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Continuum Theory: physical nature viewed from a deeper level; a rewarding replacement for SR/GR and its mortal inconsistencies*

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Relativity Theory currently rests upon devastating inconsistencies: **1)** embracing the function of transverse e.m. (TEM) waves as perfect messengers but denying the presence of an aether as defined by Maxwell's equations, and essential for their existence; **2)** overlooking that force communication between two electromagnetically defined, finite-sized, objects is progressively velocity-limited to ***c*** *(e.g. Weber 1854; Heaviside 1889)*, so this is what we observe with electromagnetic accelerators, not mass-increase; **3)** assuming that the finite properties of fundamental particles (mass and magnetism) can be physically generated within spatially infinitesimal singularities, despite powerful evidence that they are of finite size.

Continuum Theory (CT) apparently offers a competent and even more fruitful replacement for Special Relativity / General Relativity (SR / GR) and these basic inconsistencies. CT is based on (A) implementing Maxwell's aether as a massless all-pervasive quasi-superfluid elastic continuum of (negative) electric charge and (B) seeing mass-bearing fundamental particles as finite-sized vortical constructs of aether in motion, *(e.g. Maxwell, Larmor, etc)*, so their diffraction is no surprise. For oppositely-charged particles, one sort contains more aether and the other less, so particle-pair creation is 'easy'. This defines mean aether density as 10^{30} coulombs / cm^3 at the very least, so it provides a near-irrotational reference frame for our observations of 'absolute' direction with suitable devices.

CT recognizes the aether as reference frame for translational behaviour of otherwise-separate bodies. This legitimizes the vector addition of velocities, yielding a resultant >***c,*** thereby escaping SR's need for the Lorentz transformations. Under (B) the particle mass is measured by the aether-sucking capability of its vortex, positive-only gravitation being because the force gradient makes sucking themselves together the statistically prevalent expectation. This activity maintains a radial aether density gradient - the 'Gravity-Electric (G-E) Field' - around and within any gravitationally retained assemblage, so Newton's description of gravitation is an incomplete one. The effect on ***c*** of that charge density gradient yields gravitational lensing. Phenomenologically, aether motions inside and outside particles offer to do each of the jobs currently assigned to bosons.

We show that G-E Field action on sufficiently charged ions and plasma is, and has been, astronomically ubiquitous. This strictly radial outward force has the property, shared with radiation pressure, of increasing the angular momentum of material driven outward at constant tangential velocity. Spiral galaxies no longer require cold dark matter (CDM) to explain this pattern. The force has comprehensive relevance to the high specific angular momenta achieved in solar planet formation, to their prograde spins and to exoplanet observations. Other probable cases include the solar wind, prodigious mass loss rates of high-mass stars (supervening radiation pressure, which would inhibit building them) and the acceleration of ~10^{19} eV cosmic rays from neutron star surfaces, where the G-E field may attain 10^{12}V / m.

The MM experiment was no basis for discounting the aether if it has a particle-tied nature, as in CT. But rejection enabled Einstein to evade that it might be in random motion, causing transmission effects. But a particle-tied character renders such motion inescapable. I show that random motion of aether charge gives rise to four distance-cumulative, wavelength-independent transmission effects upon TEM-waves, plus the generation of a low level of TEM-wave emission (the CMB). Redshift, one of the effects, has been observed experimentally and is demonstrably manifest as the cosmic redshift and as intrinsic redshifts generated in intragalactic plasmas and stellar atmospheres, including solar. This removes Big-Bang expansion and any need for CDM to control it. Dark Energy is not required either; the demand for it arises solely from applying the relativistic doppler formula to a linear redshift, which is inappropriate if the redshift is not a velocity. Random electromagnetic excitation at small scales by all-pervasive aether motion offers a potential basis for activity of the Weak Nuclear Force, for quantum electrodynamical behaviour and the ZPF.

Finally, and briefly, the ***c***-dependent mode of gravitational inter-communication in CT leads directly to *Paul Gerber's (1898)* formal resolution of perihelion advance, adopted, unacknowledged, by Einstein for GR. This lays a path to a Mach's Principle origin of inertia and suggests that inertial force is ***c***-limited also, yielding a new and fruitful QSO model with lots of intrinsic redshift, including those of the Lyα forest (of absorption lines). The aether motion which constitutes a mass-bearing particle needs space in which to exist, which limits the mass-capacity of a black hole. When this is exceeded, e.g. by shrinkage, mass annihilation and a gamma ray burst (GRB) is likely,with potential for light-element synthesis. The CT cosmology which emerges is of an infinite Electric Universe with progressive auto-creation of mass-bearing particles from the random motions of the aether, its original energy resource. Gravitational interactions enhance energy levels and the rate of auto-creation, explaining the creation of clustered galaxies. Such ongoing creation inverts the Big-Bang view that low metallicity material is very old and illuminates its prevalence in dwarf galaxies and spiral galaxy haloes. Deprived of such material infall, galaxies in the centres of clusters evolve into plasma-poor Ellipticals. Five further experimental tests of CT are suggested.

Foreword

This paper is written with certain philosophical maxims in mind, based in part on personal experience. "It is what we think we know that prevents us from learning" (Author unknown). If what you think you know leads you to the absurd, then the choice lies between piling on more absurdity and starting all over again. If scientific progress is really your aim, difficult problems are better not regarded as enticing mathematical challenges until simpler alternative avenues have been fully explored - Nature only does what is easy and then does it abundantly. My big paper (on building the Alps), (Osmaston 2008), was acclaimed by the editor for its integration of knowledge with such 'incisive, innovative thinking'. Hopefully this paper succeeds in doing likewise.

Contents

1. Introduction

From the time of Newton in the 17th century, and particularly in Britain during the 19th century, there was a belief that there is a medium, called the aether, through which and by which 'light' is propagated. So, beginning in 1864, James Clerk Maxwell (1865, 1873, 1878), noting its observed polarizability, used the then known laws of electricity and magnetism to derive his now-famous 'Maxwell's equations' which describe the existence and propagation of transverse electromagnetic waves (hereafter TEM-waves) in an aether. It is a matter of practical experience that those equations really work.

An important feature of the equations is their incorporation of a modified form of Ampère's Law, stating in effect that electric and magnetic fields, or the variations of either, are physically associated, so you can't have one without the other, a point not always remembered by those who observe and model magnetic fields. Specifically, rigorous application of this law also requires that the magnetic fields of fundamental particles, hitherto regarded as intrinsic, must actually be the product, in some way, of the circular motion of electric charge.

There was a persistent problem as to the exact nature of the aether, likened variously to everything from an elastic solid to a perfect fluid. The problem was that the equations prescribe the aether as having elasticity in shear, a property usually seen only in solids, which the aether clearly is not. Successively, Maxwell (1861a,b, 1864, 1873, 1878), W. Thomson (Kelvin) (1867), J.J.Thomson (1883), Larmor (1894, 1897, 1904) and Milner (1960) envisaged, originally for molecules (the smallest objects then recognized), that material particles might, in some, possibly vortex-like, rotational way, be 'made out of aether'. But many people in mainland Europe thought of aether and matter as totally different and independent.

In 1887 the existence of an independent aether was widely thought to have been disproven by the Michelson-Morley (MM) experiment (1887), which failed to detect a direction-

dependent difference in TEM-wave velocity supposedly caused by the Earth's 30km/s orbital velocity through the aether (but - importantly, as we see later - was nowhere near sensitive enough to detect any changes due to the Earth's surface rotational speed, which amounts to 0.465km/s on the equator at sea level). So during the decade astride 1900 several people, notably Poincaré (Fr) and Lorentz (Dutch), recognized a Principle of Relativity, embracing the view that space is empty, so velocities have to be considered relative to other observable objects, not absolute with respect any wider reference frame. Lorentz (1892), in particular, had emphasized a total dichotomy between material particles and aether. In this they were reinstating the view first stated by Gottfried Leibniz, a contemporary of Isaac Newton who, on the other hand, had favoured 'absolute space' as the reference frame.

At that point physics had a choice. Either (a) there isn't an aether (in which case you have to ignore the aether seemingly required by Maxwell's equations) or (b) the aether is tied to particulate matter and moves with it. I would record here that Poincaré eloquently expressed the argument for an aether, whose absence he was about to try to justify, when he wrote (1900)

> *"Does our ether actually exist ? We know the origin of our belief in the ether. If light takes several years to reach us from a distant star, it is no longer on the star, nor is it on the earth. It must be somewhere, and supported, so to speak, by some material agency."* [Transl. from p. 1171]

From 1920 onwards various people (Michelson & Gale, Kennedy & Thorndike, Miller (1933), etc) repeated the MM experiment with improvements but without convincing results on aether drift. Nevertheless, the sophisticated repetition by Brillet & Hall (1979), using lasers, as analyzed by Aspden (1981) and by Hayden (1991), and the further experiment of Hils & Hall (1990), led Kelly (2005) to summarize that the surface velocity of Earth's rotation does produce a closely related aether drift but that the Earth's orbital velocity does not. So we will adopt that analysis here. It is a variant of option (b), in that the interparticle aether is rather tightly, but not fully, tied to the particulate matter which it surrounds and is made of it. That seems very reasonable.

In 1905 Einstein implemented the former view (a) by setting up SR with the Lorentz transformations to define how to interrelate things going on in differently moving reference frames. He claimed to be embracing Maxwell's equations because they are invariant under those transformations but failed to acknowledge the constraint thus imposed for the very existence of TEM-waves. From that day to this, such is the path which has been followed by the world of physics. Its essential and disagreeable feature for our purpose has been the clear inconsistency that light is supposed to propagate somehow without the assistance of an aether, so nothing can modify the light on its journey between emitter and receiver. Not only this, but Maxwell's equations clearly define that the velocity of light (***c***) depends upon two specific properties of such an aether, one electric, the other magnetic; the actual relation being $c = 1/\sqrt{\varepsilon\mu}$, where ε and μ respectively are the permittivity and permeability of 'free space', or of whatever medium is at issue. By ignoring the aether, Einstein was able to ignore this dependence, postulating that the value of ***c*** is an 'absolute constant of physics', thereby ruling out of consideration any effect that might arise if those properties, and the value of ***c***, were subject to physical influence and not universally uniform. From a philosophical viewpoint it seems unlikely that anything in Nature should actually be absolutely constant, unaffected by anything else, so a postulate of constancy, or even an experimental semblance of that, should be recognized as likely to be no more than a convenient approximation. Einstein's desire for constancy was because his implementation of the Lorentz transformations required light to be a perfect messenger between reference frames. To this day, therefore, the *in vacuo* velocity of TEM-waves, determined with impeccable precision in laboratories at ground level on Earth, is regarded as applicable throughout the Universe, including its least accessible corners, such as stellar and atomic interiors.

I contend that physics took the wrong choice in 1905. Consequently, what no-one since then has had reason to consider is that if particles are 'made out of aether' not only must the aether around them to some extent be 'particle-tied' but also would have random motion that reflects the gas particle motions of the transmission path. I will show that in this case four distinct and correlated transmission effects on TEM-waves are to be expected, which build up in magnitude the longer the path-length. So if these effects are found, then *either* there must be an aether, you must ignore those effects, *or* you must devise an escape from such a conclusion.

It has widely been believed that the Lorentz transformations provide an unique account of various 19th century observations. So I recall here that the supposition of uniqueness was shown incorrect in 1941 by the highly regarded experimenters HE Ives and GR Stillwell. For relativists, these names and date refer to their I & S canal rays experiment (repeating one they had first performed in 1938) in which I & S claimed to have demonstrated the 'transverse doppler effect'[1] (a redshift) of SR, a theory for which they therefore confirmed their support. What I & S did not then mention, nor has anyone else since that I can trace, is that only 10 months earlier (Ives & Stillwell 1941) they had published in the same journal beautiful results and rigorous calculations relating to interference patterns produced in gravity waves on a pool of mercury. In that paper they showed that all the "relativistic adjustments" - the Fitzgerald contraction, the Larmor-Lorentz change of clock rate and the Fresnel convection coefficient - were both to be expected and had been observed BUT with ***c*** in this experiment being not the velocity of light, but the velocity of gravity waves on mercury. In other words, though they didn't say so, there is nothing special about the velocity of light in these formulations so long as there is a transmitting medium (e.g. mercury) for the waves. The "relativistic adjustments" arise only if one chooses, as in SR, to deny that by vector addition the waves can, along any part of their path, travel faster than ***c*** relative to the observer, although travelling no faster than ***c*** relative to the propagating medium. Evidently, by restoring the local aether as the reference frame for the propagation of change, all the phenomena currently attributed to SR effects become equally explicable. One is led to guess that their 1941 publication of

[1] In fact the TDE redshift simply relates to the longer hypotenuse in a vector-addition triangle involving ***c*** and a transverse velocity (as is involved in the phenomenon of stellar aberration), but the SR view of such a triangle limits the hypotenuse to ***c*** maximum. At the particle transverse velocities used by I & S and the low precision obtained their distinction from a classical equivalent triangle was dubious. Later in this paper we have abundant occasion to discuss the latter as a redshifting mechanism.

this provocative result forced I & S to redeem themselves with the SR-adhering establishment a few months later by recalling their canal rays experiment.

As an engineer with strong dynamical interests, my wish to perceive how forces are generated and conveyed to other objects leads me to build up mental images, in the hope of illuminating any peripheral desiderata that might constrain the model. It has been said that this was a *modus operandi* exceptionally strongly embraced by W. Thomson (Kelvin), Maxwell, and by JJ Thomson (Topper 1980) which commends it as a scientific method and as an important preliminary to mathematical development. In GR, by contrast, Einstein's proposed universal applicability of the now-famous (though not his own, but apparently that of Poincaré (1900)) mass-energy equivalence formula $\boldsymbol{E = mc^2}$ offers what is from an incisive point of view a slipshod shortcut between events and processes without due care as to how the equivalence is physically or dynamically achieved in the particular case at issue. This fixation with energy rather than with mechanism seems to have been adopted from Thomson & Tait (1867).

In this paper our first port of call in this context will concern the velocity-dependent relativistic mass increase predicted by General Relativity and apparently abundantly confirmed in particle accelerators. The flaw to be examined is that the GR prediction is independent of how the particle acquires its velocity, and therefore fails to consider how the supposedly corresponding energy increase is transferred to it in the distinct cases of electromagnetic acceleration and orbital velocity speed-up (in which case there may also be a question of where the kinetic energy comes from).

Armed with a result from that discussion, I will then outline my implementation of Maxwell's aether and a way in which mass-bearing fundamental particles, such as the electron, might be vortical dynamical configurations made out of it. Consequently they must possess finite size, providing my reason for assigning the name Continuum Theory to these proposals. This leads the paper to an extended outline of how it appears that CT has many physically advantageous and truly Universe-wide implications at all scales.

2. Is the relativistic mass increase real?

During the preceding 50 years many experimenters had noted that particle velocities did not increase so much as linearly as the accelerating voltage was increased, so it was logical for Einstein to incorporate this into SR and GR in 1905-1915, using the idea of inertial mass increase that had already been mooted. But Einstein made the GR effect to be universally a function of relative velocity, regardless of how that velocity had been achieved. In fact all such observations until then and ever since (*e.g.* at CERN) have produced the acceleration by an electromagnetic force depending on communication between the electromagnetic field of the particle and that of the apparatus. What is more, those observations have appeared to be consistent with the SR / GR proposal. But there is a snag.

Except perhaps by special pleading, from which we abstain in CT, the speed of such communication is limited to the value of $\boldsymbol{c}$ determined by the local aether**.** This has the inevitable consequence that the force transferred will fall as the terminal velocity for doing so is approached, as was already foreseen with mathematical rigour by the highly respected classical electrodynamicist Oliver Heaviside (1889), the reduction being formally almost indistinguishable from the relativistic prediction. A similar limitation had been inferred experimentally by the physicist Wilhelm Weber in 1854 (Weber & Kohlrausch 1856). The shock-wave-like sweep-back angle seen in the Çerenkov effect, daily used for determining particle velocities, constitutes observational confirmation of this effect, albeit in a material where the TEM-wave speed is deliberately reduced by the refractive index. The basis for ignoring this communication-time effect in accelerators appears to have lain in the GR-based belief that particles are of zero physical size; a belief which we will argue there is abundance evidence to show is incorrect. Consequently CT is able to regard the mass of a particle as wholly independent of its velocity relative to its surroundings, providing the essential justification for CT's view that the interior of a particle can be 'designed' to generate a specific gravitational mass. For the relativistic effect to be regarded as present in accelerators, nonetheless, would require that the above 'terminal velocity effect' is zero, implying an infinite velocity of electromagnetic force communication, to reach the centre of the particle; unacceptable in any electrodynamical theory.

It follows that by concluding that the velocity-dependent GR effect is lacking in the case of electromagnetic acceleration, neither is it present in the case of orbital velocities. So the effect should not be applied to enhance the inferred mass of a black hole around which a high-speed orbit is observed.

But if we are correct that the mass of the particle has not increased, but just that the pushing efficiency has gone down as the velocity rose, how is it that such fast particles (*e.g.* cosmic rays) penetrate further into the e.m. structure of particle assemblages, just as if they had that greater mass and kinetic energy? The answer lies in the same effect; the retarding field of the assemblage cannot get so much 'grip' on that of the intruding particle, the nearer its speed is to $\boldsymbol{c}$**.** If it be suggested that it is the particle's *mass* that the assemblage is trying to retard, the answer in CT (see below) is that the mass property is itself ultimately electromagnetic in nature, not different, so the answer is unchanged.

Our conclusion in CT , therefore, remains that the mass of a particle, or of assemblages thereof, remains constant and unaffected by its velocity relative to anything else. But, in the case of electromagnetic acceleration, the pushing force and the resulting acceleration goes down as the velocity approaches $\boldsymbol{c}$**.** The manner in which it does so, when applied to Newtons' Second Law $\boldsymbol{a = F/m}$, lowers $\boldsymbol{F}$ indistinguishably from the relativistic form in which it is $\boldsymbol{m}$ that has gone up. This is a case (and we will meet others as we proceed) in which identity of quantitative result is ***not*** incontrovertible proof of identity of physical cause.

We will also need to consider the nature and considerable masses of the particles that emerge from the collisions in electromagnetic accelerators, but this is postponed until CT's implementation of Maxwell's aether and the construction of particles from it has been outlined, next. Constancy of a given particle's mass is an essential basis for setting about the design of its construction.

3. Maxwell's aether as the fundamental substratum of Nature

3.1. Implementation of Maxwell's aether and building ordinary fundamental particles with it

During the past 20 years I have been building a picture for the generation of gravity by a particle, and hence with a bearing on the properties of gravitationally retained assemblages.

For this I take up the 150-year-old view, mentioned at the beginning, that mass-bearing particles are 'made out of aether', being rotational (vortex-like) configurations of its motion. Thus they are NOT the GR-based infinitesimal mathematical singularities currently supposed, and they are clearly distinguished from TEM-waves, which (on Maxwell's equations) involve no rotational activity, and cannot therefore possess gravitational mass. This incisive reasoning contradicts both GR's insistence that they do, and the incorporation of that view into quantum theory. We will return to these matters.

I have taken the apparently unprecedented step of implementing Maxwell's aether as a massless and elastic quasi-superfluid continuum of electric charge whose compressibility derives from the mutual repulsion of its constituent charge. I reason later from widespread observation that the charge is of the character conventionally called 'negative'. To consider that electric charge exists in a continuum form is a considerable reversion to earlier thinking because, ever since Stoney (1874) introduced the name 'electron' and J.J. Thomson (1897) identified the electron (Thomson called it a 'corpuscle') as a single-sized particulate carrier of the electricity in cathode rays, it has been thought that electric charge only exists in the form of indivisible particles, although Maxwell's equations make no such stipulation. Thomson was apparently much concerned with the relationship between ponderable matter and the aether (Navarro 2005) but seems not to have given much thought to it being a bearer of charge. In our continuum view the prescribed elasticity in shear is then provided by the restorative energy storage in the magnetic field which, on Ampère's Law, results from transverse displacement of that charge. To that extent the description 'superfluid' is perhaps less than accurate. The aether now provides a vehicle for the "dielectric displacement current" of Maxwell, which has hitherto been lacking.

In this way the familiar electron-positron pairs would easily be made without introducing or removing any aether, but merely by 'stirring it up' appropriately, which could explain both why they mirror one another and why it seems impossible to produce one without the other. In turn, if the electron exemplifies a particularly stable aether dynamical form, it follows that the mean density of the aether defines the electron as the elementary unit of charge throughout the Universe - and likewise the uniformity of atoms built by its means. This is an important result in a Universe in which (see later, Sections 5.2 & 8) there was no Big-Bang to provide a common source and point of origin.

Further, in the frame of universal cosmogony, if we regard the electron as the most primary of created fundamental particles, its charge will, to provide the dynamical stability and persistence of the hydrogen atom, have dictated the exact equality of the total charge of the quarks assembled to form its proton nucleus. Quarks and quark groupings that didn't do that would, as I discuss in Section 6, have found themselves homeless or as couples (mesons) rendered unstable by the presence of a randomly moving aether. In this sense, formation of hydrogen atoms could have acted as a selective filter from a random sea of aether vortices.

But what is the aether's charge density? Particle-scattering experiments at CERN and elsewhere show that electrons and positrons do have finite and similar estimated effective 'size' (~10^{-16} cm or less; the emphasis being that it's *much* smaller than the 'classical' value) and we know each contains the same amount of charge (1.6 x 10^{-19} coulombs). This yields a mean density in their interiors of >3 x 10^{29} coulombs/cm^3 and therefore almost certainly higher than that at some point on its cross-section - the highest there is in any particle?

Note at this point that the very fact that encounters and resultant scattering do occur at all means that these particles must have a non-zero effective size, with a defensive force gradient as you approach the middle, not the infinite central mass-concentrations endorsed by GR and incorporated into the theory of black holes.

But both negative and positive particles exist, e.g. electrons and positrons. With an aether made of only one sort of charge, the simplest way to make one particle positive and the other negative is to make one include *more* aether and the other *less*, as shown (Fig 1)[2]. For this to be possible the mean density of the aether must at least equal the peak relative charge density, i.e. aether deficiency, in the positron.

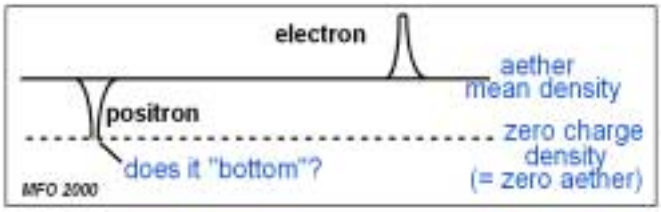

Figure 1. Notional aether (charge) density profiles that would equip electron and positron aether dynamical configurations with equal and opposite amounts of aether. The diagram is drawn for an aether with negative polarity, see text. Less than 'zero aether' is not an option

In high energy experiments, proton-antiproton pairs are of frequent occurrence also. These are possible clues to universal cosmogony which I take up later. It also suggests that some particles, rather than pre-existing and 'found' in such experiments, may actually have been created[3] from the highly disturbed aether generated. If, as we demonstrate later, and the MM experiment also showed, the aether around particles is strongly 'tied' to them, a volume of aether (say) 10 times the diameter of the accelerated particle would provide enough co-moving aether for 1000 more, or their equivalents, to be built, drawing their vortical/rotational component from the huge provision of energy in the machine. It would not, as discussed above, be acceptable to regard them as mass-increase fragments from the particles put in at the start. In the same vein, I

[2] In this suggestion I am apparently preceded by an editorial in The Electrician (1891), commenting on William Crookes' presidential address to the IEE, that he had failed to consider the existence of positive and negative electricity as possibly being "two converse manifestations of one and the same entity" (see p.329), though according to Isobel Falconer (pers comm 2010) this idea was not altogether new even then.

