More on using the Earth's Magnetic Vector Potential

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1. Introduction

In my previous paper [1] I argued that electric charge moving around a curved orbit in a uniform **A** field obtained a force from the gradient of the **v**•**A** potential, even though this was forbidden in the many texts dealing with the subject. Those texts used vector math, such as the gradient, with the proviso that it applied only to spatial variations in the vector **A**, not spatial variations in the velocity vector **v**. It is that suppression of velocity terms that I questioned, since the inclusion of those allowed my force to exist. I have since found another paper [2] that follows that same suppression of velocity terms, but presents the math in a different way that throws new light on the subject.
Reference [2] contains the following.

Besides, we know that the generalized "impulsion" of a massive charge particle in presence of a vector potential writes: $\mathbf{p} = m\mathbf{v} + q\mathbf{A}$. *Following Maxwell, one can define an "electro-tonic impulsion" density* $\mathbf{G} = \rho_e\mathbf{A}$, *which is the product of the electric charge density with the vector potential, which physically is an electromagnetic momentum per unit charge. Now, the product of the charges velocity by the "electro-tonic" momentum is an energy:*

In my earlier paper [3] I refer to this "electro-tonic" momentum $q\mathbf{A}$ as a "canonical" (by definition) momentum, being a momentum not associated with mass or velocity, but nevertheless having the dimension of mass×velocity. I also reasoned that qAv has the dimension of energy, then went on to state "*In this paper we show that these energy considerations apply both to the source of the **A** field and to the moving charge, that the moving charge has potential energy qAv which can only be accessed when the charge moves out of the **A** field region and, if the charge gains that energy by being accelerated while within the **A** field, the energy is taken from the current generator that supplies the **A** field.*"

Reference [2] goes on to state

"*The Lorentz force can be rewritten as a function of the potentials*:

$$\frac{d}{dt}(m\mathbf{v} + q\mathbf{A}) = -q\mathbf{grad}(\phi - \mathbf{v}\cdot\mathbf{A}) \tag{1}$$

and also states

where **grad** *applies only to* $\mathbf{A}(\mathbf{r},t)$ *and not to* $\mathbf{v} = \dfrac{d\mathbf{r}}{dt}$.

That last statement is the usual one forbidding the use of spatial variations in the velocity vector.

Of interest is (1) that equates the force on the charge q (the RH side of (1)) to the rate of change of momentum (the LH side). If there were no **A** field present (1) reduces to

$$\frac{d}{dt}(m\mathbf{v}) = -q\mathbf{grad}(\phi) = -q\mathbf{E} \tag{2}$$

which is simply stating force=mass×acceleration for a charge q of mass m being accelerated by an electric field **E**. Ignoring for the moment the source of the force on q (it could just as easily be produced magnetically of mechanically) the LH side of (2) tells us the magnitude of the force we need to apply in order to achieve the acceleration $d\mathbf{v}/dt$. It also tells us the magnitude of the force that can be *produced* by supplying $d\mathbf{v}/dt$, as is the case for centrifugal force where $d\mathbf{v}/dt$ is always at right angles to $\mathbf{v}$. Similarly the LH side of (1) represents a force either applied *or created*, and this is the first time I have seen it presented in this way. Now within a uniform **A** field, for a particle the momentum $q\mathbf{A}$ is constant, but if we deal with other forms of charge, such as a charged sphere, q need not be constant. Hence if q changes with time we can obtain a force on our charged sphere given by $\mathbf{A}\frac{dq}{dt}$. This force doesn't seem to have been recognized before and is certainly new to me. This paper explores how that could be used to advantage.

2. A Racetrack Example

Consider cars moving at velocity v around a racetrack where the straight sections lay E-W, as shown in figure 1.

