Eletromagnetismo

21 de março
Eletrostática

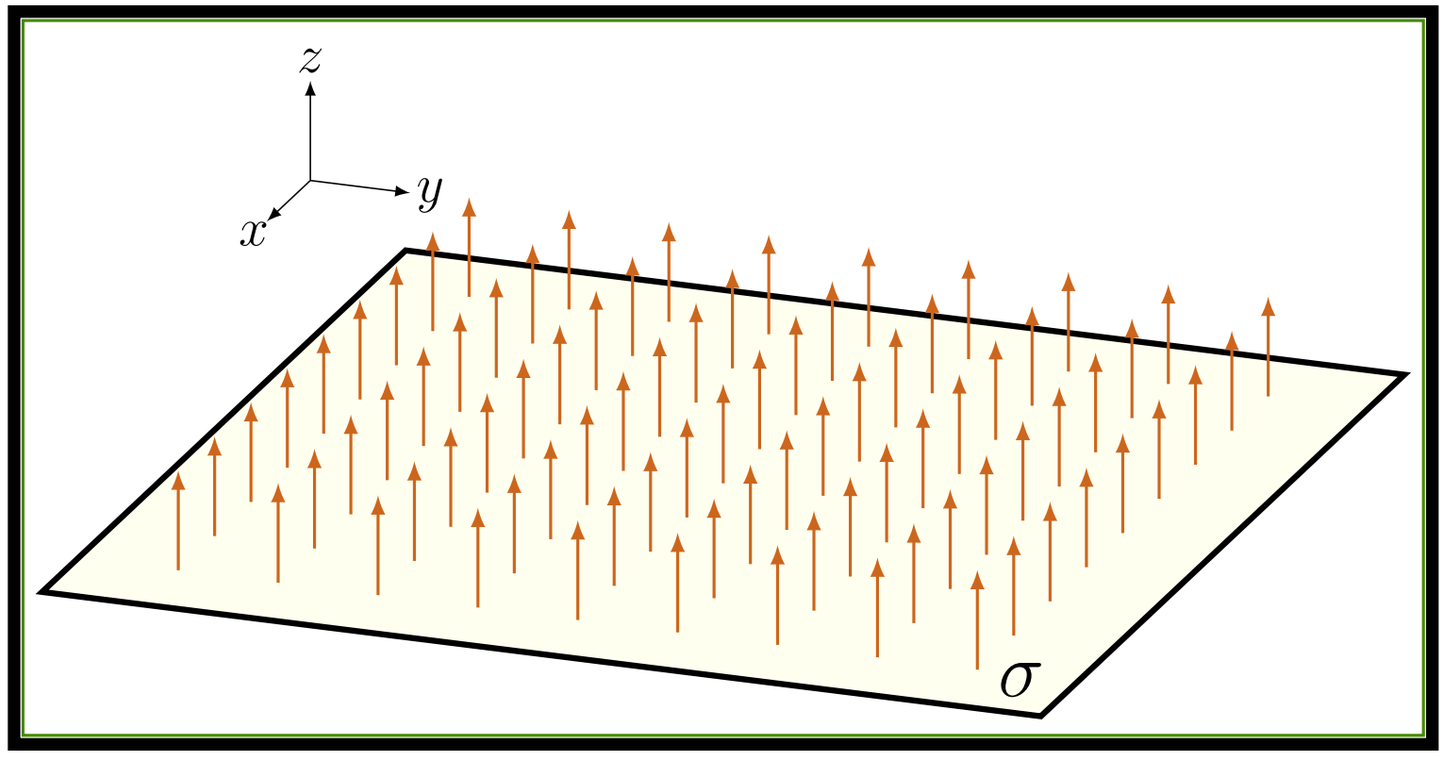
Lei de Gauss

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

$$\int_S \vec{\mathbf{E}} \cdot \hat{\mathbf{n}} \, \mathrm{d}A = \frac{Q}{\epsilon_0}$$

Divergente do campo elétrico

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



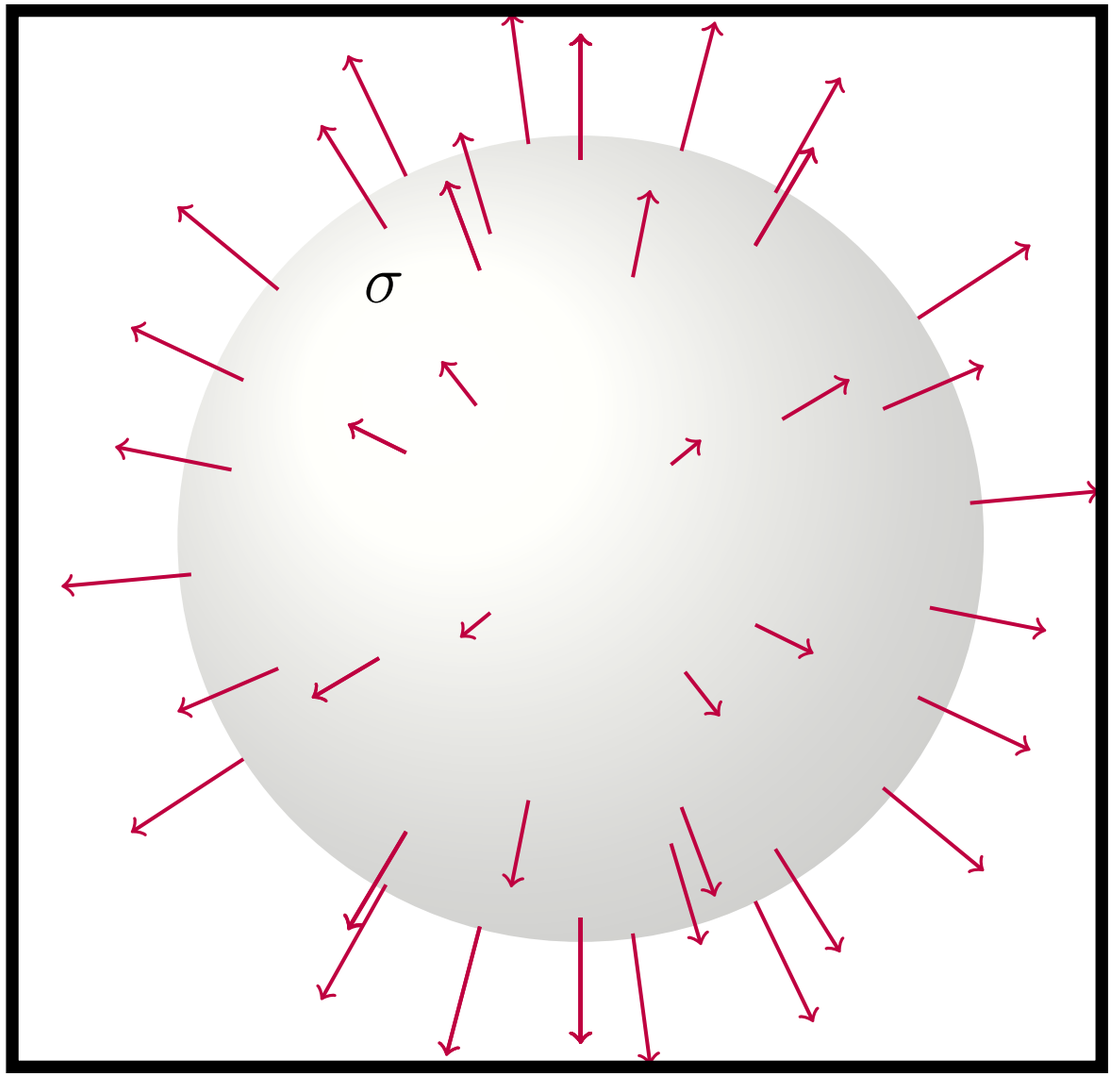
$$\frac{\partial \cancel{E}_x}{\partial x} + \frac{\partial \cancel{E}_y}{\partial y} + \frac{\partial E_z}{\partial z} = 0$$

