Universe according to the STOE

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Abstract

We are at a special moment in our scientific evolution that requires the big of cosmology and the small of light and of particle physics be united by a single model. The Scalar Theory of Everything model (STOE) suggests fundamental assumptions with consideration for the successful parts of current models and for the data inconsistent with current models. The STOE is simpler, corresponds to both General Relativity and quantum mechanics, and solves many current mysteries and inconsistencies. Data comparisons with redshift, discrete redshift, rotation curves, asymmetric rotation curves, universe temperature, and the double slit experiment are successful. Therefore, the STOE is founded on orthodox science. Data analysis in 2011 confirmed predictions of the STOE made in 2006 that no other model suggested. A new test of the double slit experiment rejected the wave model of light and confirmed predictions of the STOE. The fundamental principles are applied to life and the purpose of life in our universe.

Theory of Everything - CMB temperature - redshift - Hubble's Law - rotation curves pioneer anomaly - diffraction

1 INTRODUCTION

Human kind is at a critical time in the evolution of our understanding of the universe. Cosmology models and elementary particle models are fundamentally inconsistent. Technology advances during the last 30 years have allowed surprising discoveries. These observations indicate that the "standard" models of cosmology and particle physics are likely incomplete. We are ready for the next evolutionary step in understanding the universe. This future model has already been named the "Theory of Everything" (TOE).

Each revolution in physics such as Aristotle's physics, Newtonian mechanics, electromagnetism, and nuclear forces has produced unanticipated and far–reaching consequences. The new physics of each of these revolutions involved a new paradigm, correspondence to several previous models that are inconsistent with each other, an explanation of anomalies to the previous models, and predictions of future observations.

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Before each revolution in thought, observational anomalies accumulate, the accepted models become a patchwork of ad hoc modifications, and a need to unify several academic disciplines seems necessary. The process that led to the Scalar Theory of Everything (STOE) involved studying the data that supports the current standard models and that are inconsistent with the current models. Thinkers such as Democritus, Aristotle, Descartes, and Newton had developed many of the principles of the STOE (Hodge 2012a). The data of the last 200 years is then added to the ideas of these thinkers. Predictions about the Pioneer Anomaly (PA) are starting to be realized.

The STOE is a self–consistent model that was derived from considerations of galaxy clusters (Hodge 2012a). The STOE explains many mysterious phenomena from diverse observational disciplines. The STOE is simpler and more encompassing than other models. The STOE was shown to correspond to the Big Bang (BB) and Quantum Mechanics (QM)(Hodge 2014). This allows the successes of the current models to be incorporated into the STOE.

This Paper summarizes the developments to date of the STOE.
Section:
2 lists the fundamental principles the STOE,
3 applications:
3.1 to life
3.2 to the STOE
3.3 to the Universe Temperature
3.4 to Galaxy redshift
3.5 to Hubble's Law
3.6 to Discrete redshift
3.7 to spiral galaxy rotation curves
3.8 to Rotation curve asymmetry
3.9 to Spiral galaxy central mass and central velocity dispersion
3.10 to the Pioneer anomaly
3.11 to Photon Diffraction
4 discussion and conclusion.

2 Principles

The Reality Principle states that results of any action must be real. Calculations that yield results of infinity, of singularities, or of negative numbers for physical conditions are not real. The Strong Reality Principle states that any step in the calculation that yield results of infinity, of singularities, or of negative for physical parameters yields unreal results. Transformations are allowed because the transformed parameters are unreal.

What our senses detect is real and our goal is survival. However, our perceptions can misinterpret the sensory input. The struggle for existence, for survival, has formed our senses to detect only certain phenomena. The restriction of "only certain phenomena" is efficiency of resource use. The addition of instruments and recorded images aids our perception and interpretation. Instruments readings depend on the model of their operation. The instruments also have limitations. Ultimately the interpretation of instrument readings must be reproducible to our senses and helps us understand the impact of the model on our survival.

A corollary of the Reality Principle is that all the mathematics of the models in modern physics has their analogy in our everyday life. Therefore, a conceptual statement of modern models can be built by analogy to everyday experience. For example, the application of General Relativity to the Big Bang concept uses the math of the macro properties of gases or fluids.

The Principal of Fundamental Principles is that a Fundamental Principle, and the models developed from it, is a meaningful and useful principle that applies to all scales of physical systems. To be meaningful is to be able to be used to describe and predict the outcome of experiments and observations. To be useful is to be able to be used to cause desired outcomes. The desired outcome for us is survival. Therefore, to be useful is to aid our survival. An outcome of an experiment includes placing bounds on what (parameter or event), where (position coordinates), and when (time coordinate).

Corollary I is if a candidate to be a Fundamental Principle is found to not apply in a scale of a physical system, then it is not a Fundamental Principle. The scale of a physical system refers to the size of the domain of applicability over which a set of physical theories applies such as galaxies versus atoms and Newtonian versus Special Relativity. Corollary II is if a principle is found in all of physical systems, then it is likely to apply to larger and smaller scales and to new concepts. Corollary II is an extrapolation of the Fundamental Principle.

The Principle of Superposition, the Correspondence Principle, and Principle of Minimum Potential Energy are such Fundamental Principles. The Correspondence Principle is an interpolation of the Fundamental Principles.

A "scientific model" (theory) is derived from the transcendent idea of the Fundamental Principle and is applicable to a defined domain. Because life and social systems are physical systems, by Corollary II, the transcendent idea of the Fundamental Principles must also apply to life and to social systems. The more fundamental scientific models have larger domains. A proposal becomes a scientific model when a deduction from it is observed. This concept does not require a candidate model to include "falsifiable predictions" and does not invalidate the usefulness of a scientific model for a domain because of the existence of falsifying observations in another domain. For instance, Newtonian dynamics is a valid scientific model. Observations in the domain including relative velocities approaching the speed of light falsify Newtonian dynamics. However, this only limits the Newtonian dynamics domain. Religious ideology models based on belief and philosophy models may be scientific models provided they are useful and meaningful with restricted what, where, and when bounds. To survive, a scientific model must compete for attention. The concept of a scientific model survives because the human mind is limited in the ability to maintain a catalog of the nearly infinite number of possible observations. Scientific models with empty or more limited domains have little usefulness and meaningfulness.

The Universality Principle states that the physics must be the same at all positions in the universe. A Theory of Everything must exist. The only difference from one place and time to another is a question of scale and history. For example, the physics that states all objects fall to earth was found to be limited to the Earth domain when Galileo noted moons rotating around Jupiter. Newton's restatement of physics was more cosmological, was simpler, and corresponded to Aristotle's model. However, the Universality Principle is not extended to imply the universe is isotropic and homogeneous. Near a star is a unique position. The physics must explain other positions. The physical theories must explain any isotropies and anisotropies. Our presence may change the outcome of experiments according to quantum mechanics. However, this is true for any observer or physical presence. If, in some set of observations, we appear privileged, the privilege must be incorporated in the model. For example, we are in a galaxy disk and are close to a sun. We are in a highly unique and privileged area. Just because we are carbon based does not imply all intelligent life is carbon based.

The Universality Principle appears to be a combination of the Cosmological Principle in the form that states that observers of the physical phenomena produced by uniform and universal laws of physics and the Copernican Principle in the form that states observers on Earth are not privileged observers of the universe. However, the STOE rejects both the Cosmological Principle and the Copernican Principle because they are limited to cosmology and inapplicable to the small. Our solar system is not isotropic and homogeneous. Variation in physical structures cannot be overlooked because the greater physical models must describe these variations to be a Theory of Everything. The physics is in the details.

The Cosmological Principle is false in our local view. GR needs a volume radius of more than 200Mpc to use this principle. The STOE uses the Universality Principle in the form that states universal laws produce physical phenomena at all locations and at all scales in the universe. Further, the STOE rejects the Cosmological and Copernican Principles because they are limited to cosmology. This implies a reductive philosophy.

Sellwood and Kosowsky (2001) suggested the problem of a single model explaining both galactic scale and cosmological scale observations is fundamental. Linking cosmological scale, galactic scale, solar system scale and Earth scale observations is an even more daunting task. Even more daunting is linking cosmological scale (the big) with QM (the small) while corresponding to Earth scale observations.

Physicists have used the concept that observations of the cosmos have their counterpart in earthborn experiments. For example, the observed spectra from galaxies are assumed to be the same spectra produced by elements on Earth with a frequency shift. However, an observation outside our domain may have an explanation not found in our domain. For example, much higher temperatures have been modeled in the universe than can be produced on Earth. However, the STOE should have the capability to describe both conditions.

The Anthropic Principle is accepted to the extent that what is observed must have been created and have evolved to the present. What is observed must be able to be observed. Note this statement of the Anthropic Principle omits the requirement that it depend on an assumption of “life” and “intelligence” because life and intelligence are inadequately defined. The existence of life, social systems, and intelligence are observations of our universe and, therefore, must be able to exist. An unobserved parameter may or may not be able to be observed. Therefore, the negative model candidates are not useful.

The Anthropic Principle is expanded to include not only our physical existence but also our successful social and economic creations. “Successful” means the set of rules that allow survival in competition with other sets of rules. That is, the rules for the successful functioning of social and economic structures may be the same as the functioning of physical cosmology. Conversely, the determination of the functioning of physical cosmology may point the way to a more successful set of social and economic rules.

Some argue the Anthropic Principle cannot be part of science because it cannot yield falsifiable predictions.

The Change Principle states that all structures change by a minimum step change. What exists will change. A structure is a relationship of the components of the universe. Change involves modifying the influence of one structure on another structure. A rigid structure maintains the relation of the components while the relation with the rest of the universe changes. If the influence between components is large, the structure behaves as a rigid structure. Particles became a hydrogen atom followed by evolution of other atoms. Atoms became molecules. A model that requires a large step where there are possible intervening steps is not observed and is forbidden.

A corollary of the Change Principle is that all components are injected into our universe. We observe in our domain that all structures have a beginning (birth) and an end (death). After a rigid structure is formed, it is either growing by acquiring components or ending by losing components. Also, all components are ejected from our universe. All structures have an end. The components that are injected into our universe are balanced by the components that are ejected from our universe in the very long term.

The Limited Resources Principle states components of the universe and rigid structures are resources for building other structures. Most rigid structures become larger at the expense of other structures.

The Limited Resources Principle combined with the Change Principle is the Principle of Minimum Potential Energy. Can we see the competition need in this principle? Could the Principle of Minimum Potential Energy be expanded to include the idea of profit?

