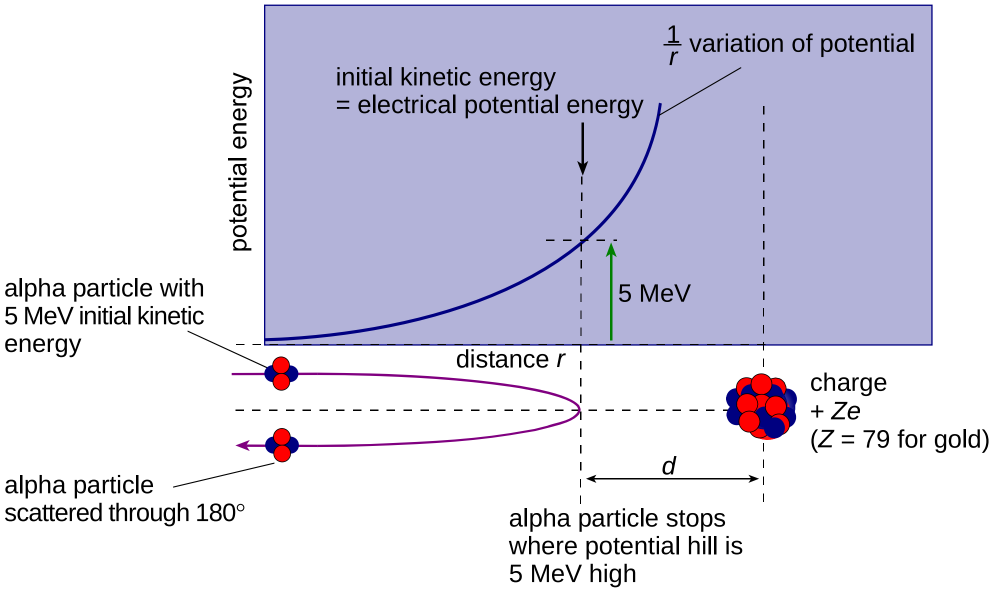
TAP 522-2: Distance of closest approach

Distance of closest approach



Where does the alpha particle stop?

Initial kinetic energy

= 5 MeV

$= 5 \times 10^{6}\ \text{eV} \times 1.6 \times 10^{-19}\ \text{J eV}^{-1}$

$= 8.0 \times 10^{-13}\ \text{J}$

Electrical potential energy

$$V = \frac{+2\,Ze^2}{4\pi\varepsilon_0 d}$$

$Z = 79$, $e = 1.6 \times 10^{-19}$ C,

$\varepsilon_0 = 8.9 \times 10^{-12}\ \text{C}^2\ \text{N}^{-1}\ \text{m}^{-2}$

Alpha particle stops where

initial kinetic energy = electrical potential energy

$$8.0 \times 10^{-13}\ \text{J} = \frac{+2\,Ze^2}{4\pi\varepsilon_0 d}$$

substitute values of Z, e, ε_0:

$$d = 4.5 \times 10^{-14}\ \text{m}$$

Radius of gold nucleus must be less than of the order of 10^{-14} m

Atoms are 10 000 times larger than their nuclei

Practical advice

The diagram could be used as an OHT and discussed in class

External reference

This activity is taken from Advancing Physics chapter 17, 130O