Evidence for the Anisotropy of the Speed of Light

Bob Johnson, Luton 3rd Sept 2011
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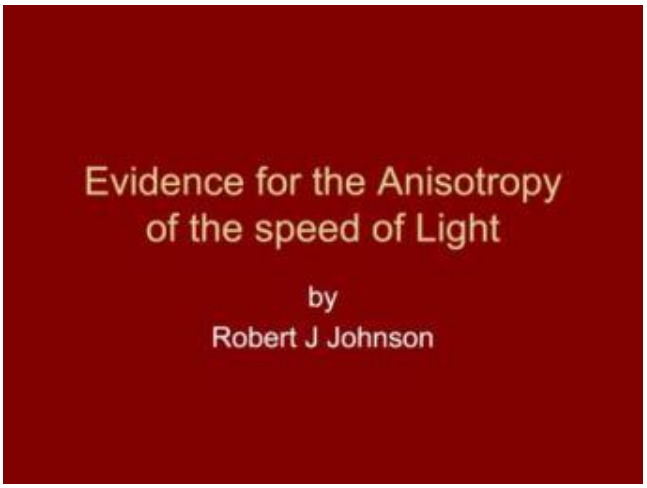


In this talk we're going to challenge one of the foundations of 20thCentury physics which assumes that the speed of light in space is constant. We'll see that it isn't. We'll also find that the speed of light on Earth can be different in different directions – that means it's anisotropic.

First I'd like to take you back to the 19thCentury and the debate about the nature of light. There were two main theories at the time and both had to deal with the problem of how light crossed what was thought to be the vacuum of space.

The ballistic theory thought that light consisted of small particles which could cross the vacuum like bullets.

The other theory thought that light was a wave. But scientists knew that light could not cross a vacuum because all waves need a medium in which to travel. Something needs to vibrate in order to let a wave pass through.

So the scientists of the 19thC suggested that space was filled with a substance called ether.

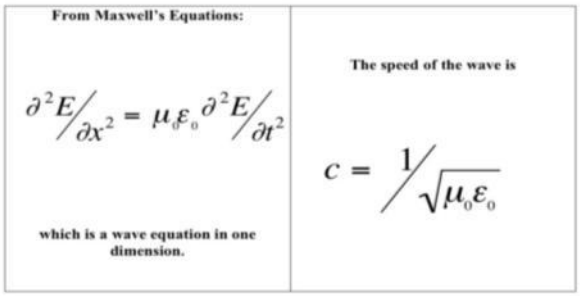
Bradley had discovered stellar aberration in 1728. Aberration means you have to point a telescope forwards in the direction of Earth's motion to catch the falling light, like leaning an umbrella forwards to catch raindrops.

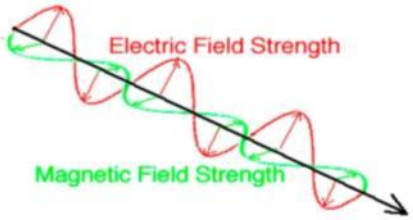
Aberration could be explained by both theories but the ballistic theory was the easier explanation to understand and it became the more popular theory for a time.

But in 1861 Maxwell proved that light was an *electromagnetic wave (e/m)*.

Therefore scientists concluded that space must be filled with an ether after all.

Figure 1: Transmission of Light





The wave travels in the direction of the **Poynting Vector**

Here we see that Maxwell's Equations lead directly to a wave equation. The speed of the wave 'c' is defined in terms of the electrical permittivity ε and magnetic permeability μ of the ether.

