

Aether Friction in the Planetary Orbits

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10th April 2021*

Abstract. When a theory of electromagnetism promotes the idea that the medium for the propagation of light waves is an elastic solid comprised of electric particles, the question is always going to be asked as to why this medium would not generate friction in the planetary orbits, such as would cause the planets to spiral into the Sun. It would be impossible for a moving body to completely avoid any physical interaction with these electric particles, and so, in order to comply with Kepler's Laws of Planetary Motion, this interaction must be the actual cause of the inertial forces, as opposed to being the cause of any dissipative friction.

The Inertial Path

I. The Barnett Effect, discovered in the year 1915 by American physicist Samuel Jackson Barnett, demonstrates that a magnetic field, albeit extremely weak, is generated around a spinning body, even if the body is electrically neutral [1]. It will now be investigated whether the inertial forces can be linked to this weak magnetic field. A body in motion will satisfy the equation,

$$m\ddot{\mathbf{r}} = m(\ddot{r} - r\dot{\theta}^2)\hat{\mathbf{r}} + m(2\dot{r}\dot{\theta} + r\ddot{\theta})\hat{\boldsymbol{\theta}} \quad (1)$$

relative to any polar origin. See **Appendix I** for the derivation and interpretation of symbols. In the special case where $\ddot{\mathbf{r}} = 0$, a body will be undergoing its uniform straight-line inertial path and equation (1) then becomes Newton's first law of motion expressed in polar coordinates, relative to an inertial frame of reference. It can then be reduced to,

$$m\ddot{r}\hat{\mathbf{r}} = +mr\dot{\theta}^2\hat{\mathbf{r}} \quad (2)$$

where $mr\dot{\theta}^2\hat{\mathbf{r}}$ is the *centrifugal force*. Equation (2) can alternatively be written as,

$$m\ddot{r}\hat{\mathbf{r}} = +mh\hat{\mathbf{r}}/r^3 \quad (3)$$

where h is a constant related to angular momentum. See **Appendix II** for the derivation. This means that a body in motion has a centrifugal force to every point in space, implying the existence of a centrifugal force field surrounding all moving bodies. Meanwhile, the transverse term $2m\dot{r}\hat{\theta}$ is known as the *Coriolis force*. The centrifugal force and the Coriolis force are known as *inertial forces*.

It should be further noted that the centrifugal force field mentioned in the paragraph above must be solenoidal since the sum of all the centrifugal forces in the field is zero. This is similar in principle to what happens in the case of the magnetic field that surrounds a long straight current carrying wire. If we define the magnetic field intensity, \mathbf{H} , with respect to a point on the wire and then add the values of \mathbf{H} at every point in space, the resultant is zero.

In 1861, James Clerk Maxwell, in the preamble to Part I of his seminal paper entitled “*On Physical Lines of Force*”, explained the magnetic field as a centrifugal force field [2]. He proposed that space is filled with tiny aethereal vortices that press against each other with centrifugal force while striving to dilate [3], [4], [5], and that since these tiny vortices naturally align along their mutual rotation axes, creating magnetic lines of force, magnetic repulsion between like-poles is then caused by the centrifugal force in the equatorial planes of the vortices. This centrifugal force acts perpendicularly to the magnetic lines of force.

It is now suggested that these same tiny aethereal vortices are responsible for the inertial forces and that there are in fact two separate, but inter-related physical causes involved. Firstly, there will be a shear interaction between all moving bodies and the background sea of tiny vortices, which Maxwell referred to as the *luminiferous medium*. This interaction leads to the formation of vortex rings, concentric on the line of motion, and centred on the moving body. This will be the weak magnetic field associated with the Barnett effect and it will exist in conjunction with a gyroscopic stability in the atoms and molecules of the moving body, resulting in the uniform straight-line inertial path [6]. Secondly there will be an interaction at the interface of the magnetic fields surrounding any two bodies that are in a state of mutual motion. The latter effect, just like the Barnett effect, will however be negligible in terrestrial situations on the laboratory scale, but may well become of considerable significance in the case of compressed interactions on the molecular scale [7].

