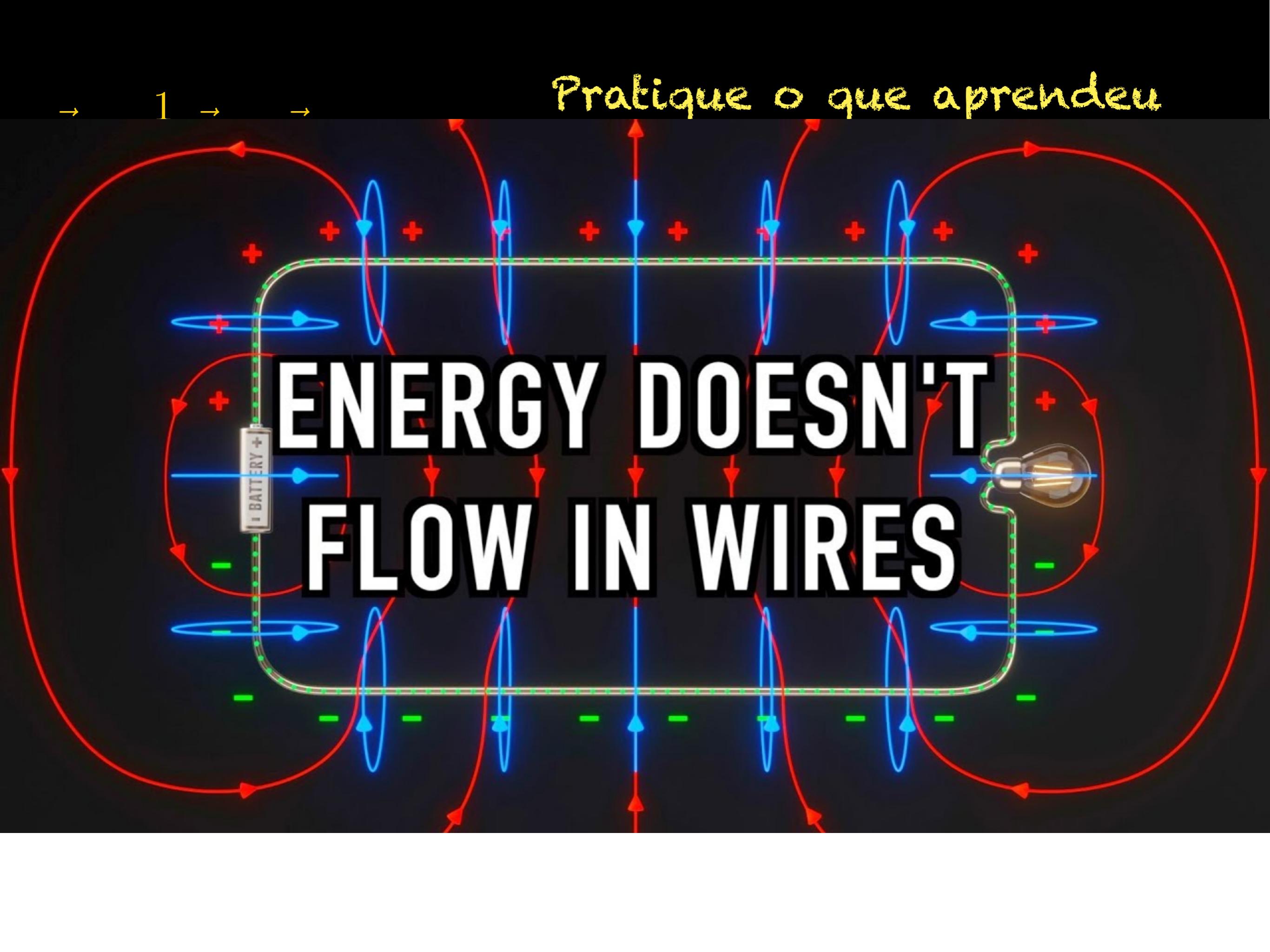


Electromagnetismo Avançado

28 de agosto
Leis de conservação

Pratique o que aprendeu

→ 1 → →

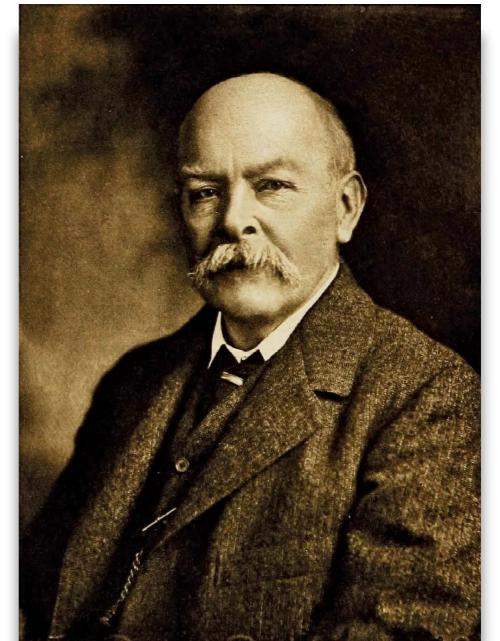


The diagram illustrates an electrical circuit consisting of a battery, a light bulb, and a switch. Red arrows indicate the direction of electron flow from the negative terminal of the battery through the wires and back to the positive terminal. Blue arrows show the flow of energy or potential difference along the wires. A light bulb is shown glowing, indicating the presence of electrical energy. The text "ENERGY DOESN'T FLOW IN WIRES" is overlaid in large, bold, white letters.