$$\Rightarrow \quad E_z = \text{constante}$$

Divergente do campo elétrico

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

$$\frac{1}{r^2}\frac{\mathrm{d}(r^2 E_r)}{\mathrm{d}r} = 0$$



Divergente do campo elétrico

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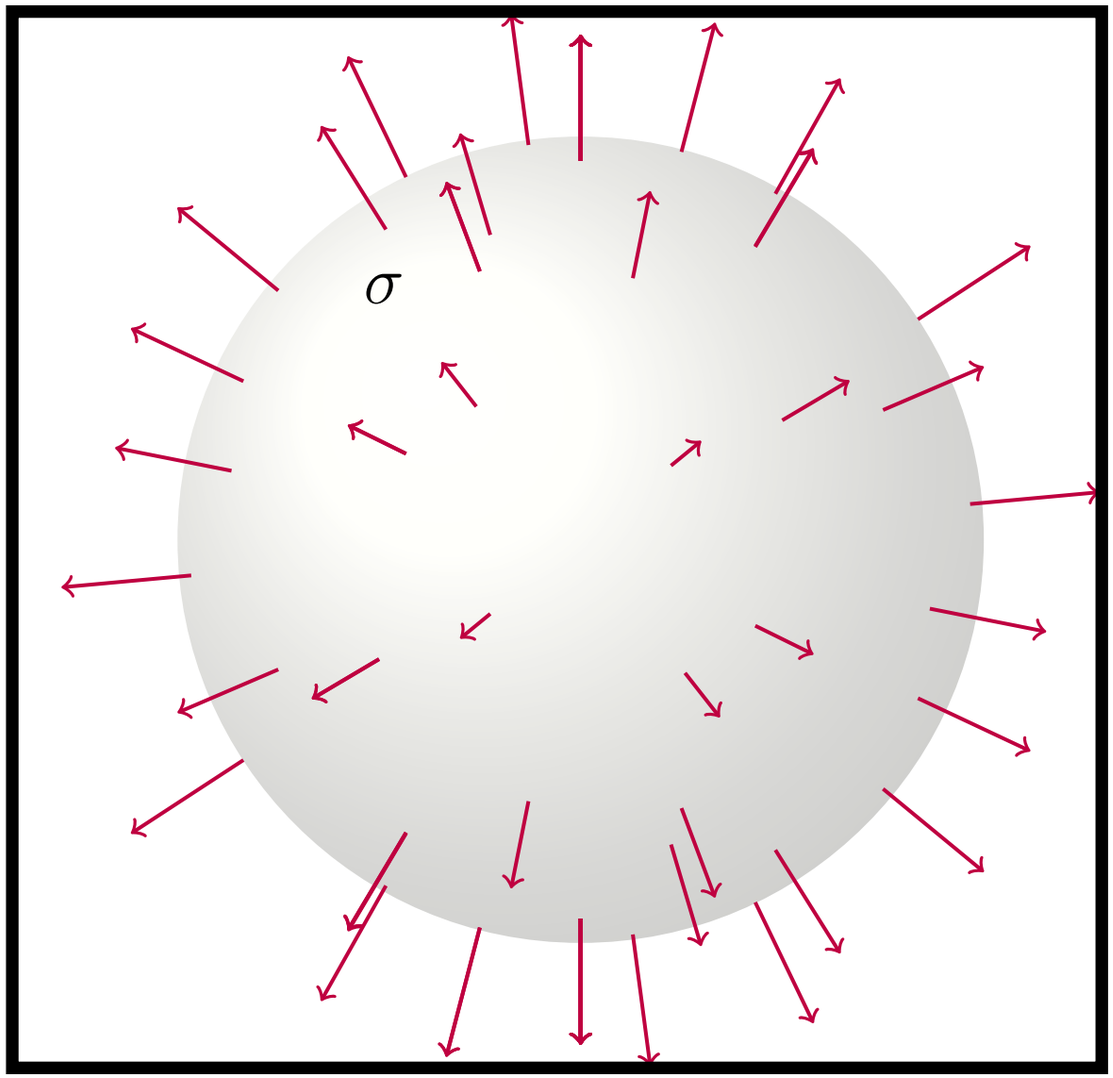
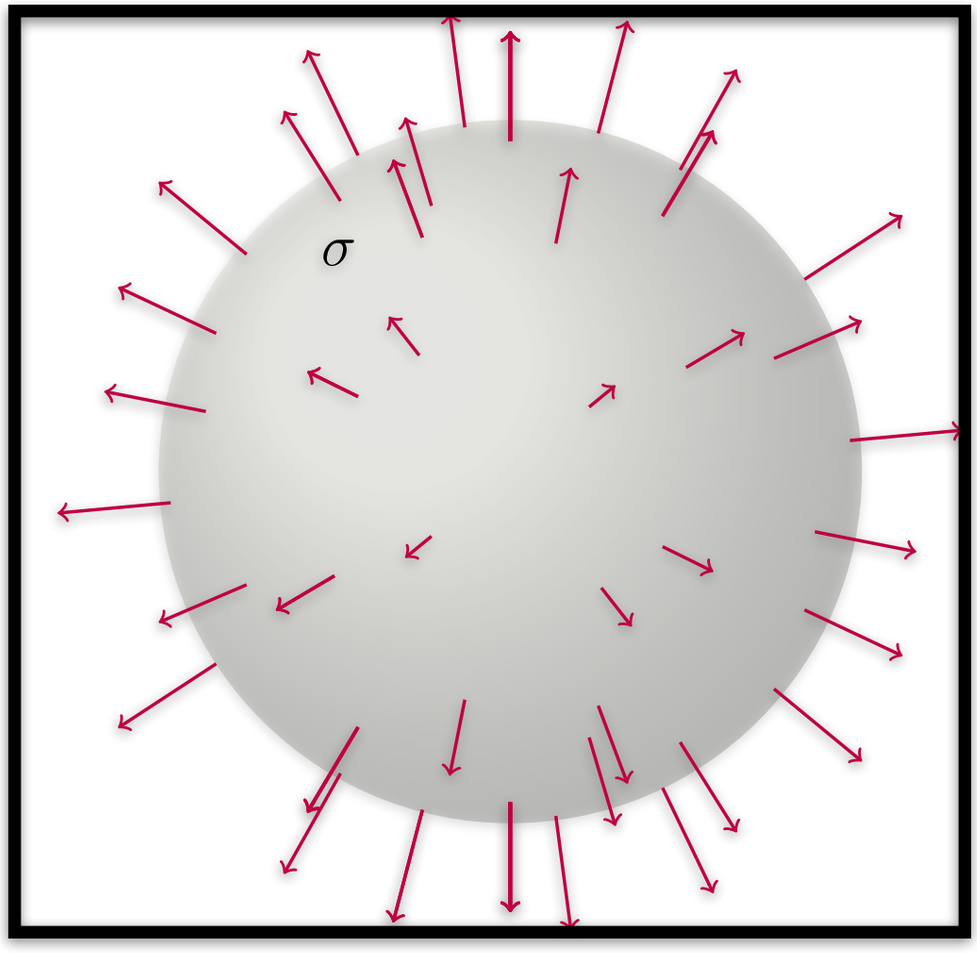
$$E_r = \frac{\text{constante}}{r^2}$$