Newton’s Second Law of Motion and Inertial Mass

II. Where a force seeks to change only the speed of a body, but not its direction, the inertial mass of the body serves as a reactance to this force and the situation comes under the jurisdiction of Newton’s second law of motion. No inertial forces will be involved.

The Inertial Forces in the Relaxed State

III. When two terrestrial bodies do a fly-by past each other while undergoing their uniform straight-line inertial paths, they will possess a mutual centrifugal acceleration which is maximum at the point of closest approach. The magnitude of this centrifugal acceleration can be substantial, and it produces a physical effect that can be commandeered for useful purposes in mechanical devices. This physical effect is centrifugal force. However, since the two bodies are not having any direct influence on each other, we must ascribe this centrifugal force to the direct gyroscopic interaction that each of these two bodies has with the dense background sea of tiny aethereal vortices. This is an example of *the relaxed state*.

Where an applied force seeks to change the direction of a body that is undergoing its uniform straight-line inertial path in the relaxed state, the situation will be different than in the case where a force merely changes the speed of the body. When it comes to trying to curve the path of a moving body, this will be opposed by an inertial force, and this inertial force will depend, not only on the body's inertial mass, but also upon its velocity. The centrifugal force field that surrounds a moving body takes the form of concentric constricting vortex rings that squeeze on the body from all sides so as to keep the body on a straight-line course. But if these concentric rings amount to the weak magnetic field as predicted from the Barnett Effect, then they cannot be the main player. This magnetic field will be too weak in relation to the mass of a typical terrestrial body to cause any significant effect on another body. The root cause of the straight-line inertial path will surely lie in the gyroscopic interaction between the atoms and molecules of the moving body and the background sea of aethereal vortices, the latter which is then in turn rendered into a magnetic alignment by this interaction.

Inertial forces are measured relative to a point origin and we normally choose the point origin that is significant to the applied force that the inertial force is opposing. For example, if a centripetal force is applied, we will normally use the origin of the centripetal force. If a transverse force is applied, as for example when we roll a marble along a radial groove in a turntable that is undergoing a forced rotation, we will locate the origin at the centre of rotation. The transverse force impressed on the marble by the forced rotation will then be opposed by an inertial Coriolis force, to that origin.

In many cases, it is the inertial motion itself which pro-actively causes the inertial force, such as when a weight is being swung around in a circle on the end of a string. In this case, the centripetal force does not come into existence until the string is taut, and it is the centrifugal force which causes the string to become taut in the first place. It can therefore never be said that a centrifugal force is always a reaction to a centripetal force. It is often the action. We could accurately say that an inertial force is a force which is *at the ready for action*

when a body is undergoing its uniform straight line inertial path. The centrifugal force field is already there, squeezing inwards on the motion from all sides. It acts perpendicularly to the direction of motion but can be resolved into any direction, reducing to zero along the line of motion. There is therefore no pressure fore and aft. Along the line of motion, a body will encounter no resistance from the dense background sea of aethereal vortices. Resistance from the sea only occurs when attempts are made to curve the path of motion.

Likewise, when a marble is rolled along a radial groove towards the centre of a freely rotating turntable, the Coriolis force is pro-active and it will cause the turntable to angularly accelerate, and hence to spin faster. The inertial forces exist in their own right, and they are a product of both the mass of a body and its velocity. Centrifugal force is actually the radial gradient of rotational kinetic energy, otherwise known as centrifugal potential energy. Its magnitude is independent of the magnitude of any external centripetal force that the body might be subjected to. The applied centripetal force will have its own magnitude already set, and it will determine a point origin. But the magnitude of the centrifugal force which opposes it from this origin will be determined by the mass and velocity of the moving body. Only in the special case where the centripetal force causes circular motion will the two opposing forces have the same magnitude. It is a common error to believe that a centrifugal force is the reaction in an equal and opposite action-reaction pair with a centripetal force. Even Newton wrongly believed this [8], but Kepler's laws of planetary motion reveal that centrifugal force is totally independent of gravity [9], [10]. We can see in a centrifuge machine that centrifugal force acts to fling the heavier particles to the rim where no centripetal force is even involved. So long as a body is forced to co-rotate in a rotating system, a centrifugal force will fling it radially outwards.

