Colour, Temperature & Line Spectra

The Space Physics unit is designed to bring together the topics we have met in the previous units.

The vastness of space means that we can't visit a star to find it's temperature, what it's made of, etc. Instead, we investigate the properties of the light we receive from the star to unlock its secrets.

Colour and Temperature

How does the temperature of an object affect the colour of light it gives out?

Let's think about a torch. Normally, the filament in a torch bulb glows white hot to give out a bright white light. However, if the torch batteries are running out there may not be enough energy to heat the filament to the correct temperature and bulb may only glow red hot and not give out any white light.

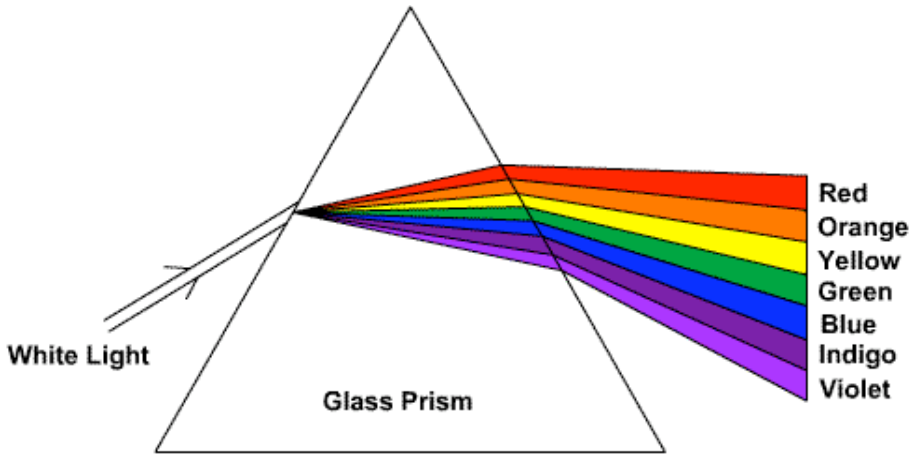
For example, this picture shows a car interior light that has a high proportion of red light in it.

Some bulbs, such as the halogen bulbs used in some car headlights, contain filaments that get so hot that the light they give out actually looks blue. This picture shows a halogen bulb. Note the blue colouring of the light given out.

Just like torches (but on a much larger scale!) the colour of light given out by a star depends on the star's surface temperature. The stars that appear red (e.g. Betelguise) are cooler than the yellow stars (e.g. our Sun) and the hottest stars (e.g. Rigel) give out a blue-white light.

Line Spectra

White light is made up of many different colours. We can show this by shining white light through a prism – the white light is split up into a **spectrum** containing all the colours from red through to blue.



Astronomers can learn a lot about a star by passing its light through a prism and looking at the spectrum produced. The spectrum obtained from a star is made up from the spectra of all the elements present within the star.

Each element produces a unique series of colours called a **line spectrum** when it is heated. For example, the yellow colour of street lights is due to the strong yellow emission from the element sodium when it is heated. You might remember using flame colour tests in 2nd year Science to work out whether a salt solution contained sodium (yellow flame), potassium (lilac flame) or calcium (red flame). Without knowing it, you were using the line spectrum of these elements to identify them.

The line spectrum of each element in the Periodic Table is unique and can be used like a fingerprint to determine whether or not the element is present in a star.

A white light source has a spectrum like this

white light spectrum

The light we obtain from a sodium light source emits the following spectrum

sodium emission spectrum

Notice that there are more colours present in the sodium light than the yellow we see with our naked eye. The yellow emission is very intense and we only see the other colour components of the sodium spectrum with a spectroscope.

Here are some emission line spectra for other elements.

argon emission spectrum

helium emission spectrum

hydrogen emission spectrum

lithium emission spectrum

nitrogen emission spectrum

oxygen emission spectrum

Once we obtain the spectrum for a star, we can compare the lines in the spectrum to the known lines for each element to work out which of the elements are present in the star.