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Implications and evidence of a particle-tied aether: steps towards a deeper foundation for physics and relativity

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1. Introduction

This contribution is primarily about the transmission of transverse electromagnetic (TEM) waves, our principal source of physical information. The Michelson-Morley experimental result *[1* of 1887, that the earth's orbital velocity has no effect upon the propagation of light at the earth's surface, led to final abandonment of the notion of an universal reference frame based on an independent, fixed aether. Its replacement, the Relativity Principle of Poincaré-Lorentz *[2* *[3*, embodying the Lorentz transformations with their ingenious reciprocity, sought to permit the interrelation of events in different frames of reference. An essential component of the transformations was the use of light as the messenger, whose velocity ***c*** was seen to be the maximum attainable in any given reference frame.

From there it seemed but a short step for Einstein in 1905 to postulate *[4* universal immutability of the value of ***c***, thus securing the one-step interrelation of events in widely separated frames. The price of this simplification was the total exclusion of an aether which might modify the message along the way. My purpose here is to show that while, in many cases, such simplified relativity is fully justified, there are also many others in which observations betray the action of an aether, particularly of one that is in random motion, a matter that has escaped previous study. Not surprisingly, a majority of these cases are in the astrophysical realm, where the distances allow the build-up of transmission effects.

To encompass these, the relativity principle, that nothing can exceed the *local* velocity of TEM waves, will be firmly retained but regarded as only strictly applicable at the smallest scale of physical nature - that of the local aether.

Another aspect of Relativity is that, as its name implies, it seeks to describe the relationships between entities in various circumstances but it doesn't illuminate the nature of those entities, a gap which quantum electrodynamics and particle physics endeavour to fill.

Further, there is now a considerable body of phenomena, mainly but not exclusively astrophysical in character, that does not fit comfortably within the current framework of physics.

In an effort to help with these matters a continuum (aether) theory (CT) of physical nature will be outlined, in which fundamental particles are special, rather (but finitely) concentrated, rotational forms of disturbance of the continuum. Particle random motions thus imply random motion of the aether (the older spelling is preferred on grounds of priority) and this affects the propagation of TEM waves by it. Under this proposal particles are "made of" aether and the Michelson-Morley result is satisfied.

Although conceived independently, this picture bears some similarity to earlier ones. Maxwell *[5* seems to have regarded particles as mere modifications of the aether. Larmor *[6* regarded electrons as nuclei of aether rotational (static) strain, but later came to visualize them as perfect-fluid rotational "nuclei of beknottedness in some way" *[7*, with an external influence indefinitely co-extensive with that of others. Milner *[8* regarded aether as a "fundamental substratum of matter from which we can imagine particles are formed".

It will emerge as we proceed that, to a remarkable extent, phenomena widely regarded as specific attributes, and "proof", of the Theory of Relativity, become equally accountable in the new context (CT), even to the extent of involving an indistinguishable parametric formulation.

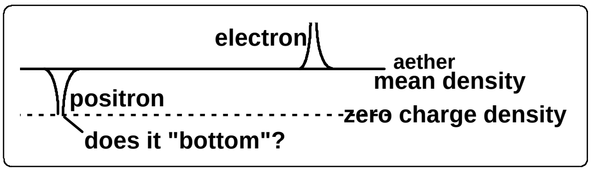
Following further description of the proposed basis for CT, successive parts of the paper deal with CT/Relativity comparisons for various phenomena, theoretical treatments of various phenomena specific to CT, and the large body of evidence for those phenomena. A final part additionally draws briefly upon aspects of gravitation and inertia to suggest a consistent model for quasars.

2. A basis for CT.

2.1 Nature of the aether. Aether is seen as an all-pervading compressible superfluid of electric charge whose compressibility derives from the mutual repulsion of its constituent charge. Thus spatial differences in aether density (however caused), represent spatial differences in electric charge density, and set up aether pressure differences that always attempt to smooth them out. To transmit transverse, or shear, waves appeal is made to the electromagnetic field induced in the surrounding aether by the transverse displacement of aether, i.e. electric charge, associated with the E-vector of the wave. This electromagnetic field stores the energy with which to restore the displaced aether as the E-vector falls, thus providing by dynamic means the required elasticity in shear despite the superfluid nature of aether. Similarly, the magnetic linkage ensures that no macroscopic shear displacement of aether can be irrotational in its effect.

The continuum nature of the aether ensures that there can be no discontinuities or point singularities within it. To provide particles with (relative) charge, their dynamical configuration is proposed to incorporate a concentration or a depletion of aether (charge) density. If, for example, the aether is a continuum of negative charge, the cores of electrons and positrons contain similar concentrations and depletions (respectively) of aether. The cores of electrons and positrons contain the highest charge densities known. Based on electron-positron scattering experiments, their charge of ± 1.6 x 10^{-19} coulombs is contained within a volume 10^{-16} cm across, and possibly much less (G.E. Kalmus, pers. comms. 1991, 1996). Assuming, conservatively, that this "size" is spherical, the spatial charge density in them is thus at least as great as ± 3.1 x 10^{29} coulombs/cm³.

If, say, aether is a continuum of <u>negative</u> charge and its density is not to go "below zero" in the core of a positron, aether mean (i.e. unmodulated) charge density "outside" must be equal to or greater than this. Schematically:-



This huge density implies that huge forces are potentially available, given the means to set up spatial differences in aether density. Conversely, it implies that almost all directly observable phenomena involve only extremely small modulation of the aether density. The aether density affects the quantity sometimes known as "the dielectric constant of free space", a rise in which increases ***c*** in Maxwell's equations. Thus the random modulation of aether local density, associated with random motions of particles, may be expected to give rise to a low level of random TEM radiation.

The aether provides a vehicle for the "dielectric displacement current *in vacuo*" of Maxwell, which has hitherto been lacking. Consequently, when a vacuum-dielectric capacitor is charged, this sets up a charge density gradient in the intervening aether, by moving aether away from one plate and towards the other, the associated aether displacement being measured as the charging current. In view of the huge charge density of the aether just inferred the proportionate change in its density, available by this means using man-made potential differences, will be extremely small. It is worth noting, however, that in principle, *via* the expected effect of aether charge density upon the value of ***c****,* it might be possible not merely to check the theory proposed here but actually to derive a figure for aether charge density. To do this one would need to compare the light transmission velocities adjacent to the positive and negative plates.

Although the details fall outside the scope of the present paper, it is further proposed that the aether dynamical configuration of a particle is what enables it to generate the gravitational force which is evidence of its particular mass. Thus aether does not possess the mass property *per se*, so its motions do not suffer from inertial effects, such as centrifugal forces, which would make the rotational configurations fly apart. Further, being a superfluid, its motions are lossless and capable of being perpetual.