**ENERGY DOESN'T
FLOW IN WIRES**

Conservação do momento

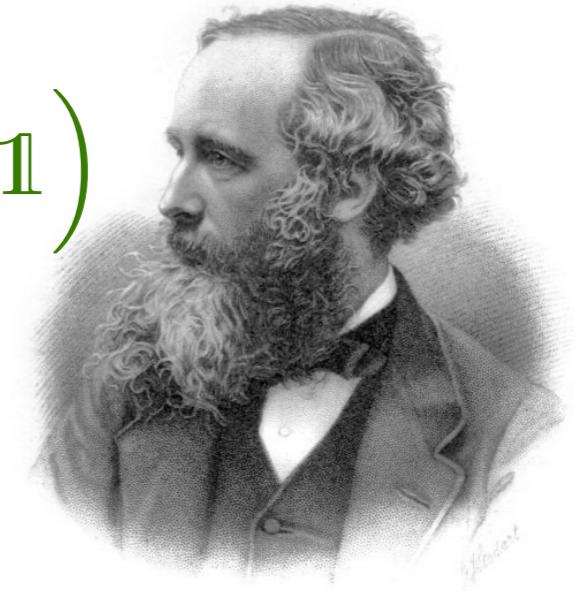
$$\frac{\partial}{\partial t} (\vec{E} \times \vec{B}) = \frac{\partial \vec{E}}{\partial t} \times \vec{B} + \vec{E} \times \frac{\partial \vec{B}}{\partial t}$$



Conservação do momento

$$\overset{\leftrightarrow}{T} = \epsilon_0 \left(\vec{E} \otimes \vec{E} - \frac{1}{2} E^2 \mathbf{1} \right) + \frac{1}{\mu_0} \left(\vec{B} \otimes \vec{B} - \frac{1}{2} B^2 \mathbf{1} \right)$$

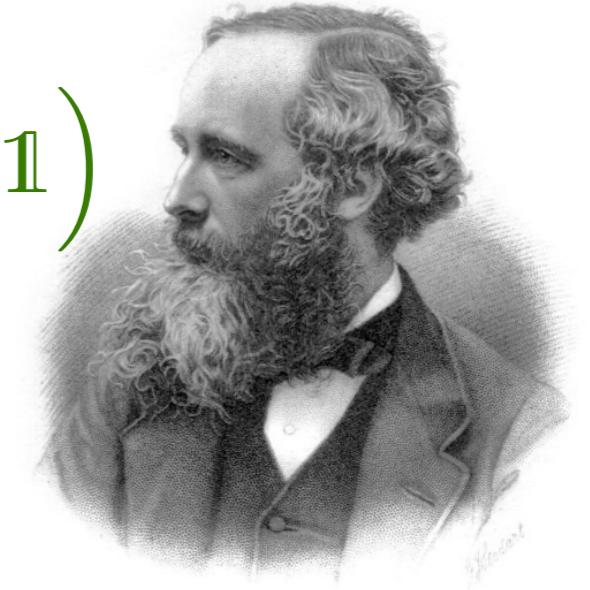
$$\vec{f} = \vec{\nabla} \cdot \overset{\leftrightarrow}{T} - \epsilon_0 \frac{\partial}{\partial t} (\vec{E} \times \vec{B})$$



