

Assignment 1

Due Jan 18, 2016 at beginning of class. Marked out of 30 and worth 10% of your final mark.

1. **[0 marks]:** Read Chapter 13. Suggested problems: 13.2, 13.3, 13.5, 13.6, 13.7, 13.11. You do not have to hand these in; they will not be marked. Solutions will be provided.
2. **[15 marks]:**
 - a) (5 marks) The file *hipparcos.txt* contains parallaxes and magnitudes in three filters (B, V and I) for many nearby stars (see the file *hipparcos_cols.txt* for column definitions). Make a graph of absolute V magnitude (M_V) as a function of (B-V) colour. Orient your graph so brighter stars are at the top, and bluer stars are at the left.
Hint: The file *template.m* will get you started to make a plot in MATLAB.
 - b) (5 marks) Use eq 13.36 to calculate the temperature of each star and plot $\log L_V/L_\odot$ as a function of $\log T$.
 - c) (5 marks) Use the Stefan-Boltzmann law to calculate L as a function of T for blackbodies of different radii: $R = R_\odot$, $R = 0.2R_\odot$ and $R = 5R_\odot$. Show these as lines on your graph from part b. What can you infer about how the radii of stars depends on their temperature?
3. **15 marks** The file *W16_assignment1_orbit.dat* gives the orbital phase, the radial velocity (in km/s) of each star, and the apparent magnitude of an unresolved, double-lined spectroscopic binary system. The period is 50 days.
 - a) (2 marks) Make a graph of radial velocity as a function of time, over one full orbit. Show both stars on the same graph.
 - b) (3 marks) From the graph in a, calculate the value of $m \sin^3 i$ for each star.
 - c) (2 marks) Make a graph of the logarithm of L/L_\odot as a function of time, where L_\odot is the luminosity when both stars are visible (no eclipse).
 - d) (3 marks) Using the graph and data from c), calculate the ratio of temperatures of the two stars.
 - e) (5 marks) Using the graph and data from c), calculate the radius of each star.