Chapter 5

Cosmological Anomalies: EH Versus ECE Field Theory

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Abstract

Some anomalies of contemporary cosmology are discussed by considering the advantages of Einstein Cartan Evans (ECE) unified field theory over the original Einstein Hilbert (EH) un-unified gravitational field theory of 1915. A classical explanation of diffraction in the Eddington effect is given, including ring diffraction. A new explanation is given of the anomalies that apparently lead to missing mass using the Beer Lambert law to account for observable intergalactic absorption and to redefine the relation between intrinsic luminosity, distance and mass of a cosmological object. ECE theory allows a self-consistent explanation of differing red shifts for equidistant objects, something which is not allowed for by the Hubble law. Red shifts in ECE field theory are due to the relative permeability of ECE spacetime, so that rotational as well as translational motion is taken into account in ECE theory. Only translational motion is considered in the EH theory underpinning the concept of Big Bang. It is shown that Big Bang is riddled with anomalies which can be addressed by the required ECE unified field theory.

Keywords: Cosmological anomalies, Einstein Hilbert (EH) field theory, Einstein Cartan Evans (ECE) field theory, Beer-Lambert law, Eddington effect, diffraction, red-shift, missing mass anomaly, diffraction rings in cosmology, quantized red shifts, equidistant anomalies in the Hubble law, permeability in ECE field theory, gravitational dependence of permeability.

5.1 Introduction

A theory of the unification of gravitation with electromagnetism and other radiated and matter fields has recently been suggested [1]– [31] and has rapidly become the main field theory in physics [32] because it is predictive, relatively simple, and much more powerful than other attempts at field unification such as the unpredictive and unphysical string theories of pure mathematics. The new unified field theory has been well tested experimentally and is based on the ideas of relativity theory and thus of rigorously objective physics. Such a unified field theory is needed to describe cosmology - a subject based on the spectroscopic observations of astronomy and therefore on the properties of electromagnetic radiation. A cosmological theory should therefore be based on the interaction of light and electromagnetic radiation with gravitation, but the prevailing Big Bang theory is purely gravitational, being based on the Einstein Hilbert (EH) theory of 1915 [33], a theory that does not deal self consistently with electromagnetism. The Einstein Cartan Evans (ECE) unified field theory [1]– [31]accounts self consistently for the effect of gravitation on light and electromagnetic radiation.

In Section 5.2 the homogeneous field equation of the dielectric version of ECE theory is applied to give an explanation of red shifts as spectral phenomena, not necessarily due to an expanding universe. The origin of shifts to lower frequency (red shifts) in cosmology is traced to the relative permeability of ECE spacetime, a four dimensional spacetime with torsion as well as curvature [34]. In EH field theory there is no torsion, and in consequence EH theory loses a great deal of information. For example, EH theory does not have the ability to describe classically refraction effects in cosmology. The most well known refraction effect is the Eddington effect [35] and this is described using a semi-classical theory in which a photon is captured by the gravitational field of the sun. The path of the photon is therefore an orbit. This is a kinematic and central theory in which the photon is assumed to have a mass which is centrally attracted to the sun's mass. The resulting orbit in EH theory is found to produce twice the deflection of Newtonian theory, the weak field limit of EH theory. However, the assumed photon mass does not appear in the final expression for the orbit of the photon and so the photon mass cannot be estimated from the Eddington experiment. Despite the known accuracy of this central theory (one part in one hundred thousand [35]) it is therefore only partly successful, in particular there is no classical electrodynamics in the EH theory by definition. ECE theory on the other hand builds in classical electrodynamics and is able to describe the Eddington effect classically [1]– [31] in terms of refraction in an inhomogeneous dielectric whose refractive index is a function of ECE spacetime. This refraction is accompanied by a red shift in frequency ω/μ_r where μ_r is the relative permeability of EEC spacetime. Both the refraction and the red shift are caused in ECE theory by the interaction of gravitation with electromagnetic waves on the classical level. The functional dependence of the refractive index n on ct, X, Y and Z defines the observed orbit of the light. The EH theory is the well defined zero torsion (or central) limit of ECE theory and so the Eddington effect can also be described by the central limit of ECE theory, its kinematic part. Therefore ECE theory gives both the classical and the well known semi-classical theory of the Eddington effect. The orbit of the light is therefore defined to one part in one hundred thousand by the central or semi-

classical part of ECE and so the functional dependence of the refractive index on ct, X, Y, and Z is also defined classically and accurately to one part in one hundred thousand.

ECE theory is however capable of giving much more classical information from its homogeneous field equation. The explanation in Section 5.2 is confined to refraction in the absence of optical absorption. In section 5.3 optical absorption is considered classically using the Beer Lambert law and by using a complex-valued refractive index. The latter is a function of the power absorption coefficient of the Beer Lambert law [36]. Using this information it is shown in Section 3 that various type of red shifts are possible due to the absorption and simultaneous refraction or dispersion of light from a distant cosmological object in inter-stellar or inter-galactic spacetime. One possible cause of absorption is the interaction of the light with the gravitation of well observed [37] inter galactic dust particles. It is well known experimentally [38] that radio frequencies are absorbed in inter galactic and inter stellar regions. In general the light from equidistant sources in different parts of the sky is absorbed in different ways on its journey to the observing telescope, giving rise to different red shifts for equidistant objects as observed by Arp [39]. These findings invalidate the simple Hubble law, both experimentally (Arp) and theoretically (ECE theory). Red shifts alone cannot therefore be used to measure the distance of an object from a telescope. The only valid method is direct parallax measurements currently possible only for objects relatively close to the observing telescope.

The arguments in Sections 5.2 and 5.3 cast further doubt [40] on the basic premise underpinning the Big Bang model - that inter-stellar and inter-galactic space is a vacuum, and that the observed red shift of galaxies is due to expansion of the metric of the universe according to the EH field equation. The ECE field theory shows that the underlying red shift could be due to the absorption coefficient and not the expansion of the metric. Assis [40] has argued that if the power absorption coefficient of the Beer Lambert law is H/c then the Hubble law follows. Here H is the Hubble constant and c is the vacuum speed of light. There may therefore be a constant background absorption in the observable universe which means a constant background refractive index greater than the unity of the vacuum. Assis has also shown [40] that the Beer Lambert law leads straightforwardly to a more accurate value of the 2.7 K background radiation than Big Bang, and Vigier et al. [41] have shown that the tired light model is more accurate in several ways than Big Bang. The tired light model may also be obtained from the Beer Lambert law [40]. In Big Bang cosmology the Beer Lambert law is not considered, despite the contrary evidence of the Eddington effect. ECE theory shows that superimposed on the cosmological red shift there may be a theoretically infinite number of different types of red shift due to different types of absorption in different parts of the universe, a big and complicated place. Examples are the data given by Arp [40], the quantized red shifts and the diffraction rings observed in contemporary gravitational lensing. It is shown in Section 5.4 that these arguments also cast grave doubt on the way in which luminosity is related to mass and distance in conventional cosmology, so the arguments for missing mass and dark matter may be false. They could equally well be due to absorption. Also, it has been argued already that the criteria used to measure the distance of far galaxies by red shift also depend on the assumption that inter stellar and inter galactic spacetime is a vacuum, whereas this assumption has already been invalidated by data [40] - for example

