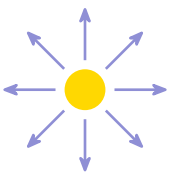
Astrophysics & Cosmology

A2 Physics ▪ Topic 25

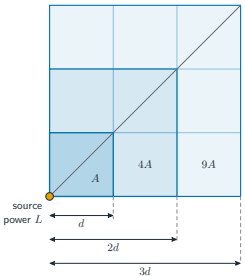
A-Level Physics



What we will cover

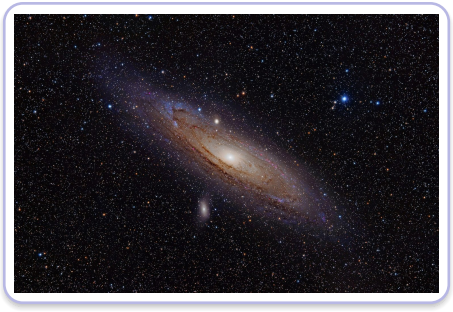
1. Luminosity & flux
2. Standard candles
3. Stellar temperature
4. Redshift & Hubble's law
5. Recap

Luminosity and radiant flux intensity



$$F = \frac{L}{4\pi d^2}$$

flux: F, $\frac{F}{4}$, $\frac{F}{9}$



andromeda galaxy

Worked example – flux from a star

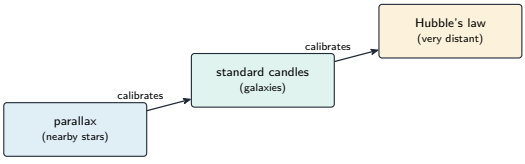
A star of luminosity $4.0 \times 10^{26}\,\mathrm{W}$ is $2.0 \times 10^{17}\,\mathrm{m}$ away. Find the flux at Earth.

$$F = \frac{L}{4\pi d^2} = \frac{4.0 \times 10^{26}}{4\pi (2.0 \times 10^{17})^2}$$

$$\approx 8.0 \times 10^{-10}\,\mathrm{W\,m^{-2}}$$

Square the distance. Double d and the flux falls to a quarter.

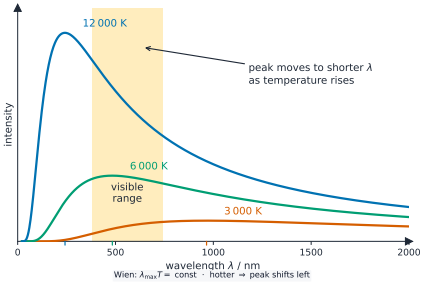
Standard candles



each rung is calibrated by the one below, reaching ever further

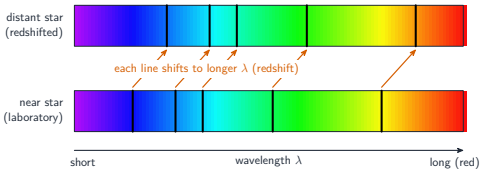
hubble ultra deep field

Stellar surface temperature



very large telescope

Redshift, Hubble's law and the Big Bang



Distant galaxies are **redshifted** 红移: their light stretches to longer wavelengths.

$$z = \frac{\Delta\lambda}{\lambda} \approx \frac{v}{c}, \qquad v = H_0 d$$

Recession speed $\propto$ distance is **Hubble's law** 哈勃定律 – the universe is expanding, which run backwards points to the Big Bang.

Topic 25 – key takeaways

1 Flux

$F = L/4\pi d^2$ – inverse square

2 Candles

known L + measured F gives distance

3 Temperature

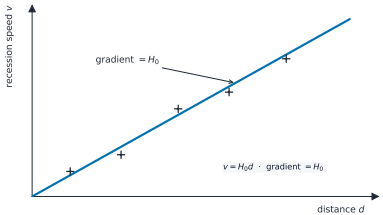
Wien $\lambda_{\max} T$; Stefan $L = 4\pi r^2 \sigma T^4$

4 Hubble

$v = H_0 d$ – expansion, the Big Bang

Check yourself

1. Double the distance – what happens to flux?
2. What is a standard candle for?
3. A bluer star – hotter or cooler?
4. What does $v = H_0 d$ tell us?



Answers **1.** falls to a quarter **2.** finding distance **3.** hotter **4.** the universe is expanding