, must be spatial sources. As with two stellar sources, we would expect two galaxial sources to attract one another due to the deceleration of their outflows. Galaxies within clusters will also be gravitationally-bound as space can flow out of the regions between them and into the voids. As do stars within galaxies, galaxies within clusters will entrain space into their motion, causing space within the cluster to accelerate centipetally and revolve

with the galaxies and therefore produce additional centripetal accelerations and higher orbital velocities than expected ("dark matter").

However, source gravity will differ from Newtonian calculations under other circumstances. Consider the interactions between galaxy clusters—the largest objects in the Cosmos that exist at very great distances from one another across voids. Space is being continuously created by all galaxies in amounts that far exceed the spatial consumption of the inert matter among the galaxies (gas, dust etc.). The Cosmos as a whole therefore must be expanding in size during the epoch of bright galaxies. The spatial cells are increasing in number; so the space of the Cosmos must be expanding into the void, into true nothingness. The Cosmos is space, outside of space is nothing. All galaxy clusters are creating space and each is surrounded on all sides by other galaxy clusters. The cluster's outlfowing space everywhere collides with flows coming towards it from other clusters and superclusters. There is nowhere else for space to go, it cannot exit the regions among the clusters without resistance. Therefore space accumulates between the clusters and pushes them apart. The voids between the clusters and filaments continually expand in size. Light from one cluster must travel through a continually increasing amount of space (number of spatial cells) to reach another cluster across a void, producing a Doppler redshift. With all clusters expelling space into the voids between them, the farther away two clusters are, the greater the number of expanding spatial voids between them, the faster they move away from each other, and the greater the Doppler redshift. The farther away the galaxy or cluster of galaxies, the faster it moves away from us. Thus the creation of space by active stars, and therefore by all galaxies in this epoch, is a sufficient explanation of the accelerating recession of galaxies with distance, eliminating the need for the *ad hoc* "dark energy" hypothesis.

