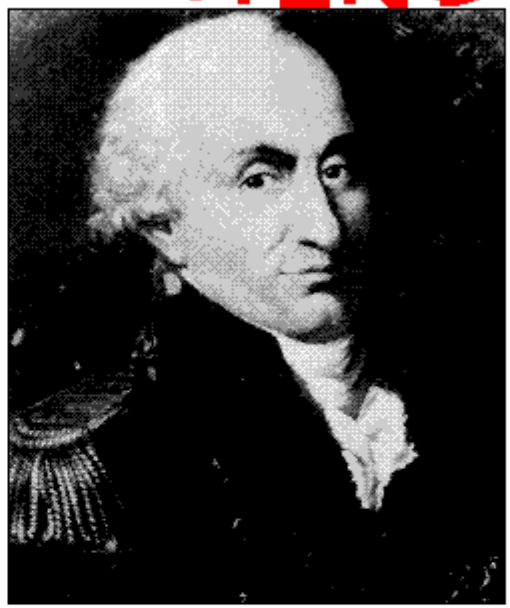
Physics 114 - Jan. 26, 2006

OUR HERO !

Last time:

$$\vec{F} = \frac{k q_1 q_2}{r^2} \hat{r}$$

Coulomb's Law



Charles Coulomb (1736-1806)

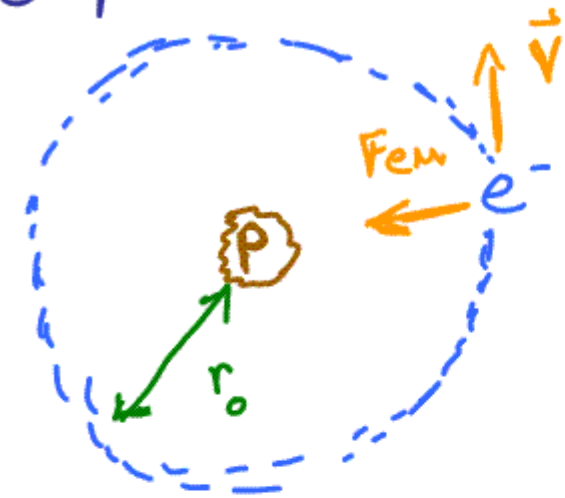
French military engineer

Also credited with

$|\vec{F}_{friction}| \propto$ (normal force)

k often written as $\frac{1}{4\pi\epsilon_0}$

The power of Coulombs Law



$$F_{em} = \frac{mv^2}{r_o}$$

$$\| $$

$$\frac{ke^2}{r_o^2}$$

→ Solve for v

gives us KE of ground STATE e^- in H atom

$KE = \frac{1}{2}mv^2$

$= 13.6\ eV$

move To ∞

How Much work done?

Measured Value = 13.6 eV

$$W = \int_{r_o}^{\infty} \vec{F} \cdot d\vec{r} = 26.9\ eV$$

initial E for e^-

↓

$- KE = 13.3\ eV$

$H_{ionization} = W_{to\ remove}$

- electric charge is conserved.