[3] That creation of mass may, on an $\boldsymbol{E = mc^2}$ basis, have occurred from the energy put in, is not a new idea, but our concern is with how that transformation occurs, not just to invoke the magical action of a boson.

envisage that by racking up the energies for the LHC, the long-sought and supposedly mass-property-promoting Higgs boson may indeed be 'found', though unstable and very short-lived, and turn out to be no more than the aether rotational energy needed for mass creation in the foregoing manner.

So I conclude that the mean density of the aether is at least 10^{30} coulombs/cm^3. And that electron 'cores' (whatever that may mean on closer acquaintance, despite the representation in Fig. 1) have twice that. If the density in the positron doesn't 'bottom' (Fig. 1), then the mean density of the aether could be very much higher than this. Indeed, the otherwise-matching properties of electrons and positrons would be easier to conceive if that were so, both then being quite small proportional departures from the mean density.

Note also that if a particle is a dynamical structure within the surrounding aether, deciding how to define its boundary and hence its 'size' becomes a somewhat subjective matter.

Thus the aether is no longer something that one should contemplate ignoring. If, as outlined above, it is in a state of continuous random motion, this must constitute an almost unfathomable energy resource which has hitherto escaped our incorporation into energy-balance calculations such as those relating to entropy and the Second Law of Thermodynamics. The cosmogonical creation of particles from that motion (Sect. 8) would clearly conflict with the latter if we didn't do that.

This line of reasoning carries the implication that systematic relative aether motions also incorporate energy. This is important as an $\boldsymbol{E = mc^2}$ basis for relating the mass of a particle to the aether flows generated by what is going on inside it (see the next Section).

Obviously, moreover, the self-repulsion of all that charge would endow such an aether with very great force capability if its uniformity were disturbed. I argue below that this is what gravitational interaction actually does, but it seems unlikely we ourselves could do anything that would change it much.

By naming the new theory 'Continuum Theory' (CT), the aim is to emphasize that singularities are nowhere present, in total contrast to existing views, which hold that particulate singularities, electrons among them, are ubiquitous and endowed with all manner of finite properties. Indeed new 'particles' continue freely to be proposed by researchers for performing newly identified tasks, but with scant consideration of how they might be equipped to do so. As we proceed, we will discover CT mechanisms which offer to fulfil the functions of the main such ones in the Standard Model, the bosons in particular.

In this context, we may note here that by making electrons 'out of aether' we now have a basis for understanding why they undergo diffraction, an observation which has been one component of the supposed wave-particle duality.

3.2 Generation of the mass property, and the process of gravitation

No-one so far seems to have been able, or has considered it legitimate, to propose a mechanism for the generation of gravitational force - mass is currently a property assigned to each individual particle on the evidence of how it behaves, but that is as far as it goes. So it would be a huge step to be able to show how the property arises and thereby to dispense with a need for 'gravitons'.

To provide gravitational attraction between particles and thereby to equip them with the property of mass, we now suppose that their vortical action results in sucking aether through themselves and pulling themselves towards one another, the force being due to the aether 'density gradient' thereby generated. The inverse square law (or locally steeper(?) in this case, see footnote[4]) makes convergence predominate statistically because a given δr of mutual approach has more force-effect than an identical δr of separation, which is why there is no negative gravity. In this model the rate of the aether through-put, or the vigour of it, in a particular case constitutes a measure of that particle's mass. Here again the cross-section needed to accommodate that flow means that it cannot be done within an infinitesimal singularity.

The value of Big-*G*, Newton's Universal Constant of Gravitation, is then a measure of the vortical particle's ability to sense that aether density gradient and slide down it.

Because the proposed aether is massless *per se*, it has no inertia either and no tendency for rotation to make such a vortex fly apart. For the same reason, in any calculation of the magnetic moment associated with the rotation of its charge it is inappropriate to assume that the internally circulating charge / aether present, although representing energy, has the attribute of mass / momentum at that stage. That attribute only accrues from the *external* aether flow which it causes. We are working here at a more fundamental physical level. This might be why such calculations have suggested a very much larger size for the electron than the one observed. On the other hand, by recognizing that mass-bearing fundamental particles are of finite size, not infinitesimal singularities, as is currently held, and are made of electric charge in some sort of rotation, we have for the first time a model-based opportunity, via Ampère's Law, to understand how it is that all such particles do possess a magnetic property. If they were singularities the current loop would be of zero size and not generate a field.

So now we are in a position to suggest why it is, in particle accelerators, that the resulting particles detected add up to much more mass than the particles we put in, creating the illusion that their masses have increased and broken apart, releasing all sorts of particles in the process.

The CT answer, as noted above, is that the accelerating field cannot distinguish between the charge of the particle and the (many orders greater) charge all around it in the form of the ultrahigh charge-density aether. All is set in motion and the resulting vortical disturbances are the particles we observe – indeed, have created. This is cosmogony in action, though not necessarily the way that Nature does it. We will return to this**.**

In pursuit of our afore-mentioned precept of 'building up mental images, in the hope of illuminating any peripheral desiderata that might constrain the model' we will now consider a conceptual model (Fig. 2) of what aether flow arrangements might be present inside fundamental particles such as the electron and the proton.

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[4] By seeing gravitational force as due to a fixed total flux (aether flow) generated by the central object we are in harmony with existing geometrical explanations of the inverse square law, except that, instead of 'fields in free space', we here substitute density gradients in the aether. Even Newton insisted that he had deduced this law from Kepler's observations but refused to speculate on the reason for it. The proposed polar character of individual particles means that at very close quarters the force / flow gradient must steepen additionally towards each pole.

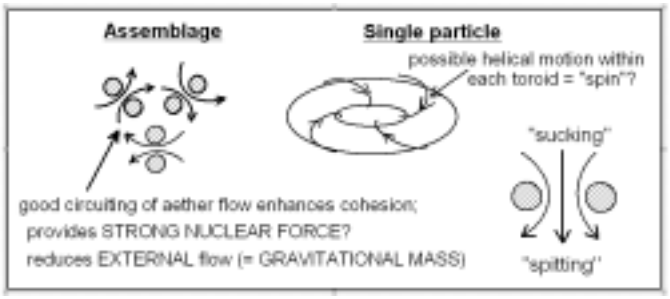

Figure 2. Basic CT conceptual model of fundamental particles and assemblages of them. Figure from Osmaston (2006 in press). The RHS represents a cross-section of the central image. The mass of a particle or particle assemblage is measured by its ability to generate gravity. Two quarks (= mesons) are unstable ($<10^{-7}$ sec) because aether short-circuiting is poor (strong nuclear force is insufficient). As a simple example of the versatility of this basic concept when building up more complex versions to meet requirements, note that 'spin' direction, as illustrated, can reverse without reversing the sucking and spitting poles. Notice that the flow configuration of the suggested 'vortex' is not the familiar one associated with conservation of angular momentum because the aether is regarded as massless. The actual vortical dynamical configuration, of which many variants may be possible, but not necessarily stable, is envisaged as being constrained by the electromagnetic coupling generated by moving electric charge, but this needs detailed analysis.

The aether flow short-circuiting mechanism for the Strong Nuclear Force (SNF) – the CT replacement for gluons - suggested in Fig. 2 offers an understanding of why, when only two component particles are involved, such as mesons (two-quark) and neutrons (a 3-quark ring proton + an electron) the circuiting is poorer, the SNF weaker and lifetimes when free are limited. I discuss later why confinement within atoms could confer their observed stability there. The aether-circuiting idea might perhaps be extended to explain the exceptional strength of the SNF that confers such stability upon the four-proton ^{4}He nucleus. Achievement of its zero spin and magnetic moment cannot be achieved with only one antiparallel vortex pair, because (Fig. 2) the alternative helicities / spins must also cancel.

In CT we reject the idea of intrinsic magnetism, born of the GR view that particles have zero size, and we favour Ampère's law as basis for doing the job by the circulation of aether charge inside particles. So now we will briefly explore how this might lead eventually to an estimate of the aether spin rate inside the electron.

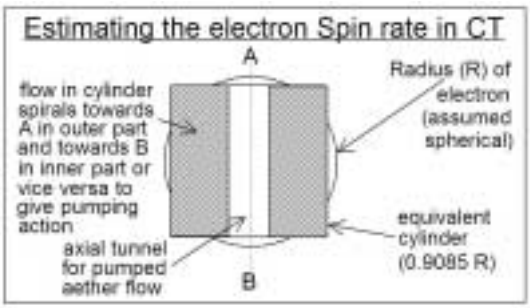

Figure 3. Geometrical approximations used for estimating aether spin rate inside the electron.

We take 10^{-18} m as the 'effective' diameter of the electron, as estimated by high-energy electron-positron scattering experiments in accelerators (Sect. 3.1). Simplifying the electron's configuration (Fig. 3) as a cylinder of the same volume, note that on the basis of Figure 1 the total aether charge spinning within it is at double the mean aether density. If, neglecting the volume of the axial tunnel for the pumped aether flow which gives it its mass, we arbitrarily assume the effective size of the current loop within the cylinder is 71% of the cylinder radius, i.e. 0.645R, its area is 0.32 x 10^{-36} m^2. The magnetic moment generated at a spin rate of 1 revolution / s is then:-

3.2 x 10^{-19} (amperes) x 0.32 x 10^{-36} (m^2) = 1.02 x 10^{-55} J / T.

Unfortunately we cannot derive the actual spin rate by comparing this figure with the currently accepted magnetic moment (~928 x 10^{-26} J / T) because that figure appears to derive from assuming that the mechanical moment and the magnetic moment are directly related, which is not the case in our CT picture because the spinning aether charge has no inherent mass. What we need is an actual experimental determination of the magnetic moment. To generate the above value would require the inordinately high spin rate of ~3 x 10^{28} rev / s, and an impossible 'equatorial' velocity of ~10^3 ***c.***

One possible route for bringing down whatever figure ultimately emerges would be to recognize that the 'size' we have used, obtained by high-energy impact scattering observations, must necessarily lie well up the protective force gradient wrought by the aether circulating around it. If that fringe extends outwards by 3.3 orders of magnitude, approaching the classical size, the spin rate could come down by ~10 orders. This would also require that the 'charge of the electron' is what is concentrated in the centre and does not include what is in that fringe, a picture that is in general accord with the 'particle-tied aether' view developed in other parts of this paper.

Incisively, as already mentioned, the mass-equivalence short-cut $\boldsymbol{E = mc^2}$ is inapplicable to the energy of the circulating aether, but only to the gravitational effect of the aether pumping achieved by the whole structure.

Once, as we have done, one repudiates the tidy agnosticism that it is illegitimate to enquire what goes on inside a so-called 'fundamental' particle, new questions of important detail are bound to arise. But the purpose of this paper, rather, is to build *outwards* from the simple concepts of Figures 1 and 2 to very much bigger scales, and to outline the very tangible benefits of so doing. Ultimately, perhaps, these may constrain those innermost details of particles upon which it all rests.

The former discussion relates mainly to the nature of mass-bearing particles, so what about neutrinos? These, as energy transporters out of stars, have been required and shown to possess energy, which has been equated to mass by researchers, using $\boldsymbol{E = mc^2}$; but they lack the gravitational property and exhibit no charge. In CT the simplistic view would be that they are plain rotational eddies of the aether, with neither any aether-'pumping' through-put action nor any deficiency or excess of aether charge. Neutrinos and antineutrinos could, in accord with existing thinking, involve opposite-handed helicities[5]. Since, as noted already, differential aether motion constitutes an energy resource, that could be where the energy resides, without attributing mass to it. An interesting implication of such a model is that aether rotation must surely be involved and generate a magnetic moment, as in other particles. Is there evidence of this? Could it be detected? See Balantekin (2006) for a discussion.

[5] Note that the prefix 'anti' for antiparticles usually refers to opposite electrical charge, as in the case of electrons and protons, but to spin-related matters in the case of uncharged particles.

3.3. Generation of the Gravity-Electric (G-E) field

If vortical mass-bearing particles suck themselves together to form a gravitationally retained assemblage, the result must be that the aether charge density in the interior is reduced. Such a charge density gradient is an electric field, which I have named the **Gravity-Electric (G-E) Field**. Similar interaction with the rest of the Universe would cause the G-E field to extend indefinitely outside the body too, as also does its gravity field. This recognition, if correct, would be of the greatest fundamental importance for physics, in that it would mean not only that we have a deeper understanding of the mechanism of Newtonian Gravitation, but that Newtonian theory is an incomplete description of the forces at work. It would also bring to fruition the dream of Michael Faraday when in 1849 he wrote of his desire to find a unifying relationship which he called 'gravelectricity' (Hamilton 2002).

Solar mass loss by expulsion of positive ions (radiation pressure is far too low) tells me that lower aether density = positive behaviour. This is the basis for proposing (above) that the aether charge polarity is negative in conventional terms. Because of its direct relationship to the gravitational field, intensity of the G-E field at the surface of an object will depend directly upon the gravitational potential there, being highest at neutron stars, with white dwarfs second, and may be what accelerates the most energetic cosmic rays up to a few 10^{19} eV. We will return to this later (Sect. 7.2.1).

A simple calculation shows that removal of all the negative aether in the Sun would yield ~40 orders more coulombs of effective positive charge than is required to expel all its protons. The Sun would get smaller in so doing, so its content of negative aether would diminish too, but the point is well made none-the-less. So the Sun and other stars can never lose their electrically positive behaviour, thus contradicting an objection raised (Oster & Philip 1961) to the original proposal by Bailey (1960) that the Sun has a positive charge. Such behaviour is seen in planet ionospheres too; the Earth's ionosphere (for example), ionized on the dayside by solar EUV, is moving outward, but not on the night-side, and exhibits a potential gradient of several hundred mV/m (Karlsson *et al* 2003). Notice, however, that in the absence or negligibility of ionic or other electrically charged bodies, the dynamical action of the G-E field is zero and the dynamics reduce to pure Newtonian.

A remarkable example of these different forces acting (now) in the same astronomical object is provided by the bright young star Fomalhaut and its 'planetary nebula'. Here, as in other planetary nebulae ('The Ring Nebula' M57 and 'The Helix Nebula' NGC 7293) there is a light-emitting ring or band now seen to be made up of many hundreds of narrow streaks aligned almost perfectly radially to the (quite distant) central star. I see these as mass loss from the central star, but being formed like the plasma tails of comets (also strictly radial from the Sun (Fernández 2005)) by the G-E field. BUT a planet, named Fomalhaut b, recently found just inside the ring (Kalas *et al* 2008), is *not* moving radially but on a CCW orbit. This is a nice demonstration that an uncharged object (planet) senses no G-E field but only the Newtonian one unless the disk wind is dense enough to drive it outward aerodynamically. This explains why Newtonian dynamics serve so well at present throughout most of the solar planetary system, but (as we will see later) should not be assumed to have held sway in the presence of dense protoplanetary disk plasma.

In Sections 7 and 9, I show how the dynamical effects of the G-E field appear to have been, and still are, both very great and Universe-wide at all scales. But there are other matters to deal with first. So I deal next with a matter of gravitational dynamics that has been thought to be the exclusive achievement of GR - the angular advance of eccentric orbits.

3.4 Gravitational communication and the perihelion advance of Mercury

The application of Newton's Laws of gravitation is customarily treated as a field theory in which the test particle senses the field of the central body instantaneously and reacts to it, the assumption being that the field is an intrinsic property of the central body and is unaffected by the arrival of the test particle. But if Newton's Third Law, that action and reaction are equal and opposite, is to be satisfied one needs to establish how the reaction force gets from a non-contact position of the particle to the central body that is the source of the field, to generate its reaction. For this purpose the limiting velocity of communication must be the maximum ***c*** permitted in GR and in CT, the latter being dictated by the properties of the only intermediary available - the aether. But such a set-up fails to cover what will happen if the force between the bodies is a stimulated response, each to the presence of the other, as in CT.

To clarify this point, note that in CT gravitation is the product of interaction of two objects. The Sun, if alone in the Universe, would have no external gravitational field, i.e. no interactive means of generating an external aether density gradient.

For CT, therefore, we eschew the use of a field theory, adopting one that recognizes the limitations of communication time. A successful account of periastron advance/the perihelion advance of Mercury is neither original nor unique to GR. In CT, as outlined above, gravity is an interaction intercommunicated at finite velocity (***c***) due to the particles sensing and reorienting their sucking poles in response to the aether density gradient generated by the other body. Paul Gerber (1898a,b) successfully modelled this kind of response delay with the implication that if the distance, and the force demand, is changing, then the interactive force actually communicated will have a magnitude which relates to a slightly previous position. The qualitative effects of this are illustrated in Fig. 4.

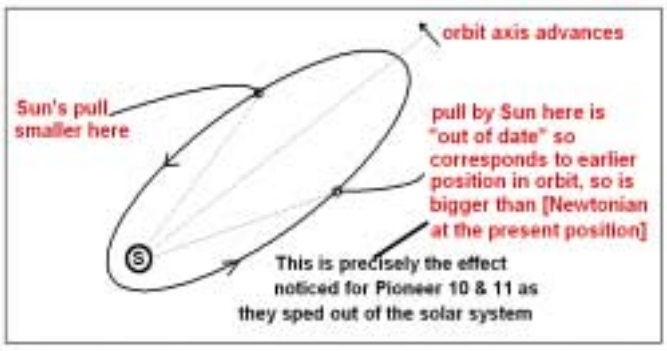

Figure 4. The qualitative effect of gravitational communication time. See Anderson *et al* (1998) for the Pioneer observations.

Gerber's achievement was to make the gravitational potential time- and route-dependent, as distinct from that of Weber, which depended on position only. Gerber inverted the problem. From the then-approximately-known perihelion advance

rate to be explained he set out to determine the effective velocity of inter-communication, which he found to be close to ***c,*** as then known.

The relation Gerber obtained for this in 1898 was the now-familiar

$$d\omega/dt = 6\,\pi GM_{\odot}/Pac^2(1 - e^2)$$

(period, major axis, c, eccentricity along the RHS bottom line)

which Einstein incorporated within GR in 1915 but refused to acknowledge Gerber's priority, despite the republication (1917) of Gerber's paper by an infuriated editor (Gehrke 1916). Evidently plagiarism had yet to become an acknowledged sin. As a matter of history, Gerber's work was discussed by Mach (1902) whose full obituary Einstein wrote as a close friend in 1912, so it is unlikely that Gerber's paper was unknown to Einstein when he published GR.

This remarkable formal identity resulting from two quite different physical approaches could be an important general warning to those who consider formulae to be distinctive of one and one alone. But if this formal identity was deliberately devised by Einstein in his formulation of GR, knowing that it worked, this caveat would bear less weight.

This lack of a formal difference upon which to base his objections to Gerber's interpretation seems to have forced Roseveare, (1982)[6] a relativist, to raise two others, both of which are invalid within CT. One was that Gerber's theory needed to be joined by an electrodynamic theory in which TEM-waves are regarded as particulate and mass-bearing, dependent upon velocity (concepts specifically excluded here), which would add a further perihelion advance, on top of the correct value.

The other was that, again by treating TEM-waves as mass-bearing particles (photons), an incorrect solar gravitational deflection of starlight would result. In CT, on the contrary, the view of this phenomenon to be taken (below) is identical in its effect to that adopted in GR, namely that the velocity of TEM-waves becomes dependent upon the local gravitational potential.

Note that the orbital precession within atoms, responsible for spectral fine structure, is a phenomenon of identical character to that of perihelion advance, so is no longer to be seen as relativistic either.

3.5. Gravitational light deflection/lensing, distortion of space-time, and the G-E field

Eddington's claim, whether accurate or not, to have observed the GR deflection during the 1919 solar eclipse was what really launched Einstein to fame, although Eddington's motive seems more to have been his fascination with the mathematics of GR. The verity of the GR prediction and its value is now no longer in doubt. Remarkably, CT, just like the perihelion advance matter, offers what seems likely to be the formal equivalent in this case also. This is that the G-E field constitutes a radial gradient of aether charge density which, by Maxwell's equations, will cause the value of ***c*** to be lower, nearer the Sun, rather like the refraction by the thicker, slower, part of a glass lens. In GR the deflection is attributed to gravitational distortion of space-time; this is only terminologically different from the distortion of TEM-wave propagation space arising in CT, and is likewise proportional to the actual gravitational potential at each point on the path of the TEM-wave. An interesting possible diagnostic between them is that it seems to me that the CT deflection may operate only on the E-vector, so the lensed light would be polarized radially to the central object, which is not the case under GR. It would be simple to check observationally.

4. The aether and the origin of inertia

4.1. 'Absolute direction'; is the aether irrotational?

For providing a measure of absolute direction, customarily termed sidereal, two kinds of device are known and widely used; (i) Foucault pendulum and mechanical gyroscope - using inertia / gravitation; (ii) ring laser gyroscope - using TEM-wave propagation / Sagnac effect. That such differing kinds of device should both do the job, points strongly to the aether as the link, because it is tied not only to TEM-wave propagation but, as shown above, to the gravitational process also. The ultra-high charge density of the aether that we have inferred here strongly suggests that it must exhibit an irrotational (or nearly) behaviour at all scales except very small ones because of the enormous magnetic fields that would be produced - but are not observed (but see Section 10 on quasar interiors).

This sets the Sagnac effect in a new light - the TEM-waves are propagating at their proper velocity ***c*** in an irrotational frame while the apparatus spins within it, thus making the travel time to reach the moving receiver longer in the forward direction than in the backward. For the record, this is precisely the conclusion drawn by Georges Sagnac (1913a,b) when he reported his discovery. Note that Dufour & Prunier (1939, 1941, 1942) showed experimentally that the effect varies with path length, *i.e.* transit time, not the area of the circuit originally supposed by Michelson (he moved one side of a rectangle) and assumed in popular treatments. Thus the Sagnac effect has nothing to do with the supposition that TEM-waves travel at different speeds in the two directions (which would in any case conflict with the SR postulate that ***c*** is absloute constant). Classical and SR treatments both yield the correct result because SR introduces effects which cancel out. But SR fails to relate Sagnac to its gyro property of providing an 'absolute' directional reference frame, whereas this classical form does.

