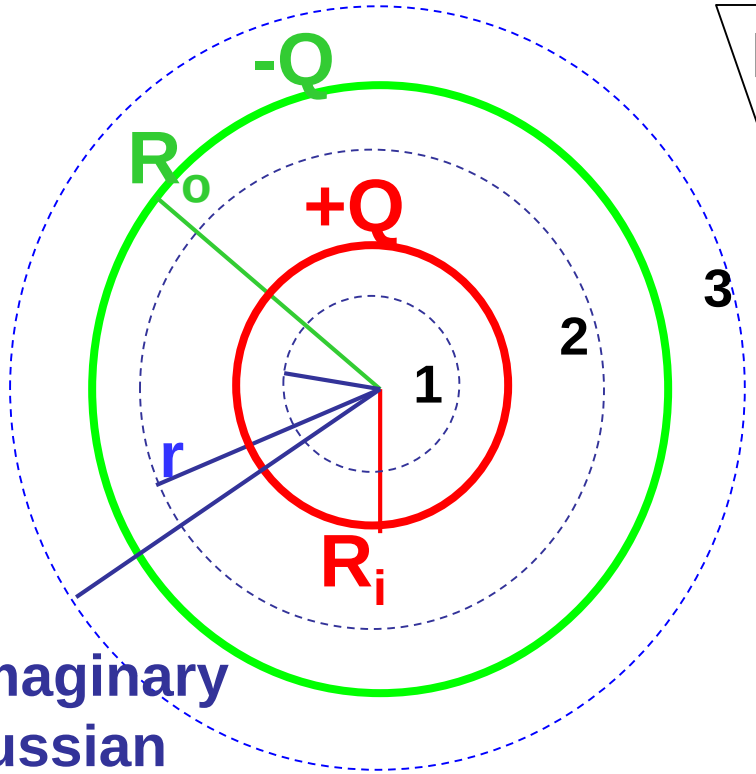
# Hollow spherical shells of charge: $R_o$ (-Q) ; $R_i$ (Q)




3 imaginary Gaussian Surfaces With r in 1, 2,3

**Region 1: r< $R_i$ $Q_{in}$ =0**

$$E_1\, 4\pi r_1^2 = \frac{Q_{in}}{\varepsilon_0} = 0$$

$$E_1 = 0$$

**Region 2: $R_i$ < r< $R_o$ $Q_{in}$ = +Q**

$$E_2\, 4\pi r_2^2 = \frac{Q_{in}}{\varepsilon_0} = \frac{Q}{\varepsilon_0}$$

$$E_2 = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r_2^2}$$

**Region 3: $R_o$ < r $Q_{in}$ = (+Q) + (-Q)=0**

$$E_3\, 4\pi r_3^2 = \frac{Q_{in}}{\varepsilon_0} = \frac{0}{\varepsilon_0} \qquad E_3 = 0$$

Shells-sum

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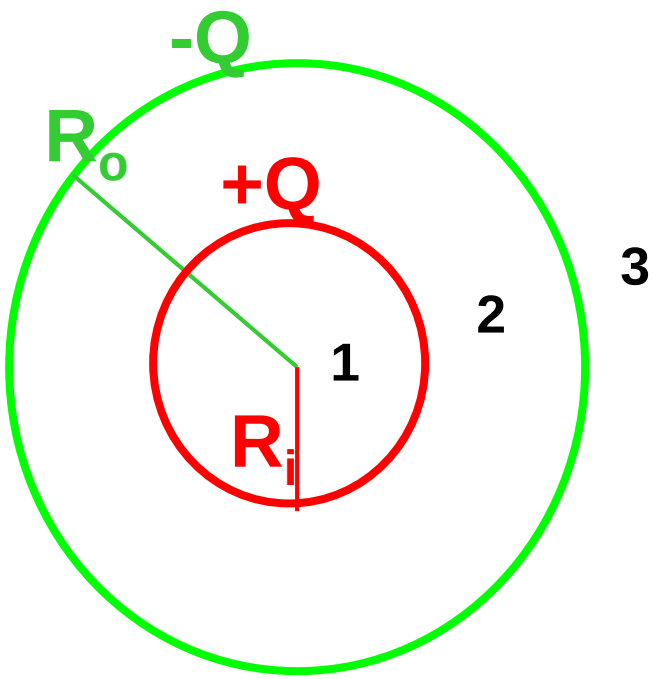

