

The Paradigm of the Electric Universe*

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The Electric Universe paradigm has offered serious challenges to gravity only-based field concepts in fundamental physics and astrophysics for over half a century, but these challenges have been resisted without serious examination and evaluation by the prevailing schools, whose accepted paradigm is shown to have departed from the foundational principles of science into a state that is akin to fantasy. Accordingly, the resulting "melt-down" of the prevailing paradigm offers to Caribbean-based scientists a unique opportunity for leadership in the work of paradigm renewal in many areas of science that are commonly supposed to be "hard".

The paper points out the grave deficiencies of the schools' accepted paradigm in its treatment of the following areas of physics and astrophysics: the nature of gravity: aether and wave theory: mass and its definitions from Sir Isaac Newton to the present time: the use of mathematics in physics modelling, with particular reference to the solar system, the Theory of Relativity, and exotic concepts in astrophysics such as magnetic reconnection: the states of matter: and dating the past. In each area it outlines the Electric Universe paradigm, and shows it restoring the physical model to the role of reliably describing the reality of our perception, rather than allowing the employment of mathematics to extend our perception to fantasy.

1. Gravity Adjustment

The idea that the force of gravity can be intentionally interfered with will seem to many people - perhaps Westerners most of all - to belong to the realms of fiction, science fiction or otherwise. Believers in the possibility of a controlled gravity adjustment process may be likened to adult believers in Father Christmas or maybe flying saucers. But scepticism and scornfulness are not the same. Electric Universe theory will be more open than the current majority paradigm is, to the idea that gravity adjustment is a practical possibility. Sir Isaac Newton emphatically denied that he had explained how gravity worked physically; he confined himself to a role of demonstrating the form of its mathematical appearance on earth and in the solar system. However, he remained dissatisfied with the notion that a ponderous body could act upon another body at a distance, without any intermediary action between the bodies [1]. The nature of gravity continues to be undiscovered by science in general. Under the new paradigm of EU theory this limitation is beginning to break down, and this being the case, it will become more normal to consider that gravitational force might indeed be interfered with - once we become sufficiently aware of the way it actually works.

There have been attempts to demonstrate gravitational screening effects: spinning superconducting disks have been cited as experimentally causing objects placed above them to lose weight. These results remain controversial and their verification is uncertain. Whatever may be the merits of Einstein's theory of gravity (his General Theory of Relativity), it fails to "establish a cause within matter that has an effect on empty space." (Wal Thornhill) [2]. It is unfortunate that Einstein's theories only increase the layers of mathematics around the subject while its physics has remained quite non-existent.

2. When Gravity is and is not the Driving Force

The question that confronts us still, many years after Newton and several decades after Einstein, is "What is the physical nature of gravity?" One physical observation is that it is a very weak

force compared with others. The attraction of magnets for one another in or out of the laboratory is obvious, and electrical attractions can be experienced among certain objects, such as a plastic comb and bits of paper. Electricity and magnetism are combinable in devices that produce a very evident motor force. But you cannot directly observe the gravitational attraction between body and body in a laboratory except indirectly, as in the Cavendish-Boyd apparatus. You do not need to take into account any gravitational effect upon or among the electrons travelling round your circuit-boards. Yet objects fall off the laboratory table just as much as anywhere else. In earthbound experience, gravity is everywhere, yet in its weakness is undetectable within electrodynamic environments.

Prof Donald E. Scott has in Ch. 5 "How Big Is the Space Around Us?" in his book **The Electric Sky** applied the laboratory experience to the cosmos [3]. He follows Robert Burnham, Jr. [3] in showing that a fair scale model of the cosmos could represent one light-year by one mile, and also represent one Astronomical Unit (distance from the Sun to Earth) by one inch.

In the model the orbit of the Earth around the Sun would be represented by a circle with a one-inch radius. An 880,000-mile diameter Sun would scale down to a mark of 1/100 inch across - just a speck. Pluto the outermost planet (or planetesimal) would orbit around this speck at a radius of approximately 3 1/2 feet.

But the nearest star - another mere speck on the model - would lie four and a half miles away. This is not at all atypical of the closest distances between any of the stars in the galaxy.

How conceivable can it be, therefore, judging from what we have experienced in the laboratory, for gravity to be the driving factor of a galaxy? We are thinking, comparatively speaking, of forces between 1/100th inch specks isolated by over four miles from one another.

