COSMIC DISTANCES

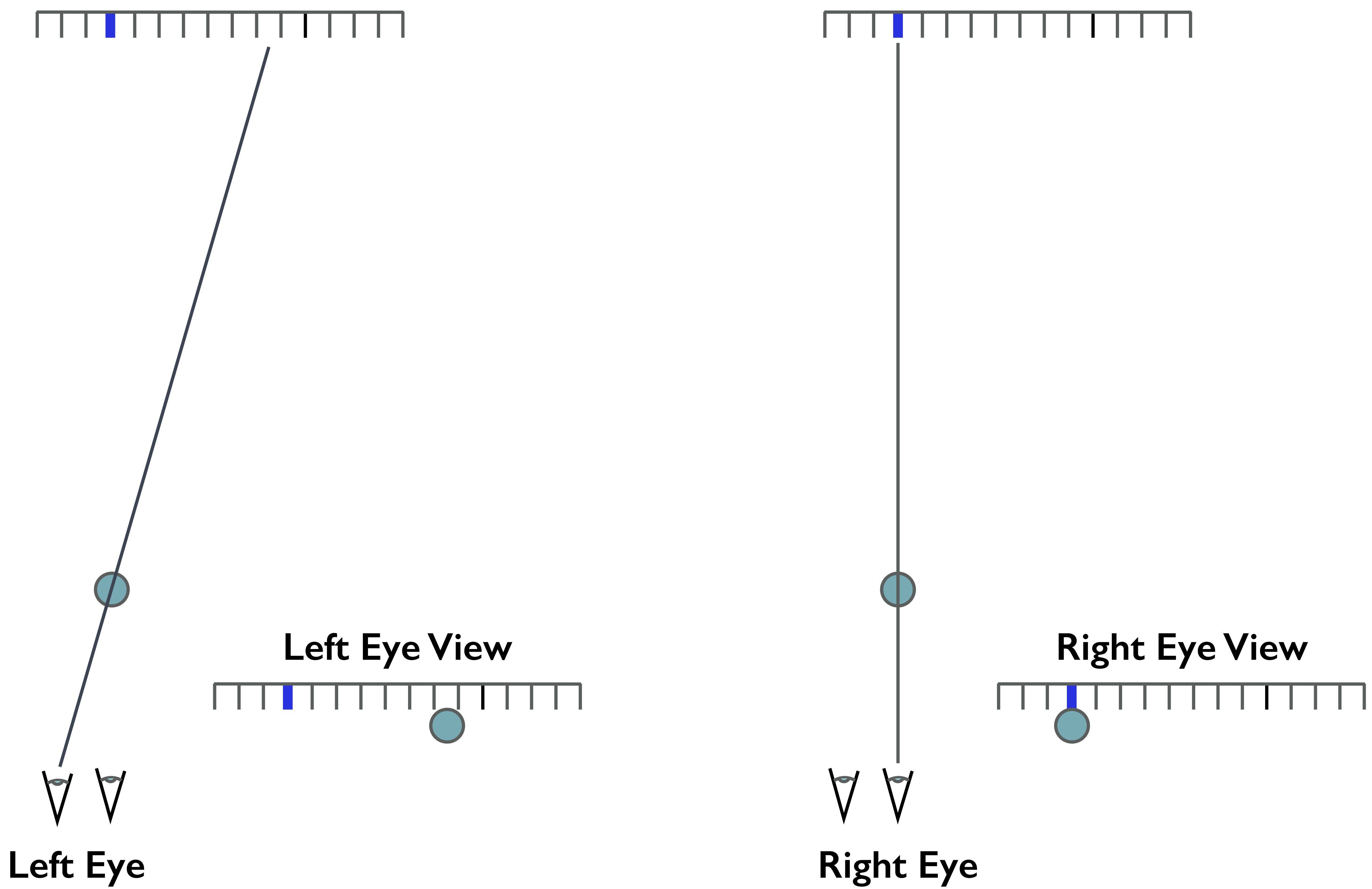
or, 'how far away is that thing anyway?'

