WJEC England Physics A Level

Topic 2.7 Using Radiation to Investigate Stars

Flashcards

What are emission line spectra and how are they formed?

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A series of coloured lines on a black background.

When light passes through the outer layers of a star, the electrons in the atoms absorb photons and become excited. They then de-excite, releasing photons of specific wavelengths. These photons are detected on Earth and have wavelengths characteristic of the elements in the outer layers, shown as emission line spectra.

What are continuous line spectra?

What are continuous line spectra?

Continuous line spectra – all visible wavelengths of light are present. They are produced by the atoms of heated metals.

What are absorption line spectra?

What are absorption line spectra?

A series of dark lines against the background of the continuous spectrum, with each line corresponding to a wavelength of light absorbed by atoms in the outer layers of a star. The dark lines are at wavelengths that are characteristic of the elements in the outer layers (as with emission spectra).

What is meant by ‘black body’?

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A perfect absorber and emitter of electromagnetic radiation – it absorbs all EM radiation incident upon it.

Stars can be approximated as black bodies.

State Wien’s displacement law.

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The wavelength of emitted radiation at peak intensity is inversely proportional to the temperature of the black body.

$$\lambda_{max} T = 2.9 \times 10^{-3} \; m \; K$$

State Stefan's law.

State Stefan's law.

The power output of a star is directly proportional to its surface area and to its (absolute temperature)^4.

$P = \sigma A T^4$ where σ (the constant of proportionality) is the Stefan-Boltzmann constant.

What is the inverse square law for intensity?

What is the inverse square law for intensity?

The intensity of radiation at a given distance from a source is given by:

$$I = P / 4\pi r^2$$

I = intensity (W m^{-2}), P = source power output (W), r = distance from the source (m)

How can the distance to nearby stars be measured?

How can the distance to nearby stars be measured?

If the radius of the star and its temperature are known, you can calculate the luminosity/power of the star.

Then, by measuring the intensity of the star from the Earth, you can use the inverse square law to find the distance.

How can we work out the surface temperature of a star?

How can we work out the surface temperature of a star?

By using the equation for luminosity/power:

$$P = 4\sigma\pi r^2 T^4$$

(from Stefan's law, converting area to $4\pi r^2$)

r = radius of the star, σ = Stefan-Boltzmann constant,
T = surface temp

What is multiwavelength astronomy?

What is multiwavelength astronomy?

Using different wavelengths of electromagnetic radiation to observe the universe. Many astronomical objects emit most of their radiation outside of the visible spectrum.