- Charge moves freely
  → Conductor
  Metal

- Charge does NOT move freely
  → insulator
  rubber

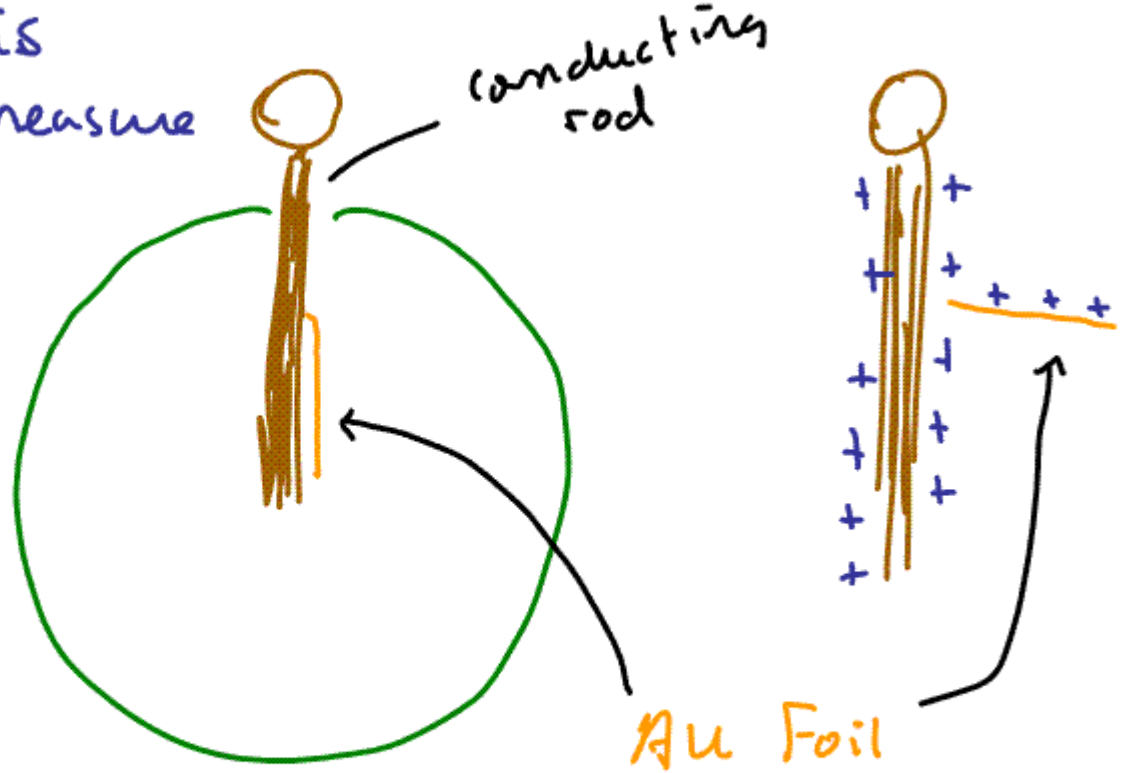
induced

Charge Separation

electric dipole

Electroscope

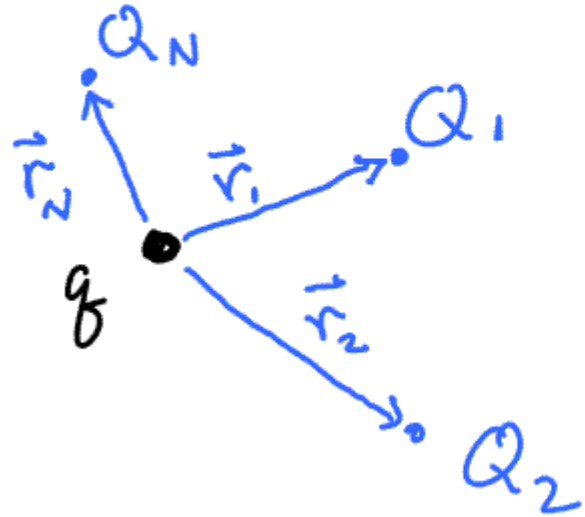
Can use this device to measure Amount of charge



Charge Distributes over rod and foil. Repulsion between like charge on rod and foil causes the thin foil to rise.

Series of discrete charges

$\vec{F}$ is a vector

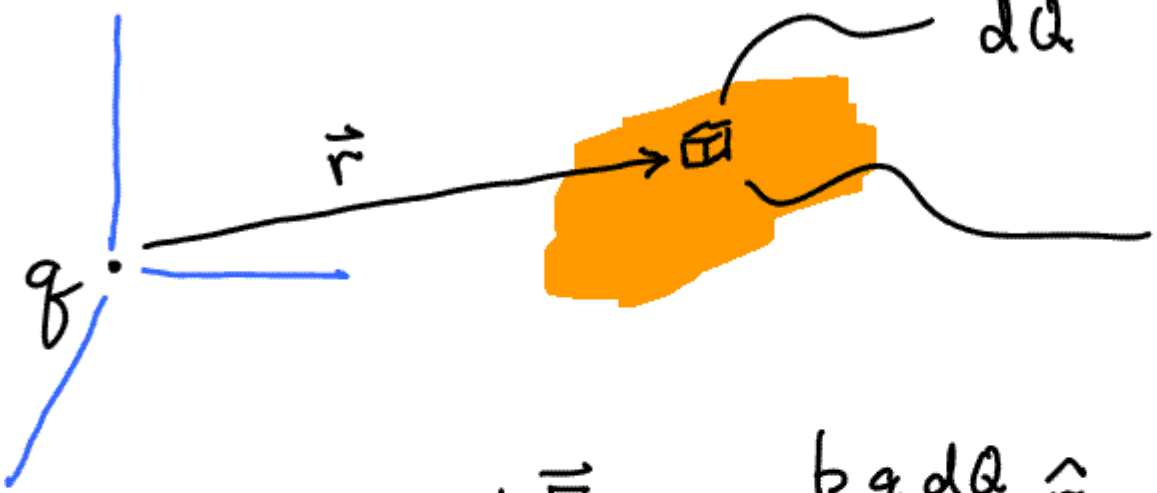


$$\vec{F}_{on\,q} = \vec{F}_{Q_1} + \vec{F}_{Q_2} + \cdots + \vec{F}_{Q_N}$$

$$\vec{F}_{on\,q} = \frac{kQ_1q}{r_1^2}\hat{r}_1 + \frac{kQ_2q}{r_2^2}\hat{r}_2 + \cdots$$

$$\cdots + \frac{kQ_Nq}{r_N^2}\hat{r}_N$$

Continuous Charge Distribution



$$dQ = \rho(\vec{r})\,dv$$

ρ : Volume Charge Density

$$d\vec{F}_{on\,q} = \frac{kq\,dQ}{r^2}\hat{r}$$

$$\vec{F}_{on\,q} = \int_{\text{charge volume}} \frac{kq\,dQ}{r^2}\hat{r} \;\rightarrow\; \int \frac{kq\,\rho(\vec{r})\,dv}{r^2}\hat{r}$$

$\rho \sim \text{Coul}/m^3$ Volume charge density – 3d

$\sigma \sim \text{Coul}/m^2$ Area charge density – 2d

$\lambda \sim \text{coul}/m$ Linear charge density – 1d

Pt charge

Electric Field

$$\vec{E} = \frac{\vec{F}}{q}$$ = Force/charge on test charge at that point