

## Workshop 6

1. In a spectrum of a galaxy the H $\beta$  Balmer line of hydrogen that has a rest wavelength of 486 nm is observed to be close to the wavelength of H $\alpha$  at 656 nm instead.

- a) What is the redshift and radial velocity of the galaxy?
- b) What is the distance according to Hubble's law ( $H=74 \text{ km s}^{-1} \text{ Mpc}^{-1}$ )
- c) What is the lookback time of the galaxy, i.e. how long has it taken the light to travel from the galaxy to us?

2. By assuming that the universe has been expanding at a constant rate use Hubble's "Law" to make an estimate of the age of the universe.

3. Suppose that the Sun's distance from the centre of the Galaxy is 8.0 kpc, and its orbital velocity about the centre is 220 km/s.

- Calculate the length of the Galactic 'year' (the time taken for the Sun to complete one orbit around the Galaxy), expressing your answer in (Earth) years.
- Estimate how many times the Sun has orbited around the centre of the Galaxy.

Age of universe  $13.8 \times 10^9 \text{ y}$

Age of Milky Way  $\sim 10 \times 10^9 \text{ y}$

Age of Sun  $\sim 5 \times 10^9 \text{ y}$