the existence of inter galactic and inter stellar dust [37] and the absorption of radio waves [38] in these regions. Finally in Section 5.4 it is argued that the apparent acceleration of far galaxies is due to a changing refractive index of EEC spacetime in these regions. However, as soon as doubt is cast on the Hubble law the actual distance of these objects becomes unknown. The reason is that this distance cannot be measured by parallax and the Hubble law cannot be used to estimate these distances from red shifts alone. So it is not even known whether far galaxies are in fact more distant than near galaxies, they only APPEAR to be more distant because of what has happened to the light on the journey from source to observing telescope. The overall conclusion is that the universe is as likely to be in a non-expanding steady state as expanding. There may be local regions of expansion giving rise to the formation of galaxies, stars and planets, and to the distribution of the elements as argued by Pinter [42] in convincing detail. In Section 5.5 it is argued that recent spacecraft data show many gravitational anomalies within the solar system. Jensen [43] has argued that these anomalies are due to a mass dependent permeability. The latter is incorporated into ECE theory in Section 5.5 using the fact that in pure gravitational theory the torsion is not in general zero. Incorporation of torsion leads to a mass dependent permeability as used by Jensen [43] to explain numerous gravitational anomalies in EH theory within the solar system.

5.2 Red Shift By The Relative Permeability of ECE Spacetime

It has been shown [1]– [31] that the homogeneous field equation of ECE theory gives the Faraday law of induction in the required objective form, it must be an equation of general relativity rather than special relativity as must all equations of physics in the theory of relativity. The requirement for objectivity in physics goes back to Bacon in the sixteenth century. Thus, objectivity in physics has the major advantage of giving a classical equation for the effect of gravitation on electromagnetism. A mechanism is therefore deduced that has not been hitherto considered in cosmology and astronomy for explaining the well known cosmological red shift in terms of the effect of gravitational fields on electromagnetic radiation emanating from a far distant source. The frequency of a feature such as the sodium D line is decreased to ω/μ_r as argued in the introduction and this effect does not necessarily imply that distant cosmological objects such as galaxies are moving away from the observer. The objective (i.e. generally relativistic) Faraday law of induction is [1]– [31]:

$$\nabla \times \mathbf{E}^a + \frac{\partial \mathbf{B}^a}{\partial t} = \mu_0 \widetilde{\mathbf{j}}^a. \tag{5.1}$$

Here $\mathbf{E}^a$ is the electric field strength (volt / m) and $\mathbf{B}^a$ the magnetic flux density (in tesla) of electromagnetic radiation such as a light beam emitted by a distant source and observed in a telescope. In Eq.5.1 μ_0 is the vacuum permeability and $\widetilde{\mathbf{j}}^a$ is the homogeneous current [1]– [31] of ECE theory. It has been shown that Eq.5.1 can be re-written as:

$$\nabla \times \mathbf{D}^a + \mu_0 \epsilon_0 \frac{\partial \mathbf{H}^a}{\partial t} = \mathbf{0} \tag{5.2}$$

where $\mathbf{D}^a$ is the displacement, $\mathbf{H}^a$ the magnetic field strength and ϵ_0 the vacuum permittivity. In these equations the index a denotes the state of polarization of the light beam. For example in the complex circular basis [1]– [31], the space-like polarizations are denoted:

$$a = (1), (2), (3) \tag{5.3}$$

where (1) and (2) indicate complex conjugate transverse states and (3) indicates a longitudinal state of polarization. In general the permittivity and permeability are functions of spacetime:

$$n^2 = \epsilon\mu/\epsilon_0\mu_0 \tag{5.4}$$

and so the refractive index, n, is also a function of spacetime.

In Eq.5.2 the following definitions are used:

$$\mathbf{D}^a = \epsilon_0\mathbf{E}^a + \mathbf{P}^a = \epsilon\mathbf{E}^a \tag{5.5}$$

$$\mathbf{H}^a = \frac{1}{\mu_0}\mathbf{B}^a - \mathbf{M}^a = \frac{1}{\mu}\mathbf{B}^a \tag{5.6}$$

where $\mathbf{P}^a$ is the polarization of ECE spacetime and $\mathbf{M}^a$ is the magnetization of ECE spacetime considered as a ponderable medium or dielectric with properties different from the vacuum. Here ϵ is the absolute permittivity and μ the absolute permeability of this dielectric. In order to obtain Eq.5.2 from Eq.5.1 the homogeneous current must be defined as:

$$\widetilde{\mathbf{j}}^a = \frac{\partial\mathbf{M}^a}{\partial t} - \frac{1}{\mu_0\epsilon_0}\nabla\times\mathbf{P}^a \tag{5.7}$$

and is the mechanism responsible for the interaction of gravitation with the light beam as the latter travels from source to telescope, a distance Z. Over this immense distance it is certain that the light beam encounters myriad species of gravitational field before reaching the telescope and the observer. However weak these fields may be in inter stellar and inter galactic ECE spacetime, the enormous path length Z amplifies the current $\widetilde{\mathbf{j}}^a$ to measurable levels, and appears in the telescope as a red shift. This inference is analogous to the well known fact that the absorption coefficient in spectroscopy depends on the path length - the greater the path length the greater the absorption of the light beam and the weaker the signal at the detector. Therefore what is always observed in astronomy is the effect of gravitation on light through the current of Eq.5.7 - in general an absorption (or dielectric loss) accompanied by a dispersion (a change in the refractive index). It is also well known in spectroscopy that the more dilute the sample the sharper are the spectral features (the effect of collisional broadening is decreased by dilution). Since inter stellar and inter galactic spacetime is very tenuous (or dilute) the stars and galaxies appear sharply defined. This does mean at all that the spacetime is empty or void as in Big Bang theory [40]. The empty inter stellar and inter galactic spacetime of Big Bang is defined by EH theory alone, without any classical consideration of the classical effect of gravitation on a light beam. The red shifts are defined in Big Bang by a particular solution to the EH field equations using a given metric. No account is taken of the homogeneous current $\widetilde{\mathbf{j}}^a$ and so the effect of gravitation on light is not considered classically. These are major omissions, leading to the apparent conclusion that the universe is expanding - simply because the metric

demands this conclusion. This is however a circular argument - the conclusion (expanding metric deduced) is programmed in at the beginning (expanding metric assumed).

The homogeneous current of ECE field theory [1]– [31] is defined by the Bianchi identity of Cartan geometry and in standard differential form notation [34] is:

$$j^a = \frac{A^{(0)}}{\mu_0} \left(R^a{}_b \wedge q^b - \omega^a{}_b \wedge T^b \right). \tag{5.8}$$

Here $A^{(0)}$ is the fundamental vector potential magnitude of ECE field theory, $R^a{}_b$ is the curvature or Riemann form, T^a is the torsion form, $\omega^a{}_b$ is the spin connection and q^a is the tetrad form, the fundamental field of ECE theory. It is seen from Eq.5.8 that the interaction of the light beam with gravitation is governed by geometry as required in relativity theory [34]. Without going in to the details of the geometry and without using supercomputers we can go far using the dielectric version of ECE field theory.

