2 Galilean Electromagnetism Re-examined

Each of the four cases is comprised of two pairs of comparison, which are \((x^0, x^1)\) and \((A^0, A^1)\) respectively. By which one is significantly larger than the other in each pair, we have these four cases:

1. Case 1: \(x^0 > x^1, \quad A^0 > A^1, \quad y: 1\)
2. Case 2: \(x^0 > x^1, \quad A^0 = A^1, \quad y: 1\)
3. Case 3: \(x^0 = x^1, \quad A^0 > A^1, \quad y: 1\)
4. Case 4: \(x^0 = x^1, \quad A^0 = A^1, \quad y: 1\)

And if we hope, assume that the electric field and the magnetic field are not dependent on the electromagnetic four-potential, we will can ignore the Case 1 and the Case 4.

2.1 Case 1: \(x^0 > x^1, \quad A^0 > A^1, \quad y: 1\)

In the first case, we consider Maxwell's equations under the conditions (??):

\[
x^0 > x^1,
A^0 > A^1,
y = \frac{1}{\sqrt{1-(\frac{v}{c})^2}} : 1.
\]  

(1)

Maxwell's equations are related with the electric and the magnetic fields. Therefore, we first need to know the electric field and the magnetic field first, if we want to explore Maxwell's equations in this case.

The electric field and the magnetic field are:

\[
F^{0i} = \partial^i A^0 - \partial^0 A^i \quad \text{and}
\]

\[
F^{ij} = \partial^i A^j - \partial^j A^i.
\]

respectively. From these two fields listed above, it is clear we could have a clear clue that we have to discuss determine \(A^a\)'s equation and \(\partial^a\)'s equation if we want to know the electric field and the magnetic field in this case.

Comment [BM1]: CHECK: Do you mean 'conditions' here? A 'case' is a 'situation', 'circumstance', or specific set of conditions. A 'condition' is a single 'requirement' or 'specification'. For example, 'in the condition that \(x > y\)' and 'In the case that the machine reaches the B state...'. The words have similar meanings but different uses. Please check them carefully.

Comment [BM2]: CHECK: It is redundant to say 'A\(^a\)'s equation' when A\(^a\) is itself an equation. It is okay to say 'the equation of A\(^a\)' however, but it seems that you mainly wish to determine the 'value' of A\(^a\). However, if you are splitting A\(^a\) into A\(^0\) and A\(^1\), then it would be correct to say 'A\(^a\)'s equations' with the plural.
We will explore \( A^0 \)'s equations first. The original basis equations of \( A^0 \) are:

\[
A^0 = \gamma (A^0 + \frac{v_t}{c} A^t) \quad \text{and} \\
\dot{A}^0 = \gamma (A^t + \frac{v_t}{c} A^0) .
\]

We take an approximation of these by using this case's conditions (condition (1)). Therefore, the equations of \( A^0 \) can be rewritten as follows:

\[
A^0 = A^0 \quad \text{and} \\
\dot{A}^0 = A^t + \frac{v_t}{c} A^0 .
\]

The next equation to be discussed next is \( \dot{A}^t \)'s equation. This equation can be introduced by using \( A^t \)'s equation via the chain rule, and since \( x^t \)'s equation is easy to be calculate, so we can start from it with that. The \( x^t \)'s equations are:

\[
x^t = \gamma (x^0 + \frac{v_t}{c} x^t) \quad \text{and} \\
\dot{x}^t = \gamma (x^1 + \frac{v_t}{c} x^0) .
\]

We take the same approximation as the last one by using this case's condition (condition (1)). Therefore, the equations of \( x^t \) can be rewritten as follows:

\[
x^t = x^0 \quad \text{and} \\
\dot{x}^t = x^1 + \frac{v_t}{c} x^0 .
\]

If we use the Chain Rule from the conclusion above, we will obtain:

\[
\dot{x}^0 = \dot{x}^0 + \frac{v_t}{c} \dot{x}^t \quad \text{and} \\
\dot{x}^t = \dot{x}^t .
\]
2 Galilean Electromagnetism Re-examined

Each of the four cases is comprised of two pairs for comparison: \((x^0, x^i)\) and \((A^0, A^i)\) for \(\gamma: 1\). By comparing which one is significantly larger than the other in each pair, we have these four cases: (1) Case 1: \(x^0 = x^i\), \(A^0 = A^i\), \(\gamma: 1\); (2) Case 2: \(x^0 = x^i\), \(A^0 = A^i\), \(\gamma: 1\); (3) Case 3: \(x^0 = x^i\), \(A^0 = A^i\), \(\gamma: 1\); and (4) Case 4: \(x^0 = x^i\), \(A^0 = A^i\), \(\gamma: 1\). If we assume that the electric field and the magnetic field are not dependent on the electromagnetic four-potential, we can ignore Case 1 and Case 4.

2.1 Case 1: \(x^0 = x^i\), \(A^0 = A^i\), \(\gamma: 1\)

In the first case, we consider Maxwell’s equations under conditions (8):

\[
\begin{align*}
x^0 &= x^i, \\
A^0 &= A^i, \\
\gamma &= \frac{1}{\sqrt{1 - (\frac{v}{c})^2}} \approx 1.
\end{align*}
\] (8)

Maxwell’s equations are related to the electric and magnetic fields. Therefore, we first need to know the electric field and the magnetic field if we want to explore Maxwell’s equations in this case.

The electric field and the magnetic field are:

\[
F^{i0} = \partial^i A^0 - \partial^0 A^i \quad \text{and} \quad F^{ij} = \partial^i A^j - \partial^j A^i,
\]

respectively. From these two fields, it is clear that we have to determine \(A^\alpha\) and \(\partial^\alpha\) if we want to know the electric field and the magnetic field in this case.

We will expand \(A^\alpha\)’s equations first. The basis equations of \(A^\alpha\) are:

\[
\begin{align*}
A^0 &= \gamma(A^0 + \frac{v^i}{c} A^i) \quad \text{and} \\
A^i &= \gamma(A^i + \frac{v^i}{c} A^0).
\end{align*}
\] (10)

We find approximations of these using this case’s conditions (condition (1)). The equations of \(A^\alpha\) can be rewritten as follows:
\[ A^{\prime 0} = A^0 \text{ and } A^{\prime i} = A^i + \frac{v^i}{c} A^0, \]  

(11)

The next equation to be determined is \( \partial^{\prime \alpha} \). This can be produced from \( x^\alpha \)'s equation via the chain rule, and since \( x^\alpha \) is easy to calculate, we will start with that. Its equations are:
\[ x^{\prime 0} = \gamma (x^0 + \frac{v_0}{c} x^t) \quad \text{and} \quad x^{\prime i} = \gamma (x^i + \frac{v^i}{c} x^0). \]

(12)

We use the same approximation as before using this case's condition (condition (1)). Then, the equations of \( x^\alpha \) can be rewritten as follows:
\[ x^{\prime 0} = x^0 \text{ and } x^{\prime i} = x^i + \frac{v^i}{c} x^0. \]

(13)

If we use the chain rule from the conclusion above, we obtain:
\[ \partial^{\prime 0} = \partial^0 + \frac{v_0}{c} \partial^t \quad \text{and} \quad \partial^{\prime i} = \partial^i. \]