Centrifugal Force in the Compressed State

IV. Consider a sealed box containing a multitude of gravitating point particles moving in every direction. If we compress the box, this will have two effects. Firstly, the average separation distance between neighbouring particles will decrease, and secondly, as the walls are moving inwards, the collisions at the walls will result in more kinetic energy being imparted to the particles, in turn leading to an increase in the inter-particle angular momentum. As a result, as per equation (3), there will be an increase in the inter-particle centrifugal force between every pair of particles in the box. This inter-particle centrifugal force will however only amount to an actual physical repulsion if the Barnett effect is significant, and in order for this to be so, the *speed to mass ratio* of the particles must be very high.

When we take into consideration the gravitational fields of the particles, the act of compressing the box will cause the inter-particle gravitational potential energy to be converted into additional kinetic energy, hence further increasing the inter-particle centrifugal force. If the compression continues indefinitely, it is hard not to imagine an actual inter-particle repulsion eventually emerging to resist the compression, with this resistance being additional to that of the outward pressure caused by the particles colliding against the walls of the box. Should this be so, it can only be due to magnetic repulsion arising from the Barnett effect, with magnetic repulsion being a particular manifestation of centrifugal force.

Centrifugal Force between Electric Particles

V. In the case of gas pressure as explained in *Section IV* above, the repulsive force between the particles is generated by the actual magnetic field lines themselves. But what explains the magnetic repulsion? Consider two electron-positron dipoles sitting side by side. In each dipole, the electron and the positron are orbiting each other in a circular orbit. They are each orbiting in the same plane and in the same direction, and they each have the same angular velocity. See *“The Positronium Orbit in the Electron-Positron Sea”* [11]. When the electron of one dipole passes the positron of the other dipole in the opposite direction, then, at the moment of closest approach, the electrostatic field lines should be connecting directly between the two particles, and so according to Coulomb’s law there should be a force of attraction acting between them, as in the case of any two particles of opposite charge. If, however the electrostatic force field, E_s , is based on tension in an aethereal electric fluid that is flowing from the positron to the electron, their mutual transverse speed will induce a curl in the velocity field. Above a certain threshold of angular speed, the flow lines connecting the two dipoles will be cut, and the two separate regions of electric fluid, assumed to be inviscid, will now be shearing past each other in opposite directions. The dipoles will be striving to dilate and so the pressure emanating sideways from the opposing flow lines will push the two dipoles apart, since the aether cannot pass laterally through itself. A centrifugal repulsion will have taken the place of the electrostatic attraction. This centrifugal repulsion is akin to that with which the water in Newton’s rotating bucket pushes outwards against its inside walls. This is the underlying principle behind both magnetic repulsion and electrostatic repulsion at the deepest fundamental level. Meanwhile, Maxwell’s aethereal vortices can now be identified with rotating electron-positron dipoles.

Centrifugal Force in Planetary Orbits

VI. In the case of the large planetary bodies where the gravitational fields are significant enough to entrain a pocket of the background sea of tiny electron-positron dipoles with them along their orbital paths, it would seem that the centrifugal force acting between two planets is physically induced at the interface of their respective gravitational fields by a shear interaction involving the centrifugal pressure arising in the electron-positron vortices that are present at this location. It will be a kind of hovercraft effect involving fine-grained gyroscopy [12], [13].

