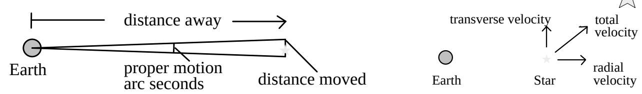
Motion of Stars



distance moved = (distance away) x (proper motion in radians)

transverse velocity = (distance moved)/(time between observations)

- Nearby stars can be seen moving relative to the background of distant stars. This is called the *proper motion* of a star. The largest proper motion is 10" arc per year

Motion in the Great Bear

FIG 12.9

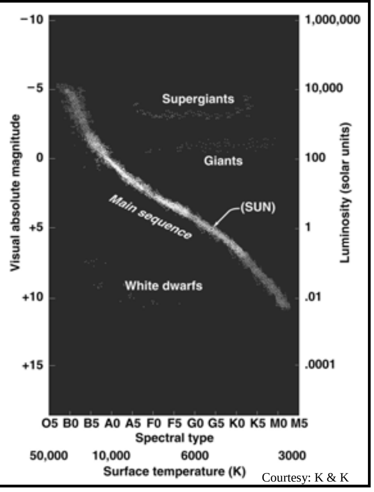
(animated)

Courtesy: K & K

Hertzsprung-Russell Diagram

- absolute magnitude/ spectral class

Fig 12-17 →



Courtesy: K & K

Hertzsprung-Russell Diagram

- The H-R diagram is a plot of absolute magnitude (or luminosity on a logarithmic scale) versus spectral class (or temperature)
- 90% of stars cluster around a line called the *main sequence*
  - the main sequence tells us about the range of different stars that are formed
  - stars slowly evolve across the width of the main sequence and then move quickly away from it
- Giant and dwarf stars lie off the main sequence

Spectroscopic Distances

- Astronomers call estimating stellar distances using the H-R diagram as measuring by **spectroscopic parallax**. The method is:
  - determine the spectral class and apparent magnitude, m, of a main sequence star
  - Find the range of absolute magnitudes, M, from the H-R diagram
  - Compare M (which refers to 10 *pc*) with m (which refers to actual distance) and hence find the approximate distance of the star

Spectroscopic Parallax Example

- The brightest component of *Spica* (α Virgo) is a *main sequence* star of spectral type B1 and apparent magnitude, m, of 0.9. Is it further away than 10 *pc*? About how far is it?
- From H-R diagram, absolute magnitude, M, is in range -3.2 to -5. Say typical M of -4.1 (brightness at 10 *pc*)
- Difference between m and M is 0.9 - (-4.1) = 5
- Brightness decrease when moved from10 *pc* is 2.512^5 = 100. Hence star must be a lot further than 10 *pc*
- A brightness decrease of 100 means the star is really 10 times further than 10 *pc* (inverse square law), i.e. distance is ≈ 100 *pc*. Actual distance 80 *pc*

Luminosity Classes

Courtesy: K & K

- Spectra of non *main sequence* stars show subtle differences
  - one feature of different spectra is *pressure broadening*
- The detail in spectra (corroborated by other measurements) lets astronomers define a set of **luminosity classes**. These are denoted with Roman numerals I - V

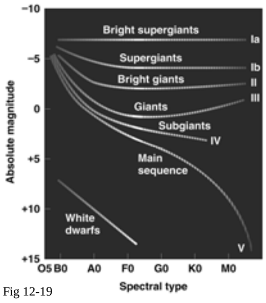


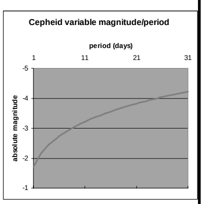
Fig 12-19

Mass - Luminosity Relationship

- Main sequence stars show a simple relationship between mass and luminosity
- $L = M^{3.5}$, where L and M are measured relative to our Sun
  - if M = 1.93 solar masses, the star's luminosity is 10 times our Sun, since $1.93^{3.5} = 10.0$
  - this relationship demonstrates that the *main sequence* is a mass sequence, with the massive stars at the top left and 'lightweight' stars at the bottom right

Cepheid Variables

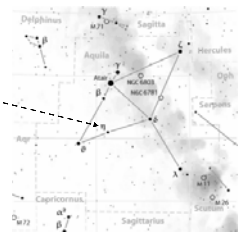
- Uncommon stars very useful in measuring large distances - nearest is Polaris at 430 LY
  - maximum distance our Sun could be seen at apparent magnitude +25 is 10^5 *pc*
  - *Cepheids* are intrinsically brighter
  - they have a characteristic variable appearance and period 1 - 30 days
  - the absolute magnitude can be found from the period
  - hence the distance of a Cepheid can be deduced



Visible Cepheids

- The first Cepheids were discovered by astronomers from York: *Edward Piggott* and *John Goodricke* in 1784

- look in the sky for η Aquilae (period 7.18 days – near Altair, one of the summer triangle stars), δ Cephei (5.37 days) and Polaris (3.97 days)



End of Course

- We have two level 2 courses on offer next year (2008/2009), both intended for the non-specialist
  - **An Introduction to Space Science & Remote Sensing** PX2011
  - **Cosmology, Astronomy & Modern Physics** PX2512
    - this course can be taken as a 'key learning', self-study course with no lecture commitments