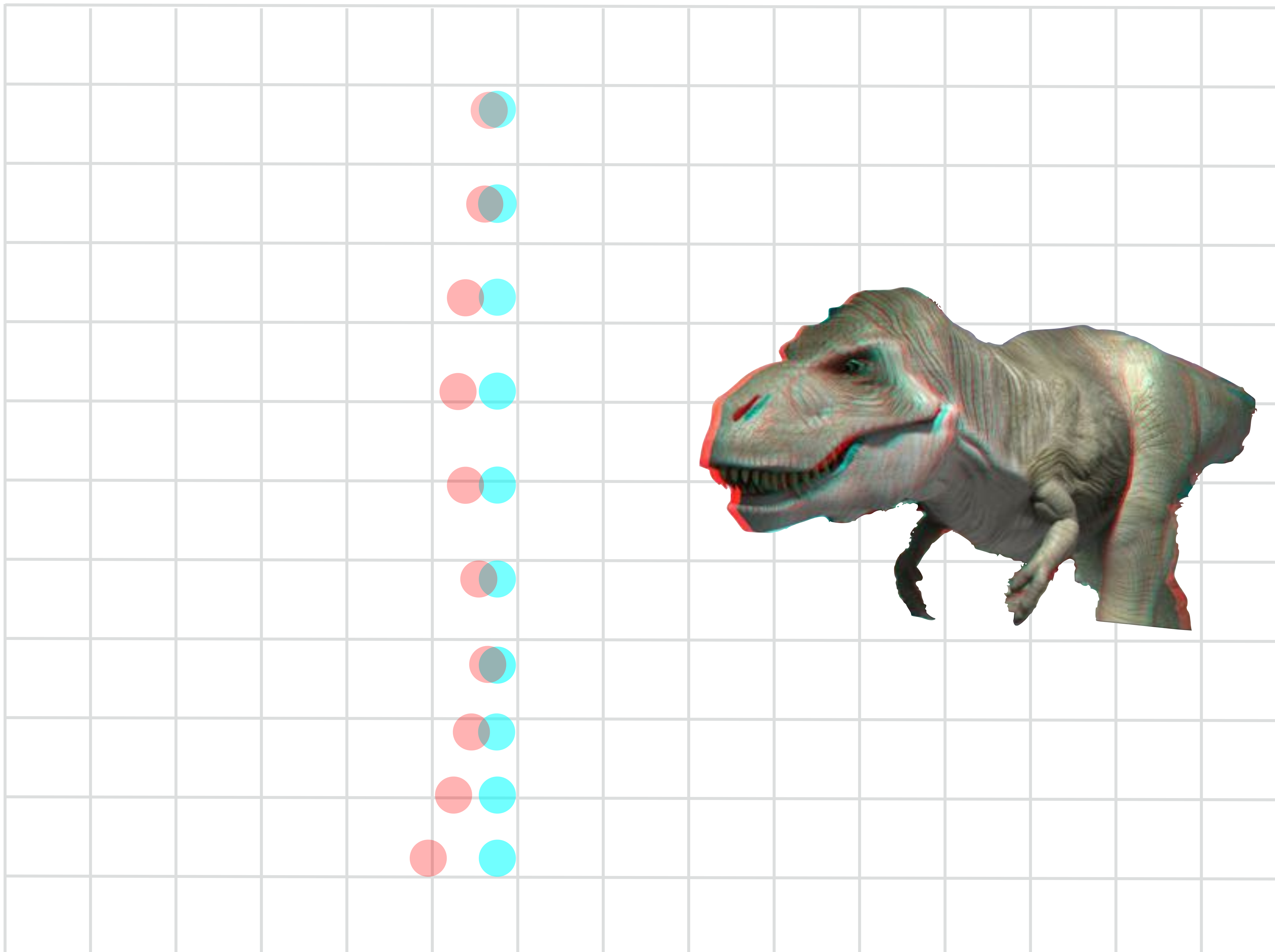
SMA
SOUTHERNMAINEASTRONOMERS

IN ASTRONOMY…

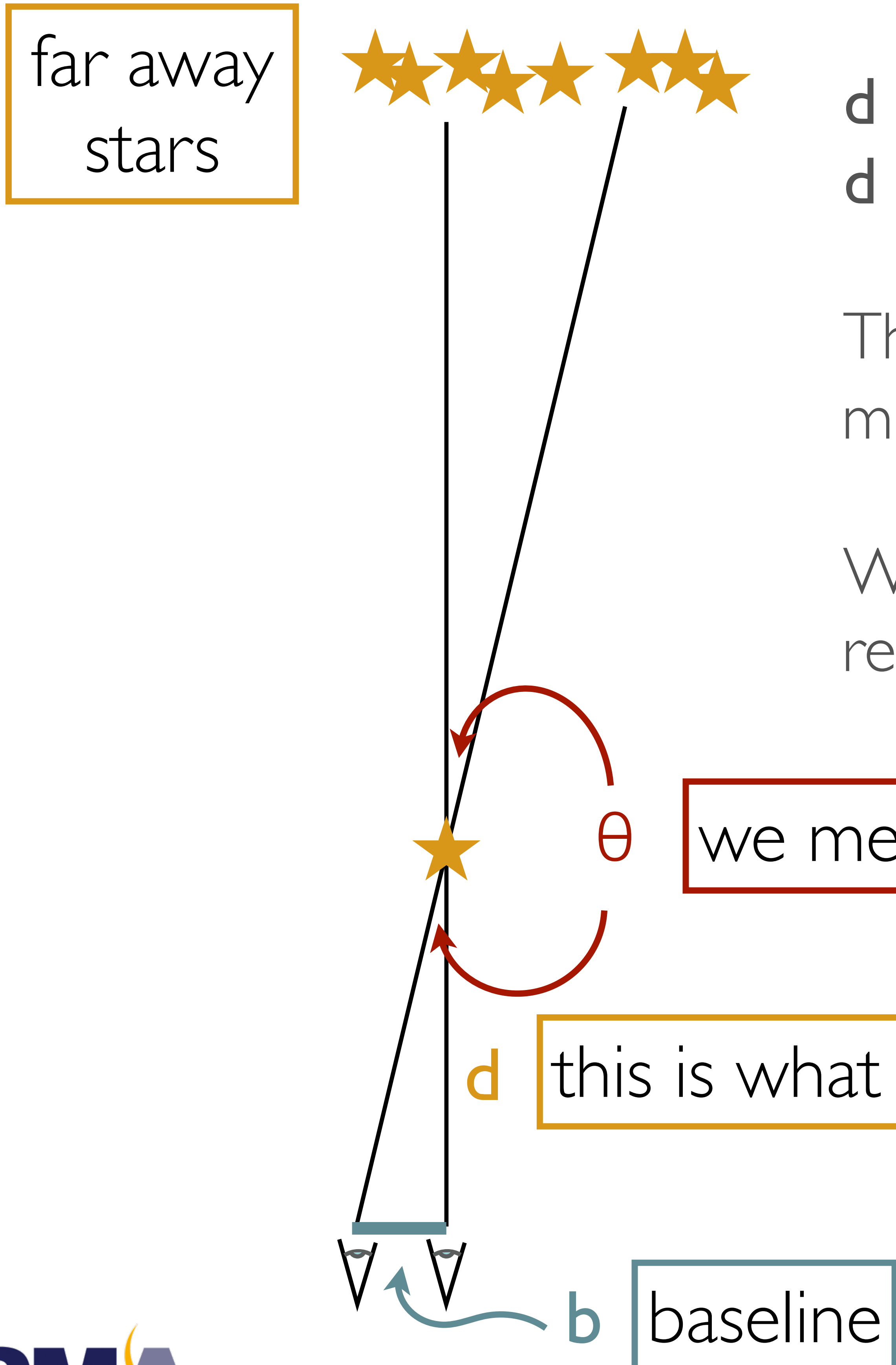
- Angles are easy.
- Distances are hard.
  - Parallax
  - Standard Candle
  - Red Shift

PARALLAX





PARALLAX



$d = b/\tan\theta$

$d \sim b/\theta$ (theta in radians)

The bigger the baseline, the bigger the measured parallax angle θ.

