The new galactic dynamic

A complete model of DE, DM and their role in forming galaxies

By James E. Beichler

Abstract: This paper is nothing short of a positive and complete verification of the unification of current physics paradigms of single field theory (SOFT) in light of recently published observational data in astronomy. An article by Sabine Hossenfelder and Stacey S. McGaugh, titled "Is Dark Matter Real?', has just appeared in the August 2018 issue of *Scientific American*. Every physicist, astronomer, astrophysicist and cosmologist as well as everyone interested in science needs to read this article because it portends one of the greatest scientific advances in several hundred years, the complete unification of physics and science in general. Due to new observational evidence in astronomy, they have concluded that "Astrophysicists have piled up observations that are difficult to explain with Dark Matter. It is time to consider that there may be more to gravity than Einstein taught us." But they have understated the case. In effect, the new observational data found by McGaugh and an international group of astronomers clearly shows that specifically designated dark matter particles do not exist, so the supposed Dark Matter halos around spiral galaxies do not exist and the rotational speed discrepancies in galaxy orbiting stars and star systems that go unaccounted for by normal gravity are, in fact, due to a secondary effect of normal matter within the galaxy. This finding not only challenges the present theories of gravity (Newtonian and Einsteinian), which it demonstrates are incomplete, it also blows some big logical holes in the fundamentality of the quantum theory, the Standard Model of point-particles and quantum field theories in general that seem to rule the world of modern theoretical physics. Given other recent confirmations of Einstein's general relativity, found mostly in the detection of gravitational waves that Einstein predicted a century ago, relativity theory seems on the ascendancy and quantum theory is falling behind. The time for a unified field theory that combines the best of both paradigms is at hand.

Keywords: unification, single field theory, Dark Matter, Dark Energy, galactic dynamics, verification, UDGs, DM dominated galaxies, galactic survey, 4-D space, 5-D space-time, single field potential, quantized curvature, modified gravity theory

The problem

In November of 2016, Stacey McGaugh, Federico Lelli and James Schombert published an article in *Physical Review Letters* titled "Radial Acceleration Relation in Rotationally Supported Galaxies." There was nothing especially conspicuous about the article at first glance, but its ramifications will eventually go far beyond its innocuous looks and title. Quite frankly, the observations and conclusions reported in this article may well initiate a new scientific revolution in physics. These astronomers employed the new Spitzer Photometry and Accurate Rotation Curves (SPARC) database of 175 disk galaxies and narrowed the number down to 153 galaxies "representing all rotationally supported morphological types" (McGaugh, et al, 1) giving them a sample size of 2693 data points. In doing so, they took absolutely no heed of any particular Halo or Dark Matter model and only looked at "the distribution of dark matter follow[ed] directly from the relation [between dark and baryonic matter], and [could] be written entirely in terms of the baryons," thus concluding that the "dark and baryonic mass [were] strongly coupled" without reference to some form of Dark Matter. Therefore, there would be no need to hypothesize or assume the existence of any type of dark matter particles or any other quantum particle that displays the same properties and physical characteristics as dark matter. What science mistakenly refers to as "Dark Matter" or the "Dark Matter Halo" is just a natural gravitational effect of the normal baryonic matter in any given spiral galaxy.

Although the interaction of the alleged DM/DE and normal matter shows up more readily in the radial velocities of galaxies, McGaugh, et all, purposely chose to ignore the radial velocities in lieu of radial accelerations and demonstrated that "the correlation between the radial acceleration and that predicted by the observed distribution of baryons". No extra dark matter particles laying outside the galaxy in a halo are necessary to explain the anomalous motion and velocities of stars in the outlying portions of the galaxies, i.e., the spiral arms, beyond the galactic core. Given this, they concluded that

> Possible interpretations for the radial acceleration relation fall into three broad categories: (1) it represents the end product of galaxy formation; (2) it represents new dark sector physics that leads to the observed coupling; (3) it is the result of new dynamical laws rather than dark matter. None of these options are entirely satisfactory. (McGaugh, et al, 4)

In other words, an empirical relation for their findings regarding the radial acceleration (and thus the radial velocities), tantamount to an internal structural relationship, must exist independent of any presently accepted theoretical models and hypotheses. This would include the current belief that dark matter particles create the 'halo' that surrounds galaxies. The new structural component of the baryons that constitutes the normal internal gravitational structure of the galaxy (Newton's law and Einstein's general relativity) must be incomplete, while the "radial acceleration relation appears to be a law of nature, a sort of Kepler's law for rotating galaxies" that goes beyond presently accepted gravitational models and points to a new "natural law for rotating galaxies". (McGaugh, et al, 5)

These findings are revolutionary because they demonstrate that the existence of the physical effects presently attributed to particles of DM and/or DE cannot be any form of Dark Matter and/or Dark Energy particles, neither of which really exist. This finding implies that science needs a fundamental and radical modification of our old physics, of not a whole new physics. The McGaugh group's observational research clearly indicates that all previous dynamical models of gravity, classical and quantum, are inadequate at present to explain their results, while modifications to the dominant quantum particle models have been thoroughly discredited and thrown out the window. So, whatever form the proposed new dynamical law of nature to explain this 'dark effect' finally takes, it must both incorporate and go beyond the already successful theories of gravity as well as the Standard Model of the quantum which wrongly posits 'axions' as the leading candidate for Dark Matter. However, as groundbreaking and revolutionary as this research has been, it is useless unless it is recognized, accepted and popularized within the scientific community, and the sooner the better given the present state of war between relativity and the quantum in modern physics which is further enhanced by the growing failures of the Standard Model to further theoretical physics.

Popularization of the research

The popularization of this and similar research, the 'getting it out there and known' part of conducting science within the general scientific and intellectual communities, are an integral and necessary part of the revolution in science that has begun. In this respect, Sabine Hossenfelder and Stacy McGaugh's popular article in the August issue of *Scientific American* was a very welcome breath of fresh air in the overly stilted and polluted scientific atmosphere of 'everything physics is the quantum and nothing else'. But you cannot make an apple pie if you have only peaches and pears. If you want an apple pie, then replace the peaches or pears with apples. For the same reason, Modified Newtonian Dynamics or MOND doesn't so much as imply the need to

change Einstein's metric space-time model, as stated in the article, but instead implies modifying Newtonian gravity theory or MONG. Successfully developing MONG (replacing the peaches with apples) would then imply that modern general relativity is incomplete, and a modified theory of general relativity (traditionally called the unified field theory) needs to be developed. However, all of this has already been accomplished.

Oliver Heaviside modified Newtonian gravity theory in 1891 by adding a new term, such that $\mathbf{F}_{gr} = m\mathbf{g} + m\mathbf{v} \otimes \mathbf{S}$, instead of just Newton's $\mathbf{F}_{gr} = m\mathbf{g}$. Heaviside's reason for doing so was simply to correlate gravity theory with electromagnetic theory as summarized in the Lorentz equation $\mathbf{F}_{EM} = q\mathbf{E} + q\mathbf{v} \otimes \mathbf{B}$. However, this new equation implies that there is a dual geometrical structure to our commonly experienced space, in that it can be represented as either an extension (as m**g** and q**E** in Newtonian relative space and $\mathbf{G}_{ij}{}^{k}$ in modern relativity) or point (as q**v** ⊗ **B** and m**v** ⊗ **S** in Newtonian absolute space and Ψ in modern quantum theory) space. When the Heaviside equation is rewritten in terms of kinetic energy, $\mathbf{F}_{gr} = m\mathbf{g} + (2KE/\mathbf{v}) \otimes \mathbf{S}$, it has an inverse relationship to the centripetal speed of an orbiting object which yields (predicts) a similar graph to that given by Hossenfelder and McGaugh to explain the constant radial accelerations of star systems in the spiral arms of galaxies with no reference to a particulate Dark Matter halo.

The Heaviside equation can also be written in terms of the de Broglie wavelength, $\mathbf{F}_{gr} = m\mathbf{g} + (h/\lambda) \otimes \mathbf{S}$, which simply but effectively quantizes Newtonian gravity. This new formula demonstrates that normal gravity is strictly an extension (relative structural) phenomenon and the quantum strictly a point (change in structure) phenomenon. This interpretation means that no such thing as a graviton need or can exist and the Standard Model of the quantum can never, nor for that matter can any quantum theory ever, explain simple (**F**=m**g**) gravitational attraction.

This equation is also important because it implies that the space-time metric used in general relativity is incomplete, as Einstein knew it was, but not exactly in the way that he thought it was. However, Einstein was thoroughly convinced that the incompleteness of the Riemannian metric he used in general relativity could only be used to unify gravity and electromagnetism, and that was his and his colleagues' mistake. As early as 1947, Erwin Schrödinger pointed out to Einstein that the Einstein-Cartan anti-symmetric tensor is a more general example of the metric tensor plus Einstein's non-symmetric tensor plus a constant he dubbed **Λ**. In his 1951 book *Space-Time Structure*, Schrödinger suggested that **Λ** could possibly be associated with either the Yukawa potential, Einstein's earlier cosmological constant or a new gravitational effect. In other words, Schrödinger very nearly predicted Dark Matter (Λ_{CDM}) in the late 1940s.

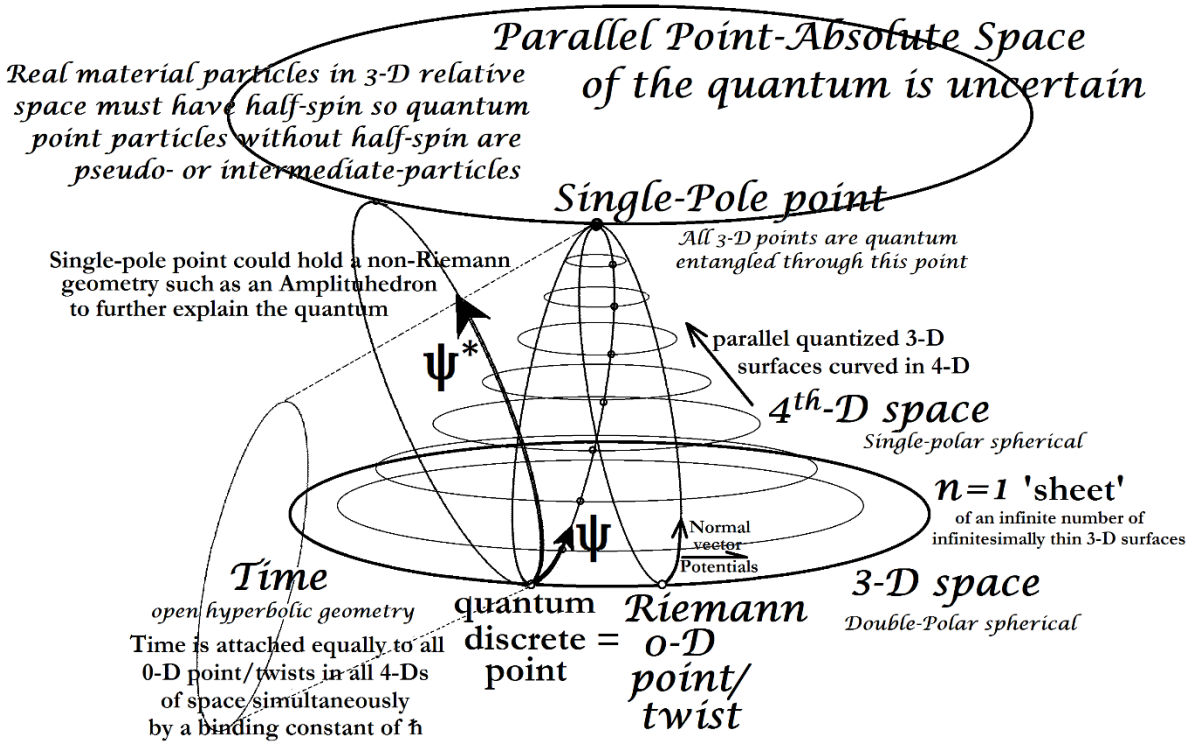
Since Einstein had been burned so badly with his earlier cosmological constant, he rejected the notion of the **Λ**-constant altogether but continued to work on the Einstein-Schrödinger non-symmetric tensor as a representative of electromagnetism in the unified field. When Einstein calculated the effect of his non-symmetric field on a charged particle, his calculations showed the effect to be negligibly small and indifferent to the electrical charge, thus depending only on mass. So, it almost seems like Einstein unwittingly and unintentionally calculated what is today called the Dark Energy effect on a charged particle as a secondary effect of gravity just as Schrödinger had forecast, and without realizing it, the existence of $\mathbf{\Lambda}_{CDM}$ or the Dark Matter effect. Yet, both men were so obsessed with unifying gravity and electromagnetism that they missed the new 'Dark' point or point-element effects of normal matter due to the point-geometry of space, as opposed to the extension or metric-element structure of space.

