

Defining distance units for use in HR diagram code

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Throughout this document I have referred to Carroll & Ostlie p.61 to base my definitions from. One magnitude will indicate a difference of a factor e between fluxes,

$$\frac{F_1}{F_2} = e^{m_1 - m_2}. \quad (1)$$

Taking the logarithm (base e) we have

$$m_1 - m_2 = \log \frac{F_1}{F_2}. \quad (2)$$

Recall that we have

$$F = \frac{L}{4\pi r^2}. \quad (3)$$

Here I choose to define an absolute magnitude M to be the magnitude at 1pc (here we take a parsec to be an arbitrary but natural unit). Combining equations 2 and 3, we have

$$e^{m-M} = \frac{F}{F_1} = \left(\frac{d}{1\text{pc}} \right)^2. \quad (4)$$

This gives us an equation for the distance, where d is in parsecs,

$$d = e^{\frac{m-M}{2}}. \quad (5)$$

Finally we compute the distance modulus,

$$m - M = 2 \log d, \quad (6)$$

which we can use to find that

$$M = m - 2 \log d. \quad (7)$$