The Competition Principle states all things are competing for the limited resources. Those rigid structures that are not gaining components from other structures are losing components to other structures. Gaining means the total internal energy is increasing. That is, the energy used to gain is less than the energy gained. Each rigid structure is acquiring profit. Competition is a feedback mechanism to control parameters such as the relation between mass of the Supermassive black hole and galaxy mass and velocity dispersion. Centers of energy (stars) are in competition to gain mass for greater energy production. Are nucleons and quarks in some form of competition? There are three ways to effectively compete for limited resources: form new relations, repeat or reproduce the same structure, or to destroy competitors.

The Repetition Principle states that there are two ways to repeat a Change: (1) If conditions allow an observable change, then the change will occur again under similar conditions. (2) The repeated Changes have a common cause (reproduction). A corollary is that if two systems have the same observable results, then similar conditions exist or the systems were reproduced. A strong statement of the Repetition Principle is that the amount of increase of a parameter by the Repetition Principle depends on the size of the parameter. Destruction of objects to have "room" for "the new" is a Repetition because the only objects that can be built from the pieces are a Repetition of objects.

The Negative Feedback Principle states that any system with relatively narrow parameter relationships must evolve from a broader system and must have a negative feedback loop to maintain the narrow parameters and achieve balance between the Change and Competition processes. Otherwise, the system is unstable and transitory. The effects of the unstable system will cease to exist without consequential fallout or permanent change. Transitory means the structure can exist but is ending. Therefore, there will be very few observations of the transitory type of rigid structure. We observe objects that have limited size. So, there is a limiting force or negative feedback condition controlling the size of each object. So too must black holes have a size limitation and a negative feedback condition. When the size of a structure of an object becomes limited, a new structure comprising a combination of existing structures can occur. Alternatively, the structure may be dissolved into smaller structures.

Conversely, if a functional relationship is measured between two parameters, then there exists a negative feedback physical mechanism such that a change in one parameter produces only the amount of change in the other parameter allowed by the relationship. For example, the ratio of the central mass to the mass of the bulge is constant. Therefore, there exists a physical mechanism to cause this to happen (Merritt and Ferrarese 2001a).

Because all structures have parametric relations with other structures, all processes of change are part of a negative feedback loop. The problem of physics is to identify the negative feedback loops. Each complete negative feedback loop is a fractal.

The Local Action Principle states influence is only upon the immediate adjacent volume by contact. This action is then iteratively transmitted to other volumes. The summation or integration of this local action is calculated with nonlocal models. The calculation must take care that the Reality Principle is obeyed. The integration of actions results in the abstract models such as action–at–a–distance.

The Minimum Action Principle can be stated as a Principle of Minimum Potential Energy, which states the path of least energy expenditure will be followed during the change from one state to another.

The Fractal (or Self-similarity) Principle states that the universe has a fractal structure. There is no natural system in our universe including our universe as a whole that is totally adiabatic. Even laboratory-isolated systems have some energy leakage. The Universality Principle combined with the Fractal Principle implies physics models are analogies of the world we can experience. We directly experience approximately 10 powers of two larger to 10 powers of two smaller than our size (2 meters). Instrumentation technology allows the expansion of our knowledge approximately as many powers of two larger as powers of two smaller. For example, the telescope and the microscope developed together.

For instance, if we can see the tree in the distribution of matter in the voids and filaments of the universe, then may we postulate the universe is distributing matter according to the same underlying rules and solving the same problems as the tree? The physics problem is to identify the common principles.

What is the tree doing?
1. To survive it has to be competitive, it must use limited resources (energy) efficiently to produce food.
2. It must do this more efficiently than other trees.
3. It gets the sun's energy over a surface area. It must use its resource (wood) to produce the maximum surface area for the wood used - be more profitable.
4. So the fractal structure is efficient for a tree. What does such a structure do for the distribution of matter in the universe?
5. Perhaps the energy in the physical world has an analog of resources in the economic world.

The Principle of Geometric Rules states that the observed geometric relationships apply in all levels of systems. Hence, the conservation of energy/mass must be related to geometric rules we observe in our universe. Hence, π = circumference / diameter in two dimensions must be the same number in three dimensions. However, π is an irrational number, therefore it is a transformation. The division by two is another universal concept. The division by two for each dimension into equal angles yields the right angle.

3 Applications

3.1 Life

Our universe is one entity. Therefore, all in it must be related. Science is questing after a Theory of Everything (TOE) that must unite the big of cosmology, the small of light and particle physics, and the classical of our size domain. Therefore, life and social systems must obey the same fundamental principles and in the physical realm. The corollary is that the weird quantum assumptions should beg for another explanation following the observations in the cosmological and classics domains.

Individuals have a birth and a death. Birth is a rearrangement of existing matter to create a new relationship or spirit. Throughout the individual's life, the matter and the spirit change. Eventually the individual dies. The spirit stops and the accumulated resources (matter) are returned to the universe.

Life also reproduces. Reproduction is making new self–similar copies of the life form. Reproducing more copies than the environment can support is also part of life. This is a tremendous waste of energy encouraged by nature. The fractal universe philosophy should be promoted to a fundamental principle. That is, the universe is a collection of reproduced mechanisms.

Life eats other life. The ultimate source of life is the energy from physical processes such as suns. Life on Earth tends toward increased rates of entropy growth because Earth is an open system with energy supplied by the Sun. The fractal philosophy suggests the universe must also be an open system. This suggests the universe is not adiabatic (Hodge 2006b).

Life units have physiological processes specifically pertinent to the functioning of integrated living units such as cells, tissues, organs, and organisms. More complex living organisms can communicate through various means, which is part of the functioning of an integrated unit. A unit induces a change in its environment that travels to the other unit such as laying a chemical trail. A change in state or activity occurs as a result of a stimulus. An organism changes in terms of movement, secretion, etc. Change requires a stimulus by contact not by "action–at–a–distance".

Organisms possess a capacity to grow. Those life forms and societies not growing are dying.

Organisms maintain homeostasis. A negative feedback loop is postulated to approach homeostasis instead of "fine tuning" in any form. Further, if the measurements suggest "fine tuning", then the physical mechanism is part of a negative feedback loop. For example, the ratio of the central mass to the mass of the bulge is constant implies there exists a negative feedback mechanism (Merritt & Farrarese 2001). The problem for physics is finding the feedback loop. The discovery process begins with the fundamental principle that the universe is composed of nested, negative feedback loops.

Combining fractal philosophy and the feedback principle suggests proportionality constants are also the result of feedback loops. This structure repeats down to very few (perhaps one) relationship(s). For example, the equivalence principle could be the result of a basic relationship(s).

Evolution suggests a change principle that states that change steps are small. A repetition principle states that there are two ways to repeat a change: (1) If a condition allows a change, then the change will occur again under similar conditions. (2) The repeated changes have common causes. That is, if two systems show similar results, then similar conditions exist.

The cooling flow from spiral galaxies is a loss of energy by matter that is too hot for the elliptical galaxies. The infall nucleosynthesis and the formation of suns serves the same purpose in spiral galaxies. The development of life requires more energy than lack of life development. The inflow of matter into spiral galaxies causes the development of suns and of life. This is more time efficient than cooling flows for increasing entropy.

Similarly, life serves the purpose of dissipating energy, also. A developing model of life proposes life is more efficient at eating energy and dissipating energy as heat (England 2013; Crooks 1999). This process is constrained by the laws of thermodynamics. The rate of increase in entropy is higher for life and the complex organisms than for the mineral components of the universe. The evolution of life is toward a greater rate of entropy increase. This idea balances the natural selection of evolution to include the rate of entropy increase alongside the efficiency requirement of survival–of–the–fittest.

3.2 STOE

How nature chooses the laws of physics may be unknowable. But the idea that the mathematics that has evolved should work suggests there is a unique way to model events. For example, the four known forces are thought to be unifiable. Quantum field theory suggests there are infinite combinations and that there is not a unique combination. This suggests Quantum field theory is incorrect or incomplete.

"Unique" also suggests the statistics of QM is really a measure of measurement error as the Bohm Interpretation suggests. The Bohm Interpretation argues against ideas of infinitely many paths of particles until a collapse happens. Mathematics characteristics may eliminate many of the possible interpretations of QM as being unphysical.

Newtonian mechanics has a calculation problem as $r \to 0$ where r is the distance between the centers of objects. This produces a singularity at $r = 0$ with which mathematics has difficulty. This characteristic is carried into General Relativity (GR). GR suggest the universe is homogenous to avoid the $r \to 0$ issue. Where mathematics has difficulty is where the physics should conceive of another model for the universe such as very close to matter and for the description of matter.

Cosmology suggests that matter (discrete, extended, with edges) warps "space" (continuous or infinitely divisible, gravitational ether, plenum, quantum vacuum, fills between matter particles) and "space" directs particles. Therefore, the de Broglie–Bohm theory of 2 components of our universe seems much more likely to yield a TOE than the weird duality notion. It helps that the de Broglie–Bohm theory can derive the Schrdinger equation because real waves direct the particles.

The source of the wave field that directs the particles is still a problem for the de Broglie–Bohm theory if we insist the speed of the waves is c or less. Thomas van Flandern has championed the idea the speed of gravitational waves is much (billions of times) faster than c. If only matter is limited to c, the instruments measurements would be the same. But that doesn't make the "space", gravitational ether, plenum, or quantum vacuum any less real.

Mathematics shows only two mutually exclusive characteristics in reality - discrete (counting) and continuous (geometry). Perhaps there are only two mutually exclusive constituents in the reality of our universe. One constituent is matter that is discrete and has boundaries. Democtitus' atoms are indivisible and are the smallest matter that has distinct boundaries. The other constituent is continuous such as Descartes' plenum. The plenum is infinitely divisible with infinite differentials possible. Continuous allows waves. Waves through Fourier (a transform function) analysis can reduce any analog observation or function to waves that may not be real. But if matter has a dimension in the universe, it cannot be part of the continuum (infinitely divisible). This suggests physics should be seeking not more space dimensions for Descartes' atom, but fewer.

A boundary is where a significant increase in energy is needed to move beyond the boundary or to remove a piece of the matter. If there is a smallest piece of matter, matter as we currently think of it (three dimensions) may be a combination of other smallest pieces and of a portion of the continuum.

The division by two for each dimension into equal angles yields the right angle. The relatively easy developments of Euclidean geometry compared to curved space geometries suggest the universe is flat.

Life on Earth can increase although entropy increases because Earth is an open system with energy supplied by the Sun. That fractal mathematics works suggests the universe must also be an open system. This suggests the universe is not adiabatic.