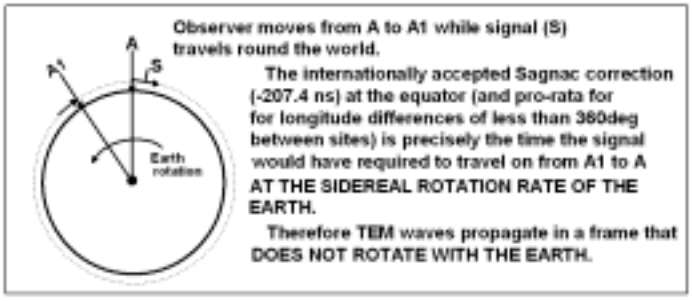

Figure 5. Global correlation of time signals - the CT significance of the Sagnac correction for Earth rotation**.**

A globally significant result of this understanding is illustrated in Figure 5. The 207.4 ns figure is, of course, before ap-

[6]As already pointed out, (Osmaston 2003), Roseveare's derivation of Gerber's result is confused. He starts (p.137) assuming a field-propagation-rate theory, in which gravity falls with recession velocity, and would result in perihelion retard, but then (p.137-138), apparently realizing his mistake, swaps to an intercommunication-response-time theory (like CT) and obtains the correct result. It is remarkable and serious that this *non sequitur* was not dealt with editorially before publication. The destructive effect of so doing may have been why it was not.

plying a correction for height above sea level. Evidently the huge charge density of the aether does indeed give it (nearly?) perfect torsional rigidity. Presumably, therefore, the aether doesn't rotate with the Sun or with galaxies either, although we will see in Section 10 that the interiors of quasars and AGN may be an exception.

This result bears upon the MM and subsequent aether drift results discussed earlier, in that it is consistent with the observation of a drift that corresponds to the surface rotational linear velocity within a *non-rotating* aether frame. This suggests that we must be aware of the aether's differing responses to rotational and to linear displacements. Its torsional rigidity is apparently enough to undo any particle-tiedness in the context of rotations as rapid as the Earth's; but the observed lack of aether drift in the case of the much lower angular velocity relating to the Earth's orbital motion implies that it fails to do so in those circumstances.

Have we here the beginnings of an insight on an aether-provided universal frame of reference, albeit subject to local motions, including random ones, on the smallest of scales? A frame with respect to which the motions of larger bodies can be measured - a replacement, in fact, for the 'absolute space' favoured by Newton in this regard? And providing an intermediary frame that renders the Relativistic treatment of velocities between tangible objects unnecessary?

4.2. The aether as the site of inertial action

Interpretations of inertia based on Mach's Principle continue to be sought and this was the declared aim, as a friend of Mach, by Einstein too in the formulation of GR, though close inspection suggests that GR does not succeed in so doing. A primary snag with a strictly Machian interpretation of inertia, requiring communication 'with the rest of the Universe' has been the evident lack of time-lag in its behaviour. By embracing the infinite communication velocity inherent in field theory, as noted above, this is a problem which GR avoids. Our CT aether, as noted, has both an immense force capability and the possibility of providing a reference frame that substitutes for Newton's 'absolute space', so one wonders whether the rather local enveloping and all-pervasive aether, with negligible 'communication time', could be the volume from which inertial action originates.

I see an important consequence of so retaining a velocity of inertia intercommunication (with the aether of a very local 'rest of the aether Universe') which is limited to ***c*** as being that this will cause inertial force to be ***c***-limited in just the same manner as we explored above in the case of the supposed relativistic mass increase when under ***c***-limited electromagnetic acceleration force. I return to this later (Sect. 10) as the basis for a fertile new model for the nature of quasars.

By making the aether the underlying agent for both gravitational mass, as above, and for inertial mass, one would hope automatically to achieve the rigorous equality of gravitational and inertial mass shown by the Ëotvos experiments and which has so long been a problem. A similar equality was recorded by the Mössbauer experiments which we will discuss in Section 6.3.

5. Random motion of an all-pervading aether - large-scale effects

5.1. Transmission effects on TEM-waves due to a particle-tied ether

These effects, simply arising from our reinstatement of Maxwell's aether, combined with its substantially particle-tied behaviour that results from making particles out of it, appear to have implications that are among the most far-reaching of those studied in this paper.

The four effects, all **wavelength-independent**, and progressive with increasing path-length, are:

(1) RTV (Random Transverse Velocity) redshift due to the aether motions transverse to the sight-line, which stretch the wave along the hypotenuses of the successive resulting velocity triangles. The transmission time is unaltered although the path is lengthened, but at no point is the velocity ***c*** relative to the local aether exceeded. A strictly transverse displacement is irrotational but the magnetic self-coupling of aether charge motion ensures that this is not the case here.

(2) RLV (Random Longitudinal Velocity) spectral line-broadening due to the longitudinal components of aether motion. It is the variance that grows, so the line-width increases more slowly than the RTV redshift, which may visually dominate when large.

(3) RTV or Deflection Scattering, due to (1).

(4) Attenuation due to (3).

The rates of all four increase with the gas particle velocity present so, for a Maxwellian distribution of velocities, the growth rate with distance varies as the square of the absolute gas temperature along the path. They also grow with the degree to which the aether is particle-tied, hugely different as between neutral particles and ionized ones, because the aether itself is electric charge. The ratio is that of the gravitational and electric forces between two identical particles, namely $\sim 10^{36}$ for protons and $\sim 10^{42}$ for electrons, so even minor ionization can have a very big effect on the amounts of **(1) - (4)**. Finally, of course, the effects grow faster, per unit path length, the higher the gas density and the closer its particles, though this is offset by spatial averaging (see below).

Processes **(1)**, **(3)** and **(4)** all invoke the angular deflection of the TEM-wave train propagation vector as the result of a strictly transverse displacement of a part of it. But Lorentz (1896), when discussing stellar aberration, pointed out that an irrotational displacement cannot produce an angular deflection. This is particularly the case for the motions of a superfluid, which by definition lacks viscous coupling between motions. In this problem we are again rescued by the electromagnetic behaviour of the aether, in which, just as for TEM-waves themselves, any transverse motion of it is magnetically coupled to the surrounding aether.

Overall, there is another factor. Because the degree to which the aether is bound to a particle must fade with distance from it, the aether motion at any point will be the product of the spatial averaging of the action of a large number of particles in that region. Using the 1968 ground-level observations of redshift discussed in the next Section, I have compared (Osmaston 1996) the observed redshifting rate with distance with what one would get by assuming the full transverse displacement done by the r.m.s. gas particle velocity to happen every mean particle interval along the path. The surprising result is

that spatial averaging apparently cuts down the effect by the factor 5 x 10^{-13}.

5.2. Experimental observation of RTV redshift over ground-level paths

In May-June 1968 (Sadeh *et al* 1968), two sets of caesium clocks, on trucks, were progressively separated by distances up to 1500 km, sitting at each location along a NE path for a week. The ticks received from the immobile one were compared at the other. Further comparisons from the base at Cape Fear were also done with the US master clock in Washington (a NW path) and on a much warmer SW path to Florida.

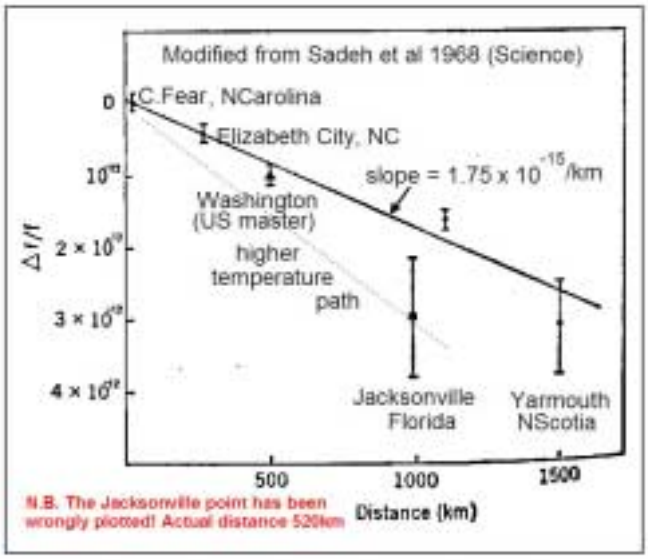

Fig. 6. Observations, in 1968, of the progressive slowing, with increasing reception path-length from Cape Fear, of ticks received from its stationary and intercompared set of caesium clocks.

The account given shows that the observations were carried out with good experimental rigour, using only the ground wave, and their results are reproduced in Figure 6.

I interpret these results as ground-level experimental verification of CT's predicted RTV redshift (Section 5.1).

5.3. The cosmic redshift as RTV redshift

Now we wish to assess whether the redshifting rate recorded by the slope of the line in Figure 6 could indeed be the cosmic redshift. To do this we must extrapolate from the ground-level atmospheric transmission parameters to those (hopefully) of intergalactic space across which we view the redshift of galaxies. Those parameters (Sect. 5.1) are the temperature, expressed as the Maxwellian most probable particle velocity, and the particle number density along the path.

The important thing is that the redshift observed grew almost linearly with distance, as predicted for the RTV effect. In 1969, on discovering the paper, I extrapolated from reasonable atmospheric parameters that if the mean (baryonic) density of the Universe is taken as 10^{-25} kg / m^3, neutral atomic H taken as its composition and its temperature as 2.75K, enticingly, the result extrapolates to a Hubble constant $\boldsymbol{H_0}$ = 59.5 km. s^{-1}.Mpc^{-1}, well within the range considered.

[My adoption of the 2.75K temperature was and is justified both by my recognition (Sect. 5.8) that the CMB temperature is indeed indicative of the transmission path temperature in intergalactic space, and by my recognition (Sect. 10) that the redshifted absorptions recorded in the Lyman alpha forests of quasar spectra are generated within the structure of the quasar and are *not* evidence of correspondingly high temperature clouds in the intervening cosmos.]

BUT we must now note that the density of the Universe is now recognized as involving vast voids between clusters and skeins of galaxies and it is these voids that form the majority of any long-distance path, along which the RTV redshift accrues, so the baryonic density is almost certainly very much lower than the value I assumed. The 10^{-26} kg / m^3 density estimate currently available (ten times lower than that used in the above calculation) is based on Relativistic, expanding Universe, considerations and incorporates allowance for CDM and Dark Energy, so it is inappropriate here if this is really the cosmic redshift. Any result can probably, however, be comfortably accommodated as a genuine demonstration of RTV redshift by taking the degree of ionization in inter-galactic space to be higher than what it was on the ground-level atmospheric paths of the 1968 experiment. This would allow the real mean density to be up to many orders lower than the one used above.

My conclusion, therefore, is that the cosmic redshift is indeed an example of RTV redshift as a TEM-wave transmission effect, so there was **no Big-Bang and the Universe is not expanding.** But this does not rule out non-systematic velocities.

Because the effects 1-4 (Sect. 5.1) are cumulative, so grow exponentially with path length, it might be asked why the cosmic redshift appears to grow linearly with distance. My inferred answer is that the redshift exponential growth is matched by exponential growth of the attenuation, which modifies the distance determinations similarly, leaving a linear relationship. On the other hand, the distances inferred by use of the standard candle method must be too great, particularly at high redshift, if this additional attenuation is not allowed for.

The belief that the redshift is a velocity has led to the application of the relativistic form of the Doppler formula, which reduces the velocities at the high (distant) end to prevent them ever reaching $\boldsymbol{c}$. It is this that has conveyed the appearance of a young-end acceleration of expansion and resulted in the invention of Dark Energy to do that. **Dark Energy (DE) is unnecessary if the Universe is neither expanding nor accelerating**. If the redshift is not a velocity there is no reason why the value of $\boldsymbol{z}$ (= $\delta\lambda/\lambda$) should have any upper limit, except observationally, due to attenuation.

According to Wikipedia website in March 2010, DE is currently regarded as constituting about 73% of the mass-energy content of the Universe, with Cold Dark Matter (CDM) at ~23% and baryonic matter at 4.5%. So before the advent of the DE idea, CDM was evaluated at 84% of the whole. But we will see (Sections 5 and 9) that the combined effects of RTV intrinsic redshift in stellar atmospheres and galaxies, and of G-E field action in spiral galaxies, may well **abolish all need for CDM also.** In that case the baryonic density of the Universe, insofar as it has been assessed in a CT-acceptable manner, rises from 4.5% to 100%. In fact, however, it is likely that the cited baryonic figure is not based on factual observation at all but on theoretical considerations in a Relativistic Universe, invalid in CT. So a more useful option would be, if this RTV interpretation is accepted, to use the observed value of $\boldsymbol{H_0}$ to assess the density and ionization parameters along such sightline paths.

5.4. RTV redshift: What becomes of the 'lost ticks'?

In the case of ordinary Doppler redshift, fewer waves per unit time reach the observer because an increasing number are 'paving' the lengthening transmission path. When there is no relative motion of source and observer, as in the CT redshift

case proposed here, how can fewer waves / unit time reach him? I conclude that, because the TEM-waves are continually reconstituted by the resilience of the aether motion they have generated, the energy of the lost waves is funnelled into the scattered waves, thus increasing the attenuation with distance over and above that of the inverse square rule**.** This conclusion, together indeed with the whole idea of RTV redshift, would be illegitimate in a quantum theory which, as is currently the case, regards photons as individual energy packets, each with a precisely defined wavelength, any change in which requires the emission of a complementary low-energy photon. Such a criticism was indeed made by McCrea (1974) in respect of the redshifting inferences by Finlay-Freundlich, referred to in the next section. So I will offer later (Sect. 6) a CT perspective on quantum electrodynamics (QED).

5.5. RTV redshifts in stellar atmospheres and galaxies

5.5.1. Solar redshift

The solar redshift is commonly cited by relativists as exhibiting the GR prediction (0.636 km / s velocity-equivalent at the surface). Closer inspection[7], however, reveals the falsity of that conclusion. It rises, from well below the GR value over the central 30% of the disk area, to nearly twice the GR value at the solar limb. This variation, shown by Finlay-Freundlich (1930) to be similar for all radii on the disk, and its variation with spectral line source depth, seems entirely consistent with an RTV redshift origin, a rather similar interpretation having been offered by Finlay-Freundlich (1954a, b). As the limb is approached, the radiation leaves the Sun at an increased zenith angle, involving a much-increased path length through the solar atmosphere. Ter Haar (1954) agreed that Freundlich's observations did show that the redshift is produced within stellar atmospheres. The continuing rise at the solar limb, but for UV lines only half as great as for red ones (Evershed & Royds 1916), suggests that refraction in the lower atmosphere is refracting red light round from just behind the limb, as in the case of a red sunset on Earth. In the central area of the disk the redshift also varies steeply from line to line with the line strength and reversing level within the photosphere at which the absorption line originates; much more steeply than GR's $1/R^2$ dependence on radius / gravitational potential. This variation is even seen when comparing different spectral lines with the nearly the same wavelength. The popular 'explanation' of the variation, that the velocity structure of solar granulation is superposed upon the GR value, becomes unrealistic near the limb and along polar traverses because of the velocity patterns it would imply. Our recognition as being RTV redshift in character is consistent with the CT view, already noted, that TEM-waves are the wrong kind of aether motion to possess gravitational mass.

An interesting off-limb coronal extension of the solar redshift appears to have been observed in 1968. As the Pioneer-6 spacecraft passed behind the Sun, the communications TEM-wave carrier (2292 MHz) from it was successfully monitored until its transmission path came to within a solar diameter of the solar surface and was found to exhibit a redshift which I calculate (after removing a linear drift of carrier frequency) as rising to an equivalent ~11 m / s (Merat *et al* 1974) at the closest approach and decreasing symmetrically on the other side of the Sun. This appears to have been the off-limb corona-generated continuation of the solar disk RTV redshift. This observation has been regarded as spurious because in 1968 the observations (Shapiro *et al* 1968, confirmed by Robertson *et al* 1991) of delays on pulses passing the Sun from the pulsar 3C273 established the correctness of the path-length increase predicted by the GR gravitational deflection of TEM-waves, whereas the wave-stretching rate to get the apparent 11 m / s recession seen in the Pioneer observation would suggest a delay about 200 times greater. In fact, as noted above, the RTV redshift mechanism has zero effect upon the travel time, so would have been unobserved by the pulse-delay observations. The two kinds of observation are not observing the same thing. The Pioneer 6 observations should be repeated with one of the now-numerous space vehicles with suitable orbits; it would cost little and could be of great significance for physics.

5.5.2. Stellar RTV redshifts and RLV spectral line broadening

Several white dwarf stars with large expected GR redshifts exhibit very little (or insufficient) redshift for a GR interpretation but consistent with very thin atmospheres in which to generate RTV redshift. The white dwarf Sirius B has a redshift often acclaimed as supporting GR, but seems to be alone in so doing with good control. The stellar K-term, established by the works of Trumpler, Weaver and Feast (*e.g.* Feast 1958), considered important by Finlay-Freundlich, tabulated by Allen (1955), and discussed by Rubin (1963) and by Johnson (1965), is a spectral-type-dependent apparent velocity of recession, relative to stars in the same spatial group, that decreases with stellar atmospheric temperature and optical depth, from WR (Wolf-Rayet) and O to A (or 'to least type F' (Johnson 1965)**,** and then rises again slightly at M**,** with their deep, but cooler, atmospheres. This disparate redshift is particularly starkly seen in disparate binaries, the excess displayed by the WR component being as much as 150 km / s (Kuhi *et al* 1974).

Further, it is common to interpret line-widths that are too large for the colour temperature of the star - and examples of this abound among O and B stars - as due to stellar rotation. On this basis, rotation has been inferred to decrease greatly during evolution from O to F**,** with an especially steep decline at F5 but, as noted by Struve (1950), creating a problem as to the implied mechanism of a.m. disposal. But an RLV line-broadening interpretation relates nicely to the inferred K-effect RTV redshift and would simply suggest a slight drop in temperature and atmospheric depth at this stage in stellar evolution. This need not be great, in view of the strong influence of ionization.

A reminder of the numerous past observations of these effects by J-C Pecker (2006) provides access to his extensive database on them. Many date from the 1930s, but they have become fewer over time, because interest has moved on. They include, as noted by Johnson (1965) such dynamical absurdities as a closely bounded and dense stellar cluster in which the greater O and B star redshifts suggest they are receding through the rest of the cluster. O and B stars are commonly very massive so attempts were made to explain the redshift as gravitational under GR, despite potential conflict with their positions on the HR diagram.

5.5.3. Intrinsic RTV redshifts of galaxies

[7]paying especial regard to the detailed work by M.G.Adam and her colleagues, using a very refined Fabry-Perot Interferometer, at the Oxford Solar Observatory and published in numerous papers in MNRAS during 1948-1959.

and the ages of clusters

De Vaucouleurs' (1961) study of 76 of the brightest galaxies in the Virgo cluster showed the redshifts to be correlated with galactic type, extending from a mean of 1670 km/s for Sc (most gassy) to a mean of 990 km/s for E (old scheme). This would be consistent with a cosmic RTV redshift of 900 km/s for the cluster, (*cf.* the mean of 863km/s got by Arp 1988) overlain by intrinsic RTV redshifts between 90 km/s at E and 770 km/s at Sc[8]. The redshift-inclination correlation, but confined to the gassy members of the cluster (Ftaclas *et al* 1981), may tell the same story. Arp (1988) and the two Burbidges have greatly added to the database of galaxy intrinsic redshifts. Removal of intrinsic redshifts from the individuals of a cluster will clearly reduce the demand for CDM to hold the cluster together, which arises from application of the virial theorem and an assumption of cluster longevity.

The latter assumption has reduced validity in the context of CT's continuous auto-creation cosmology offered in this paper (Section 8), in that the mass of a cluster has grown over time, thus further eroding (even eliminating?) the inferrable demand for CDM in this context.

5.6. RLV line-broadening in SCEPTRE III and ZETA, 1958

It appears that this mechanism of spectral line-broadening has been observed in terrestrial equipment. In Britain in 1958 an early attempt at achieving thermonuclear fusion was made with toroidal plasma devices named SCEPTRE III and ZETA.

After much published trumpeting that a temperature of 5MK had been achieved, it was subsequently admitted by Kaufman & Williams (1958) that a variety of measurements (inadequate energy input, electrical conductivity, He^{I} ionization, non-isotropic neutron output) showed that no more than 250kK had been reached. The original temperature observation had been based on spectral line breadth, viewed with a tangential sight-line, provoking the authors to remark (p. 558) "the need to explain the large Doppler widths which are observed is even more compelling than hitherto". This caused Spitzer (1958) to consider the problem to be "of great interest in basic physics".

5.7. RTV or deflection scattering: origin of the CT idea

My recognition of this scattering was what all my work on CT has sprung from, so there follows a short history of events.

In 1959, when working on a weapon-related airborne astronavigation project in UK, I discovered, wholly serendipitously, that the kind of scattering (3) accounted much better at high flight altitudes (18 - 37 thousand feet) for the carefully observed daylight sky brightness distribution (Barr 1953 and references therein) than did/does the current theory of scattering by molecules. Such brightness gradients are a matter of great importance when your device is searching for a chosen navigation star in a patch of sky. Not only was the distributed sunlight different in intensity but its colour also, with the overlaid component lacking the blue bias explained by current theory (Rayleigh scattering) and familiar to us as the blue sky. In this wavelength-indiscriminate respect the scattering has something in common with Thomson scattering. However, among various other discrepancies, a principal surprise was the presence of a patch of enhanced brightness approximately centred on the antisolar point and which became important, rising above the horizon-related brightening, as the solar altitude decreased below 40 degrees. The contrast provided by this patch was seen to increase with flight altitude, thus ruling out specular reflection from atmospheric dust as the cause.

Coming from my earlier radio 'ham' background among whom it was widely supposed (see Admiralty Handbook... (HMSO 1938)) that radio waves are propagated by 'the aether', I envisaged that the scattering might be deflections caused by the random motion of an interparticle aether, the particles being those of the atmosphere. With the help of a colleague (R.L. Nelson) we showed with mathematical rigour that this would indeed yield an expectation of a circum-anti-source-point brightening.

The principle is simple. The scattered brightening at any point on the sky is the product of two functions. One (i) is a scattering probability function that decreases radially in all directions away from the source direction. Along radii towards the horizon this function will not be the same as zenith-wards. The other (ii) is the angular area of the elementary annulus from which that light reaches the observer. This increases up to the angle $\pi/2$ from the source, but decreases to zero at the anti-source point, thus concentrating all the probabilities and providing a brightening rate which, at some point, inescapably surpasses the rate of decrease associated with the probability function.

The head of my establishment, a 1st Class physicist, saw at once the possible wider significance of this, apparently blowing a hole in Relativity theory's rejection of the aether, and he got me specially funded (away from the project), plus the literature support of a librarian, to pursue the matter for 9 months. That really got me started. It then emerged that the night sky exhibits a similar antisolar point brightening long known as the *gegenschein*. Moreover, the *gegenschein* was observed from the Pioneer spacecraft when millions of kilometres from Earth (1.86 AU) (Weinberg *et al* 1973) where its colour was, as noted above, very close to that of the Sun. Popular attribution of the *gegenschein*, lacking our CT alternative, is that it is a branch off the zodiacal light, but this fails to account for its greater brightness by several orders when seen in the high-flight-altitude daylight sky. As the Sun is the source in both cases, this can only, I think, be explained by the much more intense scattering associated with the random motion of the particle-tied aether of the warmer and much denser Earth's atmosphere.

