INSTITUTO FEDERAL
SANTA CATARINA

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BRASIL
PAÍS RICO É PAÍS SEM POBREZA

ELM20704
Eletromagnetismo

Aula 12

Equações de Maxwell (Revisitadas)

Professor: Bruno Fontana da Silva
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Equações de Maxwell (Generalizadas)

TABLE 9.1 Generalized Forms of Maxwell's Equations

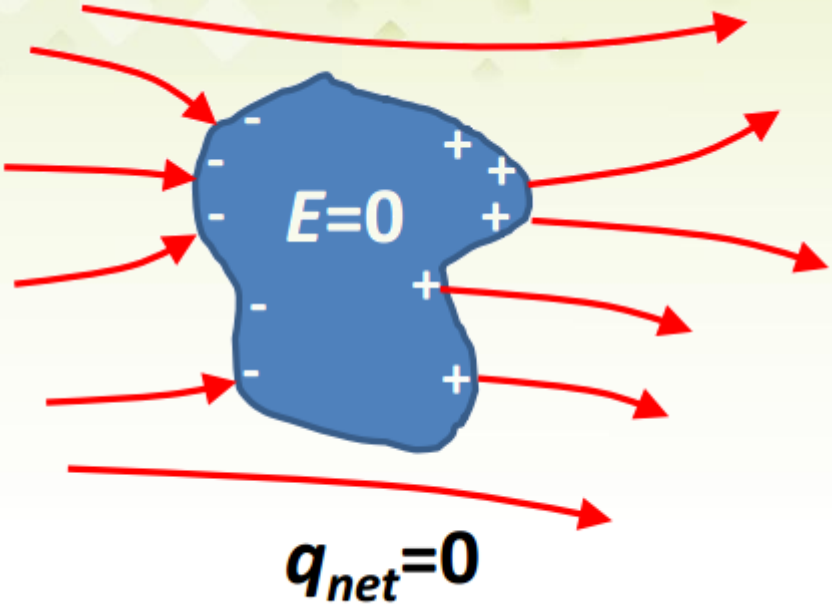
Differential Form	Integral Form	Remarks
$\nabla \cdot \mathbf{D} = \rho_v$	$\oint_S \mathbf{D} \cdot d\mathbf{S} = \int_v \rho_v \, dv$	Gauss's law
$\nabla \cdot \mathbf{B} = 0$	$\oint_S \mathbf{B} \cdot d\mathbf{S} = 0$	Nonexistence of isolated magnetic charge*
$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$	$\oint_L \mathbf{E} \cdot d\mathbf{l} = -\frac{\partial}{\partial t} \int_S \mathbf{B} \cdot d\mathbf{S}$	Faraday's law
$\nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t}$	$\oint_L \mathbf{H} \cdot d\mathbf{l} = \int_S \left(\mathbf{J} + \frac{\partial \mathbf{D}}{\partial t} \right) \cdot d\mathbf{S}$	Ampere's circuit law

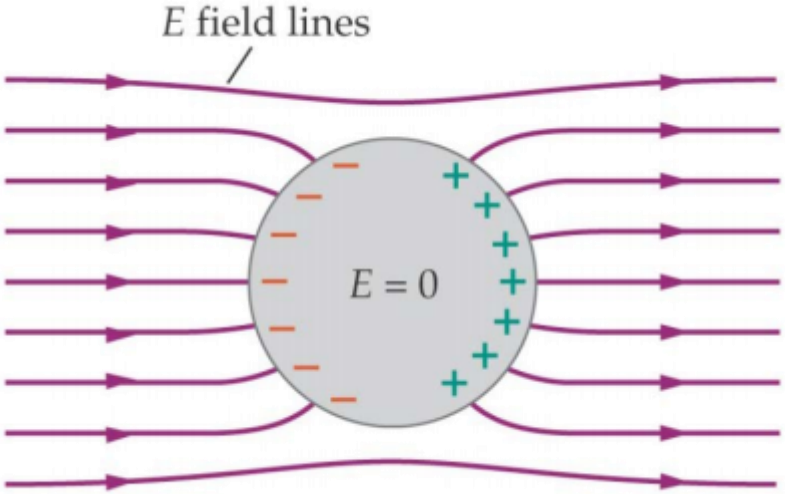
*This is also referred to as Gauss's law for magnetic fields.

