

## Homework # 5; due Wednesday, March 28

Reading: Chapter 6 of Boecker and Grondelle's *Environmental Physics*

13. In nuclear power, we get on the order of 100 MeV of energy per one atom of fuel, whereas for chemical fuel, we get roughly 1 eV per atom. How does hydroelectric power rank in this comparison? (Please estimate the order of magnitude of energy per water molecule that can be generated.)
14. Estimate the height of the potential barrier due to the Coulomb repulsion that the nuclei of two hydrogen isotopes have to overcome before they can fuse. Explain how this is accomplished in a thermonuclear reactor.
15.
  - a. Write down possible fusion reactions involving two deuterium nuclei ( $^2\text{H}$ ). Is  $^4\text{He}$  formed in any of these reactions? Why?
  - b. Using the facts that  $\sim 3\text{-}4$  MeV of energy is released in each fusion process from part (a) and that ocean water contains  $\sim 150$  ppm of deuterium (i.e., per one million hydrogen atoms, about 150 are deuterium), and making a highly optimistic assumption that someday we will learn to conduct highly efficient controlled thermonuclear reactions, estimate the volume of water we will need to use per year to supply the entire humankind with power.