Two other points should be noted. If the source-point were a singularity, there would also be a corresponding singularity at the antisource point, but the solar disc is not a singularity. The probability function (i) necessarily relates to scattering both towards and away from the Sun or star, so also produces a virtual image superposed upon the source. It is this light, now RTV-redshifted by the corresponding transverse deflections, which constitutes the redshifted stellar image of a distant star. There would be no such redshifted image if the transverse deflecting action only moved light *away* from the source. An (eventually, but not yet) important result of the redshifted im-

[8] Erratum. Note that, embarrassingly, in my 2003 paper entitled 'A particle-tied aether....', I erroneously cited Holmberg (1961) as the source of the data analyzed here. Holmberg in fact is one of those who have disputed the presence of type-correlated redshift, mostly in the light of studies extending to fainter magnitudes. To the extent that fainter means volumetrically smaller, this would involve emergent radiation in shorter transmission paths through intrinsic redshift-producing gas and plasma.

age being the product of scattering action is that it must apply an ultimate limit to its resolution, beyond which the lengthening of interferometer base-lines will no longer be useful.

The second point is that the up-down asymmetry of (i) on the sky when the Sun is seen from within the Earth's atmosphere, must cause the shape of the antisolar brightened patch to be asymmetrical too and to a degree that varies with the Sun's altitude. This feature seems to have lent support to the phenomenon being interpreted as an offshoot of the zodiacal light. Seen from space, such asymmetry is not to be expected.

5.8. Origin of the cosmic microwave background (CMB) radiation

Random movement of the aether surely involves accelerations of its very big charge content which, by Maxwell's equations, must certainly result in the generation of a low level of TEM-wave radiation "noise". To the extent that the random motion is the product of being particle-tied this radiation will be at the random frequencies characteristic of the gas particle motions. I see this 'noise' as the probable nature of the CMB, not as a left-over from a Big-Bang, which I have discounted - see Section 6.2. The characteristic temperature (2.73K) inferred from this radiation is therefore to be seen as the mean temperature of the particle-tied aether motions in intergalactic space, with any slight unevennesses being due to slightly higher mean temperature along that sightline, such as might be associated with large clusters of galaxies.

Currently the biggest, but still very slight, of these hot patches is in the general direction of the Coma cluster and one interpretation of this has been as a Doppler overlay due to us moving at 627 km/s towards it. But that would seem to require that there is a counterpart CMB 'low' in exactly the other direction. In fact the principal low seems to correspond with the vast cosmic void in the Eridanus direction, some 30 degrees off-line.

A more widely-held attribution of these 'pimples' on the CMB global distribution, identified observationally as being cluster-aligned, has been to the Sunyaev-Zel'dovich effect. This invokes the inverse Compton scattering of CMB photons by the galaxies. In CT, as noted, the extra radiation stems directly from the enhanced energy levels and random aether accelerative motion around clusters. More-distant clusters may be responsible for the observed seconday peak, at smaller angular subtense, in the distribution of these pimples.

Apart from these pimples, the extreme uniformity (1:10^5) of the CMB in widely differing directions on the sky has raised the 'horizon ' problem in Big-Bang cosmology and its attempted resolution by the Inflation hypothesis. In CT, that uniformity may simply be telling us that those sightlines traverse parts (including those nearby) of the Universe which preserve an uniformity of aether motion still barely touched by ongoing auto-creation since it all began (see Sect. 8).

Quasar spectra exhibit C^{IV}, N^{V}, O^{IV} and Si^{IV} absorption lines (related to individuals of the so-called Lyman α forest[9]) which have been attributed to intervening intergalactic clouds with ionization temperatures of several 10,000K. This would conflict with the above interpretation of the CMB, but in Section 10 I offer a new quasar (QSO) model in which such absorption lines are intrinsic to the body and the conflict is avoided.

6. Random motion of a all-pervading aether - atomic-scale effects and QED

6.1. Photons, photoelectric emission and Planck's radiation law

As stated already (Section 6) the idea that TEM-waves always exist as mass-bearing particulate entities called photons, or with a wave-particle duality, is not acceptable in CT because generation of the mass property requires a quite different form of aether motion. It is widely believed that radiation pressure is a consequence of such mass, but it was emphasized by Born (1944) that the pressure is validly demonstrable as an electrodynamic effect. Mass property or not, I find it impossible to accept the particulate aspect. From my experience as a youngster, generating smoothly oscillatory electric currents (as proven by their lack of harmonic content) and radiating them as radio waves, I find it unacceptable to have to believe that there was some kind of genie sitting on my aerial chopping up all those electromagnetic fields into little units of the right size for them to be radiated as photons. I argue that if, in these circumstances, the resulting TEM-waves are indeed continuous in transit, then it is wholly inconsistent to suppose that in some other situation TEM-waves are 'different' and only exist as packaged items.

Planck originally derived his formula on the basis that the 'packets' represented changes between stable energy levels within the emitter or receiver and did not require their discontinuity during movement across the cavity (Kangro 1976). It is true that when an atom radiates, it must indeed represent a jump between stable dynamical (internal) configurations, so at this scale it is indeed reasonable that the waves may be discontinuously transmitted. But Einstein, following his study of photo-electric emission of electrons, preferred the particulate alternative offered by Planck and imposed it as a generality, disregarding or possibly ignorant of the above serious inconsistency.

We have seen (Sections 3.5 and 5.4) that neither the solar redshift nor gravitational lensing require TEM-waves to have the mass property. So what about the 'spotty' emission of photoelectrons from a surface under low-level distributed illumination? This is the point at which we need to consider the invasive random excitation by the randomly moving aether. It means that an atom with a loosely bound electron may, at random intervals, be excited to near-release energy. At that moment the additional excitation by a low level TEM-wave field will trigger release of the electron. It does *not* mean, as has hitherto been supposed, that the entire release (quantum) energy has been brought to that point within the illuminating beam. Because the aether excitation is random it may instantaneously either add or subtract from that of the incoming TEM-wave, so the mean effect will appear to be zero and correspond to the TEM-wave input only.

This is a nice demonstration that in cases where one of the inputs is a random one, the use of averaging, with the aim of improving the precision of the answer, may completely obscure its physical interpretation.

Accordingly I suggest that random excitation by the all-pervasive aether might provide an entirely new foundation for the statistical overlay upon classical electrodynamics which

[9] Lyman α is the longest wavelength line (1216 Å) in the ultraviolet Lyman series of atomic hydrogen. Next shorter is Lyman β (1026 Å).

seems to lie at the heart of quantum electrodynamics (QED). Another name for that statistical overlay is 'quantum tunelling' which underlies the Schrödinger equation of quantum mechanics. It plays an important part in (for example) our understanding of how the Coulomb force defences holding two protons apart inside a star can momentarily drop their guard and enable them to get close enough together for further interaction to proceed.

Thus in CT, the statistical behaviour of particles would emerge, not as an inherent property of those individual particles, but as due to being energized by the random motion of the aether in which they are steeped. This insight appears to warrant serious consideration, motivated by the abundant evidence for such motion outlined in Section 5 of this paper. Evidence for the Zero Point Field (ZPF) and zero point energy might be accommodated in the same way. These matters fall outside the scope of the present paper.

A word here about electron shells and the emission of 'photons' as 'quanta'. If electrons are 'made of aether' as outlined in Section 3, and not as indivisible singularities, it becomes possible that an electron may lose its mass-generating aether dynamical configuration when inside an atom, simply becoming a shell or ring of excess aether charge density. Losing the mass property of that aether and the corresponding centrifugal force would be of little consequence because it would be the hugely greater (Coulomb) electrical attraction by the nucleus that constrains the size of its 'shell'. Further, being now a shell or ring of charge continuum, we no longer have the long-recognized problem of why orbiting electrons don't radiate and rapidly get slowed down; radiation requires that the field at a point should vary as the point charge passes, but the uniform distribution of charge around the ring would avoid this.

Viewed in this way, I envisage that it may be orbital stability criteria, arising ultimately from the properties of the aether, which determine the energy content of a particular electron configuration of an atom, a view very close that originally used by Planck. TEM-wave emission ('photon') occurs when the dynamical configuration jumps to another of slightly lower energy content. Likewise, in the reverse direction, the TEM-wave energy absorbed in causing an upward transition is a function of the receiver, not of the source. The subdivision of emissions into packets is thus a function of orbital stability criteria and not a property of the TEM-wave emission *per se.* Planck's constant, therefore, measures a property of atomic structure and the aether that pervades it, not a property of TEM-waves. This dependence carries the implication that it is not to be regarded as 'an absolute constant of physics', though its variability may be extremely small. In Section 6.3 we discuss a situation in which there may be evidence of such variability.

6.2. Does the aether's random excitation penetrate to atomic nuclei? The weak nuclear force?

I have referred (Section 3.2) to the limited (~15 minutes, in fact) mean lifetime of the neutron's decay to a proton, an electron and a neutrino when outside an atom, although neutrons appear able to be infinitely stable when within some atomic nucleii. It is not usually considered that a neutron does actually 'contain' an electron in addition to its three quarks but I suggest that this may prove to be a simplification. In that case we would need to consider whether this diversion of its aether pumping flow limits its Strong Nuclear Force (SNF) when it is on its own as a 2-particle entity[10]. This would render it susceptible to disruption by the random disturbing field of the aether, whereas it can be protected from that within an atom by the electromagnetic shielding provided by surrounding electron shells. The evident stability of neutrons when constituting the core of a neutron star may be evidence of the same shielding mechanism but on a vastly bigger scale.

Mesons too, as 2-particle entities emerging from the disruption of atoms, have smaller SNF, rendering them susceptible to disruption when exposed to the random aether field. That their observed lifetimes are longer, the faster they are going, has widely been hailed by relativists as substantive verification of SR. Aspden (1983) stressed that the cause of their decay was poorly understood, a situation that seems little changed today. But if the decay depends, to at least some degree, upon the random aether electromagnetic field being coupled to that of the meson, then, in exactly the manner as we discussed in Section 2, this disruptive effect will decrease strongly with increasing relative velocity, yielding a prolonged lifetime.

So what about the decay lifetimes of radioactive nuclei in general? Does observation justify that these really are 'absolute constants of physics', and if so, why is it so? Is the apparent constancy of nuclear instability the result of every component in such an assemblage ultimately having been made from a pretty uniform aether (although slightly changeable by gravitational action, as evidenced by the G-E field)? Or are the nuclei susceptible to penetration of the aether random field through their protective electron screen, whose effectiveness will depend on its details? Is this the nature of the Weak Nuclear Force? A substitute for the W and Z bosons of the Standard Model?

The emission of high velocity, high energy electrons in the beta decay process raises a question of the source of that energy, especially in the case of β^+ decay. Is this release of binding energy triggered by the penetration of aether's random excitation?

6.3. Electron shells as a cavity, the eccentric nucleus and the Mössbauer experiments

In 1959-1965 the discovery of the Mössbauer effect was put to experimental use by several groups in attempts to observe the GR-predicted redshift of TEM-waves in the gravitational field of the Earth[11]. As we have discussed in Section 5.5.1, the gravitational redshift prediction of GR is essentially unsupported by astronomical observations when these are examined in the appropriate detail, but the observed redshifts, and that of the Sun in particular, appears instead to be consistent with an RTV redshift origin. That is consistent with our proposed abandonment of the idea of photons with an equivalent mass.

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[10] In fact, it has been a problem that the mass of a neutron is about 2.5 electron masses greater than that of a 3-quark proton. Why so much? This suggests that when the neutralizing electron is present some of the proton's internal aether circuiting flow is deflected outwards, weakening the SNF-defining internal circuit and increasing the mass-defining external aether flow. So in CT the rise in mass and the drop in SNF are related. The massless bosons known as gluons are no help here.

11 Pound & Rebka, *Phys.Rev.Lett.* (1959); Champeney, Isaak & Khan, *Nature* (1963); Pound & Snider, *Phys.Rev.* (1965).

But it raises questions about these terrestrial experiments that have seemingly verified, rather precisely, the existence of the gravitational redshift using the Mössbauer effect in ^{57}Fe and ^{57}Co. The method exploits the extremely narrow bandwidth of the 14.4keV gamma rays emitted from the ^{57}Co nucleus and absorbed by ^{57}Fe, such that a very small change of the wavelength reaching the absorber will make the process go "off tune". It was found that vertical separation of source and absorber in the Earth's gravitational field caused the process to go off tune by the amount expected in GR, though the independence of the calibration of that expectation did not seem too convincing. The 1963 experiments showed a similar effect to occur if centrifugal acceleration was substituted for gravitational and this was hailed as proving the GR Principle of Equivalence of gravitational and inertial fields. In CT, as discussed in Section 4, such equality is also to be expected on physical grounds because of the closely common mechanism of gravitational and inertial forces.

At that time I wrote to the journal Nature in relation to the Champeney *et al* paper to point out that the gamma wavelength involved (8.6×10^{-11} m) is closely comparable with the theoretical (5.3×10^{-11} m) nucleus-to-K-electron-shell distance. I suggested that this cavity might provide resonance responsible for the observed narrow emission and absorption bandwidth, rather than the Mössbauer interpretation that fixity of the atom within the structure of a solid was responsible for exceptionally small 'nuclear recoil' upon emission or absorption in this case. Note that the latter interpretation inherently assumes that the mounting of the nucleus within the atom is rigid enough to transfer that external fixity to it.

I argued that in my proposed resonant-cavity interpretation one could acknowledge a resilient support of the nucleus in any acceleration field and this would be bound to render the nucleus eccentric within the electron shells and make the “upward cavity” larger and the downward one smaller, so there would be corresponding effects on the resonance wavelengths. The effect upon those gamma rays that happened to be emitted sufficiently closely to ‘upwards’ or ‘downwards’ would thus be that of a modification in the processes of emission and absorption, and not the in-transit modification implied by GR. The nuclear displacement would be exceedingly small (like the $\sim 10^{-15}$ observed frequency shift fraction) and therefore certainly a linear function of acceleration within the range of observation.

My letter was rejected by a referee for the reason that "there is no place in atomic theory for an eccentric atomic nucleus". My reaction then, as now, is that there certainly should be, albeit only applied when precision levels demand it, as in this case. In the preceding subsection of this paper, we have discussed the electromagnetic shielding provided by the electron shell structures of atoms. In a similar vein, our resonance-match proposal should perhaps recognize that the effective cavity wall would in this case probably be the rather larger M-shell, on account of its full electron-packing in the elements of the iron group.

It would indeed be a remarkable coincidence if my proposal yielded the same quantitative result as GR, but this cannot be ruled out until some atomic physicist has calculated whether the nuclear displacement stiffness is of the right order. The GR interpretation assumes the constancy of atomic properties under acceleration to a far higher precision than has ever been needed for (electron-related) spectral calculation hitherto. If it were found that some such effect is to be anticipated, and big enough measurably to affect the result, then the GR interpretation would be vulnerable by reason of the close match with observation.

My suggestion here, that the nuclear decay process (in this case the emitted wavelength, and therefore probably the energy jump also) may be affected by factors external to the nucleus, is contrary to the current theoretical view that such decay is an absolute property of each particular nucleus, but it is possibly consistent with it for most practical purposes in that the modification is so very small as to have a negligible effect upon most other decay calculations. Nevertheless it does breach one of the more remarkable taboos of physics but is consistent with our view, already expressed, that in a real and interactive universe there may be no such thing as an ‘absolute constant of physics’, even Planck’s constant.

7. The G-E field as a large-scale dynamical agent - I. Stars and planetary systems

7.1 Solar neutrino deficiency

Stellar evolutionary theory is based on the need for the rate and temperature of nuclear fusion processes in the interior to provide enough supporting pressure, including radiation pressure, for the exterior overburden. Stars implode or explode when this balance fails. The energy emerges from the centre in two forms - radiation and neutrinos, so observation of solar external radiation enables the expected neutrino output to be calculated. Although the detection of neutrinos requires highly specialized equipment, and different equipment for differnt kinds of neutrino, of which there are three - electron, muon and tauon - it was firmly established that only around half of the expected flow number of electron neutrinos were arriving here, based on the particular fusion processes believed to be occurring in the Sun. Because the muons and tauons are of lower energy and very hard to detect, it has been concluded that a lot of the electron neutrinos are being missed because they have somehow changed into these during their journey from the Sun, by means of an invented process named ‘oscillation’. For that to be correct, oscillation would have to be a transit-time matter because passage right through the Earth was found to result in scarcely any diurnal variation.

The solar interior is inhabited almost exclusively by ions or simply by protons, so it will be strongly affected by the G-E field, resulting in an extra support force for the overburden. Consequently a much slower rate of fusion, perhaps even involving different nuclear processes from those otherwise inferred, will suffice. This suggests that the shortage of electron neutrinos reaching us could be real and tell us what is actually coming out of the Sun from lower-rate fusion reactions. If this turns out to be a correct interpretation, it could mean that stellar evolution times may be roughly twice those currently calculated, though the factor would be different for the fast-evolving high-mass stars. This would be no problem for CT in that, as noted above, (Sect. 5.2) and pursued cosmologically in Section 8, there was no Big-Bang to define the age of the Universe. It should be noted that the fusion rate inside the Sun depends on the 26th power of the temperature so halving it would have no detectable effect on the external temperature.

The standard solar model (SSM), based on the stellar evolutionary theory principles mentioned above, has been in close

agreement with the model built from solar seismology, except for a persistent sharp discrepancy just at and below the tachocline[12]. The tachocline is the boundary, at ~0.71 $\boldsymbol{R}_{\odot}$, between the radiative (below) and convective (outer) zones, above which subsists only about 2½% of the solar mass. It appears that this particular discrepancy could be avoided by the presence of more opacity (which radiation pressure depends upon) than is provided by present theory (Turck-Chiese 1998). An attractive thought is that CT's RLV line-broadening mechanism (Sect. 6) could supply this opacity deficiency.

7.2. Further notes on other likely G-E field examples

7.2.1. Acceleration of cosmic rays (CR) to very high energies (Section 3.3) - with a supernova connection?

Being directly proportional to the gravitational potential at the surface of a body, the G-E field will be highest at the surface of neutron stars. Erlykin *et al* (2002) noted on directional evidence that such CR do seem to come from pulsars. Based on the field reported for the Earth's ionosphere (Karlsson *et al* 2003), extrapolation suggests the G-E field at a neutron star surface as being in the order of 1 teraVolt/m, (but see Sect. 11 for uncertainties). This opens a new perspective on the pulse mechanism. Instead of being due to an oblique rotator magnetic field, the pulses may be the product, via the synchrotron mechanism, of strong G-E-driven radial electric currents from (mobile?) surface patches of proton-bearing material. Those patches might be where neutrons (free $\boldsymbol{\lambda}_{½}$ ~10.8 min.) are decaying, due to exposure through an e.m.-shielding skin/crust of the resulting electrons left behind, as for the abundant negative H ions that form the solar photosphere (Sect. 7.5). **This model secures the very existence of neutron stars.** It would cope with the existence of multiple-pulse pulsars (Lyne & Graham-Smith 2005). It might also bear on the correlated changes in pulse shape and apparent spin-down rate reported by Lyne *et al* (2010). But varying refraction by intervening plasma may also play a part (Graham Smith *et al* 2010).

CR abundance curves drop sharply at a 'knee', at ~3 x 10^{15} eV energy (Erlykin & Wolfendale 2006), some 4 orders below the seldom-exceeded high-end CR limit of a few 10^{19} eV. If the latter is of neutron star origin then the 'knee' may correspond to the upper limit of derivation from white dwarfs. Their surface gravities (and therefore their G-E Field strengths) are in roughly that ratio. Disparities among white dwarf and neutron star models make it hard to be more precise at present.

Neutron stars are the product of supernova implosions, so the G-E field will inevitably play a major part in all such cases. The high-velocity expulsion of the rest of the parent star material is, in some types, attributed to 'recoil' or 'rebound' on encountering the dense and freshly formed neutronic core-body. It is tempting to envisage that this expulsion may be electrical, rather than mechanical, and due to the huge G-E field intensity then present. Such a mechanism would efficiently leave the neutrons behind.

7.2.2. Cometary tails and planetary nebulae (Section 3.3)

As a comet gets near the Sun it commonly develops two tails, both of them pointing away from the Sun (Fernández 2005). The tail of dust and bigger particles is deflected aerodynamically from a radial direction but the plasma tail is driven in a strictly radial direction, which I see as due to the solar G-E field. As noted earlier, such radially directed G-E field-driven tails are abundantly present in planetary nebulae, and contrast nicely with the adjacent Newtonian-orbiting electrically neutral planet in the Fomalhaut example.

7.2.3. Star formation and stellar mass loss mechanisms

One of the fascinating problems of star formation is that stars of upwards of 20 $\boldsymbol{M}_{\odot}$ are not uncommon but they seem to lose most of it extremely quickly by radial mass loss, to reach 5 $\boldsymbol{M}_{\odot}$ or less, a process often seen to have blown a hole in a luminous cloud. High-mass stars have very high temperatures and evolve fast, and radiation pressure has been widely accepted as the mass-expelling force, leading to inferred mass loss rates of up to one solar mass in 20,000 years (e.g. Vink 2001).

But by treating radiation pressure as the sole agent of the mass loss, this has left unanswered one of the most fundamental questions of astronomy - How is it that a star manages, in the first place, to grow to such a size without radiation pressure halting the infall of material long before that, even soon after thermonuclear ignition and radiative light-up at a fraction of one solar mass?

On this matter our G-E field has the critical advantage that its electrical repulsive action is discriminatory. Radiation presssure is fully effective against opaque materials but the G-E field only affects ionized materials and those entrained with them. This means that the heavy opacity of the dust-laden infalling material prevents ionization and the initiation of G-E field repulsion until it is so close that the dust is vaporized and ionized. Thus the Newtonian force of almost the entire column above, plus any ram effect, is opposed by the G-E field force on only the short lowermost, ionized, part of that column. It seems likely that a sufficient imbalance here is possible for continuing infall to occur. The importance of this question is emphasized by the recent discovery of the 265 $\boldsymbol{M}_{\odot}$ star called R136a1 in the 30 Doradus complex in the Large Magellanic Cloud (Crowther *et al* 2010).

I conclude that the G-E field is the main mechanism of stellar mass loss, so that its relative absence during dust-opaque infall provides the essential mechanism for stars to grow beyond the point of thermonuclear ignition. On cessation of dust-opaque infall, G-E field action on wholly ionized materials could then yield the inferred very high mass loss rates, with radiation pressure a 'junior partner'. This could still blow the holes in luminous clouds. [The solar heliosphere is our local example of such a cavern, here due to the G-E field-driven solar wind (see Sect. 7.5).]

This exciting result is subject to an obvious limitation. The need for dust opacity during infall means that we still have no idea how stellar growth may be accomplished within a low metallicity, low opacity source. But is this need the trigger of the starburst mechanism? Mass losses from the resulting stars would then further increase the opacity and the potential for star formation.

7.3. Formation of the solar planetary system, and others

My 2-stage new scenario for formation of the solar planetary system (Osmaston 2000) has now been repeated, with developments, nine times at different venues (*e.g.* Osmaston

[12] Except that recent downward revision of solar metallicity (Asplund *et al* 2009) has shown up further conflicts between SSM and helioseismology.

