Physical Interpretations of Relativity Theory VII, Imperial College, 15-18 Sept 2000. Brit.Soc.Philos.Sci.
Late Papers (M.C. Duffy, editor), 230-240. PD Publications, Liverpool, UK (2003)ISBN 1 873 694 05 9.

A PARTICLE-TIED AETHER

INDICATIONS OF A DEEPER FOUNDATION FOR PHYSICS AND RELATIVITY

Miles F. Osmaston, The White Cottage, Sendmarsh, Ripley, Woking, Surrey GU23 6JT, UK. miles@osmaston.demon.co.uk

Basic concepts. This contribution† is primarily about the transmission of transverse electromagnetic (TEM) waves, our principal source of physical information. Relativity, as its name implies, seeks to describe relationships between entities in various circumstances but doesn't illuminate the nature of those entities, a gap that quantum electrodynamics and particle physics try to fill. A variety of well-observed phenomena, to be outlined below, appear inconsistent with this currently accepted framework of physics. It will be shown that these phenomena indicate the need for a physics framework that admits the occurrence of TEM-wave transmission effects, a factor explicitly denied in the conceptual basis of Special Relativity (SR). To help with these matters, a continuum (aether) theory *(*CT*)* of physical nature is outlined in which particles are special, rather (but finitely) concentrated, mainly-rotational forms of disturbance of the continuum. Particle random motions imply random motion of the aether, and this affects the propagation of TEM waves by it. Under this proposal particles are "made" of aether (originally a suggestion of Larmor, 1894), and the Michelson-Morley result is satisfied. 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.

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 everywhere 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, thereby providing by dynamic means the required elasticity in shear despite the superfluid nature of aether. The aether provides a vehicle for the "dielectric displacement current" of Maxwell, which has hitherto been lacking.

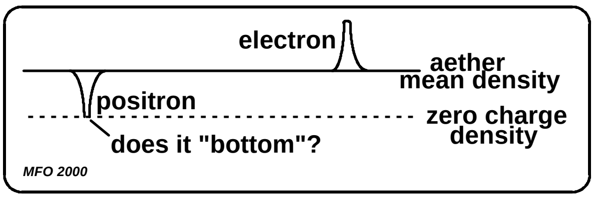


Figure 1. Notional aether density profiles that would equip otherwise-similar(?) electron and positron aether dynamical configurations with equal and opposite amounts of electric charge (aether). The diagram is drawn for an aether with negative polarity.

To provide particles with 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 (Figure 1). In the limiting case that aether density just attains zero in the core of a positron the "normal" aether density must be at least 3.1×10^{29} coulombs/cm^3 of negative charge, based on evidence of their effective maximum "size" in electron-positron

† **Updated and revised November 2000, mostly from an earlier, more comprehensive version (PIRT V, Late Papers, pp. 182-198, May 1997) in which more extensive references may be found, but partly from some even earlier work (published as PIRT V, Supplementary Papers, pp. 241-253, July 1998). Initial assistance with the present version, by Prof. Mogens Wegener, Aarhus University, in an editorial role is gratefully acknowledged.**

Physical Interpretations of Relativity Theory VII, Imperial College, 15-18 Sept 2000. Brit.Soc.Philos.Sci.
Late Papers (M.C. Duffy, editor), 230-240. PD Publications, Liverpool, UK (2003)ISBN 1 873 694 05 9.

scattering experiments. 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 effect upon ***c*** of the charge density of the aether is important. The density measures the aether's state of elastic charge-compression, so a reduction in aether density would reduce its elastic modulus and would reduce ***c*** in Maxwell's equations. On the other hand, the 'dielectric constant of free space', often written as epsilon in Maxwell's equations, clearly controls Maxwell's dielectric displacement current and hence should be proportional to aether charge density. Now ***c*** varies *inversely as the square root* of epsilon, whereas ***c*** varies *directly* as the elastic modulus of the aether, so, as we are dealing with small differences on a big number, the net effect on ***c*** should be half that of the elastic modulus alone.

Further, the random modulation of aether local density, due to the random motions of particles, implies random acceleration of electric charge, so may be expected to give rise to a low level of random TEM radiation.

Mass. 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. (The rotational component of the motion is potentially constrained by the gyromagnetic ratio of the particle.) 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. Nevertheless, the motions constitute an energy resource which has to be put in when a particle is made and becomes available if the motions are disrupted. This means that the standard dimensional definition of energy as ML^2T^{-2} requires modification to encompass aether energy.

