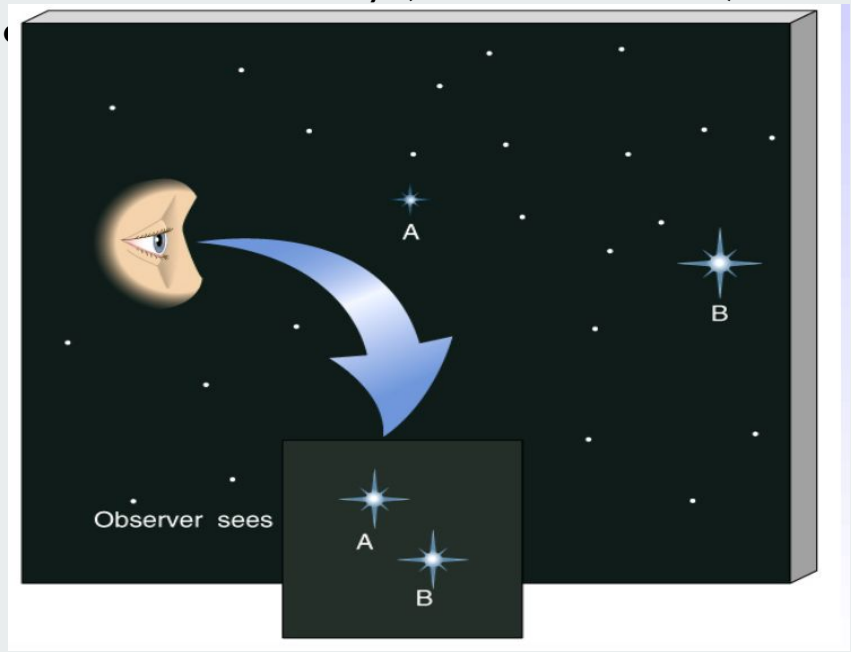
Measuring the Brilliance of the Cosmos: Flux and Photometry

Luminosity

- Luminosity: The total amount of energy that a star puts out as light each second is called luminosity. (Unit : Watt or J/s)

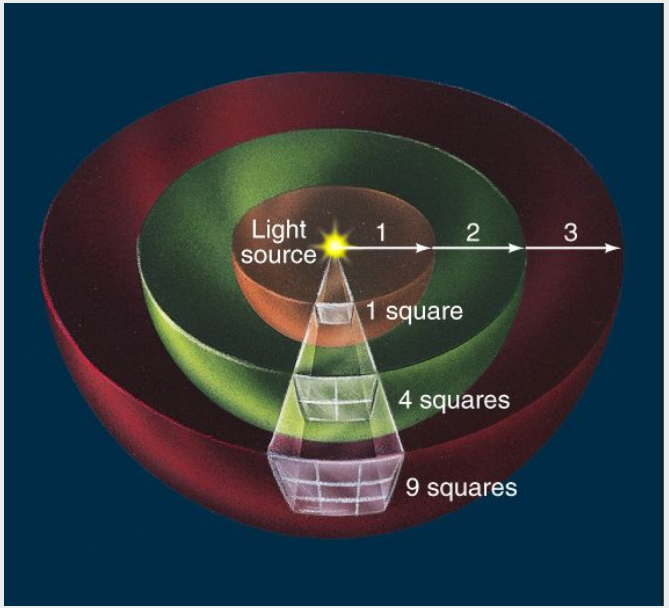


Star B is more luminous, but they have the same brightness as seen from Earth.

This brightness is termed as apparent brightness because it is not the actual brightness of the star.

Here, star B is more distant than star A. i.e , Light appears fainter with increasing distance.

FLUX



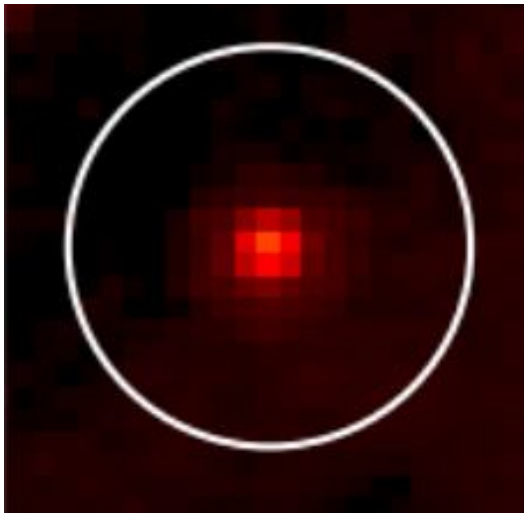
- If we increase our distance from the light source by 2, the light energy is spread out over four times the area.
- Hence we consider the flux.
  (area of sphere = 4πd^2)

$$\text{Flux} = \frac{\text{Luminosity}}{4\pi d^2}$$

- Each dot in the Image is a celestial object(stars, far away galaxies etc)
- How do we determine the flux(light coming out of each source) ?
- Photometry deals with the analysis and measurement of electromagnetic(E.M) radiation emitted by celestial objects.

Aperture Photometry

- Aperture Photometry is a method to measure the amount of light (flux) received from a celestial object within a specific aperture or circular region.

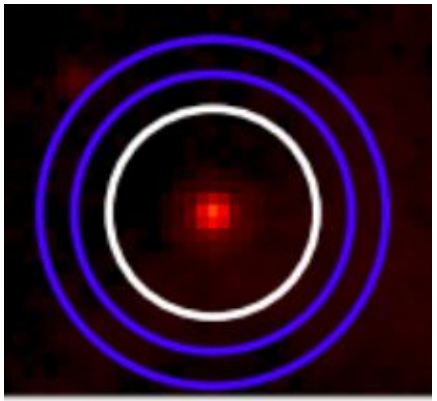


- The value of each pixel represent the flux falling on that pixel.
- In aperture photometry, we place an aperture around the object of our interest.
- Then we are summing the pixels that fall inside our aperture to get the total flux inside the aperture.

Is this enough?

- There might be background flux inside our aperture. This might contributions from the sky background,nearby sources , instrumental noise etc.

- So we must correct for this background flux. This is done by choosing a annular ring over our aperture.



- We calculate the total flux inside the ring(annulus). Then we find the **flux/unit area(bkg)** of the ring by dividing the total flux by the area of the ring.

- Now, let the area of the central aperture be **a**. Then the total background flux inside the aperture will be equal to **flux/unit area(bkg) * a(area of the aperture.)**

- This background flux is then subtracted from the initial aperture sum which in turn gives the final corrected aperture sum of the object. This value is then converted into magnitudes.