Mathematics negative feedback loops and their implementation have proven very useful. Negative feedback loops suggest a narrow output parameter range may be maintained for long periods when there is a wide variation in inputs. A negative feedback is used in many engineering application such as temperature control. A negative feedback loop is postulated to approach homeostasis in living beings. Perhaps the universe has negative feedback loops instead of "fine tuning" in any form. Further, if the measurements suggest "fine tuning", then a physical mechanism is part of a negative feedback loop. For example, the ratio of the central mass to the mass of the bulge is constant implies there exists a negative feedback mechanism (Merritt & Farrarese 2001). The problem for physics is finding the feedback loop. The discovery process begins with the fundamental principle that the universe is composed of nested, negative feedback loops. The concept of survival of the fittest is a negative feedback loop where the unfit are removed after a test.

Combining the concepts of fractal mathematics and of feedback mathematics suggests proportionality constants are also the result of feedback loops. This structure repeats down to very few (perhaps one) relationship(s). For example, the equivalence principle could be the result of such a basic relationship(s). Therefore, the equality shouldn't be stated as a "principle" (assumption) but should result from other principles.

The simplest structure that can conceptually produce a wide range of differing observations is an interaction of two different types of entities. The simplest form of the small that we experience is light. Light in experiments suggests two types of behavior, particle–like and wave–like. Therefore, the STOE posits two components and their interaction produce differing structures, more complex objects, and the diverse behavior observed in our universe. One component that can produce wave–like behavior is a plenum named after Descartes' plenum. The plenum is infinitely divisible and ubiquitous. The density of the plenum produces a scalar potential ρ field.

The particle–like component of our universe is called a hod. The limit of the speed of light implies the hod is two–dimensional because that presents a zero cross section in the direction of travel through the plenum. Hods cause a static[1] warp in the ρ field in accordance with the Newtonian spherical property. "Static" because matter is neither a Source nor a Sink of energy. Matter merely modifies the ρ field. Because the ρ field near hods must attract other hods, the hods decrease the ρ field. Only the divergence of the plenum density acts on only the surface of the hod. The flow of the plenum has no effect on the hod[2]. Therefore, the plenum is not a fluid. The minimum plenum density is zero. Therefore, the hod surface marks a discontinuity in the plenum of zero ρ.

The forces are applied by contact rather than action-at-a–distance. The forces are hod to plenum, plenum to plenum, and plenum to hod.

Supporting this conjecture is the observation that there are two types of physical energy, potential and kinetic. Hods cause potential energy. The plenum causes kinetic energy. The interaction is a third form of force in our universe that may be likened to "spirit".

Matter or bodies are structures of hods and plenum. The divergence of the ρ field on the surface of a hod then causes matter attraction according to established gravitational physics and causes the frequency change of electromagnetic signals.

The two types of matter effects are inertia mass and gravitational mass. The hods' influence on the plenum implies some plenum is "bound" to the hod and causes close hods to be bound to other hods. This structure is matter. The plenum content of matter causes the inertial characteristics. The hods cause the gravitational effects. The equality of potential energy and kinetic energy in matter results in the weak equivalence principle. The STOE speculates the amount of plenum bound to hods depends on the ρ environment of the matter. The relative amount of plenum per hod determines the gravitation constant and the equivalence principle.

The STOE suggests nucleosynthesis occurs from the center of spiral galaxies outward. This accounts for many galaxy observations such as outward flowing hydrogen and shocked gas clouds near the center of spiral galaxies. Therefore, the infall model of galaxies is not necessary. The infall model has too many inconsistencies most notably in the differences between spiral and elliptical galaxies and in the cooling flow characteristics (Hodge 2006b). Some hydrogen forms stars that create the heavier elements. Denser elements are attracted back to the center of the spiral galaxy. The STOE suggests the observation of the variation elemental types (metallicity) with spiral galactic radius is caused by the ρ field (Hodge 2006a). The stars become denser and eventually supernova, neutron stars, quark stars, and black holes. Thus accounting for the many relations between central mass and disk properties that puzzle the standard model (Hodge 2006d). Some matter continues outward to become part of the cooling flow to form elliptical galaxies.

Investigation into the characteristics of and differences between spiral and elliptical galaxies yielded the conclusion that the Sources of the plenum and

[1] "Static" such as caused by a stationary electron in a stationary electromagnetic field.

[2] This is indicated by the Michelson-Morley experiment that is also why the Lorentz Ether Theory and gravitational ether developed.

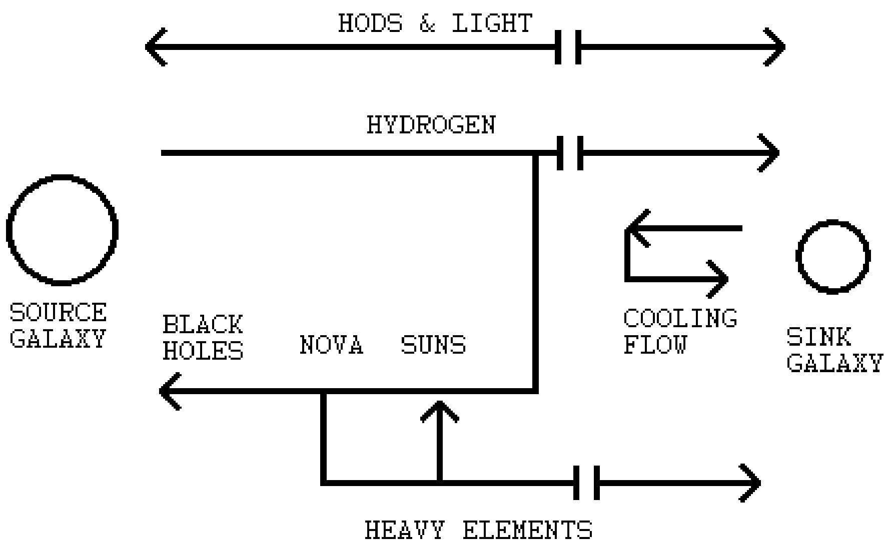

Figure 1: The trace of the path of the simulated photons.

hods are in the center of spiral galaxies (see Fig. 1). Sinks are in elliptical galaxies.

The STOE suggests the hods and plenum flow from Sources to Sinks. Figure 1 is a diagram showing the general suggested structure of the universe. In the very high ρ near the source or center of the spiral galaxy the black holes are compressed into high–energy photons that again flow outward. Some of the gas and heavier matter from nova are ejected out of the galaxy and gravitationally flow to form elliptical galaxies. Elliptical galaxies form sinks. Some of inflowing gas and matter is too hot and is ejected to form the cooling flows. Further, the spiral galaxy matter may form elliptical galaxies with matter from other spiral galaxies to form the galaxy clusters.

3.3 Universe Temperature

The STOE suggests the temperature of the universe is a galaxy cluster issue (Hodge 2006b). Because the STOE suggests the redshift of distant light of the Hubble's Law is not a Doppler shift (Hodge 2006a), the light from very distant galaxies could be redshifted below the temperature of the local galaxy cluster. Thus, the amount of radiation in the very low end of the radiation spectrum should be higher than a black body curve that has been verified by black body experiments on Earth. Instead, the microwave background radiation is an excellent example of blackbody radiation. Therefore, the temperature of the local cluster causes the microwave background radiation. Because radiant energy is exchanged between galaxies, all galaxy clusters approach near equilibrium.

The $\rho_{\rm m}$ at a point in space is the heat equation solution for point sources or sinks in a three dimensional space,

$$\rho_{\rm m} = -\sum_{i}^{N} K_i S_i / R_i, \tag{1}$$

where N is the number of hods, Sources, and Sinks used in the calculation; K_i is the relative strength multiplier of the type of the $i^{\rm th}$ object, S_i is the strength of the $i^{\rm th}$ object, and R_i is the distance from the center of the $i^{\rm th}$ object to the point where ρ is calculated. The $K_i S_i > 0$ for masses is the gravitational strength of the mass M of a body times the Newtonian gravitational constant G. The S_i of the Source ($K_i < 0$), or the S_i of the Sink ($K_i > 0$) is a function of the luminosity of the object.

The temperature of the universe appears to be a fine tuned parameter and it is very close to the natural logarithm base e K. Combining the characteristic equation that produces the e solution, negative feedback loops, and a non–adiabatic universe can model e K with a small oscillation as the theoretical temperature of the universe (Hodge 2006b). Oscillation suggests the temperature of the universe was once increasing. Increasing temperature implies increasing volume if there is no boundary and universe expansion that has been measured. The oscillation and the model also solve a problem of Newtonian and GR gravity of how the universe can be unbounded, flat, and long–lived.

The Sink's rate of attracting hods and plenum depends on the size of the Sink, which is indicated by the mass/luminosity around the Sink. The hods and plenum require time to travel from Sources to Sinks causing cooling flows in the process. This creates a feedback mechanism such as a thermostat (the Sink's mass) controlling the temperature (energy density of the cluster) of a room. The temperatures of clusters hunt 2.718 K. The hunting explains both acceleration and deceleration of the expansion of the universe. Figure 2 is a plot of $v_{\rm l}/V$ versus kt/l^2 for a stable value of kl, where $k = C/K$ is a positive constant.

where v_l is the temperature at a distance from a Sink core, $V = 2.718$K is the theoretical temperature of the universe (Kelvin), t is time, k is the rate of matter input from sources divided by the conductivity of matter from sources to sinks.

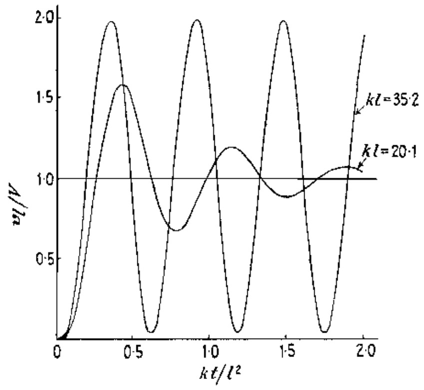

Figure 2: Behavior of v_l with feedback control for intermediate values of kl.
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3.4 Galaxy redshift

The universe on the galactic scale is inhomogeneous and galactic redshift z is less than zero for some galaxies. Current wisdom holds that z is caused by the Doppler shift. However, the determination of the Hubble constant H_o has a large uncertainty. The generally accepted value of H_o was calculated by Freedman et al. (2001); Macri et al. (2001) using Cepheid variable stars to determine distance for 32 galaxies versus the measured galactocentric redshift z_m. The correlation coefficient is 0.80. Further, the correlation coefficient for galaxies beyond 10 Mpc is approximately 0.30. A discrete variations in z was reported by Tifft (1996, 1997), was confirmed by others (Bell et al. 2004; Russell 2005), and remains unexplained by the Doppler model. Also, the redshift elongation of galaxy clusters along our line of sight (sometimes called "the fingers of God") remains a poorly explained mystery.

