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The Nicola Tesla Connection

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According to a 1937 press statement by Tesla, he had succeeded in **unifying gravity and electromagnetism** (wich would result in a **unified field theory**). But he never published his own theory. For me, it always seemed a good wish but I never saw the actual possibility of unifying gravity and electromagnetism – until recently.

First step: In 1982 I realized that electromagnetism (classical electrodynamics (CED)) can be extended inside the elementary particle which can be thought of as a completely classical object – as a closed boundary containing a "material continuum" which is surrounded by a "vacuum". The "material continuum" is a new concept: it is a part of space where the density of current (thought of as a continuous field) is different from zero. A "vacuum" is an alternative part of space where all the components of current density are zero. The "material continuum" can not be thought of as a system of material points – it is actually a new concept. The current density inside a material continuum satisfies the equation:

$$\Delta j^k - \frac{1}{c^2}\ddot{j}^k = -k_0^2 j^k; \quad k_0 \approx 7\cdot 10^{13} cm^{-1} \tag{1}$$

It is the wave equation for the field of current density where the sources are the current density itself. The constant is reciprocal to the size of elementary particle. It appears that the mere presence of a current density in space makes a contribution to the energy-momentum tensor:

$$\begin{aligned}
T^{00} &= \frac{1}{8\pi}(E^2 + H^2) - \frac{2\pi}{k_0^2 c^2}[(j^0)^2 + (\vec{j})^2] \\
T^{33} &= \frac{1}{8\pi}(E^2 + H^2 - 2E_3^2 - 2H_3^2) - \frac{2\pi}{k_0^2 c^2}[(j^0)^2 - (\vec{j})^2 + 2(j^3)^2] \\
T^{03} &= \frac{1}{4\pi}(E_1 H_2 - E_2 H_1) - \frac{4\pi}{k_0^2 c^2} j^0 j^3 \\
T^{12} &= -\frac{1}{4\pi}(E_1 E_2 + H_1 H_2) - \frac{4\pi}{k_0^2 c^2} j^1 j^2
\end{aligned} \tag{2}$$

where the first terms are the usual terms that originate from the electromagnetic field.

Second step: Again, the Nicola Tesla connection: Tesla attributed a physical meaning to the potential. Main stream physics denied it, saying that potential is only a mathematical tool. If we take a potential vector as a gradient of some function then the corresponding electromagnetic field

is zero and the energy-momentum tensor is also zero. This was the reason to deny the physical significance of potential. I succeeded in using the least action principle to prove that the potential has to be continuous on all disruption surfaces. At the same time, the electromagnetic field can jump onto the disruption surfaces, producing surface charges/currents. This means that in those places of space (like inside the elementary particle) where the potential defines the electromagnetic field and currents, this potential can be influenced through the required boundary conditions by the outside potential field that has no electromagnetic field and energy connected to it. We have to attribute a physical meaning to the potential in general. This way we subscribe to the existence of physical reality that has no energy or momentum connected to it. What is it? Is it actually the "luminiferous aether"? Pretty much so! It is described by the vector-potential that satisfies the wave equation. Though, the trick is: the "luminiferous aether" was thought of as an indication of "absolute rest", as a contra-argument against SR. But "absolute rest" does not exist even in the aether. Nicola Tesla was against both SR and GR. I agree with him on GR. GR is a good math exercise but not a physical theory. Regarding SR – it requires a high level of math to understand it. I think that even today, even among those who have a high math level, there are only a few who understand it correctly.