Lei de Gauss (Equação Maxwell 01) para a Eletricidade

$$\nabla \cdot \mathbf{D} = \rho_v$$

$$\nabla \cdot \mathbf{E} = \frac{\rho_v}{\epsilon}$$





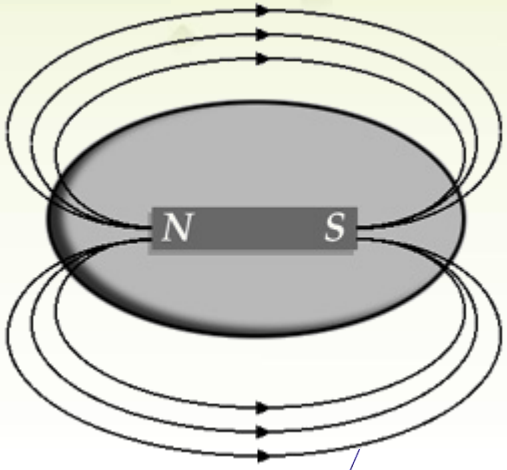
Fonte: $Q_T > 0\ (+) \rightarrow \mathrm{div(E)} > 0$

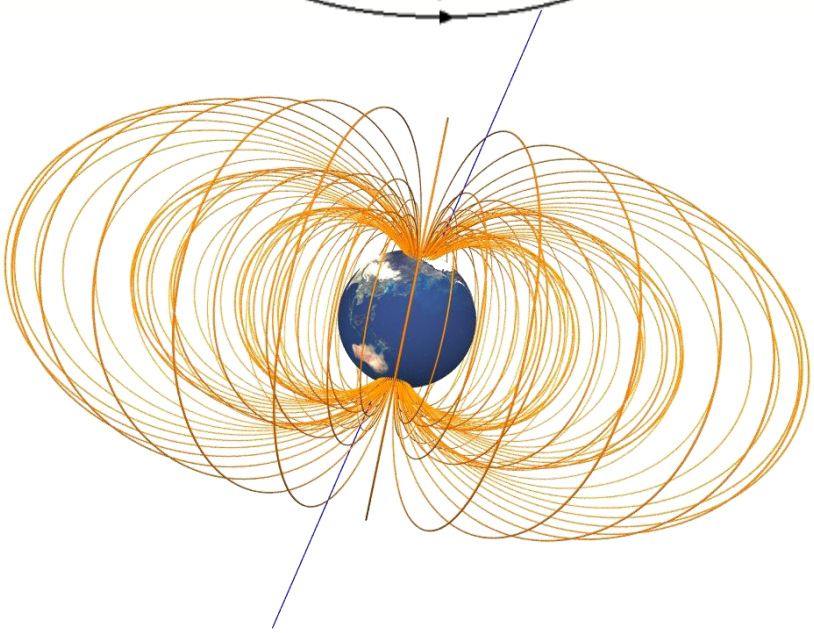
Dreno: $Q_T < 0\ (-) \rightarrow \mathrm{div(E)} < 0$