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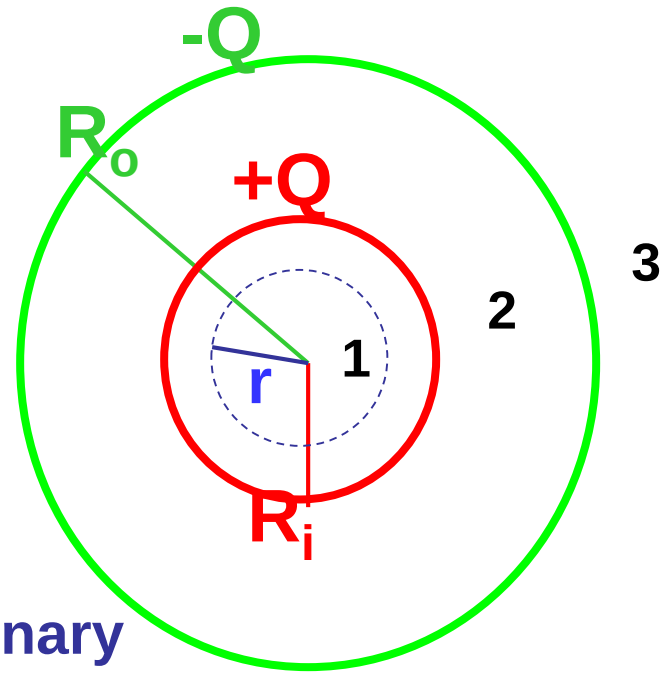


imaginary Gaussian surface

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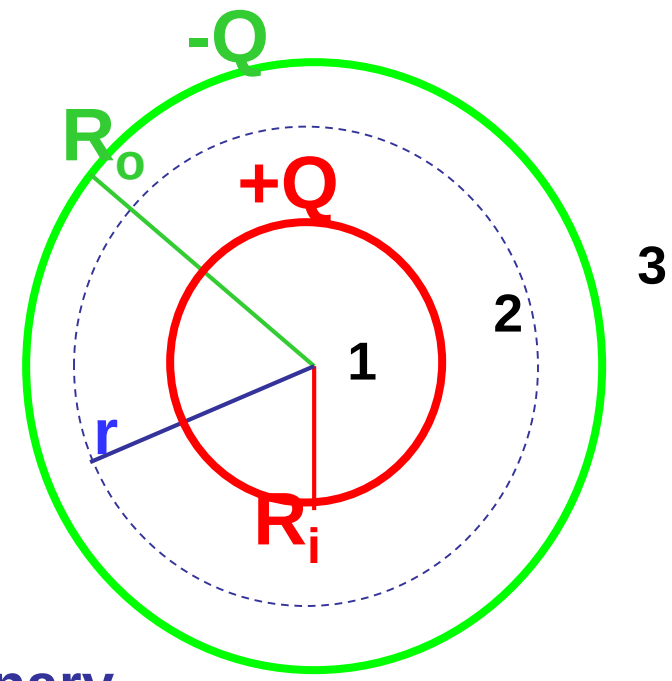


**imaginary Gaussian surface**

**Region 2: $R_i < r < R_o$** $Q_{in} = +Q$

$$E_2\, 4\pi r_2^2 = \frac{Q_{in}}{\varepsilon_0} = \frac{Q}{\varepsilon_0}$$

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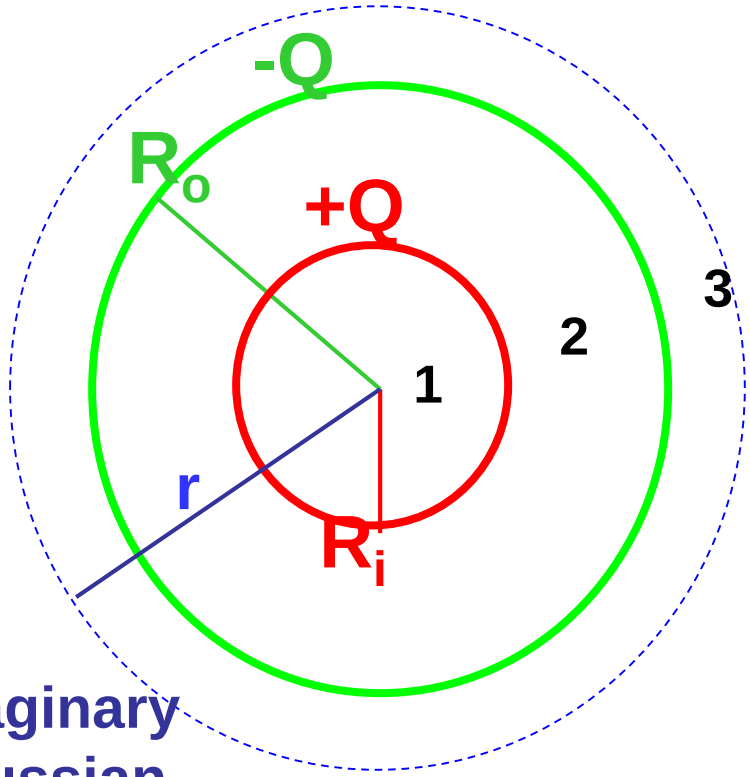


imaginary Gaussian surface

**Region 3: $R_o$ < r  $Q_{in}$ = (+Q) + (-Q)=0**

$$E_3\, 4\pi r_3^2 = \frac{Q_{in}}{\varepsilon_0} = \frac{0}{\varepsilon_0} \qquad E_3 = 0$$