Physics 492 homework IV, due Fri Jan 31

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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. [*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 ${}^{181}_{73}$Ta is 1454 MeV, check your value of $a_C$. Comment on any discrepancy you may find.
The nucleus ${}^{235}_{92}$U can undergo spontaneous fission (see Ch. 5.5) and one of the many fission channels is

$${}^{235}_{92}\mathrm{U} \rightarrow {}^{87}_{35}\mathrm{Br} + {}^{145}_{57}\mathrm{La} + 3\mathrm{n} \, .$$

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.