Using Eqs.5.5 and 5.6 Eq. [2] can be written as:

$$\nabla \times (\epsilon_r \mathbf{E}^a) + \frac{\partial}{\partial t} \left(\frac{\mathbf{B}^a}{\mu_r} \right) = \mathbf{0} \tag{5.9}$$

where the relative permittivity ϵ_r, and relative permeability μ_r are defined as

$$\epsilon_r = \epsilon/\epsilon_0, \qquad \mu_r = \mu/\mu_0. \tag{5.10}$$

Therefore the effect of gravitation on a light beam is summarized by:

$$\mathbf{E}^a \rightarrow \epsilon_r \mathbf{E}^a \tag{5.11}$$

$$\mathbf{B}^a \rightarrow \frac{1}{\mu_r} \mathbf{B}^a. \tag{5.12}$$

The various changes to the light beam caused by gravitation are given by solutions of Eq.5.9, either analytical or numerical. With a powerful enough computer we can calculate these changes from the original geometry of Cartan but proceed here without loss of insight or generality using the summary structure of Eq.5.9. Cosmological red shifts and the Eddington type of experiments [35] show that gravitation influences light and this influence is described classically for the first time by Eq.5.9. Such an influence may also be detectable on the opposite microscopic scale in the close vicinity of an electron in a circuit. Near an electron, spacetime is curved considerably and electric and magnetic fields are intense. These are ideal conditions for the generation of the homogeneous current $\widetilde{\mathbf{j}}^a$. Therefore electric power can be obtained from ECE spacetime through the current $\widetilde{\mathbf{j}}^a$. If harnessed technologically this power is of clear importance.

The laboratory conditions under which the Faraday law of induction is usually tested are intermediate between the macroscopic domain of cosmology and the microscopic domain near one electron. This is the reason why the special relativistic Faraday law of induction:

$$\boldsymbol{\nabla} \times \mathbf{E} + \frac{\partial \mathbf{B}}{\partial t} = \mathbf{0} \tag{5.13}$$

appears to be adequate. Under these conditions gravitation is very weak in comparison with electromagnetism, and this limit is described by:

$$\epsilon_r \rightarrow 1, \quad \mu_r \rightarrow 1, \quad n \rightarrow 1, \tag{5.14}$$

$$\widetilde{\mathbf{j}}^{a} \rightarrow \mathbf{0}. \tag{5.15}$$

Therefore the homogeneous current vanishes in this limit, and the ECE spacetime reduces to that of the vacuum. The Faraday law of induction under these conditions is written conventionally without reference to the polarization index a, and is a law of electromagnetism uninfluenced by gravitation. In this limit the ECE spacetime reduces to a Minkowski spacetime and the equations of electromagnetism are covariant under the Lorentz transformation only. More generally they must be covariant under the general coordinate transformation [1]– [31,34] as for any equations of general relativity. These are therefore the limits of validity of the well known Maxwell Heaviside field equations. The Faraday law of induction 5.13 is one of these equations. In the elegant differential form notation of Cartan geometry [34] the Maxwell Heaviside equations are well known to be:

$$d \wedge F = 0 \tag{5.16}$$

$$d \wedge \widetilde{F} = \mu_0 J \tag{5.17}$$

where J is the inhomogeneous current and where $d\wedge$ is the exterior derivative of Cartan geometry. The tilde denotes the Hodge dual transform [1]– [31, 34]. In ECE field theory Eqs.5.16 and 5.17, respectively its homogeneous and inhomogeneous field equations, evolve to:

$$d \wedge F^{a} = \mu_0 j^{a} \tag{5.18}$$

$$d \wedge \widetilde{F}^{a} = \mu_0 J^{a} \tag{5.19}$$

and Eq.5.1 is part of Eq.5.18 in vector notation rather than differential form notation. Eqs.5.18 and 5.19 are capable of describing the effect of gravitation on electromagnetism, whereas Eqs.5.16 and 5.17 are not.

The well known plane waves [44, 45] of light are exact transverse solutions to Eq.5.13 for each index a. For example, for

$$a = (1) \tag{5.20}$$

the transverse electric and magnetic plane waves are:

$$\mathbf{E}^{(1)} = \frac{E^{(0)}}{\sqrt{2}} \left(\mathbf{i} - i\mathbf{j}\right) e^{(i(\omega t - \kappa Z))}, \tag{5.21}$$

$$\mathbf{B}^{(1)} = \frac{B^{(0)}}{\sqrt{2}} \left(i\mathbf{i} + \mathbf{j}\right) e^{(i(\omega t - \kappa Z))}. \tag{5.22}$$

Here ω is the angular frequency at an instant of time t of electromagnetic radiation propagating with a phase velocity c in the vacuum, and κ is the wave vector magnitude of the radiation at a point Z, which is the axis of propagation being considered. Here $\mathbf{i}$ and $\mathbf{j}$ are unit vectors in the X and Y axes. The unit vectors of the complex circular basis are defined by [1]– [31]:

$$\mathbf{e}^{(1)} = \mathbf{e}^{(2)*} = \frac{1}{\sqrt{2}} \left(\mathbf{i} - i\mathbf{j}\right), \tag{5.23}$$

$$\mathbf{e}^{(3)} = \mathbf{k}, \tag{5.24}$$

and the light beam described by Eqs.5.21 and 5.22 is circularly polarized. The Evans spin field of the radiation propagates with it and is defined [1]– [31] by:

$$\begin{aligned} \mathbf{B}^{(3)} &= \mathbf{B}^{(3)*} \\ &= -ig\mathbf{A}^{(1)} \times \mathbf{A}^{(2)} \\ &= B^{(0)}\mathbf{k} \end{aligned} \tag{5.25}$$

where

$$\mathbf{A}^{(1)} = \mathbf{A}^{(2)*} \tag{5.26}$$

is the vector potential of the wave. Here:

$$g = \frac{\kappa}{A^{(0)}} \tag{5.27}$$

The spin field is observed experimentally in the inverse Faraday effect [1]– [31]- the magnetization of matter by circularly polarized electromagnetic radiation - and the spin field is the key property of light and electromagnetic radiation that shows that the latter is a phenomenon not of special relativity but of general relativity [34]. In special relativity the Evans spin field is undefined but in general relativity it is well defined because light is realized to be the spinning of ECE spacetime. This is an important inference of ECE field theory, an inference which overhauls the theory of light from the nineteenth to twenty first centuries. In the Cartan representation of the nineteenth century Maxwell Heaviside field theory the relation between the field and potential of light is [1]– [31]:

$$F = d \wedge A. \tag{5.28}$$

In ECE field theory of the twenty first century it is:

$$F^a = d \wedge A^a + \omega^a{}_b \wedge A^b \tag{5.29}$$

where the spin connection self consistently defines the spinning frame and the Evans spin field [1]– [31] of general relativity. Eq.5.29 cures a problem that plagued field theory throughout the twentieth century: gravitation was considered to be a curving spacetime (the EH spacetime) whereas electromagnetism was considered to be still the pre-relativistic nineteenth century theory: essentially an abstract entity (the electromagnetic field) superimposed on a separate frame - the passive and flat Minkowski spacetime of special relativity. This severe self inconsistency prevented the unification of gravitation with electromagnetism for over one hundred and fifty years and therefore blocked the development of cosmology. In the unified ECE field theory [1]– [31] the true nature of cosmology can be seen to be the interaction of gravitation with light reaching telescopes in astronomy. The interaction is precisely defined by the currents j^a and J^a. In this paper we restrict attention to j^a and to simple analytical solutions of Eq.5.9.