Now, why is this still important if it already implies that general relativity is incomplete but can be easily modified to account for what is mistakenly called Dark Matter and Dark Energy? It is important because it implies that the other point-method of unification, extending a three-dimensional point in space into a higher embedding dimension, can unify the new modified anti-symmetric tensor and electromagnetism. Now the work of Theodor Kaluza in 1921, Oskar Klein in 1926 and Einstein, Peter Bergmann (1938) and again with Bargmann (in 1941) becomes crucial to unification of not only electromagnetism and gravity, but the quantum and gravity. Bernhard Riemann's original surface geometry depended only on extension or metric-elements because he was unable, by his own admission, to account for point-elements in the geometrical structure. But now, modifying Riemannian geometry to include point-elements allows the derivation of the mathematical/physical characteristics of the fourth embedding dimension of our extrinsically curved four-dimensional space-time continuum.

While our three-dimensional space continuum is double-polar spherical according to Einstein, the higher fourth-embedding dimension of space is single-polar spherical. This structure is necessary to give our experienced three-dimensional space its physical characteristics and, in fact, explain the half-spin of real material particles. For example, all possible rotations that can be made in three-dimensional space require a four-dimensional algebra to fully describe them as was clearly demonstrated by William Rowan Hamilton in the 1843 when he developed his quaternion algebra. Quaternions are literally four-dimensional numbers, which is why they were adopted and adapted by Clifford as biquaternions to explain his four-dimensionalization of Maxwell's electromagnetic theory in 1873 after he added the 'twist' using Riemann's geometry of surfaces. All we need then is a geometry that includes both extensions and points, both adequately defined relative to each other, and that geometry was developed just recently. (Beichler, 2012)

Now that we have a model for the embedding dimension, we only need apply Kaluza's theory to completely unify gravity and electromagnetism. Since the fourth dimension of space is a continuous dimension filled by an infinite number of infinitely thin parallel surfaces along the lines that Einstein, Bergmann and Bargmann reasoned, with each surface having the same physical characteristics or physics, all we need to do is apply Klein's suggestion that we quantize the fourth direction of the embedding space to quantize our three-dimensional material world. This can be done successfully by establishing equally thick quantum-sized 'sheets', each consisting of equal infinite numbers of infinitesimally thin parallel three-dimensional surfaces, which allows us to successfully unify the quantum at Riemannian point-elements in three-dimensional space called 0-D point/twist Voids.

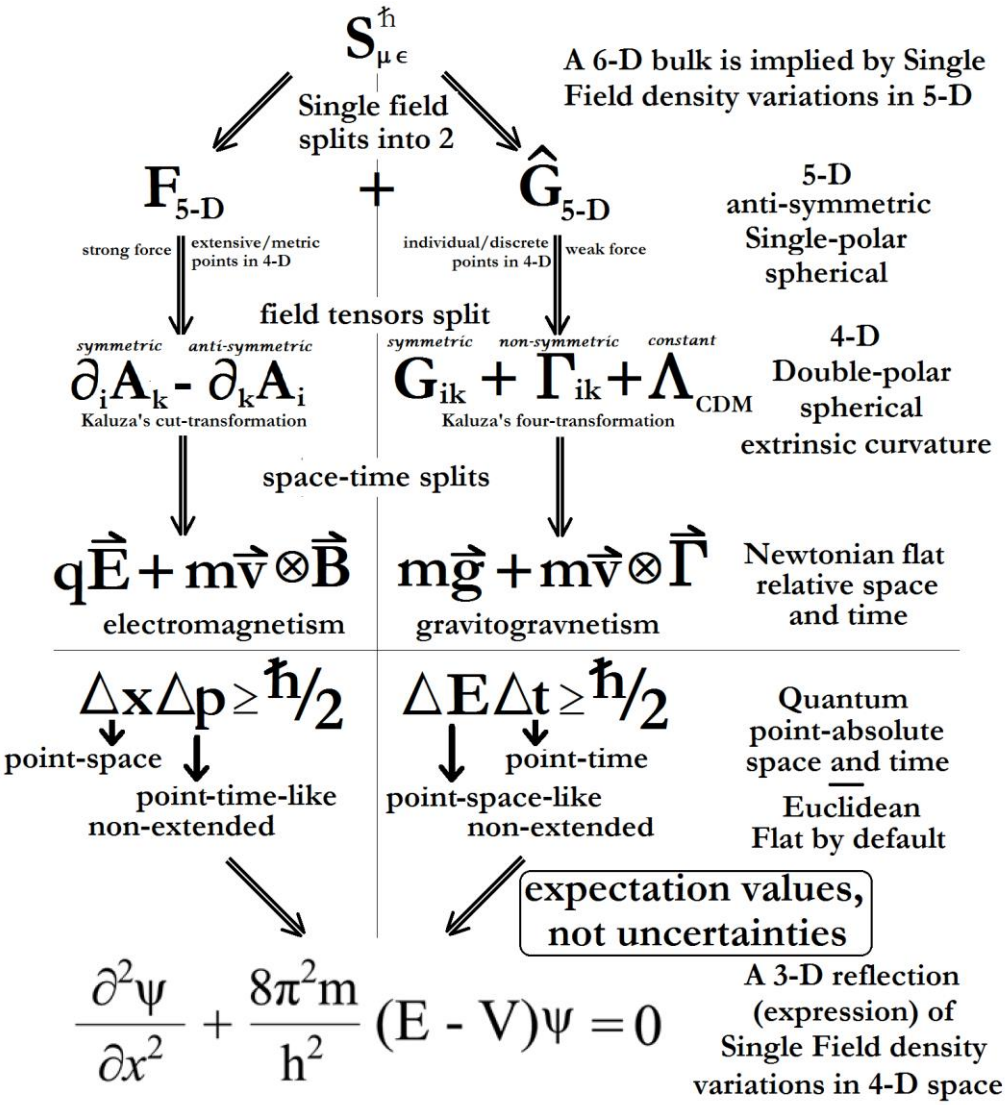
It can also be shown (in this case proven) that the mathematically probabilistic quantum theory acts within a mathematical, but not physical, parallel point-absolute space. When Schrödinger's Ψ-function collapses to its relativistic reality with the observer by physical means of measurement (observation, experiment, entanglement), the quantum-point in point-absolute space is reduced and made to conform with the restrictions of physical laws and rules of our normally experienced three-dimensional relative space or four-dimensional space-time.



In other words, the discrete point in quantum theory coincides with the 0-D point/twist Void in the three-dimensional surface space of a physically extended relative Riemannian geometry expressed by the new extended version of relativity theory known as SOFT.

The point-particles of the Standard Model in quantum theory have now been reduced to three-dimensional point-elements in the new theory (0-D point/twists) and the various quantum fields are no more than different contextual aspects of the single field potential associated with the point-elements or what we physically identify as 0-D point/twist Voids in the context of SOFT. The new unification theory is called SOFT or single (operational) field theory instead of the unified field theory (Beichler 2012-2018) because the inherent fields and material particles/objects in our commonly experienced three-dimensional space are just individual density pattern structures in the single field from the four-dimensional point-of-view. All the present laws and theories of physics now fall in together to form a single structure that we call nature and/or our physical reality.

Single field theory, or SOFT, is summarized below in one simple diagram.



Single field theory or SOFT needs to be recognized, popularized, vetted and confirmed by the scientific community because it is the only theory which offers science a true unification, rather than a takeover by one paradigm or another, if not a complete rewriting of all science in new as yet unidentified or undefined terms, of all known and accepted physical theories and laws. The physical reality of the fourth embedding dimension of space is the most important aspect of SOFT and differentiates it from other theories, while the final verification of its existence will do more to verify the whole of SOFT than any other prediction that can be made by the SOFT model of physical reality.

The Heaviside equation and anti-symmetric tensor (Einstein-Cartan, 1929) are not unknown in science, but used widely in the alternative physics community dealing with GEM (gravito-electromagnetism) and similar torsion-space theories. However, the discrete points of space are not torsion-points as they believe, but rather discrete points of space characterized by an internal three-dimensional twist (W.K. Clifford, 1873) whereby torsion represents a twist acting through some extension. If the twist is within a three-dimensional point, then the torsion occurs along an extension in the fourth dimension of space, which is not covered within the

various torsion-field theories popular among some alternative theoretical physicists since their torsion fields are completely three-dimensional.

The torsion-field theorists have made many predictions for their theory to be tested but have not yet developed a complete model of gravitation that would include Dark Matter/Energy in their theories, let alone gone further to develop a comprehensive unified field theory such as SOFT, because they have not related their concept of torsion to the concepts of DM and DE. Yet their calculations can still be applied and used to verify parts of SOFT because the DE effect that they really portray is a three-dimensional surface phenomenon, but what is needed at this time to validate SOFT is a single prediction which can verify the whole theory in one shot. It is how everything, all the various parts of the theory, fit together seamlessly to complete the whole of our reality, as specified in all the different paradigms of physics, that is the best evidence of SOFT's overall validity and truth. It is within this context that the hoped-for Grand Unification of physics has now been completed and the work that Hossenfelder and McGaugh have written about is just the first significant verification of the new theoretical model.

