Galilean Invariance and Mach's Principle

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Abstract. Galileo's *"Principle of Relativity"* omits any consideration of an absolute frame of reference with respect to which motion is measured. Kinetic energy would appear to be a relative quantity whose magnitude depends on the chosen frame of reference, or in the case of its centrifugal force derivative, depends on which polar origin is chosen. The magnitude of any physical interaction involving two bodies is only ever dependent on their relative velocity, and there seems to be no way of exposing the existence of any special frame of reference with respect to which linear kinetic energy is an absolute physical quantity. The fact of centrifugal force however does indicate that such a frame of reference must exist, and that this frame appears to be embedded in a medium that is in a state of zero rotation relative to the fixed background stars. Rotation relative to the fixed background stars induces centrifugal force, which suggests that kinetic energy is indeed an absolute physical quantity that is induced by the interaction of a moving body with a physical medium which pervades all of space.
     In this article it will be proposed that the physical medium for the propagation of light is also the cause of kinetic energy and centrifugal force, and we will be reminded that Maxwell's equations are formulated specifically with this medium as the standard of rest. Important questions relating to the motion of this *luminiferous medium* relative to the planets and the stars will then be discussed.

The Aether

I. It is proposed that space is densely packed with tiny aethereal whirlpools that are pressing against each other with centrifugal force while striving to dilate [1], [2], [3], [4]. Gravity and electric current consist in the flow of this aether, with the flow momentum normally denoted either by the vector **A** or **J** according to the context. It is most important however to make a distinction between the pure aether itself, on the one hand, and the sea of tiny aethereal whirlpools which constitutes the *luminiferous medium* for the propagation of light, on the other hand. Kinetic energy and centrifugal force on the large scale are induced when a body moves through the background luminiferous medium. The induction follows from the shear interaction which causes an angular acceleration of the tiny aethereal whirlpools. The induced angular acceleration in these tiny whirlpools causes an increase in the centrifugal pressure surrounding the moving body, while electromagnetic radiation constitutes a propagation of such

fine-grained angular acceleration through the luminiferous medium. Hence the medium that is the cause of kinetic energy and centrifugal force is also the medium that is the cause of electromagnetic phenomena and which acts as the carrier of electromagnetic waves. The phenomenon of linear kinetic energy can never be measured absolutely and neither does it provide any basis upon which we can detect the existence and relative motion of the luminiferous medium. In the case of two bodies in relative motion, kinetic energy can only be physically experienced when the two bodies come into contact with each other, and when this occurs, the magnitude of the physical reaction depends entirely on their relative velocities. The laws of linear classical mechanics are said to be *“Galilean Invariant”*.

The absence of the luminiferous medium in modern physics does not impact upon linear classical mechanics, but it does create a serious deficiency in both rotational classical mechanics and electromagnetism. Galileo's *“Principle of Relativity”* was good for linear motion, which is all that he intended it for, and the law of vector addition of velocities which stems from it still holds good even when we introduce the luminiferous medium. The manner in which Einstein later confused matters, due to his inability to comprehend Maxwell's equations, should not on any account be blamed on Galileo.

Electromagnetic Induction and Galilean Invariance

II. When a moving magnet induces an EMF in a coil, it makes no difference whether we move the magnet into the coil or move the coil over the magnet. The energy comes from the relative motion, and the situation is parallel to that of a collision in classical mechanics. In both cases the input energy is linear kinetic energy. It would seem therefore that Galilean invariance applies to convective electromagnetic induction. There are however further issues that will be discussed in section **IV** below.

Rotational Motion

III. Rotational motion in classical mechanics does expose the existence of the luminiferous medium by virtue of the induction of centrifugal force when the rotation is measured relative to the fixed background stars. Centrifugal force is the radial derivative of kinetic energy relative to an arbitrarily chosen polar origin, and so just like linear kinetic energy it is a relative quantity which is realized during a mutual physical interaction. In the case of spinning bodies of finite size, the centrifugal force is induced by the interaction with the

luminiferous medium and in opposition to the intermolecular bonding forces within the spinning body. We therefore conclude that the rotation of a body does not cause the luminiferous medium contained within it to co-rotate, and that the luminiferous medium moves freely through the interstitial spaces between the atoms and the molecules, just like water flows through a basket.

Maxwell's EMF Equation

IV. Maxwell's electromagnetic force equation first appeared in his 1861 paper ***"On Physical Lines of Force"*** [5] as equation **(77)**,

$$\mathbf{E} = \mu\mathbf{v}\times\mathbf{H} - \partial\mathbf{A}/\partial t - \text{grad}\psi \qquad\qquad \textbf{(77)}$$

and it is nowadays wrongly named the ***Lorentz force equation***. Equation **(77)** also appeared as equation (D) of the original eight Maxwell's equations listed in his 1864 paper ***"A Dynamical Theory of the Electromagnetic Field"*** [6], [7]. Maxwell physically explained the convective term $\mu\mathbf{v}\times\mathbf{H}$ on the right hand side of equation **(77)** on the basis of compound centrifugal force. In other words, it's a Coriolis force of sorts with the velocity **v** being measured relative to the luminiferous medium. The symmetry inherent in convective electromagnetic induction described in section **II** above, suggests that we must be dealing with the convective $\mu\mathbf{v}\times\mathbf{H}$ term irrespective of whether we consider the magnet to have moved relative to the coil, or whether we consider the coil to have moved relative to the magnet, and as such we deduce that a magnet in linear motion must entrain a region of luminiferous medium within its magnetic field.

