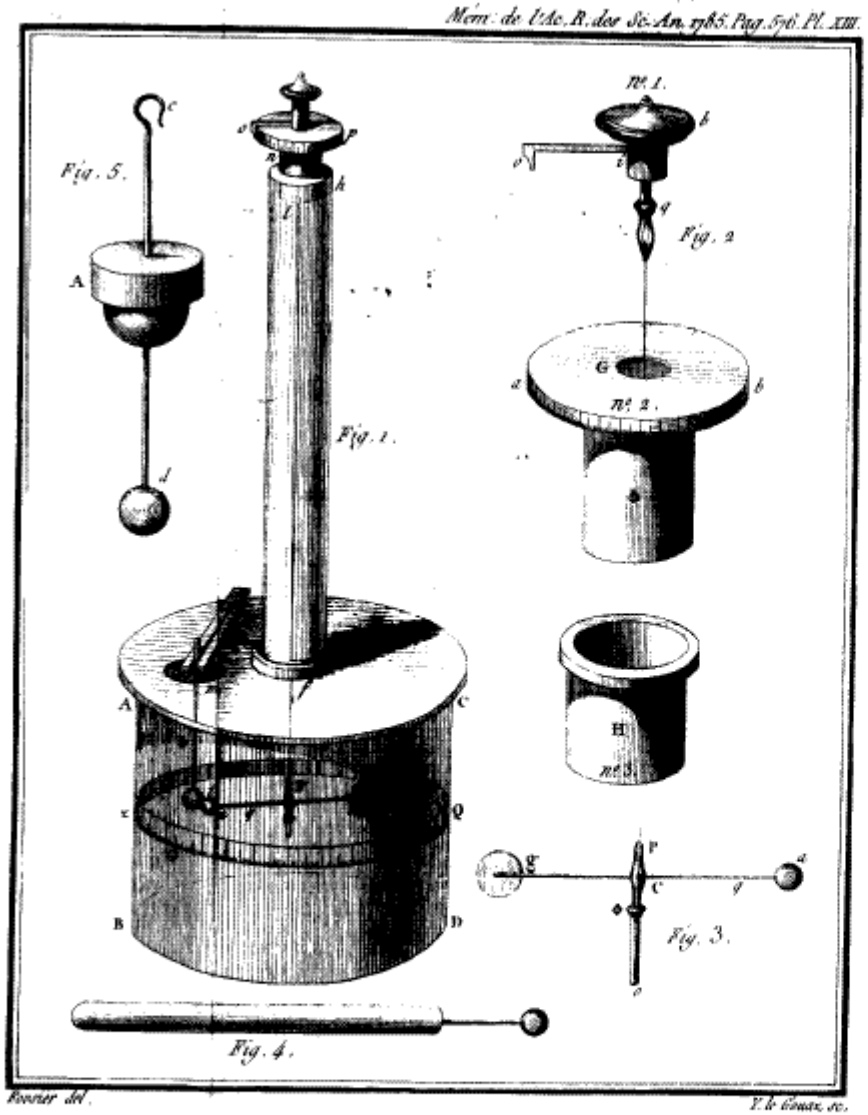
Physics 142 - Sept 2, 2008

Electric charge

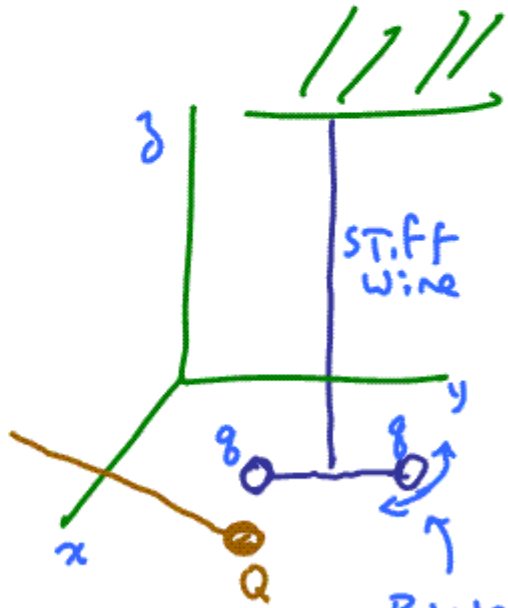
repulsion + Attraction → 2 types of charge

Charles Augustin Coulomb (1736 - 1806)

