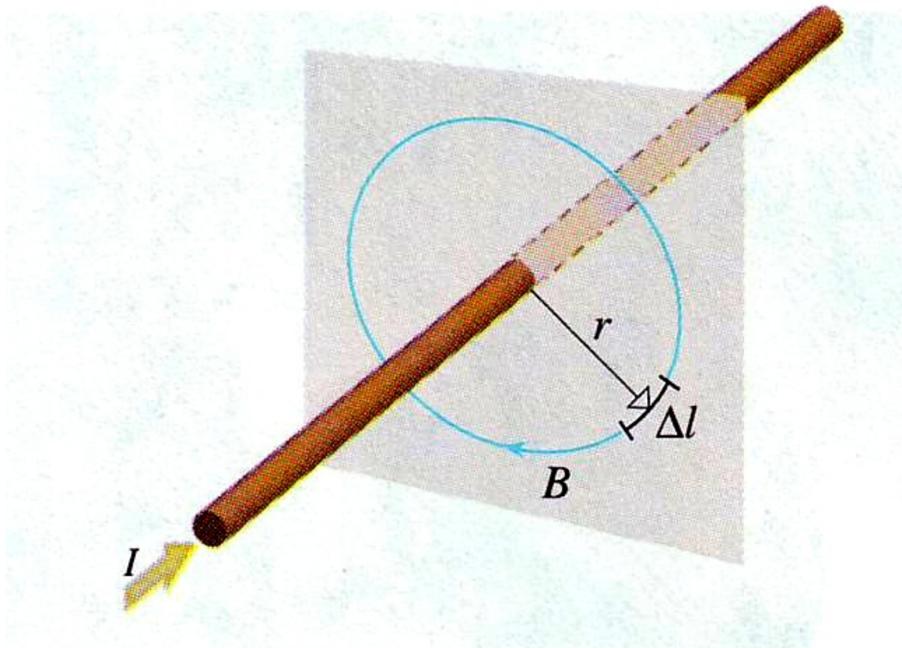
# Displacement Current

Another step toward

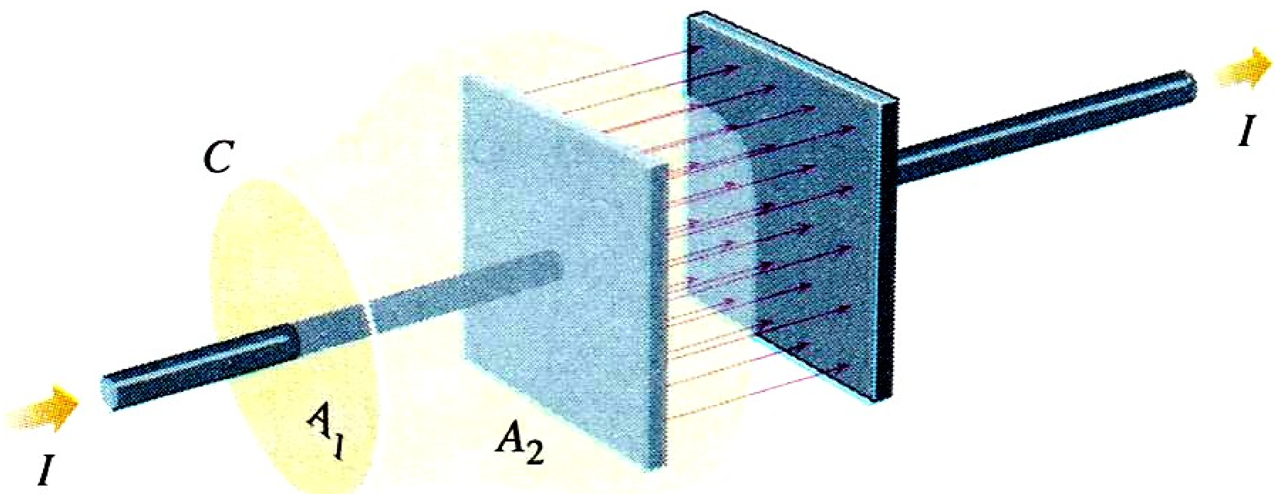
Maxwell’s Equations

# Recall Ampere's Law

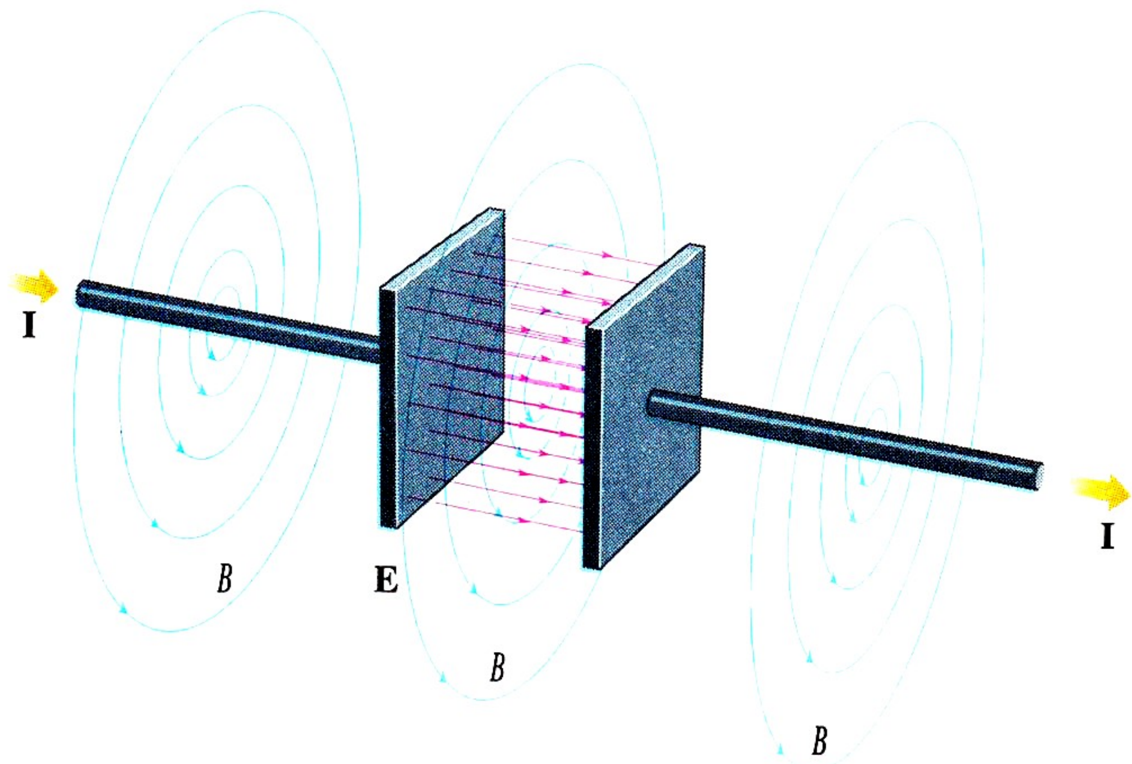



$$\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{enc}$$

Imagine a wire connected to a charging or discharging capacitor. The area in the Amperian loop could be stretched into the open region of the capacitor. In this case there would be current passing through the loop, but not through the area bounded by the loop.



If Ampere's Law still holds, there must be a magnetic field generated by the changing E-field between the plates. This induced B-field makes it look like there is a current (call it the **displacement current**) passing through the plates.



# Properties of the Displacement Current

- For regions between the plates but at radius larger than the plates, the B-field would be identical to that at an equal distance from the wire.
- For regions between the plates, but at radius less than the plates, the $I_{\text{enc}}$ would be determined as through the total $I$ were flowing uniformly between the plates.

# Equation for Displacement current

$$I_d = \varepsilon_0 \frac{d\Phi_E}{dt}$$

# Modified Ampere's Law (Ampere-Maxwell Law)

$$\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{enc} + \mu_0 I_{d,enc}$$

$$\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{enc} + \mu_0 \varepsilon_0 \frac{d\Phi_E}{dt}$$