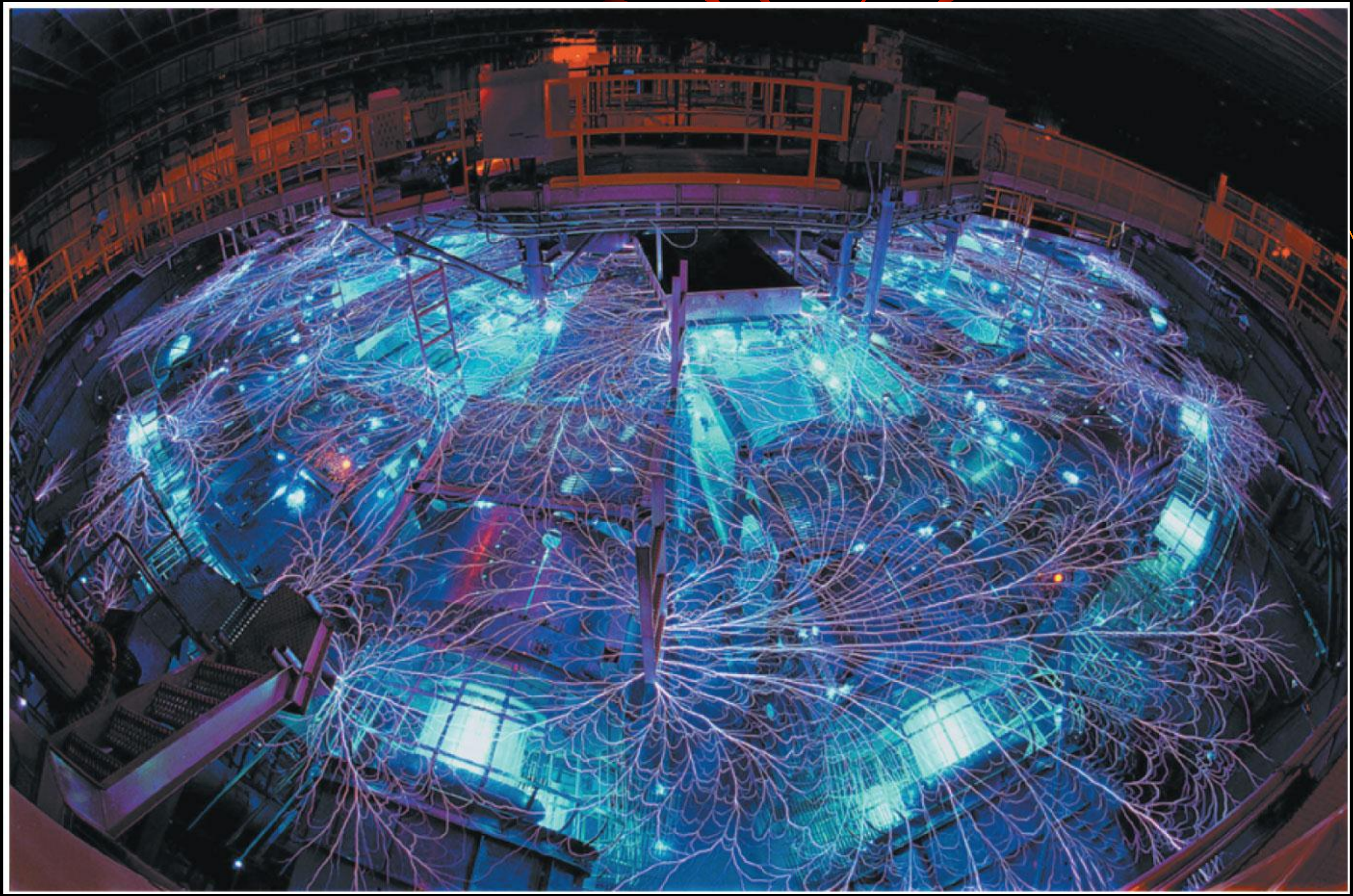
