Evidence for the Anisotropy of the Speed of Light

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The Beckmann model is considered in relation to both the Electric Universe perspective of a charged Earth and to the actual non-null results of the various Michelson-Morley-type experiments. It is demonstrated that the Beckmann model is consistent with both concepts. Furthermore, application of the Beckmann model to an orbiting charged Earth offers support to the interpretation of the non-null Michelson-Morley results as evidence not of an 'ether wind' but rather of an electromagnetically-induced directionally-dependent anisotropy of the speed of light. This hypothesis offers a new direction for research and possible re-analysis of existing data.

1. Introduction

The original Michelson-Morley experiment of 1887 failed to detect an ether wind *of the expected magnitude*; the presumption of a null result led to the development of the Fitzgerald-Lorentz Transformation and Einstein's Special Theory of Relativity, based on the postulate that the speed of light is constant with respect to the observer. The presumed null result also implies that the speed of light is isotropic, i.e. the same in all directions. However, the original Michelson-Morley experiment and the overwhelming majority of subsequent experiments of the same type have actually produced *non-null* results.

In 1987, Petr Beckmann offered an alternative to the observer-based frame of reference, suggesting that the speed of light is relative to the local dominant field. Because Beckmann assumed the Earth to be uncharged he argued that the relevant frame of reference for Earth-based experiments is the Earth's gravitational field. Beckmann also assumed that the Michelson-Morley experiments produced null results.

Proponents of the Electric Universe argue that the Earth is charged and that it orbits within the Sun's electromagnetic field.

The question naturally arises, how would the Beckmann model relate to a charged Earth and the non-null Michelson-Morley results?

2. The Beckmann Model of the Transmission of Light

Bethell introduced the Beckmann model of the transmission of light to last year's NPA-17 conference [1]. The model is explained and analyzed mathematically in full in Petr Beckmann's 1987 book, **Einstein Plus Two** [2].

The essence of the Beckmann model is that the speed of light is measured with respect to (henceforth 'wrt') the local field, not the observer, who in Beckmann's words is *'condemned to observing without interfering'* [2, p. 94].

The local field forming the frame of reference is whichever field is dominant in the region i.e. either the gravitational field or the local electromagnetic (henceforth 'e/m') field which, if present, will usually dominate a gravitational field. The Earth's local field orbits with the Earth but does not rotate with the Earth because the gravitational field does not itself rotate.

A key difference compared to the Einstein model for an Earth-bound observer is that in the Beckmann model the Earth's rotational velocity will cause the observer to move relative to the frame of reference in which light travels, whereas in Einstein's model light always has a fixed velocity wrt the observer.

3. Implications of the Beckmann Model

The implications of this simple change from an observer-dependent speed of light to a field-dependent speed of light are profound. From a rigorous mathematical analysis based on the Maxwell Equations and the Lorentz Force Law (not the Lorentz Transformation!), Beckmann derives a number of remarkable results.

First, the Maxwell Equations are restored to Galilean invariance because the observer's velocity is also relative to the local field and can be eliminated in the normal Galilean manner. The only effects in which the observer's velocity is significant are those relating to the perception of events by the observer, such as Doppler shift and aberration.

Beckmann's analysis also explains the anomalous precession of the orbit of Mercury; explains why planets orbit the true position of the central body despite the speed of light delay in the transmission of the gravitational force; derives the quantized electron orbit directly from considerations of the energy balance; derives mass increase with velocity as an e/m effect; and derives the Schrödinger Equation directly from the now-invariant Maxwell Equations, re-interpreting the quantum-mechanical 'probability wave function' as in fact a measure of the energy density of the electron's electric field.

The model resolves the contradiction of Newton's Third Law inherent in Einstein's theory when applied to co-moving masses or charges, which results in action and reaction not being equal and opposite.

Beckmann's analysis does not use or need Minkowski metric 4-dimensional tensor algebra, merely classical maths. The results evolve naturally from the single change of interpretation: velocity is measured relative to the local dominant field, not to the observer.