The STOE redshift model yields the Hubble Law, better correlation to Cepheid galaxy distances, an explanation for the discrete redshift, and an explanation of the fingers of God (Hodge 2006a). Hodge (2006a) suggested that photons traveling between galaxies could loose energy caused by the ρ field. The equation derived is:

$$\frac{1}{z+1} = K_{\min} + e^X, \tag{2}$$

where

$$X = K_{\mathrm{dp}} DP + K_{\mathrm{p}} P + K_{\mathrm{f}} F + K_{\mathrm{vp}} P v_{\mathrm{e}} \tag{3}$$

where the terms are defined in Hodge (2006a). The K terms are constants, the D is distance the signal travels, the v_e is direction dependent caused by the Milky Way, the P is a measure of the amount of ρ the signal travels through, and F is a measure of the inhomogeneity (turbulence) of ρ the signal travels through.

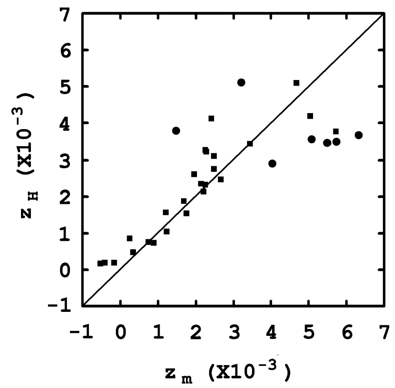

Figure 3: Plot of the calculated redshift z_H using Eq. (9) and D calculated using Cepheid variable stars for 32 galaxies (Freedman et al. 2001; Macri et al. 2001) versus the measured redshift z_m. The straight line is a plot of $z_H = z_m$. The circles indicate the data points for galaxies with (l,b) = $(290° \pm 20°, 75° \pm 15°)$. The correlation coefficient is 0.80.

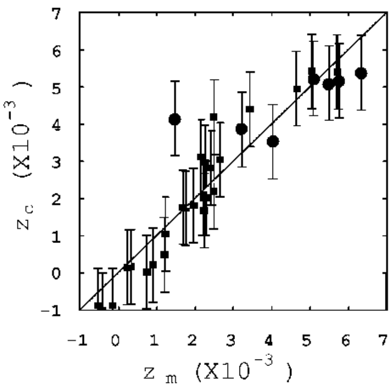

Figure 4: Plot of the calculated redshift z_c versus the measured redshift z_m for 32 Category A galaxies (Freedman et al. 2001; Macri et al. 2001). The straight line is a plot of $z_c = z_m$. The circles indicate the data points for galaxies with (l,b) = $(290° \pm 20°, 75° \pm 15°)$. The correlation coefficient is 0.88. If the outlier NGC 4639 is omitted, the correlation coefficient is 0.91.

3.5 Hubble's Law

Figure 5 is a plot of D_{a} versus X. The straight line is a plot of the least squares fit of the data. The line is

$$\begin{aligned} D_{\mathrm{a}} &= (-2700 \pm 500\mathrm{Mpc})X - (1.4 \pm 0.8\mathrm{Mpc}) \\ &\approx \frac{c}{H_{\mathrm{spm}}} z \end{aligned} \tag{4}$$

at 1σ and with a correlation coefficient of 0.93, where $H_{\mathrm{spm}} = 110 \pm 20$ km s^{-1} Mpc^{-1}. Thus the Hubble law is recovered without the assumption of an expanding universe.

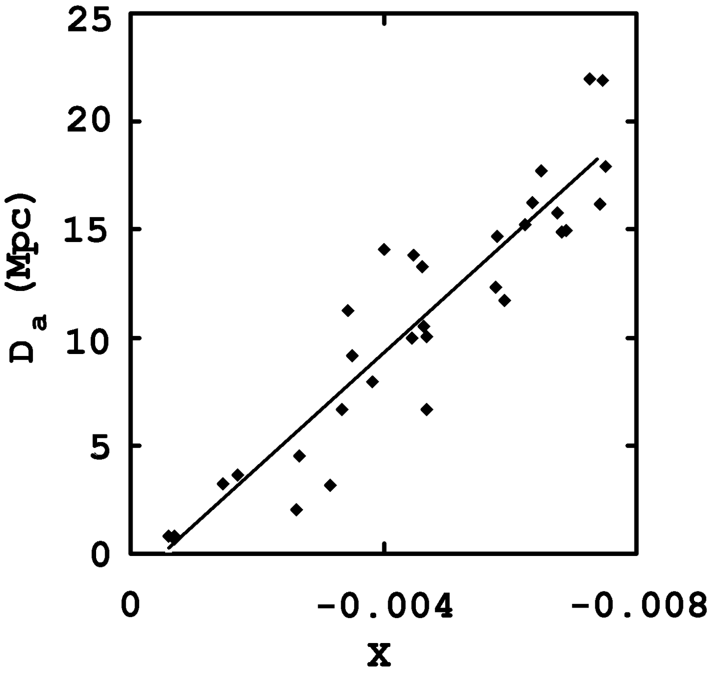

Figure 5: Plot of distance D_a (Mpc) versus exponent factor X of the redshift calculation for 32 Category A sample galaxies. The straight line indicates $D_a = -2600X - 1$.

At $D = 18$ Gpc, $\exp(X) \approx K_{\mathrm{min}}/2$. At large cosmological distance, $z \longrightarrow K_{\mathrm{min}}^{-1} \approx 500$. The X term of Eq. (2) predominates and K_{min} is relatively small for distances less than a few Gpc. Therefore, $z \longrightarrow \exp(-X) - 1 \approx -X$. A plot of D versus X of the redshift calculation for 32 galaxies showed a straight line. The line is

$$
\begin{aligned}
D &= (-2700 \pm 500\text{Mpc})X - (1.4 \pm 0.8\text{Mpc}) \\
&\approx \frac{c}{H_{\text{spm}}} z
\end{aligned}
\tag{5}
$$

at 1σ and with a correlation coefficient of 0.93. $H_{\text{spm}} = 110 \pm 20$ km s^{-1} Mpc^{-1}.

Therefore, the STOE model reduces to the Hubble Law within limited circumstances.

3.6 Discrete redshift

The STOE suggests the proportionality constant is between distance, redshift and the intervening ρ field and not between distance and $\frac{c}{H_{\text{spm}}}$.

If redshift is caused by a mechanism other than universe expansion, then the derivations of many features of the standard model fail. The finding of a flat or very low curvature of the gravitational ether implies the universe is much bigger than the Doppler Hubble Law allows. The STOE allows a much larger universe and retains the measured distance to redshift relation (Hodge 2006a).

If the path of the photon passes near a Sink (elliptical galaxy) such as from the far side of a cluster from our viewpoint, the redshift is increased. If the path of photon has a Sink beyond the emission mass such as from the near side of a cluster from our viewpoint, the redshift is decreased. This accounts for both the discrete redshift and the fingers of God.

Figures 6 and 7 show G_{lat} versus G_{lon} of the galaxies within approximately six arcdegrees surrounding the identified Sink. The angular location of the identified Sink is marked by the crosshairs. The filled circles denote the galaxies within one arcdegree of the identified Sink of Figs. 3.

The $X_{\text{core}+}$ effect is z value of galaxies closer than the identified Sink is increased. The z value of galaxies farther than the identified Sink is decreased due to $X_{\text{core}-}$. The overall effect is the range of z values of galaxies around the identified Sink are tightened toward the z value of the identified Sink.

3.7 Spiral galaxy HI rotation curves

The Source of the scalar field acts as a monopole at the center of spiral galaxies. The scalar potential field causes Newtonian mechanics to considerably underestimate the mass in galaxies, which is the "missing mass problem".

Traditionally, the focus has been on accounting for HI RCs that are flat in the outer region immediately beyond the knee. However, observations also include rising RCs, declining RCs, an abrupt change in slope at the extreme outer region in many galaxies, and rotational asymmetry with non-relativistic velocities. These other characteristics of the RC are poorly accounted in standard models. For example, the dark matter hypothesis suggests a large amount of unobserved matter causes the RC to be flat rather than declining. The rising RC is some galaxies require even more matter. However, these galaxies have other measures that require a smaller amount of matter in the galaxy.

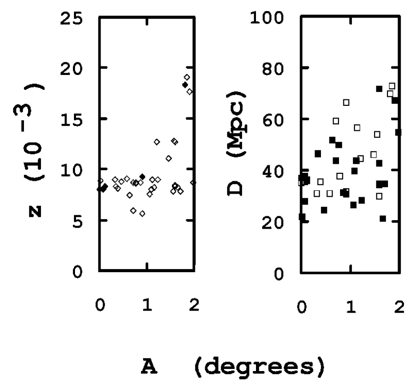

Figure 6: The left plot is of the measured redshift z_{m} versus the angle A (arcdegrees) subtended from NGC 5353 (S0 in Canes Venatici, $M = -20.8$ mag.) $(l, b, z) = (82.61°, 71.63°, 8.0203 \times 10^{-3})$. The open diamonds indicate the data points for Source galaxies. The filled diamonds indicate the data points for Sink galaxies. The right plot is the distance D (Mpc) from earth versus A. The open squares indicate the data points for galaxies with the D calculated herein. The filled squares indicate the data points for galaxies with the D calculated using the Tully-Fisher relationship.

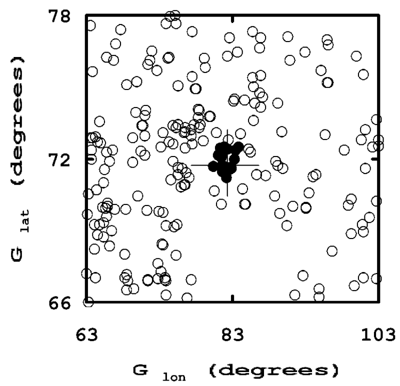

Figure 7: Plot of the galactic latitude G_{lat} (arcdegrees) versus the galactic longitude G_{lon} (degrees) approximately six arcdegrees around NGC 5353. The open circles indicate the data points for galaxies more than one arcdegree from NGC 5353. The filled circles indicate the data points for galaxies within one arcdegree of NGC 5353. The "+" or crosshairs indicate the position of NGC 5353.