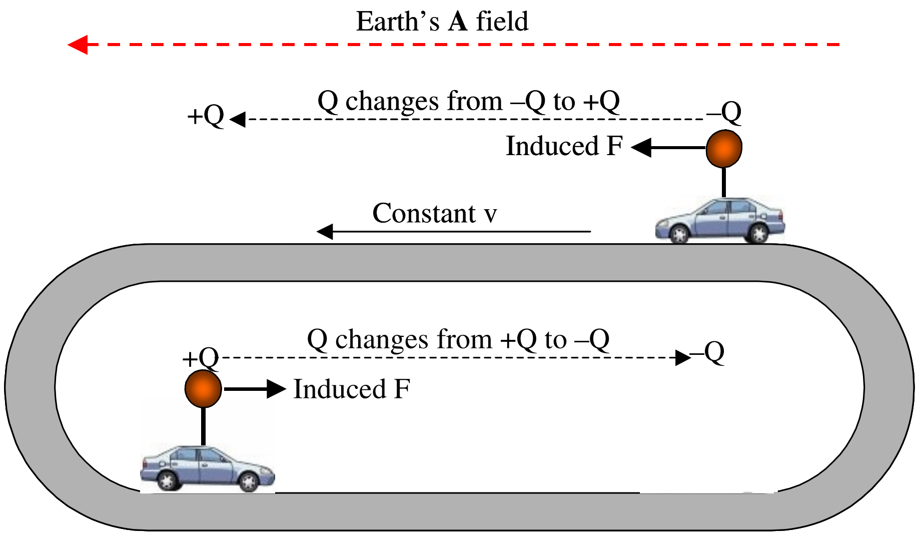

Figure 1. Racetrack example.

These cars carry charged spheres that obtain their charge from electrical circuitry within each car. Ignore for the moment the energy source driving that circuitry. The circuitry applies negative charge Q at the start of the straight section where the cars are travelling toward the West, along the Earth's **A** field, then gradually reduce that charge to zero then increase it in the opposite polarity to arrive at positive charge Q at the other end of the straight section. The charged sphere experiences a force F. This would attempt to accelerate the car, but suppose the car has electrical generators connected to the wheels, with the output of the generator supplying power and the resulting drag force exactly countering the accelerating force. We have constant velocity, so mass inertia doesn't consume any energy. It will be seen that the energy stored in the charges sphere is constantly recycled, hence ignoring losses the output from the generator is free to use for other purposes. On the return journey travelling East over the other straight section the charge changes from positive Q to negative Q which also results in an accelerating force. On the curved end sections we have constant charge following a circular orbit at constant speed where current theories dictate that the charge endures zero force because the gradient of **v**·**A** applies only to spatial changes in **A**, not **v**, and **A** is everywhere constant. During this period the generator attached to the wheels is disconnected from the load.

Along the straight section of the racetrack as q changes from $-Q$ to $+Q$ over a time period τ we get a force from $\frac{d}{dt}(q\mathbf{A})$ which becomes $\mathbf{A}\frac{dq}{dt}$ which is then a force $\mathbf{F} = \frac{2Q\mathbf{A}}{\tau}$ pointing along the **A** vector. If the length of the straight section is l and the force F is doing work driving generators attached to the wheels, then ignoring losses the energy W transferred to the load is $W = \mathbf{F}l = \frac{2QAl}{\tau}$ and since $\frac{l}{\tau}$ is the velocity v we get the satisfactory result that $W = 2QAv$. Note that energy gained over a complete circuit is twice this value, $W = 4QAv$, is independent of the length travelled, so we can shorten the racetrack resulting in greater force over smaller distance. Eventually this becomes a circular track where the change in charge is almost instantaneous and the energy pulse is almost a delta function.

The energy term qAv associated with charge q moving along a magnetic vector potential **A** at velocity v has been considered in another paper of mine [3] but this is the first time I have seen a method for capturing that energy. That paper [3] explores the reaction with the *source* of the **A** field to demonstrate that energy gained by the (moving) charge was taken from that source, but only considered energy gained if the charge was accelerated within the **A** field. Effectively the accelerating charge radiates electro-magnetically, that radiation arriving at the distant **A** field source in a manner to extract energy from it. Here we gain energy by causing the charge value to change while it moves at constant velocity, but that also constitutes a system that can radiate electro-magnetically. The radiation from the moving *and changing Q* can react with ions in the spinning Earth's core to extract exactly that amount of energy. This is illustrated in figure 2.

