

# Electric Charge

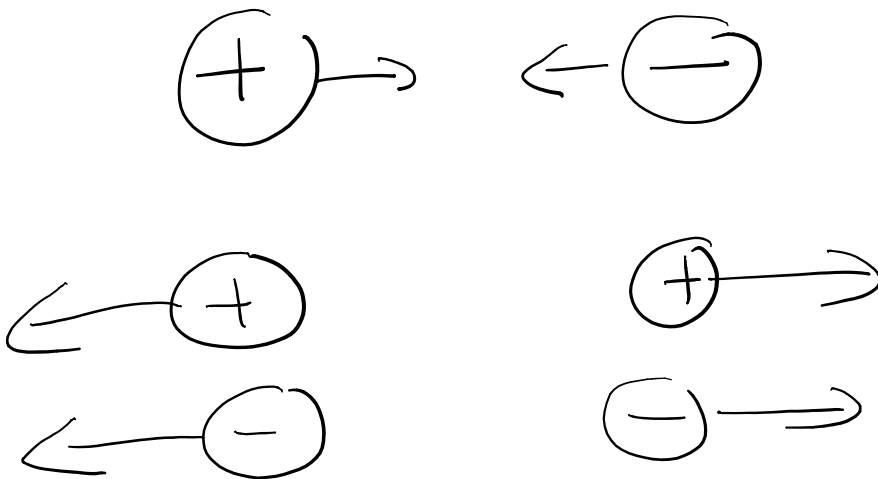
Gravitation

Electricity  
&  
Magnetism

Weak  
N. force

Strong N.  
force

Almost all the  
forces around us!



2 kinds  
of  
charge



Neutral systems  
are possible!

(Net) Electric Charge is conserved!

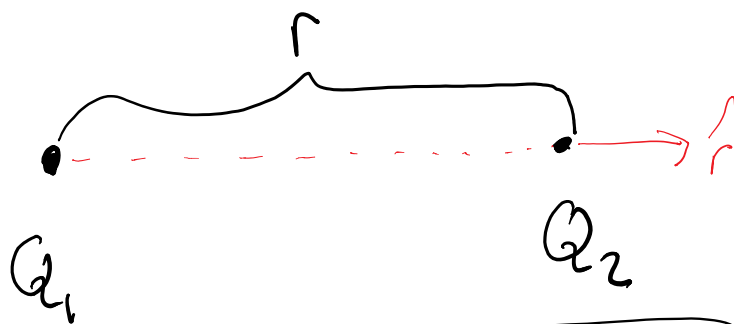
(Isolated) Electric charge is quantized!

$$Q = N e$$

$\downarrow$  Integer       $\downarrow$  charge of an electron.

This is very very small compared to macroscopic charge scales.

Force Between isolated point charges.



$$\vec{F} = \frac{1}{4\pi\epsilon_0} \frac{Q_1 Q_2}{r^2} \hat{r}$$

$$k \rightarrow \frac{1}{4\pi\epsilon_0}$$

$\epsilon_0 \rightarrow$  permittivity of free space

$\mu_0 \rightarrow$  similar constant for magnetism

**SPOILER!!**

$$\frac{1}{\sqrt{\mu_0 \epsilon_0}} = c$$

$\downarrow$   
speed of light!!

$$\vec{F} = \frac{1}{4\pi\epsilon_0} \frac{Q_1 Q_2}{r^2} \hat{r}$$

Coulomb's Law.

units  $[Q_1] \rightarrow \text{Coulomb} \rightarrow \text{New fundamental unit.}$

$$[\epsilon_0] = \frac{[Q_1][Q_2]}{[F][r^2]} = \frac{C^2}{Nm^2}$$

$$\epsilon_0 = 8.85 \cdot 10^{-12} \frac{C^2}{Nm^2}$$

Electrical forces are  
Additive

Superposition principle

