

Week 5 Problem Session

Error Correction

Date 04/29/14

A mistake was made on the blackboard when I wrote:

$$\begin{cases} \vec{E} = \vec{B} \times \vec{c} & (1) \\ \vec{B} = \vec{c} \times \vec{E} & (2) \\ \vec{c} = \vec{E} \times \vec{B} & (3) \end{cases} \quad \text{Equation (2) and (3) are wrong!}$$

Only the first equation above is correct. What I wanted to discuss here is only the relation between the directions of the three vectors (\vec{E} , \vec{B} and \vec{c}), neglecting their magnitudes. So I should've written the equation with (\hat{E} , \hat{B} and \hat{c}) instead. A hat (^) means that the magnitude of that vector is 1.

The correct vector equations are:

$$\begin{cases} \hat{E} = \hat{B} \times \hat{c} \\ \hat{B} = \hat{c} \times \hat{E} \\ \hat{c} = \hat{E} \times \hat{B} \end{cases}$$

The three equations above tell you how to find the "direction" of the third one, if the directions of the other two are given. As for the "magnitude", you should use:

$$\begin{aligned} |\vec{c}| &= \frac{|\vec{E}|}{|\vec{B}|} \\ \text{or} \\ |\vec{E}| &= |\vec{B}| \cdot |\vec{c}| \\ \text{or} \\ |\vec{B}| &= \frac{|\vec{E}|}{|\vec{c}|} \end{aligned}$$

where $|\vec{c}| = 3 \times 10^8 \text{ m/s}$ in vacuum or in the air.