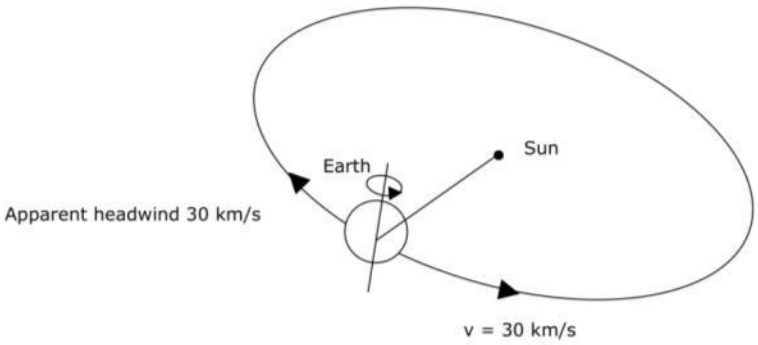
Putting in the values of permittivity and permeability showed that the speed of the wave was very close to the known speed of light. So light must be an e/m wave.

The bottom diagram shows that the electric and magnetic fields of a beam of light are at right angles to each other and that the beam propagates in the third direction which is given by the Poynting Vector arrow to P vector of the beam.

According to Maxwell, ε and μ were constants in the ether. This meant that 'c' was also constant and isotropic, that is to say 'c' was the same in all directions in space.

But this ether was very strange stuff. It had to be stiffer than steel to allow the light waves to vibrate in it at the necessary frequency, and at the same time it had to let the planets pass through without any resistance.

Figure 2: The Ether Model

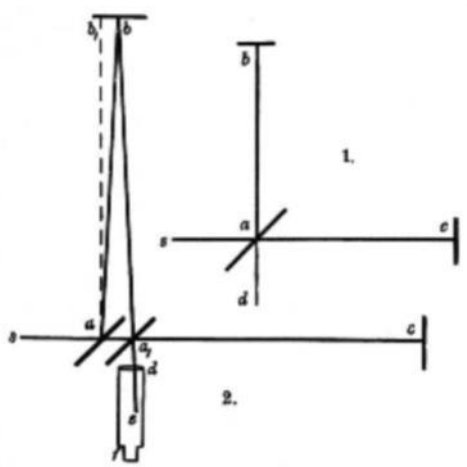


So the race was on to try to identify it. Bradley's discovery of aberration had proved that if there was an ether in space then it was not being dragged along with the Earth like the atmosphere because if the ether was being dragged along then aberration would not occur.

So the ether had to be stationary, as Fresnel had proposed.

That meant that light on Earth should experience some sort of ether headwind as the Earth ploughed through the stationary ether at 30km/s orbital velocity.

Figure 3: The Michelson-Morley Experiment



Michelson and Morley attempted to detect this headwind in their famous experiment of 1887 using light split into two beams at right-angles which should show different travel times because one beam would experience an ether headwind and the other would experience an ether crosswind.

They didn't find the headwind. At least not the anticipated headwind of 30 km/s. Michelson and Morley (MM) reported that the relative velocity of the Earth and the ether was less than $1/6^{th}$ of the Earth's orbital velocity, which completely undermined Fresnel's theory of aberration in a stationary ether.

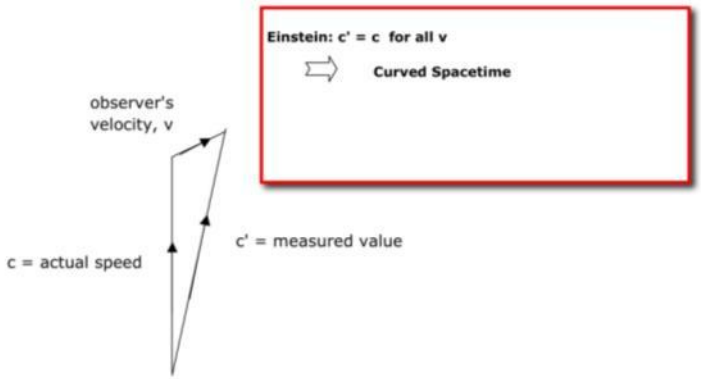
Because the expected headwind had not been found, scientists concluded that the stationary ether did not exist and therefore that the smaller effects that MM did find must have been experimental errors.