It may be, therefore, that solar system dynamics, with our own as the only example we can know to any great extent, are atypical of the dynamics of the galaxy as a whole. If we are right in judging gravity to have a comparatively dominant influence

upon the positions and movements of the planetary bodies of our system - and it may be that even in our solar system we have to give place to other forces as well to a much greater extent than we have been used to doing - that certainly does not imply we would be right to assume gravitational dominance for interstellar forces in a galaxy, or even less so, for intergalactic forces in the cosmos. Indeed, if the galaxies were powered by vast electrical energy transfers through the plasma environment of so-conceived "empty" space, the force of gravitation in such a context could be safely ignored altogether.

Corollary: A "cosmos without gravitation" (apart from local effects of planetary systems like our own) would require the ditching of fashionable fictions (say I) such as magnetic reconnection, dark matter, dark energy, Black Holes, the expansion of the universe and the Big Bang!

3. Mass and Gravity

Henri Poincaré in 1914 -

"What we call mass would seem to be nothing but an appearance, and all inertia to be of electromagnetic origin." [5]

Yet mass has been regarded as an absolute measure of what most physics textbooks call "quantity of matter". Using the word "quantity" as a definition, however, obscures the issue of "what kind of quantity?" (For in modern physics, "quantities" have units, and if you give this "quantity" a unit of mass (kG) you have argued in a circle.) Is it the space that is occupied by this matter? Is it its weight (heaviness)? In that case the attraction of gravity has been made part of the definition of the quantity. In that case, any laws that involve the force of gravity upon an object and its mass are a product of circular reasoning. The mass of the object would already have been defined to take into account the pull of gravity upon it.

Then is mass the sum of all the various particles that make up the body - considering these particles to be fundamental particles? It does not appear, however, that such a calculation would give a result consistent with our understanding of mass as we normally measure it. In that respect, such a measure of mass is no better than seeing it as the space or volume occupied by the body.

Mass is seen also in Newtonian physics as Inertia, and this can start us on a fruitful track. It is clear (as Wal Thornhill says [2, p. 88]) that if we apply force (for example, a push) to a body, which then moves (or at least reacts to the force), the interaction between the force and the body is an electrical one, pure and simple. Whatever attractive forces might exist are more than overcome by the forces of repulsion, chiefly those between the outer electrons in the atoms closest to the points of contact. As Poincaré pointed out nearly a century ago, inertia (and therefore inertial mass) is an electromagnetic quantity.

This suggests that if the weight or heaviness of the body is proportional to its inertial mass, the pull of gravity is likewise an electrical (or electromagnetic) effect. As Thornhill says, "if we can explain inertia, gravity and magnetism in electrical terms, the electric force would become the only one required in the universe." The pertinent unexplained piece in this intriguing science story is how to explain gravity in electrical terms.

And to help us find the missing piece, we follow Thornhill in turning to Ralph Sansbury, who posits that all subatomic particles, including the electron, are resonant systems of orbiting smaller electric particles of opposite polarity that sum to the charge on that particle. Sansbury referred to the smaller electric charges as "subtrons". It can be shown moreover, that in order for the electron (or the proton or the neutron) to be a stable particle, the transfer of energy between the subtrons in their orbits must be near instantaneous [2].

From the domain of fundamental particles through the domain of the planets orbiting the sun [see below, section 5. Aether and Wave Theory] to the domain of the spiral galaxies, the electric force must operate between charges incomparably faster than the speed of light. If it were not so the system in question could not remain coherent. And if that is the case, the special theory of relativity, in which the assumption that light is the fastest messenger, must be rejected. But perhaps in referring to the domain of the planets orbiting the sun (let alone the spiral galaxies) we have got ahead of the argument. For the missing piece of our puzzle is how to explain gravity in electrical terms. However, with Sansbury's "subtrons" orbiting in a resonant system that now defines the electron (or the proton or the neutron), we have gained an essential tool.

