

49. Let the distance in question be r . The initial kinetic energy of the electron is $K_i = \frac{1}{2}m_e v_i^2$, where $v_i = 3.2 \times 10^5$ m/s. As the speed doubles, K becomes $4K_i$. Thus

$$\Delta U = \frac{-e^2}{4\pi\epsilon_0 r} = -\Delta K = -(4K_i - K_i) = -3K_i = -\frac{3}{2}m_e v_i^2 ,$$

or

$$\begin{aligned} r &= \frac{2e^2}{3(4\pi\epsilon_0)m_e v_i^2} = \frac{2(1.6 \times 10^{-19} \text{ C})^2 \left(8.99 \times 10^9 \frac{\text{N}\cdot\text{m}^2}{\text{C}^2}\right)}{3(9.11 \times 10^{-31} \text{ kg})(3.2 \times 10^5 \text{ m/s})^2} \\ &= 1.6 \times 10^{-9} \text{ m} . \end{aligned}$$