Three important properties of this setup are:

(a) the observed production of particle-anti-particle pairs is made very easy and, in the case of electron-positron pairs (which contain the highest charge densities known), the median density of the aether defines the amount of charge contained in that particular dynamical configuration and hence defines unit charge throughout the Universe;

(b) the influence of the motions of charged particles upon the r.m.s. velocity of the aether around them is immensely greater, probably by a factor of at least 10^{36}, than the influence of a similar neutral particle, 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 puts a limit to the extent to which matter can be compressed. Big Bang cosmology is based on the lack of such a perceived limit.

Within this setup, neutrons could have aether dynamical configurations which incorporate no excess or deficiency of aether but do generate gravitational force, whereas those of neutrinos would lack the latter capability, thus embodying aether rotational energy in a pure form.

Einstein's equivalence of mass and energy, $\boldsymbol{E = mc^2}$, is in principle incorporated into the present proposals, but in a restricted form. The idea that certain aether motions within the particle (a form of energy) are a measure of the mass of the particle, directly implies that equivalence. The notion that all forms of energy, however, and notably TEM wave energy, can be expressed as, and can behave as, a mass is expressly excluded here. TEM waves no longer have a wave-particle duality, so it is proposed 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 existing in an intermediate energy state. This, if successful, and combined with a recognition of the finite size of charged particles, will remove the need for those unphysical charge renormalization procedures that have long dogged the consciences of many

Physical Interpretations of Relativity Theory VII, Imperial College, 15-18 Sept 2000. Brit.Soc.Philos.Sci.
Late Papers (M.C. Duffy, editor), 230-240. PD Publications, Liverpool, UK (2003)ISBN 1 873 694 05 9.

physicists involved in quantum electrodynamics *(*QED*)*. Similarly, recognition that the ubiquitous state of the aether is one of random motion provides a vehicle for the 'random field of the absolute vacuum' much invoked by quantum physicists as a necessary adjunct to the classical-type interpretation of phenomena.

The implied continuous random excitation of otherwise-stable configurations means that local attainment of the critical excitation for a given transition is a statistical matter not necessarily implying the arrival of a discrete 'quantum' at that moment and site. In that, in general, the amount of aether *not* involved within the structures of individual particle configurations is vast compared to that which is so involved, the random motion of the former constitutes a vast and hitherto unrecognised energy resource within the Universe. Clearly, though the topic will not be developed here, this is of potentially crucial importance for an understanding of the origin of the matter in the Universe.

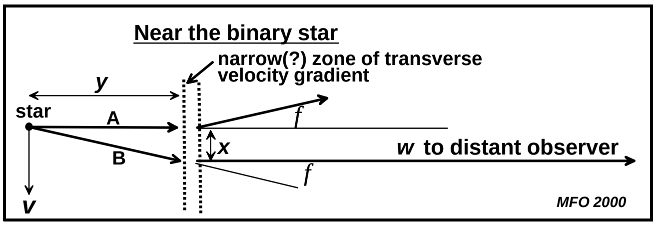
We now proceed to outline the phenomena at issue.

(a) Stellar aberration.

The classical velocity triangle treatment of Bradley leads to an aberration angle $\tan^{-1} v/c$, and the SR formulation is $\sin^{-1} v/c$ (to prevent vectors exceeding c), where 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). However, the relativistic treatment also predicts, since it is only concerned with the relative velocity of source and observer, an appropriate aberration for, say, a stellar spectroscopic binary component moving transverse to the line of sight. This is not observed; if it were, such binaries would appear to scoot to and fro across the sky, a behaviour which would long ago have been used to detect them without a spectrograph. Appeal to a transmitting medium (the aether) resolves this at once. In the case of the Earth's orbital velocity the gradient of transverse velocity, between transmitting medium and receiver, is clearly concentrated relatively near the receiver, and a classical triangle of velocities yields the aberration angle.

For a binary star component (Figure 2), on the other hand, the gradient of transverse velocity, relating to the orbital velocity of the source, is somewhere near the far end of the transmission path, and 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 amount perceived by the observer.

Figure 2. Aberration diagram for a distant orbiting binary star in the presence of a transmitting medium (aether).



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

$f = \tan^{-1} v/c$ **and** $x/y » \tan f$.

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

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

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 Continuum Theory redshift ("aberration- related (or AR) redshift", see text), equivalent to the "transverse Doppler effect" of Relativity Theory, depends only upon the actual aberration, wherever it occurs, not upon its perceived amount.

(b) Ives and Stillwell (1941).

Physical Interpretations of Relativity Theory VII, Imperial College, 15-18 Sept 2000. Brit.Soc.Philos.Sci.
Late Papers (M.C. Duffy, editor), 230-240. PD Publications, Liverpool, UK (2003)ISBN 1 873 694 05 9.