Beckmann's model is also consistent with all experiments purporting to support Einstein's Special Theory of Relativity.

4. Beckmann's Model from the Electric Universe Perspective

Beckmann makes three *a priori* assumptions:

1. That the Earth is electrically neutral (and therefore has no electric field) [2, p. 48]
2. That the relevant frame of reference for Earth-bound experiments is the Earth's gravitational field [2, p. 27]
3. That all Michelson-Morley (henceforth MM) experiments produced null results [2, p. 39]

From the Electric Universe (EU) perspective, all three assumptions are questionable and are considered below.

The EU perspective maintains that the Earth carries a significant electrical charge which results in the observed 100V/m vertical electric field and is the cause of the Earth's magnetic field due to the rotation of the charged Earth in the Sun's e/m environment.

The combination of this electric field and the well-known magnetic field together produce an e/m environment which dominates the gravitational field. **This paper suggests that the relevant frame of reference for the speed of light on Earth is always the Earth's e/m field.**

The Earth's local e/m field extends throughout the magnetosphere and is bounded by the magnetopause; beyond that, the Sun's field is the dominant field in the heliosphere, extending to the heliopause. By analogy, beyond the heliopause the galactic field is dominant, and so on, similarly to Beckmann's argument in relation to the gravitational field [2, p. 28].

This pattern of local dominance may also be further modified by the cellular nature of plasma in space, where regions with differing e/m parameters are often separated by double layers at the regional boundaries.

In every case, in the Beckmann model the speed of light is related to the locally dominant field.

If gravity should prove to be an e/m effect, as others will argue at this conference (NPA-18), then it will simply become a radial component of the overall e/m field.

This change of frame of reference from the Earth's gravitational field to its e/m field does not invalidate Beckmann's analysis as both the gravitational field and the e/m field orbit but do not rotate with the Earth. **Therefore we conclude that the EU perspective is entirely consistent with the Beckmann model in respect of the first two *a priori* assumptions above.**

Turning to the third assumption, the original MM experiment was fundamental to determining the course of physics at the end of the 19th century but, contrary to received opinion, it did *not* produce a null result. The experiment merely failed to observe an ether wind at the expected orbital velocity of the Earth of approx. 30 km/s; the result was taken to mean that the ether wind could not be observed and therefore that the ether did not exist. Fitzgerald, Lorentz and Einstein subsequently developed theories to explain the apparent null result.

However, MM *did* report an 'ether-wind-like' effect of some 5 km/s from their experiment. This and similar results will now be examined in more detail.

5. The Original MM Experiment

In essence, the MM experiment split a single beam of light into two parts which were sent on return paths at right angles to one another and then recombined and compared in an interferometer [3]. The theory states that if there was an ether headwind of a given velocity then the two light paths would shown a different average velocity (relative to the laboratory) for the return trip in the same way that flying a return trip into and with a headwind of a given velocity would take longer than the same length trip with a crosswind of the same velocity.

Once the MM apparatus was set up and an interference pattern established, the whole experiment was rotated so that the headwind and crosswind legs were effectively swapped over. Any difference to the first case would show up as a displacement of the interference pattern, from which the velocity of the 'headwind' could be determined.

MM performed their experiment at noon and again at 6 pm local time on each of three separate days. Each session involved 6 full turns of the experimental set-up, taking over half an hour for each session once the experiment had been properly initially calibrated.

MM concluded that '*… the relative velocity of the earth and the ether is probably less than one sixth the earth's orbital velocity, and certainly less than one-fourth*', i.e. probably less than 5 km/s and certainly less than 7.5 km/s [3, p. 341].

