

Homework 4, due 10-2

Consider the semi-empirical formula for the binding energy

$$B = a_V A - a_{sur} A^{2/3} - a_{sym} \frac{(Z - A/2)^2}{A} + a_C \frac{Z^2}{A^{1/3}} \pm \delta,$$

with $a_V = 15.75$ MeV, $a_{sur} = 17.80$ MeV, $a_{sym} = 94.76$ MeV and $a_C = 0.71$ MeV. Ignore the pairing energy δ .

1. Give a general formula for the nuclear charge Z of the most tightly bound nucleus with a given A . What is the nuclear charge Z for mass number $A = 56$ and $A = 208$?
2. Find the condition for α instability,

$$(A, Z) \rightarrow (A - 4, Z - 2) + \alpha$$

For what mass number A do nuclei become unstable towards α emission?

3. Find the condition for (symmetric) spontaneous fission,

$$(A, Z) \rightarrow (A/2, Z/2) + (A/2, Z/2).$$

For what mass number A do nuclei become unstable towards fission?