For relativists, these names indicates the I & S canal rays experiment in which I & S claimed to have demonstrated the transverse doppler effect (a redshift) of SR, a theory which they therefore espoused. What I & S did not mention, nor anyone else that I can trace, is that only 10 months earlier (also in *JOSA*, 1941) they had published beautiful results and rigorous calculations relating to interference patterns produced in gravity waves on a pool of mercury. In this 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 any part of their path, travel faster than ***c*** relative to the observer, although travelling no faster than ***c*** relative to the local 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.

(c) The "transverse Doppler effect" redshift.

The classical velocity triangle treatment of aberration discussed in *(a)* above leads also to an expected stretching of the wave train to a degree represented by the extra length of the hypotenuse of the triangle which is in practice (that is, to the first order of small quantities) indistinguishable from the relativistic value. The vector summation of the velocities results, in effect, in the wave velocity relative to the observer being slightly increased, but the component of velocity directly towards the observer remains at ***c***, so the transmission time is unaffected. Under the present proposals such vector summation, and resulting velocities higher than ***c*** relative to an observer - though not relative to the instantaneously transmitting aether - are regarded as normal, whereas in SR they are denied by Einstein's second postulate. The mechanism of this aberration-related (AR) redshift is an embryo form of the cumulative one to be discussed later for the cosmic redshift.

(d) Brightness distribution of the daylight sky.

Comprehensive measurements [1], required for the development of airborne astronavigation, showed that at heights of 5-12 km the brightness distribution could not be explained by a Rayleigh scattering theory even if modified for the effects of ground reflection, dust and haze. The most notable discrepancies between the modified Rayleigh theories and observation are the unexpected 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 if the Sun's altitude decreases below 40^o, as an upward bulge of the isophotes from a horizon-parallel disposition. Likewise the observed intensity, even at right angles to the Sun, is often higher than can be attributed to a plausibly impure atmosphere. These discrepancies increase with the height at which the observations are made, which is not to be expected if airborne impurities are the cause.

Although he was probably aware of it, this issue was neglected by Chandrasekhar [2] who confined his attention to much lower heights, it being left to Barr [3] to stress that the problem remained. In the late 1950s, the present author made substantial (unpublished) progress with the case, on an embryonic form of the present proposals, in which it was assumed that random motions of the aether, as induced by atmospheric molecular motions, produced deflection scattering of the sunlight propagation direction. The key feature of this treatment is that, whereas the probability of the light being deflected to reach the observer from within an elementary annulus subtending an angle q from the Sun line decreases with increasing q, the angular area of that annulus decreases strongly as q approaches p, concentrating all the probabilities, and the brightness rises towards the antisolar point on the sky. The extreme brightness of the Sun as a source is what makes this antisource point brightening observable.

A continuation of this process outside the Earths atmosphere is manifest in the *gegenschein*, a much-discussed brightened patch in the night sky, centred upon the antisolar point and with a diameter to half intensity of about 26 degrees.

(e) The "relativistic " mass-increase.

An increasingly large amount of electromagnetic effort has to be put into accelerating particles by small amounts as velocity $\boldsymbol{c}$ is approached. With Relativity theory this effort is regarded as having increased the particle mass on the $\boldsymbol{E = mc^2}$ 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. Conversely, it is well established that particles travelling at such velocities have the ability to penetrate much further into other particles, or structures of such, than would be expected for particles whose kinetic energy was a normal square-law function of their velocity. Consequently it is generally considered, relativistically, that the kinetic energy (*K.E.*) of a particle is given by:- $\boldsymbol{K.E. = \tfrac{1}{2} mv^2 \ (1 - v^2/c^2)^{-\frac{1}{2}}}$ where $\boldsymbol{m}$ and $\boldsymbol{v}$ are particle mass and velocity. Application of mass-energy equivalence then leads, in Relativity, to the bracketed factor being regarded as the multiplier of $\boldsymbol{m}$.

The ability of a particle to penetrate or damage another is, however, not wholly a matter of its kinetic energy. The phenomenon of Çerenkov radiation, much used for measuring particle speeds, is the shock-wave-like generation of a cone of radiation whose included angle is a direct measure of $m\, \boldsymbol{v/c}$ when a charged particle having velocity $v > \boldsymbol{c}/m$ 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 the electromagnetic field structure of its environment, efforts to accelerate or decelerate it must be greatly weakened as particle speed approaches $\boldsymbol{c}$. This consideration probably applies in any theory which acknowledges that electromagnetic fields are propagated with finite speed. It follows that if a relativistic increase in mass were to occur too, the difficulties in affecting the speed or path of a high-speed particle would be markedly increased - which they apparently are not. The extended lifetime of high-velocity mu-mesons is often cited as incontrovertible ‘proof’ of time dilatation at high velocity; it may, however, merely be another example of the ‘insulating’ effect of high velocity from the decay-triggering action of external ubiquitous aether perturbations referred to earlier.