But it was still necessary to explain Bradley's aberration.

That led Fitzgerald and Lorentz to propose that all things contracted in the direction of their motion, and led on to Einstein formulating his Special Theory of Relativity (STR) on the basis that the ether could not be detected.

How did not being able to find the ether lead to STR?

Figure 4: The Speed of Light and the Observer's Velocity
Einstein's Model



Einstein started from the basis that the ether can't be detected. He assumed that space is a true vacuum except for an undetectable ether which allows light to be transmitted.

But if the ether can't be detected then any observers in space who are moving relative to each other cannot know what their own velocity really is because no-one has a fixed frame of reference to compare to.

Therefore no observer is able to deduct their own velocity from the measured speed of light in any experiment, but all observers must be able to derive the same answer for the speed of light according to the *Principle* of Relativity (which is not the same as Einstein's *Theory* of Relativity).

Without a frame of reference, the only way to do this is to assume, as Einstein did, that light always has a constant speed with respect to (wrt) the observer. That effectively means that every observer actually measures c' as usual but they ignore their own velocity and assume that they have really measured c.

The maths then results in STR and 4D curved spacetime, which turns classical physics on its head.

For example, Einstein's Special Theory of Relativity contradicts Newton's Third Law of Motion that 'Action & Reaction are equal and opposite'. Under Einstein's theory, Newton's Third Law cannot be true for one moving and one stationary mass or one moving and one stationary charge!

Also, by assuming that 'c' is constant wrt the observer, this makes Maxwell's Equations vary in different Frames of Reference. In this talk we apply the Lorentz Transformation to 'correct' for this variance.

It all gets very complicated in 4D tensor maths in Minkowski spacetime.

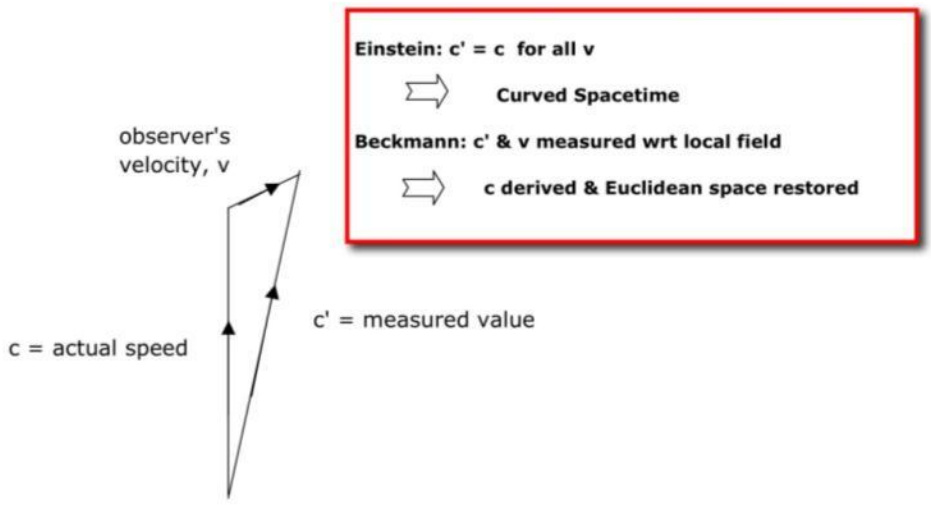
But we now know that space is not a true vacuum. It is not filled with ether but spacecraft have found that space *is* full of plasma and e/m fields. There is something there to wave.

And we can detect it. So we should be able to measure the observer's velocity after all.

Shouldn't this fact alone have made scientists reconsider the very foundations of Special Theory of Relativity?

But they didn't and we all know the history of the success of Einstein's theory.

Figure 5: The Speed of Light and the Observer's Velocity
Beckmann's Model



Less well known is that in 1987 Petr Beckmann derived all the other results of the STR mathematically directly from the Maxwell Equations and the Lorentz Force Law just using classical maths.

