Eletromagnetismo Avançado

2º ciclo
Aula de 15 outubro

Potencial e potencial vetor

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

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

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$$\vec{\mathbf{B}} = \vec{\boldsymbol{\nabla}} \times \vec{\mathbf{A}}$$

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$$\vec{\mathbf{E}} = -\vec{\boldsymbol{\nabla}} V - \frac{\partial \vec{\mathbf{A}}}{\partial t}$$

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$$\vec{\boldsymbol{\nabla}} \times \vec{\mathbf{B}} = \mu_0 \vec{\mathbf{J}} + \mu_0 \epsilon_0 \frac{\partial \vec{\mathbf{E}}}{\partial t}$$

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$$\vec{\boldsymbol{\nabla}} \times \vec{\mathbf{B}} = \mu_0 \vec{\mathbf{J}} + \mu_0 \epsilon_0 \frac{\partial \vec{\mathbf{E}}}{\partial t}$$

$$\vec{\boldsymbol{\nabla}} \times \left(\vec{\boldsymbol{\nabla}} \times \vec{\mathbf{A}}\right) = \mu_0 \vec{\mathbf{J}} - \mu_0 \epsilon_0 \left(\vec{\boldsymbol{\nabla}}\left(\frac{\partial V}{\partial t}\right) + \frac{\partial^2 \vec{\mathbf{A}}}{\partial t^2}\right)$$

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$$\vec{\boldsymbol{\nabla}}\left(\vec{\boldsymbol{\nabla}} \cdot \vec{\mathbf{A}}\right) - \nabla^2 \vec{\mathbf{A}} = \mu_0 \vec{\mathbf{J}} - \mu_0 \epsilon_0 \left(\vec{\boldsymbol{\nabla}}\left(\frac{\partial V}{\partial t}\right) + \frac{\partial^2 \vec{\mathbf{A}}}{\partial t^2}\right)$$

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$$\vec{\boldsymbol{\nabla}} \times \vec{\mathbf{B}} = \mu_0 \vec{\mathbf{J}} + \mu_0 \epsilon_0 \frac{\partial \vec{\mathbf{E}}}{\partial t}$$

$$\nabla^2 V + \frac{\partial}{\partial t}\left(\vec{\boldsymbol{\nabla}} \cdot \vec{\mathbf{A}}\right) = -\frac{\rho}{\epsilon_0}$$

$$\nabla^2 \vec{\mathbf{A}} - \mu_0 \epsilon_0 \frac{\partial^2 \vec{\mathbf{A}}}{\partial t^2} - \vec{\boldsymbol{\nabla}}\left(\vec{\boldsymbol{\nabla}} \cdot \vec{\mathbf{A}} + \mu_0 \epsilon_0 \frac{\partial V}{\partial t}\right) = -\mu_0 \vec{\mathbf{J}}$$

GAUGE DE COULOMB $\Rightarrow \vec{\nabla} \cdot \vec{A} = 0$

$\Rightarrow \nabla^2 V = -\rho / \epsilon_0$ ← POISSON

$\Rightarrow \nabla^2 \vec{A} - \mu_0 \epsilon_0 \frac{\partial^2 A}{\partial t^2} - \mu_0 \epsilon_0 \frac{\partial}{\partial t} \vec{\nabla} V = -\mu_0 \vec{J}$

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$$\vec{\boldsymbol{\nabla}} \times \vec{\mathbf{B}} = \mu_0 \vec{\mathbf{J}} + \mu_0 \epsilon_0 \frac{\partial \vec{\mathbf{E}}}{\partial t}$$

$$\nabla^2 \vec{\mathbf{A}} - \mu_0 \epsilon_0 \frac{\partial^2 \vec{\mathbf{A}}}{\partial t^2} - \vec{\boldsymbol{\nabla}}\left(\vec{\boldsymbol{\nabla}} \cdot \vec{\mathbf{A}} + \mu_0 \epsilon_0 \frac{\partial V}{\partial t}\right) = -\mu_0 \vec{\mathbf{J}}$$

$$\vec{\boldsymbol{\nabla}} \cdot \vec{\mathbf{A}} + \mu_0 \epsilon_0 \frac{\partial V}{\partial t} = 0$$