Reccessional motion

Supercluster node

Space accumulates
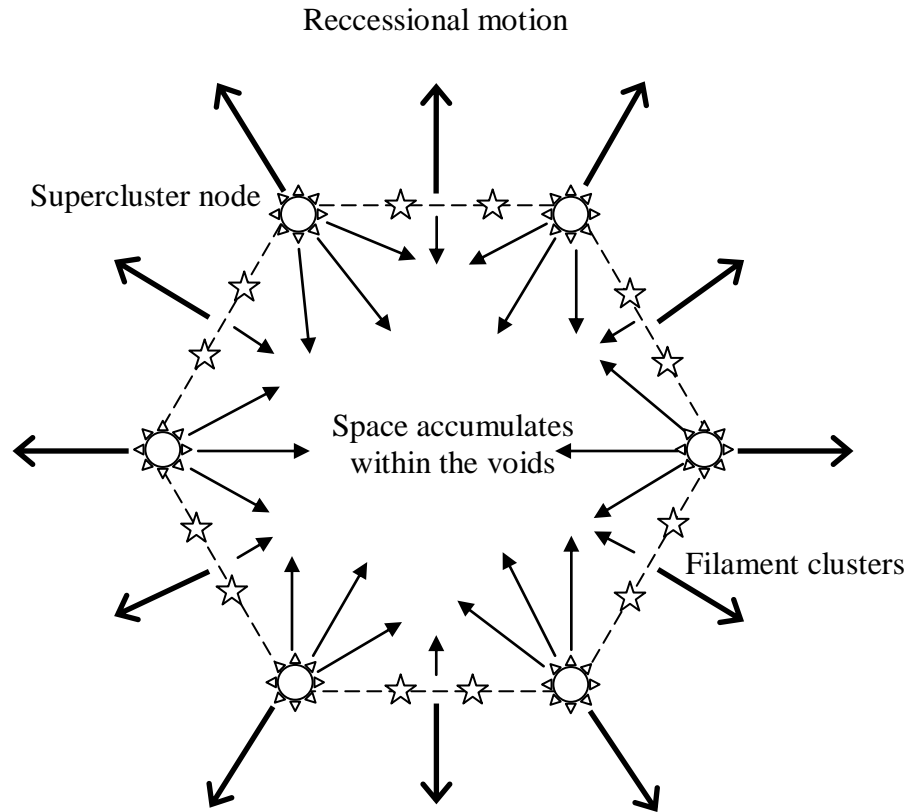within the voids

Filament clusters

Figure 1. Two-dimensional representation of a single three-dimension cell in the Cosmic Web.
Nodal superclusters and filament clusters of galaxies expel space into the voids between them,
causing the voids to grow and an accelerating expansion to occur.

## XIII. THE HADRONIC-COSMIC CYCLE

All non-reacting hadronic matter is consuming space. Eventually all space-producing stars
will burn out and no more new stars will form. The Cosmos will become dominated by inert
matter and spatial consumption. If Cosmic space is finite in amount as seems most probable, then
spatial consumption must eventually slow the recession of the galaxies and then reverse it.
Cosmic contraction will follow. As the last space is consumed, all galaxies, all matter will
implode in a single central location. All or most of the Cosmos' hadrons will be destroyed in a

single immense nuclear reaction. A vast amount of new space will be created in a very brief period of time, expanding outward into the void at superluminal velocity. Space-creation in nuclear reactions, including the destruction of hadrons, is the only plausible physical explanation for the Cosmic inflation that is needed to account for the flatness and isotropy of the observable universe. After the explosion, new electrons, quarks and then hadrons condense in the new space, forming hydrogen and eventually new galaxies and stars. It is probable that some matter from the preceding Cosmos survives in the outer parts of the reacting mass, explaining the continued domination of matter over anti-matter with each cycle. When stellar space production again becomes dominant, the new Cosmos begins to expand, producing an expansionary epoch like the one in which we live today. Eventually the stars will all burn out again and spatial consumption will predominate—beginning another Big Crunch. The Cosmos thus is inherently cyclical, but space and motion are eternal.

## XIV. CONCLUSION

To explain fundamental physical phenomena we require the theory that space is a substance. Space theory produces an an entirely new physics; a physics of physical assumptions and causal mechanisms. Space physics is the foundation of an entirely new natural philosophy; taking us beyond observer-based, merely descriptive "Science" to fulfill our need to understand the nature and causes of all Cosmic phenomena, from the simplest to the most complex. Space is the eternal being, the origin of all things. Space must have a propensity to evolve into more complex and even self-aware entities. We humans are space become linguistically self-conscious. No doubt we are only one of many self-conscious, tool-making creatures in this galaxy and the billions of other galaxies—all trying to understand the Cosmos that gave us birth.

**Appendix A:  Entrainment over Relativity**

The entrainment of surrounding space by matter not only explains the phenomena without paradoxes, it also provides many tests to distinguish entrainment theories from theories without entrainment. Relativity cannot logically include entrainment since it categorically holds that all motion is only relative to any arbitrarily-chosen coordinate system. Relativity is invalidated if there is indeed a physical space that is the unique physical frame for all phenomena: the substance that controls the motion of light, slows of atomic clocks, prevents the luminal motion of particles, etc. Relativity is likewise invalidated by the existence of a physical space that co-moves with matter. Consider differences between the quantitative predictions for spectra with and without entrainment. Disregarding the small rotational velocities, this entrainment theory predicts that spectra emitted by identical sources on the surfaces of the Sun and Earth should have periods differing only by the velocity of the local inflows:

$$(v_{Sun}^2 - v_{Earth}^2)/c^2 = (2\varphi_{Sun} - 2\varphi_{Earth})/c^2 = 4.24 \times 10^{-6} \,, \tag{5}$$