In summary, Beckmann made one very simple adjustment. He assumed that 'c' was measured wrt **the locally dominant field**, not the observer. The observer, in Beckmann's words, is therefore '*condemned to observing without interfering'*.

Suddenly everything becomes clear. The observer's velocity can be found and deducted from the measured value of c' in the classical manner, which then gives the correct value for c for all observers.

Maxwell's Equations are then automatically invariant under translation. Newton's Third Law still applies. Space stays 3D. And time flows on uniformly as the classical physicists expected.

We simply assume that light has a definite speed relative to the medium in which it travels, like every other type of wave, and the medium is the local field.

I must point out that all the experiments purporting to support Einstein's theory also support the Beckmann model but without needing the contortions of Minkowski tensor maths and curved spacetime to do so.

I'll repeat that. **There is NO experimental evidence that contradicts the Beckmann model**.

It is extremely powerful and achieves everything that relativity does and more, but without causing the problems that Einstein's Theory does. I have enormous respect for Beckmann's Model and I am basing this paper on it.

Nevertheless, there are a couple of peripheral assumptions in the model that I suggest should be reconsidered.

The first is that Beckmann assumed that the Earth is uncharged and that therefore the relevant field for light to travel in is the gravitational field. If the Earth and other bodies in space are charged, as proponents of the EU argue, then the locally-dominant field for Earth-bound experiments must be the Earth's e/m field.

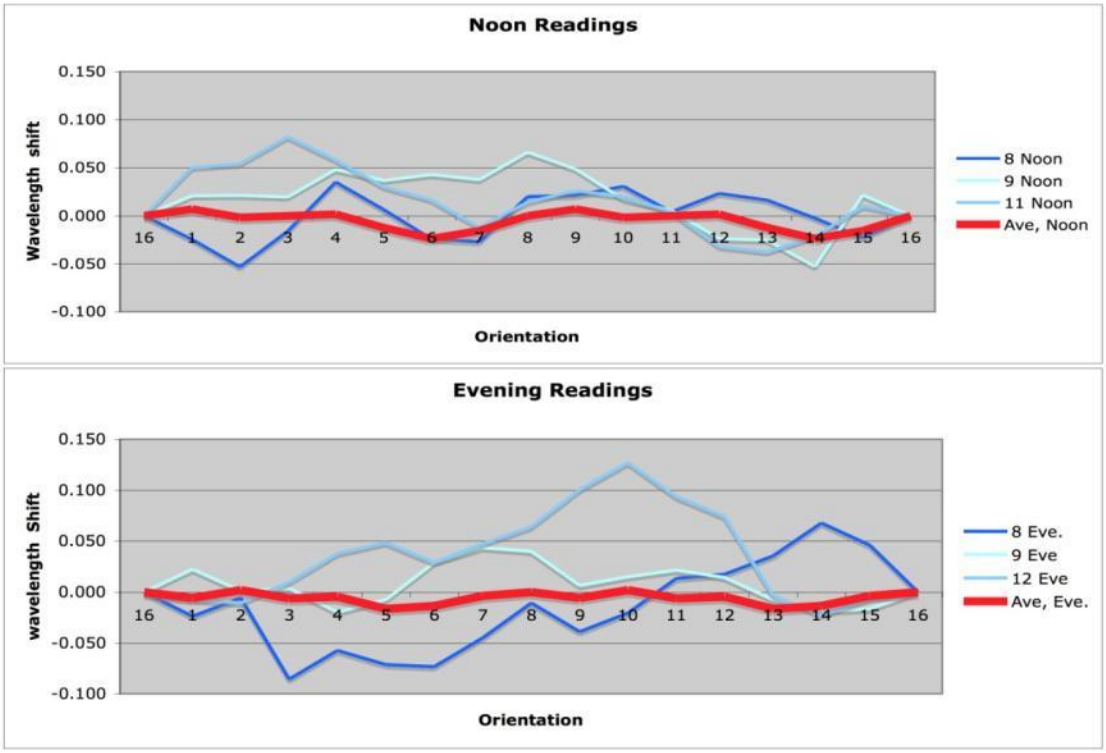
This does not change Beckmann's maths one iota because both the gravitational field and the e/m field orbit with the Earth but do not rotate with the Earth's daily rotation.