This non-zero result actually reported by MM was the average of 3 separate experimental sessions, with each session itself being an average of 6 turns of the equipment. However Hicks pointed out that, due to small differences in the mirror positions from session to session, averaging the three daily sessions tends to average out the very effect that the experiment was attempting to measure [4, p. 34]. After correcting for this, Hicks concluded that "*instead of giving a null result, the numerical data published in their* (i.e. MM's) *paper show distinct evidence of an effect of the kind to be expected.*" [4, p. 36].

According to Múnera, Miller reanalyzed Hicks' corrected MM data using his harmonic analyzer and concluded that MM had actually detected velocities of 8.8 km/s at noon and 8 km/s at 18:00 [5, p. 43].

Múnera reanalyzed the MM experiment and identified a further theoretical error [5, p. 41]. MM deliberately ignored the relative angle between the orbital velocity projected onto the plane of the experiment and the direction of local North, which was taken as the experimental reference direction, but in fact this angle changes with time. The necessary correction depends strongly on the time of day that the experiment was carried out, and even varies during the length of any one session.

In addition, Múnera demonstrates that the projection of the orbital velocity vector onto the plane of the interferometer also undergoes significant scale length changes; in other words, the expected detectable velocity varies significantly with the time of day and the season of the year and is not always close to 30 km/s [5, pp. 42-43].

6. Subsequent MM-type Experiments as Discussed by Múnera

Múnera undertook a comprehensive review of all the subsequent MM-type experiments; this section of this paper draws on that review, supplemented by reference to the original papers wherever possible [5].

Various later experiments of the original MM type were undertaken over the following decades. One of the most detailed was the series of experiments carried out by Dayton Miller carried out over a period from 1904 to 1933.

Miller's first publication in 1904 co-authored by Morley initially concluded that there was a fringe shift of less than 1/100th of that expected, corresponding to an ether drift of less than 1/10th of the expected magnitude ("*..the difference in velocity was less than 3.5 km/s ..*") [6,p.685], but, as Múnera points out, the authors had made the mistake of averaging the daily results [5, p. 44]. Miller himself later corrected the mistake and concluded that "*The morning and evening observations each indicate a velocity of ether drift of about 7.5 km/s*" [7, pp.216-7]

In 1925 Miller reported, "*The ether drift experiments at Mount Wilson during the last four years 1921 -1925 lead to the conclusion that there is a relative motion between the earth and the ether at this Observatory, of approximately nine km/s, being about one-third of the orbital velocity of the earth.*" [8,p.314]

Continuing his experiments, Miller published results again in 1933, measuring an observed velocity of around 10 km/s at the interferometer which he compared to an expected cosmical velocity of around 200 km/s [7, Table V, p. 235]. Miller could not explain the difference, stating: "*The observed displacement of the fringes, for some unexplained reason, corresponds to only a fraction of the velocity of the earth in space.*" [7, p. 236] Nevertheless, the observed velocity of around 10 km/s is clearly non-null.

Shankland et al re-analyzed Miller's results in 1955 and claimed to have shown that Miller's non-null results were due to "*temperature effects on the interferometer*" [9, p.178], to the satisfaction of supporters of Einstein's theories. However, Múnera points out that Shankland, et al, failed to correct for the epoch-dependent variation in the angle of the projection of the Earth's orbital velocity onto the plane of the interferometer, which error rendered their conclusions invalid [5, p. 45]. Múnera concludes that "*On the contrary, Miller's results are clear confirmation of equations (1), (2) and (10) in this paper*", i.e. those relating to epoch-dependency of the expected velocity.

Múnera discusses both Kennedy (1926) and Illingworth (1927) who used the same equipment. Referring to Kennedy, Múnera states, "*To our knowledge, this is the only experiment that ever reported a null result*", going on to observe "*… Kennedy's qualitative result is quite surprising in view of the detailed experiments carried out by Illingworth with Kennedy's own interferometer and at the same location ...*" [5, p. 46]

Again according to Múnera, Illingworth reported a result that '*showed no ether drift to an accuracy of about 1km/s*', [5, p. 46].but Múnera suggests that this conclusion was not supported by Illingworth's own data, some of which was reported in detail. Múnera re-analyzed Illingworth's published data and found strong evidence of the expected ether drift [5, p. 51].