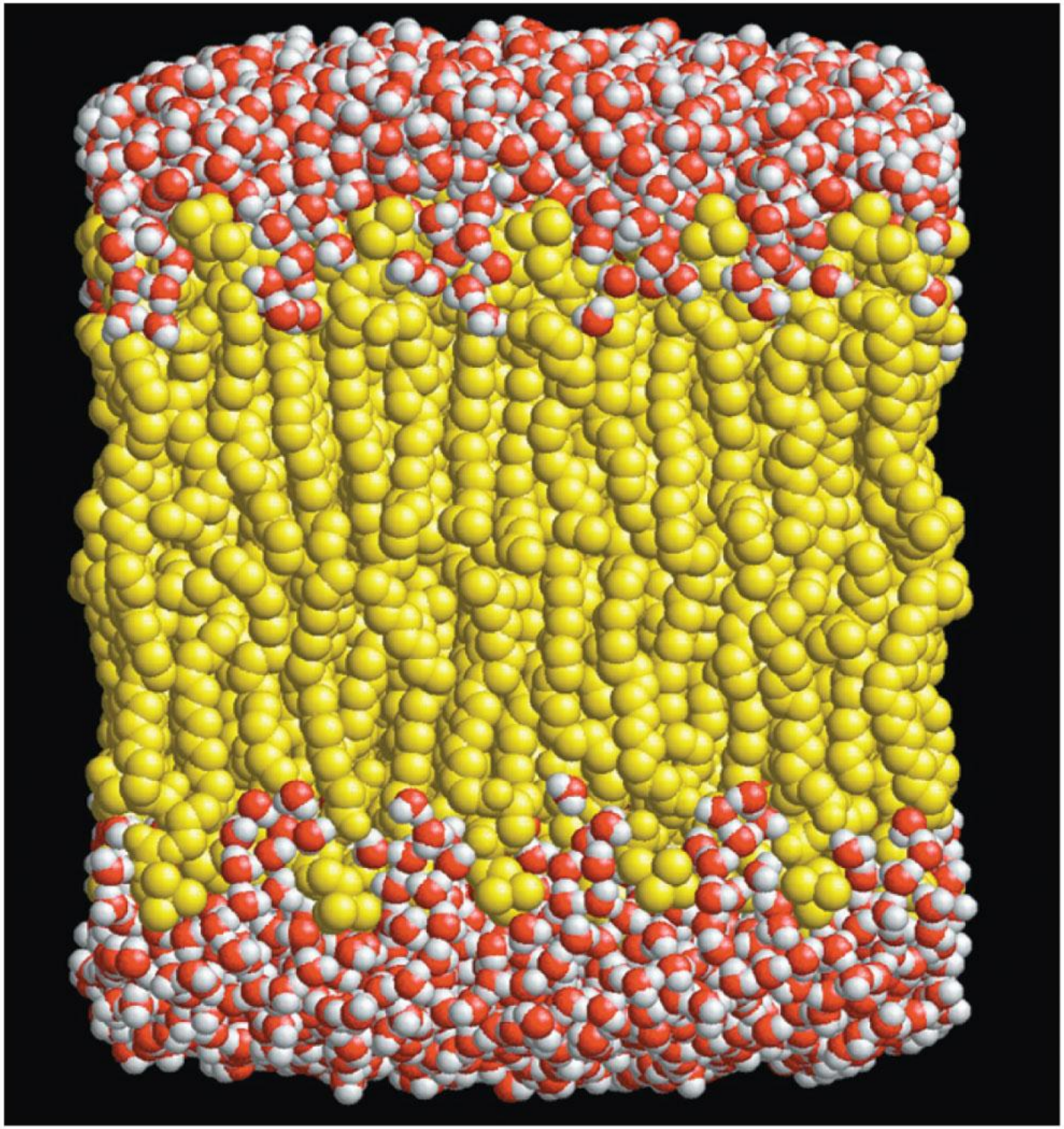
Touch Screen

