PH-104: Stellar Structure

Thomas Lake
(Typed from notes made in lectures)

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1 The Stars

1.1 Organising the Stars

1.1.1 Constellations and Names

Stars are organised into constellations (of which there are 88), which are regions of the night sky based on imaginary patterns of stars. Constellations are used to navigate around the night sky, and generally have Latin names. Individual stars tend to have Arabic names (cf Betelgeuse). Polaris is a notable exception to this rule. Stars can also be referred to based on their constellation, using Greek letters prefixed to the name of the constellation, e.g α-Centauri. Normally alpha(α) is the brightest star in the constellation, followed by beta and so on.

1.1.2 Apparent Magnitude

Apparent Magnitude is a measure of a star's brightness, as seen from Earth.

Definition due to Hipparcus

- Brightest stars are defined as 1st Magnitude
- Stars half as bright as 1st Magnitude stars are defined as 2nd Magnitude
- Stars half as bright as 2nd Magnitude stars are defined as 3rd Magnitude
- 6th Magnitude stars are about as faint as is visible by the human eye

Modern Definition
The modern definition has been slightly altered, but attempted to remain similar to Hipparcus' definition.

- A standard brightness, B_0 is defined, corresponding to an apparent magnitude of Zero. Vega comes close to this brightness
- A star of magnitude $+1$ is $\frac{1}{2.514}$ as bright as B_0
- A star of magnitude $+2$ is $\frac{1}{2.514^2}$ as bright as B_0
- A star of magnitude $+3$ is $\frac{1}{2.514^3}$ as bright as B_0
- A star of magnitude $+5$ is $\frac{1}{2.514^5} = \frac{1}{100}$ as bright as B_0

- A star of magnitude +10 is $\frac{1}{2.514^{10}} = \frac{1}{100^2}$ as bright as B_0
- A star of magnitude +15 is $\frac{1}{2.514^{15}} = \frac{1}{100^3}$ as bright as B_0

Stars with apparent magnitude +20 are visible by eye with a large telescope. Using a photographic plate allows stars of magnitude +25 to be observed.

1.1.3 Distance from Earth

Distances in astronomy is difficult to determine. For nearby stars, parallax can be used to determine the distance from the Earth to the star, based on the difference in the angle between the star and a fixed reference. Two pictures of a star are taken, 6 months apart. The different in the angles allows a distance to be found using trigonometry, as we now have two angles and a side of the triangle. A parsec is a measure of distance, defined as the distance to an object whose parallax effect is 1 arc-second ($\frac{1}{3600}^{\circ}$). A light year is another unit used in astronomy. 1 Light year is defined as the distance light travels in 1 Earth year, equivalent to 9.4×10^{15}m. 1 Parsec is 3.26 Light years.

α-Centauri	4.3 Light years
Proxima-Centauri	4.2 Light years
Betelguese	310 Light years
Rigel	910 Light years

Table 1: Distances to selected stars

1.1.4 Absolute Magnitude

1.1.5 Spectral Type