The simplest solution of all can be deduced by noting from Eq.5.22 that:

$$\frac{\partial \mathbf{B}^{(1)}}{\partial t} = i\omega \mathbf{B}^{(1)} = -\omega \frac{B^{(0)}}{\sqrt{2}} \left(\mathbf{i} - i\mathbf{j}\right) e^{(i(\omega t - \kappa Z))} \tag{5.30}$$

and from Eq.5.21 that:

$$\begin{aligned}\nabla \times \mathbf{E}^{(1)} &= \frac{E^{(0)}}{\sqrt{2}} \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ \frac{\partial}{\partial X} & \frac{\partial}{\partial Y} & \frac{\partial}{\partial Z} \\ e^{i\phi} & -ie^{i\phi} & 0 \end{vmatrix} \\ &= -i\frac{E^{(0)}}{\sqrt{2}}\kappa\left(i\mathbf{i}+\mathbf{j}\right)e^{i\phi}\end{aligned} \tag{5.31}$$

where

$$\phi = \omega t - \kappa Z. \tag{5.32}$$

Therefore

$$\omega B^{(0)} = \kappa E^{(0)}. \tag{5.33}$$

From Eqs.5.30 and 5.31, Eq.5.33 is true if:

$$E^{(0)} = cB^{(0)} \tag{5.34}$$

i.e. if:

$$\frac{\omega}{\kappa} = \frac{E^{(0)}}{B^{(0)}} \tag{5.35}$$

and if the phase velocity is:

$$c = \frac{\omega}{\kappa}. \tag{5.36}$$

In order to find the required simplest possible solution of Eq.5.9, identify the phase as:

$$\phi = \frac{\omega}{\mu_r}t - \epsilon_r\kappa Z. \tag{5.37}$$

If for the sake of simplicity we assume that the relative permeability μ_r is a function of X, Y and Z but not a function of t then:

$$\frac{\partial}{\partial t}e^{i\phi} = \frac{i\omega}{\mu_r}e^{i\phi}. \tag{5.38}$$

It has also been assumed implicitly that the wave-vector component κ is κ_Z, i.e. defined by:

$$\kappa = \kappa_z\mathbf{k}, \tag{5.39}$$

because the wave is propagating in Z. So it follows that:

$$\frac{\partial}{\partial Z}e^{i\phi} = -i\epsilon_r\kappa e^{i\phi}. \tag{5.40}$$

The required simplest possible solutions are then:

$$\mathbf{E}^{(1)} = \frac{E^{(0)}}{\sqrt{2}}\left(\mathbf{i}-i\mathbf{j}\right)e^{\left(i\left(\frac{\omega}{\mu_r}t-\epsilon_r\kappa Z\right)\right)} \tag{5.41}$$

and

$$\mathbf{B}^{(1)} = \frac{B^{(0)}}{\sqrt{2}}\left(i\mathbf{i}+\mathbf{j}\right)e^{\left(i\left(\frac{\omega}{\mu_r}t-\epsilon_r\kappa Z\right)\right)} \tag{5.42}$$

provided that

$$\frac{\omega}{\mu_r}B^{(0)} = \epsilon_r\kappa E^{(0)}. \tag{5.43}$$

From Eq.5.43 we identify the RED SHIFT:

$$\omega \rightarrow \frac{\omega}{\mu_r} \tag{5.44}$$

where μ_r is in general a function of X, Y and Z. The red shift is therefore caused by the relative permeability of ECE spacetime. The phase velocity v of the light beam is also defined by Eq.5.43 and is less than c. The light beam is slowed by its interaction with gravitation to:

$$v = \frac{c}{n^2} = \frac{c}{\mu_r \epsilon_r}. \tag{5.45}$$

In the next section this will be shown to be the root cause of the tired light theory, a theory shown conclusively by Vigier et al. [41] to be preferred experimentally to Big Bang. The slowing of light by a dielectric (ECE spacetime) is analogous to the well known refraction of a light beam by a medium such as water or glass. The refraction causes the path of the light to be changed, and this is exactly what happens in the Eddington effect. Historically the latter has been addressed with great accuracy by the central part of ECE theory as described in the introduction. The central part is EH theory, and EH theory is recovered when the torsion vanishes, leaving only the curvature. In the central limit the first Bianchi identity of Cartan geometry [1]– [31, 34]:

$$d \wedge T^a + \omega^a{}_b \wedge T^b = R^a{}_b \wedge q^b \tag{5.46}$$

reduces to the Ricci cyclic equation:

$$R^a{}_b \wedge q^b = 0 \tag{5.47}$$

because the torsion form T^a is zero. The Ricci cyclic equation 5.47 implies that the Christoffel connection of Riemann geometry is symmetric:

$$\Gamma^\kappa{}_{\mu\nu} = \Gamma^\kappa{}_{\nu\mu} \tag{5.48}$$

and this assumption pervades the whole of EH field theory. The latter can therefore describe central effects with great accuracy, but cannot describe rotational accelerations involving torsion. EH theory was applied historically to the bending of light by the sun by considering the interaction of photon mass with the sun's mass. It happens to be that this theory is accurate to one part in one hundred thousand for the sun, but as discussed in the introduction, this is a semi-classical theory without any consideration of the electric and magnetic fields of the light. The Eddington effect in ECE field theory can be calculated to one part in one hundred thousand accuracy [35] from its central part (EH theory) and ALSO recognized as being the red shift:

$$\omega \rightarrow \frac{\omega}{\mu_r(X, Y, Z)} \tag{5.49}$$

where μ_r is defined by the trajectory of the photon around the sun (an orbit). So the ECE theory describes the gravitational pull of the sun on the photon defined as a particle with mass, and also defines the interaction of gravitation with electromagnetism inherent in the process but unrecognized in EH theory and Big Bang. One cannot have a photon without an electromagnetic wave and

the orbit of the photon is described by the fact that the relative permeability is a function of X, Y and Z. This function is the classical description of the orbit as a REFRACTION, or gradual change in path of a light beam in an inhomogeneous dielectric (one in which the relative permeability is a function of X, Y and Z).