Predictions of the SOFT model

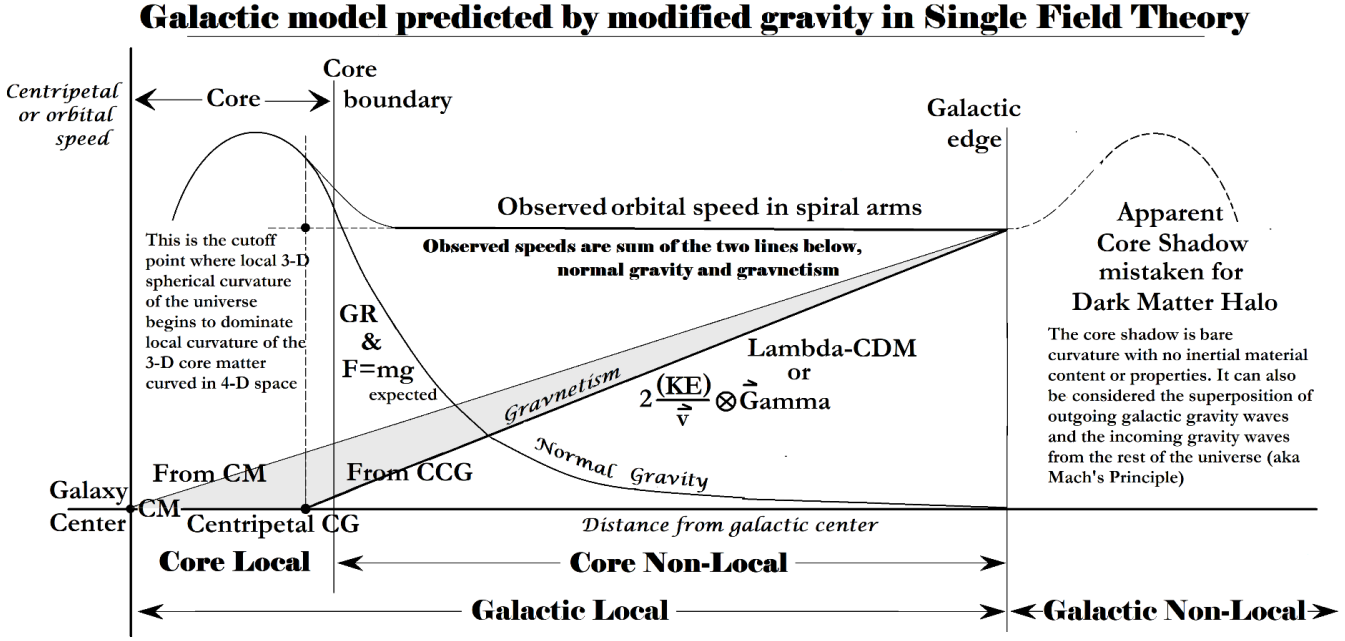
The SOFT model of DM and DE originated in 2003, but all attempts to publish the original article failed (including placement of the article on arXiv.org for commentary purposes) and the theoretical research that the article was based upon was overwhelmingly rejected. An extended version of the original article was finally published in 2010, but in an alternative physics publication rather than a mainstream journal or book, so it has had little recognition or effect on the scientific community except, perhaps, as a curiosity. However, one of the major predictions made in that article has now been verified by McGaugh's, et al, observations. The simple truth is that the massive core of a galaxy creates an apparent shadow (apparent curvature without inertial mass or actual material content) as a hyperspatial remnant around the galaxy that is misinterpreted as the suspected DM Halo. The existence of the so-called DM Halo is only implied (it cannot be directly measured or observed) by the fact that the radial speeds of stars in the galactic rim are nearly constant and this fact cannot be accounted for by normal gravity theory, whether Newtonian $\mathbf{F} = m\mathbf{a}$ or Einsteinian $\mathbf{T}_{ijk} = \mathbf{G}_{ijk}$.

This purely physical fact implies a strictly linear factor is added to the stars' speed as the distance from the galactic core outward increases. SOFT explains this an absorption of negative single field potential, otherwise called the DE effect, by the stars in the rim that inversely increases radial speeds in the spiral arms of the galactic rim (according to their distance from the center of the galaxy). The stars literally absorb DE to compensate for the four-dimensional differences associated with the internal three-dimensionality of the galaxy and the much weaker three-dimensionality of the spherical surface of the universe. So, the McGaugh group's data not only confirms the SOFT model, but more importantly it irrefutably brings the strongest possible evidence that our universe is spatially four-dimensional, or rather we live in a physically real five-dimensional space-time continuum even though we are materially three-dimensional.

The following graph is based on the SOFT model and the comments that go with it give a more elaborate and complete description (prediction) of how normal baryonic matter in the form of the stars and star systems that exist in the galaxy interact with normal matter in the core to form spiral galaxies as predicted by either modified Newtonian gravity, in the form of the Heaviside equation, and/or modified Einsteinian gravity, in the form of the anti-symmetric tensor which yields a constant factor of Λ-CDM. Both 'classical' theoretical models

are affected in a similar matter because real physical space has a dualistic nature representing the difference between point and extension in the geometry used to describe gravitational interactions of material bodies. The graph clearly and decisively shows the relationship between actual radial speed of stars and their distance (radius) from the galactic center is affected linearly as a function of the distance from the CCG or centripetal center of gravity, rather than the normally thought CM/G, by Dark Energy in the form of negative single field potential.

In this case, the relationship is idealized for modelling purposes, although the graph roughly represents the case for Andromeda or a common spiral galaxy with similar star distribution characteristics in its core and rim.



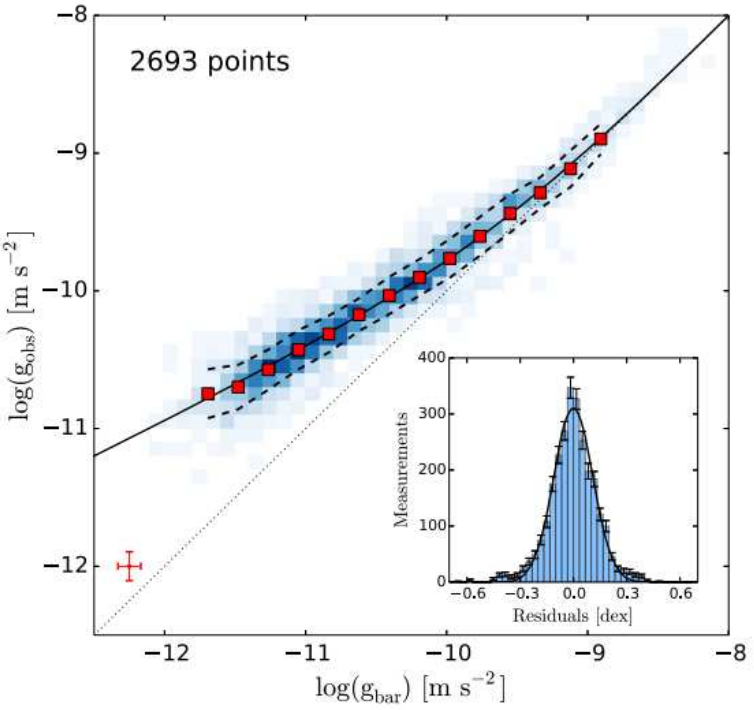
A new physical characteristic which is essential to determining the speed and radial relationships within a galaxy is introduced in this model – the CCG. CCG stands for the 'centripetal center of gravity' or the 'center of gravnetism', where gravnetism is the name of the new secondary gravitational component due to the point-nature of physical space. The area (as well as the three-dimensional volume) between the CM/CG and the CCG is core curvature dominant while the area of the galactic plane (and the three-dimensional galactic volume) from the CCG out to the furthest reaches of a galaxy at its edge is universe positive curvature dominant.

The grey area of the graph indicates the range of the core's direct influence on radial speeds for variously composed galaxies, and thus radial acceleration, and the CCG. The exact position of the CCG depends on the relative masses of the central body/object, the masses and distribution of masses in the core and their mass relative (which together constitute the core-local mass) to the mass and its distribution in the rim and spiral arms (core non-local mass). In other words, the CCG will be somewhere between the CM/G and the core boundary for well-defined galaxies with a core, depending on the ratio of core mass to rim mass. The CCG literally marks the point where the three-dimensionality of the core becomes dominant over the three-dimensionality of the universe's positively curved surface within the context of a real four-dimensional space. So, the verification of this SOFT model of galactic dynamics opens the gate for a new explanation of galactic dynamics or at least shows that such an exploration could be scientifically profitable.

Galaxies form or shape themselves around or according to the CCG or cutoff point between the core matter curvature and the local spherical surface curvature of the universe (Gamma), which is constant and continuous and represents the mass of galactic components (stars), their density distribution and the radius of any particular galaxy relative to the overall curvature of the universe. The CCG is the Centripetal Center of Gravity or alternately, the Center of gravnetism along any radius to an orbiting body from the core CM. The CCG is key to understanding galactic structure and dynamics. The CCG is different for every galaxy, depending on component star masses, sizes and characteristics, their relative positions, distribution, density of distribution, number and the overall galaxy size (radius).

For an overall larger core mass relative to the spiral arms' mass, the core center of gravity or mass is closer to the overall centripetal center of gravnetism. The CCG is a single point along the outward radius in the galactic plane but forms a ring around the core CM in the two-dimensional galactic plane. How 'lumpy' or distorted the ring is depends on both the mass density and the distribution of stars in the core as well as in the arms. The CCG forms a spherical (or elliptical, oval or egg shape) boundary or shape in 3-D space connected to the ring of interactions surrounds the core. The ring is only the part of that sphere that intersects the galactic plane. If a supermassive black hole is at the galactic center, the CCG moves closer toward the CM of the galaxy. If a less massive black hole and/or a greater number of massive stars inhabit the core (relative to the mass of the central object/body), then the CCG moves further away from the CM of the galaxy toward the core boundary. The core boundary would also move to the right or left for a vastly different variety of galaxies depending on relative distribution of core stars (whether massive or less massive) relative to the number of stars and their masses in the spiral arms, their distances from the galactic centered boundary, and the density of stars in the core as well as their distances from the galactic center. Statistical speaking then, it is highly unlikely that two galaxies would have the same structure.

All McGaugh and group's observations fall between the ideal CM line and the CCG line shown above for a variety of galaxies with different structures and different CCGs but tend closer to the CCG line the greater the radial distance of any given star in the spiral arm from galactic center. Thus, verifying the SOFT model and the hypotheses (that our commonly experienced three-dimensional space is embedded in a physically real and macroscopically extended four-dimensional manifold or space) upon which it was originally developed.



(McGaugh, et al, 4)

Given all of this, we still have two problems to solve, because radial (centripetal) speeds, which are constant, cannot account for the apparent stability of the spiral arms: (1) If the observed radial speed (and thus the acceleration as observed by the McGaugh group) is approximately constant throughout the spiral arm, how does the spiral shape maintain itself over time; and, (2) how does the spiral form in the first place? The answer is easy. We turn to the fundamental force of electromagnetism, or in this case the simple magnetic **B**-field in three-dimensional space. The radial speed emanating outward from the polar axis of the **B**-field at the CM is constant at all points along the radial length, which creates a rigid 'plate', platform or template of sorts, upon which orbiting stars in the spiral arm 'ride' along.

