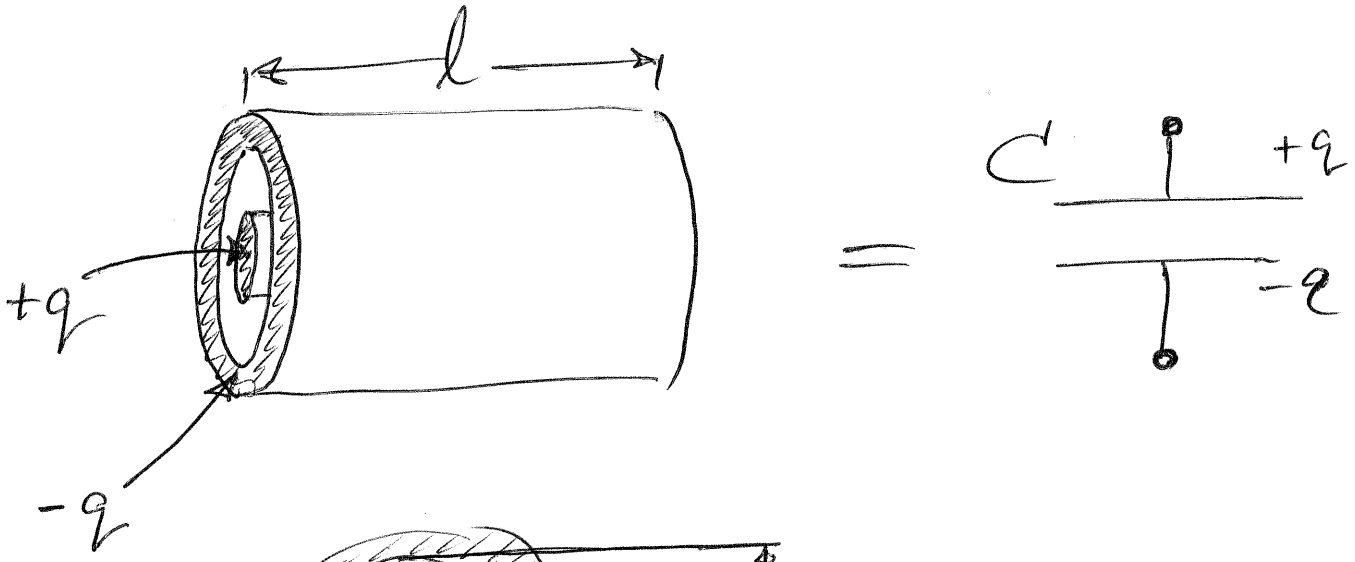
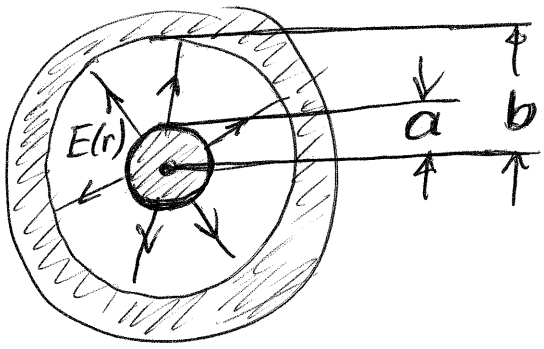
Lecture 5





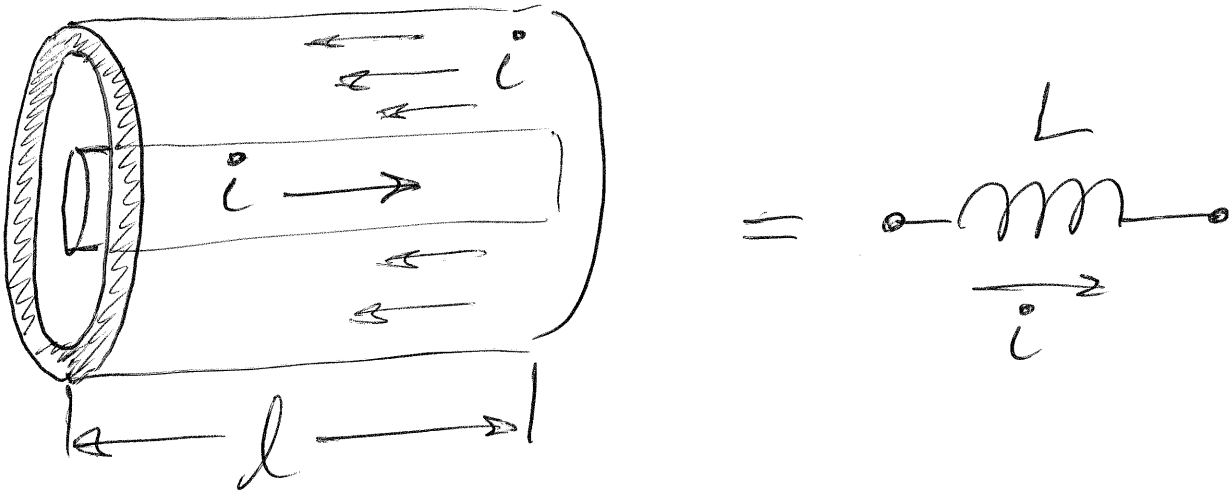
$$E(r) \cdot 2\pi r l = q/\epsilon_0 \,, \quad E(r) = \frac{q/l}{2\pi\epsilon_0 r}$$