5.3 Absorption And The Beer Lambert Law In ECE Cosmology

As argued in Section 5.2 it is important to account for absorption processes in inter stellar and inter galactic regions because absorption means that the light reaching a telescope is not related straightforwardly in general to the intrinsic luminosity of a cosmological object. Luminosity in astronomy is defined in watts, the rate at which energy of all types is radiated in all directions. This is the area integral of the power density I in watts per meter. Luminosity in physics is defined as the density of luminous intensity in a given direction, i.e. watts per square meter per steradian, or power density per steradian (the measure of solid angle). All that can actually be measured experimentally in astronomy is the power density or intensity of light reaching a telescope from an object such as a star or galaxy:

$$I = \frac{L}{4\pi Z^2} \tag{5.50}$$

where L is the assumed intrinsic astronomical luminosity of an object and where Z is the distance from object to telescope. It is almost always assumed that there is no absorption along the entire length Z - despite the fact that this may be an immense distance. Even the nearest star is millions of kilometers away from the telescope. It is almost certain however that the light from any cosmological object has been absorbed in many different ways by many different absorbing mechanisms before it reaches the telescope. The absorption is defined by the well known Beer Lambert law:

$$I = I_0 e^{-\alpha Z} \tag{5.51}$$

where α is the power absorption coefficient in S. I. units of neper per meter [46] and where I and I_0 are respectively the power density or intensity of the radiation after and before absorption. The assumption of no absorption means that:

$$I = I_0, \tag{5.52}$$

$$\alpha = 0, \tag{5.53}$$

and this is the assumption used in standard astronomy to measure the intrinsic luminosity of a given object such as a star. This assumption is vanishingly unlikely to be true.

The intensity I must be measured with a detector. The first type was a photographic plate. The film was exposed to a light source of known intensity and the total energy required to produce the image was calculated for a given

exposure time and given telescope aperture. This gave a baseline for the measurement of I from an object such as a star. The distance Z in Eq.5.50 can only be estimated if the intrinsic luminosity L of the object is known independently. Vice versa L can only be calculated if Z is known independently. Only I can be measured experimentally, and as argued this is vanishingly unlikely to be I_0. Therefore L is vanishingly unlikely to be the true intrinsic luminosity of an object in astronomy. These simple facts question the experimental basis of the whole of cosmology. Before the advent of photography the method of intensity could not be used to estimate the object to telescope distance Z. A method such as parallax could be used, a method which directly estimates the distance of a star by trigonometry. Contemporary electronic methods such as the helium cooled Rollin detector [46] can measure I accurately, but the assumption that I is I_0 is almost always used. This false assumption makes the accuracy of measurement of I irrelevant. Trigonometric parallax in contemporary astronomy may be used for nearby stars and is accurate to a thousandth of an arc second. This is therefore the only reliable measure of distance Z in astronomy. Even then, the intrinsic luminosity of an object has to be based on the assumption of no absorption. Therefore L is not known with any certainty even when Z has been measured by parallax. The various assumptions of cosmology, such as dark matter, missing mass, and universal expansion are based on extrapolations from data of this kind. It is assumed that there is a relation between the intrinsic luminosity L and the mass of an object. This is a theoretical model, not a law of nature. Above all, as argued in Section 5.2, cosmology is based on EH cosmology, which is not the required unified field theory, and therefore has shaky foundations.

Assis [40] has also argued for the presence of absorption in inter-stellar and inter-galactic regions. He uses the Beer Lambert law for the total electromagnetic energy density U (joules per cubic meter), which is related to the power density I (watts per square meter) by:

$$I = cU \tag{5.54}$$

Thus

$$U = U_0 e^{-\alpha Z} \tag{5.55}$$

Assis assumes that the beam of light is monochromatic, (made up of n photons at the same frequency), so that the following equation is valid:

$$U = \hbar\omega/V. \tag{5.56}$$

The red shift in this monochromatic beam is therefore defined directly from the Beer Lambert law as follows:

$$\omega = \omega_0 e^{-\alpha Z}. \tag{5.57}$$

The observed red shift in this simple monochromatic model can therefore be deduced to be due to absorption and not due to the expansion of the universe. Different red shifts may occur for physically linked objects equidistant from the observer because the light reaching the telescope has simply been differently absorbed. Standard cosmology cannot explain this simple observation by Arp et al. [39].

The extra input to the Assis theory given by ECE theory is that light has been absorbed by the residual gravitational field in a universe produced by n gravitating objects. As for any absorption process [46] a spectrum (frequency dependent power absorption coefficient) is produced at a detector (a telescope), accompanied by frequency dependent dispersion and refraction. The mechanism for absorption is given by Cartan geometry and the homogeneous current j^a. The light may be thought of as a source, and the gravitational field through which the light travels may be thought of as a sample of absorbing dielectric. The absorption of light by gravitation produces heat, and heat is governed by the laws of thermodynamics. The absorption process is therefore accompanied by an increase in entropy in the universe as observed [40]. The interaction of light with the gravitational field produces heat from the homogeneous current j^0 and this is radiated as the background black body radiation of the universe at an observed temperature of 2.7 K [40]. This is the origin of cosmic radiation, which is well known experimentally to arrive at the earth from outside our galaxy, and to pervade the known observable universe. The 2.7 K temperature is described by Assis [40] as the average temperature of the whole universe, made up of stars, galaxies, other objects and also the background radiation.

Regener [47] measured a temperature of 2.8 K and later Penzias and Wilson later [48] confirmed Regener's much earlier result using radio astronomy, a different method. Regener considered cosmic rays to be black body radiation consisting of many frequencies. The black body radiation from an ensemble of N Planck oscillators (photons) is described [44] by:

$$\frac{dU}{dv} = \frac{8\pi h v^3}{c^3}\left(\frac{e^{-hv/kT}}{1-e^{-hv/kT}}\right) \tag{5.58}$$

where v is the frequency, h is the Planck constant, k is the Boltzmann constant, and T the temperature. The total electromagnetic energy density (U) of a black body such as the 2.7 K background radiation is obtained by integrating Eq.5.58 over all frequencies contained within the radiator. Thus:

$$\begin{aligned} U &= \int_0^\infty \frac{8\pi h v^3}{c^3}\left(\frac{e^{-hv/kT}}{1-e^{-hv/kT}}\right) dv \\ &= 4\frac{\sigma}{c}T^4 \end{aligned} \tag{5.59}$$

where

$$\sigma = \frac{2\pi^5 k^4}{15c^2h^3} = \frac{1}{4}\left(\frac{\pi^2 k^4}{15c^2\hbar^3}\right) \tag{5.60}$$

is the Stefan-Boltzmann constant [44]. Thus:

$$I = cU = 4\sigma T^4 \tag{5.61}$$

and at 2.7 K [44]:

$$U = 4.02 \times 10^{-14} Jm^{-3}. \tag{5.62}$$

Regener [47] and others [49] measured I and obtained T through the Stefan-Boltzmann law 5.61. In ECE theory the further insight given is that the origin of I (cosmic ray intensity) is the interaction of light (or electromagnetic radiation) with the residual gravitational field of the universe. This is also the origin of all

