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Displacement magnetism experiment design

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According to Ampere-Maxwell equation, displacement current creates magnetic field. I call this theory displacement magnetism. I have proven that displacement magnetism violates energy conservation law and as a consequence, the wave equation is inconsistent (1,2,3).

The above conclusions need experimental test. I propose an experiment whose design is shown in the Figure 1. A round plate capacitor is charged by an alternate current, I_c. In the circuit a long rectangular loop is connected in series. The magnetic field variation in the space between the plates and outside the capacitor is measure by an EMF sensor. Another EMF sensor measures the magnetic field near the long side of the loop.

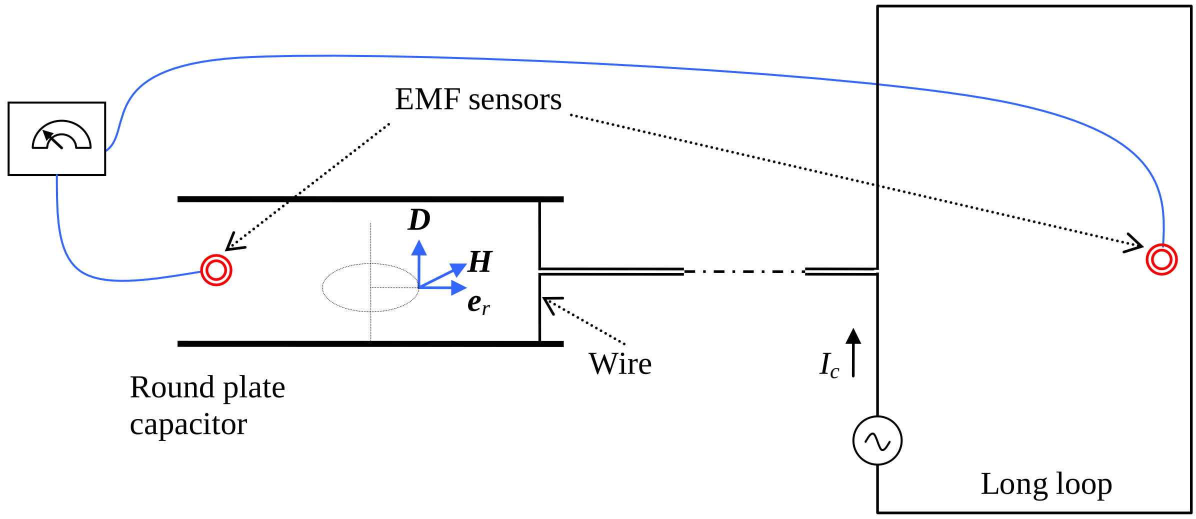

Figure 1

The magnetic fields are computed in the article Phantom Lorentz force Paradox http://pengkuanem.blogspot.com/2012/07/phantom-lorentz-force-paradox.html. The magnitude of the magnetic field inside the capacitor is:

$$H = \frac{I_c r}{2\pi R^2} \tag{1}$$

That outside the capacitor is:

$$H = \frac{I_c}{2\pi r} \tag{2}$$

The object of this experiment is to measure the magnetic field created by the displacement current of the capacitor only. What is the contribution of displacement current in the magnetic field? Ampere-Maxwell equation does not provide an answer. We have to use Biot-Savart law.

Consider the capacitor charged by an infinitely long wire, as shown in the Figure 2 (a). The magnetic field ***H*** can be considered as the sum of the magnetic field from the displacement current and that from an infinitely long wire from which a segment of length Δl is removed at the place of the capacitor (see the Figure 2 (b)).

The magnetic field of an infinitely long straight current is the equation (2), which is obtained by integrating Biot-Savart law (see the Figure 2 (c)). That of the interrupted long wire is the equation (2) minus the contribution of the removed segment, $H_{\Delta l}$:

$$H_{l-\Delta l} = \frac{I_c}{2\pi r} - H_{\Delta l}$$

Since the magnetic field outside the capacitor is given by the equation (2), the contribution of the displacement current is the equation (2) minus the above $H_{l-\Delta l}$:

$$H_c = \frac{I_c}{2\pi r} - \left(\frac{I_c}{2\pi r} - H_{\Delta l} \right) = H_{\Delta l} \quad (3)$$

As the length Δl is very short, $H_{\Delta l}$ is nearly 0. So, the contribution of the displacement current is nearly 0. Please note that the equation (3) is only an estimate of the expected value, but not a law that defines correctly the magnetic field of the setup.