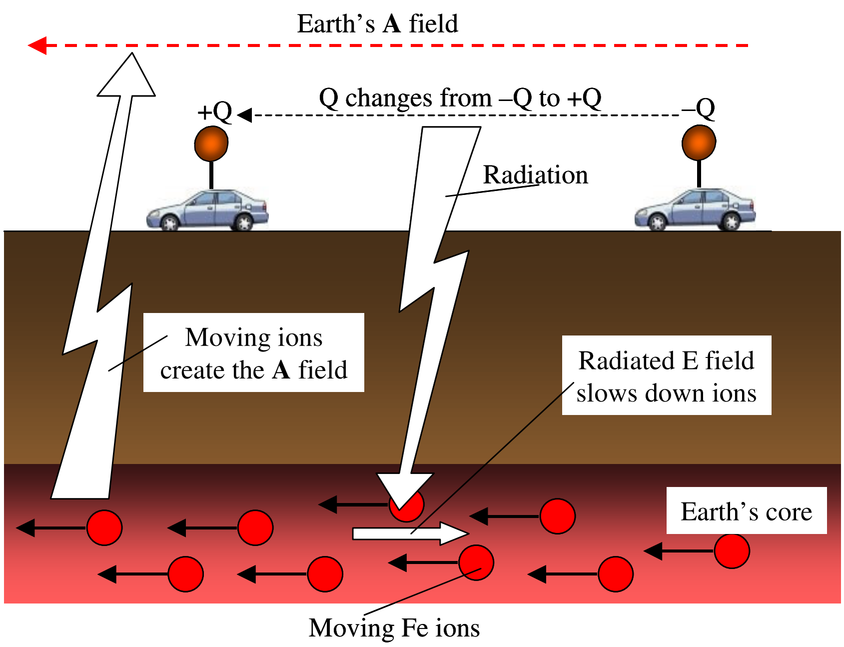

Figure 2. Illustrating where the energy comes from

3. Rotating Disc Example

For the rest of this paper we consider a circular track, initially of spheres that can be charged at appropriate positions around the track. If we take spheres or electrodes at a radius of ⅓ m rotating at 600 rpm in an **A** field of 100 Weber/m we obtain a velocity of about 20 m/S hence each electrode gains a quantity of energy 4000Q joules on each revolution, which at 10 revs per second is a power of 40,000Q watts. If we have 10 electrodes around a rotating disc that is now 400,000Q watts. To achieve just 4 W average power requires a Q of 10^{-5} Coulombs per electrode, and with the self capacitance of 10cm electrodes being about 10pF it requires a voltage of 1 megavolt to get that quantity of charge. This is too high to be practical, so is there any way we can get higher value capacitance and lower voltage?

If we consider a charged sphere moving above a fixed ground-plane it may be thought that the image charge moves with the sphere, hence introducing a counter force, but that is not the case. The image charge is an artefact, in reality there is a surface charge distribution centred blow the moving charge, and although that *distribution* moves with the charge the actual electrons creating that distribution move at drift velocity in the ground-plane, as illustrated in figure 3. Any reaction from that drift results in a force within the fixed plane.