where $v$ is the spatial flow velocity at the surface and $\varphi$ is the gravitational potential, $GM/r$, with units $m^2/s^2$, corresponding to $\frac{1}{2}v^2$. This is indeed what the data show[25] and how the data are treated in textbooks.[26,27] However, this popular treatment is incompatible with Relativity and with any model that lacks entrainment. In Relativity, the Earth-Sun spectral comparison should reflect not only the difference in their gravitational redshift, but also the additional slowing ("time dilation") due to their $30\,\text{km/s}$ relative motion, and the additional redshifting of Earth-surface spectra/clocks by the Sun's gravitational redshift at Earth's distance, a $43\,\text{km/s}$ spatial wind. So a full non-entrainment relativistic treatment, would predict that an Earth observer would see the Sun clock slowed by:

$$[2\varphi_{Sun} - (2\varphi_{Earth} + 2\varphi_{Sun@Earth}) + v_{Sun-wrt-Earth}^2]/c^2 = 4.22 \times 10^{-6} \,. \tag{6}$$

This is only a small difference compared to the entrainment prediction, and the rising and falling of emitters on the Sun's surface makes the Sun's spectral red-shift too difficult to determine with sufficient accuracy. However, the principle is clear and should be testable in many other situations, such as observing spectra on other planets or data from atomic clocks on probes in orbit about other planets. It is already supported by the GPS system as described above.

Indeed, entrainment effect is already invoked in other cases. Adhering to Relativity has not stopped cosmologists from asserting that galaxies that are receding from us at superluminal velocities are "at rest in their own frame",[28] so they are not "really" moving at $>c$ relative to us. Such an assertion has no basis in Relativity; it requires a theory of physical space and spatial entrainment such as is presented here. This is but one more example of how Relativists don't understand Relativity. Likewise, they treat the redshifts of distant galaxies as if there is only the $1^{rst}$ order Doppler effect due to relative motion, and no transverse ($2^{nd}$ order) Doppler—no "time dilation" caused by the galaxies' velocity relative to the observer. This too assumes that every galaxy exists within its own co-moving spatial "frame". The study of quasar light curves shows no "time dilation" due to their motion relative to us.[29] In summary, in the flowing space theory, with the entrainment of space by all large celestial bodies, the relative slowing of atomic clocks or atomic spectra on the bodies' surfaces should reflect their individual spatial inflow velocities only; with no transverse Doppler redshift ("time dilation") due to their relative motion and no additional gravitational redshifts caused by "overlapping" gravitational field potentials-velocities. Spatial flows affect other flows by contiguous fluid-dynamic interaction—one cannot just mathematically sum all the flows from surrounding masses at a given point in space and produce a final flow vector.

**Appendix B: Aberration over Relativity**

In Relativity**,** aberration must result from any relative motion of source and observer, but this is not what is observed. In Stark's experiment, the direction of light arriving from stationary and high-velocity (600km/s) atoms at the same location was identical, no aberration due to relative velocity was seen.[30] If all motion were merely relative, then motion of the source should create the same aberration as motion of the observer, but in this Cosmos it does. Aberration occurs only when the observer is moving in the light-medium. This is seen in the data from individual stars in a binary system. The stars' aberration does not vary with their velocities relative to Earth, i.e. when they are moving with or against Earth's motion.[31,32] Other astronomical phenomena also demonstrate this source-observer asymmetry in aberration which is inconsistent with Relativity.[33] The facts support the theory that space is the physical medium of light transmission; and aberration is produced only by the observer's velocity in the luminiferous medium; not by the source's velocity in the medium, not by merely relative motion. The source's velocity produces only a light travel-time-delay displacement of its apparent location.