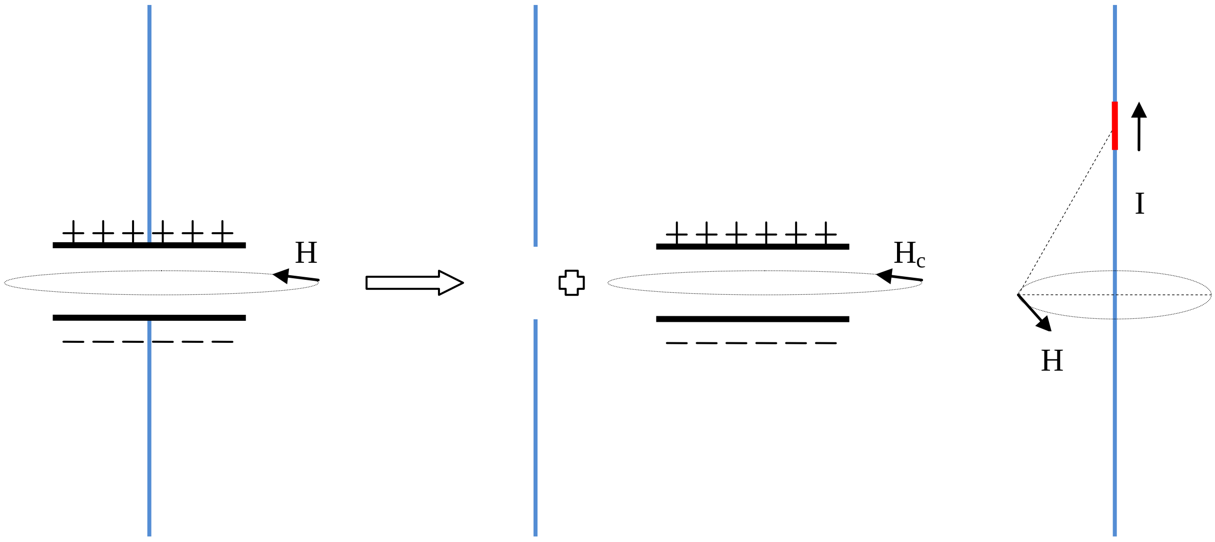

Figure 2

In order to eliminate the magnetic field of the wire, the charge wires connect the capacitor from the space between the plates (see the Figure 1).

As shown above, the expected measurement of magnetic field is nearly 0. By 0 we mean the magnetic fields inside and outside the capacitor are very weak relative to a reference value, which is the magnetic field of the long straight current of the loop. This reference value is measured by the EMF sensor of the loop; it is also well defined by Ampere's law (the equation (2)). The loop must be sufficiently far from the capacitor to not interfering with it.

This experiment is critical because it verifies the validity of displacement magnetism which is the base of the wave equation. Displacement magnetism in free space is defined by Ampere-Maxwell equation: $\nabla \times \mathbf{H} = \frac{\partial \mathbf{D}}{\partial t} = \frac{\partial \varepsilon_0 \mathbf{E}}{\partial t}$

Along with Faraday's law: $\nabla \times \mathbf{E} = -\frac{\partial \mu_0 \mathbf{H}}{\partial t}$

These 2 equations give the wave equation: $\varepsilon_0 \mu_0 \frac{\partial^2 \mathbf{H}}{\partial t^2} + \nabla \times \nabla \times \mathbf{H} = 0$

The electromagnetic wave theory depends on the magnetic field ***H*** created by displacement current ***D***. As electromagnetic wave is detectable, the magnetic field created by displacement current should be detectable directly, for example in the proposed experiment. However, it seems that direct measurement was never done before and no direct experimental evidence of displacement magnetism exists. Electromagnetic wave is only indirect evidence.

Direct measurement will either confirm displacement magnetism by finding real creation of magnetic field by the capacitor, or refute it by finding that the magnetic field inside and outside the capacitor is very weak. Both results are interesting.

If displacement magnetism is confirmed, then it will be necessary to search for 2 new laws that describe back actions on displacement current, one for Lorentz force, one for EMF, because without back actions, displacement magnetism violates energy conservation law. It will also be necessary to revise the wave equation because the velocity of its solution is variable and faster than light. This is contrary to the relativity principle [(3)].