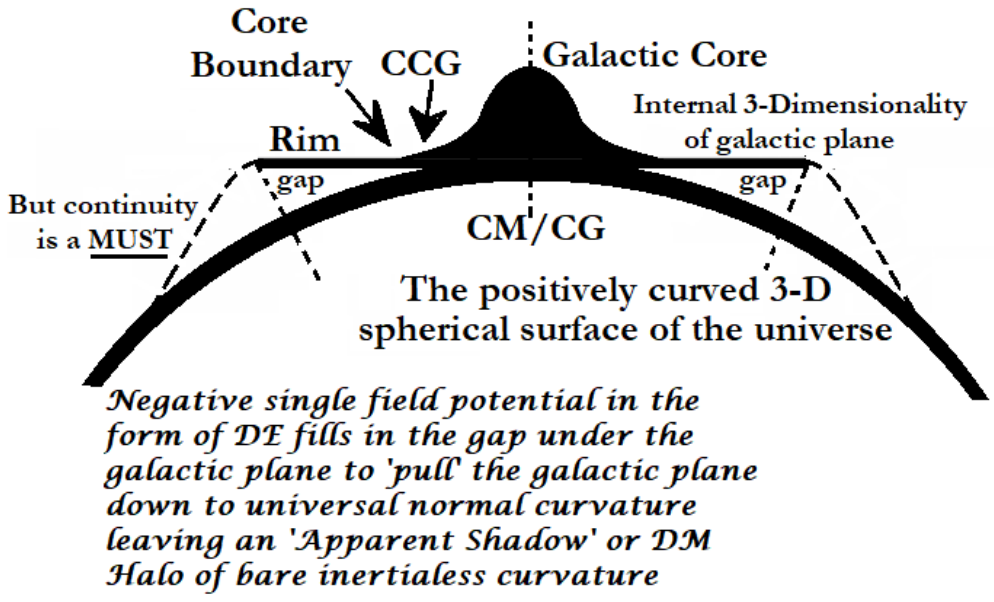
The rapidly rotating core will generate a strong **B**-field which radiates outward from the center of rotation (CR) of the core/galaxy. The **B**-field decreases in strength from the core in inverse proportion to the distance from the center, or **B** α 1/**r**, just the opposite of the gravnetic contribution to the orbiting speeds in the spiral arm. This variation creates and holds the spiral arms on their classic shape, affecting stars near the core to a much greater extent and trailing off moving outward to the farthest stars in the system. The **B**-field is much stronger and affects the inner orbiting stars to a much greater extent, decreasing with distance from the core or CCG, giving the arms their spiral shape. The **B**-field literally 'sweeps' the stars nearer the core along more strongly even while astronomers observe the centripetal speed of the orbital stars as nearly constant due to the 'dark effect' of gravnetism (DM/DE). Magnetism and gravnetism couple together to form the rigid plate or platform upon which the galaxy as a complete undifferentiated unit rotates at a constant radial speed. So once again, not only does the McGaugh study all but verify SOFT, it also verifies that our three-dimensional space is embedded in a real four-dimensional space as specified by SOFT.

The simple geometrical model

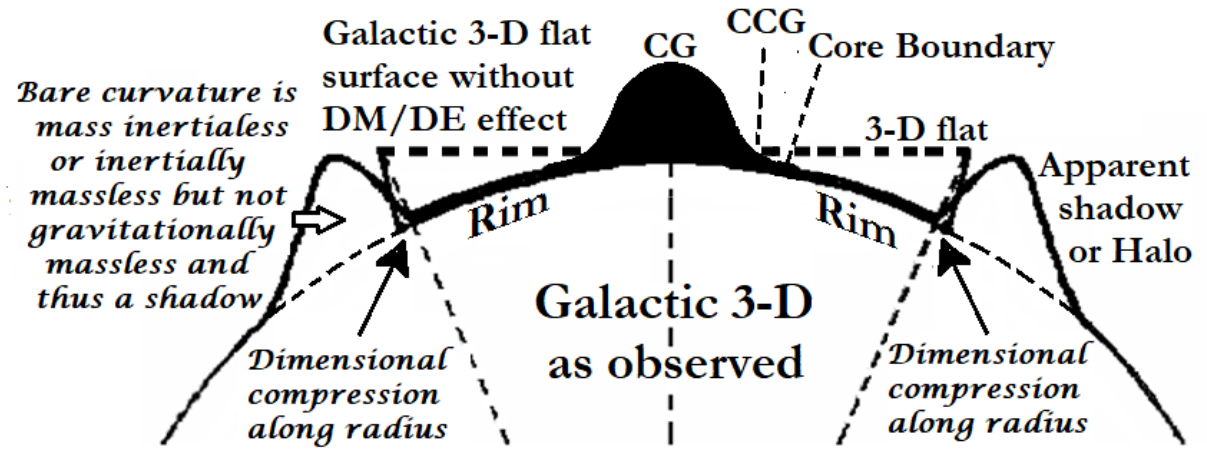
Due to the large number of variables and possibilities that determine the CCG, and their very nature (solving the many body gravity problem is nearly impossible in this case), making predictions about the structure of galaxies that can lead to observable/testable verification of the SOFT model is extremely difficult, even when using modern computers. However, that need not be true for the extreme examples of galactic structures. It is necessary for the galaxy to have a very large massive object (a supermassive black hole works best) at the CM/CG of a galaxy complemented by a very dense tightly bound high-numbered group of stars in the core to offset the 3-D galactic plate, a semi-rigid plate, platform or template, four-dimensionally from the overall 3-D curvature of the spherical surface of the universe geometrically if the embedding dimension was neither closed nor well structured (such that the structure could be easily defined, *i.e*., single polar).

The galaxy would look like a flat plate sitting defiantly on a much larger beachball, tangent to the radius of the beachball due to the simple fact that the galaxy core's internal gravitational forces are strong enough to maintain its galaxy local flatness relative to the much weaker universal three-dimensional surface's gravitational ability to force (pull down) the galactic plate to conform to the universe's positive spherical three-dimensionality. If the central mass and the core are not massive enough to hold the three-dimensional plate rigid and true to its internal three-dimensionality, the galactic plane would bend like a skullcap to tightly fit the curvature due to the much weaker gravitational attraction forces of the rest of the universe, which maintain and follow the spherical curvature of the universal surface.

But the galactic plane, under all conditions, must be both continuous with and conform to the universe's curvature so something 'else' must pull the galactic plane down to fit. This process of pulling the galactic plane down to fit could be called the Dark Energy effect, but that still leaves the term Dark Energy undefined. The tangentiality of the galactic plane is necessary so that the extra energy of the negative potential of the higher-dimensional single field under our three-dimensional surface (our experiential space) can pull (or better yet hold) the plate down to conform with the three-dimensional sphericity of the universe surface. So Dark Energy is the effect of the single field potential on the negative or underside of our three-dimensional surface (or experiential space) on the materiality of the stars and star systems in the galactic plane.



The Dark Energy effect leaves the apparent shadow core, or dark matter halo as it is more commonly called, a naked or bare curvature without any internal inertial mass around the outer edge of the galaxy as a remnant (artifact) and reminder of the four-dimensionality (the necessary continuity of the galactic surface with the universe surface) of that single field potential. The input of negative single field potential (mistakenly called Dark Energy) acts oppositely to the inverse square law of normal gravity to increase the radial speed of stars, increasing their radial speed instead of slowing them down the greater the radial distance from the center of the galaxy.



The CCG, centripetal center of gravity, or center of gravnetism marks the cutoff point or point of contact between the local galactic plane and the non-local three-dimensional surface of the universe beyond which the central three-dimensionality of the galaxy 'overrules' the three dimensionalities of the universe. Knowledge of and calculating the position of this point is necessary for understanding galactic structure since it is from this point and outward along the radius that the Dark Energy effect is added linearly with the common gravitational attraction of the core CG to determine the actual radial speeds of stars.

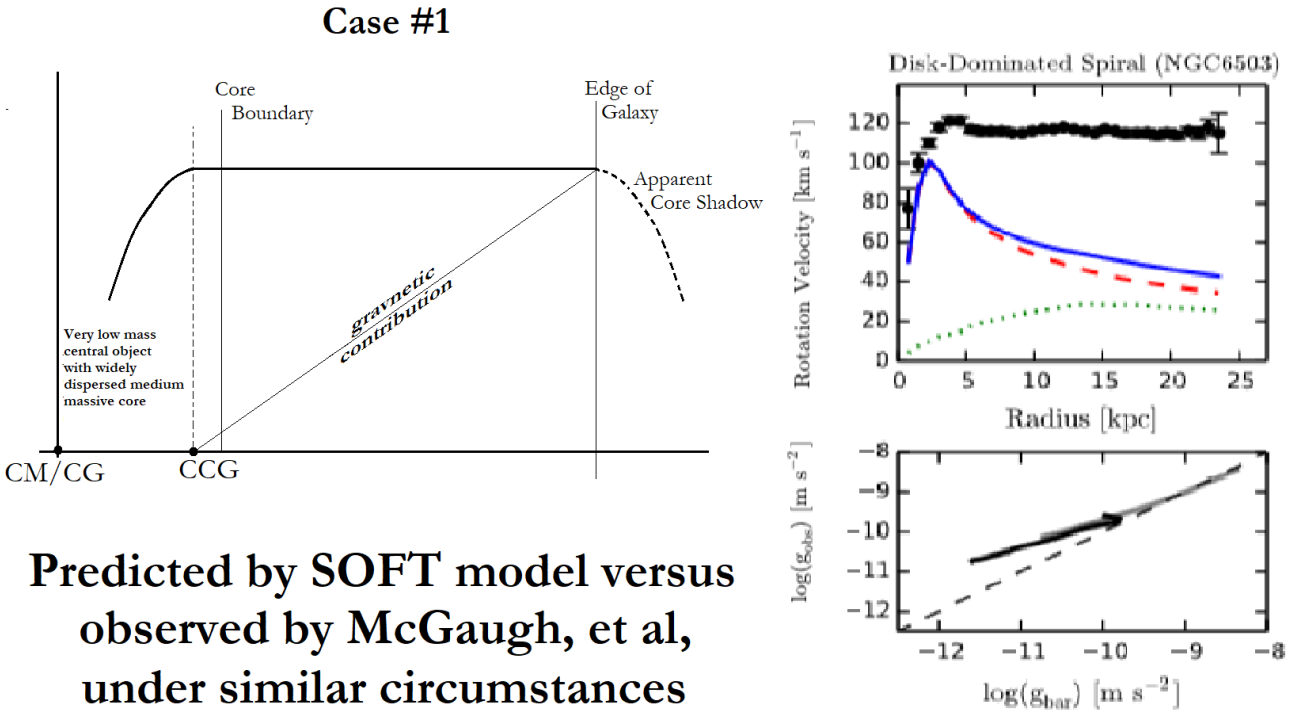
This higher radial speed would normally fling the outer stars and star systems out of the galaxies if not for the 'potential' exhibited by the 'bare curvature' of the 'apparent core shadows' that holds the stars within the galactic plane. That phantom potential must be, but cannot be, overcome before the stars could leave the galactic plane. In other words, the outer stars themselves would part ways (spin off tangentially into the unknown) with galaxies if physically possible, so the 'apparent core shadow' forms (as bare curvature) as the outer stars in the galactic rim suck up Dark Energy (negative single field potential) in an amount equal to the material inertia that would have otherwise existed under the bare curvature of the shadow to compensate velocities. This increases the orbital speed and physically stabilizes the overall galactic structure without the outer stars spinning off at the higher speeds that characterize them.