It follows that at least some of what has been attributed to mass increase is in fact merely the result of a finite field superposition rate. So for our present purpose we shall choose to regard the particle mass as constant at its 'rest-mass' value but that its kinetic energy is a non-linear function of $\boldsymbol{v^2}$. This result is important for the present continuum theory. If stable mass-possessing particles are particular aether dynamical configurations that happen to confer stability, there is no place for a continuous mass-variation. Under existing theory, of course, there is no place for a continuous variation of mass either, but the microwave-frequency quanta regarded as being added by the accelerating equipment are so small that the lack of continuity is never expected to be apparent.

TRANSMISSION EFFECTS UPON TEM WAVES

Physical Interpretations of Relativity Theory VII, Imperial College, 15-18 Sept 2000. Brit.Soc.Philos.Sci.
Late Papers (M.C. Duffy, editor), 230-240. PD Publications, Liverpool, UK (2003)ISBN 1 873 694 05 9.

Under the new proposals, transmission effects upon TEM waves arise from 3 sources:
(i) non-random aether velocities, both transverse to and along the direction of propagation;
(ii) random aether velocities, both transverse to and along the propagation direction;
(iii) variations in the density of the aether, both regional and local random.

(i) ***Non-random aether velocities.***

For velocities transverse to the line of sight, the effects have been outlined in *(a)* and *(c)* above. The results are aberration (observable to an extent depending on where the transverse velocity gradient occurs) and aberration-related redshift (AR redshift), which always occurs.

(ii) ***Random aether velocities.***

With the present proposals, four effects stem from long-distance transmission in a randomly moving (e.g. a Maxwell-Boltzmann gaseous) environment, all of which appear to be of major astronomical importance. They are: random transverse velocity (RTV) redshift; RTV directional scattering ("deflection scattering"); random longitudinal velocity (RLV) line broadening and spectral dispersion; and thermal noise generation (a product of the associated random density variation of the aether).

(ii a) ***RTV redshift.*** This is an elaboration of the transverse doppler effect redshift associated with aberration discussed earlier. In this case the wave-train is subject to *random* transverse displacement at different points along its length. These always stretch the wave-train; there is no balancing process to shorten it. The process is proportional to distance for small proportions of stretching, but its proportional incremental nature becomes apparent as an exponential build-up when the amount of redshift rises. Thus $l_{d} = l_{0}\boldsymbol{e}^{\boldsymbol{Rd}}$, where l_{0} and l_{d} are the wavelengths at emission and after travelling a distance ***d***, and ***R*** is the redshift proportion per unit distance. Analytical treatment of this process of transmission by a Maxwell-Boltzmann gas of neutral particles shows that the redshift (***R***) per unit distance will be given by: ***R*** µ ***T*** Ö(***n/m***), where ***T*** is absolute temperature, ***n*** is particle number density, and ***m*** is particle mass.

This redshift appears to have been observed in 1968 by Sadeh et al. [4], using caesium clocks in a horizontal ground-level experiment over distances up to 1500 km, but curiously not recognized as such by them, nor by their readers. In this experiment, two groups of regularly intercompared caesium clocks were used and both groups were stationary for a week while the ticks transmitted from the distant group were compared, upon receipt by radio, with the ticks from those at base. Their results yield a redshift rate of about $1.75 \times 10^{\mathbf{-20}}$ per cm in standard-pressure air at around 290 K (temperature not recorded).

In the case of a Doppler-effect redshift, the fact that in unit time fewer waves, or ticks, arrive at the receiver than were transmitted is readily understood as because the 'lost' waves fill in the extra space created by the continuing separation. In the experiment [4], source and receiver were not moving apart, so where did the lost waves/ticks go to? In the RTV redshift process the propagation route of any given wave, or part of a wave, is being *actively* lengthened *during its transit time* by the transverse deflections it undergoes. This is precisely analogous to a separation rate for source and receiver, and the 'lost' waves are left along the myriads of different lengthened paths, in the form of the energy in the scattered component of the radiation (see below).

Extrapolation of the Sadeh et al. [4] result to intergalactic conditions of 2.75 K, atomic hydrogen (assumed ionized to the same low degree as Sadeh et al.'s atmospheric air) at a density of $r_{IG} = 10^{\mathbf{-28}}$ g.cm^{-3} gives a predicted Hubble "constant" $\boldsymbol{H_0(p)}$ = 59.6 km/s/Mpc, well within the currently discussed range. The value used here for the intergalactic density is unrealistically high, however, but the extreme sensitivity of aether motions to the presence of ions suggests that an RTV redshift interpretation of the cosmic redshift could be sustained down at least to $10^{\mathbf{-38}}$g.cm$^{\mathbf{-3}}$.