Conservação do momento

$$\overset{\leftrightarrow}{T} = \epsilon_0 \left(\vec{E} \otimes \vec{E} - \frac{1}{2} E^2 \mathbf{1} \right) + \frac{1}{\mu_0} \left(\vec{B} \otimes \vec{B} - \frac{1}{2} B^2 \mathbf{1} \right)$$

$$\vec{f} = \vec{\nabla} \cdot \overset{\leftrightarrow}{T} - \epsilon_0 \frac{\partial}{\partial t} (\vec{E} \times \vec{B})$$



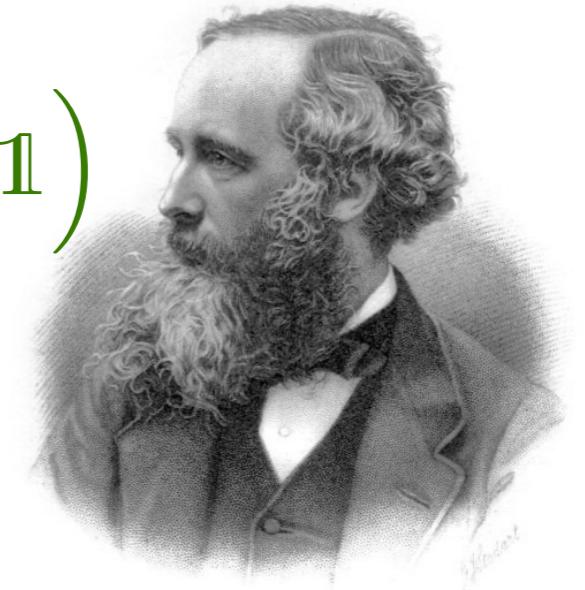
$$\vec{F} = \int_S \hat{n} \cdot \overset{\leftrightarrow}{T} da - \epsilon_0 \frac{d}{dt} \int_V (\vec{E} \times \vec{B}) d\tau$$

$$\vec{F} = \int_S \hat{n} \cdot \overset{\leftrightarrow}{T} da - \underbrace{\frac{d}{dt} \epsilon_0 \int_V (\vec{E} \times \vec{B}) d\tau}_{\vec{p}_{EM}}$$

Conservação do momento

$$\overset{\leftrightarrow}{T} = \epsilon_0 \left(\vec{E} \otimes \vec{E} - \frac{1}{2} E^2 \mathbf{1} \right) + \frac{1}{\mu_0} \left(\vec{B} \otimes \vec{B} - \frac{1}{2} B^2 \mathbf{1} \right)$$

$$\vec{f} = \vec{\nabla} \cdot \overset{\leftrightarrow}{T} - \epsilon_0 \frac{\partial}{\partial t} (\vec{E} \times \vec{B})$$