Lei de Gauss (Equação Maxwell 02) para o Magnetismo

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla \cdot \mathbf{H} = 0$$

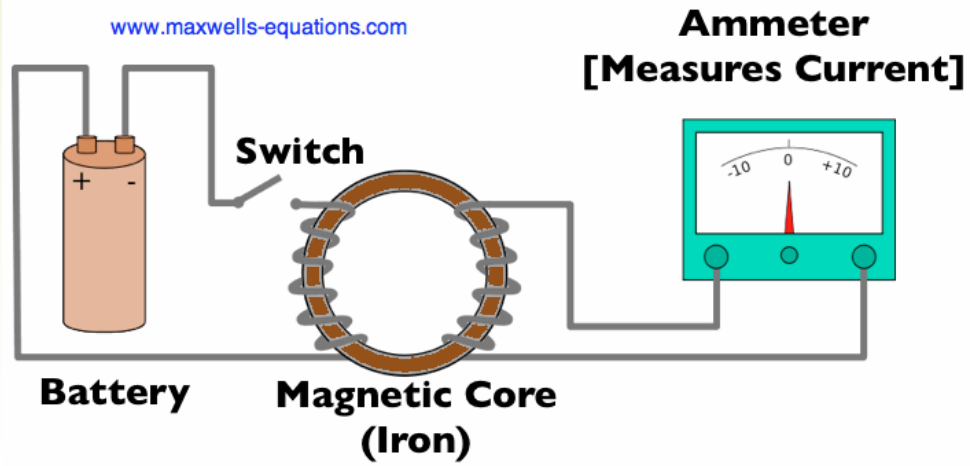




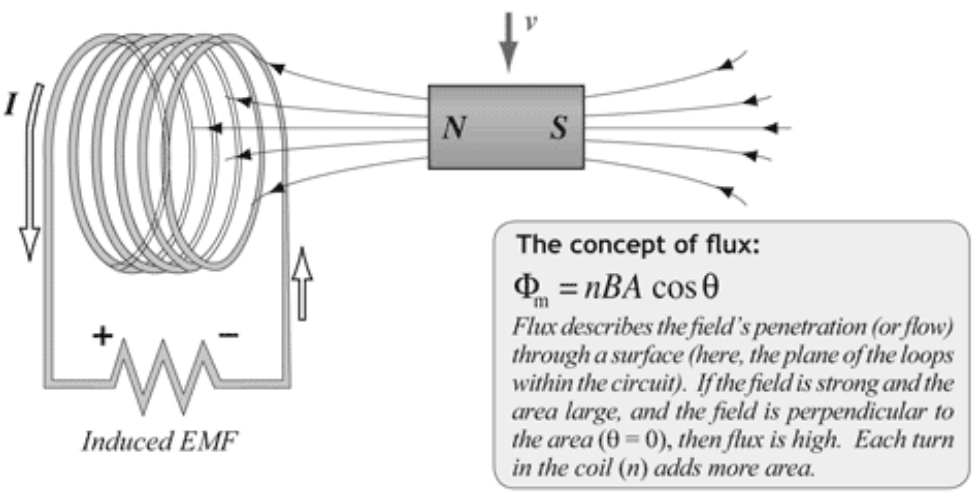
**não existência de monopólos magnéticos*

Leis de Faraday/Lenz (Equação Maxwell 03)