This scheme for the origin of mass ("rest-mass" in current parlance) escapes a persistent difficulty encountered by the mass-bearing elastic-solid aether theories of the 19th century, that of its resulting inertia.

Three important properties of this setup are: (a) the widely observed production of particle-antiparticle pairs is made very easy, (b) the influence of the random motions of charged particles upon the r.m.s. velocity of the aether around them is immensely greater than the influence of corresponding neutral particles, so the TEM-wave transmission effects to be discussed will be much enhanced in ionized media and (c) a mass-possessing particle requires a finite volume in order to exist; this offers a limit to the extent to which matter can be compressed. Big Bang cosmology is based on the lack of such a perceived limit, so the avoidance of a Big Bang becomes an important requisite of the proposed theory.

<u>2.2 Mass, energy, photons and mass-variation.</u> The famous equivalence of mass and energy, $\boldsymbol{E = mc^2}$ (attributed to Einstein but actually first inferred by Poincaré ***<u>[9</u>***) is in principle incorporated into the present proposals but in a restricted form. The idea that aether motions within a particle, clearly a form of energy, is a measure of the mass of the particle directly implies that equivalence.

The notion that <u>all forms of energy</u>, however, and notably TEM-wave energy, can be expressed as, and can behave as, a mass is expressly excluded here. The phenomena of light pressure and emission recoil are **<u>not</u>** exclusive evidence of such mass, both being accountable within Maxwell's TEM-wave theory ***<u>[10</u>*** ***<u>[11</u>***, although in the case of the emission recoil of fundamental particles, it requires that they must have finite spatial extent, as already envisaged above, and as the avoidance of infinite self-energies already demands. Accordingly, TEM waves no longer have a wave/particle duality, so I propose that the quantized results of their interaction with matter are to be seen as dictated entirely by the operation of dynamic (e.g. orbital) stability criteria in source or receiver which inhibit either from persisting in an intermediate energy state. For this reason it is convenient here to distinguish between "photons" (discrete entities of TEM-wave energy in transit) and "quanta" (energy emitted, transferred, or absorbed in well-defined amounts in consequence of the characteristic stability levels of the material sytem involved). Planck's original derivation of his black-body radiation law was done without appeal to photons ***[12***.

If, as proposed above, TEM-wave energy does not exist as mass-bearing photons, the gravitational redshift of General Relativity (GR) becomes inapplicable. We shall return to this presently.

Concealed aether energy. The foregoing line of argument means that the aether displays to us the presence of energy in the forms of rest-mass-bearing particles and their motions, TEM waves and neutrinos (possibly these are rotational forms not configured to provide any gravitational force). Other kinds of aether motion, random translation in particular, must surely be present and represent a vast energy resource within the universe, of which we are largely unaware. Such random motion may be the seat of evidence for "zero-point energy", implying non-zero physical activity at zero Kelvin, e.g.***[13***. Similar considerations may also provide an explanation of the "spotty" emission of electrons in the weak-illumination photoelectric effect, long thought to require photons, that is consistent with the scheme proposed here. The line here would be that the presence of subliminal, random-intensity TEM-wave energy provides atoms in the photo-surface with an unobservable time-integrated excitation that only achieves electron-emission level at scattered points in the surface.

This suggests that the principle of the conservation of energy, one of the totems of physics, may require yet further stretching to allow for unobserved energy, a process already begun in order to accommodate neutrinos.

Relativistic mass increase and the mechanism of gravitation. Although, as already mentioned, gravitation is not the main concern of this paper, it is hoped that the foundations to be studied herein may prove fertile in the investigation of gravitation. If the Relativity concept of the unlimited variation of mass of particles in transit as a result of high velocity could be abandoned it would at last open up the possibility of "designing" a particle to develop its rest-mass quota of gravitational force. The notion of unlimited variability, dependent not upon the particle but upon its relationship to an altogether independent observer, has hitherto made such a line of inquiry futile.

This is potentially such an important matter that I will outline the reasoning. An increasingly large amount of electromagnetic effort has to be put into accelerating charged particles by small amounts as velocity $\boldsymbol{c}$ is approached. Under Relativity this effort is regarded as having increased the particle mass (and therefore its kinetic energy) on the $\boldsymbol{E} = \boldsymbol{mc^2}$ basis, though the apparatus is always so inefficient that no-one has ever shown that the apparatus actually lost that amount of energy to the particle. Nevertheless it is very precisely established that the electromagnetic deflectability of high-velocity particles is consistent with such an enhanced mass. Conversely, it is well established that particles travelling at such velocities have the ability to penetrate much further into other particles, or structures of particles, than would be expected for particles whose kinetic energy was a normal square-law function of their velocity.

The Relativistic mathematical treatment that lies behind this interpretation (e.g. ***[14***) finds that the accelerating force on the particle increases with velocity according to the factor $(1 - \boldsymbol{v^2/c^2})^{-½}$. This result seems to overlook, or to apply incorrectly, that the process of acceleration or of deflection involves the interaction, at high relative velocity, between the electromagnetic fields of the charged particle and the apparatus. In many cases the particle is accelerated within the apparatus by, in effect, chasing the particle with an appropriately slowed electromagnetic wave. In any comparable dynamical process, e.g. someone pushing a motor-car to get its engine started, the push force available decreases as the terminal velocity of the pusher is approached.

The phenomenon of Çerenkov radiation, much used for measuring particle speeds, is the shockwave-like generation of a cone of radiation whose included angle is a direct measure of $\boldsymbol{v}m/\boldsymbol{c}$ when a charged particle having velocity $\boldsymbol{v}$ (> $\boldsymbol{c}/m$) is fired into a medium of refractive index m. This shows that the electric field of the particle can only be superimposed on the field structure of the medium at velocity $\boldsymbol{c}/m$.

Because of this limitation on the speed of interaction between a moving particle and its environment, efforts to accelerate, decelerate or de- flect it must be greatly weakened as the particle speed approaches $\boldsymbol{c}$ relative to its environment. It appears that this consideration must apply in any theory that accepts that electromagnetic fields are propagated with finite speed, and would mean that the apparent increase in mass with velocity cannot be real. Such a conclusion would obviously have wide repercussions on the mass-energy scale derived for particles.

3. CT/Relativity comparisons.

3.1 Stellar aberration. The classical velocity triangle treatment of Bradley leads to an aberration angle $\tan^{-1}\boldsymbol{v/c}$, and the Special Relativity formulation is $\sin^{-1}\boldsymbol{v/c}$ (to prevent any vector exceeding $\boldsymbol{c}$), where $\boldsymbol{v}$ is the transverse velocity of the observer relative to the source. At the small angle (20.6 arcsec) produced by the Earth's 30 km/s orbital velocity it is not practical to distinguish between these formulations (10^{-7} arcsec difference).