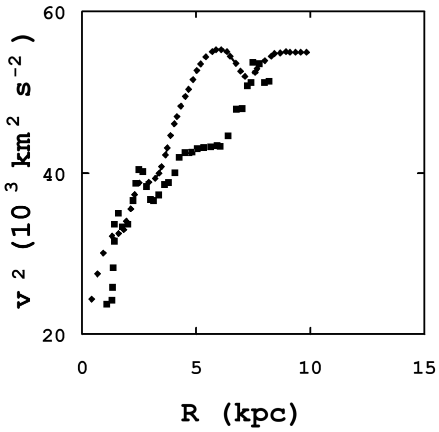

Figure 8: Plots of the square of the rotation velocity v^2 (10^3 km^2 s^{-2}) versus galactocentric radius R (kpc) of the H I RC (filled diamonds) and Hα RC (filled squares) for NGC4321 (Sempere, et al 1995).

The RC differs for different particles. For example, the H I RC and the RCs of stars as shown by the Hα line for NGC 4321 (Sempere, et al 1995) differ in the rapidly rising region before the knee (RR) and approach each other in the OR as shown in Fig. 8.

Spectra coming from HII regions depend systematically on R and little else (Binney & Merrifield 1998, pp. 516-522). The interstellar abundances of metals in a disk galaxy decrease with increasing radius (Tadross 2003). Also, the absolute B band magnitude M_{B} (mag.) of a galaxy is correlated with the metallicity obtained by extrapolating [O/H] within the disk to the galactic center. Low luminosity galaxies tend to be metal poorer than high luminosity galaxies.

The STOE was created to be consistent with the observation of the morphology-radius relation of galaxies in clusters, of the intragalactic medium of a cluster of galaxies, and of the flow of matter from spiral galaxies to elliptical galaxies (Hodge 2006b). The STOE suggests the existence of a massless scalar potential $\rho \propto R^{-1}$ derived from a diffusion (heat) differential equation. Physically, the diffusion equation requires Sources and Sinks to form the potential field. The Source forming a galaxy leads to the proportionally of the Source strength and emitted radiation (luminosity). Therefore, the total mass of a galaxy is related to the luminosity of a galaxy. A cell structure of galaxy groups and clusters was proposed with Sinks at the center and Sources in the outer shell of the cells. The cell model is supported by the data and analysis of Aaronson et al. (1982); Ceccarelli et al. (2005); Hudson et al. (2004); Lilje et al. (1986), and Rejkuba (2004). Because the distance between galaxies is larger than the diameter of a galaxy, the Sources were considered as point (monopole) Sources.

Roscoe (2002) used a dynamical partitioning process and found that the dynamics in the outer part of optical RCs are constrained to occupy one of four *discrete dynamical classes*. The classes are determined by the absolute magnitude, surface brightness, and a parameter for each optical RC that is an exponent of the radius R at which the rotation velocity v is measured.

The coordinate system center was placed at the sample galaxy's kinematical center and was aligned to our line of sight. The STOE posits the v^2 of a particle in orbit of a spiral galaxy is the sum of the effects of the ρ force F_s on the cross section m_s that is radial outward for spiral galaxies opposing the gravitational force F_g on the gravitation mass M that is radial inward, where (1) the L term is due to the F_s of the host galaxy; (2) $L = K_\epsilon \epsilon = 10^{-0.4 M_\mathrm{B}}$ erg s^{-1} for Source galaxies or $L = K_\eta \eta = -2.7 \times 10^{-0.4 M_\mathrm{B}}$ erg s^{-1} for Sink galaxies (Hodge 2006b); (3) the mass of the test particle is assumed to be constant over time; (4) $||$ indicates absolute value; and (5) $\vec{a}_\mathrm{o}$ (km s^{-2}) is the acceleration caused by neighboring galaxies,

$$\vec{a}_\mathrm{o} = \frac{G_\mathrm{s} m_\mathrm{s}}{m_\iota} \vec{\nabla} \rho \,, \tag{6}$$

and (6) the number of galaxies exclude the host galaxy. Note that no assumption about the significance of $\vec{a}_\mathrm{o}$ has been made.

Because v is measured only along the major axis in the region under consideration (Binney & Merrifield 1998, p. 725) and if the $\vec{\nabla}\rho$ field is approximately uniform across a galaxy,

$$v^2 = G \frac{M}{R_\mathrm{major}} - \frac{G_\mathrm{s} m_\mathrm{s}}{m_\iota} \frac{L}{R_\mathrm{major}} + |\vec{K} \bullet \vec{a}_\mathrm{o}| R_\mathrm{major} \,, \tag{7}$$

where $\vec{K}$ (km kpc^{-1}) is a constant vector.

Fig. 8 shows the H I RC at lower radius R_rr (kpc) in the RR has two scalloped shapes that suggests spherically symmetric shells of matter. Also, the Hα RC rapidly increases, peaks, and then declines at the beginning of each shell. The Hα lines are generally formed in excited interstellar gas. In the disk region of a galaxy, the gas is usually excited by hot stars (Binney & Merrifield 1998). Because the m_s/m_ι factor must be different for different matter types, each shell has a different metallicity star type. Because the Hα RC approaches the H I RC in the disk region such as plotted in Fig. 8 with hot, hydrogen burning stars, the m_s/m_ι factor must be the same for H I and hydrogen stars. This suggests the m_s/m_ι factor varies by element type and acts on atoms at the largest. The metallicity – radius relation follows.

The m_s/m_ι ratio of stars is changing through changing elemental composition by nucleosynthesis in addition to accretion and emission of matter. Therefore, the H I RC is preferred to trace the forces influencing a galaxy outside the bulge. Because only the H I RC is considered in the calculations herein, the units used were $G_\mathrm{s} m_\mathrm{s}/m_\iota = 1$ kpc km^2 s^{-1} erg^{-1}.

The galaxy sample has LSB, medium surface brightness (MSB), and high surface brightness (HSB) galaxies; has LINER, Sy, HII, and less active galaxies; has galaxies that have excellent and poor agreement between the distance D_{tf} (Mpc) calculated using the TF relation and D_a; has a D_a range of from 0.79

Mpc to 17.70 Mpc; has field and cluster galaxies; and has galaxies with rising, flat, and declining RCs. Note the rising RC galaxies are generally rejected from the sample for most RC studies. Other galaxies are included that are often left out of the sample of RC studies.

The first approximation ignored the $|\vec{K} \bullet \vec{a}_{\mathrm{o}}|R_{\mathrm{major}}$term.

The RC of each galaxy is considered to be piecewise linear. This creates several parameters to complete the full RC. Figure 9 shows an example of a plot for the maximum extent of the rapidly rising region (RR) versus B band luminosity L ($10^8\,\mathrm{erg\,s^{-1}}$) for the 95 sample galaxies. This example was chosen for this paper because it has a correspondence to the characteristic used by the Tully–Fisher relation.

The equation that provides the best–fit correlation for the RR is

$$\frac{R_{\mathrm{rrmax}}}{\mathrm{kpc}} = K_{\mathrm{b_1}}\, B_{\mathrm{b_1}}^{b_k}\, \frac{L}{10^8\,\mathrm{erg\,s^{-1}}} \pm 14\% \,; \tag{8}$$

where b_1 denotes a galaxy, $K_{\mathrm{b_1}} = 1.3 \pm 0.2$, b_k is an integer, and $B_{\mathrm{b_1}}^{2.06\pm0.07}$.

The other parameters of the RC were treated the same.

The deviation of the data of NGC 5448 suggest a physical mechanism behind the quantized galaxy parameters. The clear departure from circular motion and the significant mass transfer inward ($\ddot{R} \neq 0$) found by Fathi (2005) suggests this galaxy is in transition from one virial state to another. Further, the noted stellar and gas velocity difference decreases at larger radii. The better fitting of the $v^2_{\mathrm{eormax}} - L$ and of the $A_{\mathrm{symax}} - |\vec{K} \bullet \vec{a}_{\mathrm{o}}|$ relations is the expected result. NGC 3031 shows strong, non-circular motion in the disk (Gottesman et al. 1966). This suggests the integer variation is caused by the accumulation of mass at potential barriers such as at R_{Δ} and R_{rrmax}. Continued nucleosynthesis and changing $|\vec{K} \bullet \vec{a}_{\mathrm{o}}|$ causes an occasional, catastrophic rupture of one or more of the potential barriers, $\ddot{R} \neq 0$, and, therefore, the transition of the galaxy from one integer classification to another. A smoothly varying transition from the RR to the OR for flat or declining RCs such as NGC 4321 suggests mass is accumulating at a potential barrier at the end of the RR and is being depleted from the outer parts of the OR.

Steinmetz et al. (2002) found in a series of N-body/gas dynamical simulations that included feedback: that feedback is a necessary component for morphology determination; that the main morphological component is regulated by the mode of gas accretion and intimately linked to *discrete* accretion events; that morphology is a transient phenomenon; and that the Hubble sequence reflects the varied accretion histories of galaxies. If luminosity is proportional to the ϵ, which directly causes the parameters of the RC, then there must exist a feedback mechanism controlling the parameters of the RC.

3.8 Rotation curve asymmetry

The second approximation involves calculating $|\vec{K} \bullet \vec{a}_{\mathrm{o}}|R_{\mathrm{major}}$ term.