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$



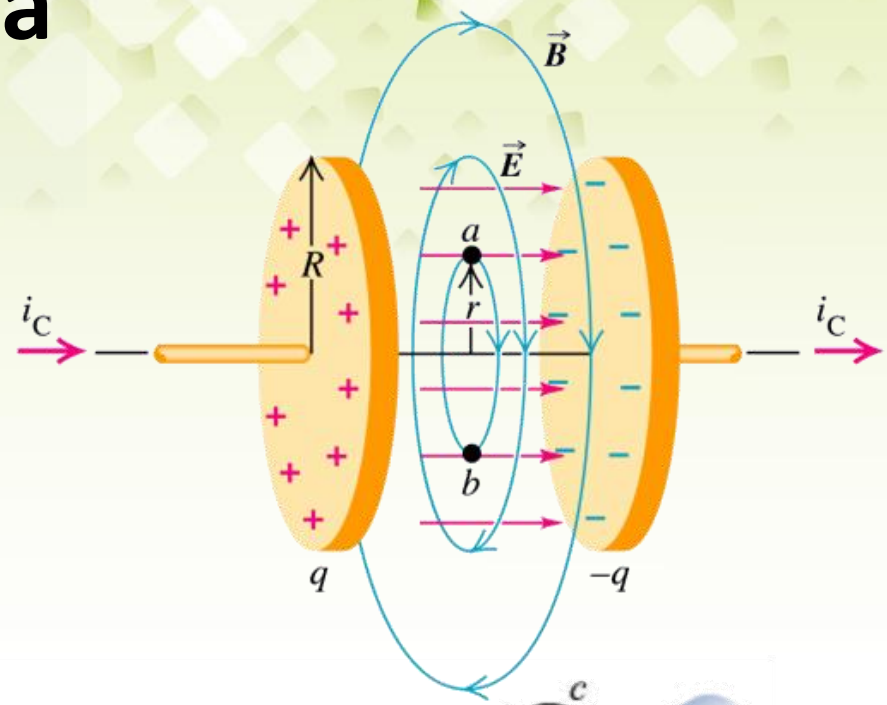
$$\oint \mathbf{E} \cdot d\mathbf{L} = -\int_S \frac{\partial \mathbf{B}}{\partial t} \cdot d\mathbf{S}$$

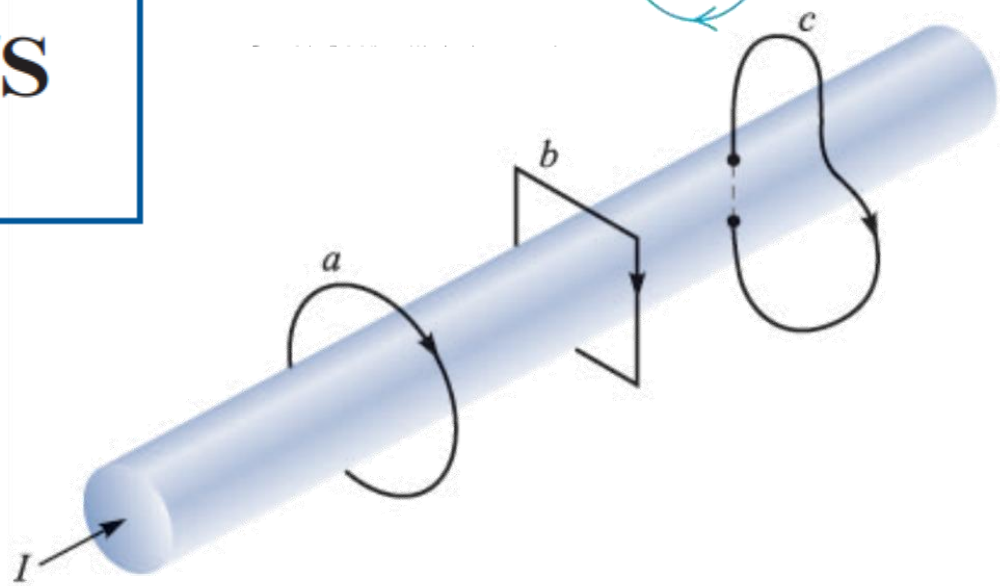


Lei de Ampère Generalizada (Equação Maxwell 04)

$$\nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t}$$

$$\oint \mathbf{H} \cdot d\mathbf{L} = I + \int_S \frac{\partial \mathbf{D}}{\partial t} \cdot d\mathbf{S}$$





Equações Auxiliares

$$\mathbf{D} = \epsilon_0 \mathbf{E}$$

$$\mathbf{B} = \mu_0 \mathbf{H}$$

$$\mathbf{E} = -\nabla V$$

$$\Phi = \int_S \mathbf{B} \cdot d\mathbf{S} \text{ Wb}$$

$$\mathbf{J} = \sigma \mathbf{E}$$

$$\epsilon_0 = 8.854 \times 10^{-12} \doteq \frac{1}{36\pi} 10^{-9} \qquad \text{F/m}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$$