Friction in Space

VII. The important thing is that the shear interaction between a moving body and Maxwell's background sea of vortices, or that between two gravitationally entrained regions of this sea of vortices, should account for the inertial forces rather than causing dissipative friction that would result in the planets spiralling into the Sun. It is clear that a body moving through a dense sea of electric particles is going to interact with those particles, and that energy will be transferred to the surroundings. It is necessary therefore to identify a possible circular energy flow mechanism. As a precedent, we are aware of the case of an inductance coil, and that when we switch off the electric power, the energy stored in the magnetic field flows back into the conducting wire again giving the electric current a final forward surge. Any analogy between the magnetic forces and the inertial forces would be persuasive as to the possibility that inertial motion involves a shear interaction with the luminiferous medium similar to that which is observed when a charged particle moves through a magnetic field. In his 1861 paper "*On Physical Lines of Force*", Maxwell derived the lossless electromotive force,

$$\mathbf{E}_L = \mu \mathbf{v} \times \mathbf{H} \quad (4)$$

where \mathbf{H} is the magnetic intensity, which in Maxwell's theory corresponds to the vorticity of the tiny vortices. Meanwhile, the magnetic permeability, μ , is a quantity related to density, while $\mathbf{H} = 2\boldsymbol{\omega}$, where $\boldsymbol{\omega}$ is angular velocity, which in this case should be that of the electric particles circulating around the edge of the vortices. Maxwell derived equation (4) in terms of differential centrifugal pressure in his sea of aethereal vortices. Meanwhile, the centrifugal force term in equation (2) in *Section I* above can alternatively be written in the form,

$$\mathbf{F} = m \mathbf{v}_t \times \boldsymbol{\omega} \quad (5)$$

If we cannot connect the inertial forces to the medium that is the cause of electromagnetic phenomena, then this will create serious problems for the planets in their orbits. The fact that equations (4) and (5) both describe a force that is velocity dependent, and which acts at right-angles to the causative motion, suggests that they are both induced by the same kind of lossless elasticity, albeit in different contexts. Ampère’s Circuital Law describing how a magnetic field exists around an electric current would therefore appear to apply to inertial motion in just the same way.

The Coriolis Force

VIII. While centrifugal force is a radial aspect of the uniform straight-line inertial path, the Coriolis force is a transverse aspect. In equation (1) in Section I, the transverse component contains a Coriolis force in the form $2m\dot{r}\hat{\theta}$ alternatively written as $2m\mathbf{v}_r \times \boldsymbol{\omega}$ where \mathbf{v}_r is the radial velocity. It would seem that the Coriolis force is exclusively a consequence of the gyroscopic stability implicit in the uniform straight-line inertial path. No cases immediately spring to mind where the magnetic field of the Barnett effect plays any significant role in gyroscopic or vortex activity, or in the case of a Keplerian orbit. It is a matter of interest also, that the Coriolis force is always cancelled by an equal and opposite inertial force, this being the underlying basis for the law of conservation of angular momentum. In planetary orbits, conservation of angular momentum is observed in the form of Kepler’s second law, which is the law of equal areas being traced out in equal times.

Just as the centrifugal force manifests itself when a centripetal force steers a particle off its straight-line path, a Coriolis force likewise manifests itself when a transverse force steers a particle off its inertial path. This manifestation is best observed in the behaviour of gyroscopes. Although centripetal force due to the inter-molecular bonds within the gyroscope has already taken the situation outside of the uniform straight-line inertial path, the action of the Coriolis force can still be observed when we subject the spinning gyroscope to a forced precession. In the case of a pivoted spinning gyroscope, gravity causes a forced precession which induces a Coriolis torque, and hence a precession at right-angles to the forced precession. Since the normal reaction of the pivot cancels one side of this Coriolis couple, the Coriolis force on the other side can make the centre of gravity rise upwards against gravity. The weight is therefore transferred from the centre of gravity to the pivot, making it easier on the wrist muscles when lifting a heavy spinning gyroscope. The gyroscope is not any lighter as such, but the induced Coriolis torque reduces the required momentary force needed to hold the gyroscope at the end of its stem.