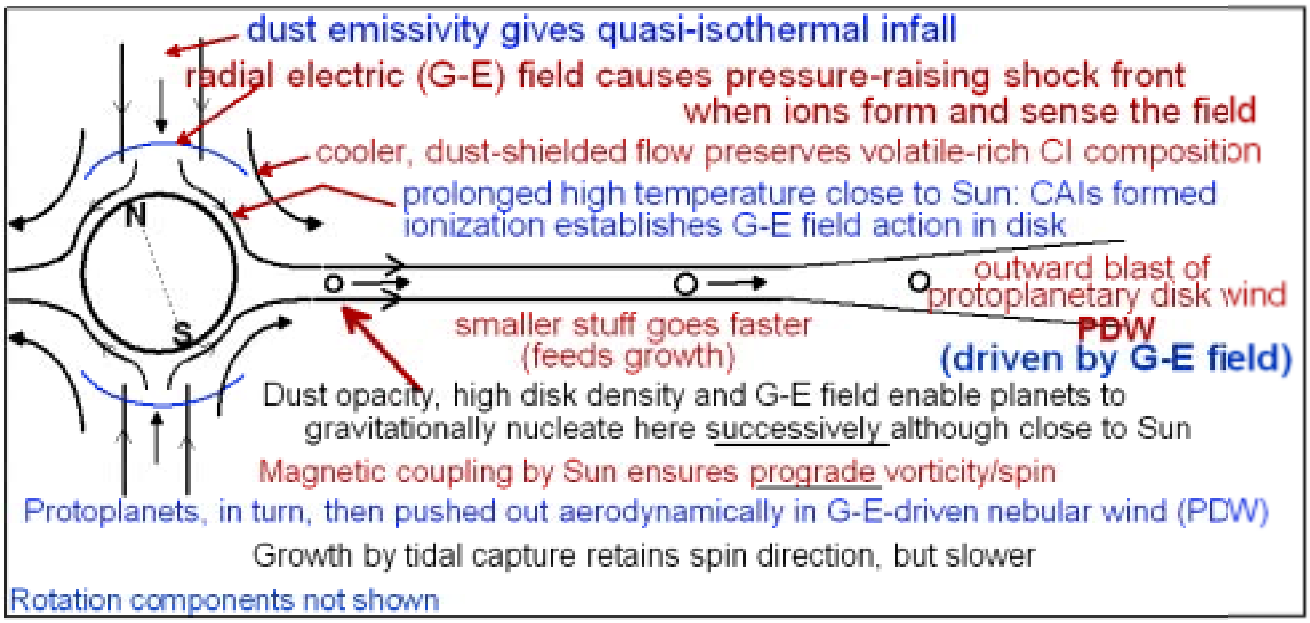

Figure 7. Principal features of the planet-forming second stage of the CT scenario for the solar planetary system (and others). The proto-Sun formed in one dust cloud, and became an already-dense H-burning star. Later it flew into another cloud, with high dust-opacity, from which the planets were formed *and* the outer 2.5% of the Sun's mass (above the tachocline) was added to and not mixed in, so its composition appears to match. This 'contamination' of the outer Sun explains why the Sun and more than 60% of exoplanet-harbouring stars have higher metallicity [Fe/H] than other members of the same stellar class. The second cloud would have had a typical initial temperature ~10K or even lower. Infall will have been bipolar, as shown, only if the protoSun's velocity through the cloud was low.

2009b). In these developments I have laid increasing emphasis on the part that needs to have been played by the solar G-E field. For an excellent critique of previous theories of Solar System (SS) formation see Williams & Cremin (1968). The major backdrop feature to have emerged since then is that, of the >490 exoplanets currently detected, over 100 orbit their star within 12 solar radii (semi-major axis) of it's centre (Schneider 2010), the distribution of these being centred on about 10 solar radii. Why so close? Why is the SS now different?

The essence of the dynamical problem presented by the solar planetary system is the fact, first pointed out by Jeans (1917, 1919), but subsequently endorsed by Lyttleton (1941), Jeffreys (1952) and Gold (1984), that the single contracting solar nebula (SCSN) model of Kant (1755) and Laplace (1796) is untenable and requires a dynamically distinct source for the planetary material, on the grounds of its enormous (>130,000-fold) mean specific a.m. compared to that of the Sun. Those of bodies in the Kuiper Belt and Oort Cloud are even bigger.

Efforts to overcome this within a broadly SCSN paradigm have met with little success. Notably, von Weizsäcker (1944) offered a model reminiscent of the Tychonian epicycles in an effort also to explain the predominantly prograde spins of the planets, in that the vorticity in a Keplerian disk is actually retrogade. His envisaged partition of a.m. involved lots of interaction between epicycles but made no estimate of the nebular heating thereby entailed. Apart from this, the Weizsäcker scheme was strongly criticized by Kuiper (1951) and rejected by Williams & Cremin (1968), so we do not discuss it further here. Lynden Bell & Pringle (1974) made another attempt at using nebular action to bring about a.m. partition in SCSN, but concluded that the work to be done by the nebula would heat it beyond recognition (which would inhibit planet condensation).

Whereas Jeans' offered 2-stage scenario (Jeans 1929) involved making the Sun and then using its gravity to drag the protoplanetary material off a passing star - now unacceptable in view of the plurality of stellar and supernova-derived materials seen in meteorites - ours proposes that the already-formed protoSun moved into and traversed a second star-forming cloud, from which the protoplanetary materials were drawn during the traverse, a feature it shares with the proposition of Schmidt (1944, 1959). In this scenario the constraint of nebular collapse time in SCSN is replaced by traverse time. So short-life isotopes can be picked up *en route*, *e.g.* ^{41}Ca ($\lambda_{½}$ = 130 ka), which is seen to have been active in CAIs but not in chondrules that are 2 Ma younger (Srinivasan *et al* 1994, Amelin *et* al 2002, Russell *et al* 2001, S.S. Russell pers comm 2007).

In this CT scenario (Fig. 7) the dynamics of infall are critically determined in the manner described above (Section 7.2(c)) in connection with infall to build high-mass stars. The imbalance which here determines that the infall is quasi-polar and the outflow quasi-equatorial is initially determined by the centrifugal force added by the quasi-equatorial magnetic coupling to that part of the new envelope that has become ionized. I speculate that the presence of such a magnetic field, dependent in turn on the presence of a tachocline, absent in the early-type stars subject to high infall rates, is what may determine whether a protoplanetary disk is the result or the star continues to build.

Once the quasi-equatorial outflow has started, it carries this plasma out to great radial distances, adding a large integrated G-E field force on it, which drives the Protoplanetary Disk Wind (PDW). Within this PDW the protoplanetary nuclei grow by tidal capture of smaller self-accreted lumps being blown past them. Preservation of the early-acquired systematically prograde spins – the result of the magnetic coupling[13] - means

[13] For the purpose of gravitational condensation in a disk, the simple criterion of vorticity is that it is **retrograde** if, relative to a chosen point, the orbiting velocity is faster closer to the Sun than outside that point. This is the case in the Newtonian-Keplerian velocity pattern now present in the SS. In the nebular disk of our scenario this vorticity could have been weakened near the Sun by the gas drag gradient associated with its inward-increasing density. On the same criterion, the

that the widely-supposed random impact process of Safronov, (*e.g.* Weidenschilling 2000) which would yield a random result, cannot have been the means of growth. A balanced population of prograde and retrograde tidal captures can be shown to do this, however. The tidal process, moreover, greatly increases the nebula-assisted capture cross-section and the resulting growth rate.

Further evidence that protoplanetary growth was ***not*** mainly by impact is that it would end, probably in post-nebula time, in multiple occurrence of late giant impacts (Weidenschilling 2000). In fact, which also disturbed Weidenschilling, all except Mercury preserve the nearly circular orbits inherited from construction with relatively small feedstock in the presence of nebular gas-drag. Uranus's 98 degree axial inclination has been attributed to a 'late giant impact' but this is inconsistent both with its very low orbital eccentricity and its closely equatorial family of satellites, which must have been acquired *after* its axis was tilted. This means that the tilting act was at a much earlier stage in Uranus's growth, when quite a small body could have done it and there would have been time for nebular gas-drag to obliterate any orbital effect.

The close-in gravitational nucleation avoids encountering the Roche condition constraint, which would inhibit it, partly because the disk density is there at its highest and partly because the G-E field would generate a force gradient in the opposite direction to the Newtonian gravity one. If these gradients exactly balance, the Roche condition becomes irrelevant.

A further factor would be that the dust opacity of the nebular material could greatly shield the nucleation process from the solar radiation, but if it shielded it too much the ionization would drop and the benefit of the G-E field would be reduced. Such a situation also offers an explanation of why, as noted earlier, around 23% of all (490+) exoplanets so far discovered orbit their star within 12 solar radii of its centre (Schneider 2010); the figure for Mercury is 83. But in that position it is far too hot for them to have been there long. So we have to suppose that we are seeing these exoplanets not long after emerging from being formed within a high-opacity cloud, which shielded them from their star (and from our view).

The disk density and the masses of the planets formed within it would be largely controlled by the density of the second cloud (which will surely vary from place to place), by the mass of the gathering star, and by its speed of passage through it. In principle, therefore, the scenario may be capable of generating objects with masses up to those of brown dwarfs and beyond, perhaps even the junior partners of disparate binaries.

As noted above, the predominantly very circular orbits of the solar planets shows they completed their growth in a gas-drag nebular environment, not the extended post-nebula accretion of solids, ending with giant impacts, that is widely assumed on accretion timescale grounds. The preserved circularity of the Earth's orbit probably denies that the Moon can be the product of a giant impact upon the Earth. But the ejecta from such an impact on Mercury, which certainly had one (tilted and eccentric orbit, two-thirds of its mantle missing), offers a possible source of the lunar material for prograde tidal capture by the Earth and its reassembly in orbit around it (Osmaston 2009c).

On the other hand, the big orbital eccentricity of some exoplanets seems (by using the analytical tools provided by Schneider 2010) statistically to increase with orbit size while this is still small. This, rather than by impact, may be attributed to the star's axis being markedly oblique relative to its direction of motion through the cloud. In that case the (probably single) infall column would be far from polar, giving a much stronger quasi-equatorial PDW on one side than on the other, thus building the orbital eccentricity every time around.

Now I return to the planetary a.m. problem noted at the beginning. Mathematically, a.m. is defined as the product of tangential velocity and the radius at which it occurs. It so happens, therefore, that the outwards push developed in an ionized disk dominated by action of the G-E field has the property, which it shares (hitherto apparently unrecognized) with radiation/light pressure, of (for example) doubling the a.m. every time the distance from the centre is doubled. The idea that a.m. can actually be **created** comes as a shock to those of us brought up on the idea that a.m. is something that is always **conserved**. For this a.m. creation to work in the case of the solar system, the second-stage material must be acquired to a near-Sun position and be moved outward by the G-E field, with the planets growing as this is done. This is exactly what our new scenario achieves (Fig. 7). The implication is that Neptune, our furthest planet, was the first to nucleate and begin its outward journey, and Mercury the last (or have we lost one, closer in, by evaporation?). A qualification upon this story is that outward movement of a large body must depend on there being sufficient aerodynamic push by the PDW. This push will fall with radial distance because both the density of the PDW and the G-E field strength will do so. But we can suppose it will remain adequate for propelling smaller feedstock materials past the body. This seems to be the state seen in the Fomalhaut example discussed earlier.

For our PDW to be driven by the strictly radial G-E field force implies that the Newtonian force is wholly overridden. In this case the tangential velocity does not alter with radius, retaining the low value present near the root of the disk, where solar magnetic coupling may determine the tangential velocity.

In fact, the Sun, with its 26.5 day rotation period, is in a class of slow rotators, whereas other G-type stars of similar mass have periods of 5 days or less (Choi & Herbst 1996). So I infer that in generating the planetary system, magnetic coupling slowed solar rotation about 5-fold. Taking the G-E field-driven a.m. growth of disk material as starting at the outside of a polar infall column with a diameter 10% of the solar radius, simple arithmetic shows that the required full ~130,000-fold a.m. differential is achieved at the orbit of Jupiter and beyond, if that 5-fold solar slowing is included.

But these a.m. values incorporate the Keplerian orbital velocities that now prevail whereas, with the G-E field in control, the tangential/orbital velocity of the created planets might all have been similar at, say, only a few times the present 2 km/s equatorial velocity of the Sun. But as the Sun moved out of the second cloud and the PDW strength waned, the transition to Newtonian gravitation means that each must have speeded up by spiralling inward *at constant a.m.* from well beyond its present distance. This validates our use of present a.m. values.

Although this new scenario illuminates beneficially several other dynamical features of the solar system (Osmaston 2009c), I confine myself here to just one - the construction of planetary iron cores as providing the origin of solar system water. The

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vorticity of a disk wholly under G-E field control (constant tangential velocity) is neutral but prograde if assisted by magnetic coupling.

latter is currently widely accepted as an unresolved problem. Although many people have regarded the comets as the source, this merely passes the problem to where that water came from. Our scenario offers the PDW mechanism for getting it out there only if we can provide a source nearer home. The CAI particle retrieved from comet Wild-2 by the STARDUST mission (McKeegan *et al* 2006) seems to confirm such a linkage, as does the widely recorded observation that the refractory objects known as CAIs are typically up to 2Ma older than the asteroid-generated chondrules in which they are embedded. Pluto's ~2 g/cm^3 mean density, implying about 50% rock content so far out in the system, tells a similar story. Interstellar dust clouds seem low in water, so not much can have been imported from there and we must look for a way of making it chemically during planet construction. This approach is supported by the observation that CAIs passed rapidly from a low oxygen fugacity during formation to one that was 5 orders of magnitude higher where they acquired their Wark-Lovering rims (Simon *et al* 2005).

It so happens that for many years (1960-1978) A.E. Ringwood, a famous petrologist and Director of the Research School of Earth Sciences at ANU, argued that the Earth's core was made by the reduction by the nebular hydrogen proto-atmosphere of the always-present FeO in volcanically erupted lavas. A concomitant of this process would be the formation of huge amounts of water by reaction; a benefit foreseen by Ringwood. If all the iron in the Earth's core originated as FeO, this would produce over 400 Earth-ocean volumes of water. Although this would likely equip the early Earth with a water-saturated mantle mineralogy [and there is good evidence that it did (Osmaston 2010a,b)], this would account for only a few ocean volumes.

So Ringwood had to abandon this idea because there seemed no way of getting rid of the remaining dense hydrous nebular atmosphere that would result. Our G-E-field-driven PDW would now do that, especially during the final outward clear-out as the Sun exited the second cloud. Up till that moment each planet had been completely shielded from solar radiation by nebular opacity, but outwards-progressing removal of that opacity would expose the hydrous atmosphere to ionization by solar EUV, thus rendering it susceptible to expulsion by the G-E field force. The gaseous envelopes of the four Gas-Giant planets were probably sourced from this material, by gravitational capture as it passed, speeding up Jupiter's spin the most (Osmaston 2009b), the remainder passing out to form or be accreted by the bodies in the cometary region. This reasoning yields a minimum density for the nebular density in the inner SS, at the moment that clear-out began, which is some 40 times the canonical SCSN value. This ensures vigour of the water-forming reaction during core genesis and fulfils the pressure (Galy *et al* 2000) for keeping down volatile loss from chondrules (melt droplets) while levitated in the nebula.

A requirement of the Ringwood model is that the nebula should be a cool one, below 600K, not the hot one embraced by SCSN, because it is thermodynamically demonstrable (Wood & Hashimoto 1993) that the iron would then be present for planetary construction as FeO, not as reduced Fe. Such a cool nebular disk and PDW is just what our scenario produces (Fig. 7), from a very cold source cloud, even after allowance for admixing with that inner part of the pole-to-equator flow that got heated by the Sun. Other features of our implementation of the Ringwood model are:-

i) To get the iron to the core, the protoplanet must first build to a size at which, not only is volcanism in progress, but so also is convective overturn. [This means that asteroids were too small for core formation, so iron meteorites must come from 'unsubducted' near-surface bottom-of-magma-chamber volcanic positions on asteroids, not from cores. The >60 distinct Ni-Fe alloys present in meteoritic irons (Burbine *et al* 1996) would be consistent with volcanic variation but would otherwise imply that number of distinct cores];

ii) Iron is conveyed to depth by convective overturn that is greatly speeded by the loading of the down-going limb, together with the concomitant fast release of gravitational energy and reduction of 'mantle' viscosity, thus offering a reasonable chance of building the core before the process is halted by departure of the nebula (~5 Ma or less). In a smaller planet this process would run slower, leading to an expectation that more FeO has been left in the mantle of Mars;

iii) The opacity of the nebular disk renders distance from the Sun irrelevant, so the heat needed to start convection has to be internally generated (accretion, radiogenic) as a thermal microcosm within that opacity. This is helped by the rapidity of accretion made possible by tidal capture. The iron cores in three of Jupiter's Galilean satellites (Kuskod & Kronov 2001) then present no special problem, despite being so far from the Sun. In our CT scenario, moreover, the asteroids and most of the satellites of the Gas-Giant Planets are seen as probable representatives of the population of outwards-moving feedstock bodies (Osmaston 2009c), so the Galilean cores seem likely to have been formed in those bodies before they got out that far and were captured by Jupiter.

Since Ringwood decided (1979) to abandon this model, it has become the widely favoured view that a hot SCSN must have been involved, with liquid Fe being accreted, and that this percolated inward to form the planetary cores. One variant of that model is that melting of the Fe developed within a 'magma ocean' formed at some mid-mantle depth, and that it separated out from that. Despite various chemical/isotopic evidences that core completion was rather quick (as also is achieved by the Ringwood model), it has not been convincingly demonstrated that percolation rates or segregation rates would be anywhere near fast enough for that, with a minimum of about 30 Ma being set by interpretation of Hf-W data (Jacobsen *et al* 2008) within that frame.

Consequently, models of planetary growth have embraced the view that accretion of solids continued for at least tens of Ma after nebular departure. That, as discussed above, means that neither the protoplanet nor its feedstock can have been equipped with the a.m. needed to enable the completed planet to attain its observed value. That a.m. requirement can only be met if the nebula *and* the associated G-E-field-driven PDW were present throughout, as provided in CT.

I conclude that the cores-by-percolation models, and their appeal to the hot SCSN model, are invalidated by an inability to satisfy the observed values of planetary a.m., whereas our CT scenario not only does so but also provides a well-researched origin for Solar System water. Its effects on the physical properties of the Earth's mantle, changing over time as the ocean water was released from it in volcanism, has had major consequences for the evolution of the Earth, including the replacement of its CO_2-rich atmosphere by an oxygen-bearing one, which is why we are here (Osmaston 2009d, 2010a,b). See also Section 11 of this paper.

7.4. T-Tauri winds, FU-Ori bursts & Herbig-Haro shocks

These phenomena are well recognized as being related and involving the accretion and expulsion of material from young stars, but exhibiting variations whose irregularity distinguishes them from the oscillatory habits of variable stars.

All three have generally been discussed within the Kant-Laplace frame of the star possessing a shrinking accretion disk. That SCSN frame was conceived for the purpose of forming the solar planets within the disk. But, in our foregoing scenario for doing that, what we have is *not* a shrinking accretion disk, so we no longer need one for that. So is it still appropriate to envisage that formation of the star itself involves such an accretion disk? It has become increasingly clear that disks, where present, are impersistent features, more than half lasting less than 3 Ma (Haisch *et al* 2001) though it is not yet clear which of those detected are of a protostellar variety and which of the protoplanetary one proposed in Section 7.3.

Furthermore, an update of the SCSN paradgm is long overdue because we all now recognize that, instead of forming within an isolated volume of gas and dust, as in SCSN, a star actually forms in highly competitive dust-cloud environments and probably moves around in them during its growth. The value of the latter expectation has been demonstrated in our planet-formation scenario.

T Tauri stars are ubiquitous in star-forming regions and observations record their early evolution and mass loss, which apparently begins before the ignition of nucleosynthesis. FU Orionis stars exhibit occasional outbursts of great luminosity and then lapse over decades back to former level. Their episodic nature means that fewer of them are yet known. Herbig-Haro objects are shock-wave-like luminosities generated by the impact of fast (several 100km/s) polar jets upon slower material that possibly has been set in motion by the jet.

T-Tauri winds are substantial outflows typically observed from pre-main-sequence stars of less than about 2 solar masses. Their onset before nuclear light-up suggests that the G-E field, rather than radiation pressure, is likely to be the agent of that expulsion. At this stage the star is unlikely to have a magnetic field, which is thought to require the presence of a tachocline, itself dependent upon having a nuclear-burning interior. So it will lack the magnetic centrifugal quasi-equatorial drive invoked in our planetary scenario as determining that the inflow would be quasi-polar. In that case a vestigial accretionary disk could indeed be present and responsible for gravitational focussing of polar outflow. But the disk's mass-storage would need to be very small, to enable the outflows to reflect the short-term variations in the cloud sources through which the star is passing.

FU Orionis outbursts involve mass loss 100-1000 times that seen in T Tauri stars and may arise as follows. A dust-opaque accretionary envelope will produce thermal blanketing of the star, causing its outer region to overheat below the blanket until this is sufficiently ionized for breakout to occur, driven by the star's G-E field. This overheat may be responsible for the unusual spectrum during outburst. It is likely that the outburst will progressively involve the entire jacket, or most of it, so the decay of luminosity will be slow while the jacket rebuilds.

The collimated jets of ionized material responsible for Herbig-Haro bow-shock luminosities seem very likely to be driven by the star's G-E field. It is fascinating that these jets reach to 0.5 pc from the star, and sometimes much more. I see the expelled material as likely to have been very close to and ionized by the star, but kept there, against G-E field action, by the overburden of non-ionized infall while the star is in an enveloping dust cloud. That constraint vanishes, and the jet is produced, when the star moves out of the cloud. If this is at the end of the primary formation of the star, rather more material may be available to enter the jet (from any vestigial disk) than if it is at the end of planetogenesis during passage through a second cloud. In the latter case, as described in Section 7.3, the PDW continues to clear the disk outward and the flow does not get reversed to join the now-reversed polar infall material as a HH jet. This outward clearance seems to have been well imaged in the case of β Pictoris. The infra-red-illuminated debris disc, seen edge-on, extends outward to well over 1000 AU but appears to cut off inwards at around 35 AU, having left a detected giant planet at only ~10 AU (Lagrange *et al* 2010).

7.5. G-E field action in today's Solar System; photosphere, corona and solar wind

As stressed in the Introduction, magnetic and electric forces are physically intertwined through Ampére's Law. Because magnetic actions on plasmas are much easier to observe at a distance than electric currents, the former have often been treated as physically primary when studying the solar chromosphere and corona. This could be incorrect. Electric fields, moreover, are very much more efficient than magnetic ones for transferring energy to charged particles. The following are some of the observations that stress the electrical aspects, favouring the presence of the radial electric G-E field. Extrapolation from that of the Earth (Karlsson *et al* 2003) suggests a value of about 10 V/m at the solar photosphere (but see our discussion in Section 11). Figure 8 sketches the other relationships in this region.

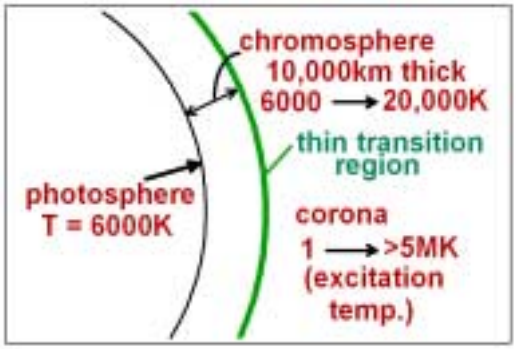


Figure 8. Generalized layout and temperatures near the Sun.

1) Coronal energy support, and the acceleration of the Fast Solar Wind (FSW) particle streams from coronal holes seem consistent with the action of an electric gradient upon ions.