Physical Interpretations of Relativity Theory VII, Imperial College, 15-18 Sept 2000. Brit.Soc.Philos.Sci.
Late Papers (M.C. Duffy, editor), 230-240. PD Publications, Liverpool, UK (2003)ISBN 1 873 694 05 9.

In that redshift is a stretching of the wave energy into a longer spatial volume, the received amplitude will vary inversely as the square of the redshift ratio. This attenuation in the energy arrival rate at the receiver is due to the scattering associated with TEM wave transmission. In a quantum theory context, the continuous variation of quantum energy during transmission, implied by RTV redshift, would present a major problem and is one aspect of why quantum theory of electromagnetic waves in transit is incompatible with the continuum theory proposed herein. Under relativity-plus-quantum theory for Doppler-effect redshifts, the emitted quantum is seen as subject to a relativistic transformation to a smaller quantum (longer wavelength) on entering the reference frame of the observer. Such transformation has never been elucidated in physical terms.[†]

(ii b) ***RTV scattering or deflection scattering.*** This scattering is a second consequence of the aether random velocities transverse to the local instantaneous TEM-wave propagation direction. The mechanism of deflection is precisely analogous to that of stellar aberration, see (a) above, but with repetition along the propagation path that is random in orientation and magnitude. Since Finlay-Freundlich, numerous authors have proposed deflection scattering mechanisms as a cause of the cosmic redshift, but all have failed because the coarseness of their individual deflections would destroy the observed quality of astronomical imagery. In the present proposal, individual deflections are inferred to be of the order 10^{-13} arcsecond, which is far smaller than the imagery resolution, and still the imagery is preserved; but the source will nevertheless be attenuated by the scattering, adding to the impression of distance.

(ii c) ***RLV line broadening and spectral dispersion.*** Differential aether velocities along the wave-train propagation direction that vary during the passage of the wave-train will stretch and compress the waves. This process will be cumulative with propagation distance but, being a balanced random process, the r.m.s. value will grow as the square root of distance. Thus spectral emission lines will get wider, but for absorption lines the effect may differ slightly, because it is the spectral continuum which is being spread. The shape of the line-broadening produced will depend on the velocity statistics of the gas along the path, but may prove difficult to distinguish from emission temperature of the source except on grounds of physical reasonability, e.g. its lower colour or spectral excitation temperature. RLV line-broadening might also be mistakenly attributed to high rotation rate of the star.

(iii d) ***Relation between these effects.*** All three of these phenomena, RTV redshift, RTV scattering and RLV line-broadening, derive from the same feature of the aether, namely its random velocity structure, so a close relationship between them in any given situation is to be expected. That between RTV redshift and RLV line-broadening is particularly worthy of comment. For any given aether velocity statistics and magnitude (e.g. for any individual transmission path), if $\boldsymbol{R}$ is the basic RTV redshift rate per unit distance and D^2 is the basic rate of growth of line-width variance, the initial ratio $\boldsymbol{R}/D^{2}$ will be a fixed quantity. Both parameters subsequently grow exponentially with distance when the buildup of the effect has become substantial. Observationally, however, interest lies in the r.m.s. line-width, not the variance, so redshift will progressively outstrip line-broadening the more the processes are repeated. This will make the RTV redshift progressively easier to observe, despite the RLV line-broadening, and is relevant to the observation of the cosmic redshift. On the other hand, over relatively short paths at very high temperature the RLV line broadening will tend to swamp the RTV redshift, rendering its detection difficult.

[†] I am here using the word 'physical' in its older sense, and not the present-day sense in which mathematics, often based entirely upon conservation perspectives, is regarded by some as an adequate substitute for physical perception.

Physical Interpretations of Relativity Theory VII, Imperial College, 15-18 Sept 2000. Brit.Soc.Philos.Sci.
Late Papers (M.C. Duffy, editor), 230-240. PD Publications, Liverpool, UK (2003)ISBN 1 873 694 05 9.

(iii) ***Random variation of aether density.***

Thermal noise generation. As previously mentioned, the random modulation of aether local density, associated with random motions of particles, is expected to give rise to a low level of random TEM radiation. This is proposed as the origin of the cosmic microwave background (CMB)**,** indicating that 2.75 K is the characteristic thermodynamic equilibrium temperature of intergalactic space. Its precisely black-body character is attributable to the effective optical depth implied by the scattering over cosmic distances, just as stars also exhibit nearly black-body spectral continua indicating the temperature at the atmospheric level where substantial opacity occurs.