Thornhill explains, "Sansbury argues that (the Earth's) gravity is due to radially-orientated electrostatic dipoles inside the Earth's atomic nuclei, with the inner pole more positive and the outer pole more negative. The force between any two aligned electrostatic dipoles varies inversely as the fourth power of the distance between them and the combined force of similarly aligned electrostatic dipoles over a given surface is squared. The result is that the dipole-dipole force, which varies inversely as the fourth power between collinear dipoles, becomes the familiar inverse square force of gravity for extended bodies. The gravitational and inertial response of matter can be seen to be due to an identical cause." [2, p. 90-91]

And how does the mass of the Earth's particles relate to these electrostatic dipoles in the Earth's atoms? - for in Newtonian physics it is the mass of the particles of the Earth that generates its gravitational field. In the new paradigm for mass, its quantity is a measure of how easily an electric field will distort the particles that comprise it [2, p. 90]. A new definition of mass must be given that replaces the unsatisfactory "quantity of matter" talk. (Newton himself wrote of "quantity of matter" and "mass", as well as "inertia" as alternative nomenclatures, rather than providing a definition of the one by means of another [6].) The mass of any particle, EU Theory proposes, is the measure of the ease of electrically deforming the particle. An electric field acting upon the particle (consisting of subtrons orbiting in a resonant system) will change the shape of the subtronic orbits, because acceleration will be caused at one section of each orbit and deceleration in the opposite section. The overall distortion in the particle, be it electron, proton or neutron, makes it electrically dipolar. Protons and neutrons are more massive than electrons because, with their charge centres (subtrons) being more separated than those for an electron, they distort more readily in an electric field than does an electron, becoming more greatly dipolar. The neutrino, on the other hand, has almost zero mass because it is the most collapsed form of matter, with its charge centers hardly being separated.

Thornhill summarizes the Electric Gravity model as follows:

- Every particle within each atom is made of orbiting near-zero mass charges.
- Every subatomic particle is distorted by the presence of others to form a tiny electric dipole.
- Like magnets that are free to rotate, all the electric dipoles in protons, neutrons and electrons line up to produce – GRAVITY.
- It follows also that neutral atoms distorted by gravity induce an electric field inside a body [2, p. 90].

4. Note on Newtonian "Mass"

It is notable that the very first Definition in the Principia concerns Mass. "Mass" is one of a number of names given to Newton's "Quantity of Matter", but these alternative appellations never appear to be used as definitions of one another, at least not in the sense in which we use the word "definition". It is also worth noting that broadly speaking the Principia explains physics in dimensionless terms, and the dimensional system with which we have become familiar was developed later. Newton proceeds to relate quantities in direct or inverse ratio or as powers of these, and so the dimensional constants and equations with which we are familiar do not appear. The first Definition in the Principia is somewhat paradoxically a non-definition, in which the "quantity of matter" of a body is a measure of matter said to "arise from its density and its volume jointly." The density of a body is always described in terms of the density of something else - usually water, in which case Newton's "density" is equivalent to our "specific gravity", which is dimensionless [6].

5. Plasma: the First State of Matter

Electric Universe proponents have explained a host of cosmological issues, such as the appearance of the many varieties of objects in the night sky or through radiotelescopes, in terms of electrical discharge. Some of these discharges (electric currents) have formed twisted-rope and Z-pinch effects, and indeed a host of variations, most of which it is possible to replicate on a small scale in the laboratory. This mode of explanation has undercut the exotic and unverifiable constructions of an electrically neutral and exploding cosmos seen through the eyes of relativistic mathematics including imaginary and unverifiable constructs such as Dark Matter and Dark Energy. However, it is not only the further reaches of the universe seen through instruments that open up to us the Electric Principle of a renewed Natural Philosophy. The solar system itself, and especially our own planet within it, must reveal to us a system that explains the unexplained of gravitation, and that through the electrical circuitry of inner space reveals to us the many unexplored causal connections among the Sun, the earth and its natural phenomena both atmospheric and geothermal that impinge daily upon our lives.

The Ancients, after all, seemed to have it right when they discerned the four "elements" of earth, water, air and fire. It is likely that they were describing the same reality as we now do when we speak of the four "states" of solid, liquid, gas and plasma. The idea of "plasma" was suggested by the multifarious forms of electrical discharge through what would without electrical tension have formed a gas but which through ionization had been

revealed under electrical tension to be another state. The forms of this electrical discharge and certain of their properties brought to mind the properties of blood plasma in living beings, and the name has stuck for the state of matter in which the discharges can occur. It is indeed appropriate that the name by which the "fourth state" of matter is recognized indicates its electrical possibilities.