Because the observational data from each side of a galaxy RC are generally averaged, only highly asymmetric cases are recognized. RC asymmetry appears

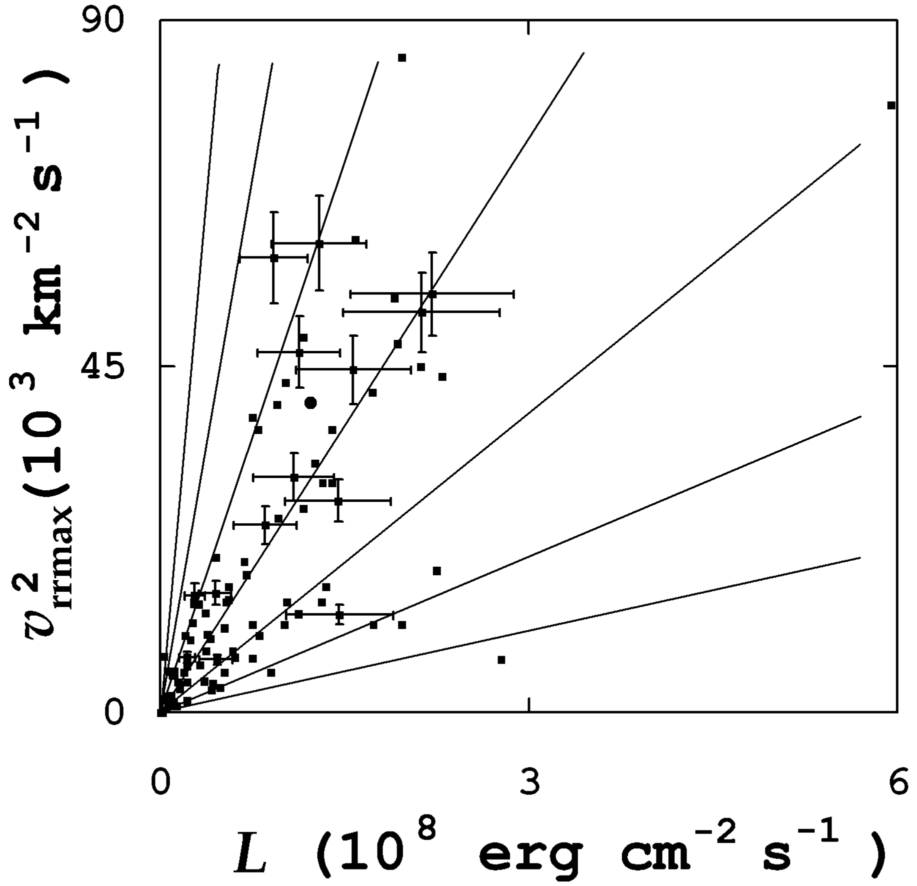

Figure 9: Plots of square of the rotation velocity v^2_{rrmax} ($10^3 \mathrm{km}^2\,\mathrm{s}^{-2}$) at the maximum extent of the RR versus B band luminosity L ($10^8\,\mathrm{erg\,s}^{-1}$) for the 95 sample galaxies. The 15 select galaxies shown have error bars that show the uncertainty range in each section of the plot. The error bars for the remaining galaxies are omitted for clarity. The large, filled circle denotes the data point for NGC 5448. The large, filled square denotes the data point for NGC 3031.

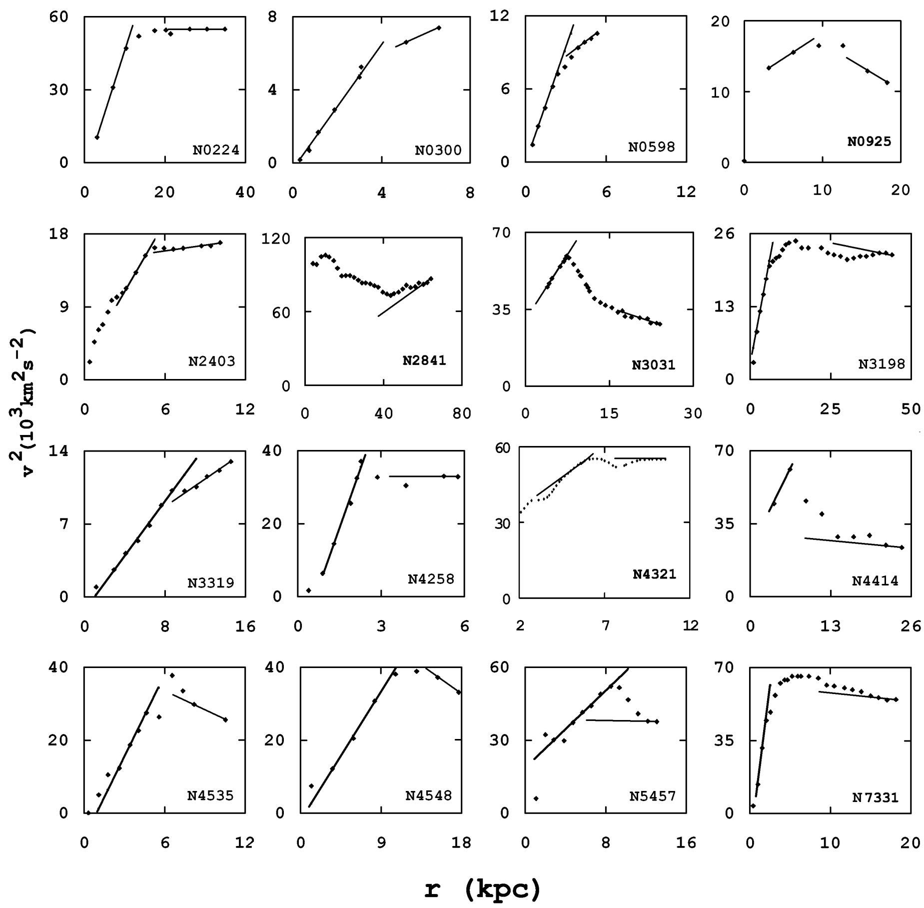

Figure 10: Plots of the square of the H I rotation velocity v^2 (10^3 km^2 s^{-2}) versus galactocentric radius R_{major} (kpc) along the major axis. The straight lines mark the application of the derived equations to the RCs of the select galaxies. The application of the derived equations to NGC 0224, NGC 0300, and NGC 0598 were omitted because these galaxies lacked a $|\vec{K} \bullet \vec{a}_{\mathrm{o}}|$ value. The references for the RCs are noted (Hodge 2006c).

to be the norm rather than the exception (Jog 2002). Weinberg (1995) and Jog (1997) proposed the implied mass asymmetry is due to an imposed lopsided potential caused by galaxy interaction. Dale et al. (2001) found RC asymmetry of early type galaxies falls by a factor of two between the inner and outer regions of clusters. The formation, evolution, and long term maintenance of galactic, kinematical asymmetry remains a mystery.

The asymmetry measure used was different than the standard. The standard measure uses the difference in R at a constant v^2. The measure of asymmetry herein uses the maximum difference in v^2 for a constant R.

The calculation method is similar to the first approximation. The effect is to reduce the error in the theoretical versus actual measurements.

The model has several lines in the parameter plots. Standard models use only one line to indicate relations. However, the standard models tend to omit some galaxies from the sample for various reasons. The omitted galaxies also have the characteristics of not fitting the standard models. For example, the dark matter model omits the rising RC galaxies.

Approximately 66% of the sample galaxies have $a_1 = 4$ or $a_1 = 5$ as seen in Fig. 9. If $a_1 = 4.5$ is used, $v^2_{\mathrm{rrmax}} \propto L$ for a majority of sample galaxies. Only NGC 4258 of the select galaxies would appear to be an outlier, which may suggest the v_{rrmax} is larger than the measured point chosen herein. Further, the neighboring galaxy effect would fail to improve the $v^2_{\mathrm{rrmax}} \propto L$ relation. The effect of the integer values is to broaden the applicability of the parameter – L relations and to establish relations wherein the neighboring galaxy effect improves the calculation.

The many lines in the plot in Fig. 9 suggest the data points may be random. The null hypothesis tested was "the data points are indeed random points". Following the procedure used in discovering the relations tested this null hypothesis. The null hypothesis was rejected. That is, the lines are not random.

This model suggests a quantized relation among spiral galaxy parameters. The result is a large number of constants. However, the inclusion of rising RCs and other galaxies usually exclude is a better model than those models that exclude their data. Indeed, the exclusion of these galaxies suggests those other models are falsified compared to the STOE model. Also, the other models leave the asymmetric RC as a mystery. The STOE model includes the asymmetric RCs.

What causes the quantization of the RCs still must be explained. The STOE suggests the m_s/m_g ratio is the answer. Consider adding one nucleon at a time to a nucleus. If the added nucleon is behind the other nucleons, the m_s does mot change and m_g does. Hence, the atoms become stratified in the galaxies.

3.9 Spiral galaxy central mass and central velocity dispersion

Because the amplitude and shape of galaxy rotation curves (RCs) correlate with galaxy luminosity (Burstein & Rubin 1985; Catinella 2006; Hodge 2006c; Persic 1996), relationships between galaxy central parameters and large scale galaxy parameters are unexpected by Newtonian dynamics. The galaxy central mass M_c and central velocity dispersion σ_c have been found to correlate with large–scale galaxy parameters for samples of galaxies with a limited range of characteristics. Nearly all other models of galaxies have matter infalling into spiral galaxies from intergalactic regions. This makes correlation of outer galaxy parameters with inner galaxy parameters mysterious and unexplained. The STOE suggests matter is emitted from a Source at the center of spiral galaxies and flows outward as light and hydrogen. Then some hydrogen forms suns that collapse back into the center of the spiral galaxy (see Fig. 1). Thus the center outflow controls the amount of matter (luminosity) in the outer regions of spiral galaxies.

References for the following observations are found in Hodge (2006d).

The ratio of the rotation velocity v_c (km s^{-1}) in the flat region of the RC and the central velocity dispersion σ_c (km s^{-1}) $\approx$ 1.7 for a sample of S0 and spiral galaxies. A power law relationship between circular velocity v_{c25} (km s^{-1}) beyond the radius R_{25} of the 25^{th} isophote and σ_c for a sample that also include elliptical galaxies was discovered. Several galaxies that are included in Hodge (2006d) were excluded for various reasons.

The masses of compact stellar clusters at the center of low- and intermediate-luminosity galaxies also correlate with the mass of the host galaxy. The compact stellar clusters and the supermassive black hole (SBH) modeled as being at the center of high-luminosity galaxies should be grouped together under the terminology of "Central Massive Objects" (CMOs) with mass M_{cmo}. The finding of the correlation between M_{cmo} and the total mass in a galaxy M_{gal} suggests a similar galaxy formation process. Keplerian motion to within one part in 100 in elliptical orbits of stars that are from less than a pc to a few 1000 pc from the center of galaxies have been observed. The stars within nine light hours of the Galaxy center have velocities of 1300 km s^{-1} to 9000 km s^{-1}(Schödel 2002) and high accelerations. A huge amount of mass M_c ($\mathrm{M}_\odot$) such as millions of black holes, dense quark stars, and ionized iron must be inside the innermost orbit of luminous matter.

That M_{cmo} is crowded into a ball with a radius of less than 45 AU in the Milky Way is proven by stellar observation. That the structure of M_{cmo} is a SBH is widely accepted, but unproven. The Newtonian model implies the M_{cmo} must either quickly dissipate or must quickly collapse into a SBH. The long–term maintenance of M_{cmo} rules out the first possibility. Observations have ruled out many models of the nature of M_{cmo} of galaxies.

Observations inconsistent with the supermassive black hole (SBH) model include shells of outward flowing, shocked gas around galactic nuclei. A repulsive force, called a "wind" (a gas), exerted a force acting on the cross sectional area of particles has been suggested. Therefore, denser particles such as black holes move inward relative to less dense particles. Less dense particles such as hydrogen gas move outward. Other observations inconsistent with the SBH model include the apparent inactivity of the central SBH and the multitude of X-ray point sources, highly ionized iron, and radio flares without accompanying large variation at longer wavelengths reported near the center of the Milky Way.