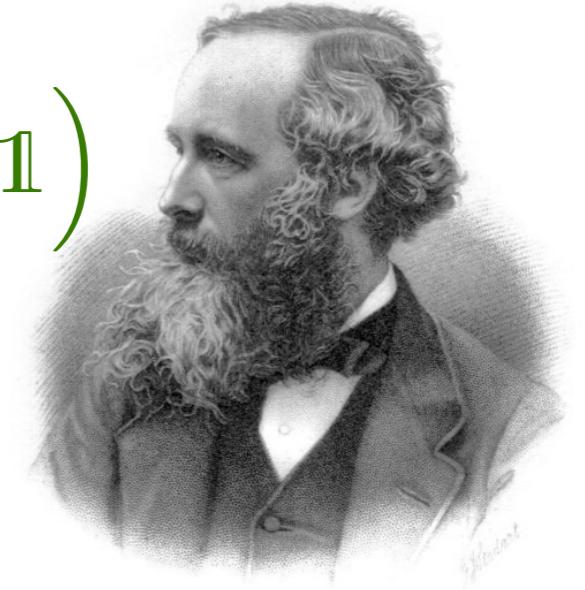


$$\underbrace{\vec{F}}_{\frac{d\vec{p}_{mec}}{dt}} = \int_S \hat{n} \cdot \overset{\leftrightarrow}{T} da - \underbrace{\frac{d}{dt} \epsilon_0 \int_V (\vec{E} \times \vec{B}) d\tau}_{\vec{p}_{EM}}$$

Conservação do momento

$$\overset{\leftrightarrow}{T} = \epsilon_0 \left(\vec{E} \otimes \vec{E} - \frac{1}{2} E^2 \mathbf{1} \right) + \frac{1}{\mu_0} \left(\vec{B} \otimes \vec{B} - \frac{1}{2} B^2 \mathbf{1} \right)$$

$$\vec{f} = \vec{\nabla} \cdot \overset{\leftrightarrow}{T} - \epsilon_0 \frac{\partial}{\partial t} (\vec{E} \times \vec{B})$$



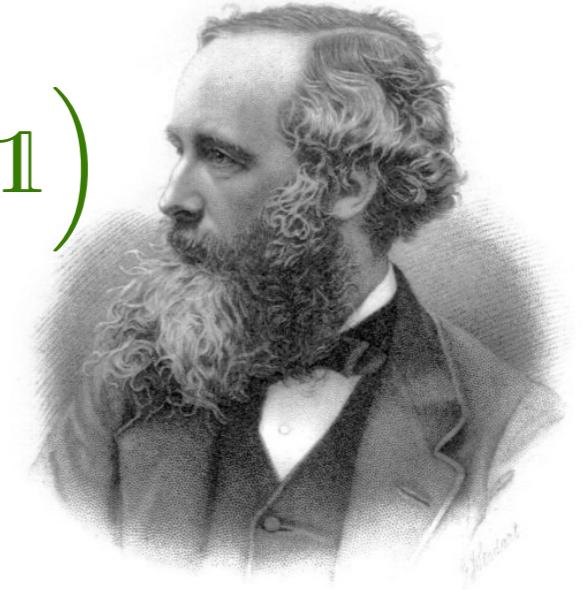
$$\underbrace{\vec{F}}_{\frac{d\vec{p}_{mec}}{dt}} = \int_S \hat{n} \cdot \overset{\leftrightarrow}{T} da - \underbrace{\frac{d}{dt} \epsilon_0 \int_V (\vec{E} \times \vec{B}) d\tau}_{\vec{p}_{EM}}$$

$$\frac{d\vec{p}}{dt} = \int_S \hat{n} \cdot \overset{\leftrightarrow}{T} da$$

Conservação do momento

$$\overset{\leftrightarrow}{T} = \epsilon_0 \left(\vec{E} \otimes \vec{E} - \frac{1}{2} E^2 \mathbf{1} \right) + \frac{1}{\mu_0} \left(\vec{B} \otimes \vec{B} - \frac{1}{2} B^2 \mathbf{1} \right)$$

$$\vec{f} = \vec{\nabla} \cdot \overset{\leftrightarrow}{T} - \epsilon_0 \frac{\partial}{\partial t} (\vec{E} \times \vec{B})$$



