The New Electromagnetics from Matter Waves

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It is well known that Maxwell's equations describe electromagnetics at an abstract level – no knowledge about atomic theory or quantum mechanics is required. However, this abstraction also overlooks the physical nature of how electromagnetic fields originate and it may be that our concept of charge needs to be replaced with the more fundamental concept of warped spacetime as described by Einstein, and that matter waves may be the result of all electromagnetic (and possibly gravitational) phenomena.

If we examine Gauss' law for magnetic fields, **div** B = 0, we note that this suggests that there no magnetic monopoles. However, there is no relevant physical intuition from this equation about why magnetic monopoles would not exist and many particle physicists suspect that magnetic monopoles do exist, as the theory behind inflationary cosmology is heavily dependent upon them [1].

If we consider the previous century's efforts in postulating and verifying matter waves, we may be lead to some useful intuition for electromagnetics. In 1924, de Broglie suggested that particles may have a dual wave nature just as the wave nature of light was shown to have a particle component known as the photon. This dual nature has been accepted but is a source of confusion which requires resolution. If we look at the Davisson-Germer experiment from 1927 which verified the existence of matter waves, we find that the de Broglie equation

$$\Delta\lambda = \frac{h}{mv} \qquad \textbf{(1)}$$

Verifies the wavelength of the matter wave for a mass of electron *m*, velocity of electron *v*, and Planck's constant *h*. Although this formula can be derived from Schrodinger's equation, there is a still much lacking in the physical description of why matter waves exist and what happens at low energy (and correspondingly large wavelengths). Looking to the Wave Structure of Matter (WSM) concept proposed by Milo Wolff [2], we find that there is reasonable explanation for this wavelength shift as a function of velocity through the classical Doppler shift for electromagnetic waves:

$$\omega = \omega_0(1 + \frac{v}{c})$$

$$\Delta\omega = \omega - \omega_0 = \omega_0(\frac{v}{c}) \qquad \textbf{(2)}$$

From the Davisson-Germer experiment we know that electrons with an energy of 54 eV were fired at a Nickel-oxide target with a lattice spacing of 0.215 nm and that an incident angle of 50 degrees from the perpendicular to the crystal surface produced the maximum scatter angle for this electron energy [3]. It is then easy to calculate that a 54 eV electron energy has a resulting non-relativistic velocity is 4.355×10^6 meters/sec which from (1) results in a wavelength of 0.165 nm, which is also the resulting interference path for an incident angle of 50 degrees (0.215 nm * sin (50 deg) = 0.165 nm). The classical Doppler shift formula of (2) produces a similar result if the Nickel-oxide crystal is seen as a stationary matter wave of frequency ω_0 equal to the Compton frequency of the electron (ω_0 = 1.25 x 10^{20} Hz based on a wavelength of 2.4 x 10^{-12} meters, the Compton wavelength of the electron) and the electron source again has a velocity of 4.355 x 10^6 meters/sec:

$$\Delta\lambda = c\,/\Delta\omega = \left(\frac{c^2}{\omega_0 v}\right) = 0.165 \text{ nm} \quad \textbf{(3)}$$

An easy way to determine whether equations (2) and (3) are more accurate than the traditional De Broglie formula (1) is to add motion to the Nickel-oxide crystal arrangement away from the incoming e-beam at velocity V_r while the e-beam is being fired at it. Then if the full Doppler equation is employed (without the approximation of 1 + v/c used in (2)) assuming the Nickel-oxide apparatus (denoted with velocity V_r) is moving away from the e-beam (denoted with velocity V_s , same as v used in (2)) which is fired at it, this changes equation (2) to:

$$\omega = \omega_0\left(\frac{c - V_r}{c + V_s}\right)$$

$$\Delta\omega = \omega - \omega_0 = -\omega_0\left(\frac{V_s + V_r}{c + V_s}\right) \quad \textbf{(4)}$$

Which when using the absolute value of (4) and combining with (3) yields for $\Delta\lambda$:

$$\Delta\lambda = c\,/\Delta\omega = \left(\frac{\mathrm{c}(\mathrm{c} + V_s)}{\omega_0(V_s + V_r)}\right) = 0.165 \text{ nm when } V_r = 0 \text{ and } V_s << c$$

As can be seen, when $V_s << c$ (such as in the Davisson-Germer experiment where V_s = 4.355 x 10^6 meters/sec) the results are the same as those given by (1) and (2). However, if we move the Nickel-oxide apparatus away from the beam at a speed of V_r = 58.2 Km/sec then the resulting $\Delta\lambda = 0.17\ nm$ instead of the 0.165 nm wavelength calculated in (3), resulting in a different angle for maxima than the 50 degrees found by Davisson-Germer. Of course, a lower speed for V_r would require better wavelength resolution and another approach would be to use lower energy electrons (smaller V_s) which will require larger spacing between the crystal planes. In any case, the difference between the classical De Broglie equation (1) and the more accurate Doppler approach (4) can be validated experimentally.