Indium Tin Oxide；ITO 氧化銦錫

Z machine



Z pinch/Θ pinch



26-6 Capacitor with a dielectric

- The capacitance is increased by κ times
  κ: the dielectric constant

TABLE 26-1 SOME PROPERTIES OF DIELECTRICS[a]

MATERIAL	DIELECTRIC CONSTANT κ	DIELECTRIC STRENGTH (kV/mm)
Air (1 atm)	1.00054	3
Polystyrene	2.6	24
Paper	3.5	16
Transformer oil	4.5	
Pyrex	4.7	14
Ruby mica	5.4	

(Continued from the last slide)

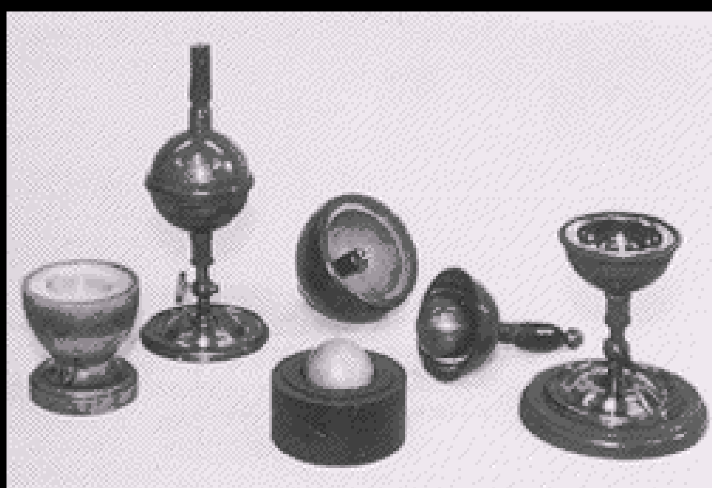
Porcelain	6.5	
Silicon	12	
Germanium	16	
Ethanol	25	
Water (20°C)	80.4	
Water (25°C)	78.5	
Titania ceramic	130	
Strontium titanate	310	8