Centrifugal force is a convective effect, which on one scale or another, is involved in all of the kinetic energy interactions mentioned in the sections above. Even though an object that is made of atomic and/or molecular matter experiences centrifugal force when it rotates, it does not however radiate centrifugal force. This can be demonstrated by the absence of mutual repulsion between two spinning gyroscopes in close proximity, or by the fact that a magnet which is rotating on its magnetic axis does not induce an EMF at a distance. When however a magnet is rotating other than about its magnetic axis, it does induce an EMF at a distance. The important difference here is that we are now dealing with precession of the magnetic axis and hence angular acceleration of the tiny aethereal whirlpools that make up the magnetic field. We are dealing with a unidirectional propagation of rotational, or more precisely of precessional kinetic energy, and there is no symmetry as like in the linear convective case described in section **II** above. Just as in the case of the transverse planetary orbital equation, Maxwell's EMF equation has both a Coriolis term and an angular acceleration term. The angular acceleration,

$-\partial\mathbf{A}/\partial$t, is the second term in equation **(77)** above. This is the basis of time varying electromagnetic induction and electromagnetic radiation, both of which are in fact a propagation of angular acceleration, and hence a propagation of fine-grained centrifugal force through the luminiferous medium. Of the three EMF terms on the right hand side of equation **(77)**, Maxwell only used the zero divergence $-\partial\mathbf{A}/\partial$t term when deriving the electromagnetic wave equation. The remaining term, $-\mathrm{grad}\psi$, is Gauss's law which can apply to gravity, magnetic attraction, or to electrostatic attraction, but like $\mu\mathbf{v}\times\mathbf{H}$, it is not involved in the derivation of the electromagnetic wave equation.

Maxwell was working on the basis that his equations apply in the rest frame of the luminiferous medium. The speed of light would therefore be measured relative to that medium. When observed from any frame of reference that is in motion relative to the luminiferous medium, the speed of light would simply be measured as per Galilean vector addition of velocities. Einstein wrongly preached that Maxwell's equations are independent of any particular frame of reference and that hence the speed of light would always be observed to have the same value no matter from which frame of reference it is observed. Einstein had absolutely no basis upon which to draw this absurd conclusion and it is his abandoning of Galilean vector addition of velocities in relation to the speed of light that lies at the cornerstone of his special theory of relativity, and as such it is fair to state that on this basis alone Einstein's theories of relativity are completely and totally false.

Because of the unnecessary confusion caused by Einstein, opponents of Einstein often get bogged down in unnecessary arguments surrounding whether or not Maxwell's equations can be said to be *Galilean invariant* as is the case with linear classical mechanics. While the speed of light obeys Galilean vector addition of velocities, the equations themselves are formulated specifically in the rest frame of the luminiferous medium, and as such are not technically Galilean invariant. There is of course never any need to subject Maxwell's equations to a coordinate frame transformation, and so the subject of Galilean invariance in connection with Maxwell's equations is merely irrelevant semantics. It's much more important that we accurately ascertain the relative motion of the luminiferous medium with respect to the Earth and the wider universe.

Those who don't believe in the existence of a physical medium for the propagation of light will of course remain eternally confused when it comes to the issue of Maxwell's equations, frames of reference, and what the $\mathbf{v}$ in $\mu\mathbf{v}\times\mathbf{H}$ is measured relative to. Their punishment will be to spend their days struggling to make sense out of that of which no sense can be made. They will find themselves immersed in endless debates, wrangling over the meaning of meaningless terms like *Lorentz invariance* and even *Lorentz covariance*! These are big words which sound scientific, but when scrutinized closely are found to lack any substantial meaning in the real world. Sadly however, even amongst

those who still believe in the luminiferous medium, many have nevertheless been dragged down into that mad world of Lorentz transformations and its many variants, due to another absurd belief, and the absurd belief in question is another of Lorentz's gems. It is the foolish belief that the Michelson-Morley null result is explained away by a physical contraction of the apparatus caused by an aether wind that just happens to exactly to cancel with the sought after effect.

The Rest Frame of the Luminiferous Medium

V. Maxwell's equations arose out of terrestrial laboratory experiments and they corroborated with the directly measured speed of light. The question then remained as to what is the relative velocity of the luminiferous medium and the Earth? The Michelson-Morley experiment of 1887created a controversy over this question, and to this day that controversy has never been resolved.
In the case of the Earth's orbital motion about the Sun, the Earth's magnetic field will entrain a region of luminiferous medium, and the Earth's gravitational field will augment this drag effect and extend the entrained region well beyond the magnetosphere. There will therefore be no relative motion of the Earth and the luminiferous medium due to the Earth's orbital motion. If this were not the case, the Michelson-Morley experiment of 1887 would have shown up significant interference fringes relating to the orbital speed of 30km/sec. Entrainment is the only viable conclusion short of entering into the absurd world of Lorentz contractions and transformations. Lorentz objected to Stokes' perfectly rational aether drag approach on premature grounds. One of his objections was that entrainment would result in vortices at the interface where the entrainment terminated. That however is not a valid objection since we do indeed have vortices at the interface and they are necessary for the production of orbital centrifugal force. Rather than cause friction that would in turn cause the planets to spiral into the Sun, the luminiferous medium in fact causes the very inertial forces that prevent this from happening.

