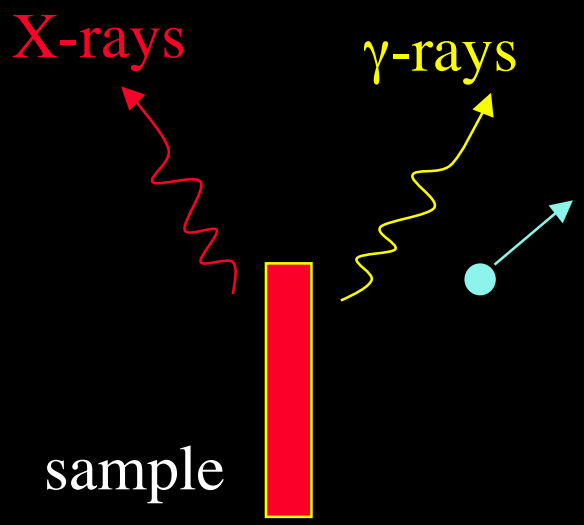
Fast ions

Different processes



The name of the -technique- depends on which "product" one uses as a probe.

Processes

Nuclear and Electron Scattering & Reactions

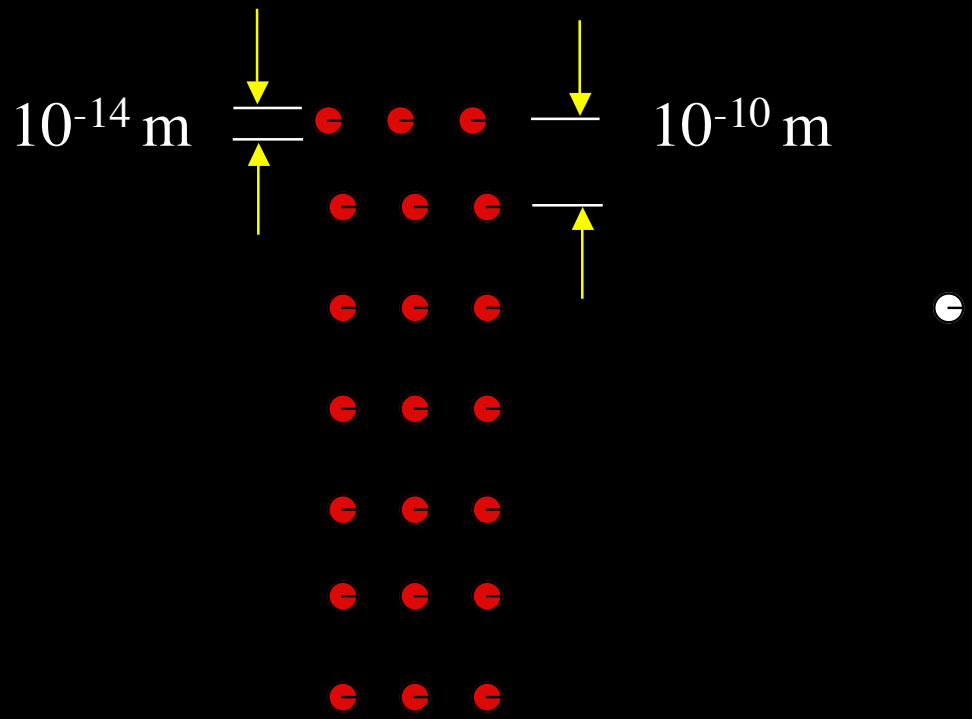
Parameters

Speed
Charge state
Mass

Mass

He - 4 u
Nuclei - 1 to 250 u
Electrons 0.00055 u

"Light" ion ($M_{ion} < M_{target}$)



Initial energy=
E_{in}

CLASSICAL
MECHANICS

$R_{nuclei} \approx 1.2\ 10^{-15}\ A^{1/3}$ m

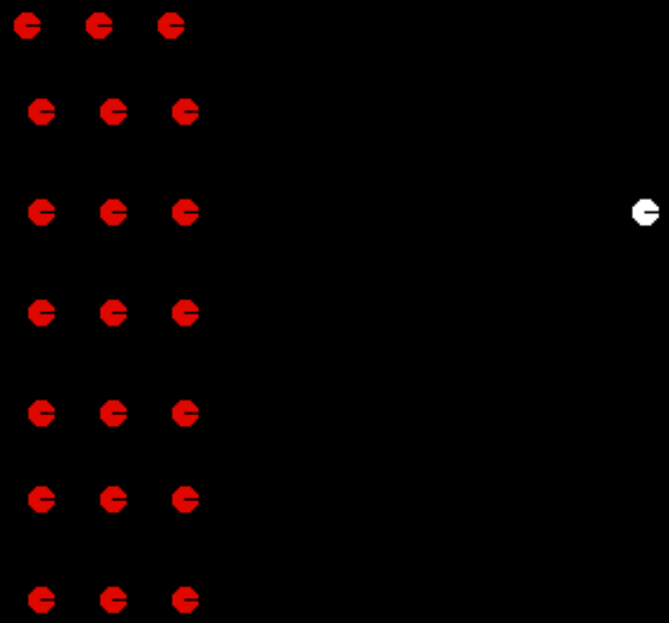
mass target = 20

mass ion =4

“Light” ion ($M_{ion} < M_{target}$)