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

Pratique o que aprendeu

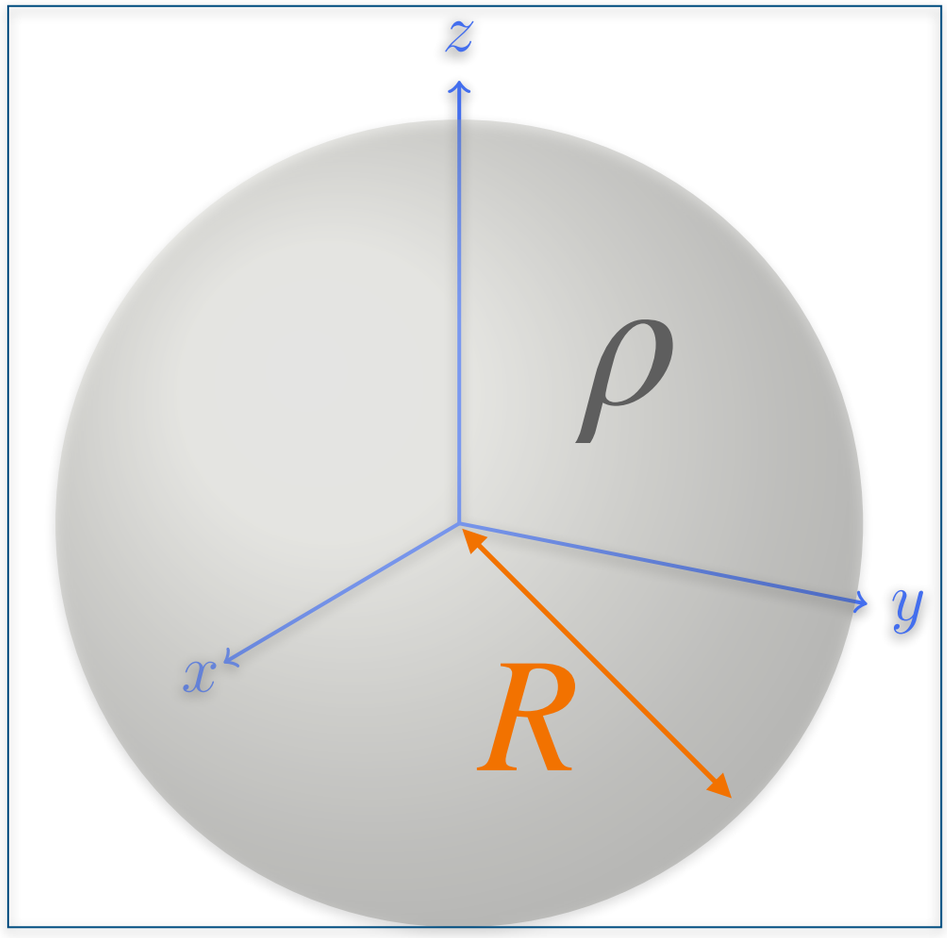
E no interior da esfera?



Campo de esfera uniformemente carregada

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

$$r < R \quad \Rightarrow \quad \frac{1}{r^2} \frac{\mathrm{d}(r^2 E_r)}{\mathrm{d}r} = \frac{\rho}{\epsilon_0}$$