Some have claimed that annual stellar aberration disproves the theory of an Earth-entrained or dragged ether-space. However, in the entrained flowing space theory presented here, even though the observer is not himself moving at $\pm 30$ km/s in Sun-star entrained space, he exists within a sphere of space that is entrained (co-moving) with Earth at $\pm 30$ km/s velocity in the Sun-star "frame". Light propagating from the distant Sun-Star space into Earth's entrained space is "aberrated" in the transition zone between the two spatial flows. It enters and then propagates within Earth's fully-entrained space at the aberrated angle. The only way to eliminate this kinematic effect of relative motion would be to have the Earth-entrained space rotate in precisely the right direction and by the right amount to counteract the aberration, and there is no evidence

or plausible argument for such a rotation. The discussion of entrainment and aberration is complex. Stokes, Lorentz, and Planck addressed this issue at end of the 19th century. Lorentz concluded that aberration was consistent with an Earth-entrained ether if the ether were irrotational, if it were condensed in gravity, and if light maintained the same velocity in both non-compressed and compressed ether.[34] The issue, like so many others, should be re-addressed in the context of this working theory of Cosmic space, gravity, light, and motion.

**Appendix C: Gravitoinertial and Electromagnetic Motion**

To understand the motion of charged and uncharged subatomic particles and of multiatomic matter, we must identify and discuss the different gravitoinertial and electromagnetic mechanisms. Space appears to have at least this bipartite character; it supports both gravitoinertial (GI) and electromagnetic (EM) motions. GI motion is fluid-dynamic in nature— involving bulk flows of spatial cells into, out of, or around hadronic matter. This same cellular spatial fluid is also the seat of electromagnetism. Electric and magnetic fields are not bulk flow phenomena but involve a different interaction between the cells, some sort of distortion or rotation of or within the individual spatial cells. This distortion is passed from cell-to-cell at the speed of light. EM radiation is not an irreducible "wave-like energy" in a void, but is a transverse wave in EM space.

Unlike the motion of multiatomic matter, the motion of free electrons appears to be purely electromagnetic; with no GI (classical, Newtonian) characteristics at all. We do ascribe "mass" to electrons, but this is based upon their frequency (energy) and upon how much they are diverted by EM fields. We can't give electrons a push or put them on a scale. The evidence indicates that electrons are composed only of EM waves. They do not include the strong-hadronic process. The mutual annihilation of electrons and positrons at low velocities produces

only light. Electrons appear to be complex EM wave-structures—essentially curled-up light. Unlike free hadrons, free electrons can't stop moving. Their velocity is directly related to their EM frequency, the higher their frequency the faster they move (de Broglie relation: $(\rho_e = hf/c)$.

An electron's EM wave-structure has an axial symmetry, it has spin. Since the electron's frequency determines its velocity, it appears that a free electron's wave-structure literally "swims" through space in a direction determined by its axis; the higher the frequency, the faster the velocity.

Free protons have the net charge of a positron, but their motion in space is qualitatively different from that of free electrons or positrons. Protons include the strong interaction and therefore have both GI and EM characteristics. Protons are spatial sinks and so when they move through space they must entrain some volume of the near-surrounding space into their own motion. Because of this entrainment, the proton's EM wave-structure, its positronic field, is somewhat isolated from the surrounding space in which the proton is moving. This may explain why, compared to electrons, free protons produce much less synchrotonic radiation at the same accelerations and have a much smaller mean charge radius than an electron ($10^{-15}$ vs. $10^{-13}$ m). Also, the proton may be composed of many positronic and electronic wave-structures, and their interactions could confine the net positronic field of the proton.

It is likely that it is because electrons and protons have charge, because their circulating EM-wave structure interacts with space, that they cannot move through space at the free-EM wave velocity. The light speed barrier is electromagnetic. Neutrons, having minimal EM interaction with their surrounding space, may be able to move at superluminal velocities in space, as may large multiatomic masses with their large co-moving sink-source flow fields. As we move upward from bare protons to nuclei, to neutral atoms and multiatomic matter, GI interactions

increasingly dominate over EM interactions with space. This is a qualitatively different notion than the current idea that the only difference between a proton and the Earth is their wavelength.

**Tests:** These ideas can be compared to the wealth of knowledge already available about the motions of electrons, protons, neutrons, nuclei, atoms, and multiatomic matter. Many additional tests could be designed to further study the GI and EM contributions to motion.

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