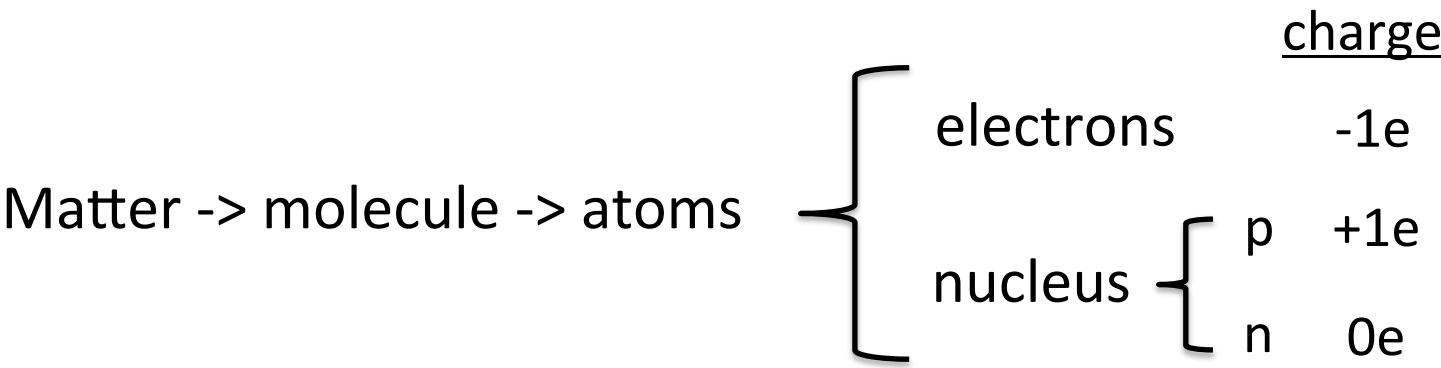
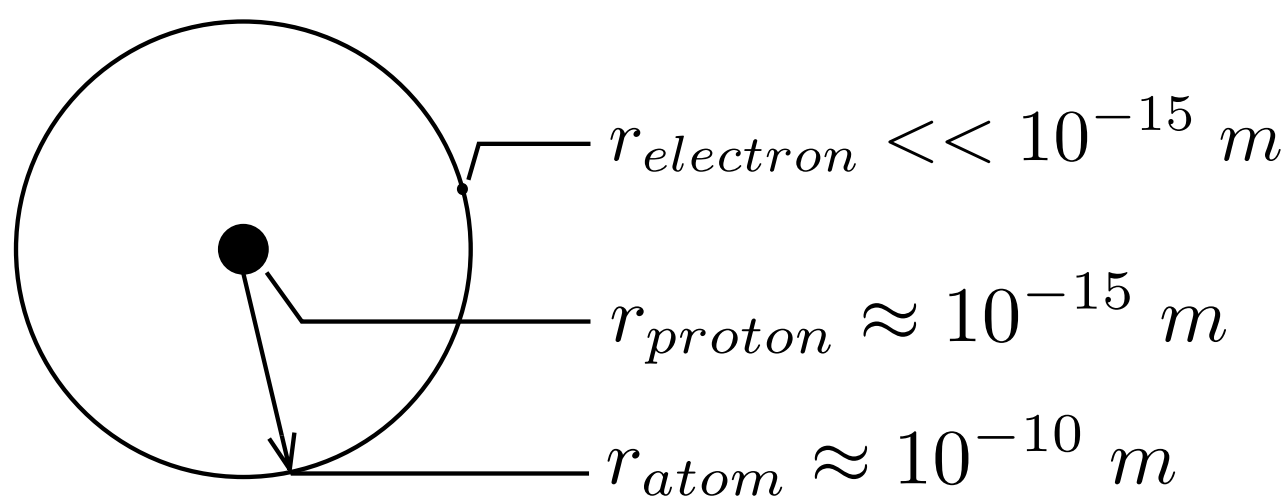


Lecture 2

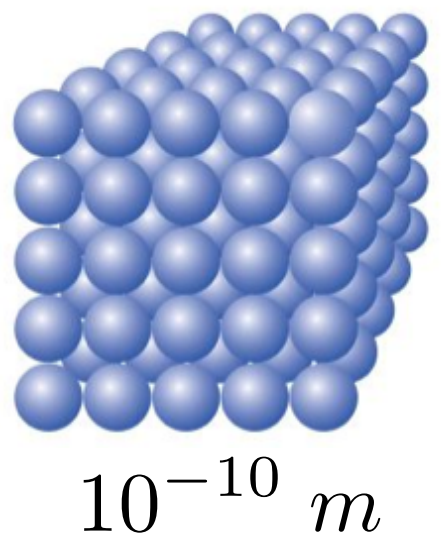
Electrical Charge. Charge is a property of the building block of matter.



$$e = 1.6 \times 10^{-19} \text{ C}$$



Lattice Spacing:



$$F = \frac{kq_1q_2}{r^2}$$

$$k = \frac{1}{4\pi\epsilon_0} \approx 9 \times 10^9 \frac{Nm^2}{C^2}$$

$$\epsilon_0 = \frac{1}{4\pi k} = 8.85 \times 10^{-12} \frac{C^2}{Nm^2}$$

k is the conversion factor: $1 \frac{C^2}{m^2} = 9 \times 10^9 N$

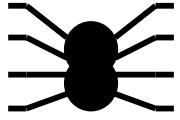
Electric Field

a. Causal Description

Coulombs law is a description of action at distance.
(acausal description)

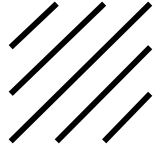
A causal description can be achieved in 2 steps.