Without a supermassive central object/body and heavy dense core relative to the less massive and less dense outer rim, the galaxy would more easily, although not necessarily, succumb to the three-dimensionality of the 3-D universe surface without the necessity to invoke Dark Energy effect. It would not need the extra speed allotted to stars in the outer rim by the application of DE/negative single field potential to keep the galaxy rotating in position and the apparent core shadows/DM halos that keep the stars from flying off tangentially at

the outer rim of the galaxy, but therein lies the rub. This fact fits astronomical observations, so this three-dimensional/four-dimensional structure is the only possible explanation of our galactic observations that does not necessitate the false existence of Dark Matter particles that do not and cannot really exist. Dark Matter particles are no more-nor-less than a mathematical gimmick, a placeholder, with no physical reality that allows scientists to more easily picture reality but cannot themselves be materially real.

Given this theoretical model picture, if we get rid of the large massive central object/body and/or the supermassive dense cores relative to the rims, at the other extreme of possibilities, we can predict with a very large hope of success what a vastly simpler galaxy would look and act like. In such cases, the centripetal center of mass (CCG) or center of gravnetism would move to the right and perhaps even past the core boundary (the core boundary would dissipate or just disappear) of the inadequately massed core, while doing so would have disconcerting and astonishing on effects orbiting star speeds in the arms relative to the speed of stars in the core. At or near this point, or limit, the galaxy becomes diffuse with no rotation or orbital stars at all. At such extremes, we have several possibilities.

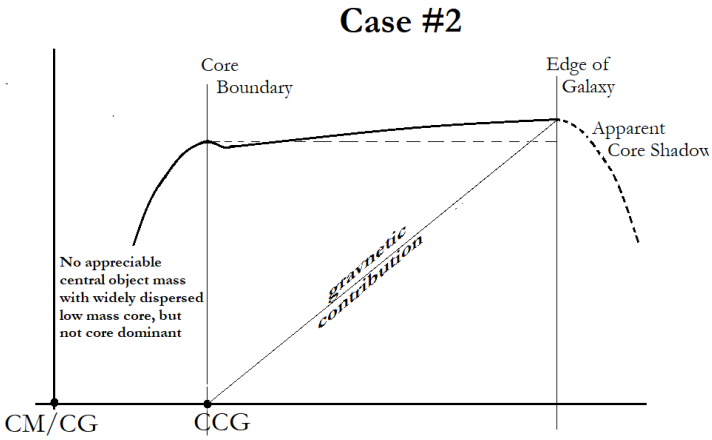
In case #1, as shown below, a low mass central object/body and a low mass (relative to the rim stars' masses) core together form a widely dispersed medium massive core. In this case, the CCG which determines the earliest (shortest radial distance from the galactic CM) application of the Dark Energy effect as the galaxy forms to give the outer rim stars an even greater corresponding speed than normally thought.

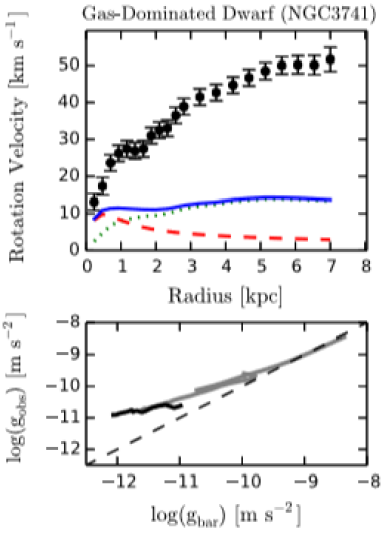


The CCG would fall near the peak speed of stars in the outer core area and the net speed of stars around the CM/CG would remain fairly constant out to the very edge of the galaxy on the galactic plane. The disk

dominated galaxy NGC6503, as portrayed in the McGaugh group paper approximates this theoretical model prediction.

Case # 2 would be even more extreme. There would be no appreciable mass at the exact center of the galaxy although the CM/CG would still be located there no matter what the central mass, and low but still greater mass in the core relative to the mass in the rim. In other words, astronomers would observe a very lightly centered galaxy that still formed a definable core and spiral arms within the galactic plane. The CCG would move still closer to the outer core boundary and the galaxy as whole would start to lose its core dominance and gravnetism would begin to dominate normal gravity. This structure would emphasize the Dark Energy effect to such a degree that the speeds in the rims would actually increase moving outward from galactic center and the core along a radius.

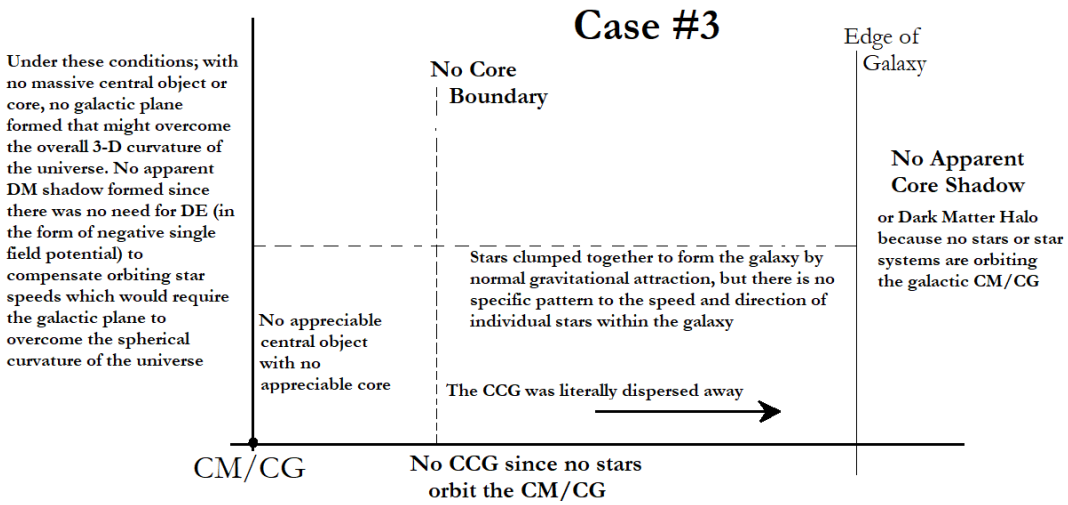




Predicted by SOFT model versus observed by McGaugh, et al, under similar circumstances

This predicted galactic structure conforms quite readily to galaxies such as NGC3741, which is a gas dominated Dwarf. This galaxy does not have a very massive central core as is predicted by this model.

But in case #3, there is so little mass in the central portion of the galaxy and what would normally be the core is so widely dispersed that any possible identifiable core would just blend into the group of outlying stars and disappear relative to the overall galaxy structure. The CCG essentially disappears under these circumstances as it moves beyond any possible core boundary outward toward the edge of the galaxy itself. So, there would be no need to pull the outlying stars down to the average three-dimensional surface of the universe because the galaxy would not have near enough internal normal gravitational force to counteract the pull of the universe surface when originally forming its galactic plane.



With no utilization or application of the Dark Energy effect (distributing negative single field potential for compensation) to correct a non-existent difference between the galaxy's and the universe's three-dimensional surfaces, no Apparent Core Shadow, or as it is popularly called Dark Matter Halo, would form.

There would still be small amounts of Dark Matter and Dark Energy coursing through the galaxy, such as that within normal star systems, and wherever any material object orbits or moves 'around' any other material object such that one has a centripetal force at some place relative to the other. That Dark Matter and/or Dark Energy effect is only that which is necessary to maintain normal orbits and internal gravitational attractions between stars and star systems and nothing like the Dark Energy effect and 'Dark Matter Halo' thought to be used in the creation of normal galaxies. This existence of a specific last type of extreme galaxy with no apparent Dark Matter is a prediction of SOFT that can and has been observationally verified.

A galaxy fitting this description has already been identified, catalogued and studied: NGC 1052-DF2. Situations like this, as represented by NGC 1052-DF2, would normally cause problems for science and theoretical physics termed 'crises', but this possibility has already been predicted, along with other supporting confirmations, by SOFT.

NGC 1052-DF2 is an ultra-diffuse galaxy in the constellation Cetus (Van Dokkum, Weaver, Villard, 3)

So far, NGC 1052-DF2 is the only galaxy of its type to be observed, but SOFT predicts that other such galaxies will eventually be discovered. They may be relatively rare, but they are still natural occurrences in the universe. They obviously conform to theory just as predicted by the SOFT model in case #3. NGC 1052-DF2, which is an ultra-diffuse galaxy in the constellation Cetus, shows no evidence of Dark Matter, nor will any be detected since no stars are orbiting a central galactic CM and core, neither of which exists in this galaxy. Individual stars systems and small star clusters in this galaxy will show some small amounts of Dark Matter independent of the galactic unit, but no more will be observed unless stars orbiting a central core object are also discovered, *i.e*., no gravnetic components of gravitation which could be misidentified as Dark Matter are present in this case.

According to van Dokkum, NGC 1052-DF2 is “like you take a galaxy and you only have the stellar halo and globular clusters, and it somehow forgot to make everything else." Moreover, "There is no theory that predicted these types of galaxies. The galaxy is a complete mystery, as everything about it is strange. How you actually go about forming one of these things is completely unknown." In further describing this galaxy he has stated that he “spent an hour just staring at the Hubble image," and recalled that "It's so rare, particularly these days after so many years of Hubble, that you get an image of something and you say, 'I've never seen that before.' This thing is astonishing: a gigantic blob that you can look through. It's so sparse that you see all the galaxies behind it. It is literally a see-through galaxy." NGC 1052-DF2 is literally a ghost galaxy that does not fit the norm of either an elliptical or a spiral galaxy. Astronomers have thus given this new type of ghostly-appearing see-through galaxy a new classification as an ‘ultra-diffuse galaxy’ or UDG.

It seems to lack a black hole at its center, which could explain why the galaxy formed without a specific core about which other stars could orbit and thus create the Apparent Core Shadow that is normally mistaken for a Dark Matter Halo. That observation, or lack of an observation, came as another surprise, since astronomers have long thought that most galaxies contain black holes. Dark Matter is thought to make up about 27 percent of the universe, but since Dark Matter emits no light it cannot be observed directly, which makes sense because there is no Dark Matter except as a secondary gravitational effect (gravnetism) of ordinary matter, at least in the SOFT model. SOFT can also be considered an advanced modified Newtonian and Einsteinian theory of gravity, but it is better described as a theory of unification that merges all previous physical 'paradigms' together.

Given the success of SOFT to model these extreme galaxies, scientists no longer need to infer the existence Dark Matter particles based on the purported Dark Matter's gravitational effects on galaxies and galaxy clusters. They can also abandon their long-held belief that galaxies evolve (emerge) when Dark Matter attracts the hydrogen gas that ultimately coalesces into stars and that once a galaxy forms, Dark Matter particles help hold it together, both of which are misguided assumptions and hypotheses that can now also be discarded. If the universe does consist of 27 percent Dark Matter, which is unfortunately and wrongly not open to question, since that percentage of Dark Matter is rather a product of the other 4 or 5 percent of real baryonic matter that astronomers and cosmologists presently believe yields our visible universe.

