Explaining the typo that was published as equation (7) in Marmet's 2003 article on the magnetic field of the moving electron

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Physicist Paul Marmet made a remarkable discovery regarding the relation between the magnetic aspect of moving electrons and the contribution of this magnetic aspect to the electron rest and relativistic masses in a paper that he published in 2003, but a typo about equation (7) makes his seamless derivation difficult to understand.

He began his derivation posing the following equation as representing the Biot-Savart equation, in which the magnetic field is represented as perpendicular to the X-axis illustrated in Figure 1 of his paper:

$$d\bar{\mathbf{B}} = \frac{\mu_0 \, I}{4\pi} \frac{d\bar{s} \times d\bar{u}}{r^2} \tag{1}$$

He obtained the following definition of current by first quantizing the electron charge for use in the Biot-Savart equation (e=1.602176462E-19 C). Defining current "I" when the circulating charges producing the current are quantified, he replaced charge "Q" by the number of electrons in one ampere in the definition of current "I":

$$I = \frac{dQ}{dt} = \frac{d(Ne)}{dt} \tag{2}$$

Since the velocity of these electrons in a conductor will be constant if current "I" is constant, the time element "dt" can be replaced by "dx/v":

$$v = \frac{dx}{dt} \quad \text{whence} \quad dt = \frac{dx}{v} \tag{3}$$

Replacing now "dt" in equation (2) by its equivalent definition established with equation (3), he obtained:

$$I = \frac{d(Ne)}{dt} = \frac{d(Ne)v}{dx} \tag{4}$$

The following equation is the scalar version of the Biot-Savart equation:

$$dB = \frac{\mu_0 I}{4\pi r^2} \sin(\theta) \, dx \tag{5}$$

Replacing in (5) the definition of "I" found with equation (4) also eliminates the time factor from Biot-Savart equation:

$$d\mathbf{B} = \frac{\mu_0 I}{4\pi r^2} \sin(\theta) \, dx = \frac{\mu_0}{4\pi r^2} \frac{d(Ne)v}{dx} \sin(\theta) \, dx = \frac{\mu_0 v}{4\pi r^2} \sin(\theta) \, d(Ne) \tag{6}$$

Summarized, equation (6) is now:

$$d\mathbf{B} = \frac{\mu_0 v}{4\pi r^2} \sin(\theta) \, d(Ne^-) \tag{6}$$

Now the part which is difficult to understand in Marmet's paper is how he transits from equation (6) to the published equation (7), which is shown as being:

$$d\mathbf{B}_i = \frac{N\mu_0 \, e^- \, v}{4\pi r^2} d(Ne^-) \tag{7}$$

THIS IS A TYPO that was inadvertently published.

The reader should also be aware that due to some transcription error in the published paper, the **B** field has the exact intensity related to the instantaneous velocity being considered, in view of the fact that only one charge is involved, which Marmet clearly explains by the way in his text between equation (6) and equation (7); his equation (7) should thus be:

$$\mathbf{B}_i = \frac{\mu_0 \, e^- \, v}{4\pi \, r^2} \tag{7}$$

As explained by Marmet in the text between equation (6) and equation (7), two values in equation (6) become equal to 1 by structure if the number of electrons considered is brought down to a single electron, for which the charge distribution and magnetic field distribution can be seen as isotropic, spherically centered on the single electron location, instead of being linearly distributed as in the initial Biot-Savart equation.

Here is how the correct equation (7) can be derived from equation (6):

First, "N" will equal 1 because only one electron is being considered, so first "d(Ne)" becomes "d(e⁻)", which is the first step to transit from equation (6) to the correct equation (7):

$$d\mathbf{B}_i = \frac{\mu_0 v}{4\pi \, r^2} \sin(\theta) \, d(e^-) \tag{6a}$$

As explained by Marmet, since that with a single electron being considered, it becomes impossible to determine a direction of continuous distribution of electric charges, since the axis of distribution of the electric charges no longer exists, the "sin(θ)" factor which relates to this now non-existent linear distribution also disappears from the equation. So we now have:

$$d\mathbf{B}_i = \frac{\mu_0 \, v}{4\pi \, r^2} \, d(e^-) \tag{6b}$$

Now since "v" was defined as constant (see equation (3)), and that the value of "e" is also constant, there remains no variable with respect to which a derivation can be made, so derivation becomes meaningless. Consequently the two "d" simplify out of equation (6b) and we obtain the real equation that should have been printed as equation (7):

$$\mathbf{B}_i = \frac{\mu_0 v}{4\pi \, r^2} \, e^- \tag{6c}$$

And finally the following form used as his derivation proceeds:

$$\mathbf{B}_i = \frac{\mu_0 \, e^- \, v}{4\pi \, r^2} \tag{7}$$

The remainder of his flawless derivation up to equation (26) can be found in his paper.

Ref: Marmet, P. (2003) *Fundamental Nature of Relativistic Mass and Magnetic Fields*. International IFNA-ANS Journal, 9. 64-76.
http://www.newtonphysics.on.ca/magnetic/index.html

This correction of equation (7) in Marmet's paper was mentioned in a paper published in 2007 (See Note at the bottom of page 5 of the paper):

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Ref: Michaud A, (2007). *Field Equations for Localized Individual Photons and Relativistic Field Equations for Localized Moving Massive Particles*, International IFNA-ANS Journal, No. 2 (28), Vol. 13, 2007, p. 123-140, Kazan State University, Kazan, Russia.
http://www.gsjournal.net/Science-Journals/Research%20Papers-Relativity%20Theory/Download/2257

This correction was also formally published in an engineering journal in March 2013.

Ref: Michaud A. (2013). *From Classical to Relativistic Mechanics via Maxwell*. International Journal of Engineering Research and Development e-ISSN: 2278-067X, p-ISSN: 2278-800X, Volume 6, Issue 4 (March 2013), PP. 01-10.
http://ijerd.com/paper/vol6-issue4/A06040110.swf

The note mentioning the correction to be made for Marmet equation 7 is made between equation (1) and equation (2) right on the first page of the paper.

But due to the difficulty in reading the .swf format that the IJERD Journal used to publish this paper online, a full pdf copy was made available on the General Science Journal so the paper can more easily be read, with a link to the original published paper and links to translations to French, Spanish and German:
http://www.gsjournal.net/Science-Journals/Research%20Papers-Relativity%20Theory/Download/3197.

Marmet's derivation of the equation providing the velocity dependent magnetic field of the moving electron, allowed separating the carrying energy of the electron from its invariant rest mass energy and determining that this carrying energy was electromagnetic in nature, and has the same internal electromagnetic structure as free moving localized electromagnetic photons as hypothesized by Louis de Broglie in the 1930's.

Ref: Michaud A (2016) *On De Broglie's Double-particle Photon Hypothesis*. J Phys Math 7: 153. doi:10.4172/2090-0902.1000153
https://www.omicsonline.org/open-access/on-de-broglies-doubleparticle-photon-hypothesis-2090-0902-1000153.pdf

which ultimately led to the reconciliation of classical/relativistic mechanics with electromagnetism and Quantum Mechanics.

Ref: Michaud, A. (2018) *The Hydrogen Atom Fundamental Resonance States*. Journal of Modern Physics, **9**, 1052-1110. doi: 10.4236/jmp.2018.95067.
https://doi.org/10.4236/jmp.2018.95067

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