So Beckmann's model fits well with the EU model and a charged Earth.

Now this is where it gets more interesting! Beckmann's second assumption was that the MM experiment gave a null result. I disagree.

Michelson & Morley themselves reported a result of 1/6th of the expected headwind. Professor Hicks later pointed out that they had made a mistake by taking the average of different sessions with different settings which averaged out the very effect they were looking for.

Figure 6: Hicks' Analysis of MM Results



Here we can see MM's results based on their published data. MM based their conclusions on the averages which are shown in red. But their true results are shown in blue and equate to a headwind of around 8.8 km/s.

Neither the original MM experiment nor the vast majority of subsequent MM-type experiments came up with a true null result.

The experimenters simply failed to find an 'ether headwind' of the expected magnitude. Any non-null results of a smaller magnitude were written off as experimental errors because, of course, after 1905 everyone 'knew' what the answer should be.

Einstein had said that the ether could not be detected, so that was that. The experiments MUST give null results!

And they did. At least, that's what the majority of experiments reported. Here is a table with the results of all the subsequent experiments of the same type.

Figure 7: MM-Type Experiments - Results
Earth's velocity relative to the "ether"

	Reported, km/s	Actual km/s
MM 1887	5	8.8
Miller 1904	7.5	7.5
Miller 1925	9	9
Miller 1933	9 - 11	9 - 11
Illingworth	<1	2.5 - 6.7
Michelson-P-P	"<1/50" x 300	= 6
Joos	1.5	? - large values rejected
Jaseja	1	up to 12.8

But under closer scrutiny, none of the results was accurately reported except for those of Dayton Miller. Everyone else had distorted their own data or simply dismissed any larger results as 'impossible'.

But Dayton Miller carried out the most comprehensive set of MM experiments ever performed and he consistently found an 'ether headwind' effect of around 8-9 km/s.

Not the 30 km/s expected from the Earth's orbital velocity, and certainly not the 400 km/s expected from the Sun's orbital velocity around the galaxy, but it's not a null result either.

Of course Dayton Miller was not in favour with the relativists but he put up a stout defence of his results until his death in 1941 left the field clear for the Einsteinians to claim that his results were all due to - yes, you guessed it - experimental error!

So where does that leave us?

If we assume that all MM-type experiments actually found *something*, what was it and how does it fit with the Beckmann model?

Let's suppose that the non-null results were real and actually due to an e/m effect rather than a small amount of motion relative to a stationary ether.

But is it possible that the effect is an e/m one? It would mean that the speed of light could be anisotropic, or different in different directions.

Figure 8: Permittivity & Permeability

$$c = \frac{1}{\sqrt{\varepsilon\mu}}$$

- c = speed of light
- ε = electric permittivity
- μ = magnetic permeability

I answer, yes, it is possible that the non-null results are an e/m effect.

Remember that light is an electromagnetic wave and that the speed of light depends on the electrical permittivity and magnetic permeability of the medium.

Maxwell's Equations assume that these are constant values in the theoretical 'vacuum' of 'free space'.

But we've seen that space is not a vacuum. Space is filled with plasma and e/m fields which have values of permittivity and permeability which depend on the plasma and fields. It's like different optical glasses which have different refractive indices because the speed of light in each type is different.