Coulomb's Law ~1785

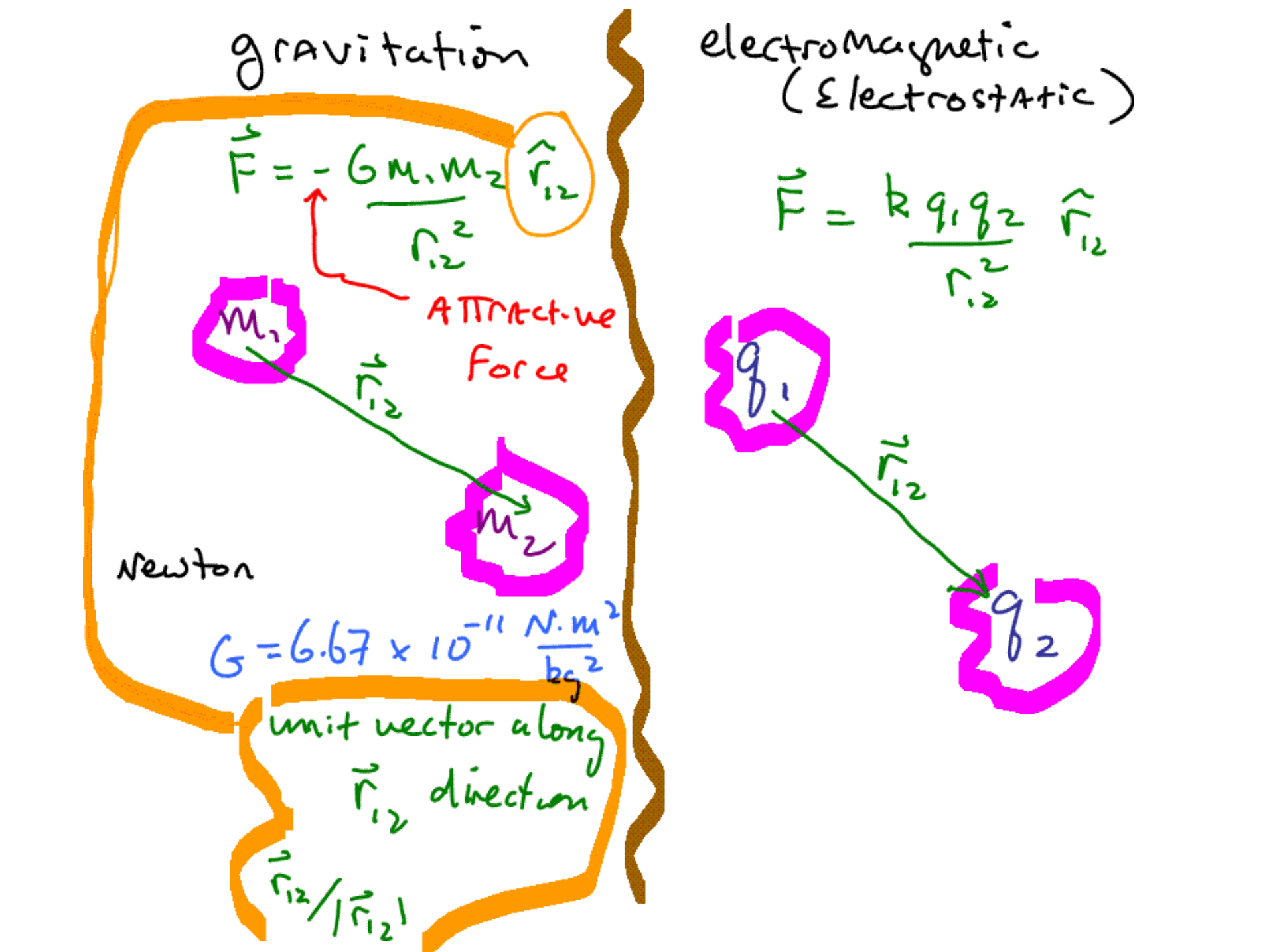


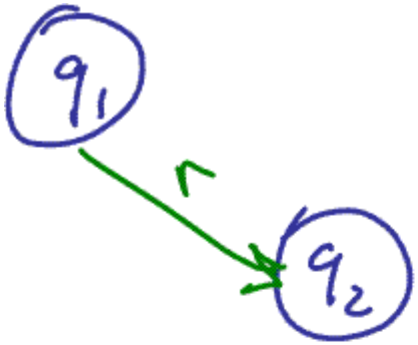
Torsion Balance



$F \propto \frac{q_1 q_2}{r^2}$

Period of oscillation depends on force


gravitation
$\vec{F} = -\frac{G m_1 m_2}{r_{12}^2} \hat{r}_{12}$
attractive force
m_1
$\vec{r}_{12}$
m_2
Newton
$G = 6.67 \times 10^{-11} \frac{N \cdot m^2}{kg^2}$
unit vector along $\vec{r}_{12}$ direction
$\vec{r}_{12}/|\vec{r}_{12}|$
electromagnetic
(Electrostatic)
$\vec{F} = k \frac{q_1 q_2}{r_{12}^2} \hat{r}_{12}$
q_1
$\vec{r}_{12}$
q_2



$$\vec{F}_{12} = \frac{k q_1 q_2}{r^2} \hat{r}$$

MKS — meter, kg, seconds

F in Newtons

r in meters

q in Coulombs

Coulomb ≡ C ≡ Coul

k CONSTANT → sets scale

$$= 8.99 \times 10^9 \frac{N M^2}{C^2}$$

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

$$\epsilon_0 = 8.85 \times 10^{-12} \frac{C^2}{N M^2}$$

Think Vacuum

→ Permittivity of Free Space

Electric charge is Conserved

Electric charge is quantized

$\pm |e| = \pm 1.6 \times 10^{-19}$ Coul ~ electric charge on electron

$|q| = \pm \frac{2}{3}, \pm \frac{1}{3}$ quarks

qqq Baryon proton, neutron

$q\bar{q}$ Meson

up
down
strange
charm
top
bottom