2) In coronal streamers, Fe^{XIII} and Si^{XII} ions are often abundant (in emission) and maintained there for months, implying electrical support, whereas gravitational settling time is of the order of a day.

3) Coronal Mass Ejections (CMEs) - bunches (>10^9 tonnes) of ions seen to *accelerate* outward to 400 - 600km/s. Some ion speeds attain ~2000km/s.

4) The release of CMEs might be due to the G-E field force causing rupture of a magnetic arch that had become loaded with ions spiralling up its legs.

5) The coronal emission line spectrum shows hugely stripped ion species *e.g.* Fe^{XXIV} (helium-like). This implies impact by

other high-velocity ions - very high *excitation* temperature; probably *not* LTE.

6) The Slow Solar wind (SSW) at low latitudes is slower but has more mass-flow than that in polar directions (FSW / SEP) - probably due to incorporation of more matter near the planetary plane. This filter converts the FSW ionic *velocity* pattern into the SSW ionic *abundance* pattern (by scattering?). This interaction could explain the incorporation of electrons in the SSW at the distance of the Earth.

7) Strong FIP effect seen in SSW abundances - selective incorporation of ions with low First Ionization Potential (5.15-8.15 eV). These ions arise at low chromosphere temperature level (7kK+). Their extraction and differential acceleration requires an electric field.

8) The solar visual 'surface', the photosphere, is due to the strong absorption and opacity of the negative H ion (Wildt 1939), which has a very low ionization potential (0.75 eV); its abundance needs a source of electrons. Apparently many electrons off solar wind ions have returned to the Sun, due to the electric gradient; they cannot have come from H (IP = 13.6 eV).

9) Strong light-isotope enhancement in frequent wind events (>1000-fold for $^{3}He/^{4}He$) (Lin 1994) all the way to Mg. Selection for charge / mass ratio is the property of an electric field.

8. A continuous auto-creation cosmology for CT; the Electric Universe

8.1. The underlying CT framework

My move here to discussing the 'ultimate topic' before dealing with the important and exciting matter of galaxies, is because we need first to develop some idea as to where from, and in what state, the matter involved in galaxy construction and evolution was provided.

Our CT rejection of the cosmic redshift as a velocity (Section 5.3), and the consequent rejection of a Big-Bang-expanding Universe, means we have to start with a fresh cosmology. A prime question for any cosmology is the provision of all the energy now present; the import, at any stage, of energy from 'outside' is denied for a Universe that is truly infinite. So, as substitute for the palpable absurdity of all the energy being confined in less than a pin-head (and what before that?), I propose that the currently observable energy, both as true mass and as TEM-waves, has been drawn from that 'unfathomable' energy resource represented by the randomly moving high-charge-density aether (Section 3.1). The difference, initially, was that if there were as yet in existence no particles made from it, this random motion must have been primordial and comprise the energy resource for our cosmology. In this context 'initially' refers to an undefinably distant past.

The reasoning set out in Section 3 leads me to the view that all particles in the Universe are ultimately more or less complex forms of aether rotational and / or vortex motions. That some very specifically sized configurations (*e.g.* electrons) confer stability, so are ubiquitous, but others not, is presumably the result of a fundamental property of the aether, yet to be explored. I envisage that the most stable configurations are probably the simplest ones and that these were auto-created from the randomly moving aether by a process of endless trial and error, while others faded back into the plethora of aether motion. How then to get from free fundamental particles to complete simple atoms of hydrogen?

In Section 3.1 we suggested that the problem of why the three quarks in the proton have charges that sum so precisely to that of the electron might be because electron-positron pairs are the primary creation.The assembly of stable hydrogen atoms then required the quarks assembled into the nucleus to have been selected by the electron's charge from a sea of aether vortices. I suggested also that the lower aether density inside positrons may explain their lower durability in the presence of aether random excitation. Consequently positrons would have had too short lives for gathering appropriate antiquarks for antiprotons. Hence the rarity of antimatter.

As we saw in Section 6.2, such vortices / quarks, even when in pairs as mesons, have insufficient internal aether circuiting (*alias* Strong Nuclear Force, *alias* gluon bosons) to enable them, more than very briefly, to withstand disruption by the random electromagnetic field of the surrounding aether (*alias* the Weak Nuclear Force, *alias* Z bosons).

As to the actual assembly mechanism of the hydrogen atom in these circumstances, this is a hurdle yet to be crossed (even in Big-Bang cosmology?) by our understanding, but it is here assumed to have freely occurred. To get from there by gravitational action to a sufficient mass concentration to permit star formation is a well-trodden matter of study and observation, though not without its problems. Could the G-E field play a part here?

8.2. Auto-creation, positive feedback, and the build-up of mass concentrations

When the separations of the earliest-created particles had, in places, decreased to the point where mutual gravitational interaction and encounters began to occur, this release of gravitational energy would have raised the temperature and particle velocities and related aether random motion, thereby accelerating the rate of auto-creation. This positive feedback would inevitably result in big spatial variations in the rate of auto-creation, and I see the presence of galaxy clusters as the end product. Broadly, therefore, I see the development of galaxy clustering as the result of a kind of *in situ* spawning, rather than as due to assembly by gravity, though this must of course play a limited part. This means that the spatial environment of a cluster of galaxies is likely to be a volume in which auto-creation of matter is proceeding at an accelerated rate, compared to other parts of the cosmos. If that is so, we should look in the morphology and internal dynamics of galaxies for evidence of ongoing infall. The observationally recognized (1978) 'Butcher-Oemler effect' - broadly, the richer the cluster the higher the proportion of young blue spirals - seems to support this.

A complementary kind of examination stems from our inferred cosmogonical youth of such material, so stars formed from it will have very low metallicity (Osmaston 2010c). This would ***invert*** the current (Big-Bang-related) interpretation of low metallicity, which is that these are the *oldest* stars in the Universe, having likewise been formed before stellar reworking processes had raised it. Notably, for our view, the haloes of Spiral galaxies are typically populated with up to thousands of low-metallicity globular star clusters, each containing up to millions of gravitationally tightly bound stars interspersed by fast-evolving 'blue stragglers'. Are these the centres of ongoing auto-cosmogenesis? Is the huge and much-studied star-forming 30 Doradus complex in the outfield of the Large Magellanic Cloud (LMC) (Fig. 9A), well known for its low metal-

licity, an example? Does locally enhanced auto-creation play a part in the starburst phenomenon? Or is opacity build-up the main key to that, as we suggested earlier?

The prospect that CT may in this manner make possible the observational study of *ongoing* Universal cosmogony, instead of being faced with the imaginative reconstruction of events 13.7 Ga ago demanded by Big-Bang cosmology, seems an extremely attractive one, not to be dismissed lightly**.**

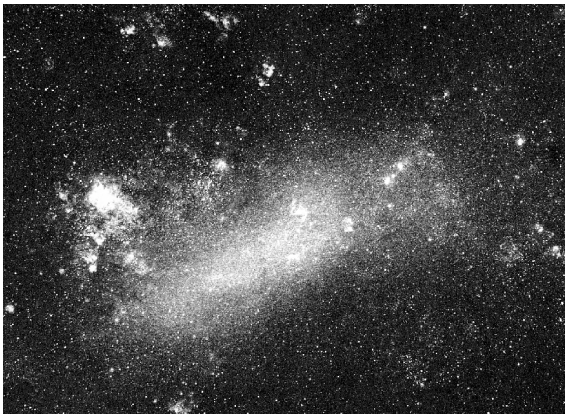
9. The G-E field as a large scale dynamical agent - II. The growth and dynamical evolution of galaxies; G-E *versus* CDM

To avoid potential misunderstanding, I mention here that, despite a broad recognition that galaxies evolve from 'gassy' spiral forms to Ellipticals with old stars and little gas, the latter are commonly still referred to as 'early-type', following Hubble's original morphological classification.

Spectroscopic determination of the tangential velocity profiles of spiral galaxies has disclosed, first for our own and then in the past 20 years for over a thousand others, that after an initial rise, related roughly to the optical bulge, the tangential velocity commonly stays nearly constant out to well beyond the visible limit (Allen 1955; Persic & Salucci 1995; Persic *et al* 1996; Rubin 2000; Sofue & Rubin 2001). Because a disk under Newtonian-Keplerian control would exhibit a markedly *decreasing* tangential/orbital velocity at increasing radius, the surrounding presence of huge amounts of similarly-acting Cold Dark Matter (CDM) has been proposed and widely accepted, with big implications for cosmology (Sect. 5.2).

However, as set out in our treatment of forming the solar planetary system (Sect. 7.3), this is precisely the profile to be expected when the G-E field is in control and pushing polar-infalling material outward in the disk. In this case, the latter flow is made possible by our suggestion (Sect. 8) that galaxies and galaxy clusters grow in mass by the infall of cosmogonically young material. Critical support for the G-E field as the cause of the flat velocity profiles comes from the observations (Romanowski *et al* 2003) that typically plasma-poor Ellipticals do show a Keplerian-like drop in velocity at increasing radius. Whereas Big-Bang cosmology supposes that there was a 'galaxy-forming epoch' before the density fell too far, and that gravitational shrinkage was then the principal activity, we are here reversing the perspective, just as in our rejection of the shrinkage-based SCSN for the planetary system.

The sequence of galactic forms assembled in Figure 9 enables us to examine this scenario.



9A. Large Magellanic Cloud (LMC). Irregular.

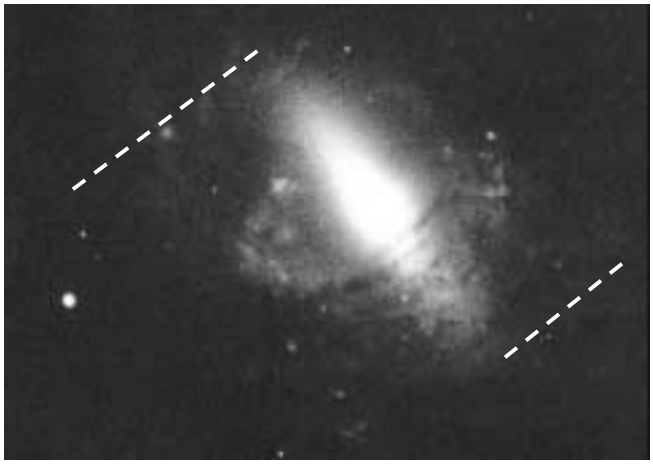
9B. M51/NGC5194; Spiral.

9C. M101/NGC 5457; Spiral.

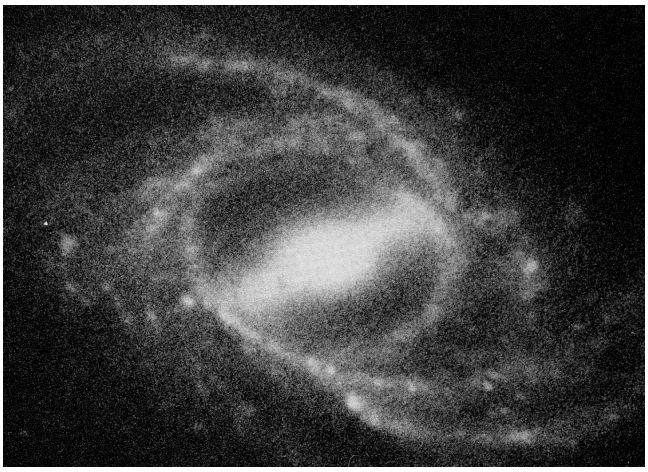
9D. NGC 4565; Spiral seen edge-on.

9E. M104 /NGC 4594; Spiral seen edge-on.

9F. NGC 1300; the type 'Barred Spiral'.



9G. NGC 2685. Inferred to be a much underexposed Barred Spiral. White lines mark possible faint arms seen in the negative image.



9H. NGC 2523. Bar with independently rotated arms.

Figure 9. A roughly sequential selection of galactic forms. Final (Elliptical) form is not shown. **A,E,G** & **H** are B&W images from Sandage (1961).

Provisional Credits (colour images):

Fig. 9B: m51_hstAPOD2001Ap10. Credit: N. Scoville (Caltech), T. Rector (NOAO) *et al.*, Hubble Heritage Team, NASA. Fig. 9C: M101-medNGC5457HST NASA, ESA. Fig. 8D: Bruce Hugo & Leslie Gaul/Adam Block/ NOAO/ AURA/NSF. Fig. 9F: ngc1300_hst_f; Hubble Heritage Team, ESA, NASA.

We might reasonably envisage the build-up of Irregulars as a starting point of galaxy formation. The mere existence of Irregulars, and of lots of them, many less coherent and smaller than the LMC (Fig. 9A), makes nonsense of the top-down, 'epoch of galaxy formation', of Big-Bang cosmology. In contrast, CT offers (Sect. 8) a bottom-up cosmology that could give Irregulars a potentially important place in any sequence.

The receipt of infall streams, once they become massive enough to attract these, might then provide an organizing mechanism which turns them into spirals. But the route by which this might be done is obscure. We will show that spirals are more likely to have originated as spirals. That would suggest that most Irregulars, by failing to attract the infall streams needed for growth, are for ever condemned to the dwarf galaxy category. Nevertheless the LMC appears already to have started along such a route. In Figure 9A the main area has been thought to be a bar, as faint arms have been detected, but that does not necessarily mean it has the long morphological history of a Barred Spiral such as we describe below. 30 Doradus is the large isolated white area.

The entire structure of Spirals such as 9B & 9C (NGC 1376 and 3982 are other fine examples) is dominated by the action of G-E field-driven outward-moving galactic winds.

1) The constant tangential velocity means geometrically that the arms trail as they move (are driven) outward – yes, ***outward***. So they are ***unwrapping***, although the direction of rotation is the same as if they were winding up.

2) Dust and less ionized material, seen as red lanes, has less G-E field drive, and has to rely on aerodynamic push, so it accumulates along the insides of arms – an ubiquitous and diagnostic feature of spiral arms. The light from the stars forming within this denser zone is reddened by the dust, but some of the redness may be the Balmer radiation of hydrogen.

3) Meanwhile the finer, ionized, G-E-driven material filters through it and is seen as outwards-trailing streaks and 'fur' on the outsides of arms. In rare cases these might link up to simulate further arms, yielding an apparently multi-arm structure.

4) Moving the arms outward, without changing tangential velocity, requires them to extend over greater length of arc, so they rupture abundantly and obliquely (black = tenuous, cooled), – opacity creates 'dust lanes'. M 101 (Fig. 9C) shows well how this discontinuity has enabled the G-E driven disk wind to drive chunks of the arms out to great distance. There seems no way that this galaxy's form could be treated as the product of gravitational shrinkage.

The two images of spirals seen edge-on (Fig. 9D, 9E) draw attention to the large amount of dust that evidently gets pushed out to the optical limits of Spirals but which, for lack of illumination, is invisible when viewed face-on. Dust is the product of stellar reworking, of which we see no evidence in the outfield, so it must have got there by moving outward from those parts of the galaxy where this has been active – further proof that Newtonian shrinkage is not in control in these Spirals.

The quite exceptionally large bulge of M 104, otherwise known as the Sombero Hat (Fig. 9E), is known to be composed of many thousands of low metallicity globular clusters. In the frame of our auto-creation cosmology (Sect. 8) this congregation probably has grown and been supplied by axial infall of cosmogonically young materials. Clearly it now constitutes a major agency for the ionization of the infall and dispatching it into the disk under the action of the G-E field. But one wonders whether its globular clusters may now also be the sites of autocreation within themselves; a positive feedback which might explain this exceptional feature of this galaxy.

Moving now to the transformation of a Spiral to a Barred Spiral (images 9F, 9G & 9H), my interpretation of NGC 1300 (9F) appears in Figure 10.

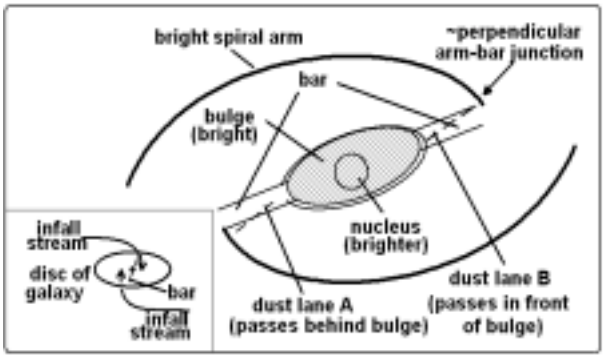


Figure 10. Interpretation of bar formation with specific reference to NGC 1300 (Fig. 9F). The polar infall streams (see inset) are supposed to have been deflected and misaligned by the gravitation of other galaxies in the cluster. This sets up a couple which forms a rotating bar, more clearly referred to as a 'roller-bar', whose length propagates outward until it encounters and engages lightly with a spiral arm. The orientation of the roller-bar's axis is fixed by the external influences, so it does not rotate with the spiral arm structure, which continues to rotate (CW) about the original axis. Non-ionized material, such as the dust lanes which line spiral arms, is able to gravitate along the bar towards the centre, being twisted into a weak spiral by the faster bar rotation at the centre, where the infall rotational drive is being applied. In this manner, these parts of the spiral arms are 'consumed' as they continue to rotate past the ends of the bar. Close inspection of Figure 9F shows that NGC 1300 has already begun to do that. This Barred Spiral story continues in the text.

It appears that all published measurements must have assumed that the bar of Barred Spirals is dynamically integral with the arms, referring to it as the 'pattern speed' (Tremaine & Weinberg 1984). So, apparently by measuring the angular velocity of the arms or of the ring (as did Treuthardt *et al* 2007 on NGC 2523, Fig. 9H) they supposed that they were also measuring that of the bar.

To be consistent with the requirement for the infall streams to have been deflected by neighbouring galaxies, our expectation is that Barred Spirals should be commoner inside dense clusters. Clearly the bar-driving polar infall streams will come and go as the relationships of near-by galaxies change, so the roller-bar rotation will slow and the a.m. in the material 'consumed' from the spiral arms may destroy or weaken the fixity in space of the bar's axial orientation. This may be why in NGC 1300 some material seems to be smeared out or trailing from the sides of the roller-bar, making the roller rotation harder to discern in the image.

But in Figure 9G, from Sandage (1961), given the presence of spiral arms suggested by my added white lines (Sandage also provides the negative image I refer to in the caption), we see obvious evidence of roller-bar rotation in NGC 2685. Otherwise the interpretation of this galaxy has been a widespread cause for puzzlement.

Figure 9H (NGC 2523) supports this account in two respects: **1)** The bar, like many others, appears straight and symmetrical about the bar axis, consistent with roller-type rotation; **2)** The arms (whose traces also display the action of G-E field repulsion) have clearly continued to rotate past the ends of the bar, but the bar has not managed to 'consume' them wholly while so doing, leaving behind a vestigial 'ring' of ionized material supported radially by the G-E field. Such rings are by no means rare. In NGC 1073 there is no ring, but the arm inner ends have moved on about 30 degrees from the bar axis, there are no spiral lanes in the bar, and the bar is unusually tenuous and broken into knots. All these bar features are consistent with it losing contact with the supply of rotating-arm material and with a weakening of the polar infall stream, the latter probably being the cause of the former.

Lastly, a variant not illustrated here, but occasionally observed (NGC 7479 perhaps): the 'polar' infall streams are not necessarily tightly constrained to be orthogonal to the spiral's plane, (see also Fig. 7 in respect of planetary formation) so may produce a roller-bar axis that does not lie exactly in the original galactic plane. This could result in a contorted appearance, which otherwise invites the speculation that a galactic encounter has been involved.

A final question concerns the end-state of galactic evolution, bearing in mind that, strictly speaking, we are not in a position to observe this, particularly in a continuous creation Universe. I envisage two end-states; Giant Spirals and 3-dimensional Ellipticals (by which I mean more or less ovoid, not flattened, and here I include S0s in this term), the divergence point being a matter of whether bar formation does or does not occur.

(A) In the latter case there would then be continued growth into the giant Spirals that have masses comparable with the giant 3-D Ellipticals, and typically seen in the outfields of clusters. The continuing infall of cosmogonically young and primitive material would prevent them getting to the Ellipticals' state of having used up all their gas for formation of new stars. This would also mean that the G-E field forces on plasma, so greatly responsible for maintaining the morphology and dynamics of Spirals, would continue to be present.

(B) For the other leg of the evolutionary path, long regarded as the only path, I now propose that intervention of the bar formation phenomenon is what leads to the terminal development of 3-D Ellipticals with hardly any young stars and very little gas, typical inhabitants of the middles of rich clusters. The Coma cluster is an especially good example at low redshift (Dressler 1980), but the same applies to the even denser ones at intermediate redshift, studied by Dressler *et al* (1997). For that destination there has been a dynamical problem, not (I think) hitherto resolved; How do you get from a very flat Spiral (look at Fig. 9D) to the fattened 3-D shape?

I propose that formation and ultimate expiry of a roller-bar has this capability, as follows. First let the original spiral arm structure be entirely consumed over time, as they passed the ends of the bar. The bar, now deprived of its end-on feed of material, will therefore collapse along its axis, conserving a.m. and enlarging the bulge already similarly built. The bars of many Barred Spirals (including NGC 1300, Fig. 9F) show the axially convergent streams of dust setting up a new rotation in the very middle, in a repeat of the convergence dynamics (inset, Fig. 10) responsible for the roller rotation of the bar itself. The temptation to link this rotation to that of the external arms should, I suggest, be resisted, as it would raise the question of how the intervening bar axis remains so straight. Rather we have here two separate dynamical systems of convergence.

In this enactment we must now explain the necessary expiry of the bar-producing polar infall streams, which would otherwise bring in young material and, with it, the action of the G-E field. I see the bar-producing infall streams as being

focused upon the middle of the disk by the very extent of that disk; this focusing is lost when the arms that comprised the disk have been consumed. I have difficulty in explaining why the infall should then disappear altogether, and not arrive in a distributed manner, unless one invokes the idea that neighbours captured the material on its way to the dense core of the cluster.

Much of the foregoing scheme seems to accord with the important observational analyses of Dressler (1980) and Dressler *et al* (1997), except that they did not distinguish Barred Spirals from Spirals. This needs to be done if the environmental significance of this dynamical form, identified in this paper, is to be fully examined. Dressler (1980) did, however, find no support for the idea, originally proposed by Gunn & Gott (1972), that motions of other galaxies could cause ram pressure stripping (RPS) of gas from Ellipticals. Although subsequent work has pursued the RPS idea (Vollmer *et al* 2002), as did many presentations during the JENAM 2010 conference in Lisbon, most of the images then displayed would appear to benefit from treatment with the G-E field in mind, a force on plasma not hitherto available for consideration. For the dearth of plasma in Ellipticals the foregoing scheme now seems preferable to mergers-with-RPS. For mergers we note that Newtonian gravity on the (uncharged) masses will bring them together, whereas the repulsive G-E field action on their plasmas could appear very like RPS.

In comparing the morphology distributions in dense clusters at low redshift and in rather denser ones at intermediate redshifts, Dressler *et al* (1997) found that the latter showed proportionately more spirals, but at the expense of fewer S0s. Their high spiral abundance could be because the higher cluster densities attract more vigorous infall streams and, when these are cut off in the interior, galaxies spend less time in the S0 transitory state between Barred and Elliptical.

