Astro 118 – Physics of Planetary Systems
Problem Set #2, Winter 2014
Due in class on Monday, January 27, 2014

1) Read "Cool Stars in Hot Places," by S. T. Mageath, et al., which can be found here: http://arxiv.org/pdf/0704.1045v1. The articles focuses on how star and planet formation are influenced by current and past generations of stars. Summarize the main points of the article in 1 to 1-1/2 single-spaced pages.

2) Let's consider what conditions would result in the formation of the Sun.
a. Consider the following: A core a giant molecular cloud (GMC) has a radius of 1 pc, a temperature between 30 K and 100 K, and a number density of $10^{10}/m^3$. Is it likely to collapse to form a solar-type star at 30K? What about 100 K? Assume pure H_2 gas, with no He or metals.
b. Small knots within the cores of GMCs have radii of about 0.1 pc, temperatures between 30 and 200 K, and number densities of $10^{12}/m^3$. It is more likely to collapse to form a star than the case from part a.?
c. For the more likely case, what is the free-fall time for collapse?
d. For most likely case, what is mean luminosity during collapse phase? Assume that the proto-star is just barely bound at the start of collapse, so that the Virial Theorem holds. Assume that the star has reached a mean internal temperature of 3000 K by the end of collapse. In what wavelength range (approximately) would this radiation come out?
e. Estimate the gravitational energy per unit volume for the 30 K case in part 2b, above. At what magnetic field strength would the magnetic energy density equal the GPE per unit volume? Note that I never gave an expression for the magnetic energy density, so you'll have to find that…

3) Problem 2.2 from our book.

4) Show that equations 2.35 and 2.36 are true.