We want a big baseline and we want to resolve very small angles.

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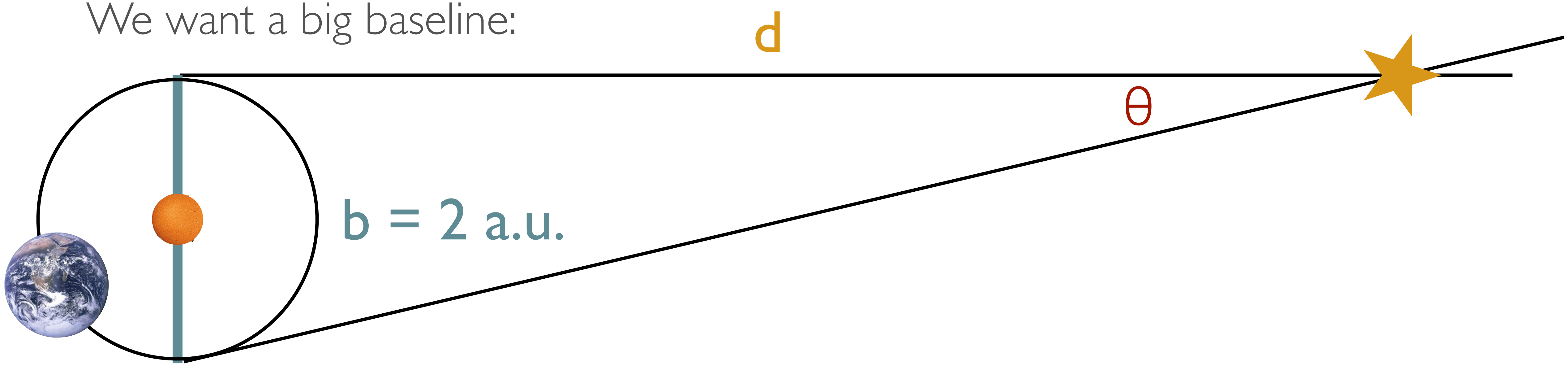
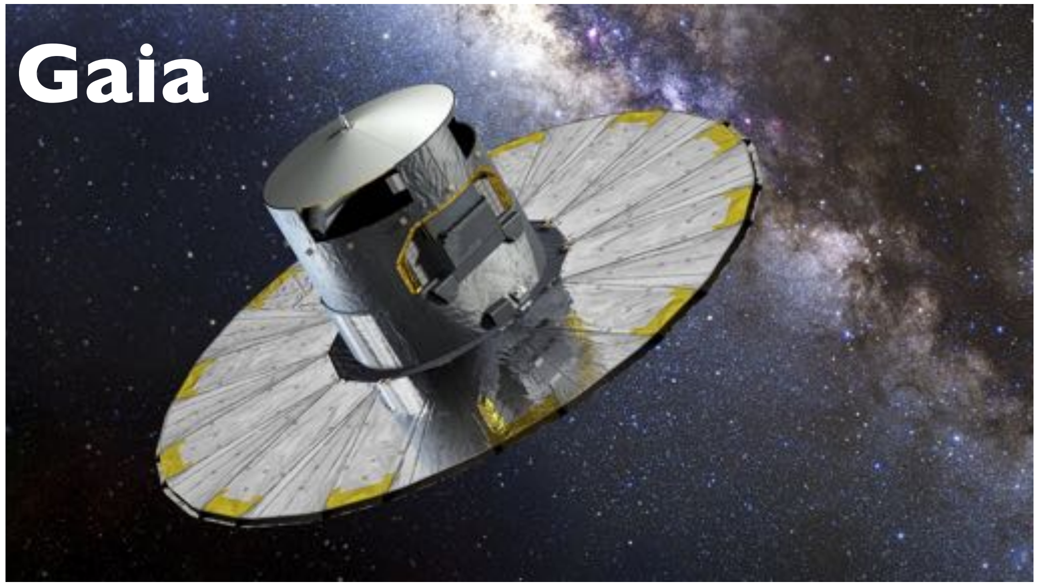
PARALLAX

We want a big baseline:



We want to resolve very small angles:



Resolution 20μAS (!)