The $M_{\rm cmo}$ correlation with Blue band luminosity $L_{\rm bulge}$ of the host galaxy's bulge has a large scatter. The $M_{\rm cmo} \propto \sigma_{\rm c}^{\alpha}$, where α varies between 5.27±0.40 and 3.75±0.3. The $M_{\rm c} - \sigma_{\rm c}$ relation appears to hold for galaxies of differing Hubble types, for galaxies in varying environments, and for galaxies with smooth or disturbed morphologies.

The STOE found parameters P of HI RCs of spiral galaxies are related to L of the host galaxy and of nearby galaxies. The parameters are the square of the rotation velocity, the radius, the mass, and the acceleration at discontinuities in the RC. The equation is

$$\frac{P}{unit} = K_1\, B_1^{I_1}\, \frac{L}{10^8\,\mathrm{erg\,s^{-1}}} + (-1)^s K_2 B_2^{I_2} \frac{|\vec{K}\bullet\vec{a}_{\rm o}|}{10^3\,\mathrm{kpc^{-1}\,km^2\,s^{-2}}} \pm \sigma_{\rm e}, \tag{9}$$

where $unit$ is the units of P; K_1, K_2, B_1, and B_2 are constants that are unique for each P; I_1 and I_2 are integers that are unique for each galaxy; $|\vec{K}\bullet\vec{a}_{\rm o}|$ is the influence of nearby galaxies and is a correction term to the primary $P - L$ relationship; s determines the sign of the $|\vec{K}\bullet\vec{a}_{\rm o}|$ term; $\vec{K}$ is a constant vector common for all galaxies; $\vec{a}_{\rm o}$ is the acceleration vector that is calculated from the orientation of the host galaxy, the L of the neighboring galaxies, and the relative position of the neighboring galaxies; and $\sigma_{\rm e}$ is the standard deviation of the relative differences ($\delta P/P$) of the sample galaxies.

The STOE was applied to central region parameters. The sample included galaxies with rising, flat and declining RCs; galaxies with a wide range of characteristics; and galaxies excluded from samples of other studies of $\sigma_{\rm c}$ relationships. The equations have the same form as the STOE equations for the parameters of the HI RCs. For a sample of 60 Source galaxies and 22 Sink galaxies, the $\sigma_{\rm c}$ was found to correlate to the host galaxy's and neighboring galaxy's B band luminosity. The sample included galaxies with rising, flat and declining RCs; galaxies with a wide range of characteristics; and galaxies excluded from samples of other studies of $\sigma_{\rm c}$ relationships. For a sample of seven Source galaxies and 22 Sink galaxies, the $M_{\rm c}$ was found to correlate to the host galaxy's and neighboring galaxy's B band luminosity. The equations have the same form as the STOE equations for the parameters of the HI RCs. The Sources and Sinks act as monopoles at the center of the galaxies around them. The STOE is consistent with $M_{\rm c}$ and $\sigma_{\rm c}$ observations of the sample galaxies.

The STOE speculates structures of the central mass and the structure of stellar nuclear clusters are the same. The suggested CMO structure is a central Source of a matter-repulsive $\rho \propto R^{-1}$, where R is the galactocentric radius, surrounded by a spherical shell of matter. The STOE suggests the $L \propto \epsilon$, where ϵ is the Source strength, and, therefore, $F_{\rm s} \propto \nabla\rho$ at a given R on the cross section of matter $m_{\rm s}$. Therefore, the density ($m_{\rm s}/m_{\rm i}$), where $m_{\rm i}$ is the inertial mass, of particles at a given radius varies with L. Therefore, the galaxies with larger L will have more mass in the center shell to balance the higher $F_{\rm s}$ with the gravitational force $F_{\rm g}$. Therefore, the STOE naturally leads to the smoothness of the $M_{\rm cmo} - M_{\rm gal}$ relation for the full range of CMO spiral galaxies.

If this speculation is essentially correct, then the correlation of central parameters with spiral galaxy global and RC parameters suggests not only a similar galaxy formation process but also a self- regulatory, negative feedback process continually occurring. Feedback processes have been suggested in several recent studies of galaxies with CMOs (e.g. Li et al. 2006; Merritt and Ferrarese 2001a; Robertson et al. 2006). I further speculate the ϵ is the control of the negative feedback process. If the mass of the CMO increases, the F_{g} increases and mass migrates inward. At very high ρ, the high repulsive F_{s} compresses matter, the mass (black hole) cracks like complex molecules in the high heat and pressure of a fractional distillation process, and matter is reclaimed as radiation and elementary particles that form hydrogen. This accounts for the large amount of hydrogen outflowing from the Galaxy center and shocked gas near the Galaxy center. A single black hole reclamation event is consistent with the periodic X-ray pulses from the Galaxy center. Further, the feedback loop controlled by ϵ is the connection among the central parameters, outer RC parameters, and the global parameters of spiral galaxies. However, the ϵ of a galaxy acts only radially. Therefore, the $|\vec{K} \bullet \vec{a}_{\mathrm{o}}|$ terms effects are the asymmetry and the formation, evolution, and maintenance of the rotation of particles. This effect may be calculated only if the classification of parameters is first calculated.

Another speculation is that there may be galaxies with higher and lower values of ϵ than in spiral galaxies. For instance, QSOs may have a higher value of ϵ that ejects matter from a spiral configuration (e.g see the images of Sulentic & Arp 1987). A smaller value of ϵ would be insufficient to form a disk.

The L term is the primary, determining factor of the parameter relations. The neighboring galaxies cause the scatter noted in previous studies. The special focus of the present investigation included galaxies that are problematic in other models. Considering the range of observations and range of galaxy characteristics with which the STOE is consistent, the STOE is a relatively simple model.

3.10 Pioneer anomaly

The observations of z, of the Pioneer Anomaly blue shift z_{p}, and of the frequency shift of light in the Pound–Rebka experiment (Pound & Rebka 1960) are different physical phenomena. The STOE suggests they are the same phenomena of light that also produce interference patterns.

That an unexplained blueshift exists in the radio signal from the Pioneer 10 (P10) and Pioneer 11 (P11) spacecrafts (PA) is well established (Anderson et al. 2002; Toth and Turyshev 2006). The PA is expressed as an apparent acceleration. That the PA is a real acceleration is unproven. The “acceleration” nomenclature is based on the unsupported hypothesis that the frequency shift is caused by a Doppler effect. That the PA is Sun directed is unproven. The PA could be an effect such as a time acceleration (Anderson et al. 2002; Nieto and Anderson 2005) or an effect of an unmodeled effect on the radio signals.

Turyshev and Toth (2009); Hodge (2012b) discussed 12 characteristics of the PA. The common opinion is that cosmic dynamics according to General

Relativity has far too little influence in galaxies to be measurable and that the expansion of the universe is negligible for scales up to galactic clusters (Cooperstock et al. 1998; Sellwood and Kosowsky 2001). Further, the expansion of the universe indicated by z has a sign opposite to z_{p}. Several new physics models have been proposed (Anderson et al. 2002; Turyshev and Toth 2009) but fail and ignore most of the characteristics of the PA. Bertolami and Páramos (2004) concluded a scalar field is able to explain the PA.

Turyshev et al. (2012) supported a model suggesting a thermal recoil force was present in the P10. Turyshev et al. (2012) dealt with only the "acceleration" value. Much of the data used to calculate the forces are less well known or supported by other data. The thermal recoil model fails to explain the annual and diurnal variation adequately. Although unlikely, a currently unknown other systematic effect is not entirely ruled out. Although incomplete, the thermal recoil force hypothesis has become strongly preferred by conservative science (ten Boom 2013, and references therein). However, ten Boom (2013) noted John D. Anderson in a recent interview argued "...that the new analysis has mis-modelled (sp) the solar radiation pressure."

Only one model presented to date is consistent with *all* 12 of the characteristics (Hodge 2006e, 2010, 2012a,b, 2013a,b). The STOE (Hodge 2006e) argued that matter causes a warp of the ρ field that causes the PA. The $\rho \propto -R^{-1}$ of the warp induces the H_{o} value and the connection to z observations. That is, the PA is an effect on only the radio signal. Therefore, gravitational attraction, the weak equivalence principle, and the planetary ephemeris remain as described by General Relativity.

Hodge (2006e) applied the galaxy redshift equation to the PA. The K_{min} term in the equation derived by Hodge (2006e) resulted from the flow from Sources. The K_{vp} term results from the relative movement of galaxies. Therefore, $K_{\mathrm{min}} = 0$ and $K_{\mathrm{vp}} = 0$ for the static warp field of matter in the Solar System. The resulting equation for the calculated redshift z_{p} for the solar system scale PA is

$$z_{\mathrm{p}} = \mathrm{e}^{-X_{\mathrm{p}}} - 1, \tag{10}$$

where

$$X_{\mathrm{p}} = K_{\mathrm{dpp}} D_{\mathrm{l}} P + K_{\mathrm{p}} P + K_{\mathrm{fp}} F, \tag{11}$$

where the terms are defined in Hodge (2006e), $D_{\mathrm{l}} = 2D$ is the distance the radio signal travels, and D is the geocentric distance to the spacecraft.

The STOE obtains the H_{o} value by $z_{\mathrm{p}} \longrightarrow \exp(-X_{\mathrm{p}}) - 1 \approx -X_{\mathrm{p}}$. A plot of D_{l} versus X_{p} shows a straight line The line is

$$\begin{aligned} D_{\mathrm{l}} &= (2800 \pm 200\mathrm{Mpc}) X_{\mathrm{p}} + (5 \pm 2) \times 10^{-11}\mathrm{Mpc} \\ &\approx -\frac{c}{H_{\mathrm{op}}} z_{\mathrm{p}} \end{aligned} \tag{12}$$

at 1σ and with a correlation coefficient of 0.95. $H_{\mathrm{op}} = 106 \pm 8$ km s^{-1} Mpc^{-1}.

Further, the STOE predicted PA observations are (Hodge 2013a):

(1) The data before the flyby encounters were insufficient to detect the PA

(Turyshev and Toth 2009). The STOE requires this rather than there was no PA before the encounters as suggested by several other models.

(2) "Although the Earth directed PA is marginally preferred by the solution, the Sun, the Earth, and the spin axis directions cannot be distinguished." (Turyshev et al. 2011, see Table III). An Earth directed PA suggests a signal related cause that the STOE calculates rather than acceleration of the spacecraft that all other models calculate. Anderson et al. (2002) examined commonly accepted models of the impact of various phenomena on the signal and concluded the commonly accepted models do not account for a signal blueshift effect. The STOE model is a model of a signal effect and, therefore, is Earth directed. Because the vast majority of PA papers considers the PA to be Sun directed and because most of the data points are with a Sun-Earth-spacecraft angle of less than 45 degrees or greater than 135 degrees, that the Earth direction is "marginally preferred" is remarkable.