The classical treatment was criticized by Lorentz ***[15*** on the grounds that the transverse velocity is an irrotational displacement which cannot rotate the light propagation vector. That criticism is valid if the medium has no linkage in shear, as is the case for sound waves in a particulate gas but, as mentioned earlier, is escaped if the medium is a continuum with internal electromagnetic linkage. Relativity, on the other hand, does not illuminate how the deflection occurs, in that it never concerns itself with details of the physical mechanisms whereby its transformations, of which this is one, are supposed to occur.

This CT treatment of aberration means that the light-wave transit time between source and receiver is not affected by the vector addition of a transverse velocity because the resultant velocity of transmission, relative to the observer, is then greater than ***c***, although at no point is it greater than ***c*** relative to the local aether through which and by which it is being propagated. The importance of this point will emerge shortly.

Since Special Relativity is only concerned with the relative velocity of source and observer a simple view is that it leads one to expect that similar aberration should be observed in the case of the transverse velocity of a distant orbiting binary star. Notwithstanding that such orbital velocities range up to nearly 10 times that of the earth, no aberration is observed, as is well known. A number of rather forced, supposedly Relativity-based, explanations for this have been put forward, but my concern here is to show that CT provides a simple explanation. This is given in Appendix A and shows that the essential ingredient is that the longitudinal gradient of transverse velocity in the aether, responsible for aberration, occurs near the other end of the sight-line, between the binary system and the interstellar environment. That distinction is not available in the current form of Relativity.

3.2 "Transverse Doppler effect"/AR redshift. In Relativity, aberration is accompanied by a redshift, the so-called "transverse Doppler effect", measured by the ratio of the hypotenuse to the longer side in the corresponding velocity triangle. In CT, the enhanced resultant velocity of transmission, without change of transit time, pointed out above, implies a stretching of the wave train to a degree represented by the extra length of the hypotenuse of the CT version of the triangle and is in practice (i.e. to the first order of terms in v^2/c^2) indistinguishable from the Relativistic value. For CT purposes this redshift is here renamed the "aberration-related" (AR) redshift. The mechanism of this redshift is an embryo form of the cumulative one to be discussed later for various astronomical redshifts.

Observations confirming the "transverse Doppler effect" ***[16*** ,***[17***, hitherto regarded as important and distinctive support for Relativity, is thus equally valid support for AR redshift in CT.

3.3 Ives and Stillwell (1941). For Relativists this citation signifies I&S's above-cited observation of the transverse Doppler effect of Relativity, a theory which they therefore espoused. What I&S did not mention, nor has anyone else that I can trace, is that only 4 months earlier ***[18*** they had published beautiful results and rigorous calculations relating to moving interference patterns they had 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 expected and 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 to deny that the waves can, along part of their path, travel with a resultant velocity faster than ***c*** relative to the observer. Evidently, by restoring the local aether as the reference frame for the propagation of change all the phenomena currently attributed to Special Relativity effects become equally explicable.

3.4 Gravitational redshift of GR. As will be discussed later, the gravitational redshift prediction of GR is essentially unsupported by astronomical observation. That is consistent with the proposed abandonment of the idea of photons with an equivalent mass. But it raises questions about the terrestrial experiments that have seemingly verified, rather precisely, the existence of the redshift using the Mössbauer effect in ^{57}Fe and ^{57}Co, e.g. ***[19***. The method exploits the extremely narrow bandwidth of the 14keV 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. The 1963 experiments showed a similar effect to occur if centrifugal acceleration was substituted for gravitational.

At that time I wrote to a well-known journal to point out that the gamma wavelength involved is comparable with the nucleus-to-K-electron-shell distance and that this cavity might provide resonance responsible for the narrow emission and absorption bandwidth (rather than the current interpretation that it is due to exceptionally small nuclear recoil upon emission). In that case, since the support of the nucleus in any acceleration field would be bound to render the nucleus eccentric within the electron shells and make the "upward cavity" larger and the downward one smaller, with corresponding effects on the resonance wavelengths. The effect upon the gamma rays would thus be one of modification in the processes of emission and absorption, and not the in-transit modification implied by GR.

My letter was rejected by a referee for the reason that "there is no place in atomic theory for an eccentric nucleus". My reaction then, as now, is that there certainly should be! 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 requires the constancy of atomic properties under acceleration to a far higher precision than has probably been needed for (electron-related) spectral calculation hitherto. If it were found that some such effect is to be anticipated, big enough measurably to affect the result, then the GR interpretation would be vulnerable by reason of the close match with observation.

3.5 Brightness distribution of the daylight sky. Though not strictly a Relativity matter this is included here for convenience. Comprehensive measurements ***[20***, required for the development of airborne astro-navigation, showed that at heights of 5-12 km the sky brightness distribution could not be explained by a Rayleigh scattering theory, even when modified for the effects of ground reflection, dust and haze. The most notable discrepancies between the modified Rayleigh theories ***[21*** (developed for lower heights) and observation are the unpredicted large increases in intensity, both as the sight line approaches the direction of the Sun and as it approaches the anti-solar point. The latter effect appears, when the Sun's altitude decreases below 40^0, as an upward bulge of the isophotes from a horizon-parallel disposition. Also the observed intensity, even at right angles to the Sun, is generally greater than can be attributed to a plausibly impure atmosphere. These discrepancies seem to increase with the height at which the observations are made, which is not to be expected if airborne impurities are the cause.

The discrepancies were the motivation that, in the course of industrial employment in the late 1950s, enabled me to make substantial (unpublished) progress with this matter. This used an embryonic form of the present proposals, in which it was assumed that random motions of the aether, induced by the atmospheric molecular motions, produced deflection scattering of the sunlight propagation direction. This is one of the CT transmission effects discussed below.

4. TEM-wave transmission by a particle-tied aether

Under the new proposals, effects upon TEM waves will arise from three sources:

(i) random aether velocities, both transverse to and along the direction of propagation;

(ii) systematic aether velocities, both transverse to and along the direction of propagation;

(iii) variations in the density of the aether, both regional and local random.

The treatment is directed at gaseous media whose particle velocities obey Maxwell-Boltzmann statistics but could easily be modified to relate to other media (e.g. electron gas) with other velocity laws.

Table 1 (after the references list) summarizes these effects and the predicted and observed examples of them to be discussed in Section 5.

4.1 Random aether velocities. Treatments for the effects of these are given in Appendix B (random transverse velocities), Appendix C (random longitudinal velocities) and Appendix D (random transverse velocity deflection scattering). These show that the transverse components result in a redshift that is proportional to distance travelled in the gas and here called "RTV redshift". The longitudinal components, on a similar basis, result in spectral dispersion, or line broadening, here named "RLV line broadening", whose variance likewise increases in proportion to distance travelled, so the r.m.s. line width increases as the square root of distance travelled.