Initial energy= E_{in}

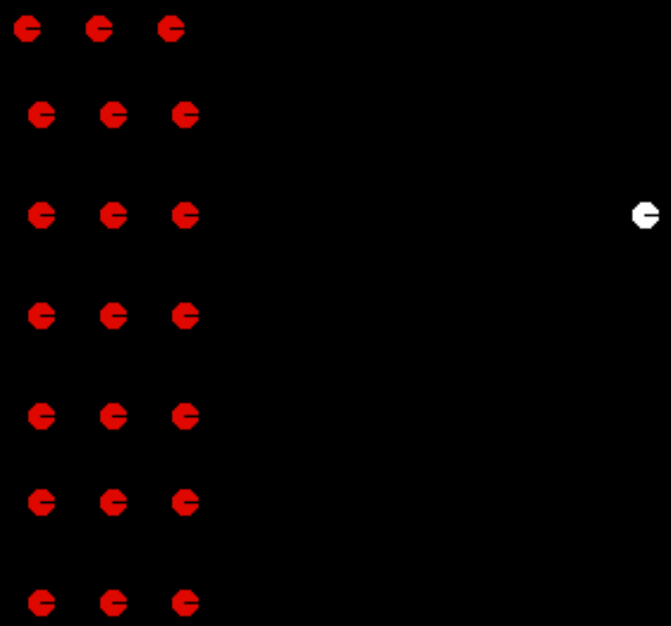
CLASSICAL MECHANICS



mass target = 20

mass ion =4

“Heavy” ion ($M_{ion} > M_{target}$)

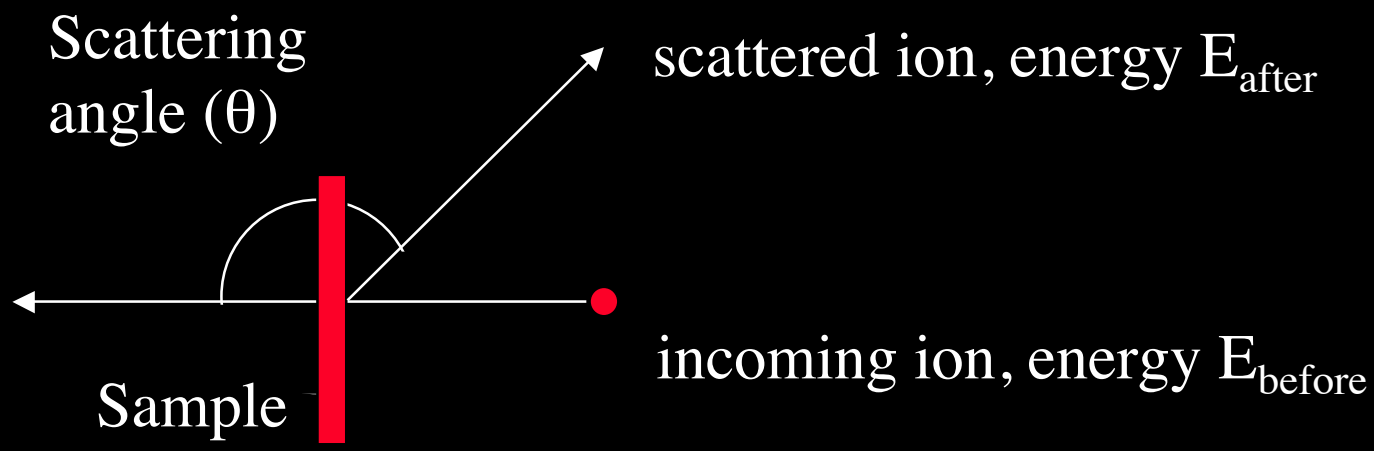


mass target = 20

mass ion =40

Scattering from a surface layer

$$E_{after} = k\, E_{before}$$



$$k = \left[\frac{\sqrt{M_{sample}^2 - M_{ion}^2 (\sin\theta)^2} + M_{ion}\cos(\theta)}{M_{ion} + M_{sample}} \right]^2$$

The energy of the ion

- The energy of the scattered ion can be calculated and measured EXACTLY!
- The probability of scattering depends on the energy of the incoming ions, for He below 2 MeV, we have the Rutherford region.

(Rutherford or Coulomb region => elastic nuclear collisions)

The probability of scattering

$$\frac{d\sigma}{d\Omega} \propto \left[\frac{Z_{ion} Z_{sample}}{E_{ion}} \right]^2$$

Electron and nuclear contributions to the scattering