Michelson, Pease & Pearson attempted to detect the orbital motion of the solar system around the galactic centre, estimated to be approx. 300 km/s, and reported in *Nature*, "*The results gave no displacement as great as one-fifteenth of that to be expected on the supposition of an effect due to a motion of the solar system of 300 km/s*" [10a, p. 88]. The 'one-fifteenth' was later altered without further comment in the reprint of their paper in JOSA to 'one fiftieth' of the expected displacement. However, even this small displacement was by no means a 'null' result given the magnitude of the expected velocity [10b, p. 182].

According to Múnera, Joos (1930) carried out the last of the true MM-type experiments and reported an ether wind smaller than 1.5 km/s [5, p. 48]. However, Múnera states that Joos had expected a null result and therefore "*rejected all large amplitudes as due to experimental errors*" (For a discussion of MM-like experiments see Section 9.3 below)

A later MM-type experiment using masers mounted at right-angles to each other on a rotating table was undertaken by Jaseja et al [11] detecting a frequency shift proportional to the square of the velocity rather than an interference fringe shift. The authors concluded that "*.. there is no anisotropy or* [*frequency*] *effect of either [sic] drift larger than 1/1000 of the small fractional term $(v/c)^2$ associated with the earth's orbital velocity.*",[11, p. 1221] which, as Hayden [12, p. 364] points out equates to an ether drift *velocity* of about 1 km/s.

However, Jaseja et al themselves reported in the abstract to their paper that "*Rotation of the* [*experimental*] *table through 90^0 produced repeatable variations in the frequency difference of around 275 [kHz] presumably because of magnetostriction in the Invar spacers due to the earth's magnetic field.*" [11, p1221] By scaling to the square of the velocity, this frequency difference equates to a velocity of approx. 12.8 km/s.

The authors do point out that this effect is largely but not entirely consistent over six hours, and therefore apparently not attributable to effects of the Earth's orbital velocity. Nevertheless it appears that the experimenters were not expecting to find any such effect at all and so, in the body of the paper, dismissed the relevant results by stating that "*The change is mostly associated .. with local effects such as the Earth's magnetic field...*" [11, p1224] The latter explanation is of course indicative of anisotropy in the lab frame of reference. We suggest that this anisotropy may be partly intrinsic to the speed of light in relation to the direction of the Earth's magnetic field, rather than entirely due to unquantified experimental effects as suggested by the authors.

In summary, the majority of true MM-type experiments have identified an apparent 'ether-drift-type' effect but of lower magnitude than the expected 'ether' velocity. The Jaseja et al experiment also appears to have detected a directional anisotropy independent of the Earth's orbital velocity.

7. Implications of the Non-null MM-type Experiment Results for the Beckmann Model

As previously stated, Beckmann assumed that the MM–type experiments gave null results; the question arises, what are the implications for the Beckmann model if in fact the results were non-null and there was an apparent 'ether wind effect' detected as a difference in the velocity of light in the two legs of the apparatus?

The Beckmann model is based on the postulate that the speed of light is measured wrt the locally-dominant field. If there is indeed an 'ether wind' of any magnitude arising solely due to the Earth's motion through a material, stationary ether, then this would appear to contradict the Beckmann model.

Suppose however that the non-null MM-type results were not due to a partially-entrained 'ether wind' but were in fact due to an e/m field effect acting on the speed of light as measured in the experiments which simply *appeared to the investigators* as though there was a partially entrained ether wind.

In that case, and taken together with our earlier conclusion that that the relevant field for Earth-bound experiments is the Earth's e/m field, then the non-null MM-type results would be entirely consistent with the Beckmann model.

We will therefore consider the implications of these non-null results within the framework of the Beckmann model.

