Referee Comments

Title: (#461114) Rephrasing Faraday's Law

In the second sentence of the manuscript replace "misrepresent" with "misrepresenting".

In the second sentence following Equation 2 replace "couluombic" with "coulombic".

In the second sentence following Equation 4b insert "expressions containing" following "integrating".

The first sentence following Equation 2 is the statement: "Here, $\Phi_B = \int \vec{B} \cdot d\vec{A}$ and is the magnetic flux, with $\vec{B}$ being the magnetic field and $\vec{A}$ the area it pierces; $\vec{E}$ is the electric field, and $\vec{s}$ is the path encircling $\vec{A}$ and over which $\vec{E}$ is evaluated." Three concerns that I have with this statement are the claims that: (1) a closed path is represented by a vector, (2) a vector field pierces an area, and (3) the electric field is evaluated over an area. I will address each of these concerns in turn.

Claim 1: A closed path is represented by a vector $\vec{s}$.

A closed path cannot be represented by a vector. The increment $d\vec{s}$ is a directed infinitesimal element of a specified path. It is not the differential of some vector $\vec{s}$.

Claim 2: A vector field pierces an area $\vec{A}$.

The increment $d\vec{A}$ is an infinitesimal directed element of a surface. It is not the differential of some vector $\vec{A}$. The area of a surface is a measure of the surface. While it is correct to state that the magnetic field pierces a surface (or a region of a surface), it is not correct to state that the magnetic field pierces an area (or an area of a surface).

Claim 3: The electric field $\vec{E}$ is evaluated over an area $\vec{A}$.

Equation 1 relates the circulation of $\vec{E}$ on a closed path, to the flux of $\vec{B}$ through any surface bounded by the path. It may be used to evaluate $\vec{E}$ only for highly symmetric situations, such as those in which $\vec{E}$ is tangent to the integration path and the tangential component of $\vec{E}$ is the same at all points along the path. In such situations the electric field is not evaluated over the integration surface. Instead it is evaluated at the boundary of the integration surface.

In addition to the three concerns just mentioned, there is a concern that the phrase "Here, $\Phi_B = \int \vec{B} \cdot d\vec{A}$ and is the magnetic flux," is likely to be found challenging to some (because it is "Φ_B", and not "$\Phi_B = \int \vec{B} \cdot d\vec{A}$", that is the magnetic flux). As a remedy, I suggest substituting $\int \vec{B} \cdot d\vec{A}$ for Φ_B in Equation 1 and then replacing the phrase "Here, $\Phi_B = \int \vec{B} \cdot d\vec{A}$ and is the magnetic flux" with "Here, $\int \vec{B} \cdot d\vec{A}$ is the magnetic flux Φ_B".

Alternately, you could completely avoid introducing a symbol for the flux by replacing "Φ_B" with "$\int \vec{B} \cdot d\vec{A}$" in Equation 1 and by replacing "$\Phi_B = \int \vec{B} \cdot d\vec{A}$" with "$\int \vec{B} \cdot d\vec{A}$" in the sentence following Equation 2.

The locution "curled electric field" appears in the manuscript several times. Until I read this manuscript I don't think I had ever come across it. While I did intuit its meaning, I used the search engine Google as a means of estimating the frequency of its usage. Googling "curled electric field", with the quotes, produced 103 hits. By comparison, googling "circulating electric field" (my preferred locution) produced 289 hits.