An analysis of this situation was carried out in “*Magnetic Repulsion and the Gyroscopic Force*” and it gives a further insight into the nature of the

physical reaction that occurs when the luminiferous medium passes through the interstitial spaces between the atoms and molecules of ponderable matter, as like water passing through the holes in a basket [14]. Gyroscopic stability in ponderable matter may involve a mechanism at a deeper molecular level on the nano-scale, akin to the aerodynamic P-factor (asymmetric blade effect) or the Magnus effect. So, while centrifugal force is the anti-gravity force in planetary orbits, the Coriolis force is the anti-gravity force in pivoted gyroscopes.

Meanwhile, just as centrifugal force manifests itself when a body is co-rotating in a rotating system, a Coriolis force likewise manifests itself when a constrained radial motion occurs in a rotating system. This situation is observed in atmospheric cyclones. The rotation of the Earth introduces angular momentum into the cyclone and the Coriolis force ensures conservation of angular momentum, manifested by a transverse deflection of a radial air current. In the case of artificial satellite orbits undergoing a non-circular orbit, the Coriolis force will simply be a geometrical fact of the inertial path since it is believed that the luminiferous medium passes right through the interstitial spaces between the atoms and molecules of the satellite. However, in the case of planets that entrain a large pocket of the luminiferous medium within their gravitational fields, and where the centrifugal force between planets is due to a fine-grained gyroscopic interaction involving the tiny rotating electron-positron dipoles at the interface between two gravitational fields, the Coriolis force will be absorbed into the general interaction. The Coriolis force will amount to equal and opposite transverse centrifugal forces pressing from each side. This will have the illusion that a Coriolis force has deflected the effects of gravity into the transverse direction in a process not dissimilar to how Coriolis force deflects the effects of gravity sideways in a pivoted gyroscope [14]. This illusion may in fact be a reality in the deeper vortex interactions occurring among the rotating electron-positron dipoles at the interface between two gravitational fields.

We are looking at an extremely subtle fine-grained gyroscopic mechanism occurring in an elastic medium which serves as the medium for the propagation of light, while simultaneously, without contradiction, underlying Kepler's laws of planetary motion. We are looking at a medium which is a solid for the purposes of electromagnetic wave propagation, but which exhibits fluid characteristics in accommodating the planetary motions.

Conclusion

IX. The elasticity in space that is involved in electromagnetism and electromagnetic waves must conform to Newton's laws of motion and to Kepler's laws of planetary motion, otherwise the planets would spiral into the Sun. The inertial forces are closely related to the convective aspect of electromagnetic induction where, $\mathbf{E}_L = \mu\mathbf{v} \times \mathbf{H}$, while Newton's second law is

closely related to time-varying electromagnetic induction where, $\mathbf{E}_K = -\partial\mathbf{A}/\partial t$, with only the latter being involved in electromagnetic waves. It is now suggested that inertial motion is closely related to the same physical cause that underlies Ampère's Circuital Law.

According to James Clerk Maxwell, Ampère's Circuital law is about how a moving element interacts with the surrounding luminiferous medium in such a way as to induce vortex rings that amount to magnetic lines of force [2]. These lines of force form concentric solenoidal rings around the direction of motion. The manner of the physical interaction that induces these magnetic lines of force is dictated by hydrodynamics in the context of a sea of tiny aethereal vortices that are pressing against each other with centrifugal force while striving to dilate. It is now suggested that this same mechanism determines the uniform straight-line inertial path by a process involving gyroscopic stability, out of which forms a surrounding weak magnetic field. This weak magnetic field, discovered by S.J. Barnett in 1915 [1], becomes significant in high energy atomic and molecular systems under pressure, and at the most fundamental level, there is no distinction between magnetic repulsion, electrostatic repulsion, and centrifugal repulsion.

The important thing however is, that if space is densely filled with electric particles in order to accommodate the propagation of light waves, then these electric particles must interact with matter in motion in such a way as to generate the inertial forces in line with Kepler's laws of planetary motion, rather than to be the cause of dissipative friction that would result in the planets spiralling into the Sun. This can be achieved if space is densely packed with tiny aethereal vortices, where each vortex comprises a single electron in orbit with a positron, hence forming a dense neutral dielectric sea.