(3) "The data favor a temporally decaying anomalous acceleration with an over 10% improvement in the residuals compared to a constant acceleration model." (Turyshev et al. 2011). Equation (2) and Section 3.4 of Hodge (2006e) suggest the decline is exponential except when the signal passes near a large mass such as during flyby maneuvers. Turyshev et al. (2012) did not study the flyby maneuvers.

The PA and the z of cosmology are the result of the same ρ effect on light. The z follows the Hubble law in the cosmological z calculation if $\rho \propto R^{-1}$. The z_{P} in a gravity well follows the negative Hubble law if $\rho \propto -R^{-1}$. The presence of other galaxies near the path of the light causes P and F variation of z. This is also the effect of matter close to the line of sight in the PA. The Hubble law and $a_{\mathrm{P}} \approx cH_{\mathrm{op}}$ in the STOE are manifestations of the Newtonian spherical property.

The Pound–Rebka experiment (Pound & Rebka 1960) is modeled to be caused by gravity. The result was confirmed by Pound & Sneider (1964) and Vessot (1980). The Pound–Rebka experiment emitted light over a vertical distance of 22 meters in Earth's gravitational field. The experiment included the source at the top and the source at the bottom of the distance. A blueshift and redshift, respectively, were observed. The two currently accepted models refer to this phenomenon as a "gravitational redshift". The Strong Equivalence Principle model refers to frequency shift of wave–like light caused by the difference in gravity between the top and bottom. The Weak Equivalence Principle model refers to the energy gain or loss, respectively, of particle–like light moving through a potential field. The Strong Equivalence Principle calculation involves a square root of the potential difference. Hence, the "redshift" term in "gravitational redshift". However, a blueshift was also observed. Therefore, the weak equivalence principle model with a photon seems a better model.

The problem with the Universality of physical laws is that some laws may be difficult to measure on Earth. The greater number of pioneer maneuvers, the greater solar pressure on the spacecraft closer to the Sun, and the age of the earlier PA data cause the earlier data that resulted in the thermal model and confirmation of the predictions of the new physics (STOE) model to be of low quality (ten Boom 2013). However, this is more than compensated by the reductionist philosophy of the STOE model. The PA is only one of three sets of different types of observations suggesting the same new physics model. The PA is the galaxy redshift model without the galaxies influence. It has the influence of only the masses of the planets and Sun. The Pound–Rebka experiment is the galaxy redshift model with the influence of only the Earth's mass. Therefore, instead of questioning the viability of the reductive agenda, the STOE model supports a reductive philosophy.

The link between z, z_{p}, and the Pound–Rebka experiment is a case where conservatism should yield to observation and a reductive model that explains the observations.

3.11 Photon Diffraction

The STOE proposes a model of light that postulates the necessary characteristics of photons to satisfy observations and yield diffraction phenomenon. The model combines Newton's speculations, Democritus's speculations, the Bohm interpretation of quantum mechanics, and the fractal philosophy. The wave–like behavior of light results from the photons changing the Ψ–field that guides the path of the photons. The resulting model is tested by numerical simulation of diffraction and interference, with application to the Afshar experiment. Therefore, the wave characteristics of light may be obtained from the interaction of photons and Ψ–field.

The STOE model was tested by explaining the diffraction and interference of light (Young's experiment).

Newton in his book Opticks (1730) speculated light was a stream (ray) of particles. The aether in query 17 overtakes (travels faster) the rays of light and directs the rays' path. Newton's analogy was of water waves. That is, Newton was using a self-similarity (fractal) postulate. The rays of light recede from denser parts of the aether in query 19. The aether grows denser from bodies in query 20 and this causes gravity in query 21. Newton seems to have suggested light is particles that are directed by the aether to produce the wave phenomena. The prevailing models of the 19th century considered light to be a wave. The prevailing interpretation of Newton's model is that Newton was suggesting light is both a wave and a particle rather than two entities having differing effects like a rock (photon) creating transverse waves in water (aether). Newton's third law suggests that if the Ψ–field acts on photons, the photons and other matter should act on the Ψ–field.

The model was developed in Hodge (2012c). The photon is a column of hods traveling parallel to the surface of the hod. It presents no cross section to the direction of travel and, therefore, travels as fast as allowed. No other matter can travel faster. Because each hod must make coherent waves in the plenum, the photon must be emitting a diffraction pattern into the Ψ field like a radio dipole antenna array. The STOE suggests the c changes with ρ (Hodge 2012b) that depends on the intervening galaxies' characteristics. Hodge (2015) adds to the model by incorporating Newtonian considerations, and a view of single

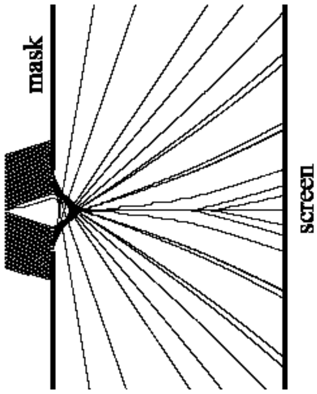

Figure 11: Plot of the trace of the paths of photons for a sample of the photons through the single slit mask according to the STOE simulation.

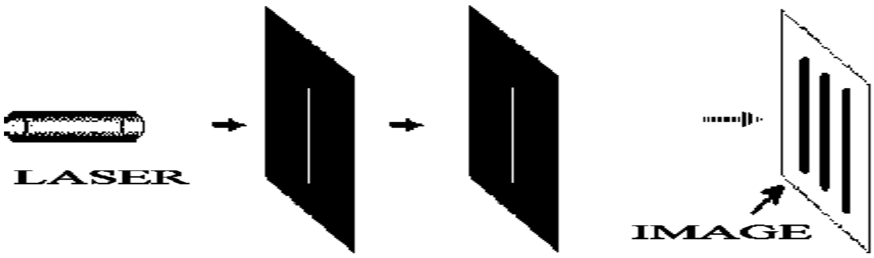

Figure 12: Diagram of the experimental fixtures.

photon in the experiment that requires the reflection of the plenum wave from molecules (atoms) in the mask.

The test was done.

Introducing a second mask was used to achieve coherent photons through one side of a slit. Figure 12 shows a diagram of the experiment.

Other configurations were tested.

The result rejects current models (wave) of light and do not reject the hypothesis. Further, the model has in it a means to falsify the model and a prediction for the result of a future test. This model is very close to satisfying the full requirement of a theory that no other model of Young's experiment does. This test is seen in the calculated patterns on the left side of the patterns of the various experiments in the above paper. I estimate the equipment must measure to 0.0001 lx (very expensive) and have a more powerful laser (at least 10 mW). If the predictions were confirmed, this would be a confirmed theory of light in QM.

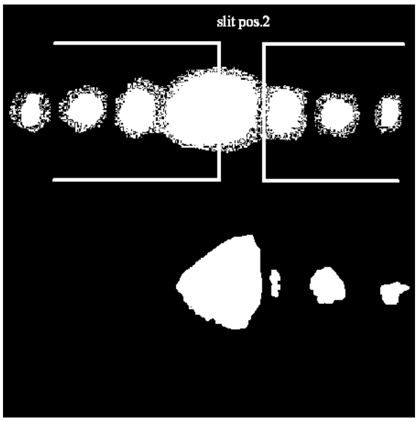

Figure 13: The top image shows the placement of the second mask slits relative to the first mask image. The bottom image is the photograph converted to black and white result on the screen.

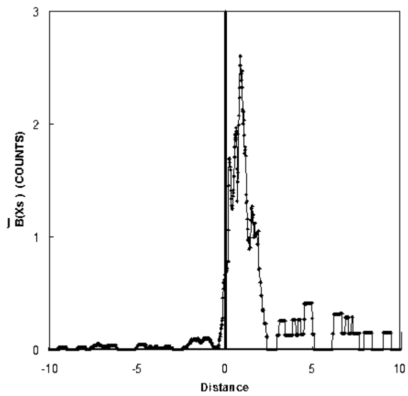

Figure 14: The simulation of the slit over the minima from the placement of slit of Fig. 13. The vertical line marks the center.

4 Discussion and conclusion

The STOE supports the viability of the reductive agenda. The STOE postulates a unification of the standard model's three forces and GR. Physical reality has two distinct domains of hods and of plenum that interact. Further, the STOE principles may be applied to life and survivability (Hodge 2012a).

The STOE suggests the wave behavior and speed of waves in the plenum could be used to form a relationship of the microscopic world and the macroscopic world regarding quantum decoherence and quantum entanglement.

Modern standard models have several observational difficulties. The STOE is less developed. However, the STOE shows how many different phenomena can be included in a single model and to reduce the sample bias (encompass more sample data) such as including rising and falling RCs.

Although the creation of the STOE followed the methods of the creation of most heterodox models[3], the STOE is an orthodox rather than a heterodox model. The current standard models became dominant because they explain more phenomena than alternate models. The STOE corresponds to the Big Bang and Quantum Mechanics and explains more data(Hodge 2014). The STOE holds the standard models to be limited not wrong. This suggests the mainstream evolution of models should come to model many of the STOE features.

The next thing for the STOE is to model "What is a Charge? and "What

[3]A creative individual working alone who doesn't require funding from the social media.

is the E field?" The structure of the electron also must be different than the discussions. One of the characteristics of the E field is that variation has a velocity of c, not more and not less than c like photons. The STOE suggest the photon has the highest speed of matter because the hods of a photon travel with the minimum dimension presented to the direction of travel. So it must be for the E field. The speed of plenum waves are orders of magnitude faster than c. Therefore, the E field is hods emitted by charged particles with an inverse square property like light and gravity to get the 1/r dependence. But electrons and other matter do travel less than c. Therefore, their structure must present a surface to the direction of travel. That is, all proposed models must have something to do with the hods - perhaps an oscillation like a drumhead. The structure of charged particles is that they must be continually emitting and absorbing hods.

Another avenue of research is the distance and nature of QSOs. Arp (1998) suggested QSOs are much closer than popular science suggests. The QSOs may be Sources without the mass of a spiral galaxy to reduce the effective Source strength (Source strength - mass) thus accounting for the higher z value. This may be tested by noting the redshift correlation of Hodge (2006a) and calculating the position and Source strength as Arp (1998) suggests.

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