observed red shifts. The numerous different types of red shift now observable [50] are due to different mechanisms of absorption. In un-unified EH theory and standard cosmology these mechanisms are absent because there is no current j^a. Red shifts in standard cosmology are described using an assumed expansion of the universe and an assumed Hubble law [40] which does not work in general. As argued by Assis the tired light model [40] can be obtained, for monochromatic radiation only, from an assumed absorption coefficient:

$$\alpha = H/c \tag{5.63}$$

where H is the so called Hubble constant. In ECE theory a more rigorous and more generally applicable derivation of the red shift [1]– [31] is given in terms of permeability as described in Section 5.2. ECE theory applies to black body radiation (many frequencies) as well as monochromatic radiation (one frequency only). Neither the tired light model nor the Big Bang model is applicable in general because the permeability of ECE space time is a complicated function of Cartan geometry, of the curvature form, the torsion form, the spin connection, and the tetrad. The tired light model is the limit of ECE theory where the power absorption is a constant. More generally, as for any spectrum, the power absorption coefficient is a richly structured function of frequency, not a constant. Thus red shifts are given by ECE theory which are given neither by standard cosmology nor Big Bang theory. Observed examples include anomalous shifts near the sun [51], quantized red shifts [52], and different red shifts for equidistant objects [39]. The fact that red shifts are observed to increase near the limits of observation of the known universe [53] is a property of absorption, a spectral phenomenon, and not due to the accelerations of far galaxies as presently thought. There is no reason to think that the power absorption coefficient generated by the interaction of light with residual gravity must be a constant, as in Eq.5.63, and data have shown conclusively that H is not in fact a constant.

The standard procedure in cosmology used to link the intrinsic luminosity or emitted bolometric power (L in watts) of a cosmological object to its observed power density at a telescope (I in watts per square meter) is:

$$I_0 = \frac{L_0}{4\pi Z^2} \tag{5.64}$$

where Z is the object to telescope distance. The area $4\pi Z^2$ is the surface area of a sphere with origin at the object and radius Z. As argued here and independently by Assis [40] the Beer Lambert law changes Eq.5.64 to:

$$I = \frac{L_0}{4\pi Z^2} e^{-\alpha Z}. \tag{5.65}$$

Assis calculates the average total flux $\langle I \rangle$ of an Universe of infinite radius consisting of n objects per m^3 in a sphere of radius Z (in units of watts m^2) as follows:

$$\langle I \rangle = \int_0^\infty \frac{L_0}{4\pi Z^2} \cdot 4\pi Z^2 n dZ = \frac{L_0 n}{\alpha}. \tag{5.66}$$

We note that this procedure is an integration over a sphere in spherical polar coordinates. The surface area of a sphere in spherical polar coordinates is given

by [53]

$$S = \int_0^{2\pi} d\theta \int_0^{\pi} r^2 \sin\phi d\phi = 4\pi r^2 \tag{5.67}$$

where the three cartesian distances along an axis (x, y, and z) for a radius r are defined by:

$$x = r\sin\phi\cos\theta \tag{5.68}$$

$$y = r\sin\phi\sin\theta \tag{5.69}$$

$$z = r\cos\phi. \tag{5.70}$$

Here ϕ is the angle between r and the z axis, and θ the angle between the projection of r on the xy plane and the x axis [53]. We therefore find that:

$$\int_0^{2\pi} \int_0^{\pi} \sin\phi d\phi = 4\pi \tag{5.71}$$

and this is the relation implicitly used by Assis in arriving at his important equation 5.66. The volume of a sphere is found by integrating over its surface area:

$$V = \int_0^r 4\pi r^2 dr = \frac{4}{3}\pi r^3 \tag{5.72}$$

and the infinitesimal angle element in spherical polar coordinates [53] is:

$$d\Omega = \sin\phi d\phi d\theta. \tag{5.73}$$

Therefore more generally, Assis' Eq.5.66 is:

$$\langle I\rangle = n\int_0^{\infty} r^2 I dr \int_0^{2\pi} d\theta \int_0^{\pi} \sin\phi d\phi \tag{5.74}$$

which is an integration over a sphere as argued. The equivalent integration over a solid angle or cone depends on the limits taken for the integrals, in general:

$$\langle I\rangle = nL_0 \int_0^r e^{-\alpha r} dr \cdot \frac{1}{4\pi} \int_0^{\theta} d\theta \int_0^{\phi} \sin\phi d\phi. \tag{5.75}$$

Eq.5.74 is applicable for integration over the whole universe and gives the value of $\langle I\rangle$ measured experimentally by Regener [47] and others [49]. From this the T = 2.7 K background is found using the Stefan-Boltzmann law. Assis' equation 5.66 or more generally Eq.5.75, are basically important because they give the correct background radiation temperature as confirmed (but not discovered) by Penzias and Wilson [48]. It has been found that the inter-stellar regions of our own galaxy are at this same temperature. The origin of this temperature in ECE theory is black body emission from the residual gravitational field of the universe, as argued already. Thus COSMIC ABSORPTION is the root cause of this temperature, not an assumed expansion as in Big Bang. Light reaching a telescope has always been absorbed in some way on its immensely long journey from the source (for example a star) to the telescope. The power absorption coefficient must always be calculated from a unified field theory (ECE), and not a theory of gravitation only (EH).

The night sky is dark because the mean temperature of the whole universe is only 2.7 K above absolute zero (colder than liquid helium). In contrast the

sun is very bright, even at a distance of ninety three million miles, because its surface temperature is very high. In standard (EH) cosmology inter stellar and inter galactic regions are assumed to be "void", i.e, a vacuum, and red shifts are assumed to be due to an initial singularity. Therefore in the Big Bang light is never absorbed on its journey from source to telescope. It is well known experimentally [40] that this assumption is incorrect, as argued in this paper already. The correct ECE cosmology of unified field theory produces red shifts from Cartan geometry, which leads [1]– [31] to the homogeneous field equation 5.9. The simplest possible solution to this equation gives the red shift rule:

$$\omega \rightarrow \frac{\omega}{\mu_r}. \tag{5.76}$$

In general the permeability of ECE spacetime is complex valued:

$$\mu_r = \mu_r' + i\mu_r'' \tag{5.77}$$

so the power absorption coefficient is defined from Eq.5.76 by [46]:

$$\alpha(\omega) = \frac{\sqrt{2}\omega\mu_r''(\omega)}{c(\mu_r' + (\mu_r'^2 + \mu_r''^2)^{1/2})^{1/2}} \tag{5.78}$$

and is in general richly structured, i.e can generate spectral features such as the diffraction rings observed in gravitational lensing, quantized red shifts and so forth. Spectral shifts also depend on whether the ECE spacetime is diamagnetic, paramagnetic , ferromagnetic or superconducting [44]– [45] because permeability depends on these properties in the theory of magnetism. None of these concepts exist in EH theory.