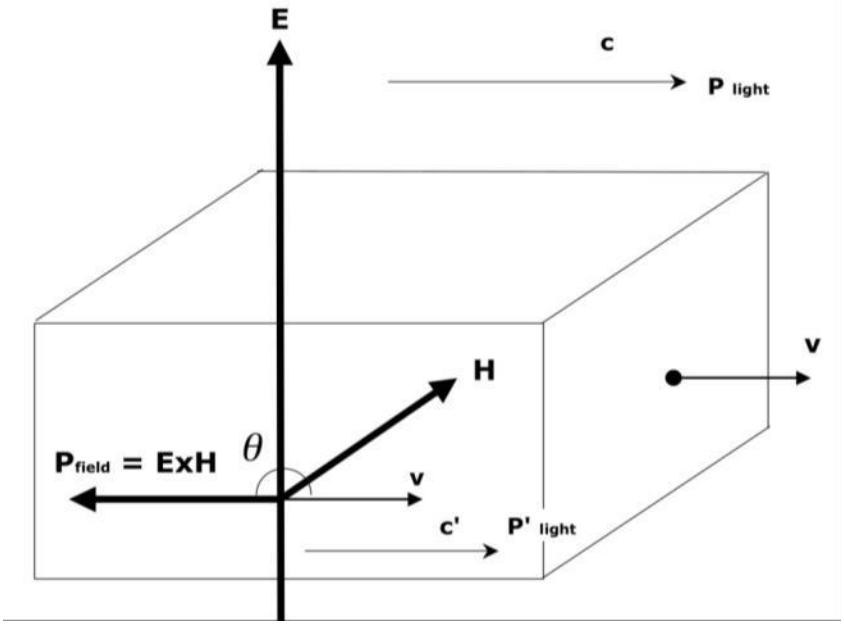
So the e/m environment, which is dependent on the values of ε and μ, must affect the speed of light. In fact we know this does happen. For example, the Stark and Zeeman effects clearly demonstrate that light is affected by the electric and magnetic fields through which it travels.

I could also mention 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.

So the non-null results may well be due to an e/m effect. And in our modified Beckmann model, light travels wrt the local e/m field.

So it seems as though space is just another transparent medium in which ε and μ can vary from region to region and so the speed of light is not constant in space after all.

Figure 9: Moving Media (1) - Glass Block



And there is more. In 1851 Fizeau had found that the speed of light is affected by fast-moving water as predicted by Fresnel's partial ether drag theory. But Beckmann showed that Maxwell's Equations *predict* that the speed of light varies in any moving medium because of changes to the e/m field inside the moving medium.

Suppose we have a moving glass block in a lab experiment. The electric field in the lab is E. The magnetic field in the glass block is H. That means the Poynting vector in this diagram is to the left. And the block is moving to the right with velocity v.

Maxwell's Equations show that the speed of light parallel to the Poynting vector is changed just because of the velocity of the glass block.

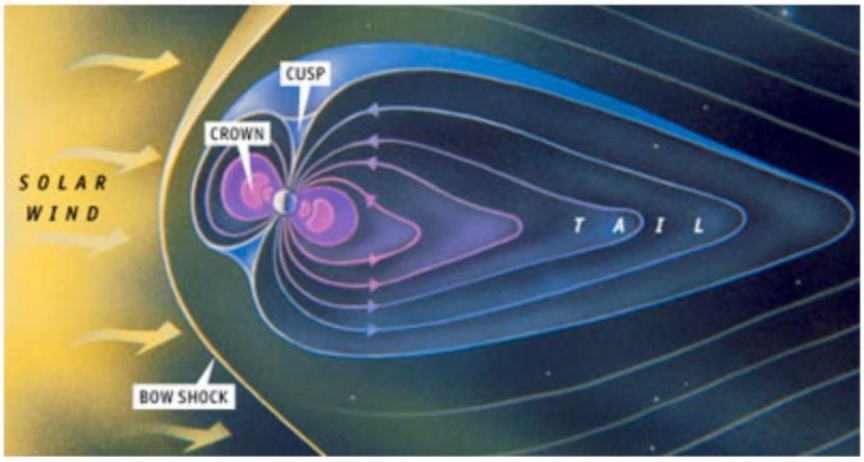
But we have seen that a beam of light also has its own Poynting vector.