Appendix I

Consider a particle moving in an inertial frame of reference. We write the position vector of this particle relative to any arbitrarily chosen polar origin as,

$$\mathbf{r} = r\hat{\mathbf{r}} \tag{1A}$$

where the unit vector $\hat{\mathbf{r}}$ is in the radial direction, and where r is the radial distance. Taking the time derivative and using the product rule, we obtain the particle's velocity,

$$\dot{\mathbf{r}} = \dot{r}\hat{\mathbf{r}} + r\dot{\theta}\hat{\boldsymbol{\theta}} \tag{2A}$$

where $\hat{\theta}$ is the unit vector in the transverse direction, and where $\dot{\theta}$ is the angular speed about the polar origin. Taking the time derivative again we obtain the expression for the particle's acceleration in the inertial frame,

$$\ddot{\mathbf{r}} = \ddot{r}\hat{\mathbf{r}} + \dot{r}\dot{\theta}\hat{\theta} + \dot{r}\dot{\theta}\hat{\theta} + r\ddot{\theta}\hat{\theta} - r\dot{\theta}^2\hat{\mathbf{r}} \quad (3A)$$

which can be rearranged as,

$$\ddot{\mathbf{r}} = (\ddot{r} - r\dot{\theta}^2)\hat{\mathbf{r}} + (2\dot{r}\dot{\theta} + r\ddot{\theta})\hat{\theta} \quad (4A)$$

Appendix II

Kepler's second law is the law of areal velocity, which is essentially a statement that angular momentum is conserved, and it means that only radial forces are involved in planetary orbits. This can be proven in reverse as follows. If the total transverse acceleration is zero, then from equation (4A),

$$2\dot{r}\dot{\theta} + r\ddot{\theta} = 0 \quad (5A)$$

hence, multiplying across by r ,

$$2r\dot{r}\dot{\theta} + r^2\ddot{\theta} = 0 \quad (6A)$$

Since,

$$2r\dot{r}\dot{\theta} + r^2\ddot{\theta} = d/dt(r^2\dot{\theta}) = 0 \quad (7A)$$

then,

$$r^2\dot{\theta} = L \quad (8A)$$

where L is a constant which is twice the areal velocity, and so the areal velocity must be constant. Hence,

$$\dot{\theta} = L/r^2 \quad (9A)$$

Substituting $\dot{\theta}$ in (9A) into (4A) in conjunction with (5A) we obtain,

$$\ddot{\mathbf{r}} = (\ddot{r} - L^2/r^3)\hat{\mathbf{r}} \quad (10A)$$

which expresses the centrifugal force in terms an inverse cube law in radial distance from the polar origin and a constant, L^2 , that is related to angular momentum. In the case of the uniform straight-line inertial path, where we have $\ddot{\mathbf{r}} = 0$, equation (10A) becomes,

$$\ddot{r}\hat{\mathbf{r}} = +h\hat{\mathbf{r}}/r^3 \quad (11A)$$

where $h = L^2$ is a constant related to angular momentum. This means that relative to any arbitrarily chosen point in space, a particle undergoing uniform straight-line motion experiences a centrifugal acceleration to this point, dependent on the angular momentum relative to it, and this acceleration diminishes as per the inverse cube of the distance from the point.

References

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Equation (77) in this paper is Maxwell’s electromotive force equation and it exhibits a strong correspondence to equation (1) above. The centrifugal and Coriolis terms in equation (1) correspond to the compound centrifugal force term $\mu\mathbf{v} \times \mathbf{H}$, while the other transverse term corresponds to $-\partial\mathbf{A}/\partial t$.

[3] 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.”

[4] Lodge, Sir Oliver, “*Ether (in physics)*”, Encyclopaedia Britannica, Fourteenth Edition, Volume 8, Pages 751-755, (1937)

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In relation to the speed of light, “*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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"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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