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PHY 502 - Shared Sheet

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An example of a Shared Sheet that students in PHY 502 worked on together through ZOOM to answer questions related to how Maxwell's Equations would be modified if photons had mass.

$$\begin{aligned}
 & \frac{1}{c} \nabla \cdot \vec{E} = -\mu_0 \vec{A}_0 + \mu_0 \vec{J}_0 \quad (1) \\
 & -\frac{1}{c^2} \frac{\partial \vec{E}}{\partial t} + \nabla \times \vec{B} = -\mu_0 \vec{A} + \mu_0 \vec{J} \quad (2)
 \end{aligned}
 \left| \begin{aligned}
 & \frac{\partial U}{\partial t} + \nabla \cdot \vec{S} + \vec{E} \cdot \vec{J} = 0 \\
 & \nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \quad (3)
 \end{aligned} \right.$$

$$\underbrace{\vec{E} \cdot (\nabla \times \vec{B})}_{\text{Max/Amp}} - \underbrace{\vec{B} \cdot (\nabla \times \vec{E})}_{\text{Farad}} = \nabla \cdot (\vec{B} \times \vec{E}) = -\nabla \cdot \vec{S}$$

$$\vec{E} \cdot (\nabla \times \vec{B}) = -\frac{1}{c^2} \frac{\partial}{\partial t} \left(\frac{E^2}{2} \right) - \mu_0 \vec{E} \cdot \vec{A} + \mu_0 \vec{J} \cdot \vec{E} \quad (4)$$

$$-\mu_0 \vec{E} \cdot \vec{A} + \mu_0 \vec{E} \cdot \vec{J} + \frac{\partial}{\partial t} \left(\frac{1}{2} \frac{E^2 + B^2}{c^2} \right) + \nabla \cdot \vec{S} = 0 \quad (6)$$

$$-\vec{B} \cdot (\nabla \times \vec{E}) = \frac{\partial}{\partial t} \left(\frac{B^2}{2} \right) \quad (5)$$