ASTRONOMICAL SUPPORT

The solar redshift, with its rise, from well below the GR value over the central 30% of the disc area, to around twice the GR value at the solar limb, and its variation with spectral line source depth - but here denied its relativistic gravitational interpretation by the absence of mass in TEM waves - seems entirely consistent with an RTV redshift origin. 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. The redshift also varies steeply with the reversing level within the photosphere at which the absorption line originates; much more steeply than GR's linear dependence on radius. The current 'explanation' of the variation, that the velocity structure of solar granulation is superposed upon the GR value (636 m/s velocity-equivalent at the solar surface), becomes unrealistic near the limb. In 1968, as the Pioneer-6 spacecraft passed behind the Sun, the communications TEM-wave carrier 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 rising to an equivalent ~11 m/s [5] 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 disc RTV redshift. This interpretation is reinforced by the observed concurrent widening of the carrier's (initially monochromatic) spectral content [6], thus representing the RLV dispersion uniquely associated by CT with the RTV redshift process. The explanation offered at the time [6] for this dispersion was electromagnetic turbulence in the corona but a mechanism for achieving this was not elaborated upon. The carrier redshift was some two orders of magnitude bigger than the *pulse* delays subsequently observed [7] in connection with the increase in path-length associated with the solar gravitational light deflection. The lack of any effect upon the delays caused doubt [7] as to the reality of the redshift but this is to be expected because, as noted earlier, the RTV redshift process affects the wavelength but *not* the transmission time.

Several white dwarf stars with large expected GR redshifts exhibit very little (or insufficient) redshift for this interpretation but consistent with very thin atmospheres in which to generate RTV redshift. The stellar K-effect, established by the works of Trumpler, Weaver and Feast, and considered important by Finlay-Freundlich, 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**,** and then rises again slightly at M**,** with their deep, but cool, atmospheres. This effect is seen in its most explicit form where one component of a binary is a WR star; the spectrum of the WR component commonly exhibits an apparent recession of over 100 km/s relative to the system. 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 with no clear idea as to its mechanism. But an RLV line-broadening interpretation relates nicely to the

Physical Interpretations of Relativity Theory VII, Imperial College, 15-18 Sept 2000. Brit.Soc.Philos.Sci. Late Papers (M.C. Duffy, editor), 230-240. PD Publications, Liverpool, UK (2003)ISBN 1 873 694 05 9.

inferred K-effect RTV redshift.

Holmberg's 1961 study of 76 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, overlain by intrinsic RTV redshifts between 90 km/s at E and 770 km/s at Sc. The work of Arp [8] has greatly added to the data-base of galaxy intrinsic redshifts. Removal of intrinsic redshifts from the individuals of a cluster will clearly reduce the demand for cold, dark matter (CDM, of unknown character) to hold the cluster together, which arises from application of the virial theorem and an assumption of cluster longevity.

The possibility of attributing the cosmic redshift to the RTV redshift process has been discussed already, under the heading of that process.

QUASARS, GRAVITY COMMUNICATION, AND MACH'S PRINCIPLE

To provide a satisfactory model for quasars with their small optical sizes and their redshifts ($\boldsymbol{z} = (l_d / l_0) - 1$) ranging from 0.2 to 4.9, a further step will be taken in these proposals. Many physicists seem to feel that gravitational communication at velocity $\boldsymbol{c}$ is implicit in the relativistic formulation. Indeed Einstein himself considered that small changes were so communicated. Some consequences of an explicit recognition of this will be outlined. In orbital studies it means that the magnitude of the gravitational pull on the body at an instant corresponds to a slightly earlier separative distance. This is readily shown to result in the angular advance of an eccentric. In 1898 (republished in 1917), Gerber [9] demonstrated that its amount is formally identical with Einstein's 1916 proposal. Both the objections to this approach raised by Roseveare [10]†† 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, an incorrect solar gravitational deflection of starlight would result. In CT, on the contrary, the view to be taken (but will be dealt with in a separate publication) is identical in its effect to that adopted in GR, namely that the velocity of light becomes dependent upon the gravitational potential.