Gauge de Lorenz

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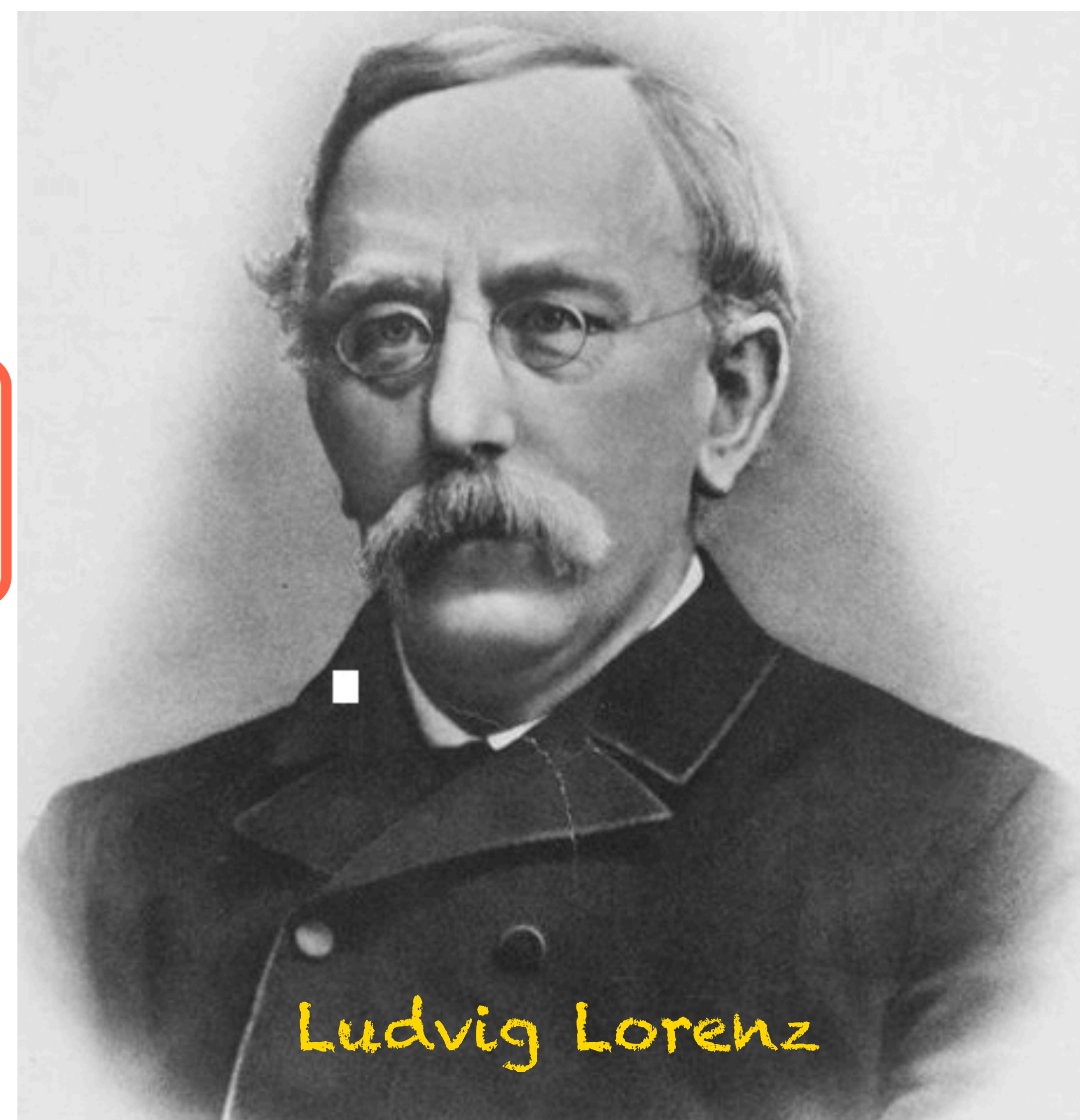
$$\vec{\boldsymbol{\nabla}} \times \vec{\mathbf{E}} = -\frac{\partial \vec{\mathbf{B}}}{\partial t}$$

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

$$\nabla^2 V - \frac{1}{c^2}\frac{\partial^2 V}{\partial t^2} = -\frac{\rho}{\epsilon_0}$$

$$\nabla^2 \vec{\mathbf{A}} - \frac{1}{c^2}\frac{\partial^2 \vec{\mathbf{A}}}{\partial t^2} = -\mu_0 \vec{\mathbf{J}}$$



$$\vec{\boldsymbol{\nabla}} \cdot \vec{\mathbf{E}} = \frac{\rho}{\epsilon_0}$$

$$\mu_0 \vec{\mathbf{J}} + \mu_0 \epsilon_0 \frac{\partial \vec{\mathbf{E}}}{\partial t}$$

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$$\vec{\mathbf{B}} = \vec{\boldsymbol{\nabla}} \times \vec{\mathbf{A}}$$

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$$\nabla^2 V - \frac{1}{c^2}\frac{\partial^2 V}{\partial t^2} = -\frac{\rho}{\epsilon_0}$$

$$\Box^2 V = -\frac{\rho}{\epsilon_0}$$

$$\nabla^2 \vec{\mathbf{A}} - \frac{1}{c^2}\frac{\partial^2 \vec{\mathbf{A}}}{\partial t^2} = -\mu_0 \vec{\mathbf{J}}$$

$$\Box^2 \vec{\mathbf{A}} = -\mu_0 \vec{\mathbf{J}}$$

EQUIVALENTES

$$\Box^2 \equiv \nabla^2 - \frac{1}{c^2}\frac{\partial^2}{\partial t^2}$$