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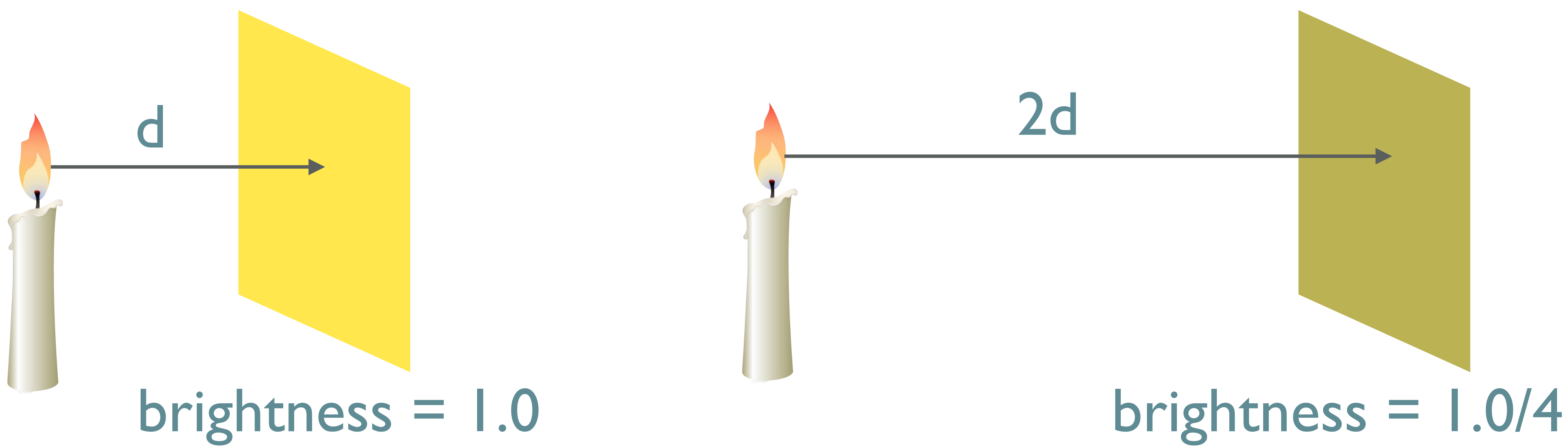
STANDARD CANDLES

- They were a real thing for a while.
- The idea is simple (and that usually means good):



STANDARD CANDLES

- Standard Candles in space.
  - Must be standard.
  - Must be (very) bright.