8. Non-null MM-type Results under the Beckmann Model

The corollary of the interpretation of the non-null MM-type results as due to an e/m field effect is that the speed of light detected in these experiments is genuinely anisotropic in the medium of the experiment.

There is nothing in the Beckmann model which precludes an anisotropic speed of light. In fact, the Beckmann model gives some indirect support to this interpretation.

By analysis of the e/m fields *in moving media*, Beckmann [2, p. 85-88] derives the Fresnel drag coefficient directly from the Maxwell Equations and demonstrates that the resulting speed of light in a moving medium depends on the cosine of the angle between the velocity vector of the moving medium and the Poynting vector **E x H** of the relevant fields.

This paper suggests that from the perspective of the Sun's heliospheric e/m environment, the orbiting Earth together with its magnetosphere is just such a moving medium. Beckmann's model therefore would *predict* that the speed of light in Earth-bound experiments must be directionally anisotropic due solely to the behavior of the electric and magnetic fields in a moving medium.

If we now apply the Beckmann 'moving medium' analysis to the magnetosphere of the Earth moving in the e/m field of the Sun, and assume a radial **E** field in the heliosphere from the Sun charged positively wrt Earth as argued by proponents of the Electric Universe, then the direction of the Poynting vector is always anti-parallel to the Earth's orbital velocity, exactly analogous to the expected 'ether wind'.

Therefore we suggest that the MM-type experiment non-null results may in fact have detected the anisotropy effectively predicted by the Beckmann model, on e/m grounds alone, when applied to the Earth in its own magnetosphere orbiting within the Sun's e/m environment.

Beckmann's analysis of moving media considered an uncharged non-rotating medium, yet still found an e/m effect on the velocity of light in the medium. It may be expected that a fuller analysis, not attempted in this paper, of the effect on a charged, rotating and moving (orbiting) medium would lead to an enhanced effect.

The principle of the e/m environment affecting the transmission of light is well established. The speed of light *in vacuo* is itself derived directly from the Maxwell Equations and given by $c = 1/\sqrt{\varepsilon_0 \mu_0}$ where ε_0 and μ_0 are respectively the electrical permittivity and magnetic permeability of free space. Light is transmitted in the direction of its own Poynting vector. It is maybe unsurprising that when this vector is opposed by an externally-induced Poynting vector from the e/m environment then the speed of light is altered.

Other known effects of the e/m environment on the transmission of light include the Stark Effect and Zeeman splitting. Mention should also be made of the Kerr Effect, the Pockels Effect, the Faraday Effect, the Voigt Effect and the Cotton-Mouton Effect, all of which involve variable permittivity or permeability in relation to the direction of polarization of light.

9. Consideration of Possible Counter-Examples

9.1. The Sun's Galactic Orbital Speed

If the Earth's orbital velocity affects the speed of light on Earth, it might be expected that the Sun's galactic orbital speed of approx. 400 km/s would have a much more significant effect.

However, the Beckmann model suggests that the Sun's galactic orbital speed would have an influence on the speed of light within the heliosphere; the e/m field in the heliosphere then becomes the reference frame for the speed of light within the Earth's magnetosphere. It is the relative movement between the magnetosphere and the heliospheric frame of reference that causes the anisotropic effect within the former; the magnetosphere is therefore effectively 'insulated' from the movement of the heliosphere within the galactic environment.

9.2. The Earth's Rotation

The anisotropy in the speed of light in a moving medium depends on the angle between the velocity vector and the Poynting vector [2, p. 86]. The Poynting vector due to the charged Earth's rotation within its own field is always Eastwards in local Earth coordinates and therefore always aligned with the rotational velocity vector of magnitude of around 350 m/s at the latitudes where the experiments were carried out. Presumably, therefore, this effect will always be present and should have been detected by the MM-type experiments.

