(16.2) Assume a linear accelerator is built in three sections, each with 30 stages of 100 kV. Between which sections should a thin carbon stripper foil be placed in order to achieve the highest final energy, when accelerating ^{84}Kr ions from an ion source emitting low energy $^{84}Kr^{4+}$ ions? Consider only the nearest integer charge after stripping.

Basic definitions:

$MeV := 1.602177 \cdot 10^{-13} \cdot joule$ $\quad amu := 1.660540 \cdot 10^{-27} \cdot kg$

Assume that the velocities are small compared to the speed of light. Hence we can use $E_{kin} = (1/2) m_0 v^2$

$z := 4$ $\quad E_{acc} := 0.1 \cdot MeV$ $\quad n_{stages} := 30$ $\quad Z := 36$

$E_1 := n_{stages} \cdot z \cdot E_{acc}$ Eqn. (16.1)

$E_1 = 12 \cdot MeV$ $\quad v_1 := \sqrt{\frac{2 \cdot E_1}{(84 - 4 \cdot 0.0055) \cdot amu}}$ Remember that we must subtract the missing e^- mass (4+ ions)

$v_1 = 5.251 \cdot 10^6 \cdot m \cdot sec^{-1}$

1. assume stripper after first section and use eqn. (16.2) to compute average charge after stripper foil:

$$z_2 := Z \cdot \left[1 + \left[\frac{v_1}{3.6 \cdot 10^6 \cdot \frac{m}{(sec)} \cdot Z^{0.45}} \right]^{-1.67} \right]^{-0.6} \qquad z_2 = 9.72$$

Nearest integer charge is 10.

$z_2 := 10$

$E_{123} := 2 \cdot \left(n_{stages} \cdot z_2 \cdot E_{acc} \right) + E_1$ $\quad E_{123} = 72 \cdot MeV$

2. assume stripper after second section:

$E_2 := \left(n_{stages} \cdot z \cdot E_{acc} \right) \cdot 2$ $\quad E_2 = 24 \cdot MeV$

$v_2 := \sqrt{\frac{2 \cdot E_2}{(84 - 4 \cdot 0.0055) \cdot amu}}$ $\quad v_2 = 7.426 \cdot 10^6 \cdot m \cdot sec^{-1}$

$$z_3 := Z \cdot \left[1 + \left(\frac{v_2}{3.6 \cdot 10^6 \cdot \frac{m}{sec} \cdot Z^{0.45}} \right)^{-1.67} \right]^{-0.6} \qquad z_3 = 13.074$$

Nearest integer charge is 13.

$z_3 := 13$

$E_{123} := \left(n_{stages} \cdot z_3 \cdot E_{acc} \right) + E_2$ $\quad E_{123} = 63 \cdot MeV$

Answer: Between first and second section.