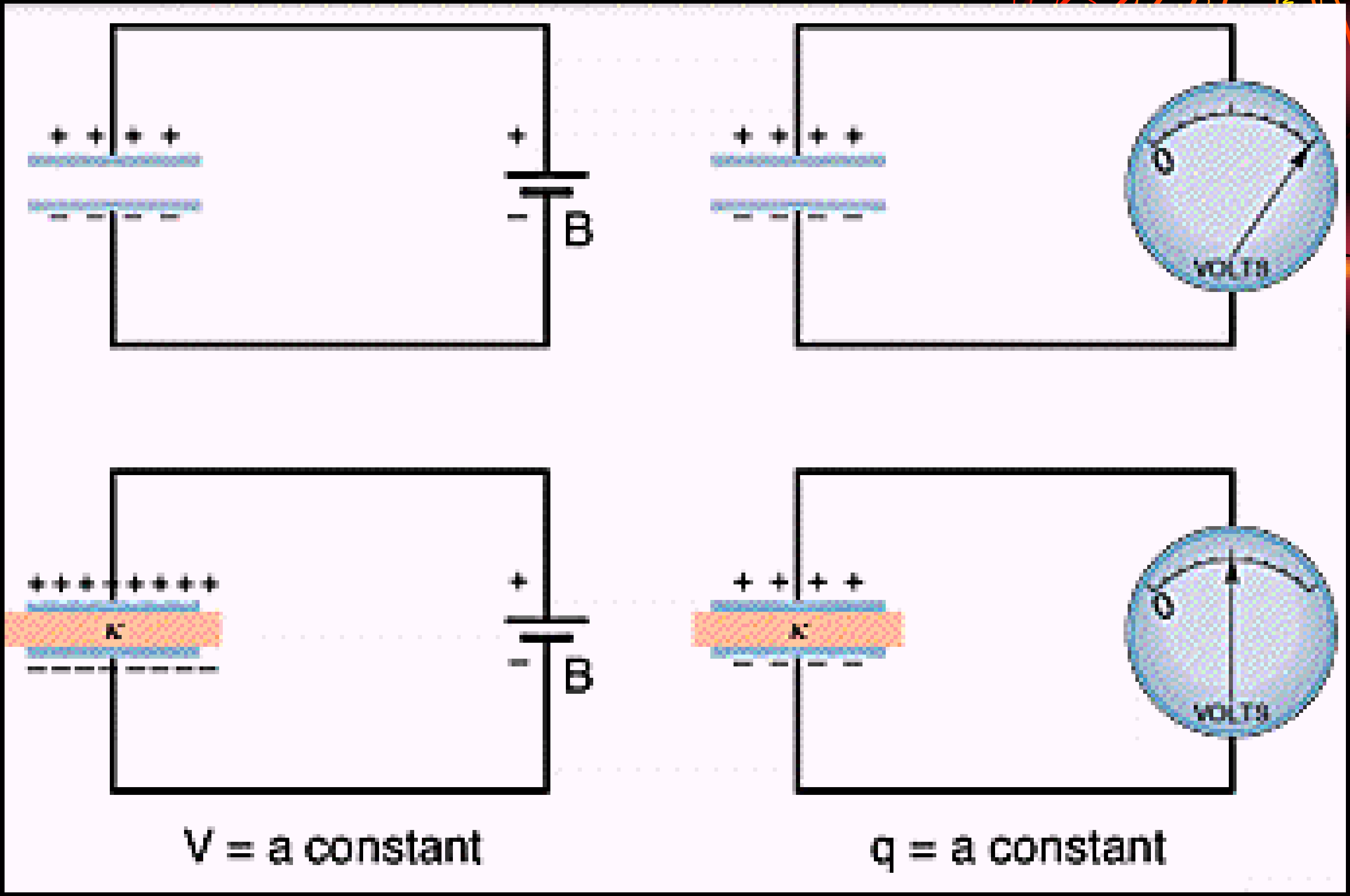
For a vacuum, κ = unity.

[a]Measured at room temperature, except for the water.

$$C_{air} = \varepsilon_0 L,\ C = \kappa C_{air} = \kappa \varepsilon_0 L$$

$$E = \frac{1}{4\pi\kappa\varepsilon_0}\frac{q}{r^2},\ E = \frac{\sigma}{\kappa\varepsilon_0}$$