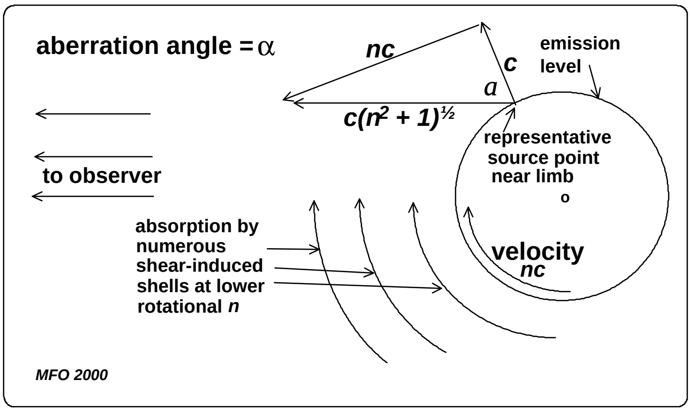
Formulations of inertial force, based on Mach's Principle that acceleration-dependent force results from a retarded-field gravitational action of the rest of the universe, have been attempted in several papers by Sciama and, more recently, by Ghosh [11]. Gravitational communication at velocity $\boldsymbol{c}$ makes such formulations reasonable since it limits the effective volume of inertial interaction within the universe. The higher the velocity, the smaller the volume. Thus, on a very rapidly rotating body, the material experiences a full gravitational pull of the interior material (with respect to which it is moving comparatively slowly) but a much-reduced inertial centrifugal force from the velocity-limited volume of material outside.

Figure 3. The suggested model for quasars, based on velocity-dependent inertia, as outlined in the text. Note that excess breadth of the emission line is primarily due to rotational, not RLV, broadening (*n* varies with latitude on the emission surface) superimposed upon normal thermal broadening. Temperatures may be high, due to the rapidity of contraction. In more massive examples the process may

† **though a study to fainter magnitudes (Huchra, J.P., 1985. *The Virgo cluster redshift survey.* In: *The Virgo cluster of galaxies* (O-G. Richter & B. Binggeli, eds) ESO Conference and Workshop Proceedings No.20, 181-200) appears to dilute this core result.**

†† **Note that 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.**

Physical Interpretations of Relativity Theory VII, Imperial College, 15-18 Sept 2000. Brit.Soc.Philos.Sci.
Late Papers (M.C. Duffy, editor), 230-240. PD Publications, Liverpool, UK (2003)ISBN 1 873 694 05 9.



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 may decay/expire on detectably short timescales, and start upon a stellar evolutionary course, degenerate or otherwise.

So superluminal rotational velocities, due to gravitational contraction, are possible without the body flying apart. Such high velocity, transverse to the observer's line of sight, produces a large aberration angle and associated AR redshift (Figure 3). A transverse velocity of 5.8***c*** gives an aberration angle of 80.2 deg. and a redshift of 4.89, the highest quasar redshift currently known (neglecting any cosmic RTV redshift from the intervening transmission path). The recognized dearth of quasars at $z > 5$ [12] is thus seen to be a matter of attenuation of the amount of light that can escape. The "Lyman-α-forest" of absorption lines, shortward of the quasar Lyman-α emission line, and related C and O lines with excitation levels suggesting several 10^4 K, can then derive from shear-induced thin shells around the central body and do not imply high temperatures in intergalactic space. Thus, as Arp (loc. cit.) has argued on observational grounds, quasars are not at cosmological distances corresponding to their total redshift, but very much closer, with very much lower energy output requirements.

Removal of the centrifugal constraint upon rapid contraction means that extreme temperatures may be reached in quasar interiors and that lifetimes will be short, perhaps attaining conditions that would remedy the insufficient stellar-production of D, He and Li that has seemed to provide such strong support for Big Bang cosmology. Current searches for 'black holes' are based on the expectation of high velocities of circulation around a centre; this is similar to the signature of the quasar model proposed here.

EXPERIMENTAL CHECKS

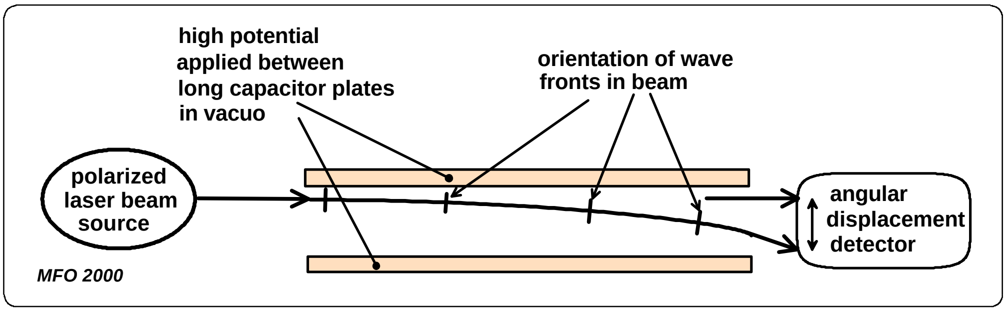
1. A repeat of the Sadeh et al [4] experiment with caesium clocks using a ground-level wave-path would confirm (or otherwise) the existence of the RTV redshift mechanism as an alternative to expansion of the Universe. It would not be expensive.