Spider-Fly Analogy



Q

Source charge



E

Field



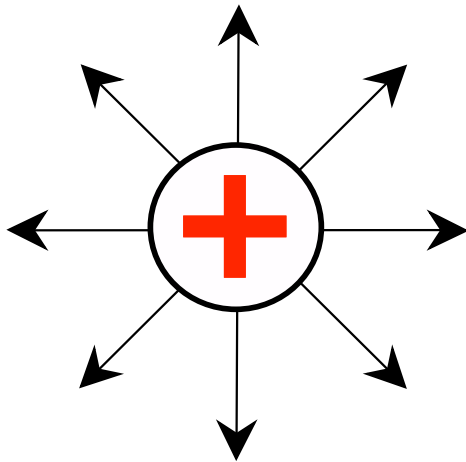
q

Test charge

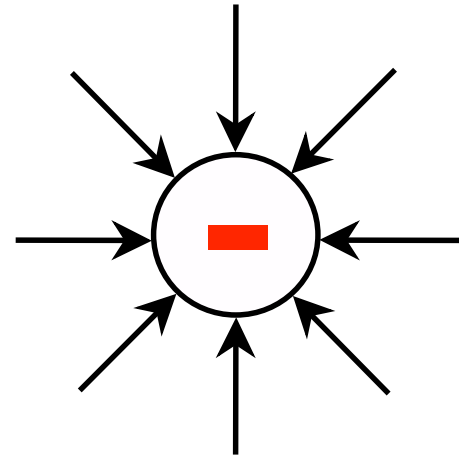
Attraction between spiders and fly

$$F = \left(\frac{kQ}{r^2} \right) q \equiv Eq$$
$$E = \frac{F}{q}$$

Description of the field: Field line



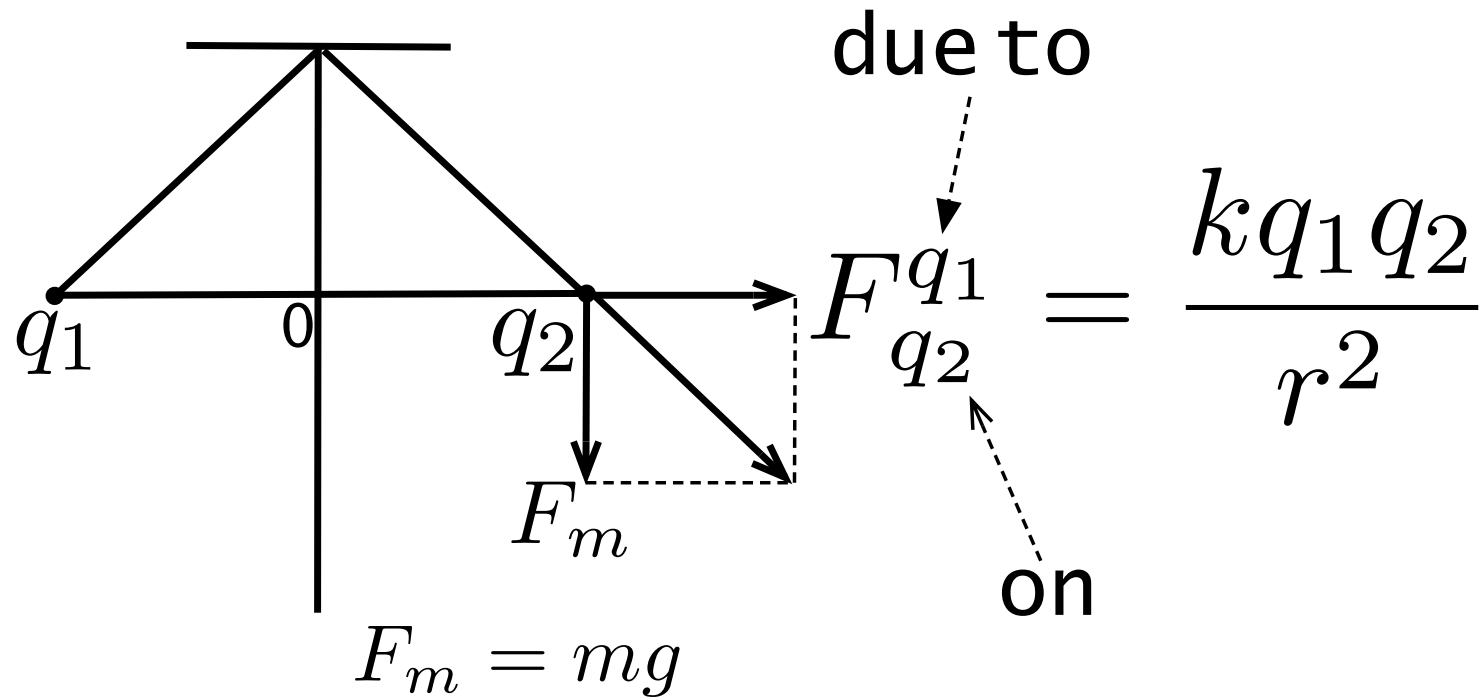
Positive charges a source of field lines



Negative charges a source of field lines

Electric Force Vectors

Combine gravitational force vector with electric force:



Adding electric force vector to gravitational force vector.

$$\vec{F} = \frac{kq_1q_2}{r^2}\hat{r} = \vec{E}q_2 \qquad \vec{E} = \frac{kq_1}{r^2}\hat{r}$$

Notice E depends on the source charge q_1 and the position of the observation point in relation to the source charge, r . E is independent of q_2 .