B
0
VOLTS
B
0
VOLTS
V = a constant
q = a constant

SP26-7 A porcelain slab as the dielectric

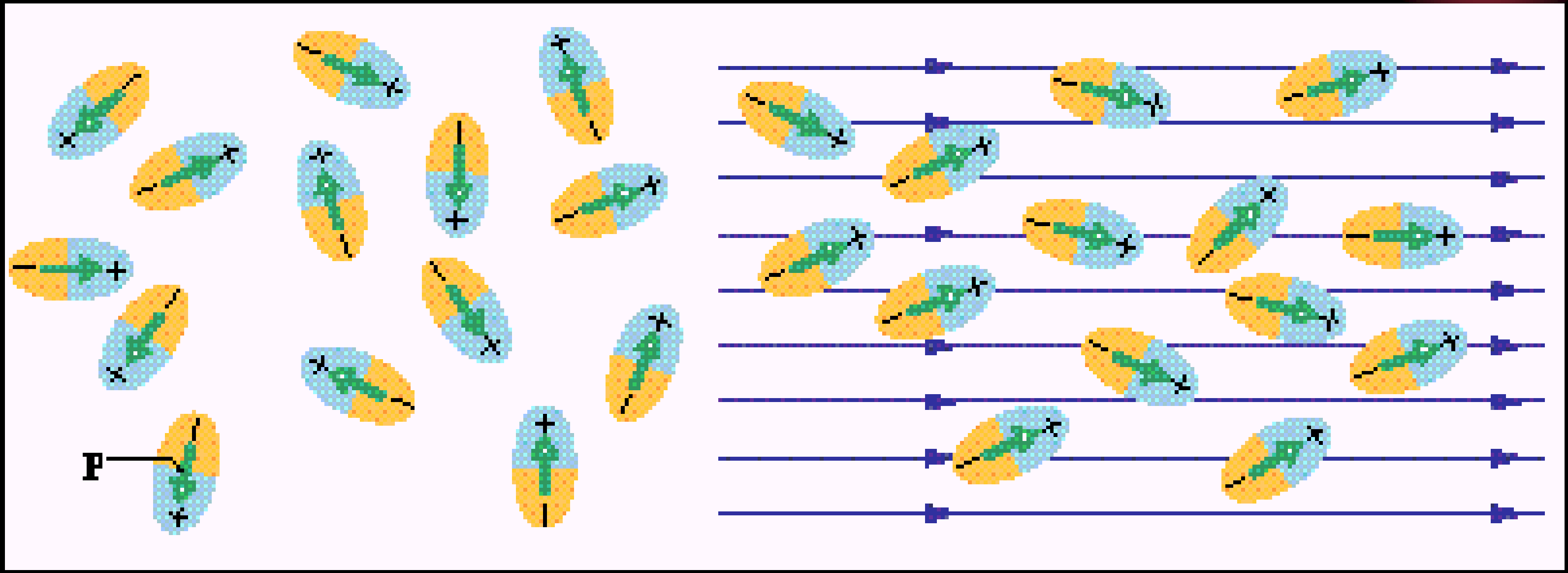
$$U_i = \frac{1}{2}CV^2 = 1055\,pJ = \frac{q^2}{2C}$$

