Astronomical Distance

22 January 2020 12:21

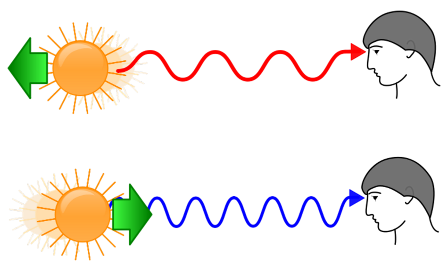
Radar

- Much like sonar in submarines
- Send out a radar pulse
- Time how long until you hear the reflection and work out the distance

Doppler Effect

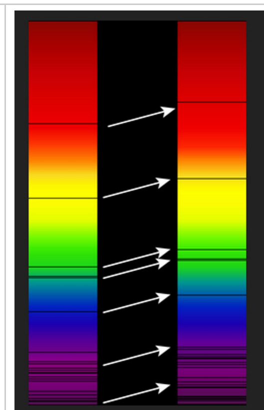
Caused by waves either being 'squashed' or 'stretched' due to relative motion between the source and receiver (think ambulance driving past)

- Squashed - moving closer, 'blue shift' -> λ is decreasing
- Stretched - moving apart, 'red shift' -> λ is increasing



Here you can see a 'yellow' star being blue or red shifted.

On the right is an absorption spectrum that has been red shifted (on the right)



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

v: velocity (relative)

$\Delta\lambda$: change in wavelength.

But!!! only works if $v << c$

Absorption Spectra

The absorption spectrum above is caused by:

- Inside the star all wavelengths are created
- In the atmosphere, where its a bit cooler, electrons in atoms are excited to higher energy levels, absorbing very specific frequencies of e/m corresponding to the energy jumps. Hence we get absorption lines
- These lines enable us to identify which elements are in the atmosphere of the star
- Which enable us to classify the star, and have a good stab at its absolute intensity
- Often the lines are red shifted - and so we can also work out how fast the star is moving away

Time Dilation

We have to assume that the speed (relative speed Albert) is much less than C, speed of light. This is because, weirdly, time runs at different speeds depending on how fast you are moving. While it does happen at tiny speeds, this 'relativistic time dilation' is very, very, very small. It only becomes significant when the speed approaches C.

$$t = \frac{t_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Where t_0 = the time measured between two events by a stationary observer and t is the time measured by an observer moving at velocity v.

$$\rightarrow \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

is called the "relativistic factor" (γ) crops up all over the place.