2. The charge-density and polarity of the aether could, in principle, be determined with the experimental set-up shown in Figure 4. An assessment is needed as to whether the very high sensitivity required could be attained.

3. The Pioneer-6 observations [5, 6] of carrier-wave redshift and spectral dispersion on traversing the inner part of the solar corona should be repeated, preferably with a simultaneous check on pulse delays. This should be possible with an existing spacecraft but would require it to be re-routed to achieve superior conjunction, a course usually avoided because of the temporary interruption of its data stream.

Figure 4. An experiment to determine the polarity and charge density of the aether. 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

Physical Interpretations of Relativity Theory VII, Imperial College, 15-18 Sept 2000. Brit.Soc.Philos.Sci.
Late Papers (M.C. Duffy, editor), 230-240. PD Publications, Liverpool, UK (2003)ISBN 1 873 694 05 9.



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 will modulate the deflection. If the aether is a continuum of negative charge the beam deflection will be towards the negative plate.

CONCLUSION

It appears that Relativity Theory is a simplified, mathematically idealized statement of physical behaviour. As Einstein said, "the rest is detail". The real world is evidently not so simple and the truth is in the detail. A Continuum Theory of physical nature offers to explain an enormous range of such detail and to underpin physically many of the matters treated ideally by Relativity Theory. In discarding the existence of an aether on the grounds that the Michelson-Morley experiment had failed to show an expected systematic effect attributable to it, Einstein neglected to consider that the aether might be in random motion, a "detail" whose potentially far-reaching significance has been outlined here. Potentially diagnostic is the CT prediction of several concurrent effects. It appears likely that several of the formal predictions/results of Relativity Theory may be correct for a physical reason different from that conceived by Einstein. Much further consolidation of detail remains to be done.

REFERENCES

1. **Tousey, R. & Hulburt, E.O.,1947: "Brightness and polarization ..", *J. Opt. Soc. Amer. 37,* 78.**
   Packer, D.M. & Lock, C.,1951: "Brightness and polarization of..", *J. Opt. Soc. Amer. 41,* 473.
2. **Chandrasekhar, S., 1950: *Radiative Transfer,* Oxford.**
   Chandrasekhar, S. & Elbert, D., 1951: "Polarization of the sunlit sky", *Nature 167,* 51.
3. **Barr, N.L., March 1953: "Brightness of the atmosphere", *U.S. Nav. Med. Res. Inst. Report*.**
4. **Sadeh, D., Knowles, S. & Au, B., 1968: "The effect of mass on frequency", *Science 161,* 567-569.**
5. **Merat, P., Pecker, J-.C. & Vigier J-.P., 1974: "Possible interpretation of an anomalous redshift observed on the 2292MHz line emitted by Pioneer-6 in the close vicinity of the solar limb". *Astronomy & Astrophysics 30*, 167-174.**
6. **Goldstein, R.M. "Superior conjunction of Pioneer-6". *Science 166,* 598-601.**
7. **Shapiro, I.I. & 7 others, 1971. "Fourth test of General Relativity: new result. *Phys. Rev. Lett. 26*, 1132-1135.**
8. **Arp, H., 1987: *Quasars, Redshifts and Controversies.* Interstellar Media, Berkeley, California.**
9. **Gerber, Paul, 1898. "Die räumliche und zeitliche Ausbreitung der Gravitation".*Zeits.f.Math.u.Phys. 43*, 93-104; abstract in *Ann.d.Phys. 22*, 529-530 (1898): republished (1917) as "Die Fortpflanzungs-geschwindigkeit der gravitation" in *Ann.d.Phys. 52*, 415-441.**
10. **Roseveare, N.T., 1982: “Mercury’s perihelion from Le Verrier to Einstein”. Clarendon, Oxford. 208pp.**
11. **Ghosh, A., *in* Arp, Keys & Rudnicki, eds., 1993: *Progress in New Cosmologies: beyond the big bang,* Plenum (p. 305-326). Ghosh, A.. Rai, S. & Gupta, A., 1988: "A possible servomechanism for matter distribution yielding flat rotation curves in spiral galaxies". *Astrophysics & Space Science 141,* 1-7.**
12. **Shaver, P.A., Wall, J.V., Kellermann, K.I., Jackson, C.A. & Hawkins, M.R.S., 1996: "Decrease in the space density of quasars at high redshift". *Nature 384,* 439-441.**