$$U_f = \frac{q^2}{2\kappa C} = \frac{U_i}{\kappa} = 162\,pJ$$

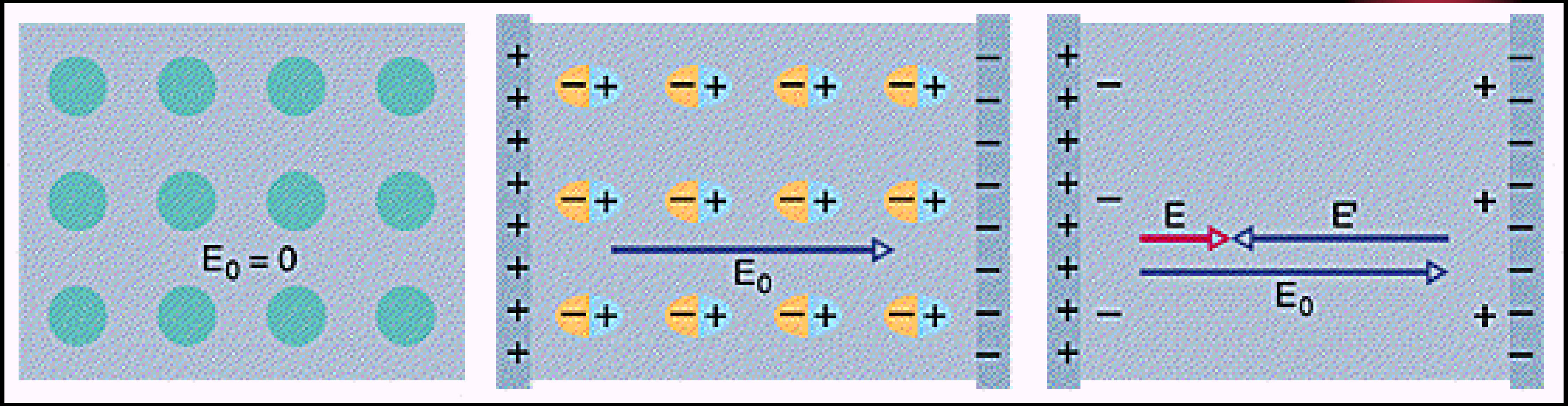
$$W = U_i - U_f = 893\,pJ$$

26-7 Dielectrics: An Atomic View

- Polar and Nonpolar Dielectrics



- **The resultant electric field is weakened**



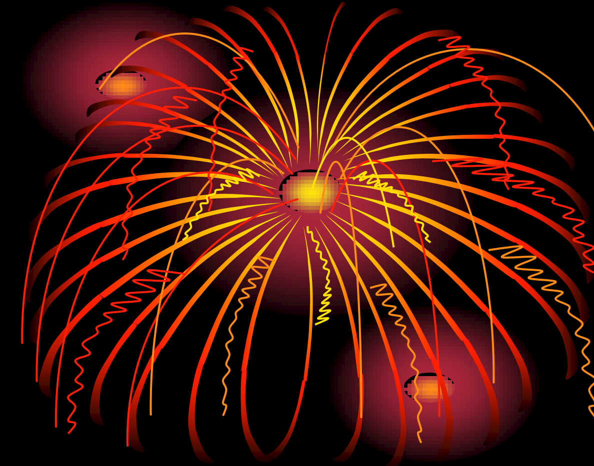
26-8 Dielectrics and Gauss' Law

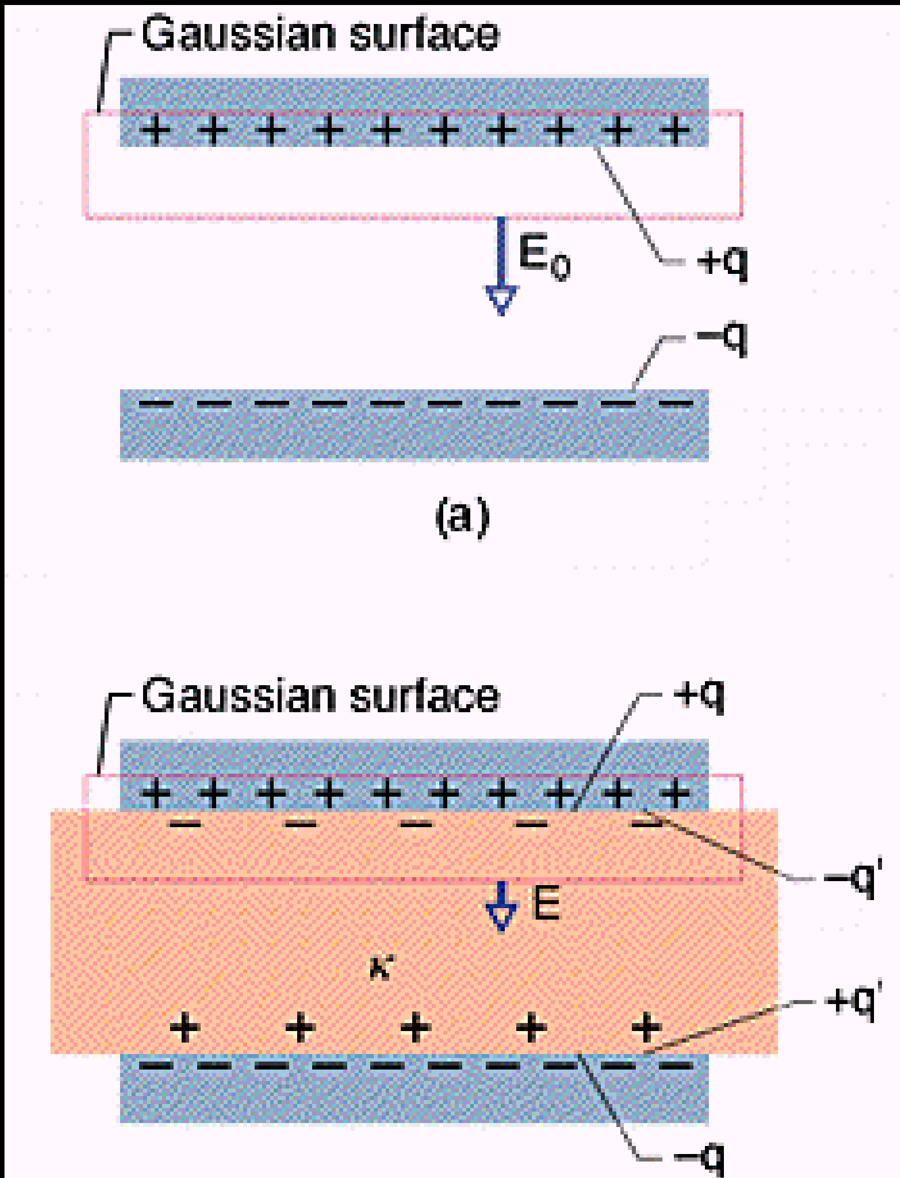
- **Without and with Dielectrics**

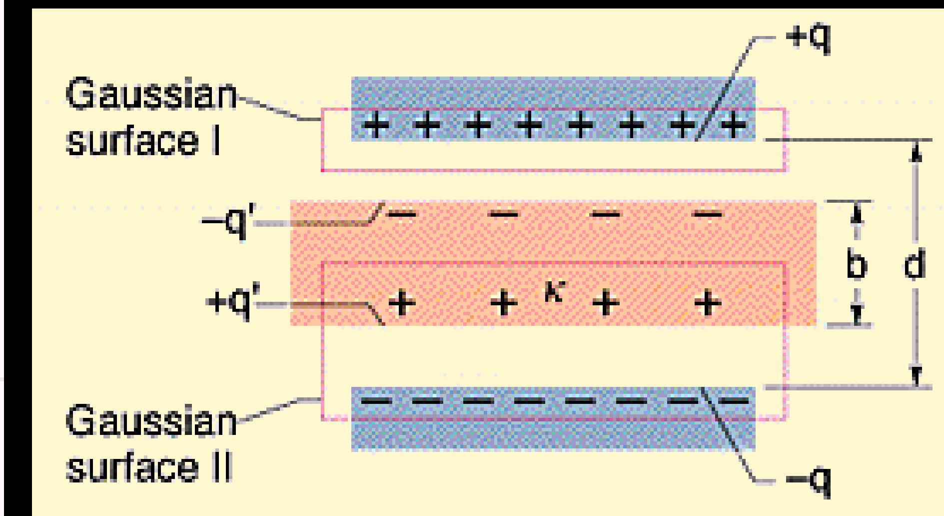
$$\varepsilon_0 \oint \vec{E} \cdot d\vec{A} = \varepsilon_0 E_0 A = q \rightarrow E_0 = \frac{q}{\varepsilon_0 A}$$

$$\varepsilon_0 \oint \vec{E} \cdot d\vec{A} = \varepsilon_0 E A = q - q' \rightarrow E = \frac{q - q'}{\varepsilon_0 A}$$

$$E = \frac{E_0}{\kappa} = \frac{q}{\kappa \varepsilon_0 A} \rightarrow q - q' = \frac{q}{\kappa}$$




Gaussian surface
+q
E0
−q
(a)
Gaussian surface
+q
−q'
E
κ
+q'
−q


+q
Gaussian
surface I
−q'
+q'
κ
b
d
Gaussian
surface II
−q

❖ Gauss' Law revised

$$\varepsilon_0 \oint \vec{E} \cdot d\vec{A} = \varepsilon_0 EA = q - q' = \frac{q}{\kappa}$$

$$\varepsilon_0 \oint \kappa\vec{E} \cdot d\vec{A} = q \quad \text{or} \quad \oint \vec{D} \cdot d\vec{A} = q$$

$\vec{D}$ the electric displacement