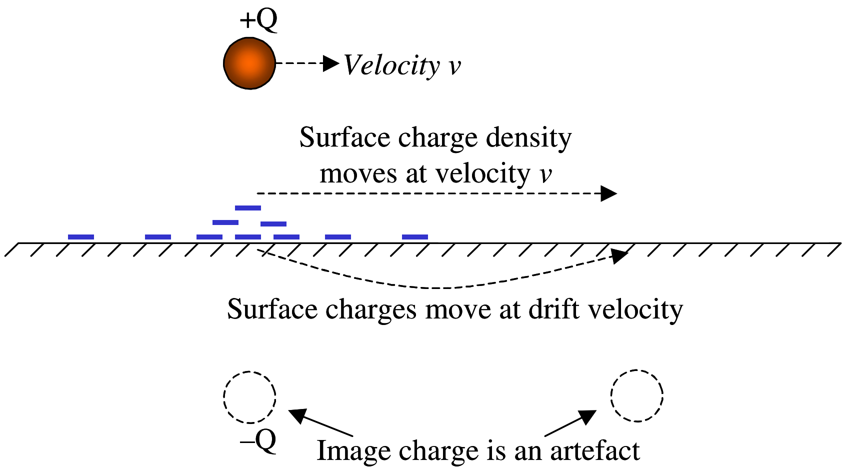

Figure 3. Moving Charge above a Ground-plane

So it is possible to have electrodes on a rotating disc offering surface area to a thin high K dielectric adjacent to a fixed conductive disc to achieve greater capacitance. A 10cm diameter area and a 1mm thickness dielectric with K=7 yields a capacitance of 500pF, which brings the voltage down to 20KV which is much more reasonable. 0.1 mm dielectric gets you down to 2KV. Can the ground-plane disc move with the electrodes? It would seem not as now we do have the surface charge distribution on the ground plane moving to create a negating force.

4. Overall System

Figure 4 shows hemispherical electrodes mounted in an insulated disc with their flat sides exposed to a thin dielectric adjacent to a fixed ground plane.

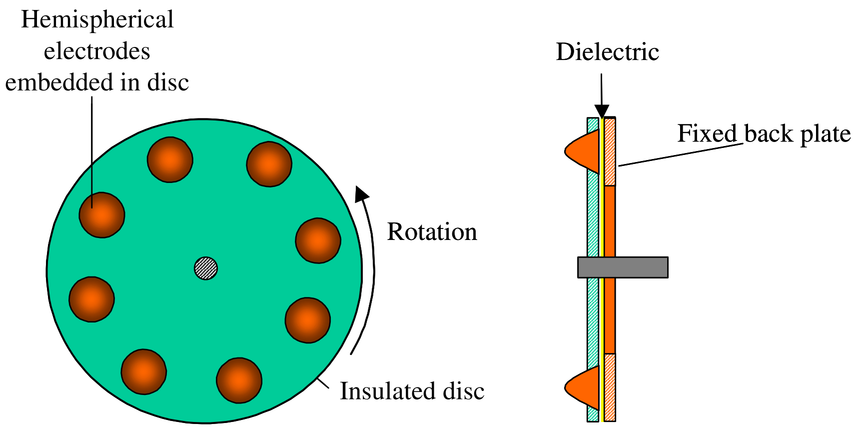

Figure 4. Electrodes on rotating disc.

The disc is driven by an electric motor that also doubles as a generator for extracting power from the disc. Initially the motor is driven from a starter battery to get it rotating, then when it is producing power the battery is disconnected. The disc electrodes get their excitation from a pair of fixed electrodes that are connected to a HV source supplying positive voltage to one electrode and negative voltage to the other. The moving electrodes obtain appropriate charge when they get close to the fixed ones either by spark or by whiskers acting as brush contacts. This form of commutation creates an electrostatic motor that supports the rotation. The system is shown in figure 5.