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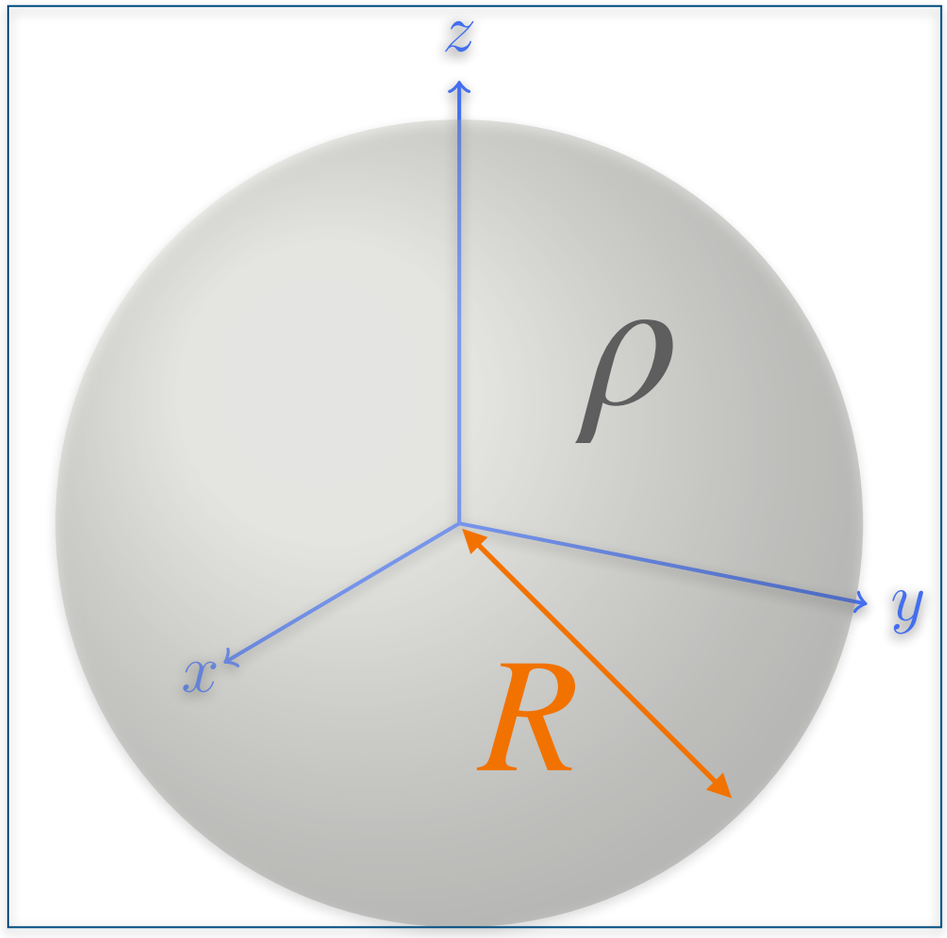

$$r < R \quad \Rightarrow \quad \frac{1}{r^2}\frac{\mathrm{d}(r^2 E_r)}{\mathrm{d}r} = \frac{\rho}{\epsilon_0}$$

$$\frac{\mathrm{d}(r^2 E_r)}{\mathrm{d}r} = \frac{\rho}{\epsilon_0} r^2$$

$$\mathrm{d}\left(r^2 E_r\right) = \frac{\rho}{\epsilon_0} r^2 \, \mathrm{d}r$$

Campo de esfera uniformemente carregada

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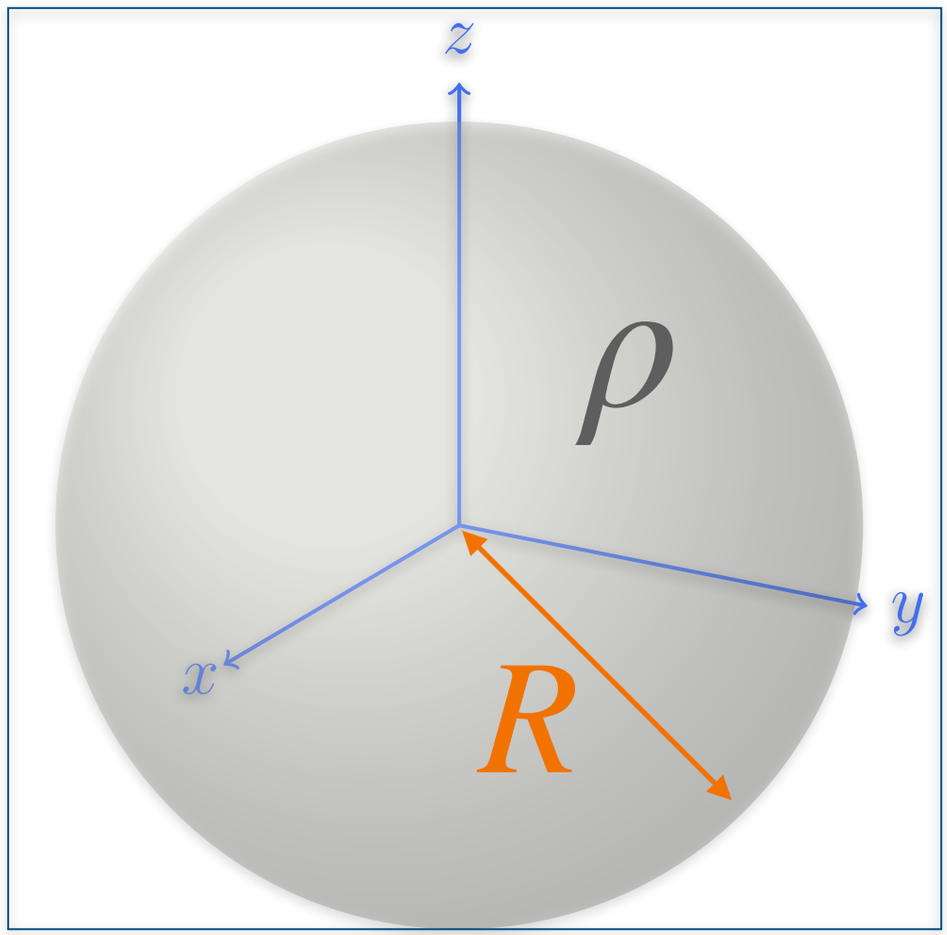
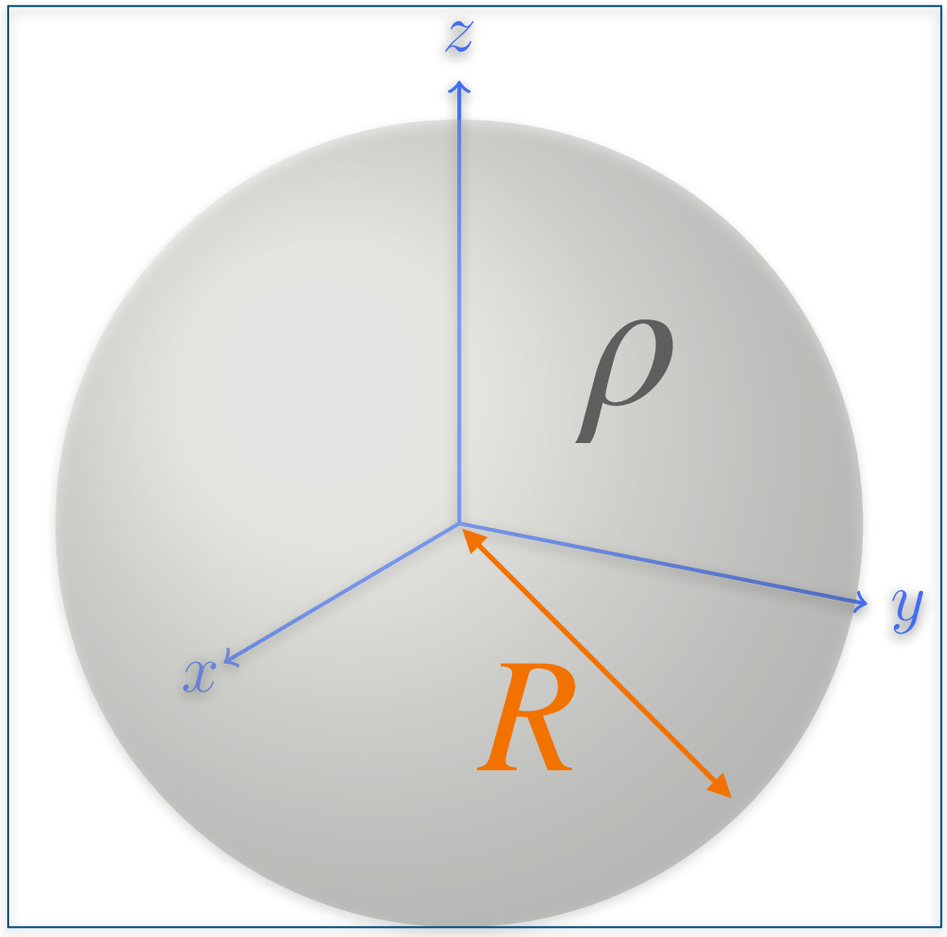


