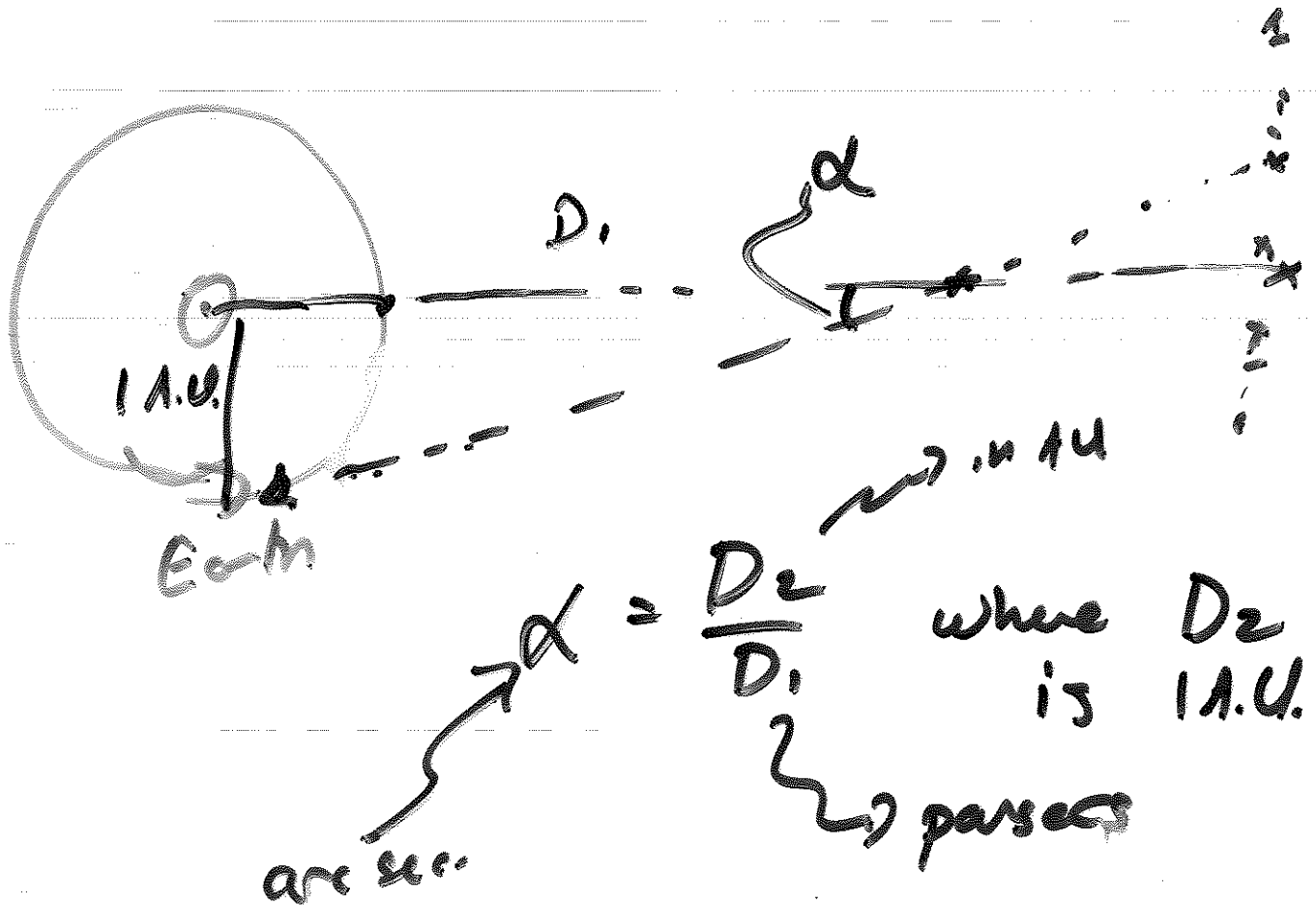








# MEASURING DISTANCE



$$\alpha = \frac{D_2}{D_1} \quad \text{where } D_2 \text{ is } 1 \text{ A.U.}$$

arc sec.  $\rightarrow$  parsecs

$$\frac{1}{\alpha} \text{ in arcseconds} = \text{distance in parsecs}$$

PARALLAX method

"parsec" is "one parallax second"

WORKS TO MAXIMUM OF  
a few hundred parsecs

Star Vega is defined  
to have magnitude 0.

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$$\log(10^x) = x$$

$$\begin{aligned}\log(3 \times 10^2) &= \\ &= \log(10^{1/2} \times 10^2) \\ &= \log(10^{2.5}) \\ &= 2\frac{1}{2}\end{aligned}$$

$$\log(10^x \cdot 10^y) = x + y$$

$$\log(10^x / 10^y) = x - y$$

$$\log([10^x]^m) = m \cdot x$$

Sirius is 3 times brighter than Vega. What's its magnitude?

$$M_s - M_v = -\frac{5}{2} \log (b_s/b_v)$$

$$= -\frac{5}{2} \log (3)$$

$$= -\frac{5}{2} \log (10^{0.48})$$

$$= -\frac{5}{2} \cdot \frac{1}{2} = -\frac{5}{4}$$

$M_s$   $\downarrow$  zero  $= -5/4$

intrinsic brightness:  
ABSOLUTE mag  
M

observed brightness:  
APPARENT mag  
m

ABSOLUTE mag:

The apparent mag IF  
The object were exactly  
10 pc away.

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Sirius is 3 pc away

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$$m - M = 5 \log (D/10 \text{ pc})$$

↑                    ↑

app mag            abs mag

if  $D = 10 \text{ pc}$

$$\log(1) = \log(10^0)$$
$$= 0$$

what is abs. mag of  
Sirius

$$\begin{aligned} -\frac{5}{4} - M &= 5 \log\left(\frac{1}{3}\right) \\ &= 5 \log\left(10^{-1.2}\right) \\ &= -\frac{5}{2} \end{aligned}$$

$$M = \frac{5}{2} - \frac{5}{4} = \frac{5}{4} \quad \text{absolute value of series}$$

$$\log\left(\frac{1}{3}\right) = \log\left(\frac{1}{10^{1.2}}\right)$$

$$\frac{1}{10^n} = 10^{-n} \quad \Rightarrow \quad \log\left(10^{-1.2}\right)$$

$$5 \log\left(\frac{1}{3}\right) = 5 \cdot \left(-\frac{1}{2}\right) = -\frac{5}{2}$$

$$\frac{5}{4} - M = -\frac{5}{2} \quad \text{or}$$

$$\frac{5}{4} + M = \frac{5}{2}$$



if you observe a star  
like Sirius and measure  
apparent mag

8.75

how far away is it?

$$m - M = 5 \log (D/10 \text{ pc})$$

$$8.75 - 1.25 = 5 \log (D/10 \text{ pc})$$

$$\frac{7.5}{5} = \log (D/10 \text{ pc})$$

$$1.5 = \log (D/10 \text{ pc})$$

$$10^{1.5} = 10^{\log (D/10 \text{ pc})} = D/10 \text{ pc}$$

$$10^{1.5} = 10^1 \times 10^{0.5} = 3 \times 10^1 = 30$$

$$30 = D/10pc$$

$$D = 300pc$$

## DISTANCE LADDER

nearby stars:  
distance from  
parallax method

examples of similar stars

~~XX!~~  $\Rightarrow$  assured abs. mag  
compute distance  
then measure app. mag

then abs. mags of  
brighter things

$\Rightarrow$  measure further  
away