Physics 492 homework IV, due Fri Jan 31

Reading: Chapters 3, 4

Problems:

1. Williams, Problem 3.1. Calculate \( \langle r^2 \rangle \) for a uniformly charged sphere of radius \( R \). Verify the validity of the formula in 3.1 for the form factor of the sphere obtained in class. [\textit{Hint:} Use again an expansion.]

2. Williams, Problem 3.4.

3. Williams, Problem 4.1.

4. The Coulomb term in the semi-empirical mass formula is

\[
a_C Z^2/A^{1/3}.
\]

Using the result of Problem 4.1, calculate the value of \( a_C \) in MeV. Assume that the nuclear radius is given by \( R = 1.12 \times A^{1/3} \) fm.

Using \( a_V = 15.85 \) MeV, \( a_S = 18.34 \) MeV, and \( a_A = 23.22 \) MeV and the fact that the binding energy of \( ^{181}_{73}\text{Ta} \) is 1454 MeV, check your value of \( a_C \). Comment on any discrepancy you may find.

The nucleus \( ^{235}_{92}\text{U} \) can undergo spontaneous fission (see Ch. 5.5) and one of the many fission channels is

\[
^{235}_{92}\text{U} \rightarrow ^{87}_{35}\text{Br} + ^{145}_{57}\text{La} + 3\text{n}.
\]

Estimate the energy released in this channel. How do the surface and Coulomb energies contribute to the release? (This is modified Problem 4.2 in Williams.)

**Reminder!**

I should receive the topic of your term paper, with a brief description the planned content, on Monday, Feb. 3.