Campo de esfera uniformemente carregada

$$\mathrm{d}\left(r^2 E_r\right) = \frac{\rho}{\epsilon_0} r^2 \,\mathrm{d}r$$

$$\int_0^{E_r} \mathrm{d}\left(r'^2 E'\right) = \frac{\rho}{\epsilon_0} \int_0^r r'^2 \,\mathrm{d}r'$$



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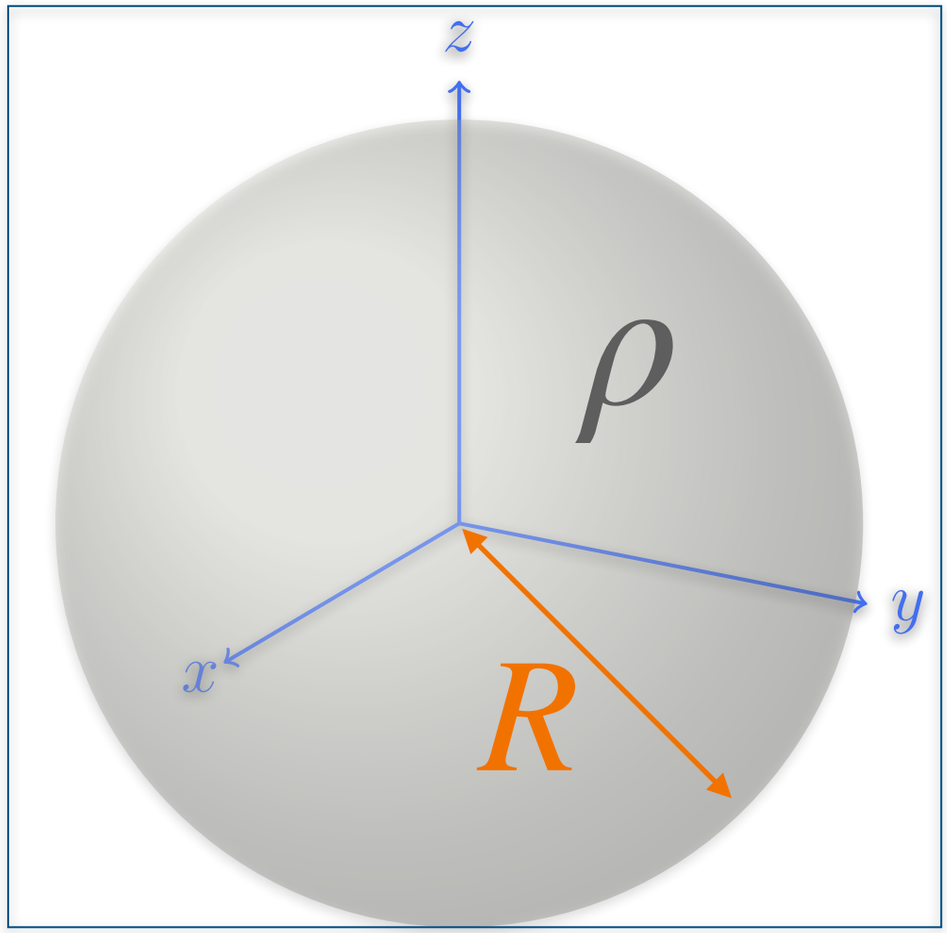
$$r^2 E_r = \frac{\rho}{\epsilon_0} \frac{r^3}{3}$$



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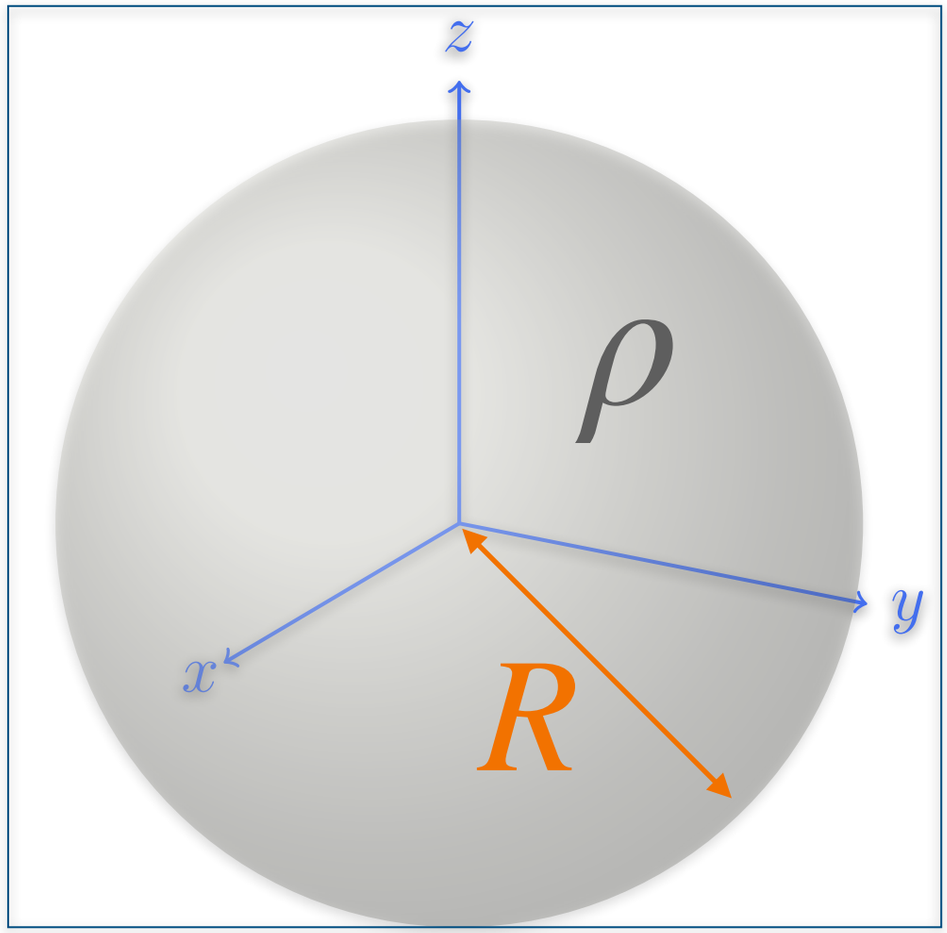
$$r^2 E_r = \frac{\rho}{\epsilon_0} \frac{r^3}{3}$$