If displacement magnetism is refuted, then Ampere-Maxwell equation and the wave equation should be discarded and classic electromagnetism overhauled. So, whether displacement magnetism is confirmed or refuted, this experiment leads to serious consequence. Though only common equipments are used and this experiment is simple and quickly realizable.

I wondered why this experiment was not carried out earlier. I suppose that most physicists would say: “Because this theory is correct”. But I think that it is because of this belief that such experiment was not done. Probably, at the time Maxwell proposed this idea, there was not equipment precise enough to measure this type of magnetic field. When suitable equipments were finally there, the theory of electromagnetic wave had already been considered as absolute truth and it was no longer possible to challenge.

Reference:

1) Displacement Current Paradox http://pengkuanem.blogspot.com/2012/07/displacement-current-paradox.html,
2) Phantom Lorentz force Paradox http://pengkuanem.blogspot.com/2012/07/phantom-lorentz-force-paradox.html
3) Electromagnetic Wave Paradox http://pengkuanem.blogspot.com/2012/07/electromagnetic-wave-paradox.html

Section added 17 November 2014

The tested EMF from the long loop and the capacitor are measured using a ferromagnetic ring with EMF collecting coil. The ferromagnetic material collects the magnetic field and creates a magnetic flux in the ferromagnetic core that is proportional to the line integral of the magnetic field in the space occupied by the ring. This magnetic flux passing across the EMF collecting coil generates a voltage that is proportional to the current or the displacement current surround by the ring. This is the operating principle of a Clamp meter, Figure 3.

Figure 3

We will measure the magnetic field generated by the displacement current inside the capacitor by placing the ring between the capacitor's plates but excluding the leading wire so that the total displacement current of the plates is encompassed and measured as the collected EMF. Using the same ring EMF collector, we will measure the magnetic field around one wire of the long loop that supplies the capacitor and obtain the EMF generated by the very same electron current, Figure 4. This measurement can be done using a Clamp meter.

According to Ampere-Maxwell's law and because the displacement current in the capacitor equals the current of the long loop, the 2 measured EMFs should be the same. By comparing the two values, we can immediately say if displacement current creates magnetic field or not and whether Ampere-Maxwell's law is correct.

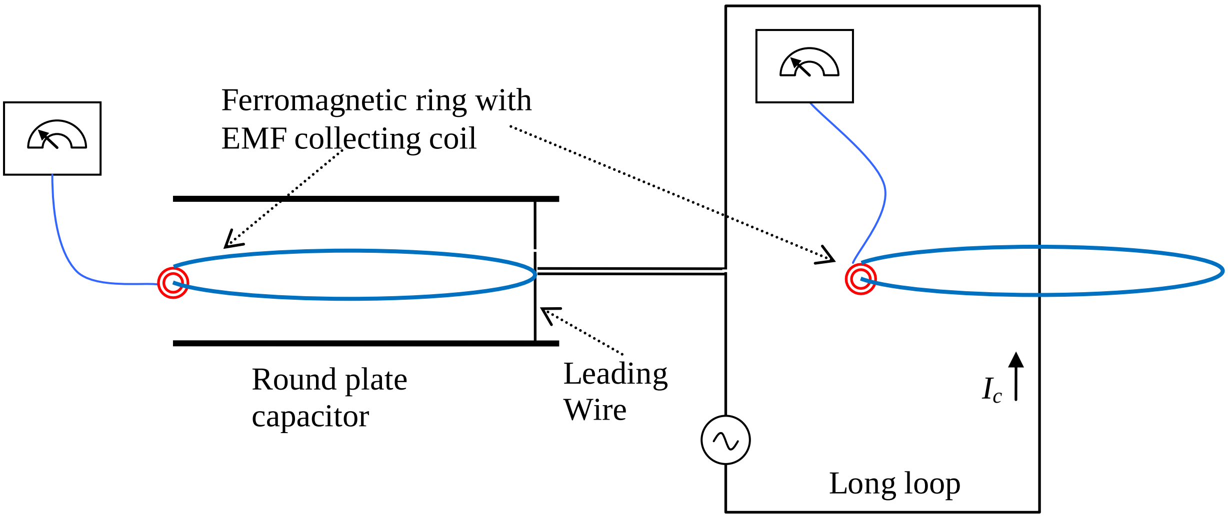

Figure 4