In both cases the growth is compound so results in exponential growth with distance when the proportionate effect becomes substantial. The treatments assume that random aether velocities (relative to the mean of the neighbouring aether) are low compared with ***c***. Higher velocities would require inclusion of higher terms in the binomial expansion (Appendix B), resulting in disproportionately faster accumulation of these effects with distance.

RTV deflection scattering and RTV redshift are randomly repeated micro-versions, respectively, of aberration and aberration-related (AR) redshift discussed above (Sect. 3.1 & 3.2).

All three effects vary with changes in gas condition according to the same scaling law, namely ***Tp*/m** (absolute temperature, mean particle separation, particle mass). This scaling law is insufficient if the character of the gas particles also changes, e.g. from neutral atoms to ions, because the influence of a charged particle upon the aether around it will obviously be very much greater.

The question arises "How particle-tied is the aether?" In other words, how far from each particle does its motion contribute to the aether motion? If that influence extends very much further than the mean interparticle distance, the magnitude of the aether random motion at any point exterior to a particle (reasonably the most important since, in standard air, for example, the interparticle distance is several hundred times the molecule dimensions) will, due to the overlapping effects of many particles, be a very much smoothed representation of the individual particle velocity distribution. This question has not yet been tackled theoretically but evidence, given later, suggests that this smoothing can indeed be very great. Therefore the term "particle-tied" embodied in the title of this paper needs to be seen in this light.

4.2 Systematic aether velocities. Stellar aberration, already discussed, is an important example of systematic transverse motion. On a CT basis this doesn't affect the light transit time (Sect. 3.1). On a small scale, the process of charging a capacitor (Sect. 2.1) involves the systematic displacement of aether. On a very large scale, if light from a star, travelling at ***c*** through the interstellar medium, enters a region with systematic velocity towards or away from the observer, transmission time will be affected, but in no circumstance can the arrival velocity at the observer be affected by this. That arrival velocity is always governed by the observer's intimate environment.

4.3 Variations in aether density. As mentioned in Section 2.1, Maxwell's equations provide that the value of ***c*** is affected. However, the framework of CT put forward in the present paper provides no major causes of systematic variation of aether density.

Random motion of the aether, on the other hand, inescapably implies random variation of its density, though we may suppose the proportionate variation due to this cause to be extremely small. Nevertheless, it does imply that the transmission of TEM waves is made a non-linear process by the combination of aether velocity variation and aether density variation. This non-linearity makes it a modulation process that may be expected to result in production of TEM-wave components at the modulation frequency.

Thus, on one hand, this should give rise to black-body-like radiation within the gas but, on the other, where the particle velocity spectrum departs strongly from local thermodynamic equilibrium (LTE), as in stellar coronae, the generated TEM-wave components will differ accord- ingly.

5. Observational support for CT.

See also Table 1 (preceding the Appendices).

5.1 Previous proposals on redshifts. Redshifts have long been a matter of much astrophysical attention and CT, like many other proposals before it, seeks to avoid, in some cases at least, the awkward aspects of Doppler or GR gravitational interpretation, hitherto the only accepted mechanisms available. A review of these other proposals individually is not possible here but certain generalities about them, to contrast with CT, may be useful.

The redshifts principally at issue have been the solar redshift, the stellar K-effect and the cosmic redshift, to all of which we shall return presently. Without exception, I think, the proposals have all embraced the photon concept. "Tired-light" proposals for these, and the cosmic redshift in particular, range from photon collisions of various kinds to deflections by the gravitational fields of galaxies en route, the loss of photon energy being equated to the increase in wavelength. (In CT the wavelength increase is due to an unambiguous direct stretching action.) All of these appear to suffer from requiring unrealistically large collision cross-sections and a much smaller number of individual actions than CT provides. Their resulting coarseness of scattering, a topic neglected by many, makes it difficult to explain why astronomical optical imagery is so excellent.

The famous proposal of Freundlich ***[22*** may be singled out here because of the influential comments it provoked ***[23***. He drew attention to the large amount of redshift evidence to be explained. To encompass all three (cosmic, K-effect, solar) forms of redshift he proposed a ($dl/l \propto \boldsymbol{T}^4$ x path-length) relation, the fourth power of ***T*** being related to the Stefan-Boltzmann law for the radiation intensity, but conveniently necessary to compensate for the short path-length in stellar atmospheres. In CT we shall seek to accomplish this, despite an only linear dependence upon temperature, by recognizing the greatly enhanced effect of charged particles upon aether random motion. Of historical interest is that Freundlich used his redshift law to infer an intergalactic temperature in the range 1.9 - 6.0K.

Among the comments ***[23***, ter Haar agreed the data were significant but disliked the large cross-sections required by Freundlich's photon collision hypothesis, and McCrea pointed to large but unobserved amounts of radio-wave energy expected from the reductions in primary photon energy. These criticisms cannot arise in CT. McCrea also calculated that, on Freundlich's proposed law, light from the remoter component of an eclipsing binary would, on grazing through the atmosphere of the near component just before eclipse, be subject to a very large but unobserved redshift. Not only, however, had Freundlich neglected to consider and draw attention to the scattering attenuation to be associated with large redshifting, but also, in fact, a substantial (e.g. +45km/sec) redshift excursion at this phase of some eclipsing binaries is indeed observed e.g.***[24*** . Gas streaming from one component to the other, often offered in explanation for this kind of thing, would suggest a matching, but not observed, violet shift when the system is the other way round.

One of the strengths of CT is that it predicts several co-ordinated effects. Not only does this enable the presence of CT-related effects to be studied in a wider range of situations but it also provides greatly reinforced support for CT when two or more such effects are seen together.

5.2 Non-astronomical observations.

RTV redshift. It appears that, unrecognized by them or by their readers, Sadeh et al. (1968) *[25* , from the US Naval Laboratory, Washington, D.C., observed this redshift using caesium clocks and radio waves over ground-level paths. They took five caesium clocks from Washington. They left two at Cape Fear, N. Carolina, their ticks being coupled to a radio transmitter. The other three were put on a truck, sited for one week at successive sites along a northeasterly path up to 1500km from C. Fear, and their ticks compared with those received by ground wave from C. Fear. The clocks were intercompared at each site, to check for stability, and with the US master clock upon return to Washington. It was found that the received tick rate at the truck was progressively and linearly slower than the truck clocks, the greater the distance. Comparison between C. Fear and Washington, a northwesterly path, provided a result closely fitting the relationship. Observation using a 1000km southwesterly path to Jacksonville, Florida, provided a steeper effect but with more daily variability in the received tick rate.

Omitting the latter point, I obtain from their results a redshift rate (dl/l), in ground-level air, of

$$R_{air} = +1.75 \times 10^{-20} \text{ per cm.}$$

with an uncertainty of ± <25%. In Doppler-equivalent terms this is about 5×10^{-7}km/s/1000km. Neither temperatures nor times of year were mentioned. Sadeh et al. tried to explain their results as an effect of mass but their reasoning is very obscure.