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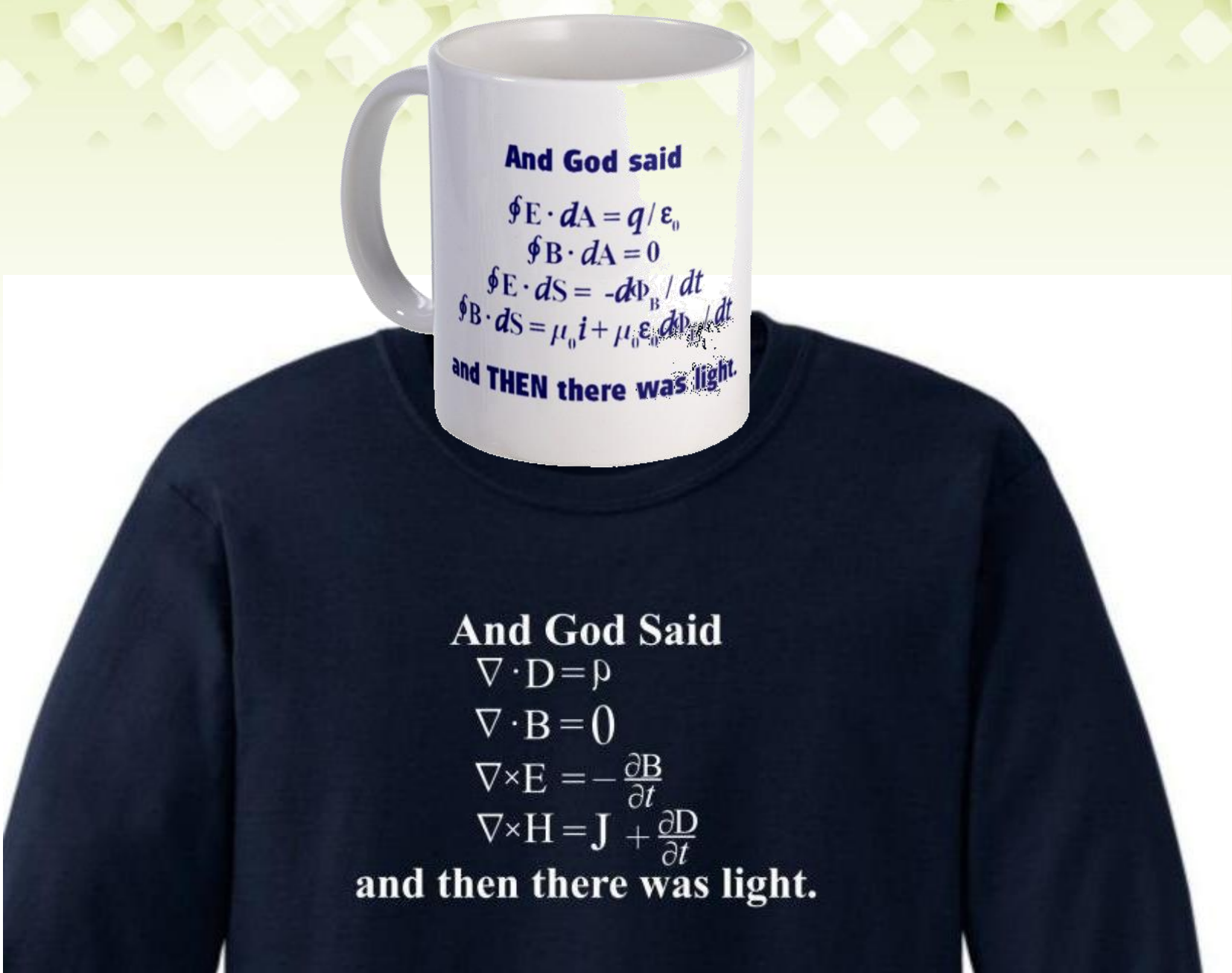
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