

(10.5) Alpha-particles from ^{218}Po (E_α 6.0 MeV) are used to bombard a gold foil. (a) How close to the gold nucleus can these particles reach? (b) What is the nuclear radius of gold according to the radius-mass relation ($r_0 = 1.3$ (fm))?

(a) Use eqns (10.12) and (10.13):

$$\epsilon_0 := 8.8541878 \cdot 10^{-12} \cdot \frac{\text{coul}}{\text{volt} \cdot \text{m}} \quad q_e := 1.6021773 \cdot 10^{-19} \cdot \text{coul} \quad \text{barn} := 10^{-28} \cdot \text{m}^2$$

$$k := \frac{1}{4 \cdot \pi \cdot \epsilon_0} \quad k \text{ in eqn. (10.13)} \quad u_n := 1.660540 \cdot 10^{-27} \cdot \text{kg} \quad \text{MeV} := 1.60217733 \cdot 10^{-13} \cdot \text{joule}$$

$$r_0 := 1.3 \cdot 10^{-15} \cdot \text{m}$$

$$Z_\alpha := 2 \quad Z_{Au} := 79 \quad A_{Au} := 197 \quad m_{Au} := 196.97 \cdot u_n$$

$$m_\alpha := (4.002603 - 2 \cdot 5.4857990 \cdot 10^{-4}) \cdot u_n \quad \text{Mass of He minus two electrons}$$

$$E_\alpha := 6 \cdot \text{MeV} \quad E_\alpha = 9.613 \cdot 10^{-13} \cdot \text{joule} \quad E_{CM} := \frac{E_\alpha \cdot m_{Au}^2}{(m_\alpha + m_{Au})^2}$$

$$x := \frac{k \cdot Z_{Au} \cdot Z_\alpha \cdot q_e^2}{E_{CM}} \quad \text{From eqn. (10.17)} \quad x = 3.948 \cdot 10^{-14} \cdot \text{m}$$

$$(b) \quad r_{Au} := r_0 \cdot A_{Au}^{\frac{1}{3}} \quad \text{Eqn. (4.14)} \quad r_{Au} = 7.564 \cdot 10^{-15} \cdot \text{m}$$