Astrophysics: Assignment 1
HRI Graduate School
August - December 2011

04 August 2011
To be returned to the tutor by 16 August 2011

- The deadline for the submission of the solutions of this assignment will be strictly enforced. No marks will be given if the assignment is not returned in time.

- You are free to discuss the solutions with friends, seniors and consult any books. However, you should understand and be clear about every step in the answers. Marks may be reduced if you have not understood what you have written even though the answer is correct.

- Let me or your tutor know if you find anything to be unclear or if you think that something is wrong in any of the questions.

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1. **Measuring solar parameters:** (i) One can measure the distance to sun using oribit of another planet, say, Venus. Assume the orbit of Venus to be spherical. Suppose we know the distance between earth and Venus r_{EV} (from, say, radar measurements) and also measure the elongation e of Venus (defined as the largest angular separation between sun and Venus in the sky). Show that the earth-sun distance is given by

$$r_{E\odot} = \frac{r_{EV}}{\cos e}$$

   The measured value comes out to be $r_{E\odot} \approx 1.5 \times 10^8$ km $\equiv 1$ AU.

   (ii) Now, we know the angular size of the sun $\theta_\odot = 0.5°$. What is the diameter of the sun $D_\odot$ in terms of $\theta_\odot$? What is the numerical value of $D_\odot$?

   (iii) The time period of earth's rotation T_E around the sun is known (1 year). How will you estimate the solar mass $M_\odot$ from this data? Obtain the numerical value of $M_\odot$.

   $$[2+1+1]$$

2. **Estimating galaxy mass:** The Sun is at a distance of about 8 kpc from the galactic centre and moves around the galactic centre in a circular path with a velocity of about 220 km s^{-1} . Make a rough estimate of the mass of the Galaxy.

   $$[2]$$

3. **Magnitude of a star:** A star at a distance of 4 pc has an apparent magnitude 2. What is its absolute magnitude? Given the fact that the Sun has a luminosity 4×10^{33} ergs s^{-1} and has an absolute magnitude of about 5, find the luminosity of the star.

   $$[2]$$