To develop the foregoing result it is instructive to get some measure of the degree to which the particle motions are reflected in the r.m.s. aether velocity from which the observed redshift arises.

Let us consider, for this purpose, the redshift that would arise if the aether velocity were to change by a (the most probable particle velocity of the gas) every distance along the light ray path equal to the mean gas particle separation ($\underline{x}$) This represents an ideal maximum standard.

For the foregoing air redshift observations, taking the parameters for air as 290K and mean molecular weight 29, the mean particle separation at standard pressure is $\underline{x} = 3.4 \times 10^{-7}$ cm. Also $a = \sqrt{2kTm^{-1}} = 4.1 \times 10^4$ cm.s^{-1}. (k = Boltzmann's Constant).

Now the redshift per influence cell (App. B) is $a^2 t_x^2/6$, where a = gradient of transverse velocity across the cell and t_x = time taken to traverse the cell. Therefore in the present case

$$\frac{\delta\lambda}{\lambda} \text{ per cell} = \tfrac{1}{6} a^2 t_x^2 = \tfrac{1}{6}(a/\underline{x})^2.(\underline{x}/c)^2 = \tfrac{1}{6} a^2/c^2$$

and $R = \frac{\delta\lambda}{\lambda}$ per cm = $a^2/6c^2\underline{x}^2$ = $\underline{9.3 \times 10^{-7}}$ $\underline{\text{cm}^{-1}}$ which is **5.3×10^{13} times bigger than the observed value for air.**

This reduction factor for air, or 'RTV redshifting inefficiency' factor, shows how low is the aether random velocity compared with the particle random velocity in what one may assume to be a substantially non-ionized gas. Since our ideal standard crudely approximates what would happen if each particle fully modulated the aether density and velocity in its immediate vicinity this ratio gives some idea of the increased redshifting rate that would then occur. It is not yet clear whether such an increase would be fully attained in fully ionized media or an electron gas.

RLV line broadening. In Britain in 1958 two early experiments in plasma containment for thermo-nuclear fusion, named ZETA and SCEPTRE III, encountered observational conflicts as to the temperature attained *[26*. Spectral line widths of O^{V} and N^{IV} used for temperature observation were, in both cases, inferred to show that ~5MK had been attained. But this conflicted with four other forms of observation. Not nearly enough energy had been put in; the electrical conductivity and He^{I} ionization suggested no more than 0.25MK; the neutron output was found not to be isotropic, so that few of them could have had a thermal origin.

Spitzer *[27* became interested but could find no clear solution, commenting that the matter could be "of great interest in basic physics". I have not followed these matters subsequently but this appears to be a clear case of RLV line broadening along the sightline in the plasma, giving a greatly excessive indication of temperature.

5.3 Cosmic redshift. The measured redshift parameter for ground-level air (see the preceding Section) enables us to use the scaling factor ***Tp/m*** to predict a value for the Hubble "constant". For this purpose I take the temperature of the intergalactic medium to be T_{igm}= 2.75K, the

same as that of the cosmic microwave background (CMB). A justification for this is offered in Section 6. I assume the gas to be neutral atom hydrogen ($m = 1$) but, for the sake of comparability with air, ionized to the same small (but unknown) extent as the air in the Sadeh et al. measurements. Initially, I take the density of the intergalactic medium as ρ_{igm} = 10^{-28} g.cm^{-3}.

These values lead to an intergalactic particle number density of 6 x 10^{-5} cm^{-3}, and together with those assumed earlier for air, lead directly to a value

$$R_{igm} = 6.4 \times 10^{-29}\ cm^{-1} = 2 \times 10^{-4}\ Mpc^{-1}$$

giving a predicted Hubble "constant"

$$H_P = c.R_{igm} = 59.6\ km.s^{-1}.Mpc^{-1}.$$

While this value is well within the observed range, the intergalactic density employed to obtain it is probably much too big and needs further discussion to set the value in perspective.

First, however, note that this prediction would only apply to relatively small redshifts because of the exponential build-up of RTV redshift. Taking the above value as applicable to 1 Mpc (giving $z = d\lambda/\lambda_0$ = 0.0002) we find that, at 6000 Mpc (~20Ga light time), z has risen to ~2.3 and H_P *to* 114 km/s/Mpc. Under a Doppler-effect interpretation this would give the impression that expansion rates have decreased with time, a feature that is sought in all big-bang cosmologies in that the gravitational effect of the universe will have this effect.

On the other hand, the increased RTV scattering attenuation associated with increased RTV redshift will increase the distances estimated on an inverse square-law basis and make the redshift law seem more linear. Within the current Doppler interpretation of the cosmic redshift, however, allowance is made for recessional reduction of luminosity, which will crudely offset the scattering allowance in CT. So a direct comparison with Doppler-derived values of H could show the non-linearity predicted by CT. Note that if m_{igm}= 2 (molecular H_2) the value of ρ_{igm} to obtain the same results rises to 4 x 10^{-28} g/cm^{-3}.

For an expanding universe (not appropriate, of course, if the present proposals are right) there is a critical mean density $\rho_{crit} = 3H_0/8\pi G$ for which expansion will gradually reduce to zero, but not reverse. For H_0 = 60 km/s/Mpc, ρ_{crit} = 7.2 x 10^{-30} g/cm^3. It is generally recognized that this density is unrealistically high in the absence of CDM (cold, dark matter, which we no longer need for controlling expansion) and for inter-galactic space in particular.

Another perspective concerns formation of galaxy masses by gravitational condensation. The minimum initial volume is probably set by the Jeans initial radius $r_J = v_{sound}\ (G\rho)^{-½}$. Thus the formation of large initial masses requires very low densities, a problem with an expanding universe which began at high density. To achieve hydrogen condensations as big as the Galaxy is now (say 10^{11} M_{sun}) at 2.75K would require an initial density as low as 6 x 10^{-42} g/cm^{-3}. It seems likely, however, that galaxies grow greatly in mass during their evolution, partly by amalgamation and partly by accretion of smaller condensations (e.g. globular clusters) formed in the increased-density surroundings of the primary condensation. Allowance for a 30-fold growth in mass would permit a 1000-fold increase in initial density.

The enormously greater effect of charged particles upon aether motion (Sect. 5.2) suggests that moderate ionization would ensure that the 60 km/s/Mpc value of H_P could still be achieved down at least to 10^{-38} g/cm^3, thus meeting the above requirements for early condensation of primary galactic masses.

At this density, gravitational collapse of the universe, which is not observed, would require (Jeans criterion) more than 50 Ga to get started.