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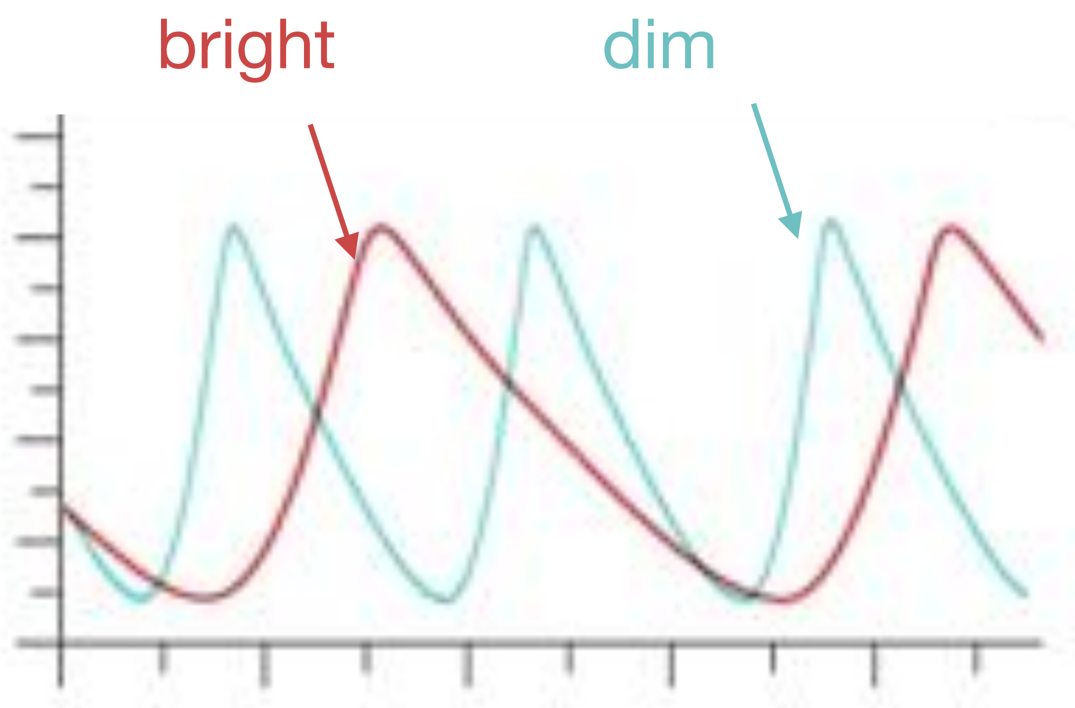
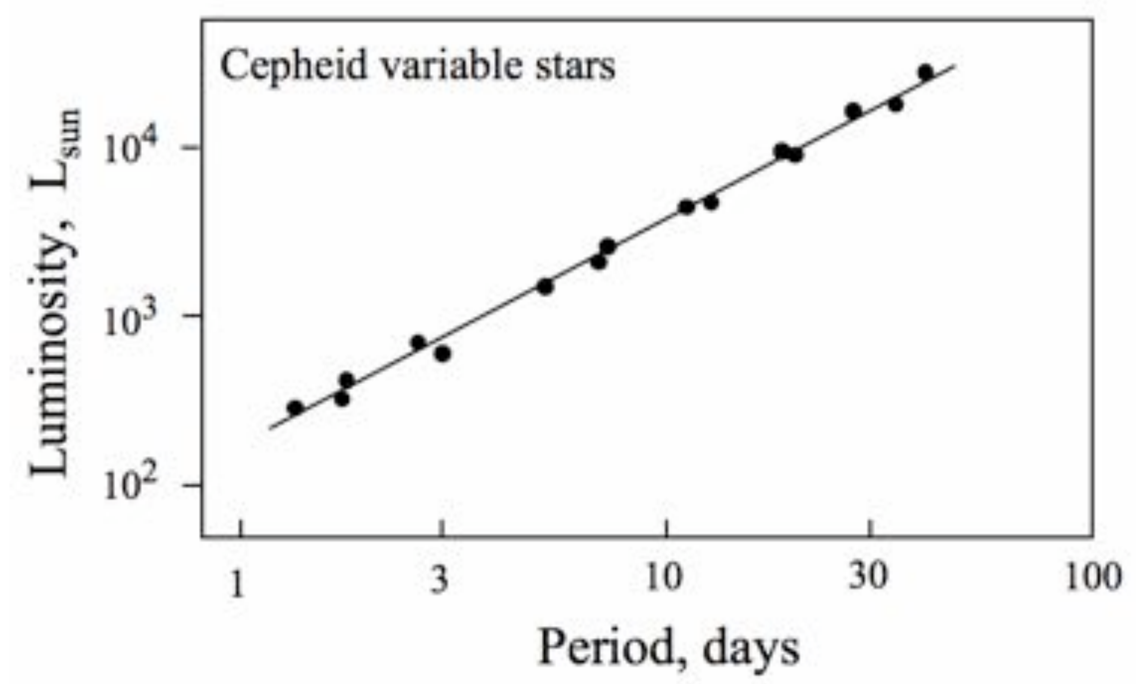
STANDARD CANDLES