However, none of the MM-type experiments were sensitive enough to detect this effect. The original MM experiment was sensitive down to approx. 5 km/s; Dayton Miller's experiments to approx. 1 km/s at the 95% confidence level; Illingworth's experiments (using Kennedy's apparatus) claimed an accuracy of about 1 km/s; and Joos reported *"an ether wind smaller than 1.5 km/s"* [5, pp. 44-49].

Hayden has analyzed Jaseja et al's published results and concluded, *"The experiment was not sensitive enough to detect the circumferential velocity. The analysis of the data precluded discovering any possible effects due to the rotation of the Earth."* [12, p. 364]

9.3. Later "MM-type" Experiments

Múnera states that the Kennedy & Thorndike experiment of 1932 *"started a new class of experiments: a null-result in the M-M experiment was assumed, thus implying a length-contraction in the context of special theory of relativity (STR), the objective was then to test the ensuing time-dilation and/or the isotropy of the space. Direct inspection of the literature confirms that all modern 'M-M experiments' actually belong to the Kennedy-Thorndike class."* [5, p. 38]

Kennedy & Thorndike's expectations of their experiment were as follows: *"Hence, such a system at a point on the earth should give rise to an interference pattern which varies periodically as the ve-*

locity of the point changes in consequence of the rotation and revolution of the earth." [13, p. 400]

They stated that *".. we have shown that there is no effect corresponding to absolute time unless the velocity of the solar system in space is no more than about half that of the earth in its orbit."* [13, p.400]

This is clearly another non-null result reported as a null result because it failed to find the expected magnitude of the effect tested for. However, as argued above (Section 9.1), the effect of the Sun's galactic motion would not, under the Beckmann model, be expected to influence the Earth-bound Kennedy & Thorndike experiment.

We note that Kennedy & Thorndike did in fact identify an effect of the order of half the Earth's *orbital* velocity, i.e. of the same order of magnitude as the true MM-type experiments.

9.4. The Brillet-Hall Laser-based "MM-type" Experiment

According to Hayden, the Brillet-Hall experiment (1979) was *"By far the best MM experiment performed to date"* [12, p. 365]. Their intention was to look for *"any effects due to a cosmic drift associated with anisotropy in the cosmic blackbody radiation."* The results as presented *"show an absence of effects due to an extraterrestrial "ether" velocity down to a limit of 16 m/s."* As already argued above (Section 9.1) in relation to the Sun's galactic velocity, the cosmic drift velocity would not be expected to show any detectable influence on the experimental results when considered under the Beckmann model.

Turning to effects from the Earth's orbital velocity, we note that Brillet and Hall's analysis of the results is based on averaging large numbers of results over long time periods of 12h or 24h [14]. As discussed above (Section 5), such averaging will tend to eliminate any 'ether wind' effects arising from the Earth's orbital velocity. Brillet and Hall themselves state that *"Averages for 24h were sometimes quieter than 12-h averages"* [14, p. 551], an effect they ascribe to tilting of the floor, but this is exactly what should be expected from the averaging process. Brillet and Hall Table 3 shows clearly that averaging over 24h results in a near-zero effect, especially in the post-Day 238 'ideal' period.

Furthermore, Brillet and Hall converted their results to sidereal coordinates and found no correlation [14, Fig. 2, p. 551]. Whilst this lack of correlation rules out any 'ether wind' effect related to the Earth's motion in relation to the cosmic background radiation, as we now expect under the Beckmann model, it does not justify Brillet and Hall's conclusion that their experiment produced a null result. As their actual results show, there is in fact a clear dependence on the orientation of the experiment to the lab frame of reference.

Despite the averaging, Brillet and Hall reported a *'persistent spurious signal (17Hz amplitude at 2f)"* (where *f* is the frequency of rotation of the apparatus) which the authors attributed to possible imperfect alignment of the vertical axis of the apparatus.[14, p. 550-551]

However, Hayden pointed out that Brillet and Hall *"handled their data in a manner such that effects that may arise from the Earth's rotation are ignored"* and concludes that the "spurious' effect reported by Brillet and Hall is, in reality, support for the Beckmann model [12, p. 365].