$$E_r = \frac{\rho}{3\epsilon_0} r \qquad (r \leq R)$$



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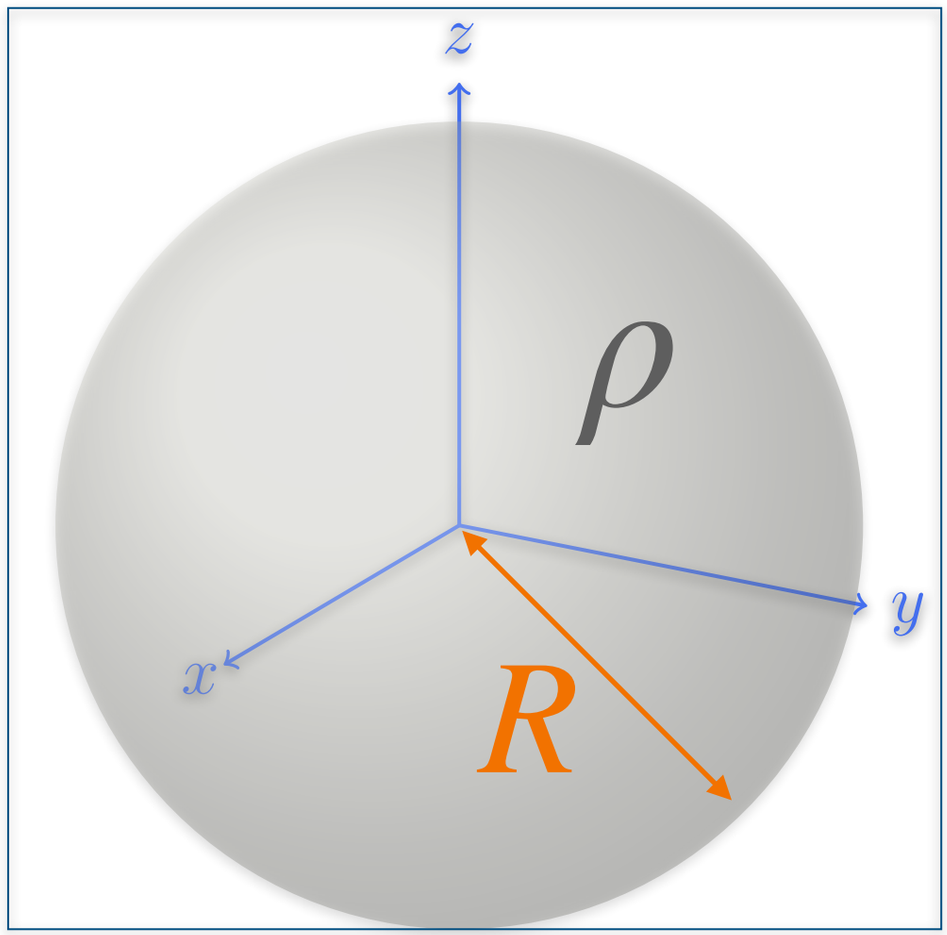
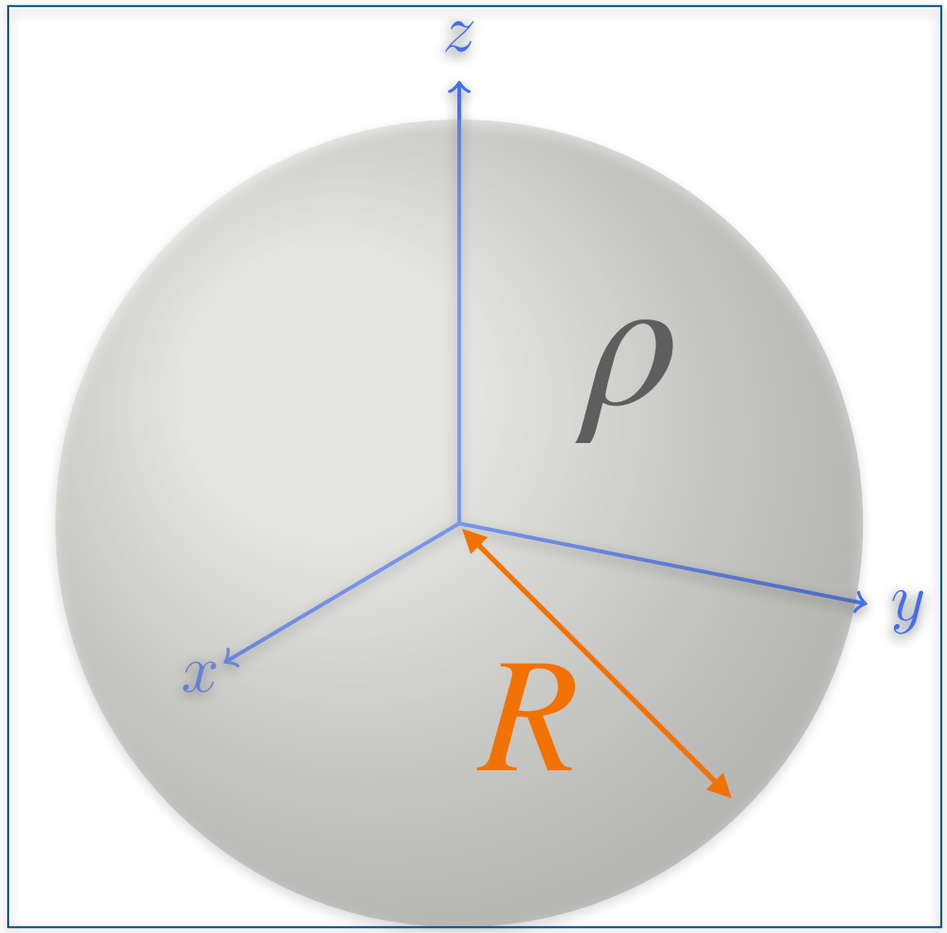


