Earth 101
Introduction to Astronomy

Properties of Stars

Instructor:
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OpenStax Ch 19
Properties of Stars (from Starlight only)
Calculating Distances to Stars Mathematically

Photo/Material Credit:
- Fred Marschak
- Dr. Jatila van der Veen
- Erin O'Connor + others

HJNP

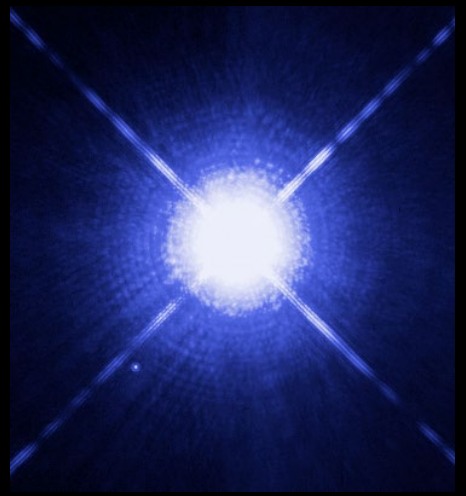

Calculating distances to stars from the difference between their absolute and apparent magnitudes

Comparing brightness of two stars from their magnitudes:

Rule: If two stars differ by 5 magnitudes, then the brighter one is 100 times as bright as the dimmer one.

For example: If star A is magnitude 6 and star B is magnitude 1, then B is 100x brighter than A.

Remember: The lower the number, the brighter the star!
Sirius, the brightest star in the northern sky, has an apparent magnitude of -1.44



Hubble image of Sirius, the "Dog Star" in the constellation Canis Major.

Absolute Magnitude = a measure of luminosity

If you know the absolute magnitude you can find the distance.

m = apparent magnitude = how bright star appears

M = an estimate of a star's Luminosity –

absolute magnitude = how bright a star would appear at a reference distance of 10 pc

$$m - M = 5\log d - 5$$

$$\Rightarrow d = 10^{(m-M+5)/5}$$

d in parsecs

Calculating distance in parsecs from visual magnitudes:

M_v = absolute visual magnitude, all wavelengths
m_v = apparent visual magnitude, all wavelengths

$$d = 10^{(m_v - M_v + 5)/5}$$

A star is observed to have an apparent visual magnitude of 5, and is calculated to have an absolute visual magnitude of 10. What is its distance in parsecs?

$$d = 10^{(5-10+5)/5}$$

$$= 10^0 = 1\,pc$$

1. Rigel is the lower right leg star in Orion. $m_v = 0.14$ and $M_v = -7.1$. What is its distance in pc and ly?

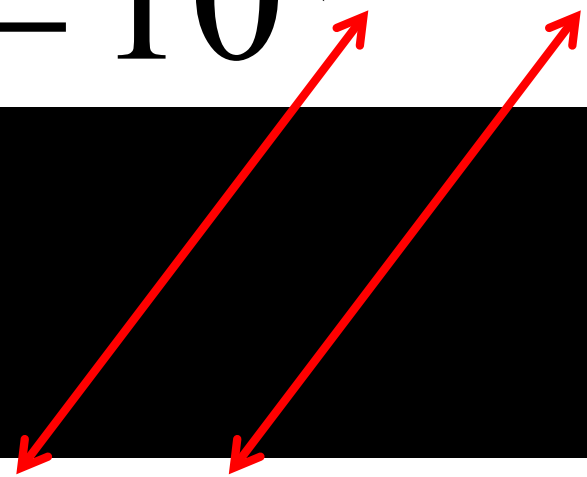
$$d = 10^{(m_v - M_v + 5)/5}$$

in pc.

1 pc = 3.26 ly

1.

$$d = 10^{(m_v - M_v + 5)/5}$$



$$d = 10^{(0.14-(-7.1)+5)/5} = 280.54\,pc$$

$$280.54\,pc \times 3.26\frac{ly}{pc} = 914.53ly$$

2. Sirius is the brightest star in the sky, with m_v = -1.47. M_v for Sirius has been measured as + 1.4. What is the distance to Sirius in pc and AU?

$$d = 10^{(m_v - M_v + 5)/5}$$

in pc

1 pc = 206,265 AU

2.

$$d = 10^{(m_v - M_v + 5)/5}$$

$$d = 10^{(-1.47 - 1.4 + 5)/5} = 2.67\,pc$$

$$2.67\,pc \times \frac{206265\,AU}{pc} = 550{,}727\,AU$$

Next time: Stars 04
Measuring masses of stars