

- o **Redshift** – light moves towards red end of the spectrum



**Speed of Galaxies**

- **Speed** of galaxies AND amount by which light from a galaxy is **red-shifted**...
  - o ...may be determined by measuring the **change in wavelength** of light coming from that galaxy



$$\frac{\text{change in wavelength}}{\text{reference wavelength}} = \frac{\text{velocity of a galaxy}}{\text{speed of light}}$$

$$\frac{\lambda - \lambda_0}{\lambda_0} = \frac{\Delta\lambda}{\lambda_0} = \frac{v}{c}$$

- $\lambda_0$  = the wavelength of light for a **stationary observer** (reference wavelength, measured in lab) → when it was **emitted** BEFORE it was **red-shifted**
- $\lambda$  is the **measured wavelength**
- $\Delta\lambda$  is the **change in wavelength**
- **speed of light** =  $3.00 \times 10^8$  m/s

**Speed of Galaxy related to its distance**

- Hubble discovered that the **speed of a galaxy is proportional to its distance from us**



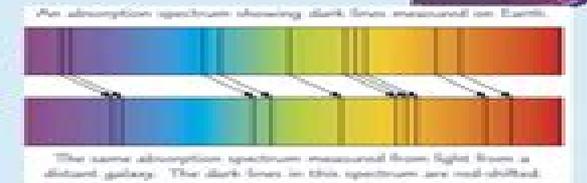
**8.17P describe the red-shift in light received from galaxies at different distances away from the Earth**

**The Red-shift of GALAXIES**

- The light coming to us from distant galaxies is **redshifted** (they are moving **AWAY** from us)

**Hubble's LAW**

- Furthermore, the **greater the distance** to the galaxy, the **greater the redshift**
  - o The **more distant galaxies** are moving away from us **faster**



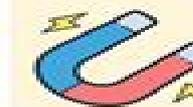
**Light from Galaxies is RED-SHIFTED**

Most **galaxies** seem to be **moving away** from each other, because:

1. Different elements **absorb** different **frequencies** (OR wavelengths) of light
2. When light is passed through a sample of an element, a **pattern of dark lines** is produced – with a dark line at each of the **frequencies** in the visible part of the EM spectrum that the **element absorbs**
3. When we look at **light from distant galaxies**, we see the SAME patterns BUT at **slightly lower frequencies** (and so lower wavelengths) than they should be
4. Patterns have been **shifted** towards the **red end** of the spectrum – **red-shift**

**8.18P explain why the red-shift of galaxies provides evidence for the expansion of the universe**

- Measurements of the red-shift suggest that **All the distant galaxies** are **MOVING AWAY** from Earth very quickly – same result in whichever direction you look in



Any questions? Email [contact@bytesofintelligence.co.uk](mailto:contact@bytesofintelligence.co.uk)



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**L Darling-Hammond**



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