Homework Set 1

Due: March 9, 2015, *before class*

1. **Energy Generation**

   (a) **Compute the specific energy generation rate of the Sun as a whole.**

   (b) **Assume a human of weight 100 kg has a "luminosity" of 100 W.**
   Compute the specific energy generation rate of a this human.

   (c) **Compare the results from (a) and (b).**

   (d) Modern micoprocessors have now reached a "gate width" of 18 nm. Assume this corresponds to the thickness of the "active" layer that contains micoprocessors and density of silicon of 2.33 g/cm^3. The typical die size is about 100 mm^2 and they have a power up about 100 W.
   What is the specific energy generation rate of the active layer?

   (e) **How long does it take for the "active" layer of the CPU to release as much energy as its rest mass?**

   (f) **What happens when you run your computer that long – having converted the rest mass of the "active" layer into energy?**

   (g) **What is the specific energy generation rate corresponding to an element of mass radiating away its entire rest mass in 1 s?**

   (h) Assume a characteristic chemical energy content of 10 eV per nucleon, and a characteristic nuclear energy content of 10 MeV per nucleon.
   Compute the energy content (supply) of the sun for each of these assumptions. How long could the sun shine at its current luminosity from each of these energy sources?