Stellar Astronomy and Astrophysics (SS12)

Ralf Klessen and Stefan Jordan

Exercise 3 for May 15, 2012

Some simple estimates:

3.1 Central temperature of the Sun

Use the equation of hydrostatic balance in order to obtain a crude estimate of the central temperature of the present-day Sun.

3.2. Pre-main-sequence contraction

Consider for simplicity protostars which follow an equation of state with $\gamma = 5/3$ for ideal monoatomic gases over all radii and use the virial theorem to obtain order of magnitude estimates.

a) Describe qualitatively the behavior of the central temperature T_c when the object contracts? What is the reason for this behavior?

b) For a one solar-mass object, estimate how long the pre-main-sequence contraction phase will last. Assume the object radiates with constant luminosity equal to the present-day Sun.

c) Why does the contraction eventually stop?

3.3 Distance estimate

You go out to observe the stars in a clear dark night. As you look around, you see a 100 W light bulb far away. This light appears equally bright as a star of 0 magnitudes. What is the distance to the light bulb?