5.4 Intrinsic redshifts of galaxies. The light from galaxies comes from the stars within them and must pass outward to us through the gas that surrounds them, so may be expected to experience RTV redshift in so doing. The rapid evolution rates of the characteristically blue O and B stars makes their presence a good indicator of the presence of abundant hot gas from which they are forming. Clots of blue stars in galaxies decrease in relative abundance in the direction Sc-Sa-E in the sequence of galactic forms, with the ellipticals containing hardly any.

Holmberg's analysis ***[28*** of 76 bright galaxies in the Virgo cluster (our nearest) yielded mean Doppler-equivalent redshifts in km/s for different forms as follows:- E-S0 (41 galaxies) 1002 ± 61; Sa-Sb (21) 1276 ± 108; Sc (14) 1669 ± 137. My own further splitting of the E-S0 group gives: E (23) 990; S0 (18) 1017. This correlation strongly suggests the presence of intrinsic (as opposed to intergalactic/cosmic) RTV redshift. Taking (arbitrarily) the mean intrinsic RTV redshift of these Virgo ellipticals as 50km/s, leaving a cosmic contribution of 940km/s, the mean intrinsic component for the Sc's becomes 1669 - 940 = 729km/s, with a maximum, for individuals, possibly at least 750km/s.

Using the virial theorem, de Vaucouleurs ***[29*** found it impossible to reconcile the observed redshift scatter velocities with evident long-term stability of the Virgo cluster. In a further study ***[30*** it was concluded that systematic errors in the redshifts were not present enough to remove the correlation, which was therefore accepted as real. This problem has recurred subsequently for many other clusters of galaxies and has led to inferring the presence of huge amounts of CDM. Allowance for intrinsic redshifts on the lines inferred above for the Virgo cluster will greatly reduce the true velocity scatter and the need for CDM. A further way of reducing this need is mentioned in Section 6.

A related aspect of this is the finding ***[31*** that of 9 relatively near-by dominant galaxies with smaller companions, some of which appear structurally linked to the "parent", all except three of the 19 companions have redshifts bigger than the parent, by amounts up to the +234km/s for M81/M82. These companions often appear more youthful.

Although not strictly intrinsic to a particular galaxy, it has been reported that when the line of sight passes through rich clusters of galaxies the redshifts for those beyond are higher and "strongly support the existence of a dependence of redshift on the position of galaxies relative to concentration of matter, that is, clusters of galaxies" ***[32***. This could well be explained by extra RTV redshift along the sightline due to higher intergalactic temperature within the foreground cluster.

5.5 Solar phenomena.

Redshift. This was an important aspect of Freundlich's 1954 argument for a new kind of redshift. Twenty-four years earlier ***[33*** he had found that the absorption line redshift present over most of the disc was less than half the GR prediction of 0.636km/s (use of Doppler-equivalents avoids involving the wavelength) at the solar surface, but that in all directions this rose steeply in the outer 10% of the disc radius, apparently heading for a value in excess of the GR value at the limb itself. Extensive work by Adam and her colleagues ***[34*** ***[35*** has confirmed and elaborated this picture at wavelengths ranging from 4400-6270A. Outstanding is the large variation in redshift from line to line, even for closely similar wavelengths, thus ranging from 5-170% of the GR value near the centre of the disc. The only correlation for this variation is a strong one with line strength. Near the limb the redshift rises and at the limb can attain at least 120% of the GR value, with a further rise just beyond the limb, attributed to "chromospheric scattering".

A further feature, reported in the later investigations ***[35***, is that the lines are asymmetrical. Between the tip of the line and an absorption level of, say, 10%, where the profile joins the wings, the median of the absorption line inclines towards shorter wavelengths, an effect especially strong at extreme limb positions, where the median-line shift can attain 0.81km/s.

The GR interpretation can do nothing to explain the large line-to-line variation of redshift, because the possible range of gravitational potential (relative to the observer) within the photosphere is far too small. However, it can readily be explained by RTV redshift as representing variations in depth to the reversing level in the photosphere, with a corresponding variation in the path length for redshift build-up. If the redshift of the tip of the absorption line represents that maximum build-up, the smaller redshift of the median at smaller absorption is also explained. At the limb this median transition from peak to lower redshift usually crosses from above to below the GR prediction which would be difficult to accommodate theoretically if the GR shift were indeed present.

The limbward rise in redshift could be due to a longer build-up path length within the atmosphere at large values of the local zenith angle q of the emergent ray at the solar surface. It was for this reason that Freundlich had proposed a redshift relation involving *cosec* q.

A more precise analysis of this idea is warranted to discover how the thickness of the effective redshifting layer might need to vary across the disc in order to satisfy the redshift observations. If the thickness of the layer is bR_{sun} the path length through it is

$$x_q = R_{sun}\left[\{(1+b)^2 - \sin^2 q\}^{1/2} - \cos q\right]$$

If b = 0.01, $R_{sun}b$ = 6960 km. Assuming, purely for simplicity, that the redshifting properties of the photosphere do not change within the relevant depth range, it appears that the layer thickness should depart from constancy at a zenith angle of about 45º, decreasing in radial thickness to less than 20% of its former value as the limb is approached. This shallowing of the layer at high zenith angles is consistent with the need for the longer path to be at higher altitudes where the absorption is less intense. By appropriate choice of the zenith angle at which the layer begins to shallow it is even possible to reproduce the slight dip in redshift seen at this position in many of the traces of redshift across the disc.

A crude estimate of the redshifting capability of this layer is instructive. If the middle-of-disc thickness is arbitrarily set at $0.02R_{sun}$ and its temperature and particle density, taken from Allen ***[36*** for the upper photosphere, are assumed I find that the redshifting efficiency of the layer must be more than 100 times greater than simple extrapolation from the value for low-ionization air (Sect. 5.2) would give. This is broadly consistent with the CT expectation that ionized media will be much more effective redshifters, but the ratio obviously needs further refinement.

Under CT an extension of the solar redshift is expected for TEM waves from an external source that have traversed the inner corona. This could explain the further rise in redshift, just beyond the limb, mentioned above. More convincingly, this effect appears to have been observed in the 2.292 GHz carrier signal from Pioneer 6 when it passed behind the sun ***[37***. The frequency decreased progressively and symmetrically on either side of the sun, as the sightline neared the sun, the total amount being 11±0.4m/s Doppler-equivalent between 9.5 and $3.0R_{sun}$, where the signal was lost. It is clearly desirable to repeat this experiment with a sightline getting close to the sun's limb, to see if there is continuity with the solar disc redshift.

Solar light-deflection. The GR-predicted value of the light deflection in the gravitational field of the sun has been observed very thoroughly both by VLBI methods [38 and by measurement of the time delay upon a signal, to be expected as a result of the deflection [39.