Campo de esfera uniformemente carregada

$$E_r = \frac{\rho}{3\epsilon_0} r \qquad (r \leq R)$$

$$r > R \quad \Rightarrow \quad E_r = \frac{\text{constante}}{r^2}$$



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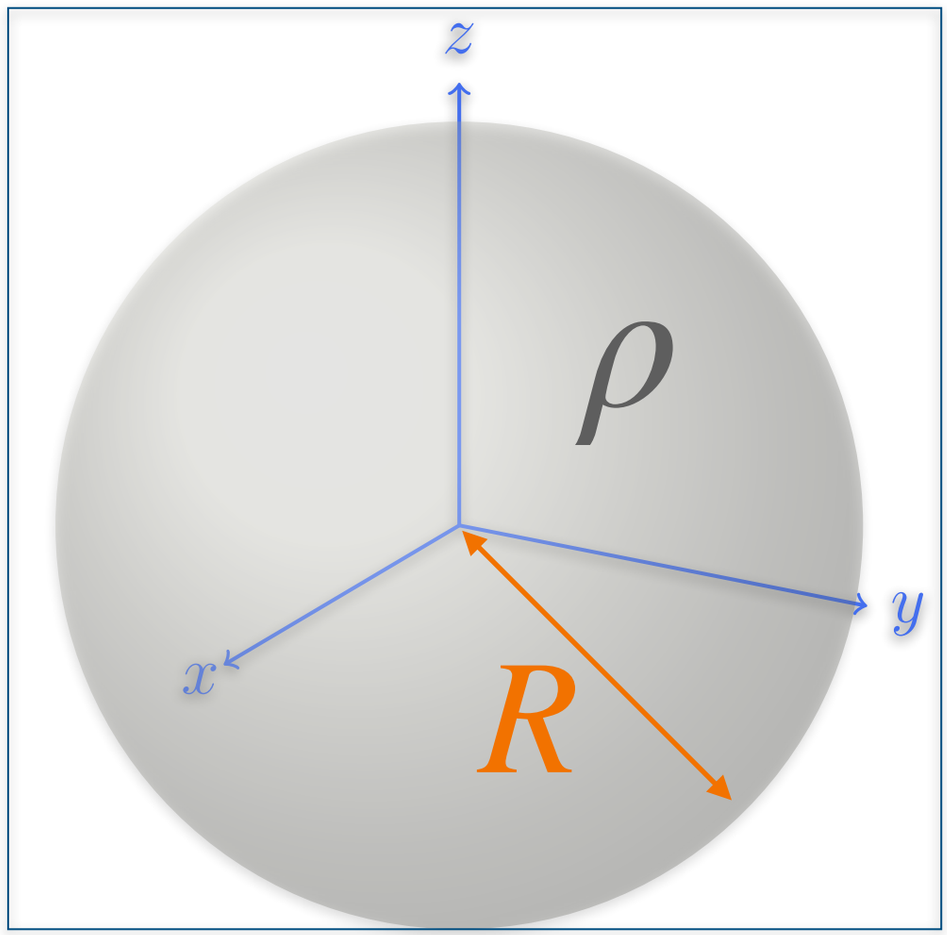

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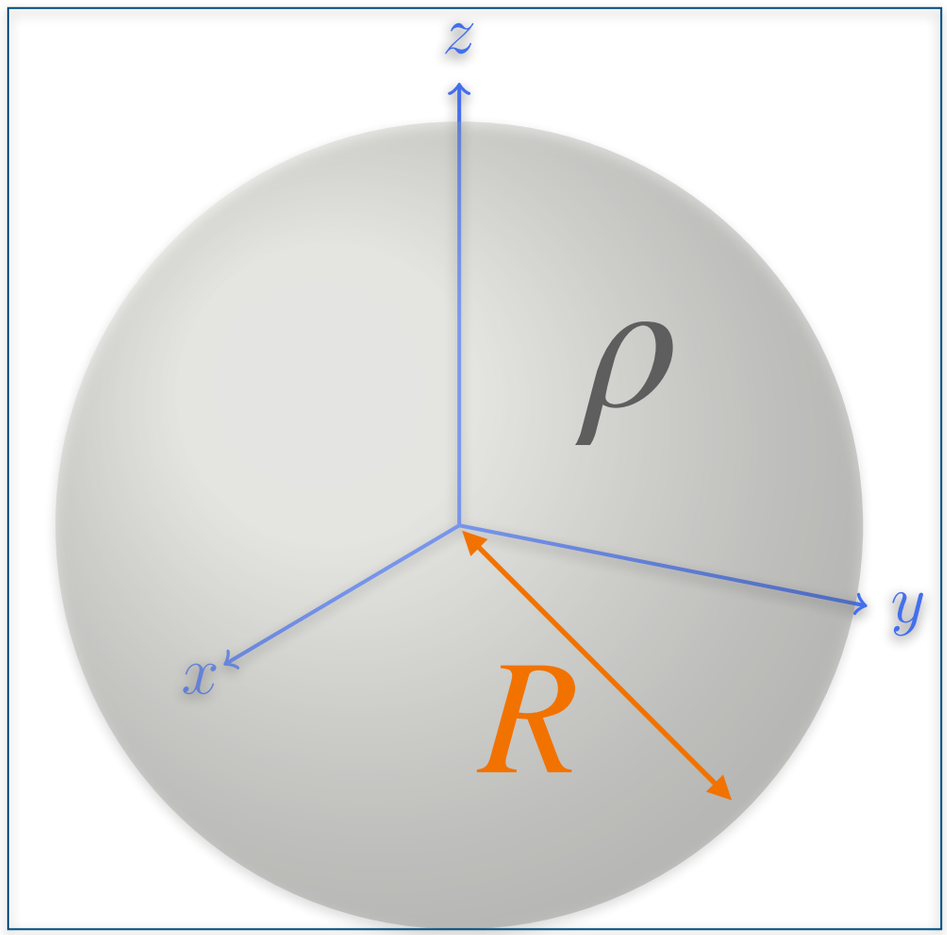
$$E_r = \frac{\rho}{3\epsilon_0} \frac{R^3}{r^2} \qquad (r \geq R)$$



