

Exercises spring 2015 PHY981

Spring 2015

Exercise 1

Masses and binding energies. The data on binding energies can be found in the file `bedata.dat` at the github address of the course, see <https://github.com/NuclearStructure/PHY981/tree/master/doc/pub/spdata/programs>

- Write a small program which reads in the proton and neutron numbers and the binding energies

and make a plot of all neutron separation energies for the chain of oxygen (O), calcium (Ca), nickel (Ni), tin (Sn) and lead (Pb) isotopes, that is you need to plot

$$S_n = BE(N, Z) - BE(N - 1, Z).$$

Comment your results.

- In the same figures, you should also include the liquid drop model results of Eq. (2.17) of Alex Brown's text, namely

$$BE(N, Z) = \alpha_1 A - \alpha_2 A^{2/3} - \alpha_3 \frac{Z^2}{A^{1/3}} - \alpha_4 \frac{(N - Z)^2}{A},$$

with $\alpha_1 = 15.49$ MeV, $\alpha_2 = 17.23$ MeV, $\alpha_3 = 0.697$ MeV and $\alpha_4 = 22.6$ MeV. Again, comment your results.

- Make also a plot of the binding energies as function of A using the data in the file on bindingenergies and the above liquid drop model. Make a figure similar to figure 2.5 of Alex Brown where you set the various parameters $\alpha_i = 0$. Comment your results.
- Use the liquid drop model to find the neutron drip lines for Z values up to 120.

Analyze then the fluorine isotopes and find, where available the corresponding experimental data, and compare the liquid drop model prediction with experiment. Comment your results.

A program example in C++ and the input data file `bedata.dat` can be found found at the github repository for the course, see <https://github.com/NuclearStructure/PHY981/tree/master/doc/pub/spdata/programs>