In the foregoing we have argued that these infall streams are mainly of cosmogonically young and low-metallicity composition, only becoming ionized and responsive to the galaxy's G-E field when they reach and mix into its bulge. Indeed the ongoing accretion of cold gas by galaxies has long been recognized (e.g. Sancisi *et al* 2008). To avoid this being in conflict with the evidence for x-ray-emitting auras around clusters, originally discovered by the ROSAT mission, we envisage these auras, whose radiation hardens outwards from the cluster, as being close analogues of the solar corona, whose emision temperature likewise rises outwards and we have attributed (Sect. 7.5) to the acceleration of ions by the solar G-E field. In this case, perhaps, we are talking about the combined G-E field of the cluster. So the picture for the infall seems to be that its low ionization enables distinct streams of it to fall, semi-convectively, through the G-E field-supported high-temperature plasma. We have here yet another example of the discriminatory action of the G-E field and, in this case, at what must be just about the largest possible scale in the Universe.

Origin and development of the spiral arm structure. Having considered the agencies responsible for the later morphological evolution of Spirals, and found that this primarily involves the unwrapping of the spiral arms, we must now face the question of how the spiral configuration may have arisen in the first place. Although the detailed layouts of many Spirals do seem consistent with there being two primary arms, as discussed above in the context of Figures 9B, 9C, there are others for whose tight multi-arm layout such an interpretation is clearly unrealistic. NGC 2841 (Fig. 11) is a good example. Other well-known ones are NGC 488 and NGC 7217; both are more-nearly face-on. NGC 2841 is the least-distant of the three.

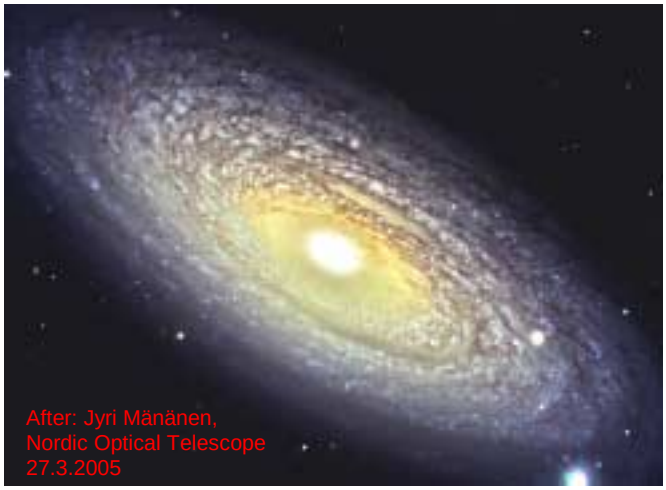


Fig. 11. NGC 2841, a closely-wrapped multi-arm Spiral.

Gravitational contraction under conditions of angular momentum conservation will produce a spiral flow pattern with an inward-increasing tangential velocity. But here the apparent 'arms' will actually be delineated by the shear zones which develop to accommodate, in steps, this gradient of tangential velocity. The 'arms' will necessarily, therefore, be tightly wrapped, in intimate contact with one another. If low nebular viscosity and the development of a sufficient concentration of mass near the centre permit the development of a Keplerian tangential velocity distribution, the streams / arms will still be much more closely wrapped than under the conditions of constant tangential velocity now so widely present in Spirals, and which we have attributed above to action of the G-E field upon plasma outflows.

In the early stage of an embryo's mass growth under gravity, the central density will not yet have built up an ionizing central bulge, nor, probably, will it yet have become massive enough to attract axial infall streams of cosmogonically young material to feed the build-up of the bulge. But as soon as this state has been passed, through the build-up of mass-loss ejection of plasma from stars, the infall will become ionized in the bulge and develop into a G-E field-driven outward flow. The tightly wrapped arms will now get moved outward to the configurations which we see (Fig. 9B, 9C) and discussed above.

In summary, therefore, we can envisage the evolution of a Spiral galaxy as having five stages:

(1) contraction to a tightly-wrapped spiral form, with a.m. conservation, under Newtonian gravity, of little-ionized and presumably cosmogonically young material (mostly H, although potentially enriched by higher-Z materials expelled from more-evolved spirals in that cosmic region);

(2) radiation from its star formation raises energy levels in the aura of the galaxy and the rate of auto-creation there, providing a source for the onset of little-ionized axial infall flows;

(3) the build-up of a central bulge, and the rate of star formation there, raises ionization and that of the infall so that the G-E field developed by the bulge's mass is now able to drive outward the plasma, and with it the arms of the spiral; this 'takeover' by the G-E field will halt the growth of the spiral configuration at its edges and the timescale involved may even

act to standardize the mass to which such tight spirals can grow at this stage[14];

(4) the presence of other galaxies, nearby, mis-aligns the now-more-powerful infall streams, dynamically converting the bulge and its core into a roller-bar and turning the galaxy into a Barred Spiral;

(5) changing spatial relationships with neighbouring galaxies shuts off the axial infall flows, enabling the bar to 'consume' the remaining vestigial spiral arms and shrink along its axis, the end result being an Elliptical or S0 galaxy.

The low level of star-forming activity in stage (1) means that such forms will have low visibility face-on and could explain the apparent preponderance of slim ones seen edge-on.

This sequence again makes use of the electrical discriminatory character of G-E field action, allowing Newtonian gravitation to rule until sufficient ionization brings about its intervention, just as we concluded for the building of high-mass stars (Sect. 7.2.3). Pursuit of the above sequence requires the widespread presence of mostly cosmogonically young neutral hydrogen, the HI (21cm) radiation from which should be observable.

But one consideration remains. The initial formation of a spiral can only be done by conservation of a.m. already present in the converging material. Pure Newtonian, radially-acting gravitational infall is incapable of generating a.m, so where could that a.m. have come from? There appear to be two possible sources; one primary, the other secondary.

For the primary one we can envisage – as we did at the smallest possible scale (Sect. 8) for the auto-creation of the aether vortices of fundamental particles – that the rotation is generated by 'roller-block' action during the 'viscous' shear coupling between oppositely-directed motions or flows, in this case, of intergalactic material. The existence (Arp 1966) of near-linear galaxy chains, each of four or more visually-small Spirals (e.g. Arp 324, 325, 329 & 331), appears to confirm that such shearing does arise between flows of cosmogonically young material. In that case, these objects should exhibit very low metallicity, were it observable. Once again, the widespread presence of such intergalactic material, even at that early stage, is supported by the dynamical demand for its presence.

The other potential source of the a.m. required is in the G-E field-driven outflow materials from any fully developed Spirals in the vicinity. These materials would not be of such low metallicity but will have greatly increased a.m. content, just as we discussed above for G-E field action in forming the solar planetary system. If the presence of this enhanced a.m. in the inter-galactic medium helps to promote further galaxy formation, we have here yet another general reason for the growth of clusters.

The foregoing account stresses the importance of studying the spatial relationships of galaxies, particularly in clusters, but this is made difficult until allowance can be made for intrinsic RTV redshifts, according to galaxy type and gassiness, as outlined in Section 5.4. Such redshifts clearly increase the apparent velocity range in a cluster, and must undermine the many studies of cluster longevity based on the virial theorem. In our auto-creation cosmology (Sect. 8), moreover, we are in any case not looking for the longevity presumed in Big-Bang cosmology, making the virial approach even more difficult to constrain and undermining any demands for CDM in this context.

[14] It should become apparent in the morphology quite soon that the transition to this dynamical condition is under way. NGC 488 has an appearance superficially similar to that of NGC 2841 (Fig. 10), but has clearly-distinct outer arms and has been found (Peterson 1980) to have a now-typical flat profile of tangential velocity, which we recognize here as evidence of such G-E field action. A velocity profile for NGC 2481 would be interesting. Has it still got a Keplerian character?

10. Quasars, velocity-dependent inertia and black holes

10.1 Features of quasars (QSOs)

Important features of quasars, to be explained by any model, are these. See *e.g.* Blades *et al.* (1988), Rauch (1998).

(a) Diminutive, star-like image size, subject in some cases to brightness changes on a timescale of days to a year, suggestive of a limited actual size of the source, but some might be flare-like in origin and lack that significance.

(b) Very broad Lyman α emission line, redshifted ($z = \delta\lambda/\lambda$)) in the range <0.2 - >6.0.

(c) Numerous (up to >100) Ly α absorption lines - the so-called 'Lyman alpha forest' - extending along the shortward flank (less redshift) of the main Ly α emission; the number increasing sharply with z beyond $z = 2$ (Carswell 1995).

(d) Forest lines become spectrally further apart (Murdoch *et al* 1986) near the high-redshift end in any individual quasar and these often have related C^{IV}, N^{V}, O^{IV} and Si^{IV} absorptions elsewhere in the quasar's spectrum.

(e) A roughly 150-fold drop in escaping flux between $5.0 < z > 6.28$ (Becker *et al.* 2001), much steeper than redshift-based inferred distance.

(f) Much more frequent spatial (on the sky) association with galaxies of relatively low redshift than is statistically appropriate (Burbidge, Arp, *etc*.). But this, being a statistical matter, has been vigorously debated and is not treated here as a primary fact.

In 1988 it seemed inescapable, in view of their differing redshifts, that the 'forest' and related absorptions must be due to intervening clouds, so need not be considered in respect of devising quasar models. But M.J. Rees (in Blades *et al.* 1988) pointed out that the column depths and ionization temperatures seen in the lines raised constraint problems for such clouds in intergalactic space. So more recent work has considered outlying regions of galaxies for this job, or has invoked constraints by CDM (Rauch 1998). Here, we revert to the previously unthinkable; namely, that the absorptions are integral to each individual quasar, and that their redshifts are generated within its structure.

10.2 Two new tools for the quasar model

10.2.1. Velocity-dependent inertia (VDI)

In CT we consider the aether to be the only available agent for force communication, beit electromagnetic, gravitational or inertial. In Section 3.2 we developed a very close link between gravitation and electromagnetism, concluding (Sect. 3.4) that both are communicated at velocity c. Close links (Sect. 4) between the properties of the aether and an origin for inertial interaction, in the light of Mach's Principle, lead us directly to an expectation that inertial interaction is also communicated at velocity c. A principal consequence of this is that inertial forces will also be **c**-limited in magnitude, in just the same manner as we inferred (Sect. 2) for electromagnetic interaction in particle accelerators. The idea of velocity-dependent inertia (VDI) has

been favoured by Ghosh (Ghosh *et al* (1988); Ghosh (2000)) but his underlying reasoning is different.

In 'normal' (low-velocity) circumstance the force balance on an orbiting body is between the gravity of the central body (or supposed black hole), stable if the orbit radius is constant, and the (inertia-dependent) centrifugal force upon it. The orbital velocity is with respect to 'the rest of the Universe', so under VDI the latter will decrease as the orbit speed increases, making a further increase of orbit velocity necessary in order to bring the forces into the required balance. If that speed-up is achieved by orbit shrinkage, while conserving a. m., the force from the central body will be increased, possibly precipitating a runaway shrinkage sequence of velocity increase and inertia (centrifugal force) reduction. By overlooking such effects, and applying a supposed relativistic mass increase to the orbiting material, we will have obtained a truly gross overestimate of the mass of the central body or black hole.

As discussed in Section 4, the Machian 'rest of the Universe' may in fact be the locally enveloping aether, so for VDI purposes we need not be concerned with the velocity of our quasar in the Universe at large.

10.2.2. Aberration-related (A-R) redshift

The stellar aberration of Bradley 1727 involves a velocity triangle formed by the transverse velocity of the observer and the speed of light ***c***. The resulting hypotenuse greater than ***c***, relative to anything, was unacceptable in SR, so Einstein recreated his triangle to limit the hypotenuse to ***c*** and called its lengthening 'transverse Doppler effect' redshift. In CT, the only velocity limitation is ***c*** *relative to the immediately surrounding aether*, so we are at liberty to envisage a relative velocity between objects, cumulatively acquired over the distance between them, that in principle has no upper limit, especially if relating to deep inside the object. Consequently the superluminal orbital transverse velocities possible under VDI will produce very large A-R intrinsic redshifts.

In a layered orbital shell structure, the innermost shell will have the highest tangential velocity and generate the biggest A-R redshift. The outermost shell(s), on the other hand, will have sub-luminal velocity relative to the aether of the external 'universe', thereby not violating CT's aether-defined ***c***-limitation on *local* relative velocities.

In CT, because the local aether, wherever that may be, is the frame of reference within which any transverse motion should produce an aberrational change of TEM-wave propagation direction, just as we have shown in the case of RTV redshift and scattering, it is useful here to recall the CT explanation (Osmaston 2003) of why, in CT, the high transverse velocities of distant orbiting stars do not produce an aberration of their apparent direction. If they did, the components of a stellar binary would appear to scoot to and fro across the sky, rendering it unnecessary to use a spectrograph to pick them out.

We saw earlier that, as supported by the MM experiment, the aether behaves in a substantially, but not rigidly, particle-tied manner. This means that in the case of the Bradley aberration, it does not occur within the telescope but builds up along a gradient of aether transverse velocity (w.r.t. the Earth) in the external environs of the Earth.

Similarly, for a binary star component, the gradient of transverse velocity within the aether is somewhere near that end of the transmission path. We show in Figure 12 that the aberration angle produced there mainly results in the observer receiving rays from the star that were not those originally emitted directly towards him, so little or no visible aberration is to be expected. It is easily shown that, contrary to simple intuition, the total aberration does *not* depend upon whether the gradient of transverse velocity is steep and confined to a small part of the sight line, or is rather widely distributed. What *does* change with position of the gradient along the sight line is the fraction of the original perceived by the observer.

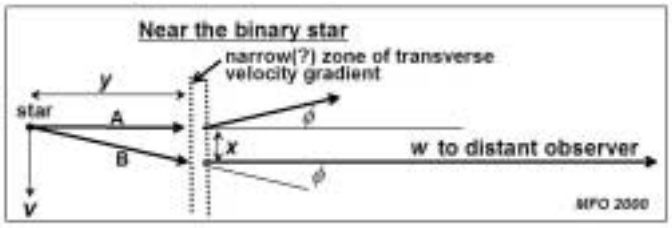


Figure 12. Aberration diagram for a distant orbiting binary star in the presence of a transmitting medium (aether).

Explanation. Distance ***y*** may be of the same order as the binary orbit radius. The aberration angle is:-

$$\phi = \tan^{-1} v/c \quad \text{and} \quad x/y \approx \tan\phi.$$

The observer sees light ray B instead of A.
The observable angular displacement is thus:-

$$a_{obs} = \tan^{-1} x/w \approx (y/w)\tan^{-1} v/c$$

which will commonly be too small to detect. In very favourable circumstances it might just be possible to do so using VLBI techniques.

Note that the associated CT redshift (aberration-related (or A-R) redshift), equivalent to the "transverse Doppler effect"of Relativity Theory, depends only upon the actual aberration, wherever it occurs, not upon its perceived amount. This result is important both for our quasar model (below) and in predicting a hitherto-unrecorded redshift in the spectra of orbiting stars, oscillating from zero at twice the orbital frequency. In the (so far) extreme case of the star S2 orbiting the supposed black hole in Sagittarius* at a transverse velocity of (say) ~5000 km/s near the pericenter, the peak would amount to a velocity-equivalent redshift of about 42 km/s.

The ability, by observing its proper motion, to track this star around an orbit about one-tenth of an arcsecond across demonstrates decisively that the roughly 1 degree aberration angle (ϕ in Fig. 12) at this velocity is irretrievably attenuated by our distance from the system.

10.3 The CT model for quasars

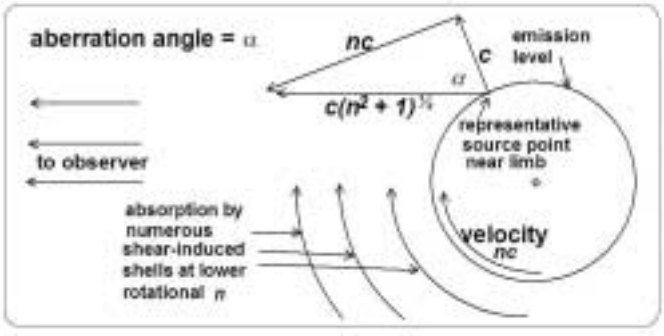


Figure 13. The new model for quasars. Figure after Osmaston (2003). When this was drawn, ***z*** = 4.89 was the highest that had been observed, and sought to show the extreme possibility that all of it could be intrinsic. It demonstrates the geometrical limitation on escaping flux which arises when the intrinsic (A-R) component of ***z*** becomes large. In fact it is not envis-

aged that the redshift of any quasar actually includes an intrinsic component which is that big. Superluminal factor – ***n***.

Description

(1) VDI, as explained above, drastically reduces centrifugal (but not central gravitational) force when tangential velocity approaches and surpasses ***c***. So *superluminal* orbital velocities, due to gravitational shrinkage of high-angular momentum clouds, are possible.

(2) The extreme case that most of the redshift can be intrinsic to the body, is of aberration-related (A-R) type, and amounts to:- $z = (n^2 + 1)^{½} - 1$. Thus z = 4.89 requires n = 5.8 and α = 80.2°, so the received intensity is predicted to fall rapidly as z increases further, as observed (Shaver *et al* 1996), but will never drop to zero. Becker *et al* (2001) attributed this drop to the Gunn-Petersen (1965) effect, but that only relates to the theoretical post-Big-Bang evolution of the Universe, which is not the case in CT.

(3) Excess emission line breadth is primarily due to rotational broadening, not RLV (random longitudinal velocity of the aether). n varies with latitude on the emission surface.

(4) Similarly, the breadth of the broad absorption line (BAL) members of the Ly α forest, near its high redshift end, is probably also due to rotational broadening, but an RLV broadening component, due to the high temperature, must also be present although small if the path length through the shell is short.

(5) The "Lyman α forest", and the high-ionization C, N, O and Si lines, is intrinsic absorption in successive shells, inevitably denser and hotter, proceeding inward. Higher shearing between these inner ones would explain the spacing-out of the lines towards the high redshift end. The absorptions are <u>not</u> due to clouds in intergalactic space, whose temperature can thus be the 2.73K indicated by the CMB (Sect. 5.7).

(6) Quasars are <u>not</u> at the cosmological distances inferred from their total redshifts. Their spatial association with (or in?) galaxies is entirely reasonable. The requirement for a high angular momentum source cloud makes their occurrence in isolation less likely.

(7) As n rises towards and past unity during contraction, centrifugal (= inertial) constraint upon shrinkage decreases. The consequent rapid gravitational compression will yield superhigh *PT* in the interior, and perhaps light element (D, He, Li?) nucleosynthesis, thus replacing the Big-Bang in this regard. Some such material may get ejected from the poles to form the widely observed jets and distribute this light-element material into the cosmos.

(8) In more massive quasars the process may go further. Under CT a particle only possesses mass if there is room to accommodate the required aether dynamical configuration. Further compression will annihilate the mass, with enormous energy release - probably seen as GRBs (gamma ray bursts) - so the gravity exerted by that mass disappears too, contrary to current black hole models. Thus GRBs may turn out to be excellent replacements for the Big-Bang light-element nucleosynthesis, which our finding (Sect. 5.3) that there was no such event now renders necessary. Such quasars (and those in (7) too) may decay/expire on quite short timescales, and if anything is left, may start upon a stellar evolutionary course, degenerate or otherwise.

(9) Viewed pole-on, aberration will prevent any TEM-wave radiation except that from close to the pole from reaching the observer, so luminosity and redshift will be low, but the object may be detectable by sub-c proper motions of objects going around it (Sagittarius A*?). Consequently, an inability to see the central body should *not* be regarded as signifying the presence of a relativistic black hole.

This assignment of each Ly α forest line to a particular shell that is part of the quasar complex means that the true cosmic-distance component of the quasar's redshift must lie shortward of the lowest-redshift Ly α forest line seen. In this area of the spectrum, however, things get complicated by overlap with Lyman β 'forest' lines, but such overlap does of itself imply that >18% of the redshift is intrinsic. So this is a matter for serious study to provide us with proper guidance as to the true distances of quasars. When this has been done, we will at last be able to get a handle on the actual energetics of quasars and on how they are positioned in space relative to visually juxtaposed galaxies.

Our model does invoke the rotation of huge amounts of aether, with the expectation of enormously intense magnetic fields, evidence of which is perhaps the focusing of jets and observed synchrotron radiation and radio emission from quasars. The main requirement for the initiation of any of this would be the combined presence of rotation and a sufficient concentration of mass, which fits well with the widespread view that Active Galactic Nuclei (AGNs) conceal quasars in the middle. On the other hand, many quasars seem to occur either in the relative outskirts of galaxies or even in comparative isolation, but spatial relationships can only be studied after the intrinsic redshift components have been extracted. Halton Arp's repeated contention that quasars get ejected from galaxies would raise a difficult dynamical question of how that could happen, but I feel it premature to discuss that here.

10.4. Black holes?

From the start, and at many points subsequently in this paper, I have demonstrated the gains in physical understanding to be achieved by recognizing that the mass property and the magnetic fields of fundamental particles need space within the particle in which these can be developed. Hitherto, for nearly a century, these properties have been treated unquestioningly as intrinsic to the particle concerned, and contained within infinitesimal singularities thus, in effect, establishing two new laws of physics for this purpose.

That is the basis upon which the Schwarzschild black hole model and its relatives have rested and have seemed to be supported by the observation of very high velocities of orbital circulation. Its defining feature, the presence of infinite gravitational field at its centre is the mark of not having had available the understanding of the physics of gravitation that motivates this paper. The quasar model outlined in the preceding section (Sect. 10.3) would, however, as noted there, have an interior with various black-hole-like external features, but whose endpoint would be mass annihilation and a GRB, probably with cosmologically very important capabilities for light element nucleosynthesis.

I conclude that relativistic black holes, as primarily conceived, are a physical impossibility. A half-way stage, present in AGN and quasars, does appear possible, but with a possible GRB endpoint, rather than the limitless accumulation of mass. Semantics must decide what these are called. To gain an illumination of the nature of GRBs and their immense releases and recycling of energy into the Universe seems a valuable swap

for the loss of all-concealing black holes and the cosmological implications of such progressive concealment.

11. Back to Earth: activities of the G-E field here

Throughout this paper we have used the Karlsson *et al* (2003) figure of 'several hundred mV/m' in the ionosphere as basis for extrapolating the G-E field strength to other bodies (Sun, neutron stars). More recent work, concentrating on the vertical component, greatly widens the bracket. Kelley (2009, p.363), using the fact that 99% of lightning strikes bring negative charge to the ground, just like we inferred (Sect. 7.5) for the abundance of the H^- ion at the solar surface, finds a potential difference of 250,000 V between ground and lower ionosphere, or about 2.5 V/m. At the other end of the scale are other investigations, less attentive to the vertical component, at about 25 mV/m.

Another phenomemon, of high potential relevance to humans, is the observation, now being vigorously investigated, that major earthquakes are preceded by well-located precursor disturbances in the ionosphere. An anomalous component of the 'vertical constant electric field is registered within the area of the earthquake preparation several days or hours before the seismic shock' (Pullinets & Boyarchuk 2004, p. 13). Rather far-fetched suggestions that release of radon might be the cause are disproven by similar, but more concurrent, ionospheric effects for three deep submarine M >8 earthquakes along the Kuril arc (Astafieva & Heki 2007). In that case, moreover, the disturbance differed for earthquakes of different movement character. We infer that these ionospheric changes must relate to the changes in gravitational potential and associated G-E field during the preseismic and co-seismic deformation. Apart from its valuable earthquake prediction property, this mechanism may turn out to be a much more sensitive way of monitoring short-term changes in the geoid than is possible with specialist gravity space vehicles.