Third step: The mathematics that goes along with the above steps is fairly complicated. The simplest would be to choose plane symmetry: say that all the fields depend only on the 3rd coordinate (z). Still, I do not want to go in math details even in that case. I will try to present carefully the results. Below, I describe the 3 idealized physical situations where we have vacuum from z=-inf. to z=0 (first region), material continuum from z=0 to z=a (second region), and again vacuum from z=a to z=+inf. (third region). This way we model the presence of an elementary particle by a thin layer of material continuum (z=a will be comparable to the size of a particle).
1. Suppose that in the first region we have a constant electric field E and the material continuum is charged with the surface charge density Q. We calculate that the electric field in the 3rd region will be $E+4\pi Q$. There is no flow of energy in this case (T03=0), but there is a flow of linear momentum because T33 is different from zero. The jumps of T33 on the boundaries mean no conservation. The linear momentum of the field is being lost/acquired at a constant rate at these boundaries. That means that the structure which is responsible for enforcement of the boundaries should acquire/lose the said linear momentum at a constant rate. That means a force. The layer of material continuum will be "squeezed" with the force density f1 acting to the right at z=0 and with the force density f2 acting to the left at z=a:

$$f1=\frac{1}{8\pi}\left[\frac{4\pi Q+E(1-\cos(k_0 a))}{\sin(k_0 a)}\right]^2;\quad f2=\frac{1}{8\pi}\left[\frac{4\pi Q\cos(k_0 a)-E(1-\cos(k_0 a))}{\sin(k_0 a)}\right]^2$$

The resulting force is $Q[E+2\pi Q]$ – exactly what we would expect in this case. Note that if Q=0 then f1=f2 and the resulting force will be zero but the squeezing will remain. This case means that we successfully explain the action of the electric field on a charge.

2. Suppose that the usual transverse electromagnetic wave with given amplitude is coming from z=-inf in the first region, and the net charge of the material continuum is zero. This wave will result in some reflected transverse wave in the first region, some transmitted transverse wave in the third region, and two transverse waves (going back and forth) inside the material continuum. These last will be accompanied by the charge density waves and the transverse current density waves. The amplitudes of these waves will depend on a. There are the flows of linear momentum (T33) and energy (T03) through the system. The flow of energy is continuous at z=0 and z=a but the flow of linear momentum is discontinuous in such a way that the material continuum is under a stretching

tension. The net force is directed to the right and corresponds to the usual radiation pressure. This case means that we are able to successfully explain the usual radiation pressure caused by transverse waves. Both (1&2) cases are just to show that our theory works correctly.

3. Suppose a "dummy" longitudinal aether wave is coming from z=-inf. in the first region. No energy, no linear momentum are connected to this wave. The solution shows that we will have a reflected dummy wave in the first region, the transmitted dummy wave in the third region, and the two (going back and forth) longitudinally, but not dummy waves inside the material continuum. These waves will be accompanied by the waves of the longitudinal electric field, charge density, and longitudinal current density. And, which is important, the energy flow (T03) and the linear momentum flow (T33) will have the jumps at z=0 and z=a. The "dummy" wave appears to produce a real physical response inside the material continuum. The jumps of the linear momentum flow will produce equal forces that squeeze the material continuum. The net force will be zero. The jumps of the energy flow are also equal and they produce a source of free energy at z=a and a free drain of the same amount of energy at z=0. How the structure that enforces the boundaries (an elementary particle) can manage this process is not yet known. So far, the net energy and the net linear momentum are conserved. The calculation shows that the energy density inside material continuum oscillates along z beginning with the positive density. If $a \le \pi / \left(4\sqrt{k_0^2 + (\omega / c)^2} \right)$ then it is positive everywhere. Here comes the real meaning of the "third step". **We have to assume that the energy density in space, if it is positive, can be lost (perhaps by radiation of transverse waves) on the way from z=a to z=0** decreasing both the energy flow and the linear momentum flow at z=0. If so, then we will get the negative net force directed towards the source of dummy waves (**gravitation**) and we will get the actual free energy (**energy source of stars**). In addition of course, we have to assume that all massive particles are the sources of dummy waves, which radiate continuously. These waves have to be outgoing waves. If, in addition, we suppose that the frequency of dummy waves is proportional to the mass of the particle: f=mc2/h then we will be able to explain De-Broglie's waves as a simple Doppler effect (see Milo Wolf who can be easily found on the internet). To explain "the wave properties of the particles" by pure classical means is already a big step. But it has to be a big work before we can provide the classical basis for quantum theory. In my opinion, we have to find the way to account for the incoming incoherent plane waves. Also we have to develop some statistical methods.