Answer on Question #75411-Physics-Quantum Mechanics

Consider nuclei with small mass number A such that N = Z =A/2. Neglecting pairing term (∈) show that semi-empirical formula is given by

BE/A = α −βA(to the power -1/3)− δA(to the power 2/3) / 4.

Obtain the value of A and Z for which binding energy per nucleon (BE / A) is maximum. Take β = 17 ,8. δ = 71.0 .

Solution

Binding energy per nucleon (BE / A) is maximum when

$$\frac{d}{dA}\left(\frac{\mathrm{BE}}{\mathrm{A}}\right) = 0$$

$$\frac{d}{dA}\left(\alpha - \beta \mathrm{A}^{-\frac{1}{3}} - \frac{\delta \mathrm{A}^{\frac{2}{3}}}{4}\right) = -\left(-\frac{1}{3}\right)\beta \mathrm{A}^{-\frac{1}{3}-1} - \left(\frac{2}{3}\right)\frac{\delta \mathrm{A}^{\frac{2}{3}-1}}{4} = 0$$

$$\left(\frac{1}{3}\right)\beta - \left(\frac{2}{3}\right)\frac{\delta \mathrm{A}}{4} = 0$$

$$A = \frac{2\beta}{\delta} = 2\left(\frac{17.8}{71.0}\right) = 0.5$$

$$Z = \frac{0.5}{2} = 0.25.$$