NGC 1052-DF2 is the first such discovery, although follow-up studies have not confirmed this. The apparent lack of dark matter in NGC 1052-DF2 is only an anomaly because the presence of Dark Matter has until now thought to have been needed for galaxy formation, which is untrue. In any case, it is thought by many in the scientific community that the conditions of this galaxy may help prove that dark matter is real, or rather what appears to be dark matter is just an undiscovered and unknown gravitational effect of ordinary matter, *i.e*., baryons, rather than some type of pre-existent Dark Matter particles. So, the absence of dark matter could lead to new models of galaxy formation, as is the case when applying SOFT. Since the discovery of this galaxy was made by Pieter van Dokkum, his students and team of astronomers, have discovered another new and even more interesting configuration of stars: A galaxy that is believed to have about 100 times more Dark Matter than baryonic matter, raising still more questions for 'normal' gravity theory.

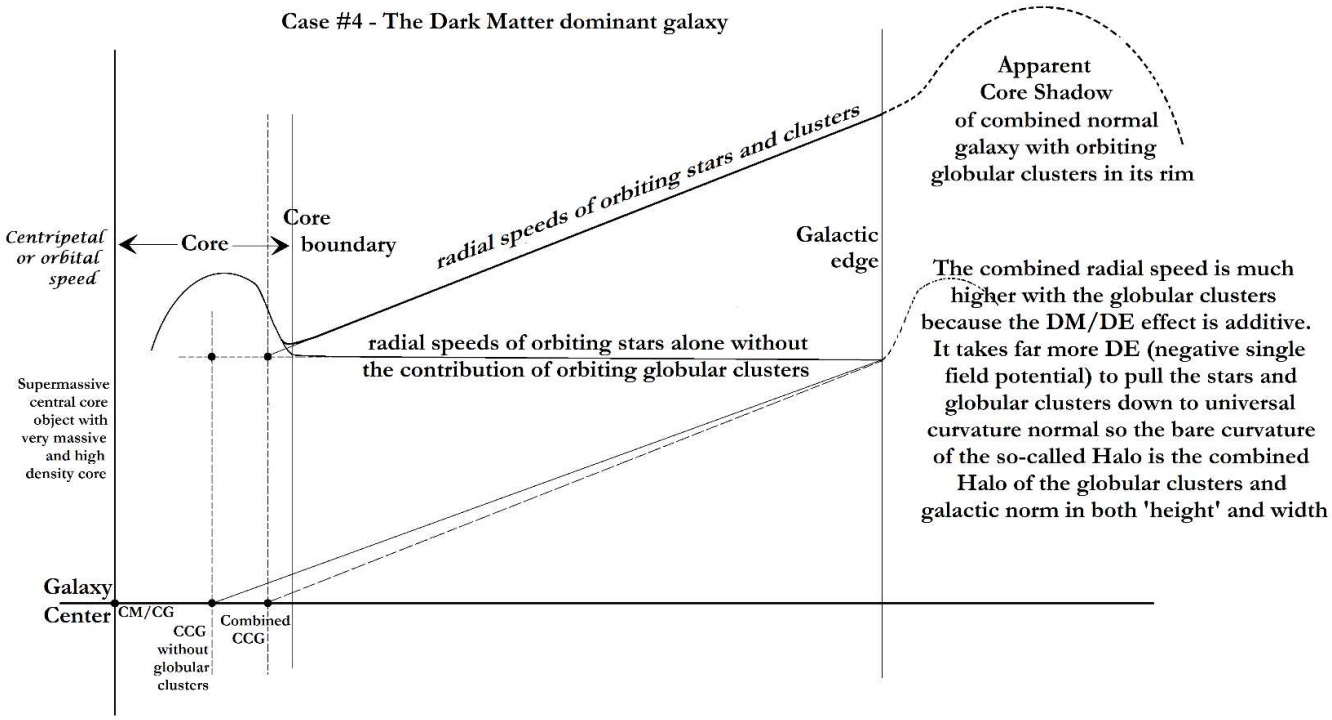
Further observational mysteries solved

Yet there is still more to this story. Roberto Abraham, van Dokkum and their groups have also discovered a galaxy with such a high Dark Matter content that it could consist of as much as 99 times more Dark Matter than normal visible matter, such that it seems to be completely Dark Matter dominant. Working together since 2012, van Dokkum and Abraham started to look at and reevaluate extreme galaxies in the Coma Cluster. What had earlier appeared as 'smudges' were actually individual galaxies that needed to be studied using new and better telescopes. What they subsequently found came to be called UDGs, or ultra-dense galaxies, some of which are extremely unusual and have been impossible to explain within the context of normal galaxies, which astronomers, astrophysicists and cosmologists believe they can explain.

The conventional wisdom would pose that these are failed normal galaxies, spiral and/or elliptical, due to the diffuse number of globular clusters in the field of the Coma Cluster. What they actually found, Dark Matter dominant galaxies, did not fit the normal theoretical model of either galaxies or how galaxies evolve. However,

these can be easily explained within the four-dimensional space model supporting the unification of SOFT. Some of the newly discovered UDGs contain a few smaller globular clusters in their rims or outer areas, but not in their cores, and unlike the conventional wisdom the globular clusters would have then added their own Dark Matter content and Halos to that of the smaller UDGs, whether spiral or elliptical. Once they became part of the galactic rim or outer area, the clusters would take all the more Dark Energy (negative single field potential) to pull them and their own Dark Matter content down to the three-dimensional surface of the universe than their normal existence outside of the galaxy required. This can be easily graphed and explained relative to the CCG method as explained above.

In this case, the core seems to be quite massive and densely packed relative to the surrounding stars. It could even have a small black hole at its center giving it a core with just enough material content to define the overall mass as a galaxy, so it would normally form a spiral galaxy except for the fact that it does not have enough overall mass in the combined core and rim to effectively be a spiral galaxy and much of the matter content in the rim is due to the presence of a large number of globular clusters.

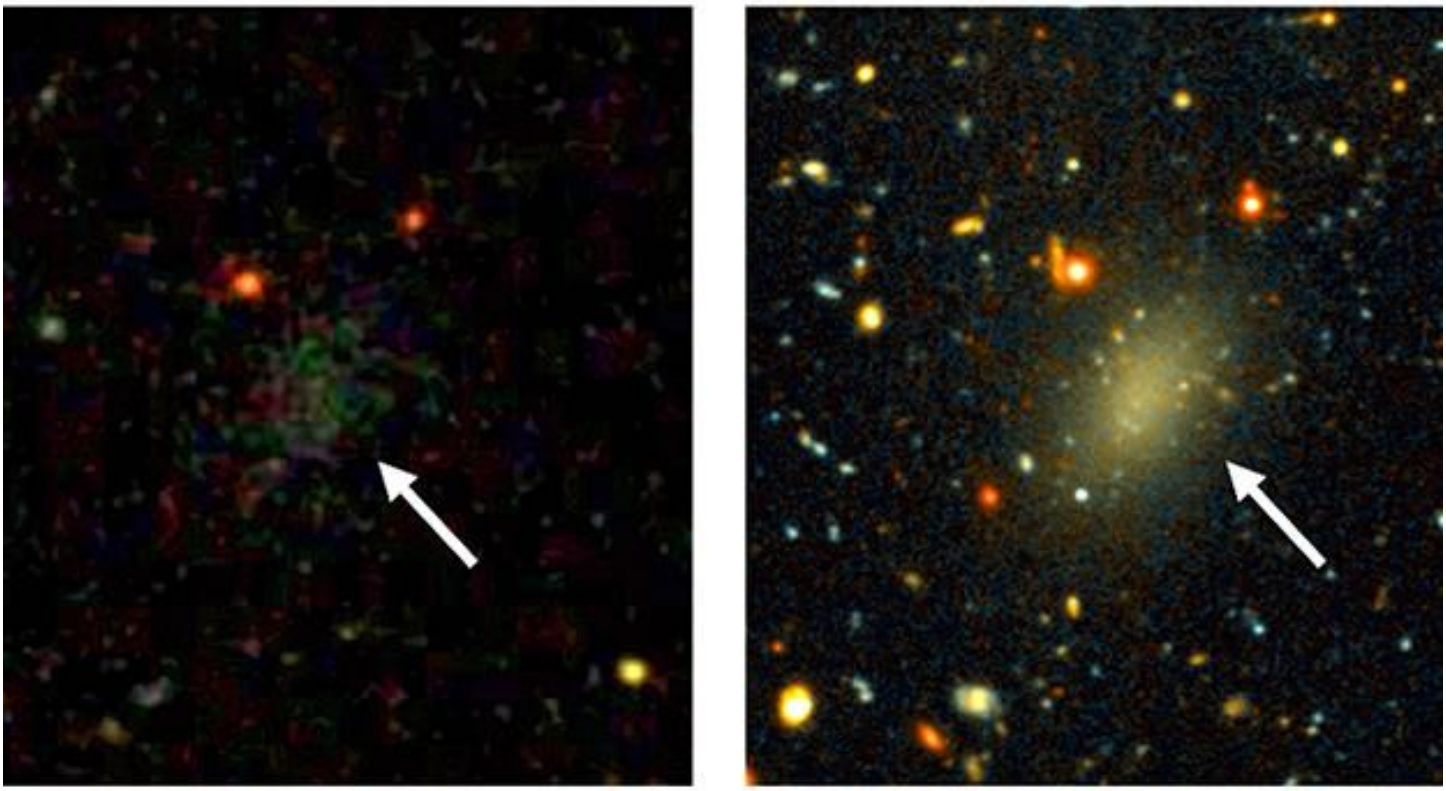


In fact, the normal CCG of a spiral galaxy and the resulting increases in radial speeds would be supplemented by a combined CCG (representing the galaxy with globular clusters) that would vastly increase the size and radial width of the Apparent Core Shadow or Dark Matter Halo.

Yet there are still more extreme cases of spiral-like or normal galaxies that can be predicted by this SOFT model. In these cases, the galaxies become even more “Dark Matter dominant”, or rather excessively gravnetic dominant rather than normal gravity dominant. In some cases, the dominance is quite profound resulting in extremely high radial (centripetal) speeds of the orbiting celestial objects in the galactic rim. In

these cases, small globular clusters have fallen under the physical influence of the normal spiral galaxies and travel around the galactic centers in lock step with the stars and star systems in the spiral arms. It is not presently known if these globular clusters evolved within the galaxies, were later captured by them during collisions, or just randomly coalesced in some galaxies for unknown reasons, but such galaxies have been observed in recent years.

An even greater or more extreme case became evident in Abraham's observations and calculations for the UDG Dragonfly 44. It is somewhat like the Milky Way with about the same overall mass content, at least that seems to be the case given its radius and radial speeds. Yet this also seemed at first to have been a failed Milky Way like spiral galaxy with only $1/100^{th}$ the number of stars and luminosity. This presented van Dokkum and Abraham with a very clear anomaly. The only answer was that Dragonfly 44 must contain nearly 99% Dark Matter, a possibility that went against all conventional wisdom regarding the evolution and subsequent structure of galaxies. So, Dragonfly 44 was studied more carefully by van Dokkum and Abraham with increasingly better telescopic instruments and technological devices.



