Important information about astronomical objects:

Composition

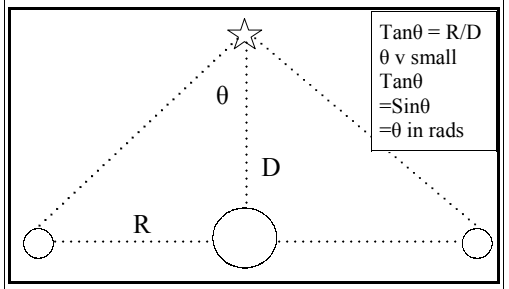
- Line spectra
  - Emission
  - Absorption

Velocity

- Using two radar pulses the velocity of an object can be calculated
- First pulse: $v \times t/2 = d_1$
- Second pulse: $v \times t/2 = d_2$
- $V = \frac{d_1 - d_2}{\text{time between pulses}}$
- If pulses return further apart in time than when sent, the distant object is receding

Distances

- Near Objects
  - Radar echo method
  - $d = 3 \times 10^8 \times t/2$ (t = echo time)
- Nearest 1000 stars
  - Stellar Parallax



- Estimate of brightness
  - $1/r^2$ brightness
  - Standard candles—stars with known brightness
  - Colour of star establishes brightness
  - Cepheid variables: Brightness varies over a fixed period

Chapter 12
Our place in the Universe

Doppler Shifts to calculate the age of the universe

As the universe has expanded so have electromagnetic waves. By calculating the change in wavelength of the electromagnetic waves the expansion of the universe since the wave set out form its source can be calculated using the following formulae:

$$\frac{\lambda_{orig} + \Delta\lambda}{\lambda_{orig}} = 1 + \frac{\Delta\lambda}{\lambda_{orig}} = 1 + z = \frac{R_{now}}{R_{then}}$$

Doppler shifts can also be used to calculate distances in one and two way measurements.

Two way radar:

$$\frac{\Delta\lambda}{\lambda} = \frac{2v}{c}$$

One way measurements:

$$\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$$

Mass