When the two vectors are opposed to each other then light is slowed down, all according to Maxwell's Equations. Quantitatively, the effect is partial vector addition analogous to Fresnel's partial ether drag.

The interesting thing is how this relates to the Earth and experiments carried out to look for the ether headwind.

Figure 10: The Earth's Magnetosphere

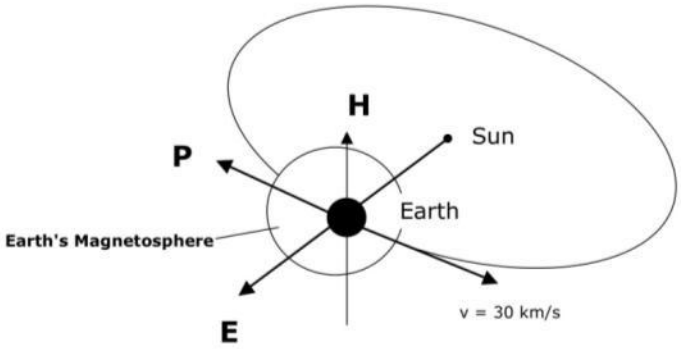
Image credit: iceagenow.com



The Earth is surrounded by its own magnetosphere which is the zone of influence of the Earth's magnetic field. The Earth and its magnetosphere orbit around the Sun together.

Figure 11: Moving Media (2) - Magnetosphere

Now from the perspective of the Sun's electromagnetic environment, the Earth's magnetosphere is a moving medium!



That means that Beckmann's analysis of 'c' in moving media under the influence of 'external' e/m fields applies directly to the magnetosphere. Therefore any experiments on 'c' on Earth must be affected by the orbital motion of the Earth.

If we assume that the Sun is positively charged according to the EU model then it turns out that the relevant Poynting vector due to the Earth's magnetic field and the Sun's radial electric field is always opposed to the orbital motion of the Earth.

In other words, the e/m effect behaves like the expected 'ether headwind' as far as light on Earth is concerned; the only difference is that the e/m effect is smaller than the expected ether headwind.

I suggest that all the non-null MM-type results actually detected this e/m effect but most experimenters were not looking for it and so dismissed the small effect they did find as 'experimental error'.

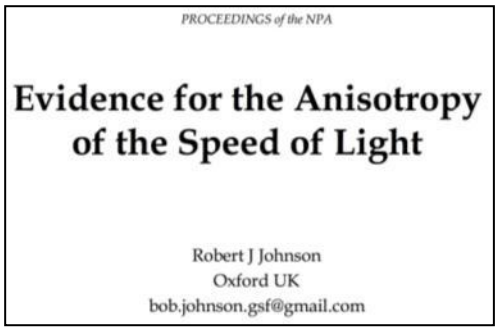
If this is correct then we already have evidence that the speed of light on Earth is genuinely anisotropic due to e/m field effects.

So to summarise what we have discussed:

- The discovery that space is filled with plasma and e/m fields means that there is **no** undetectable ether in space for light to travel in and that therefore Einstein's Special Relativity is founded on a false premise
- Beckmann's model where the speed of light is measured wrt the local field explains all the results of Special Relativity but without any of the problems
- Beckmann's model fits with the EU perspective of a charged Earth and Sun
- The speed of light in space is not a constant; it depends on the variable electrical permittivity and magnetic permeability of the medium
- The speed of light is anisotropic in moving media and the Earth's magnetosphere is a moving medium wrt the Sun's e/m environment
- The non-null results of all the Michelson-Morley-type experiments **may** contain evidence of this anisotropy

This has been a very short introduction to the subject and my paper gives much more detail. Do take a look! (NB. Follow link on SIS webpage)

Thank you all for listening.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Evidence for the Anisotropy of the Speed of Light

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