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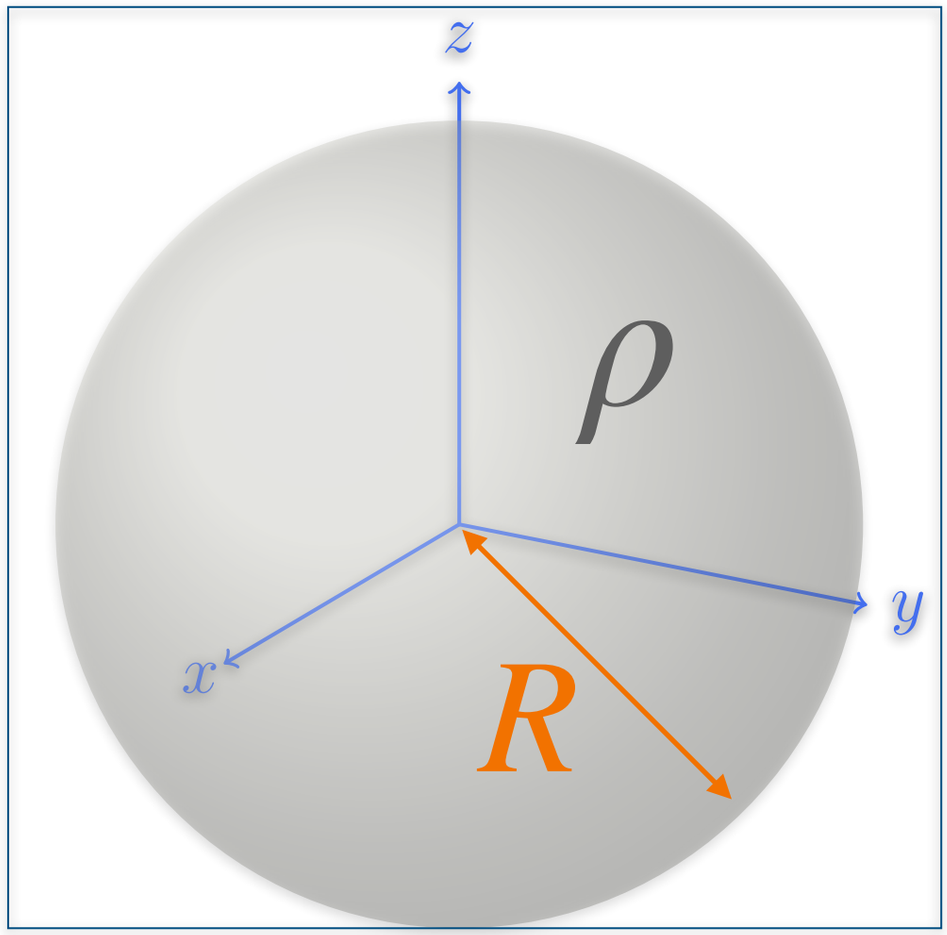
$$E_r = \frac{\rho}{3\epsilon_0} \frac{R^3}{r^2}$$

$$E_r = \frac{1}{4\pi\epsilon_0} \frac{Q}{r^2} \qquad (r \geq R)$$



Campo de esfera uniformemente carregada

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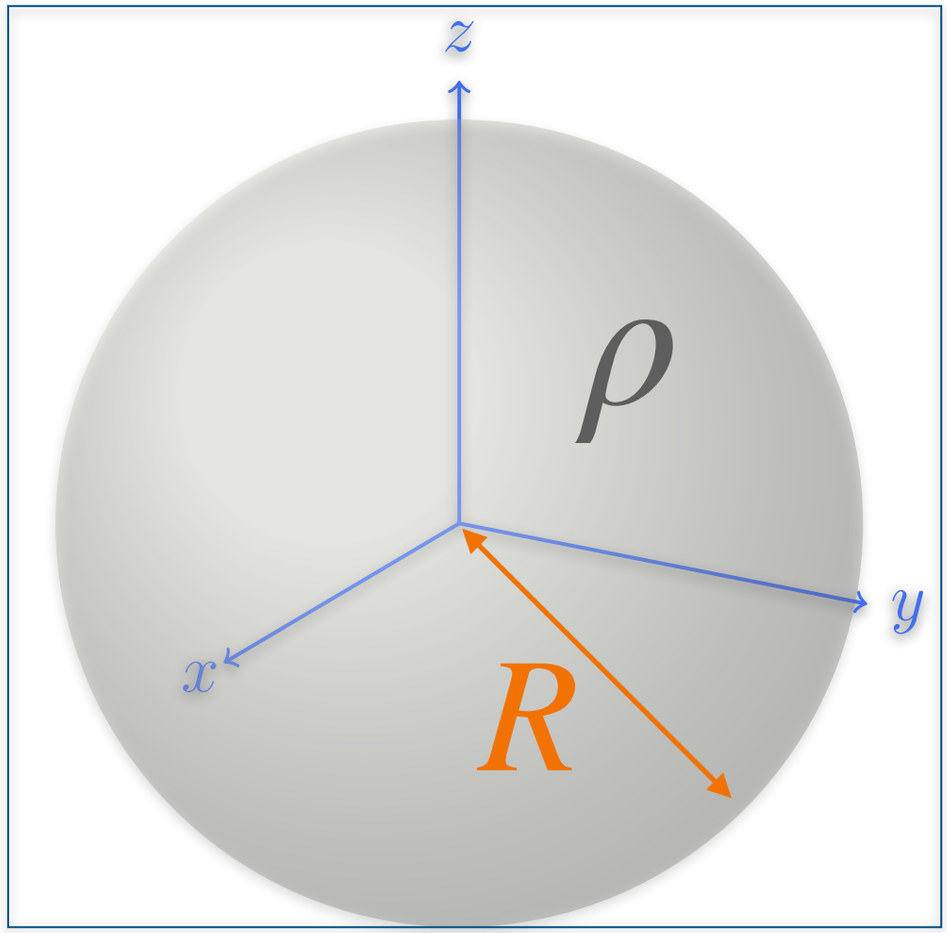

$$\int_S \vec{\mathbf{E}} \cdot \hat{\mathbf{n}} \, \mathrm{d}A = \frac{Q}{\epsilon_0}$$

Pratique o que aprendeu

$$\int_A E_r r^2 \mathrm{d}u \, \mathrm{d}\varphi = \frac{q(r)}{\epsilon_0}$$

$$q(r) = \int_{\mathcal{V}(r)} \rho \, \mathrm{d}\tau$$