PH2900 (Astronomy)
Problem sheet 4
To be turned in by 5:00 p.m., Wednesday 28 November, 2007

For all questions justify your answers and show all relevant intermediate steps.

1: Suppose the thermal broadening of the Balmer H_α line ($\lambda = 656$ nm) in a given star makes a contribution to the line width of $\Delta\lambda = 0.02$ nm. What do you expect for the corresponding $\Delta\lambda$ for the sodium D lines at $\lambda = 589$ nm?

2(a): The Hipparcos satellite measured the parallax angle π of stars with an accuracy of around $\sigma_\pi = 1$ milli-arcsecond. Using the error propagation formula, show that the relative uncertainty in the parallax distance d to the star is

$$\frac{\sigma_d}{d} = \frac{\sigma_\pi}{\pi} = \frac{d}{r}\sigma_\pi \ , \tag{1}$$

where $r = 1$ A.U.

2(b): At what distance in pc is the relative uncertainty in the parallax distance equal to 20%?

2(c): How accurately would one have to measure the parallax to determine the distance to a nearby globular cluster to within 20%? (You will need to do some research to find out a typical distance to a nearby globular clusters.)

3(a): The horizontal parallax angle for Sirius is $0.377''$. Find the distance to Sirius in pc.

3(b): Find the distance modulus for Sirius.

4: Type 1a supernovae can have an absolute magnitude of around $M = -19$. Suppose one were to occur at a distance of 100 pc from the earth. Estimate how bright it would appear compared to the sun by predicting its apparent magnitude and comparing to that of the sun. Use the fact that the absolute magnitude of the sun is $M = 4.8$ and it is at a distance of 1 A.U. (Also compare to the apparent magnitude of the full moon: $m = -12.6$.)

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