REPLY TO PAPER BY K. JELINEK ET ALII,

FOUND. PHYS. 39, 1191 (2009).

by

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ABSTRACT

A paper was recently published by Jelinek et al. in Found. Phys., 39, 1011 (2009) which claims that the Inverse Faraday Effect does not exist. This is a nonsensical claim based on poor experimental design. This paper was published without the present author being sent a preprint, and so this is a complete reply to it.

Keywords: Inverse Faraday Effect, B(3) field.

INTRODUCTION

The Inverse Faraday Effect is the magnetization of matter by circularly polarized radiation and is a well known effect. It was first observed experimentally by van der Ziel et al. {1} and since then has been inferred and observed many times {2} over a span of about sixty years. It is the basis of the well known $B^{(3)}$ theory and ECE unified field theory {3}, now well accepted. Recently Jelinek et al. {4} failed to observe the Inverse Faraday Effect, and published an incorrect claim that the $B^{(3)}$ field does not exist because of their failure to observe the Inverse Faraday Effect. To claim that $B^{(3)}$ does not exist is the same as claiming that the Inverse Faraday Effect does not exist. In Section 2, it is shown that the same $B^{(3)}$ theory used by Jelinek et al. {4} correctly produces the experimentally observed Inverse Faraday Effect. Jelinek et al. did not cite the work {3} which shows that the same $B^{(3)}$ theory that they themselves used produces the Inverse Faraday Effect observed by van der Ziel {1} and by many others. So the rebuttal of the false claim by Jelinek et al. follows as Section 2, based on previously published work {3} not cited by Jelinek et al. The latter failed to observe the Inverse Faraday Effect because of poor experimental design.

2. $B^{(3)}$ IN AN ELECTRON GAS

As in Eq. (F1), page 207, of the third volume of "The Enigmatic Photon", (available on www.aias.us) the $B^{(3)}$ field in a sample of N electrons in a volume V is, according to the same theory as used by Jelinek et al. {4}:

$$\underline{B}^{(3)}_{in\ sample} = \frac{N}{V}\,\frac{\mu_0\, e^3\, c^2}{2\, m\, \omega^2}\left(\frac{B^{(0)}}{(m^2\omega^2 + e^2 {B^{(0)}}^2)^{1/2}}\right)\,\underline{B}^{(3)}_{free\ space} \tag{1}$$

where μ_0 is the magnetic permeability in vacuo, $-e$ is the charge on the electron, c is the vacuum speed of light, m is the mass of the electron, ω is the angular frequency of the circularly polarized radiation interacting with the electron, and $B^{(0)}$ is the magnitude of the B field. In the low frequency limit (visible frequency pump laser range as used by van der Ziel et al. {1}:

$$m\,\omega \;>>\; e B^{(0)} \tag{2}$$

So Eq. (1) reduces to:

$$\underline{B}^{(3)}_{in\ sample} \longrightarrow \frac{N}{V}\left(\frac{\mu_0\, e^3\, c^2 B^{(0)}}{2\, m^2\, \omega^3}\right)\underline{B}^{(3)}_{free\ space} \tag{3}$$

The free space value of $B^{(3)}$ is defined in the Z axis as:

$$\underline{B}^{(3)}_{free\ space} = B^{(0)}\ \underline{k} \tag{4}$$

In the high field (radio frequency pump beam range):

$$m\,\omega \;<<\; e B^{(0)} \tag{5}$$

So Eq. (1) becomes:

$$\underline{B}^{(3)}_{free\ space} = \frac{N}{V}\left(\frac{\mu_0\, e^2\, c^2}{2\, m\, \omega^2}\right)\underline{B}^{(3)}_{free\ space} \tag{6}$$

In terms of pump beam power density (I watts per square metre), the free field (4) is:

$$\underline{B}^{(3)}_{free\ space} = \left(\frac{\mu_0}{c}\ I\right)^{½}\ \underline{e}^{(3)} = \left(\frac{I}{\varepsilon_0\, c^3}\right)^{½}\ \underline{e}^{(3)} \tag{7}$$

The low field limit is therefore:

$$\underline{B}^{(3)}_{in\ sample} = \frac{N}{V}\left(\frac{{\mu_0}^2\, e^3 c}{2\ m^2}\right)\frac{I}{\omega^3}\ \underline{e}^{(3)} \tag{8}$$

In a neodymium YaG laser for example:

$$I = 5.5 \text{ x } 10^{12}\ \text{Wm}^{-2} \quad , \quad \omega = 1.77 \text{ x } 10^{16}\ \text{rad s}^{-1} \tag{9}$$

So the in sample $B^{(3)}$ field is:

$$\underline{B}^{(3)}_{in\ sample} = 1.06 \text{ x } 10^{-35}\ \frac{N}{V}\underline{e}^{(3)} \sim 10^{-9}\ \text{Tesla } (10^{-5}\text{ Gauss}) \tag{10}$$

For

$$\frac{N}{V} \sim 10^{26} \ \mathrm{m}^{-3} \tag{11}$$

This is about the same order of magnitude as reported experimentally by van der Ziel et al {1} as a magnetization in the first reported Inverse Faraday Effect experiment.

CONCLUSION

The $B^{(3)}$ field was first reported about 45 years ago as a magnetization, and as is well known, the $B^{(3)}$ theory is based on this observation. Sixty years after its observation by van der Ziel, and its verification by many others {2}, Jelinek et al. claim that the Inverse Faraday Effect does not exist. Many others have observed the Inverse Faraday Effect, so many others have observed the $B^{(3)}$ field. Jelinek et al. cite incorrect claims by Bruhn which have already been rebutted in paper 89 on www.aias.us. Jelinek et al. do not cite these rebuttals, which have been accepted internationally.

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REFERENCES

{1} J. P. Van der Ziel, P. S. Perhsan and L. D. Malmstrom, Phys. Rev. Lett., 15, 190 (1965); Phys. Rev. 143, 574 (1966).

{2} J. Deschamps, M. Fitaire and M. Lagoutte, Phys. Rev. Lett., 25, 1330 (1970), ibid. Rev. Appl. Phys., 7, 155 (1972) (observation of the inverse Faraday effect in electron plasma). Review of about one hundred and fifty papers on the inverse Faraday effect in M . W. Evans and S. Kielich, eds., “Modern Non Linear Optics” (Wiley, 1992, 1993, 1997), vol. 85(1) of

"Advances in Chemical Physics".

{3} M. W. Evans, "Generally Covariant Unified Field Theory" (Abramis, 2005 to date), in six volumes, volume seven in preparation.

{4} K. Jelinek, J. Pavlu, J. Havlica and J. Wild., Found. Phys., 39, 1191 (2009).