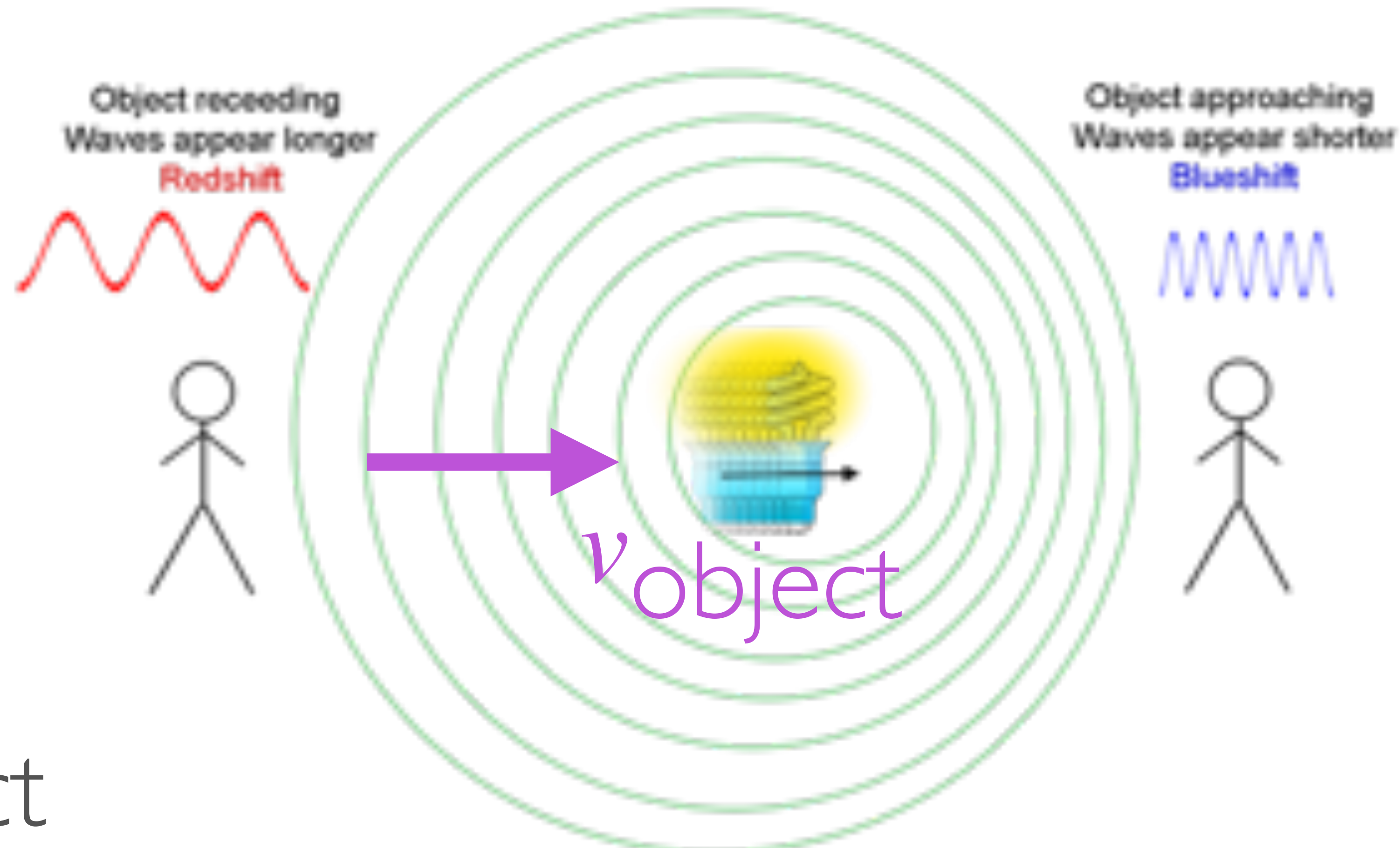




Also: Type 1a supernovae and others.