An observational link between typhoons and ionosphere changes has long been recognized, but here the possibility of atmospheric dynamical linkage is obvious. But the sea-level changes must also affect the gravity field, so a G-E field component for the ionospheric disturbance may be worth considering.

To discuss the probably most far-reaching of all the consequences of the G-E field for the Earth, we must go back to its construction. To achieve its planetary a.m., this had to be done wholly in the presence of the G-E field acting upon the nebular disk within which it was built (Sect. 7.3). This determined the manner of its core construction to be that of Ringwood and left the Earth with a water-saturated and water-weakened mantle mineralogy (Osmaston 2010c). When the ocean had emerged from it during the next 2 Ga, large parts of the upper mantle reached a critical state which suddenly stiffened its mineralogy (Osmaston 2010a) and halted convection for ~250Ma, during which oxygenic life was able to win its battle against low-pH mantle effusions and give us an oxygenated ocean and our oxygen-bearing atmosphere. Large parts of the upper mantle still remain in that state and have exerted major control on plate dynamics and the resulting earthquakes for at least the past 150 Ma (Osmaston 2009d, 2010a).

Thus three major factors governing our existence can be traced back to action of the G-E field during Earth construction – the water we need for growing our food, our oxygen-bearing atmosphere, and major aspects of earthquake distribution and magnitude, *e.g* that of Haiti 2010.

12. Holding the aether together

I conclude with a final comment about the inferred charge density of the CT aether. This number (>10^{30} coulombs/cm^3) is in fact the same as, and relates (Fig. 1) directly to, the relative charge density within an electron, were it to be a sphere 10^{-16} cm or smaller in diameter. In a Relativity Universe with no ubiquitous aether, the question of how the charge density within an electron is held together against its self-repulsion does not appear to have been asked, presumably because the electron has been regarded as indivisibly particulate; and its charge likewise. A similar question in respect of the multiple protons (each with a positive charge) in the atomic nucleus has long brought recognition of a need for the 'strong nuclear force' and we have considered it in Section 3.

In CT we have abandoned the current idea that electric charge exists only in particulate form and the idea (Fig. 1) is that the actual charge density in the electron forms a local increment above that of the aether that surrounds it, and is equal to the local deficiency in the core of a positron, thus providing their relative polarity. The hitherto mystifying durability of the electron relative to the positron may be a function of the greater vortex-maintaining forces that result from its greater aether density.

On the other hand, the question: What holds the aether itself together despite the self-repulsion of its charge? can be regarded as inappropriate if the CT Universe, although non-expanding, is truly infinite and therefore without a bounding agent. A deep-ocean fish functions happily without knowing the pressure of its surroundings; it is only the human in an exploration vehicle, who has to preserve a low-pressure reference around him, which records the immensity of the pressure outside. Our model of the positron, presented in its barest form in Figure 1, does the same job for the aether. Without that, we would be unaware of the aether's immense potential for action in the Universe around us.

13. Overview and 16 principal findings

Overview

Relativity Theory rests on four mortal inconsistences. It is, therefore, a castle built upon sand. TEM-waves cannot exist without an aether; the supposed relativistic mass increase is actually a force-communication effect; the physical properties of fundamental particles demand that they are not infinitesimal singularities; and electronically generated continuous-wave radio transmissions do not propagate in photonic packages, so why should any others do so?

CT starts from a deeper foundation – the implementation of Maxwell's aether - and all four are avoided. Newtonian gravitational force has an aether-related mechanism so, together with the strong nuclear force, it is one of the electromagnetic family. It is everywhere accompanied by, and second only to it, a radial electric force, the G-E field. There was no Big-Bang; the cosmic redshift is a TEM-wave transmission effect, not a velocity, so Dark Energy is not required for 'acceleration'. This same transmission effect, in concert with the G-E field, probably removes all need for CDM. TEM-waves are massless but do contain energy, as do the random and other motions of the massless aether. Unlimited-mass black holes are impossible.

Neutrinos do not 'oscillate'; stars simply evolve more slowly. The Universe is of undefinably great age. Its gravitational mass content is increasing with time, probably exponentially and potentially observably, by autocreation from the randomly moving aether. Altogether we have a much simpler Universe, with only one invisible item – the aether – having, moreover, a character that is here approximately quantified, and multiple properties whereby to identify its presence and actions.

In addition to the sixteen that follow, a variety of other CT-related findings are recorded in Osmaston (2006 in press, 2008 in press, a, and b).

16 Findings

1) Relativity's foundation, a rejection of the existence of a luminiferous aether on the grounds that it had no observable function, marks a serious, but perhaps deliberate, defect of perseverance, in progressing no further than the MM experiment. From an initial (essentially serendipitous) recognition in 1959 that, far from it being unobservable, the aether could actually have many widespread manifestations, my studies have led to the Continuum Theory (CT) of physical nature outlined here. Already it seems to yield many new insights with wide relevance and extensive observational support. Of these, by far the most significant for natural philosophy appears to be its unprecedented bearing on the mechanism of the mass property and the resulting behaviour of gravitation. This has been made possible by recognizing, in addition, the abundant observational evidence that fundamental particles are not the infinitesimal singularities treated in Relativity theory, but do have finite size, so it is no longer illegitimate to enquire what goes on inside them.

2) Both SR and GR, as currently endorsed, are rendered untenable by their inconsistencies:- **(i)** rejecting the fact that the aether is essential for the existence of TEM-waves, yet claiming to support the validity of Maxwell's equations (which specify that it is); **(ii)** assuming that the finite properties of particles (mass and magnetism) can be physically generated within spatially infinitesimal singularities, despite excellent evidence that mass-bearing fundamental particles do have finite size; **(iii)** not appreciating that the relativistic mass increase supposedly observed in electromagnetic particle accelerators is actually the consequence of a ***c***-limited communication of force, a limitation which is only avoided by treating particles as infinitesimal singularities, with zero communication-distance to be travelled. Further, SR's postulate that ***c*** is an 'absolute constant of physics', despite its dependence on physical properties specified in Maxwell's equations, is philosophically inconsistent with a physically interacting universe. Remarkably, in substitution, CT bears precisely, even with formal identity, on other phenomena hitherto seen as the exclusive capability of Relativity. In such cases, observational support for one theory is observational support for both.

3) The aether prescribed by Maxwell's equations for the existence of TEM-waves is an elastic quasi-superfluid continuum of negative electric charge. Its mean density exceeds 10^{30} coulombs/cm^3. Fundamental particles are vortical dynamical configurations of aether motion, opposite electrical charge being conferred by containing more or less aether density than the mean. Magnetic fields caused by local aether motions limit its superfluidity and, together with the self-repulsion of its charge, provide for the restoration of transverse displacement. This property enables the interference of linear motions to give rise to rotational/vortical motions, a process which is impossible in a true superfluid.

4) Particle random motion implies aether random motion, resulting in four correlated and cumulative, wavelength-independent transmission effects - redshift, line-broadening, scattering, attenuation - the cosmic redshift being one example. So there was no Big-Bang, the Universe is not expanding, and Dark Energy is not required. Intrinsic extra redshifts are developed in stellar and galaxy 'atmospheres'. This form of redshift has reliably been observed, but was not recognized, using caesium clocks over long-distance ground-level paths, and reported in 1968. The other three appear also to have been observed in important circumstances. A fifth effect, due to the random accelerations of charge in such aether motion, generates the CMB which also records its local enhancement in the neighbourhoods of galaxy clusters. Its extreme uniformity in other directions casts doubt upon the presence of high-temperature clouds supposedly responsible for the redshifted absorptions in QSO spectra, but whose origin we have now resolved (see **13**, below).

5) The random motion of the aether provides an ubiquitous random excitation overlay of electromagnetic energy that may represent the ZPF, explaining Brownian motion, photoelectric effect, *etc.* It constitutes a statistical overlay upon all classical electro-dynamical interactions, so it may provide the basis for a new approach to those requirements currently met by QED. The perceived need for QED-type treatment is limited to the tiniest of scales, precisely where aether random excitation will intrude most effectively. Access to atomic nuclei by this excitation may be variably restricted, due to shielding by their electron shells, thereby affecting nuclear decay timescales hitherto regarded as intrinsic. This may be the nature of the Weak Nuclear Force and substitute the supposed functions of the corresponding bosons.

6) The mass property of a mass-bearing fundamental particle is generated by the aether through-put associated with its vortical action, the resulting external aether flow being the measure of the mass of that specific particle. Both the vortical configuration and the flow through it require space in which to happen, so the unlimited compression of matter to a singularity and yet retain the mass, as postulated for the Schwartschild relativistic black hole, is an untenable proposition; mass annihilation would occur. A gamma ray burst may then be the result (see **13)**.

7) Particle mass and gravitational action are due to the vortices sucking themselves together, a statistically predominant manner, due to the inverse square law. This generates a radial gradient of aether density - an electric field, the Gravity-Electric (G-E) field - both inside and outside any gravitationally retained assemblage. So Newton's laws are an incomplete description of gravitational action and gravitation becomes a member of the electromagnetic family of forces.

8) The three-quark make-up of protons is held together - the Strong Nuclear Force - by the mutual circuiting of pumped aether flow, so the observed mass is due to that part of the flow which escapes that circuiting. Similarly, more complex nuclei, held together by the SNF, exhibit masses that are less than the sum of the separate components. This loss of mass-

equivalent energy is probably what drives stellar evolution. This SNF mechanism is thus, as long suspected, very closely linked to that of gravitation and likewise includes it within the electromagnetic family.

9) The G-E field is, in several ways, a major agent during stellar construction and evolution. The growth of stars to high post-ignition masses would be impossible if radiation pressure were the main agent of mass loss. During dust-opaque infall the relative absence of the G-E field's force avoids mass loss, but the force acquires a high mass-loss competence immediately the star establishes an ionized environment. The build-up of sufficient infall opacity for this process to succeed may be what triggers the starbust phenomenon. Internally, the field supplements the overburden-support force, enabling nucleosynthesis to proceed more slowly than has been realized, with lower neutrino output. This rate is not constrained, as there was no Big-Bang (see **4**).

10) The G-E field plays a major part in the construction of planetary systems and in Spiral Galaxy evolution. In both cases, it pushes ionized materials outward without change of tangential velocity. This provides the high a.m. content of the SS planets and removes any need for CDM in Spiral galaxies. Were CDM to be present in galaxies in the amounts that have been proposed, where would its a.m. have come from? The action of the G-E field in evolved Spiral galaxies is to drive the arms outward – unwrap them, so this stage must have been preceded by low-ionization Newtonian shrinkage to a tightly-wrapped spiral form, of which a few good examples are known. In the present solar system, the G-E field force is tiny (low density of solar wind plasma) so Newton's laws prevail, as also in relatively plasma-free Elliptical galaxies.

11) The G-E field action required for planetary a.m. reasons (**10** above) also prescribed that the Earth's, and other, iron cores were built in a manner which also happens to provide an origin for Solar System water. Evolution of the resulting water-rich mantle has played a major part in Earth history, including the mid-life changes which resulted in our oxygen-bearing atmosphere. Currently the G-E field is also manifest in the polarity of Earth lightning and probably in causing ionospheric changes coinciding with changes in surface gravitational potential precursory to, and concurrent with, major earthquakes.

12) The G-E field at the surface of neutron stars is expected to be intense, estimated at around 10^{12} eV/m, but with wide uncertainty, and appears to be what accelerates cosmic rays to their high-end value of a few 10^{19} eV. In that case, surface patches of proton-rich material (residual from their parent explosion) could supply electric current outflows that source the (synchrotron?) radiation seen from pulsars, rather than the oblique magnetic rotator model which has difficulty with multiple-pulse pulsars.

13) The aether is the sole available agent for force communication of whatever kind - electromagnetic, gravitational, inertial - between objects, so is ***c***-limited in all cases. The resulting ***c***-limited inertia yields a fertile model for quasars with large intrinsic aberration-related redshifts associated with superluminally orbiting shells responsible for the Lyman α forest of absorption lines. Such high velocities are not evidence of a black hole, but the associated compression may terminate in mass annihilation as GRBs, creating and releasing light elements into the cosmos, in substitution for the Big-Bang in this regard.

14) Recognizing that the force-generating and communicating capabilities of the aether extend also to atomic interiors appears entirely to replace the need for the hypothetical force-conferring bosonic particles, thus facilitating a transition to CT from the present wholly particulate Standard Model of theroretical physics.

15) The huge charge density of the aether renders it generally-irrotational at all except sub-atomic scales, providing a common basis for the action of disparate directional reference devices - Foucault pendulum, mechanical gyroscope, laser ring gyro. Exceptionally, however, the aether inside quasars probably does rotate, setting up powerful magnetic fields and collimating jets.

16) The Universe began an undefinably long time ago as nothing but the aether – an Electric Universe in fact - in random motion, thus embodying all the energy subsequently required. From this motion, vortices have resulted in the ongoing auto-creation build-up of all the mass in the Universe. Gravitational interactions enhance energy levels and regionally concentrate the rate of auto-creation, explaining the build-up of clusters of galaxies. This inverts the age significance of low metallicity, currently adopted and rigorously applied in the frame of a Big-Bang Universe. Infall of cosmogonically young and low metallicity material from the 'outside' drives the formation and evolution of galaxy morphologies within the cluster. For this reason dwarf galaxies typically exhibit low metallicity, as do the haloes of Spiral galaxies. Within clusters, deflection of these infall streams by neighbouring galaxies metamorphoses Spirals into Barred Spirals. But in a cluster interior a failure of this infall to reach them then collapses the bar into the Elliptical form and deprives it of active star-formation and of plasma for the dynamical action of the G-E field.

14. Five Experimental Checks

The foregoing account of CT incorporates a huge range of apparently supportive observations, but additional checks, where possible, are always desirable for any theory, new or otherwise. The following would be especially valuable:

1) Central to the whole basis of CT is the charge density and polarity of the aether. A possible experimental method to determine the polarity and charge density of the aether is sketched in Figure 14 but careful assessment is required as to whether enough experimental sensitivity can be achieved.

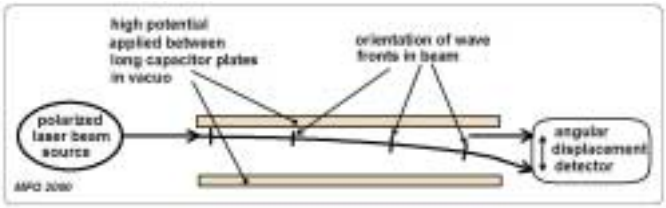


Figure 14. Suggested aether density and polarity experiment.

The CT view of Maxwell's dielectric displacement current is that the charging of a capacitor involves the displacement of aether away from one plate and towards the other. In Maxwell's equations the velocity of TEM-wave propagation rises with increasing elastic modulus of the medium, which relates

to the charge density of the aether. So a charge density (*i.e.* aether density) gradient, set up in the aether between the plates of a charged capacitor, will progressively tilt the wave fronts and deflect the beam. Rotation of the polarized source would modulate the deflection. If the aether is a continuum of negative charge the beam deflection will be towards the negative plate. This experiment would also check the proposed mechanism of the 'gravitational light deflection' (Sect. 3.4), thereby providing another check upon the intensity of the G-E field in given gravitational circumstances.

2) The mechanism of electron pairing in electrical superconductivity seems to be in need of elucidation. The transition of solids from electrically resistant to superconducting, currently known to as high as 135K, is attributed to the formation of electron pairs ('Cooper pairs') of opposite spin (Cooper 1956; Bardeen *et al* 1957). The accepted picture is that electrons, attracted by the positive field of lattice ions are drawn closer to one another than their mutual Coulomb repulsion would otherwise allow. If energy levels are low enough they are thought then to come together by 'exchange of virtual phonons'. In CT we have the possibility that the electrons are drawn together and held as pairs by mutual aether circuiting in the manner proposed in Figure 2 for the Strong Nuclear Force and discussed for mesons in that Section.

Since the phenomenon of electrical resistivity arises because the masses of the mobile electrons interact mechanically with the lattice, it follows that resistance would fall to zero if the aether flow circuiting in the electron pair were so complete that the external aether pumping, and thereby the mass property, of the pair vanished. The CT prediction is therefore that a lump of material will suddenly become lighter at the transition to superconductivity, by an amount corresponding to the mass of all the electrons involved in its Cooper pairs. If each atom in the material contributes one conduction electron the fractional change of mass would be about $1/1830\boldsymbol{N}$, where $\boldsymbol{N}$ is the mean atomic number of the material - a surprisingly easily measured quantity. If present it would provide fundamental support for the CT mode of mass-generation but if absent it would not undo other relevance of CT.

3) As discussed in Section 5.2, the Sadeh *et al* (1968) experiment using caesium clocks over a ground-level path should be repeated, with appropriate controls, to confirm the redshift-distance relation that they found. It would not be expensive. Attempts should be made to discriminate the diagnostic effects of path temperature and ionization.

4) The Pioneer 6 carrier-wave redshift observation during superior conjunction (Merat *et al* 1974), discussed in Section 5.4.1, should be repeated on the carrier wave from another space vehicle to confirm it and secure it as an example of coronal RTV redshift. With so many vehicles currently orbiting the Sun this should be quite easy to arrange, but a CW carrier wave may have to be arranged for the purpose.

5) An attempt should be made to measure the G-E field of the Earth, at ground level. This is essential for extrapolation to other bodies. Ionospheric observations (Sect. 11) suggest a potential gradient in the range 25mV/m – 2.5 V/m. The all-pervasive nature of the gradient raises problems. Being present equally within the structure of the apparatus and of any sample, it is this which has caused it to elude discovery. Some sort of ionic drift method might be worth consideration. Rotating the chamber in a vertical plane, to modulate the signal, would remove zero-point error.

15. Epilogue

In the Foreword to this paper I wrote: "If what you think you know leads you to the absurd, then the choice lies between piling on more absurdity and starting all over again". To what extent have we, in the event, actually followed the logic of this precept?

First, I would recall (Sect. 5.7) that the motivation for this work was a genuine and (in retrospect) rather ignorant attempt in 1959 to explain a set of observations which bore very significantly on the weapons project in which I was involved. Thus it was *neither then nor since* primarily driven by destructive intentions directed at what appeared to be absurdities in the paradigm of physical science, though I quickly envisaged the redshifting potential of a randomly moving aether. Rather, my motive has been constructive, starting from the deeper level I had exposed in 1959; deeper, it appeared, than has ever been attempted before[15]. If that root were truly the right one the resulting tree should lead us to more comprehensive fruition than any that rooting at a shallower level, or starting part way up the trunk, has ever yielded.

In the event it has emerged that the trunk, almost at root level, already divides into two particularly fruitful stems, both the outcome of making particles out of aether. One embraces generation of the mass property and the resulting Gravity-Electric (G-E) field; the other embraces the random motion of the consequently particle-tied aether.

Although the main thrust of the concerns pursued in this paper has been dynamical, as was that which underlay Einstein's development of Relativity a century ago, starting at this deeper level has required and enabled that scrupulous attention be paid to the physical nature of the objects involved - a defect of Relativity which led to the development of quantum theory to complement it, uncomfortable bedfellow though it has been.

The approach throughout has been phenomenological rather than mathematical, whose weakness is that it is poor at providing functional links between diverse phenomena, no matter how precisely each may seem to have been quantified. Such linkages offer to constrain and strengthen the choice of solution for any one of the elements in the network, thereby strengthening the network as a whole. Construction of a network of cohering perspectives, embracing the widest possible range of scale, has therefore been a primary aim of this work.

My use of the phenomenological approach recently received a boost in a quite different field (Osmaston 2009d). In that case, exhaustive seismic wave analysis had suggested that even the oldest tectonic plates of the Earth extend no deeper than about 200 km. But by stepping back and looking instead for the major plate dynamical consequences to be expected if much deeper 'keels' are present, it became clear that in places they do extend to more than triple that depth, explaining, for example, why India is crashing into Asia with such vigour. This previously unsuspected behaviour of mantle material has, in turn, an ancient link to the original development of our oxy-

[15] even by Maxwell himself, a deeply religious man, who seems to have been reluctant to exploit further his favoured idea of making particles out of aether, lest he usurp the prerogatives of the Creator.

gen-bearing atmosphere just before 2.2 Ga. Mathematics has no power to lead us to such disparate linkages.

It is the construction and pursuit of such linkages, albeit only in outline, within a deliberately unlimited frame of reference, that has made this paper so long. Our recognition and discard in CT of four of physics' apparent absurdities – the Big-Bang, Cold Dark Matter, Dark Energy and unlimited-mass Black Holes – are among the apparently beneficial outcomes of that pursuit, but at the price of losing a phantasmagoria that has had so much public appeal.

I want to emphasize that, in light of so many hard-thinking people, and for so long, having felt compelled to accept and build upon them, these four were not primarily targeted as being 'absurd' but are discarded in CT because the basis for each has melted away during the logical development of the theory. In this respect, therefore, we have *not* strictly been acting upon our precept, though the outcomes may seem as if we have.

In exchange for these philosophical losses, CT's implementation of Maxwell's aether appears to bring many rewards, the five most significant probably being:-

(a) the G-E field as the persistent associate of gravitation (a new law to accompany those of Newton?);

(b) the cosmic redshift as a transmission effect;

(c) the physical properties of mass-bearing particles are developed within their finite volumes without recourse to 'intrinsic physics';

(d) the aether provides our irrotational spatial reference, and

(e), but less assuredly, the quite local aether is the site of inertial force, whose action is velocity-limited like the others.

Along the way, as the reader may discern, lie what appear to be many more first-time or improved physical enlightenments than I have listed in Section 13. These, as they emerged, have continued to empower my desire to bring CT to the state presented here.

Obviously, however, this is still very much a beginning. The price to be paid in terms of the funding and redirection of physical and space research will be a major hurdle for its acceptance. That is where the five additional and relatively inexpensive tests listed in Section 14 could prove diagnostically important. Indeed there may be others. In the other direction, the more abstruse tests, supposedly diagnostic of Big-Bang cosmology and its ramifications, will need to be examined in a CT frame to see if its expectations are similar. We learned in Section 3.4 that even a precise conformity with expectation may not yield a secure choice of the underlying physical cause.

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The studies of R. Burniston Brown in 1950-60, on retarded action-at-a-distance (e.g. Proc. Phys. Soc. **68B**, 672-678 (1955)), but without an aether, drew my early attention to several of the matters discussed herein. Helpful discussions and/or correspondence with John Bahcall, Jeremy Drake, Isobel Falconer, Albrecht Giese, James Gilson, Douglas Gough, John Gowar, James Hamilton, George Herbig, John Huchra, Robert Hutchison, George Isaak, Carole Jordan, George Kalmus, Al Kelly, Roy Nelson, Bernard Pagel, Brian Ralph, Peter Rowlands, Sara Russell, Andrew Sinclair, Virginia Trimble, Mogens Wegener, Denis Whitehead, Cynthia Whitney, Iwan Williams and Arnold Wolfendale are all gratefully acknowledged.

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