For a given volume V the flux $\langle F \rangle$ of Eq.5.66 can be related to a mean measured power density $\langle I \rangle$ and temperature through the Stefan-Boltzmann law 5.61:

$$\begin{aligned} \langle \alpha \rangle &= nL_0 / \langle I \rangle, \\ n &= n_0/V. \end{aligned} \tag{5.79}$$

Therefore the power absorption coefficient is defined by:

$$\langle \alpha \rangle = \frac{n_0 L_0}{4\sigma V T^4}. \tag{5.80}$$

For black body radiation at 2.7 K [44]:

$$\langle I \rangle = 1.205 \times 10^{-5} watts m^{-2}. \tag{5.81}$$

The volume V for a radius Z is from Eq.5.72:

$$V = \frac{4}{3}\pi Z^3 \tag{5.82}$$

so the mean power absorption coefficient for absorption by the average gravitational field of the universe is:

$$\langle \alpha \rangle = \frac{3n_0 L_0}{16\sigma Z^3 T^4}. \tag{5.83}$$

It is seen that this is inversely proportional to the cube of distance Z and inversely proportional to the fourth power of the mean temperature of the universe, T = 2.7 K. Here the universe has been considered to be of infinite extent

and spherical. If there were no absorption there would be no mean intrinsic luminosity $\langle L_0 \rangle$ of the universe, meaning that *if* there were no absorption of light by the average gravitational field of the universe, there would be no heat created, and there would be no black body radiation, or cosmic radiation. This is contrary to experimental evidence, cosmic radiation is well known, but this is also the result of standard EH cosmology in which $\langle \alpha \rangle$ is zero. Thus ECE cosmology is preferred experimentally to EH cosmology. ECE unified field theory correctly predicts the 2.7 K background temperature without use of Big Bang. The latter is replaced by a cosmology in which there may be local expansions occurring (leading to the evolution of planets and elements) but no overall expansion from an unphysical singularity or arbitrarily assumed initial event.

5.4 Relation Between Power Absorption and Mass

In this section the equation relating the mass of an object to its intensity is derived, a derivation based on the fact that the intensity absorbed by an object of mass M and radius R (surface area of $4\pi R^2$) is the same as the intensity the object absorbs from the universe around it:

$$I_{absorbed} = I_{emitted}. \tag{5.84}$$

The absorbed intensity in watts per square meter is:

$$\langle I_{absorbed} \rangle = nL_0 \int_0^r e^{-\alpha r} dr \cdot \frac{1}{4\pi} \int_0^\theta d\theta \int_0^\phi \sin\phi d\phi \tag{5.85}$$

where L_0 is the intrinsic luminosity of a surface area $4\pi r^2$ of the whole universe, and n is the number of objects in the equivalent volume $\frac{4}{3}\pi r^3$. Assis [40] has considered the limit where integration in Eq.5.85 is carried out over a sphere of infinite radius. In this limit:

$$r \to \infty, \quad \theta \to 2\pi, \quad \phi \to \pi. \tag{5.86}$$

This average is described by Assis [40] as the total flux received by an object from the whole universe. The flux is a power density or intensity of black body radiation in watts per square meter, with n defined [40] by:

$$n = \rho / M. \tag{5.87}$$

Here ρ is the mean density of matter in the universe ($10^{-27} kgmm^{-3}$), and M is the average mass of an object (kgm). Therefore the units of n are inverse cubic meters.

Therefore:

$$\langle I_{absorbed} \rangle = \frac{\rho L_0}{M\alpha} \tag{5.88}$$

and so L_0 is interpreted as the average luminosity of an astronomical object of average mass M. Assis considers n such objects in an infinite spherical universe which is considered to be in a steady state. Therefore an astronomical object emits the same intensity of radiation as it absorbs (Eq.5.84) because it is in

thermodynamic equilibrium with the heat bath. If the radius of the object is R its emitted power density or intensity is [40]:

$$I_{emitted} = \frac{L_0}{4\pi R^2} \tag{5.89}$$

and it is assumed that:

$$\langle I_{absorbed} \rangle = I_{emitted}. \tag{5.90}$$

This assumption means that the emitted intensity is the same as the average $\langle I_{absorbed} \rangle$ absorbed by the object (for example a star or galaxy) from the rest of the universe. From Eqs.5.88 and 5.89:

$$\alpha = 4\pi R^2 \rho / M \tag{5.91}$$

and using the Stefan-Boltzmann law:

$$I = \frac{L_0}{4\pi R^2} = 4\sigma T^4. \tag{5.92}$$

Here T is interpreted by Assis [40] as being the average background temperature of the universe, and is the measured temperature of the all pervasive background radiation. This has been measured experimentally to be $2.725 \pm 0.002K$.

Therefore the average power absorption coefficient of the steady state universe is:

$$\alpha = \frac{\rho L_0}{4M\sigma T^4}. \tag{5.93}$$

If R can be measured independently by parallax L_0 can be found from Eq.5.92. Given the mean density ρ of the universe (about 10^{-27} kgm per cubic meter) the mass M can be expressed as being inversely proportional to α:

$$\alpha = \left(\frac{\rho L_0}{4\sigma T^4} \right) \frac{1}{M}. \tag{5.94}$$

Conventional cosmology assumes that the power absorption coefficient is the Hubble constant within a factor c [40]:

$$\alpha = H/c, \tag{5.95}$$

and therefore the mean mass M of an object can be found given R, T and H. From this model Assis [40] finds that:

$$\frac{L_0}{M} \sim 10^{-5} watts kg^{-1}, \tag{5.96}$$

$$\frac{L_0}{R^2} \sim 4 \times 10^{-5} watts m^{-2}, \tag{5.97}$$

which is in order of magnitude agreement with experimental data for most galaxies. For the Milky Way for example [40]:

$$\frac{L_0}{M} \sim 2.5 \times 10^{-5} watts kg^{-1}, \tag{5.98}$$

$$\frac{L_0}{R^2} \sim 4 \times 10^{-5} watts m^{-2}. \tag{5.99}$$

For a perfect black body at 2.7 K the intensity radiated from the Stefan Boltzmann law is $1.2 \times 10^{-5} Wm^{-2}$ [45]. In a steady state model for the universe therefore the mean intensity of radiation from the mean temperature of the universe is $1.2 \times 10^{-5} Wm^{-2}$. This is only about an order of magnitude less than the mean intensity of most galaxies so the background radiation makes up a large part of the radiated heat of the steady state universe.