Dr. Donald Scott points out that the last state of matter to be identified in modern times, the plasma, is really to be understood to be the first, rather than the fourth state of matter [3, p. 82]. For one thing, nearly all of the matter of the universe is in this form. The galaxies, stars and planets incorporate specks of dirt and dust in a sea of plasma. Dr. Scott estimates that at least 99% of the mass of the universe is plasma. The EU theory discerns the supreme importance of the universe's plasma to its continuous functioning and ultimately to the sustaining of life on Earth. However, for us on Earth, on its seemingly placid path through space, any direct experience of plasma could only occur over 50 miles high – at altitudes in which our life would without special protections and artificial sustenance be impossible, part of that impossibility being caused by direct interaction with the plasma itself. We live in a tiny sliver of a human life-friendly environment, compared with the vast and dangerous engine that exists outside that sliver and sustains it, along with the other oases or cauldrons of solids, liquids and gases that from place to place, and from time to time interrupt the expanses of plasma throughout the universe.

David Talbott points out that the Ancients spoke of the thunderbolt ruling the universe [7], and again, when we transpose their conceptual language into our own, they seem to have got it right. It is the transportation of electrical energy that the plasma facilitates that makes the stars shine, including our Sun, and produces all the electromagnetic radiation found in nature. The "solar wind" (so-called), the galactic currents and the inter-galactic electric circuits all play their part in maintaining the existence of the universe as we know it and in maintaining human existence in the biosphere. These electrical power systems form connected parts of the great plasma engine that rules and empowers our universe.

EU Theory does not postulate where, when or how this vast electrical power transportation might have come into being. EU Theory is concerned very much with producing tangible evidence that the things about which it speaks are indeed true and verifiable. Dr. Scott, for instance, produces convincing calculations showing that the collection of electrons from the space around the sun can be enough to produce the Sun's output of radiation, given the observed features such as the electrical potentials and the temperatures of the various spheres – photosphere, chromosphere, corona and heliosphere etc. - by which the Sun is characterised [3, p. 101-115]. In the EU model of the sun, the Sun's "surface" (the photosphere) acts as an anode and will continue to do so for as long as it maintains a sufficiently positive potential difference to the plasma from which it collects negative particles (electrons) and to which it discharges positive ions. The Birkeland currents that sustain this positive potential are generated by the great plasma engine of the Universe, the Sun is empowered from outside itself, as are the stars in general, and as Dr. Scott points out, there is no telling when or for how long the Sun

or any other particular star will be sustained. There is considerable evidence coming to light about the variability of star sustenance and output, but thankfully not much in human history, especially after the mythical period, about our own Sun's variability.

The plasma state is characterized by matter in a subatomic form, be this form positive ions or electrons or both. The particle inhabitants of the plasma state exist therefore in a state of lower organization than their counterparts in the three other states. The higher organization makes for greater stability, but the electrical nature of the energy transfers across lengths (as in fluorescent lights) or expanses (as in space) of plasma requires a medium of charged but moveable particles. From this point of view, electrical current in metals, which consists of streams of slow-moving electrons, can be regarded too as a plasma phenomenon, only in this case the plasma state coexists with the solid (or liquid) metallic state. A similar situation occurs when a liquid is being electrolyzed.

When an electrical potential difference is initiated across a length of gas at low pressure, certain changes take place that transform much of the gas into a state of plasma, because the atoms of the gas are being broken into their sub-atomic constituents. Unfortunately, cosmologists in general seem not to be able to apply even the most elementary knowledge about the behavior of electrified plasma to the observations of their own field. Clear evidence of plasma in space, for example, is misleadingly interpreted or visualized as streams of gravitationally-driven gases, the "solar wind" being perhaps the most well-known example. Fundamental to an understanding of the workings of the Electric Universe is a basic knowledge of how a body of plasma reacts to electrical stress in the laboratory. Physics students are familiar with such realities as dark current mode, normal glow mode and arc mode, and with this familiar knowledge it is possible to make good sense of an abundance of otherwise unfathomable cosmological observations – but in general, the penny hasn't yet dropped that we live in an electric, rather than a gravitational universe.

6. Aether and Wave Theory

As James Clerk Maxwell supposed, there is a medium through which light and all electromagnetic waves travel. Ripple pond experiments are used to the present day in schools to illustrate the behavior of wave reflection and refraction. These illustrations use water as the medium of the wave generated by a vibrating or oscillating source, and could not work without the liquid. Having used such an illustration of the behavior of electromagnetic waves, it becomes an exercise of bewilderment to profess that electromagnetic radiation needs no medium through which it can be transmitted. An electrical oscillation of nothing is indeed no oscillation.

