Maxwell's Equations – A Serious Flaw

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Abstract

As is well known, Maxwell's Equations form the foundation for analysis of all electromagnetic waves and for the typical illustration of a Maxwell Wave. All too often, however, it is forgotten that his equations simply describe the intensities of the electric and magnetic fields along an axis of a plane wave. Such a wave is hypothetically of infinite extent perpendicular to that axis, the direction of propagation. It is also often forgotten that his mathematics was based on Faraday's work which leads to an interesting question, interesting but virtually unthinkable.

Paper

Given the importance of Maxwell's work, how important is the fact that his fields are of infinite not finite extent? We might assume that for Maxwell we can truncate the field lines where convenient thus yielding finite dimensions but this cannot be. Faraday had shown that the field lines either connected positive to negative charges (ions) or closed on themselves: they are NEVER open ended! Apparently Maxwell's plane waves approximate but do not really describe electromagnetic waves. The next question is can we provide a better description based on Faraday's work? We will leave the mathematics to mathematicians because we are interested in the physical properties or characteristics. We will see that Faraday's concepts can be used to describe a conceptual electromagnetic wave. Of course such a simplistic approach does not dot the I's or cross the T's but here we are only conceptualizing.

Since electromagnetic waves do not have embedded ions to act as field line terminators, the field lines must close on themselves. To develop a conceptual wave we begin with an electric field line forming a single loop and then we duplicate that loop a number of times; we realize the number of lines in that loop may depend on the energy of the wave. To simplify the description of the wave we define the loop to lay in the horizontal plane thus the wave is horizontally polarized. From Faraday (as used by Maxwell) we know the magnetic field is perpendicular to the electric field therefore each part of the electric field loop is inside of a smaller magnetic field loop. We have just described a toroid with electric fields replacing the circular iron core and magnetic fields replacing the exterior windings. Possibly a more familiar reference would be a chocolate coated doughnut: the electric fields are the core of the doughnut and the magnetic fields are the chocolate coating or sheath. With this interesting start we next move to the local environment.

Unlike Einstein's 'empty space' where nothing exists except space and random electromagnetic (light) waves, we can see that Faraday's equivalent space would be crisscrossed with electric field lines. The terminating ions may be very few, separated by large distances and in essentially random motion: this is consistent with even the 'empty space' between the galaxies. In fairly dense space the shorter magnetic fields also come into play but that is essentially outside of this brief presentation. Our interest at this stage is the interaction between the above 'doughnut' and Faraday's electric lines in space.

Although Science does not yet know how or why electromagnetic waves travel, by definition they do and we propose that the above electromagnetic loop also travels. The 'magnetic sheath' coating the electric loop interacts with the electric fields in space (external to the loop) thereby doing a number of things: moving the fields out of the way, putting energy into those fields and traveling along those fields. Displacing a field line in space is similar to plucking a violin string that carries a pulse (energy) to its terminal (ion) where it is reflected, sending a reversed pulse back to the source. Here we have to apply yet another concept of physics; electromagnetic waves are conservative meaning they do not normally lose energy. Application of this concept yields an interesting modification to our doughnut.

Since the magnetic sheath 'points' the same direction all the way around the electric loop (say pointed down on the outside of the loop), the sheath cannot recover the returning energy. To recover the inverted pulse we need a second loop that is inverted; both the electric and the magnetic fields are reversed. This yields a single unit composed of two electric loops forming a figure eight and the associated magnetic sheaths. The front sheath transfers energy to the local environment while the back one recovers the returning energy. The common part of the internal electric loops forms an essentially straight line therefore the double loop tends toward a rectangular or block letter eight; other than this straight line the rest of the shape including the 'size' depends on the amount of energy and the local environment.

There are other functions for the magnetic sheath, one of which is very important for the conceptual wave. When two double units approach each other, depending on their orientation, the sheaths interact either repelling or attracting. This provides magnetic coupling between double units thus allowing for a long train of units while within a double loop unit (as above) the coupling is provided by sharing the electric fields. A profile through this train of loops provides a sequence of magnetic and electric fields of several amplitudes that may be mathematically expressed but not as easily as Maxwell's Equations: we leave that aspect to the mathematicians.

Similarly the magnetic sheath can couple into the short range magnetic fields of selected ions and atoms thereby transferring energy to and from those objects. With the principle of equipartition of energy, except for that used for traveling, the energy is shared between the two fields. This means that when energy is transferred to/from the magnetic sheath, energy also shifts to/from the internal electric field loops. If the energy 'sink' is large enough, all of the energy may be drained from the double loop structure through the magnetic sheath.

In the beginning we asked if the extent of Maxwell's fields was important. By recognizing the description of Faraday's fields we appear to have found an entity that travels as a wave but is detected as a particle, a true photon! Unfortunately that sentence opens a can of worms that should have been resolved in the late 1800's. This problem may also be seen as conceptual, the differences between a classical wave, the Maxwell wave and the above photon. Once again we are concerned with the physical properties, not the mathematics. There are a number of classical waves such as ocean waves, sonic waves in gasses, vibrational waves in solids, etc. In all cases of classical waves there are dual aspects: the real and the effect. The real part of the wave is composed of oscillating atoms, molecules, etc. within the local environment while the effect is the result of the oscillations, the 'structure' of the wave without the physical components. The two aspects may be separated mathematically but not physically.

When we treat a Maxwell wave as a classical wave we run into the same problem as the scientists of that time. The space through which the wave travels has to contain electric and/or magnetic fields (possibly randomly oriented), that are the constituent 'atoms' and 'molecules' of the local environment. As this classical wave flows past an observer, the observed wave has the dual aspect of electric fields and magnetic fields that are actually effects due to forced orientation/oscillations of the local fields thus fulfilling Maxwell's Equations (which are based on oscillations!). This effect could not be found in a truly empty space because by definition there was nothing to oscillate, but scientists refused to accept this and proposed a substitute named Aether. This also was never found therefore Maxwell's wave can not qualify as a classical wave. Since we are still conceptualizing we can next treat this 'wave' as a particle or a classical photon. Such a photon is an entity unto itself, it is not an effect composed of or related to oscillations of the local environment. As such, a photon may travel by interacting with local fields (as above) or independently of everything (Einstein's relativity). A physical particle corresponding to this Maxwell photon, however, can not exist as a 'wave' in either case because it has no structure tying sequential ‘photons’ together.

Looking again at the earlier double loop photon we can see (as earlier) the internal electric field is the structure tying the photon together. Alternate individual doughnuts in a photon train are inverted therefore as the train flows past an observer the sequence of sheaths is observed to continually reverse: a sequence of alternating magnetic fields. From Faraday, however, a moving magnetic field ‘induces’ or generates an electric field. To the observer the result is a traveling electromagnetic field where the observed ‘electric’ fields are an induced effect in the environment and the magnetic fields are the sheaths of the photon string, a real structure formed of magnetic sheaths and internal electric field loops. It might be noted that this ‘wave’ is consistent with the normal units of measurement; the waving external electric fields (in the environment) are in electrostatic units while the traveling magnetic fields (sheaths) are in electromagnetic units. Once again, this is a very simplistic approach but (as previously stated) a more complete description is beyond the scope of this presentation.