ECE theory is an objective unified field theory, unlike the purely gravitational hot Big Bang and steady state cosmologies of EH theory, so ECE theory is a cosmology in which there are unified fields, not isolated component fields such as gravitation, electromagnetism, weak and strong. Therefore in ECE cosmology electromagnetism can be changed into gravitation and vice versa. One field is interacting with the other. The homogeneous equation governing this interaction is Eq.5.9. The relative permittivity is defined through the refractive index and the relative permeability by:

$$\epsilon_r = n^2/\mu_r \tag{5.100}$$

and is general a complex quantity. The power absorption is defined [46] conventionally as:

$$\alpha = \frac{\omega \epsilon_r''}{n'(\omega) c} \tag{5.101}$$

Therefore Eq.5.95 is true if

$$\frac{\omega \epsilon_r''}{cn'} = \frac{H}{c} \tag{5.102}$$

i.e.

$$\epsilon_r'' = \frac{n' H}{\omega} \tag{5.103}$$

which is the mean or background dielectric loss in a steady state universe. This dielectric loss is due to the mean ρ of the universe heating up after absorbing light or electromagnetic radiation through the homogeneous current j^a. However it is known experimentally [40] that α is not H/c in general because there are many types of anomalous red shift now known experimentally as discussed already in this paper. The parameter H varies in general and is not a constant of cosmology, therefore as for any absorption coefficient α may be structured in general, i.e. may have spectral features. In other words both α and H can only be described as averages or backgrounds on which are superimposed many other features. This is an experimental result. In hot Big Bang H is asserted incorrectly to be a constant and absorption is unconsidered, inter stellar and inter galactic absorption is ignored because it is assumed that such regions are essentially high vacua. This assumption is known experimentally to be false [40]. Effectively, hot Big Bang claims to predict the background temperature of 2.725 $\pm$ 0.002 K to within one thousandth of a degree after fifteen billion years of complicated evolution. In reality hot Big Bang uses several parameters to fit data and is not a predictive theory from first principles. Its initial conditions are obviously not physics - infinite mean temperature and density within zero volume for the universe. There are other well known problems in hot Big Bang - flatness, isotropy, dark matter and accelerated rate of expansion, so there is an urgent need to replace hot Big Bang with ECE theory, a correctly unified field theory without unphysical initial conditions and groundless claims. ECE theory correctly introduces absorption α from Cartan geometry.

It is therefore clear from these simple arguments alone that the mean mass M from Eq.5.94 is meaningful only in an order of magnitude approximation. It is unsurprising that estimates of M are not the same as those obtained from other data (the "missing mass" problem). This does not mean that there is missing mass in the universe - it means simply that absorption has not been correctly accounted for in EH field theory because it is not a unified field theory. The conclusion of this section is that there is no evidence for dark matter in the universe, but there is plenty of experimental evidence for absorption processes neglected in hot Big Bang.

5.5 Gravitational Anomalies Within The Solar System

Jensen [54] has discussed small gravitational anomalies in flight paths of vehicles such as Odysseus, Galileo, Pioneer 6, 10 and 11, Polar lander and Climate orbiter. Jensen assumes a mass dependent permeability and in this section it is demonstrated that this concept is inherent in ECE theory.

We start with the Bianchi identity in the form [1]– [31]:

$$d \wedge T^a = j^a \tag{5.104}$$

where the homogeneous current is defined by:

$$j^a = R^a{}_b \wedge q^b - \omega^a{}_b \wedge T^b. \tag{5.105}$$

Eq.5.104 is the homogeneous field equation linking torsion and curvature in ECE theory. EH theory is the limit:

$$R^a{}_b \wedge q^b = T^a = 0. \tag{5.106}$$

The tensor form of Eq.5.104 is:

$$\partial_\mu \widetilde{T}^{a\mu\nu} = \widetilde{j}^{a\nu} \tag{5.107}$$

where the torsion tensor is defined by:

$$\widetilde{T}^{a\mu\nu} = \begin{bmatrix} 0 & -T^{a1}{}_s & -T^{a2}{}_s & -T^{a3}{}_s \\ T^{a1}{}_s & 0 & T^{a3}{}_c & T^{a2}{}_c \\ T^{a2}{}_s & -T^{a3}{}_c & 0 & T^{a1}{}_c \\ T^{a3}{}_s & T^{a2}{}_c & -T^{a1}{}_c & 0 \end{bmatrix}. \tag{5.108}$$

The homogeneous field equation 5.107 leads to the following vector equation:

$$\nabla \times (\epsilon_r \mathbf{T}^a{}_0) + \frac{1}{c}\frac{\partial}{\partial t}\left(\frac{1}{\mu_r}\mathbf{T}^a{}_s\right) = \mathbf{0} \tag{5.109}$$

which is the direct analogue of Eq.5.9. In this equation the relative permeability μ_r and relative permittivity ϵ_r are defined as in Eq.5.9 as those of ECE spacetime. In general the permeability is a function of X, Y and Z and therefore of mass, as postulated by Jensen [54], i.e.:

$$\mu_r\left(X, Y, Z\right) = \frac{n^2}{\epsilon_r}. \tag{5.110}$$

In the Einstein Hilbert limit the relative permeability approaches unity:

$$\begin{aligned} \mu_r &\longrightarrow 1, \\ \epsilon_r &\longrightarrow 1, \\ n &\longrightarrow 1. \end{aligned} \tag{5.111}$$

As argued by Jensen [54] very tiny departures due to Eq.5.110 can account for the flight path anomalies in the above space probes. Under the condition 5.110, following the argument by Jensen [54], the mass appearing in the Newtonian limit becomes the total proximal mass, and not the mass of the object in motion. The proximal mass becomes larger as the object approaches the sun or a planet. In consequence less potential energy is changed into kinetic energy and the orbital velocity increases at a slightly lower rate than in the Newton equations. Accelerating away from the sun again, the probe would require slightly less energy to achieve a greater acceleration and to return the probe to its predicted path. This is what is observed in Pioneer 6 as it passes near the limb of the sun. Observed solar wind effects on Odysseus and Galileo also follow this model. Therefore the argument by Jensen [54] is effectively is that more potential energy than in the Newtonian limit is stored in a more massive environment described by a particular model of the ECE permeability5.110. This means for example that probes to Venus are proportionally slowed and probes to Mars are proportionally accelerated. Therefore the mass of Venus is overestimated and the mass of Mars is underestimated in orbital calculations used by NASA. This in turn would cause negative gravity anomalies near the mountain peaks on Venus and positive gravity anomalies near valley floors on Venus. The equivalent anomalies on Mars would have opposite sign. These probes give gravity maps of Mars from 300 to 800 km but the maps at 300 km are not consistent with those at 800 km, the 300 km data showing greater anomalies. The moment of inertia for Mars is apparently different if ranging data to the Pathfinder and Viking probes are used rather than the inertial moment necessary to explain the gravity anomalies. All of the Martian probes have landed at higher velocities than predicted from Newtonian equations, and also entered at higher attitudes. All descent trajectory models have required a thinner than expected upper atmosphere and higher than expected surface winds. Additionally the data from the Huygens probe can be better modeled, according to Jensen [54], with a mass dependent permeability as defined in Eq.5.110. These include data for rocks, craters, strata and Doppler descent data. There are no indications from the latest data from the Huygens probe of the wind shear of -230 km per hour necessary to model the Huygens descent from a pure Newtonian theory. Furthermore, MRO will provide gravity maps at 150 km which would be expected to show even greater anomalies from Eq.5.110. Finally [54] careful mapping effects of Saturn's moons on the NASA Cassini probe should provide further confirmation of Eq.5.110 as developed by Jensen [54].

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