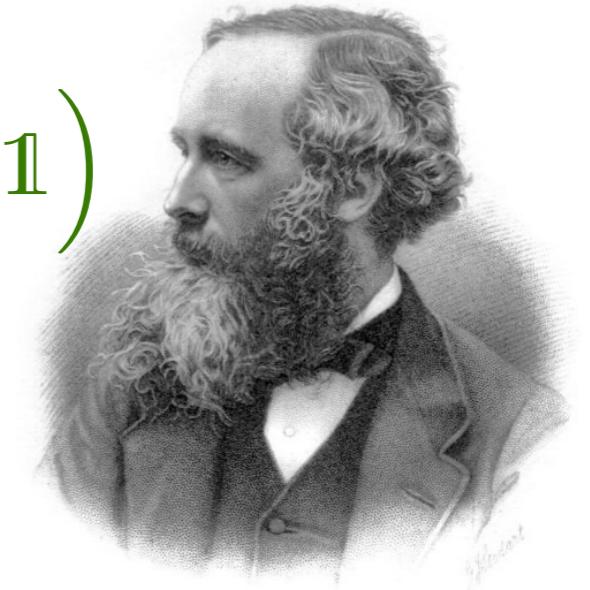
$$\underbrace{\vec{F}}_{\frac{d\vec{p}_{mec}}{dt}} = \int_S \hat{n} \cdot \overset{\leftrightarrow}{T} da - \underbrace{\frac{d}{dt} \epsilon_0 \int_V (\vec{E} \times \vec{B}) d\tau}_{\vec{p}_{EM}}$$

$$\frac{d\vec{p}}{dt} = \int_S \hat{n} \cdot \overset{\leftrightarrow}{T} da$$

Conservação do momento

$$\overset{\leftrightarrow}{T} = \epsilon_0 \left(\vec{E} \otimes \vec{E} - \frac{1}{2} E^2 \mathbf{1} \right) + \frac{1}{\mu_0} \left(\vec{B} \otimes \vec{B} - \frac{1}{2} B^2 \mathbf{1} \right)$$

$$\vec{f} = \vec{\nabla} \cdot \overset{\leftrightarrow}{T} - \epsilon_0 \frac{\partial}{\partial t} (\vec{E} \times \vec{B})$$

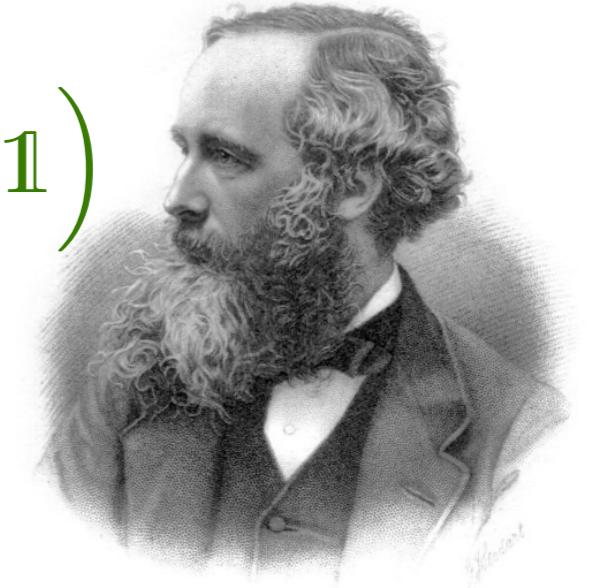


$$\vec{\mathcal{P}}_{EM} = \epsilon_0 \vec{E} \times \vec{B} = \mu_0 \epsilon_0 \vec{S}$$

Conservação do momento

$$\overset{\leftrightarrow}{T} = \epsilon_0 \left(\vec{E} \otimes \vec{E} - \frac{1}{2} E^2 \mathbf{1} \right) + \frac{1}{\mu_0} \left(\vec{B} \otimes \vec{B} - \frac{1}{2} B^2 \mathbf{1} \right)$$

$$\vec{f} = \vec{\nabla} \cdot \overset{\leftrightarrow}{T} - \epsilon_0 \frac{\partial}{\partial t} (\vec{E} \times \vec{B})$$



$$\vec{\mathcal{P}}_{EM} = \epsilon_0 \vec{E} \times \vec{B} = \mu_0 \epsilon_0 \vec{S}$$

$$\frac{\partial \vec{\mathcal{P}}}{\partial t} = \vec{\nabla} \cdot \overset{\leftrightarrow}{T}$$

Pratique o que aprendeu

$$\vec{F} = \int_S \hat{n} \cdot \vec{T} da - \epsilon_0 \frac{d}{dt} \int_V (\vec{E} \times \vec{B}) d\tau$$