Electric Universe theory reinstates the aether of earlier physicists. Space is not empty, because, being plasma, it contains subatomic particles, and in particular, neutrinos. Neutrinos are, taken as a whole, neutral, but like all particles of matter in the EU Theory, they consist of resonant systems of revolving subtrons. In the case of neutrinos, as for neutrons in atoms, the positive and negative charges of their subtrons sum to zero, but they are

distorted by an external electric field in such a way that the resonant system becomes dipolar. Although the neutrino has almost zero mass, because it is the most collapsed form of matter, its charge centers being hardly separated, it can do the job of transmitting an electromagnetic wave to neighboring neutrinos in a similar way to the action of molecules of a liquid in a ripple tank.

The surface of a pond bobs up and down as the ripple or wave moves across it: this characteristic is known as transverse wave motion. In a similar way, the directions of the oscillating electric and magnetic vectors of electromagnetic radiation are both at right angles to the direction of travel of the radiation through the aether or other medium: so light too is a transverse wave. However, the ripples of a pond travel very slowly compared with another mechanical wave transmission, namely that of sound. Sound is an example of a longitudinal wave transmission, in which the vibration vector is in the same direction as the transmission of the wave. It might be expected, therefore, that there could be some sort of analogue to this faster mechanical wave transmission in the realm of electrical wave transmission. In EU theory, this fast electrical transmission has been identified, a transmission that is vastly faster than the speed of light, just as sound is much faster than the speed of ripples on a pond.

The fast electric transmission has been identified as what physics has sometimes regarded as "gravitational waves" – the manner in which the gravity of, say, the sun is transmitted almost instantaneously through space to be picked up, and interpreted by the Earth and the other planets. EU theory proposes that the transmission of gravity is effected by the polarization of the plasma particles "daisy-chaining" longitudinally through space at a speed incomparably faster than the transverse transmission of light waves [2, p. 91-92].

All this requires us to put Einstein's Relativity Theory, which requires light to be the fastest messenger, to bed for ever. But that would have been no surprise to the great man himself, who might be heard to ask, "What took you so long?" For in his lifetime he wrote, "There is not a single concept of which I am convinced that it will stand firm, and I feel uncertain whether I am in general on the right track." [8]

7. Appendix 1: Experimentation at the University College of the Cayman Islands (UCCI)

If UCCI would be prepared to take on as an investigation the new paradigm of physics that I am proposing in this paper, the following might be three of several experiments that would be worth working on here. Experiments such as these would be essential in supporting these concepts with evidence, instead of substituting experimentation with mathematics, in the way the majority paradigm does. By supporting such a project UCCI (and by extension Caribbean science educators) could be positioning itself in the forefront of a transformation and development of physics that has been overdue for several decades.

1. Wal Thornhill's suggestion (September 2008): [2]

If you had a spinning super-conducting disc, all the electrons behaved like what is called a Bose-Einstein condensate... It was as if they were all connected... so that if one electron dipole is orientated towards the centre of the Earth, then all the other electrons will tend to be orientated similarly, but if

you were to spin a disc, so that those electrons have to go through a 360 degree alignment of their gravitational axis for every rotation of the disc, then the electrons will tend to resist that. In fact they resist it according to the square of the number of electrons, not just the number of electrons. So ... the entire disc would experience a small reduction in mass - put it spinning on a scale and the thing would weigh lighter than it did before it was set spinning.

2. Verify N. J. G. Sykes' experiment on the variability of radioactive decay. [9]
3. Confirm the variability of 'G' by repeating readings over six continuous hours per day (morning and afternoon) for four days or more.

8. Appendix 2: Creatio ex Nihilo and EU Theory

EU Theory has come up with the rather remarkable date of between 5000 to 1000 years ago for the setting of the geological clocks, by which we can measure time backwards from the present. Stephen Smith, for instance, writes:

"If Electric Universe concepts are found to be more reasonable than previous theories, that cataclysmic events completely overturned the familiar environment that older peoples experienced, then we have no "clocks" and no "calendars" to use, except those that came into being a mere 100 generations ago."