As regards the Earth's diurnal rotation, the 1925 Michelson-Gale experiment seems to suggest that the luminiferous medium does no co-rotate. This would be further borne out by Coriolis and centrifugal effects in the atmosphere and also by effects such as that observed with a Foucault pendulum which are dependent on the luminiferous medium not co-rotating with the Earth. These inertial effects may also however be augmented to a greater or lesser degree by the electromagnetic force $\mathbf{F} = q\mathbf{v}\times\mathbf{B}$ arising from the Earth's magnetic field, where q derives from the fact that all atomic and molecular matter has a mild negative electric charge.

Mach's Principle

VI. Unlike in the case of linear motion which does not expose an absolute frame of reference, rotational motion, specifically with reference to the fixed background stars, induces centrifugal force. This often raises the question as to whether or not there is some kind of physical interaction with the background stars. The background stars of course are not actually fixed. They are all in relative motion to each other, but their instantaneous position seems to define a distinct frame of reference that possesses a physical reality with respect to rotation.

Centrifugal force however will almost certainly be generated locally due to interaction with the luminiferous medium, but the rest frame of this medium, at least from a rotational perspective, will be in turn determined by the average position of the background stars. So in answer to the often asked question as to whether or not the background stars play a role in local rotations, the answer is that they do, but only indirectly.

Conclusion

VII. Mainstream physics preaches that light propagates in pure vacuum. This is an absurd twentieth century notion which is rejected by many, but amongst those who do believe in the existence of a physically real luminiferous medium, there are many side arguments. First of all there is the issue of whether the luminiferous medium is one and the same medium as the aether that is the cause of gravity. Secondly there is the issue of the relative motion of the luminiferous medium with respect to the background stars and the planetary bodies. The conclusion of this paper is that while the luminiferous medium does account for the inertial forces, it is not the same thing as the gravitational aether. The luminiferous medium is a dense sea of tiny aether whirlpools while gravity arises due to a large scale flow of aether through the luminiferous medium. The tiny aethereal vortices of the luminiferous medium absorb large scale vorticity from the gravitational aether flow, meaning that the gravitational aether and the luminiferous medium are very closely interconnected. It is the same aether, but it is very important to distinguish between the two distinct concepts.

The luminiferous medium is attracted by the Earth's gravity, but the fine-grained centrifugal pressure within it prevents it from being pulled into the Earth. The combined effect of the Earth's gravitational field and the Earth's magnetic field ensures that the luminiferous medium within the gravitational field moves with the Earth in the Earth's orbital motion around the Sun. The gravitational aether meanwhile flows radially downwards into the Earth, through the luminiferous medium. The issue of whether or not the luminiferous

medium co-rotates with the Earth's rotation is not so easy to determine precisely, but most of the evidence tends to suggest that the luminiferous medium does not co-rotate with the Earth's rotation.

Since light is aethereal, the path of light will be affected by the downward flow of aether that is the cause of gravity. However, since EM radiation is a propagation of fine-grained centrifugal force moving through the luminiferous medium, the degree of bending will not be lessened by the centrifugal force that keeps the planets in their orbits. We have no way of accurately calculating the degree of light bending by gravity.

References

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"Long ago he (mankind) recognized that all perceptible matter comes from a primary substance, of a tenuity beyond conception and filling all space - the Akasha or luminiferous ether - which is acted upon by the life-giving Prana or creative force, calling into existence, in never ending cycles, all things and phenomena. The primary substance, thrown into infinitesimal whirls of prodigious velocity, becomes gross matter; the force subsiding, the motion ceases and matter disappears, reverting to the primary substance"
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[2] Whittaker, E.T., *"A History of the Theories of Aether and Electricity"*, Chapter 4, pages 100-102, (1910)
"All space, according to the younger Bernoulli, is permeated by a fluid aether, containing an immense number of excessively small whirlpools. The elasticity which the aether appears to possess, and in virtue of which it is able to transmit vibrations, is really due to the presence of these whirlpools; for, owing to centrifugal force, each whirlpool is continually striving to dilate, and so presses against the neighbouring whirlpools."

[3] Lodge, Sir Oliver, *"Ether (in physics)"*, Encyclopaedia Britannica,
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"The most probable surmise or guess at present is that the ether is a perfectly incompressible continuous fluid, in a state of fine-grained vortex motion, circulating with that same enormous speed. For it has been partly, though as yet incompletely, shown that such a vortex fluid would transmit waves of the same general nature as light waves— i.e., periodic disturbances across the line of propagation—and would transmit them at a rate of the same order of magnitude as the vortex or circulation speed"
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