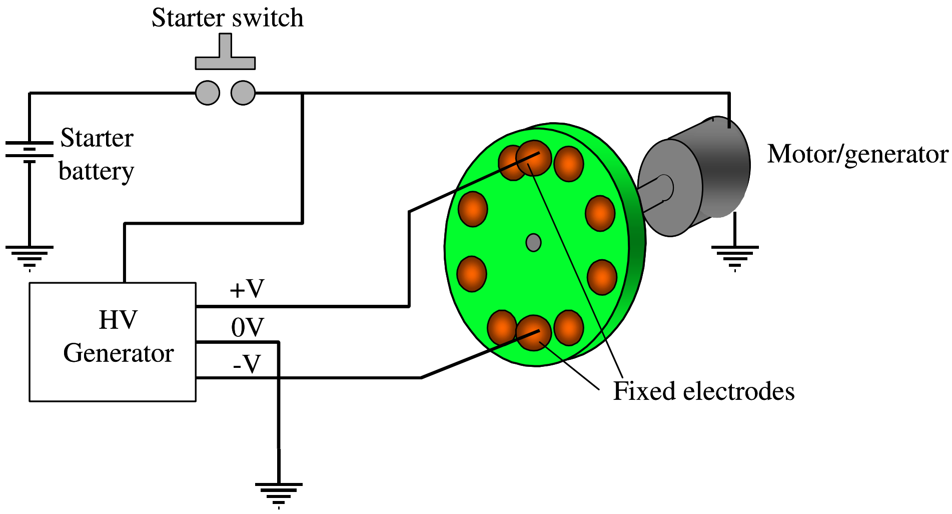

Figure 5. Complete system

Here the electrostatic motor draws continuous current from the HV supply. A more complex arrangement could store the capacitive energy removed to be resonantly recycled in the opposite polarity via an inductor.

5. Simple Experiment

In order to establish that a changing charge really does exhibit force from the Earth's **A** field it would seem worthwhile to conduct a simple experiment. This is illustrated in figure 6. A conductive sphere is suspended from the ceiling using a thin connecting wire. The sphere is charged to a high potential from an EHT source, then discharged quickly on a switch closure. If the impulse force $F = \mathbf{A}\frac{dq}{dt}$ really does exist then the sphere should be observed to jump sideways and always in an E-W direction. The velocity **v** imparted by the impulse is given by

$$\mathbf{v} = \frac{Q\mathbf{A}}{m} = \frac{CV\mathbf{A}}{m} \qquad (3)$$

where Q is the charge (Coulombs), m is the mass of the sphere (kilograms), C is its self-capacitance (Farads) and V is its voltage. If the sphere has diameter d cm its self-capacitance is 0.556d picofarads. If we take 100 Weber/m as the Earth's **A** field, a sphere 10cm diameter weighing 10 grams charged to 100KV will achieve a velocity of 5.56mm/S. That should be observable.

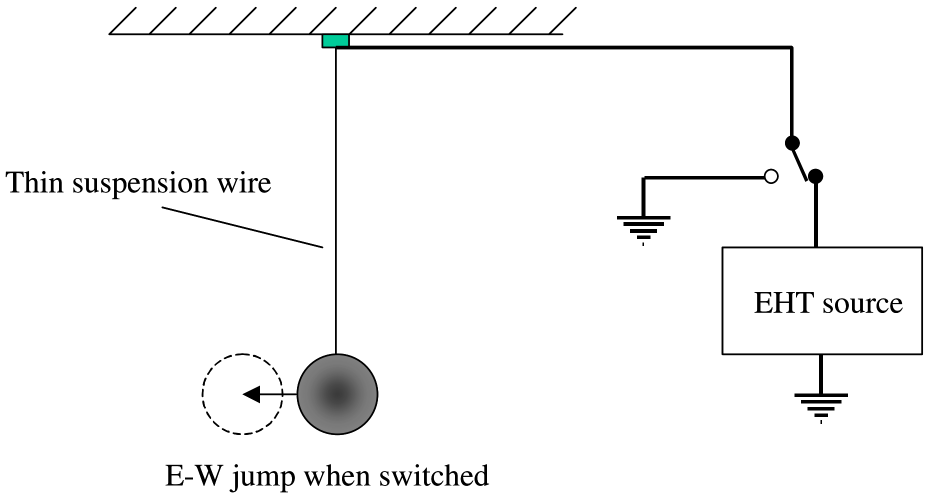

Figure 6. Simple experiment.

Care must be taken to ensure that the sudden change of electrostatic attraction to nearby objects does not obscure the results. So this needs a large laboratory with clear space around the hanging sphere. The observation camera may need a telescopic lens.

6. Conclusion

A possible new force associated with electric charge that is changing with time while within a vector magnetic field has been discovered. The presence of this force can be established by a simple laboratory experiment. If it is shown to exist there is the possibility of producing an overunity machine where the excess energy is derived from the Earth's core where the moving ions are slowed down.

References

[1] “Electro-kinetic Potential in the Earth’s A Field”

[2] “On the interaction between a current density and a vector potential: Ampère force, Helmholtz tension and Larmor torque.” By Germain Rousseaux.

[3] “On Charge Movement through a Magnetic Vector Potential Field”