Whether the Earth or the humanly inhabited Earth is only about as old as this or whether it is much older than this is, according to EU Theory, unknowable by our present instruments. This is a conclusion that is currently altogether unacceptable to the current scientific consensus, and is bound to open up EU theory to widespread ridicule. To point out that the date of creation arrived at by Archbishop James Ussher - some 6000 years before the present time - roughly corresponds with the EU's clock-setting is likely to produce knee-jerk reactions among the cognoscenti to the effect that EU Theory is just another form of young-earth creationist fundamentalism.

Archbishop James Ussher was, as Stephen Jay Gould pointed out, one of the very fine scholars of his time, and deserves great respect from the thoughtful. That being the case, the rough coincidence of dates should give us pause for further thought. Rabid mockery destroys only the mockers. Sir Isaac Newton also came up with a similar date for creation. Is he to be mocked as well? (And if not, why not?)

What, then, is there about this date just thousands of years ago? EU Theory regards a time between 5 and 10 millennia ago as the beginning of time as we know it. The theory does not say that there was no "time" of any sort before this, but only that if human consciousness existed before it, it experienced time in an entirely different way, and that whatever that way may have been was completely disrupted and reconfigured on this date - the "Day of Creation" indeed, of a sort, as we now look back upon it.

Researchers, such as David Talbott, point out that civilizations all over the world have in their own ways provided a massive consensus regarding the catastrophic nature of the events of the "Day of Creation". He has catalogued the common "arche-

types" running through the variegated myths of the world's peoples. EU Theory has been able to identify the electrical nature of components of those archetypes, and in many cases researchers have been able to reproduce them in a scaled down manner by electrical discharges in physics or engineering laboratories.

Western and Christian civilization everywhere is of course familiar with the Genesis account of Creation above any other. We are also familiar with the time-honored view that this account describes "Creatio ex Nihilo" - God's creation of the Universe out of nothing. So we would be right to say that while the Genesis account of Creation is related to the rest of the worldwide family of creation accounts - which do not, however, necessarily speak to the character of the Creator nor to a "Creatio ex Nihilo" - there is certainly an intentional element to this particular Creation account which marks it off from the others.

Within the Genesis account there are two separate strands or narratives which run into one another at chapter 2 verse 4, and the relationship between the two is a topic of scholarly disputation. I will only be looking at the narrative of Genesis chapter 1 to chapter 2 verse 4. (It is well known that the division of biblical material into the chapters and verses familiar to us is an editorial feature added just a few centuries ago to the biblical text itself.) The account provides the narrative form of a Beginning (or "genesis") followed by seven Days of creative acts. It is of particular interest that the two "lights", the greater light to rule the day and the lesser light to rule the night, appear in this narrative as created only on the fourth Day. If it is presumed (and I am not suggesting that this presumption must be universally accepted) that the greater light is the sun and the lesser light is the moon, then the "rule" of these bodies respectively over the day and the night would presumably measure the time of the day and the night with which we are familiar. But before their "rule", in other words for the period before the fourth Day, there is no such "rule", in which case the time period of the Beginning and the Days of Creation prior to the fourth Day are indeterminate.

The Genesis narrative continues up to the seventh Day, and there is no necessary connection made in the narrative between these Days of Genesis and the twenty-four hour period, at least as we know it, that marks the rule of the greater light and the lesser light stated to be established on the fourth Day. However, in later memory and practice, these Days of creation have been memorialized by our division of time into weeks of seven "day" (or day/night) periods of twenty-four hours.

The point being made here is that the Genesis narrative, taken as a whole, describes mysterious events in an indeterminate period of time, because the time-scale by which we measure events only became established during or after the events that are described. This is not inconsistent either with the determinations of EU theory, or with the computations of Newton and Ussher. The Genesis account can continue to be interpreted as a disclosure model of the Creatio Ex Nihilo, which with the help of EU theory may be confirmed to have been "before time began", unable to be pinned down in time by the computations of scholars like Ussher and Newton or their more modern counterparts. The Genesis story, however, at least in part, tells also of the "Day of Creation", witnessed in many parts of the world, in which time as we understand it began.

References

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- [2] W. Thornhill, "Electricity or Gravity: Which Rules the Universe?" *SIS Review*, p. 89 (2008, Proceedings of the 2007 SIS Conference).
- [3] D. Scott, **The Electric Sky**, pp. 31-33. "Because stars are so tiny relative to their separations, they have only a miniscule gravitational pull on each other. But because the spaces between stars are permeated with plasma, electromagnetic effects are great."
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