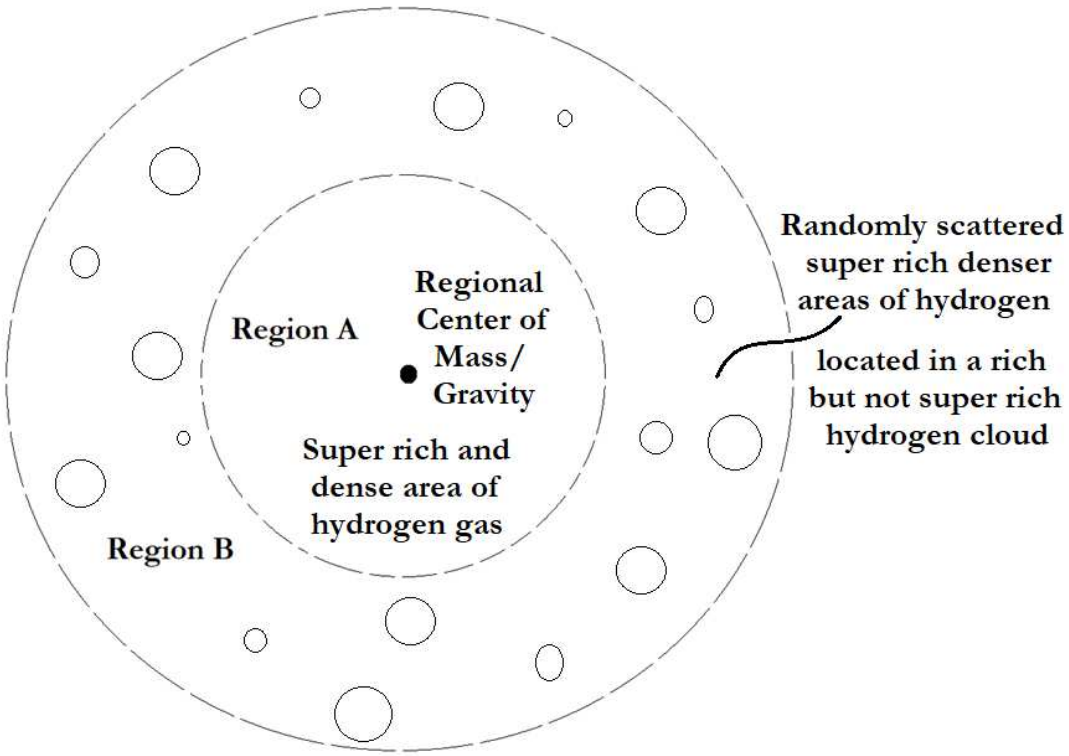
An enhanced picture of Dragonfly 44 from Yale News

According to SOFT, the greater the number, total mass, density and size of the globular clusters scattered inside an otherwise ultra-diffuse galaxy (UDG) with a smaller number of stars less densely packed together, the higher the amount of Dark Energy needed to render the galactic plane internally three-dimensional with respect to the external the universe surface, rather than three-dimensional only within itself and thus extended beyond and outside of the spherical surface of the universe in the fourth dimension of space. Thus, the greater the Dark Energy effect must be, the larger the Apparent Core Shadow, which is merely bare

curvature (gravitational equivalent) without internal inertial mass, must be. This is a feature of SOFT, so SOFT handles the situation presented by Dragonfly 44 quite well in, a straightforward and logical manner, and can even be used to explain the evolution of such an extreme galactic structure.

The major observational differences between the Milky Way and Dragonfly 44 could be found in their cores, which differ radically. The Milky Way is suspected to have a very dense core with a supermassive black hole in the center, while Dragonfly 44's core does not have enough matter to form a normal core and no central black hole or massive body to hold the galaxy together, let alone the unusually high number of globular clusters in its rim. These facts only make matter worse because 'conventional wisdom' regarding the structure and evolution of galaxies, which seems to require that the Dark Matter Halo plays a significant role in galactic evolution, are completely wrong for all intents and purposes. According to SOFT, both the Dark Energy and Dark Matter Halo, misnamed and misunderstood as they presently are, evolve and grow with the galaxy. The Apparent Core Shadows (Dark Matter Halos) consist of bare (gravitational) curvature which has no inertial mass equivalent (as required by the equivalence principle) due to the Dark Matter effect that is gravnetism. The inertial mass equivalent of (or below the bare curvature) the Apparent Core Shadows has been converted to Dark Energy in the form of negative single field potential which moves the orbiting stars, globular clusters and other material bodies at their additional radial speed above that induced by normal gravitational attractions (Newton) or by following the curvature of space (Einstein) along a geodesic.

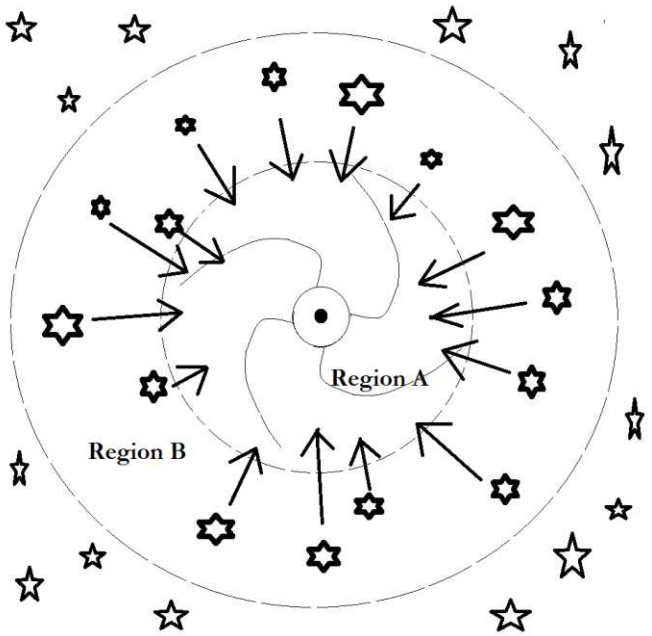
We can represent the pre-galactic period of galactic evolution by a distinct center of mass (or gravity) and denser (richer) broadly scattered area developing in space as an extremely dense mass of hydrogen gas. The densest, most uniform and richest hydrogen gas cloud would be in the central region (A) and an outer region (B) of similar high density but, in this case, filled by smaller non-uniform but even denser mini-regions that will develop into semi-independent globular clusters.



The outer circle constitutes the boundary of the region of space with a much higher than normal amount of Hydrogen. However, the hydrogen in Region A is very dense and highly uniform and thus forms individual stars and star systems around the common CM/CG, while the hydrogen in Region B is 'clumpy' with denser mini-regions. These 'clumps' of super rich hydrogen form groups of stars called globular clusters more rapidly and thus earlier than Region A hydrogen forms normal stars and systems. The 'clumps' become globular clusters of various sizes, which are more-or-less uniformly scattered throughout Region B.

By the time that these clumps form globular clusters, stars will have also begun to form in Region A which was even richer in hydrogen, but the hydrogen gas in Region A is uniformly distributed so if forms a small normal galaxy around its common CM/CG and larger (larger diameter relative to the mass of the stars inhabiting it) than normal core, whose overall mass content and effect is increased by the surrounding globular clusters. The globular clusters share the same CM/CG with the stars in the core and Region A gas cloud as well as globular clusters on the opposite side of Region A, to which everything in the galaxy is attracted, but that attraction occurs at a slower rate for the globular clusters (they have much greater inertial mass, so they begin to move toward the center more slowly) than the stars in the proto-galaxy that forms into a small but ultra-diffuse spiral-like galaxy.

Since the CM is the same for the whole group of stars in both regions, the ultra-diffuse spiral-like galaxy that forms in this manner does so 'as if' it has greater total mass and a much denser core, even though it has no black hole, super massive or otherwise, at its center. After the diffuse spiral galaxy forms, the globular clusters in Region B are attracted gravitationally toward the core of the resulting ultra-diffuse galaxy as well as toward the star clusters on the opposite side of the galaxy, all of which share the same CM/CG.

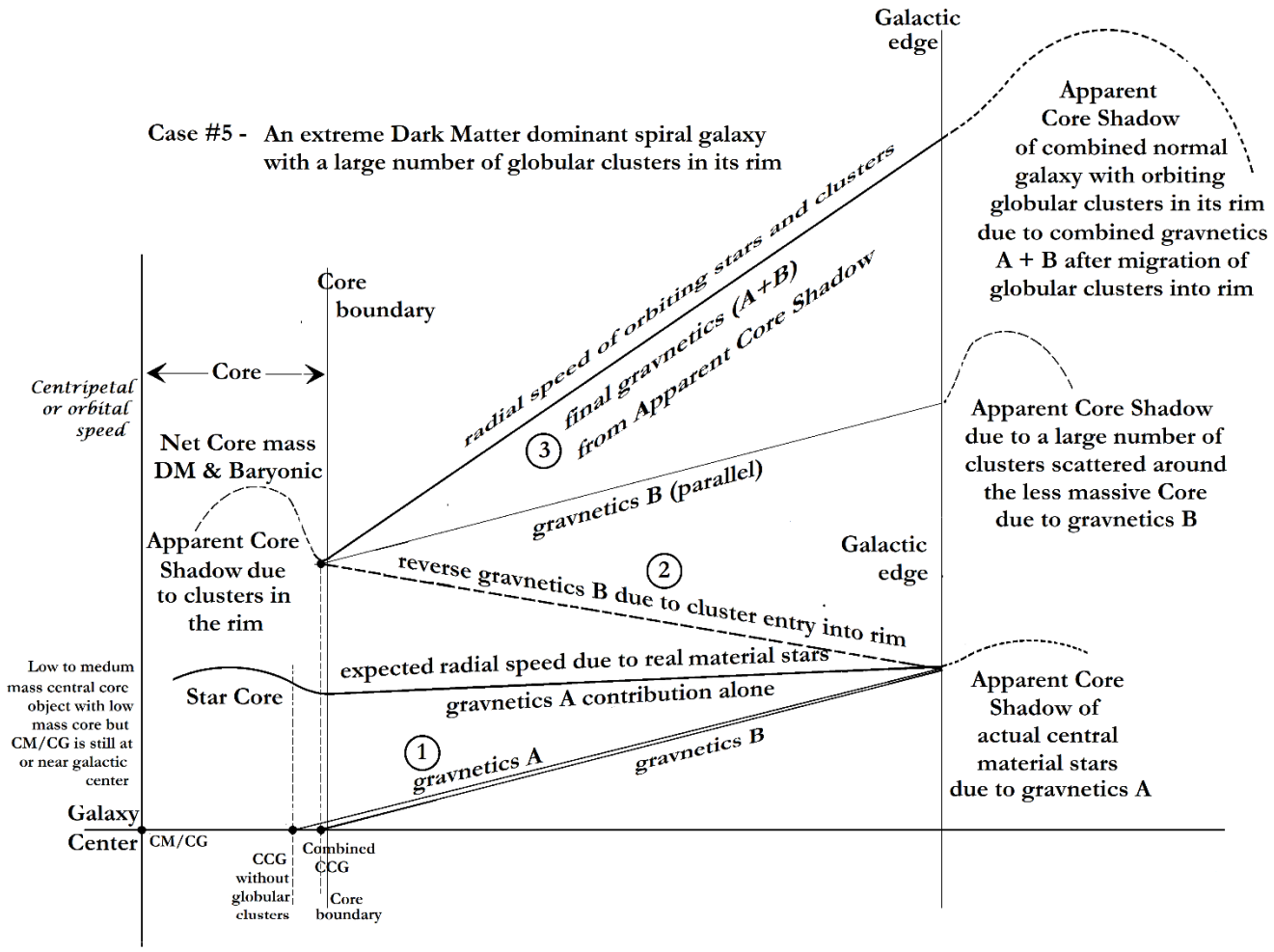


But each globular cluster carries its own Dark Matter Halo with it into the final ultra-diffuse galaxy. As the globular clusters migrate into the galaxy they would carry with them and keep their own internal Dark Matter structure, but they would also absorb more Dark Energy from the surrounding Dark Matter Halo to bring them up to ‘radial speed’ with surrounding stars and negotiate the difference between their own internal three-

dimensionality, which is just that of the universal curvature, and the galaxy's internal three-dimensionality. This newer Dark Matter would not surround the globular clusters themselves due to the influence and structure of Region A stars but would split between the core and the Dark Matter Halo surrounding the galaxy, while the new Dark Matter in the core would tend to act as a brake that keeps the globular clusters from migrating into and becoming part of the core themselves.