Note that in the latter case the proportionate delay is several orders of magnitude smaller than the proportionate redshift already observed with Pioneer 6, a fact which has made people disbelieve the Pioneer result. This apparent discrepancy is readily explained in CT by the fact, already pointed out, that the the RTV redshift process does not affect the transit time, because the random transverse deflections increase the total path length but increase the local resultant velocity by the same amount.

The apparent confirmation of GR in this case is the only one in which CT, as presented in this paper, currently offers no alternative. Note, however, that under CT aether density affects the value of ***c***, so if gravitation were to affect aether density a curved TEM-wave transmission path would result. A verdict should await an extension of CT to include gravitation.

A predicted CT-specific light deflection. Under an earlier heading of systematic aether velocities (Sect. 4.2), I mentioned that transmission times would be affected. A variant of this recognizes that if a wave train enters a region of distinct along-sightline velocity relative to an observer this is equivalent to entering a region of different refractive index. TEM waves from a source beyond the sun will encounter the rotating corona. At the west side the rotation may be carrying the aether with it towards the source; on the east side, away from the source. This will endow the corona (apart from any intrinsic refractive index its gas may have) with a refractive index of $(1 + v/c)$ on the west side, and $(1 - v/c)$ on the east side.

The effect can be modelled as light passing through very large-angled prisms, parallel to the base, the included angle b of which is given by $\sin(b/2) = r/r_o$, where r is the radius (from the sun's axis) at the point of entry and r_o is the radius at which the ray passes the solar limb. It can then be shown that on **both** sides of the sun the source will undergo an apparent westerly deflection amounting to $2w_o r_o/c$ where w_o is the angular velocity at r_o . This yields a predicted westerly deflection at both equatorial limbs amounting to 2.74 arc sec, a result that is independent of the intrinsic coronal refractive index.

If an analysis of observations were "told" to look for the symmetrical radial prediction of GR, this effect would not be discovered. Significantly, therefore, for the 1952 eclipse, the reported overall result was one of westerly deflection, rather than radial [40 .

5.6 Stellar phenomena. The existence of a stellar-class-dependent excess redshift, referred to as the K-effect, or K-term, has been recognized for more than 50 years and was one of Freundlich's reasons [22 for proposing a new redshift mechanism in 1954. The K-term is large for Wolf-Rayet (W-R) stars and for O-stars, decreasing for A and F and reappearing as a small value for M-supergiants. On the basis of masses determined in other ways, the redshift is almost always well above what could be attributed to a GR redshift, but uncertianties about star-streaming effects [41 have enabled doubters to evade the idea of intrinsic stellar redshifts. Anyhow, when faced with the possible existence of a new process, statistical arguments of this sort carry less weight for, in princple, it only needs one well-proven example to prove the case.

Convincing support for intrinsic redshifts arises when there is a good reference object for velocity comparison. A good example is the apparent different recessions of the O and B stars relative to the Orion Nebula in which they are embedded [42. In the galactic cluster NGC 3293 Feast [43 found that radial velocities of recession, relative to interstellar lines, increased strongly with absolute magnitudes brighter than -4.5. Rubin [44 decided the K-term is a real effect for cepheids and O and B stars.

A much better velocity standard is available in the case of binary stars, for which the true (median) velocity of each member must be the same. Relativists have widely claimed that the redshift of the white dwarf Sirius B, the binary companion of Sirius A, exhibits the GR redshift. The sun, seen at stellar distance, would also appear to do so. In fact, Sirius B appears unique in this regard, most white dwarfs so far observed having masses some 20% too small to explain their redshifts on a GR basis [45. At the other end of the scale, it is now well established [46 that the extremely hot W-R stars, when found in binaries, exhibit excess redshifts of 100 - 200km/s, relative to their companions which themselves range in class from B1 to W-R. This means that the true intrinsic redshift of W-Rs is the sum of those of the W-R component and its companion, possibly taking the value to around 250km/s.

CT brings fresh light to bear on this problem because of the predicted RLV line broadening associated with RTV redshift. It has long been recognized (e.g. Struve [47) that O and B stars, in particular, exhibit line widths far in excess of that expected on the basis of other indications of temperature (colour, excitation levels). This excess has generally been attributed to rotational broadening, although some studies have favoured a contribution from atmospheric turbulence with a Maxwellian velocity distribution. On this basis Struve (loc. cit. p.130) derived equatorial velocities which showed a "startling decline at F5 [which] is unquestionably real". The problem of how to remove all this angular momentum has remained unresolved.

In the CT context the excess line width, with its similarly varying K-term redshift, suggests that there may be no need to invoke excess rotation at all, both being parts of the same process in deep hot atmospheres, which decline sharply at around F5.

6. Gravitation, inertia and quasars

6.1. Gravitation at velocity *c*. It is not generally appreciated that the well-known formula for perihelion advance

$$\frac{d\omega}{dt} = \frac{6\pi G M_{sun}}{Pac^2(1-e^2)}$$ (period, major axis, eccentricity in the denominator) was first derived by Gerber in 1898 ***[48***, on the assumption that gravity interacts at velocity ***c***, 17 years before Einstein ***[49*** incorporated the same formula into GR. In the case of Mercury, the prediction of the formula is well supported by observation ***[50***, but I propose here to adopt the 'gravity at velocity ***c***' interpretation. This facilitates theories of inertia based on Mach's Principle that inertia is the retarded-field action of "the rest of the universe", or, as Mach put it, "the fixed stars"***[51***. It has been shown ***[52*** that this set-up could, in principle, explain why the observed curves for rotational velocity *versus* radius remain flat out to as far as one can measure. This has hitherto been regarded as the third main reason for invoking lots of CDM. We have already discussed the other two; cosmic expansion and galaxy velocity dispersion in clusters.

6.2 A CT model for quasars.

The following features of quasars need to be explained.

Diminutive, star-like image size.

Very broad Lyman a emission line, redshifted (***z*** = *dl/l*) in the range <0.2 - 4.89 (the current maximum known).

Numerous (up to >100) Ly a absorption lines - the so-called "Lyman a forest" - extending along the shortward flank of the main Ly a emission (+ some related C^{IV} and N^{V} absorptions) ***[53***.

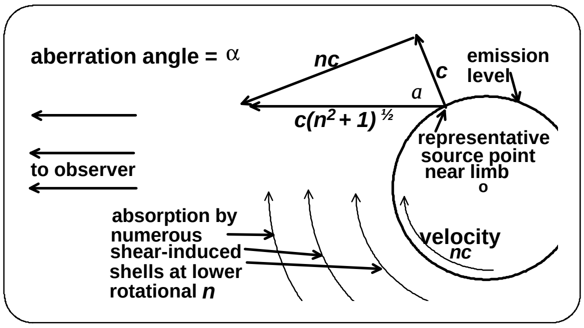
The ***z*** of the highest-***z*** members of the forest is often so close to the emission-***z*** and to one another that they cannot arise in physically separate clouds, an inference supported by the similarity of the absorption profiles ***[54***.