RED SHIFT

DOPPLER EFFECT



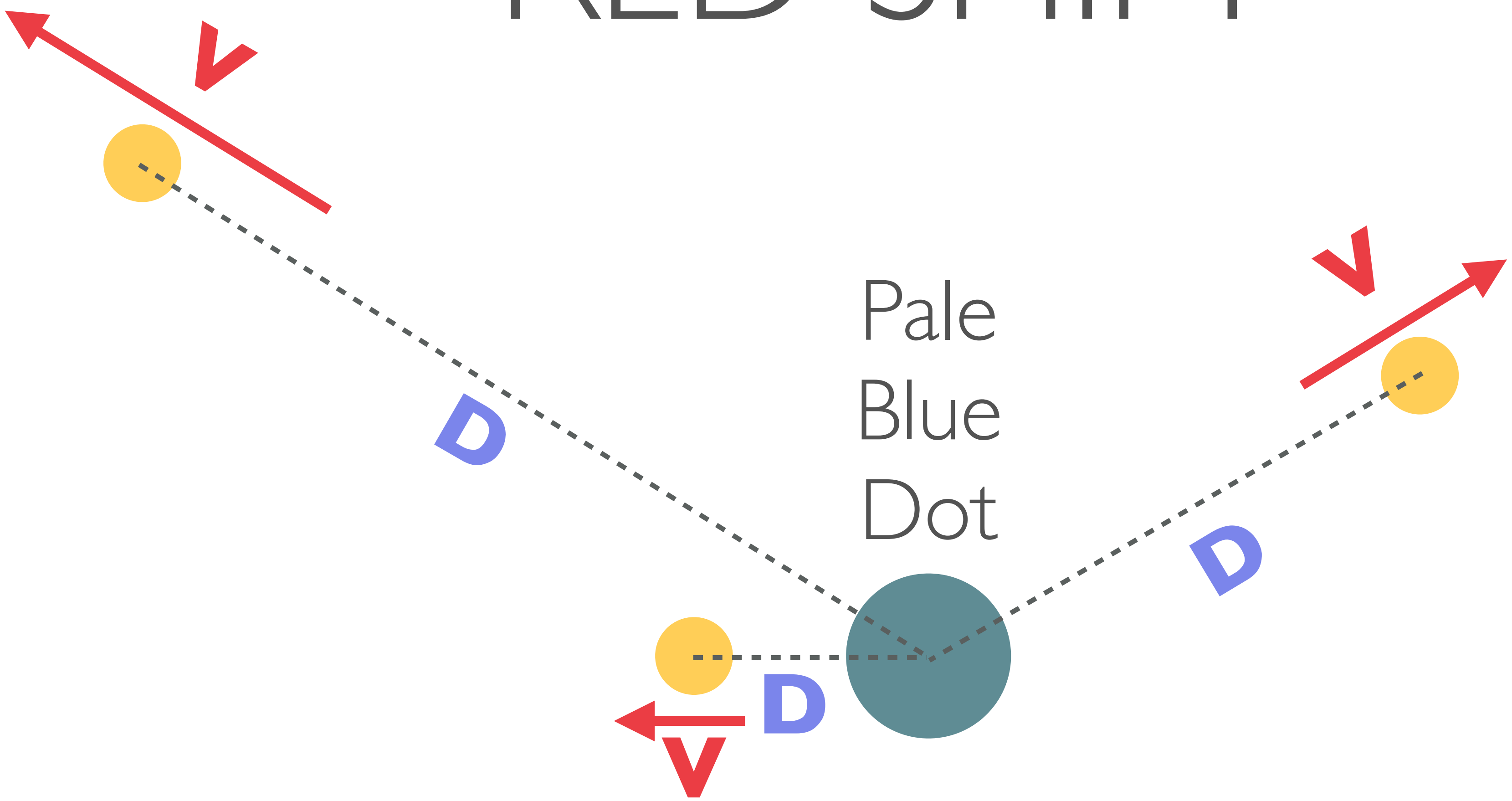
$$\frac{\Delta\lambda}{\lambda} = \frac{v_{\text{object}}}{v_{\text{wave}}}$$

$$v_{\text{object}} = v_{\text{wave}} \frac{\Delta\lambda}{\lambda}$$

$$v_{\text{object}} = c\frac{\Delta\lambda}{\lambda}$$

SOUTHERNMAINEASTRONOMERS

RED SHIFT



- Big Bang Recessional velocity is proportional to distance (**V=constant X D**). Let's call the constant '**H**'.
- **D** = **V**/**H**
- Measure Δλ, use Doppler equation to get **V**.
- Solve for **D**!