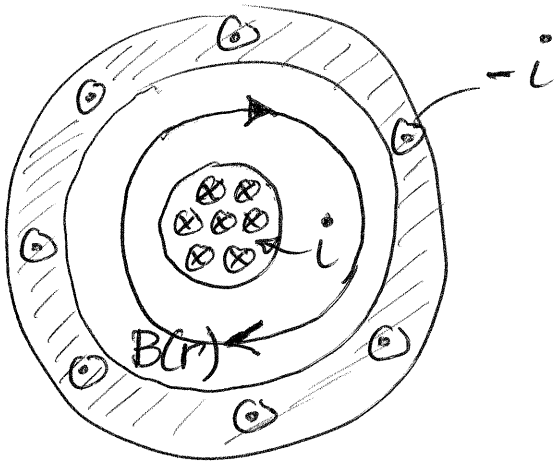
$$V = \int_a^b E(r)\cdot dr = \frac{q/l}{2\pi\epsilon_0} \log(b/a)$$

$$C = \frac{q}{V} = \frac{2\pi\epsilon_0 l}{\log(b/a)}$$

dielectric: $\epsilon_0 \longrightarrow K\epsilon_0$

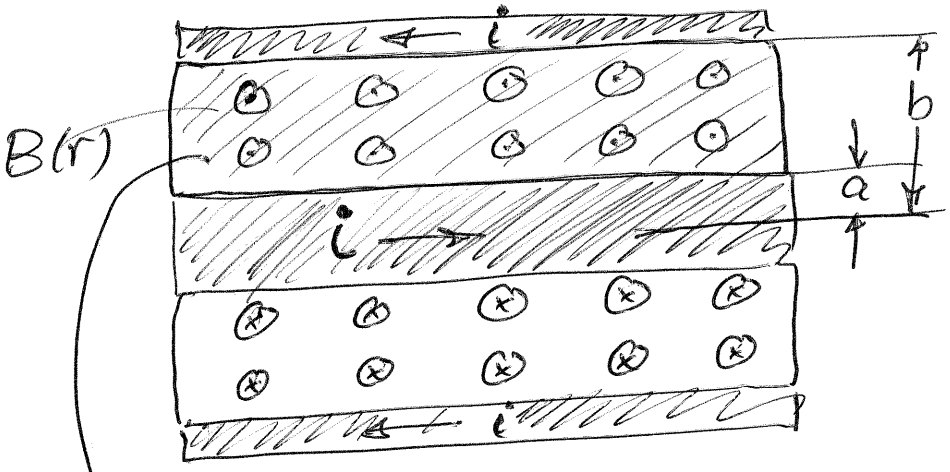
$$\tilde{C} = \frac{2\pi K \epsilon_0}{\log(b/a)}$$





$$B(r) \cdot 2\pi r = \mu_0 i, \quad B(r) = \frac{\mu_0 i}{2\pi r}$$

Co-ax cross section:



$$\Phi = \int_a^b B(r) \cdot l \, dr = \frac{\mu_0 l i}{2\pi} \log(b/a)$$

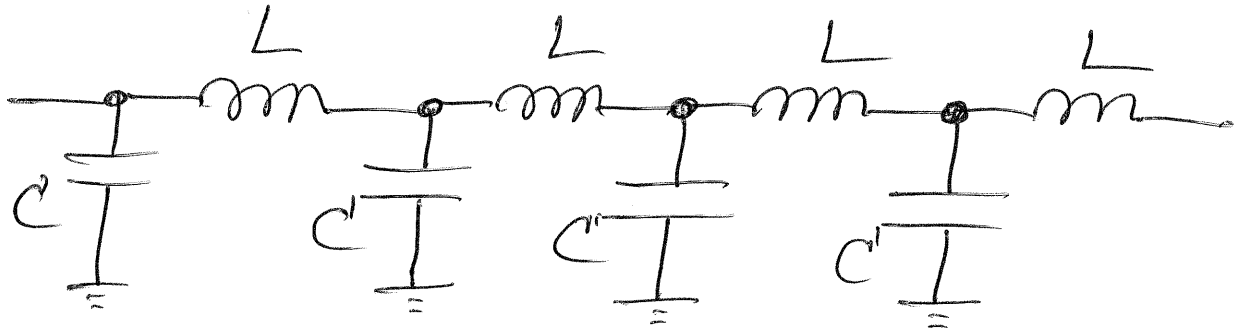
$$= L i$$

$$\Rightarrow L = \frac{\mu_0 l}{2\pi} \log(b/a)$$

$$EMF = V_L = \dot{\Phi} = L \frac{di}{dt}$$

$$\tilde{L} = L/l = \frac{\mu_0}{2\pi} \log(b/a)$$

L-C circuit model:



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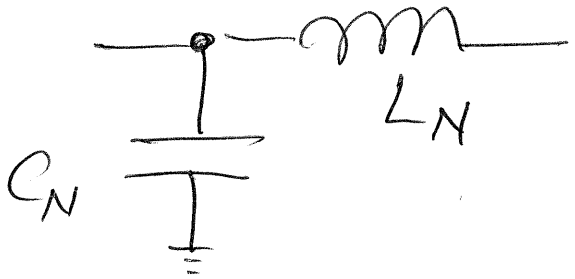

$C'_N = C_{parallel} = NC$ ✓

$L_N = L_{series} = NL$ ✓

$$C' = \tilde{C} \cdot \ell \quad , \quad L = \tilde{L} \cdot \ell$$

$$v_c = \frac{1}{\sqrt{\tilde{L}\tilde{C}}} = \sqrt{\frac{1}{\frac{\mu_0}{2\pi}\log(b/a)\,\frac{2\pi K \epsilon_0}{\log(b/a)}}}$$

$$= \frac{1}{\sqrt{K}}\,\underbrace{\frac{1}{\sqrt{\mu_0 \epsilon_0}}}$$

c = speed of light