PHYS 354 — Problem Set 2

Due Jan. 19

1. Modeling the sun to be a sphere made purely of hydrogen and having constant density, calculate the gravitational potential energy stored in it. Use that stored potential energy, and the Virial theorem, calculate the mean temperature of the sun. It’s not obvious necessarily, what “mean” temperature refers to. If you take it to be at the layer of the sun with half the mass below it and half the mass above it, where is that radius measured in terms of solar radii? How does the temperature compare to the known core temperature of 1.5x107 K and the known surface temperature of 5.8x103 K?

2. Repeat the work above with the ever so slightly more realistic model of the density falling off as I over the radius ( = 0/r) and dropping abruptly to 0 at the surface.

3. Do it all again but have the density fall off as the fifth power of the radius.

4. Let’s make this one notch more realistic. Take the density of the sun to be 150 g/cm3 and have that density fall off exponentially ( = 0e –r/h, where h is some to be determined scale height) until it drops abruptly to 0 at the surface. Repeat all your work from earlier. If you can do this calculation analytically, great! If not, and you wish to numerically integrate using MatLab, Kaleidagraph, IDL, Python, etc. that works too but guide me through the work.