So, the globular clusters have the additive effect of 'placing' or growing part of their own newly acquired Dark Matter into the core of the ultra-diffuse galaxy as well as adding to the overall Dark Matter Halo surrounding the whole of the galaxy. The galaxy core, bolstered by Dark Matter from the globular clusters, thus has an overall mass and density nearly equivalent to a much larger galaxy such as the Milky Way. This structure holds the globular clusters at relatively stable positions within the galactic rim, resulting in the diffuse appearance of the visible stars mixed with globular clusters in the galaxy which is clearly Dark Matter dominant with both Dark Matter in the core as well as in the Halo surrounding it. This particular 'evolutionary scenario' fits the unique situation represented by Dragonfly 44, rendering this model of galaxy dynamics even more convincing.

According to the SOFT model, the normal core mass and mass density are bolstered by a Dark Matter core (instead of a massive central body or black hole) that has resulted from the extra Dark Matter to compensate for the extra Dark Energy needed to hold the three-dimensionally of the globular clusters down to the three-dimensionality of the universe once they have migrated into the galactic rim. Since there is such an unusually large number of them, more-or-less evenly distributed throughout the rim, the overall Dark Matter portion of Dragonfly 44's core renders it as gravitationally substantial as the Milky Way's core, resulting in the high radial speeds of stars, star systems and globular clusters within the rim of the ultra-diffuse galaxy. This final structure can be represented graphically.



The Apparent Core Shadow curvature, which forms from the excess Dark Matter Halos of the globular clusters as they pick up Dark Energy while migrating into the galaxy, is really what holds the galaxy together even as it multiplies the Dark Matter Halo effect of Apparent Core Shadow surrounding the galaxy. Thus, the galaxy apparently has is as much as 99% Dark Matter split between its core and halo. The Dark Matter content in the core would be a unique prediction of SOFT that could further verify the model expressed here and theory behind it.

Conclusion

The SOFT unification model of galactic structure and formation easily accounts for all the anomalies observed in recent galactic surveys. In fact, it predicts the specific extreme galaxy structures according to its basic principles even if those galaxies had not yet been discovered. Furthermore, the model predicts other smaller features of galaxies (Beichler, 2010) as well as other baryonic structures (internal and atoms) that now render SOFT a fully confirmed and verified theory. No other single theory, nor any combination of other presently accepted theories (whether verified or not) can make such a claim. Yet SOFT has not yet been accepted and has not even become known to the general scientific audience yet. In fact, attempts to publish the details of SOFT have met a stiff resistance from various scientific peer reviewed Journals and other sources.

It is believed that this reticence of the scientific community to at least give SOFT a fair hearing stems from (1) the strong hold over physics that the quantum theory paradigm now holds; (2) the strong bias against Einstein's last research efforts to develop a unified field theory which has been thought to be impossible, or so modern scientists have been taught to think, for the past nine decades; and (3) the notion that relativity and the quantum are mutually incompatible has become so well ensconced in the mental fabric of physicists, physics and philosophy that they even refuse to entertain the simple possibility that they are not incompatible and that they even might be fully compatible, which can be mathematically demonstrated quite easily, that physicists and anyone concerned would need to go through a tremendously thorough and challenging 'gestalt switch' to even look at any of the vast amount of evidence to the contrary. It is easier to ignore what is before your eyes if it is going to cause serious problems in your mental vision of reality.

Although SOFT is outwardly a theory based on Einstein's work, it treats classical and modern quantum theory and general relativity as equally correct. As they now stand, both are flawed and incomplete. Correcting the shortcomings of each theory shows that, in fact, the theories are not only completely compatible, an idea that has almost never been considered possible within the scientific community, but they are complementary to one another. Once each theory has been completed within its own context and range of application, they are easily unified together into a comprehensive theory that encompasses all of physics, both past and present paradigms, as well as other physical, biological and other non-material sciences. Each theoretical structure, relativity and quantum, benefits and is expanded beyond its own present internal boundaries when the two are unified as one, with neither dominating the other, even though this theory began with the concept of space curvature and thus more directly from General Relativity than the quantum.

This last aspect of unification goes far beyond what was suspected and popularly thought unification would look like. The present attempts at unification based on pure rigorized mathematics and mathematical systems, metaphysics, all kinds of wild ideas and notions, and arguments that either the quantum or relativity are fundamentally more basic than the other, are nothing but speculative rubbish and purely escapism perpetrated by scientists who have absolutely no clue about how to unify physics, thus harming science more than helping science. The success of SOFT clearly demonstrates that science, especially physics, must return once again to the careful observation of nature and both our larger external and internal realities. Theoreticians must stop trying to develop theories and models that tell nature how nature should act under specific humanly created conditions and/or just compelling nature to act as the human mind determines nature must act, which seems to characterize a large part of post-modern physics.

Dragonfly 44 is clearly an anomaly wrapped within an enigma with no alternative solution or explanation seems to be appearing on the horizon.

> "The researchers note that finding a galaxy composed mainly of dark matter is not new; ultra-faint dwarf galaxies have similar compositions. But those galaxies were roughly 10,000 times less massive than Dragonfly 44. "We have no idea how galaxies like Dragonfly 44 could have formed," said Abraham. "The Gemini data show that a relatively large fraction of the stars is in the form of very compact clusters, and that is probably an important clue. But at the moment we're just guessing." Van Dokkum, the Sol Goldman Family Professor of Astronomy and Physics at Yale, added: "Ultimately what we really want to learn is what dark matter is. The race is on to find massive dark galaxies that

> are even closer to us than Dragonfly 44, so we can look for feeble signals that may reveal a dark matter particle." (Shelton, 2 of 3)

This means that in the absence of Dark Matter particles, which have now been all but ruled out by the McGaugh group's observations, no other theory or theoretical structure exists to explain these observations. These aberrations are obviously products of material relativity and curved space rather than a new from of quantum particles.

Nearly a century and a half ago, as non-Euclidean geometries and the idea of hyperspaces became popularly known and disseminated, astronomers attempted to determine if space was curved or not by careful observation and measurement of stellar parallax. The results have always been negative in these attempts, but the areas of observation and measurement have been so small relative to the overall size of the universe that they have been regarded inconclusive rather than completely ruling out the possibility of curved space. Now, given these new observations and the success of SOFT to easily explain and even predict the structural and dynamical characteristics of both normal and extreme galaxies, it is safe to say that the extrinsic curvature of space-time (or just three-dimensional space) is all but a foregone conclusion and that our normally experienced three-dimensional material space is embedded in a real physical macroscopically extended four-dimensional space.

Bibliography

Beichler, James E. (2010) "Physical Origins of Dark Matter and Dark Energy: Exploring Shadows on the Cave Wall." *Space-Time Ether and Cosmology: physical vacuum relativity and quantum physics*, Volume 3. Edited by Michael C. Duffy and Joseph Levy. Apeiron Press, 2010: 259-311. Available online at https://www.academia.edu/7673956/Physical_Origins_of_Dark_Matter_and_Dark_Energy_Exploring_Shadows_on_the_Cave_Wall.

Beichler, James E. (2015) "The Einstein unified field theory completed: A direct challenge to the basic assumptions, theories and direction of modern and post-modern physics". An unpublished book (1st Edition). Available at https://www.academia.edu/12035946/The_Einstein_unified_field_theory_completed_A_direct_challenge_to_the_basic_assumptions_theories_and_direction_of_modern_and_post-modern_physics_1st_Edition_.

Beichler, James E. (2017) "Unification Accomplished: Einstein's dream realized in the Single Field Theory." *WISE Journal* 6, 1: 41-51. Available online at https://www.academia.edu/32985587/Unification_Accomplished_Einsteins_dream_realized_in_the_Single_Field_Theory.

Hossenfelder, Sabine and Tobias Mistele. (2018) "The Redshift-Dependence of Radial Acceleration: Modified Gravity versus Particle Dark Matter." arXiv: 1803.08683v1 [gr-qc] 23 March 2018.

Hossenfelder, Sabine, Stacy S. McGaugh. (2018) "Is Dark Matter real?" *Scientific American* (August 2018).

McGaugh, Federico Lelli and James M. Schombert. (2106) "Radial Acceleration Relation in Rotationally Supported Galaxies." *Physical Review Letters* 117, 201101 (11 November 2016): DOI 10.1103/PhysRevLett.117.201101.

Redd, Nola Taylor. (2018) “This Ghostly Galaxy Has Almost No Dark Matter.” *Science & Astronomy Defying Theories, Space.com* (March 28, 2018). Available online at https://www.space.com/40119-ghostly-galaxy-almost-no-dark-matter.html.

Shelton, Ray. (2016) “Scientists discovery a “dark” Milky Way.” *Yale News* (10/26/2018). Available online at https://news.yale.edu/2016/08/25/scientists-discover-dark-milky-way.

Van Dokkum, Pieter, Roberto Abraham, Jean Brodie, Charlie Conroy, Shany Daniel, Allison Merritt, Lamiya Mowla, Aaron Romanowsky, Jielai Zhang. “A high stellar velocity dispersion and ~ 100 globular clusters for the ultra-diffuse galaxy Dragonfly 44.” *Astrophysical Journal Letters*, 828, 1; arXiv:1606.06291v2 [astro-ph.GA] 15 July 2016; *IOP Science*, http://iopsience.iop.org/article/10.3847/2041-8205/828/1/L6.

Van Dokkum, Pieter, Shany Danieli, Yotam Cohen, Allison Merritt, Aaron J. Romanowsky, Roberto Abraham, Jean Brodie, Charlie Conroy, Deborah Lokhorst, Lamiya Mowla, Ewan O'Sullivan, Jielai Zhang. (2018) “A galaxy lacking dark matter.” *Nature*, 555, 629 (2018) DOI: 10.1038/nature25767 Cite as: arXiv:1803.10237 [astro-ph.GA] (or arXiv:1803.10237v1 [astro-ph.GA] for this version)

Van Dokkum, Pieter, Donna Weaver, Ray Villard. (2018) “Dark Matter Goes Missing in Oddball Galaxy.” Available online at https://www.nasa.gov/feature/goddard/2018/dark-matter-goes-missing-in-oddball-galaxy.