Homework # 1, due 17 Feb

1. Consider a non-interacting fermion gas. Derive the following formula for the entropy per baryon $s$

$$ns = -\frac{g}{\hbar^3} \int [f \ln f + (1 - f) \ln (1 - f)] d^3p,$$

where $f$ is the probability that a given momentum state will be occupied:

$$f = \left[1 + \exp\left(\frac{E - \mu}{T}\right)\right]^{-1}.$$  

Here, the energy of a non-interacting particle, in terms of its rest mass $m$ and momentum $p$, is

$$E^2 = m^2c^4 + p^2c^2,$$

and $\mu$ is the chemical potential. Show your work.

2. Determine the entropy per baryon of a room-temperature gas. Alternatively, you may compute the entropy density of a room-temperature gas. Show your work.

3. Determine the entropy per baryon or the entropy density at the center of the Sun. Show your work.