9.5. Direct Measurements of the Speed of Light

The absolute speed of light has been measured indirectly by Evenson et al to an accuracy of ±1.1 m/s by separate measurements of the frequency and wavelength of laser light [15]. Hayden pointed out that even these levels of accuracy on round-trip measurements over a single beam path are insufficient to detect an 'ether wind' speed of less than 17 km/s and that the original MM experiment was *"far better than the best of the direct speed measurements with regard to minimum detectable 'ether' velocity"*. [12, p. 362]

The same argument applies to detection of anisotropic light speeds arising from the Beckmann analysis of e/m fields in moving media. In this case, the apparent 'headwind' arises due to motion anti-parallel to the Poynting vector and the apparent tailwind from motion parallel to that vector.

Clearly, direct speed of light measurements averaged over one return path are not yet sensitive enough to detect directionally anisotropic light speeds in Earth's environment.

9.6. Other Types of Optical Experiment

Hayden reviewed the other relevant types of optical experiment and concluded, *"All purely optical experiments that have had the sensitivity to detect the rotation of the Earth have produced data that point the same direction: the velocity of light measured with relation to a point on the rotating Earth combines vectorially with the rotational velocity at that latitude"* and therefore that *"the velocity of light is not constant [wrt a rotating lab frame of reference]"* [12, p. 366]

Evidence for the anisotropy of the speed of light wrt the lab frame of reference is therefore well established from other types of experiment, in accordance with the Beckmann model.

9.7. Other Evidence for Anisotropy of the Speed of Light

Hayden demonstrated by conservation of energy that the speed of light depends on the strength of the gravitational potential, and that the bending of starlight calculated according to this relation is in exact agreement with observations without invoking Einsteinian theory [16, p. 16].

10. Conclusions

This paper agrees with the Beckmann model in which the speed of light is measured wrt the locally-dominant field but has challenged certain peripheral assumptions made by Beckmann, namely:

1. That the Earth is uncharged and therefore has no electric field
2. That the relevant frame of reference for Earth-bound experiments is the Earth's gravitational field
3. That all Michelson-Morley (MM) experiments produced null results

Based on the postulate, adopted by proponents of the Electric Universe, that the Earth is a charged body, this paper suggests that the relevant frame of reference for Earth-bound experiments is always the Earth's electromagnetic field. It has been shown that this change of reference field does not invalidate Beckmann's analysis and that Beckmann's model is therefore consistent with the Electric Universe perspective in relation to assumptions (1) & (2) above.

Regarding assumption (3) above, evidence has been put forward that neither the original MM experiment nor the overwhelming majority of subsequent experiments of the same type actually produced null results.

We have suggested that the non-null results of the various MM experiments of the last century are consistent with the Beckmann model if they are interpreted not as a partially entrained ether wind but rather as an e/m field effect acting on the speed of light.

The corollary of this interpretation of the non-null MM-type results as an e/m field effect is that ***the speed of light detected in these experiments is genuinely anisotropic*** in the medium of the experiments. Support for this interpretation is found in the Beckmann model itself, wherein Beckmann has shown that anisotropy in the speed of light in moving media is a direct consequence of e/m interactions as described by the Maxwell Equations.

Consideration of possible counter-examples from other types of experiment has in fact shown further support for this hypothesis.

Furthermore, this paper suggests that the anisotropy in Earth-bound transmission of light may be related specifically to the interactions of the Poynting vectors of a beam of light and that of the local e/m field as modified by motion of the Earth's magnetosphere through the e/m environment of the heliosphere.

The above suggests a new direction for research based on detection of directionally-dependent anisotropy of the speed of light, assuming that the Earth is charged and that the Beckmann model applies.

One possible avenue which would not require additional experimentation might be a re-analysis of the original Dayton Miller experimental data under the same assumptions.

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