The numbers of forest lines increase much more than proportionately with ***z*** for ***z*** > 2 ***[55***.

Luminosity of **z** > 1 quasars is either uncorrelated with ***z [56*** or actually increases with **z *[57***, contrary to expectation if ***z*** were a measure of distance.

Much more frequent spatial (on the sky) association with galaxies of relatively low redshift than is statistically appropriate ***[58***, probably even allowing for image multiplication by gravitational lensing.

In this sketch of the proposed model the velocity triangle represents the condition at the source point, relative to external matter/aether that is not involved in the quasar system.



Features of the model are:-

1. Velocity-dependent inertia, the result of recognizing gravitational communication at velocity ***c***, drastically reduces centrifugal (but not central gravitational) force when rotational velocity approaches and surpasses ***c***. This is because the effective volume of the "rest of the universe" responsible for provision of inertia, becomes drastically reduced by retarded-field action. So *superluminal* surface velocities, due to gravitational shrinkage of high-angular momentum clouds, are possible.

2. Most of the redshift is intrinsic to the body, is of aberration-related (AR) type, and amounts to ***z*** = Ö**(n^2 + 1) - 1**. Neglecting the cosmic contribution, ***z*** = 4.89 requires ***n*** = 5.8 and a= 80.2°**.** So the highest-***z*** quasar could actually be 'on our doorstep'.

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

4. The "Lyman a forest", and the high-ionization C and N lines, is intrinsic absorption. It is **not** due to clouds in intergalactic space, whose temperature can thus be the 2.75K indicated by the cosmic microwave background (CMB), as already assumed in my treatment of the cosmic redshift as RTV redshift (Sect. 5.3).

5. Quasars are **not** at cosmological distances. 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.

6. As ***n*** rises towards and past unity during contraction, centrifugal 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, as is required by recognizing the cosmic redshift as a transmission effect..

7. 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 - so the gravity exerted by that mass disappears too, contrary to current black hole models. Such quasars (and those in (6) too) may decay/expire on quite short

time-scales, and start upon a stellar evolutionary course, degenerate or otherwise.

7. Concluding discussion.

The principal conclusion of this paper is that relativity theories which exclude the possibility of effective variation in the velocity of TEM waves *in vacuo* (thus, specifically, the form developed by Einstein in his Special Relativity) appear to be an inappropriate general basis for physics, although there are many circumstances in which this simplification appears justified. To undo this particular knot one needs a vehicle for such variability and the aether concept is the obvious avenue to explore.

By adopting an aether that is a true continuum from which everything in the universe is made, Continuum Theory (CT), as outlined in this paper, is merely articulating a concept that has certainly been around for more than 130 years. Such linkage between matter and aether at once implies that, in gaseous media in particular, the aether is in random motion. To make that random motion effective when it is transmitting TEM waves I have embraced a more rigorous form of the relativity principle of Poincaré-Lorentz, a form that might perhaps be called 'intimate relativity', in which no particle or TEM wave can ever exceed the local value of ***c***, as determined by the local aether.

Since random motion of any continuum inevitably implies random variation of its 'density' I have linked this additional variability to TEM wave propagation by making the aether a continuum of electric charge which, through Maxwell's equations, will make the local value of ***c*** vary accordingly.

On this basis four interrrelated effects are predicted to arise, which I have called:- RTV redshift, RTV deflection scattering, RLV dispersion/line broadening, and TEM-wave thermal noise generation.

In addition, a 'particle-tied' aether, even if that tie is somewhat loose in the sense of being a volume-smoothed relationship (as the data confirm), must possess systematic velocities corresponding to those of particulate matter.

The significance of these lines of argument rests on being able to give answers to two rather different questions, namely; Does it offer coherent explanations of a wide variety of observations that hitherto have had to be attacked piecemeal? and How compatible is it with the existing body of 'what we think we know'?

An answer to the first question is provided in Table 1 (preceding the Appendices) which is a distillation of Sections 4 and 5 and the theoretical treatments in the Appendices, and it appears to be 'yes'. Although detailed quantitative theoretical studies will be needed to tie the effects into the physics of stellar and galactic atmospheres/envelopes, an outstanding conclusion is that RTV redshift appears to have been observed, unrecognized, over ground-level paths in 1968 by Sadeh et al.***[25***. Their result extrapolates quantitatively, within current uncertainties, into a reasonable interpretation of the cosmic redshift as a wholly transmission effect due to the intergalactic medium. The same result leads to improved understanding of much detail in the solar redshift. The experiment of Sadeh et al. should certainly be repeated, preferably under several differing conditions, to check the dependence upon temperature and ionization.

The conclusion (Sect. 5.2) that RLV line-broadening has played a very misleading part in respect of temperatures attained in thermonuclear fusion experiments could be of major economic significance for projects now in progress.

As to the second question, dealt with mainly in Section 3, there is in a number of important cases a quite fascinating quantitative convergence of expectation as betwen CT and the current form of Relativity. The mechanism of stellar aberration not only acquires an explanation in physical terms which Relativity doesn't provide but CT also explains directly its apparent absence for distant binary stars. The "transverse Doppler effect" of Relativity finds an indistinguishable counterpart as AR redshift in CT. The three Relativistic transformations were shown 55 years ago ***[18*** to be equally applicable to waves propagating in a medium. The GR gravitational redshift observations, using the Mössbauer effect, are possibly suspect until the effects of supporting the atomic nucleus in the presence of acceleration have been explored. Solar observations, when examined closely, do not support the presence of the GR redshift.

A limited discussion of gravitation (Sect. 6) shows there are several advantages if the force is communicated at velocity ***c***. That such an assumption leads directly to the same result for perihelion advance as was later incorporated into GR was demonstrated in 1898. It also offers to explain the flat rotational velocity curves of galaxies without resort to lots of CDM. At extreme velocities, Mach's Principle considerations lead to drastic reduction of inertia, thus illuminating one of the outstanding questions of physics, the immutability (or otherwise) of ***G***, based on the Principle of Equivalence. This, in turn, permits a completely new model for quasars, in which the redshift is primarily intrinsic to the quasar and developed by AR redshift as a result of superluminal equatorial velocities made possible by reduction of centrifugal force during contractional spin-up. The currently observed maximum ***z*** = 4.89 appears to be entirely possible. The model offers to explain many previously troublesome features of quasars and their spectra. The "Ly **a** forest" is generated in shear-induced shells around the quasar, permitting the intergalactic medium to be at 2.75K, as required for the CT interpretation of both the cosmic redshift and the CMB. By rapid shrinkage, the model may generate the superhigh ***PT*** required for light element nucleosynthesis, currently regarded as a prime justification of Big Bang cosmology.

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