According the WSM-Doppler theory, the wavefront of the electron beam approaching the crystal is shifted up in frequency and when matches the interference path of the crystal, results in maxim and minima patterns. As there is also a wave front receding from the electron beam, the receding wavefront should be visible as in interference pattern as well. As the electron source would be moving away from the crystal, the V_s term in (4) would be replaced by $-V_s$, resulting in a new interference pattern.

Lastly, gamma rays at the Compton frequency of the electron (ω_0 = 1.25×10^{20} Hz based on a wavelength of 2.4×10^{-12} meters) such as those from the positronic source Na-22, can be used as an interfering source with the internal wave structure of moving electron beam which produces a simple magnetic field with one orientation of the magnetic pole corresponding to the compressed wavefront (direction with the beam) and the other pole corresponding to the receding wavefront (direction opposite of the beam). This phenomena explains why the magnetic field from electric currents traveling in opposite directions in two parallel wires attract each other – the equilibrium of compressed and receding wavefronts as a result of the Doppler effect results in a lower equilibrium energy for the opposite-traveling currents (Figure 1).

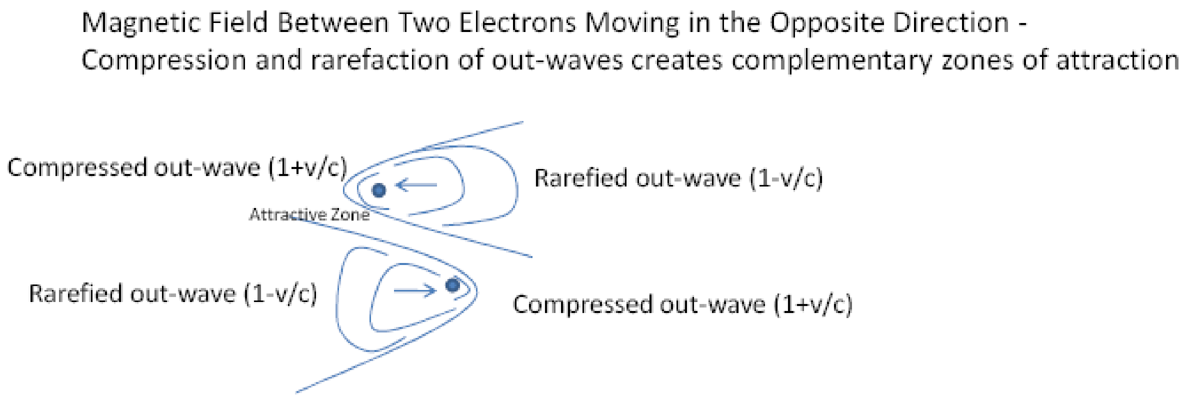

Figure 1. The Biot-Savart Law from the Doppler Effect of Two Standing Electron Wave Fronts moving in Opposite Directions

As can be seen from Figure 1, the standing wave of the electron, ω_0 = 1.25 x 10^{20} Hz, is frequency-shifted based on velocity and the result is attraction between opposite zones of compression and rarefaction. When the velocity of the electron beam is higher, the compression is greater (electric current is also higher from classical Maxwell equations) and the magnetic field is stronger. The requirement for a compressed wavefront and receding wavefront also explains why magnetic monopoles should not exist – the poles are a result of the compressed or receding regions and they both must exist together as a result of Doppler shift.

The possibility of detecting the internal frequency shifts of ω_0 is completely possible with a positronic source such as Na-22, which produces gamma rays at the frequency ω_0. Detecting a static electric field with an Na-22 source is also be possible and much easier, as no frequency shifts are involved with static electrons that exist between two plates of a capacitor [4].

In summary, the classical electric and magnetic fields that are described by Maxwell's equations are macroscopic and abstract - they exist because of the static and dynamic nature of standing matter waves. There are many experiments available to validate the concept of standing matter waves as an underlying mechanism for electromagnetic fields.

References

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