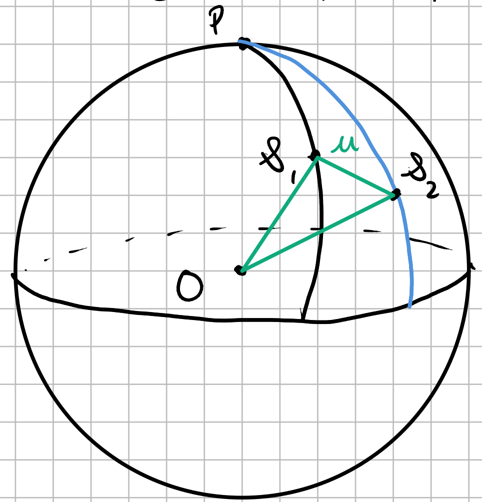
Ch4 Stellar Motion

Consider δ1 and δ2, the position of a star one year vs the next year



$\vec{\mu} = \Delta \vec{\delta}$

let $\vec{\mu} = \Delta \vec{\delta}$

μ can be so large that precession and nutation cannot account for position change

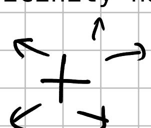
Proper Motion - The star has a angular velocity (ω)relative to other stars
- can be as large as several arcseconds/year

Two factors for proper motion
1) Stars independent motion in space

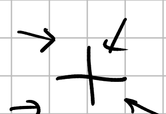
closer objects have greater ω

2) Motion of Solar System relative to star (Solar apex and antapex)

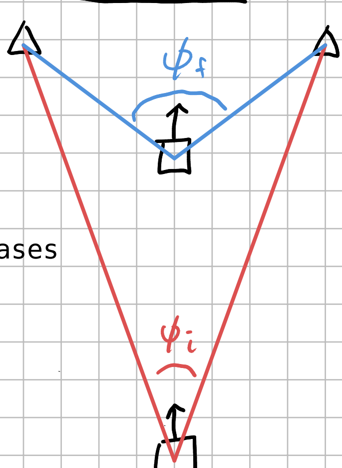
Solar apex: point in sky towards the Sun
- stars in this vicinity have ω away from apex



Solar antapex: opposite side of Solar apex
- stars in this vicinity have ω towards antapex

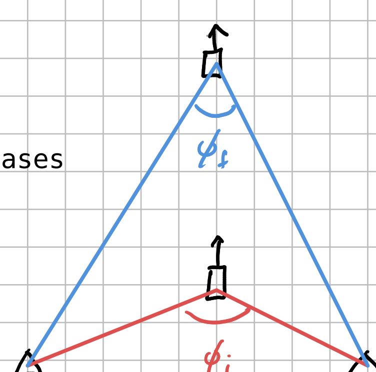


Solar Apex



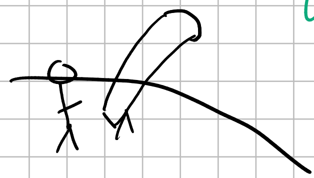
φ increases w/ time

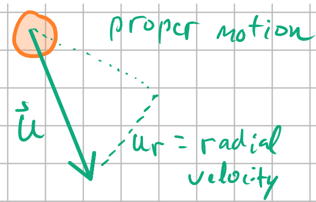
Solar Antapex



φ decreases w/ time

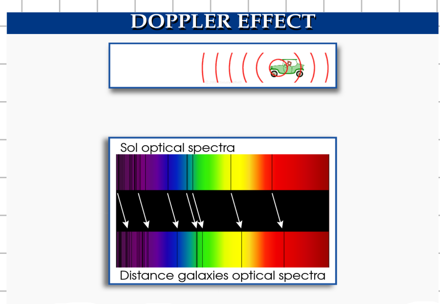
largest for close stars with high orthogonal (to us) speeds
Effectively zero proper motion for distant galaxies





Radial Velocity

Can be directly measured through Doppler Shifts (works for any star)



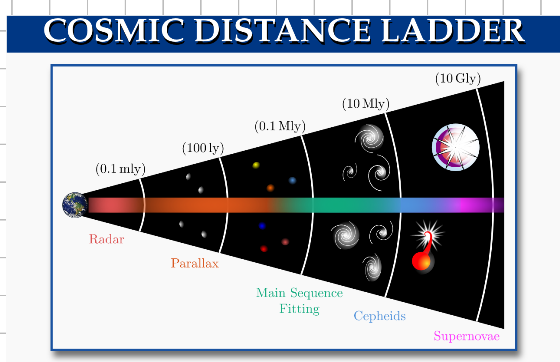
λ_0 = rest wave length

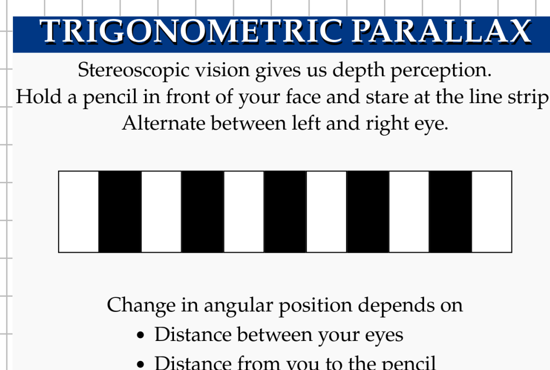
λ = observed wavelength

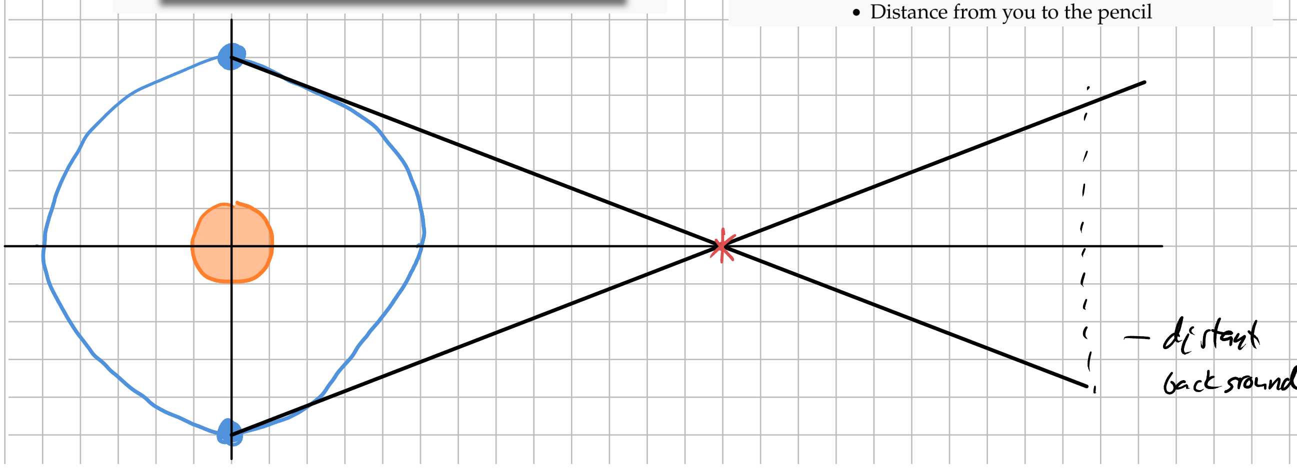
$$\frac{\Delta\lambda}{\lambda_0} = \frac{\text{object's radial velocity}}{\text{speed of light}}$$

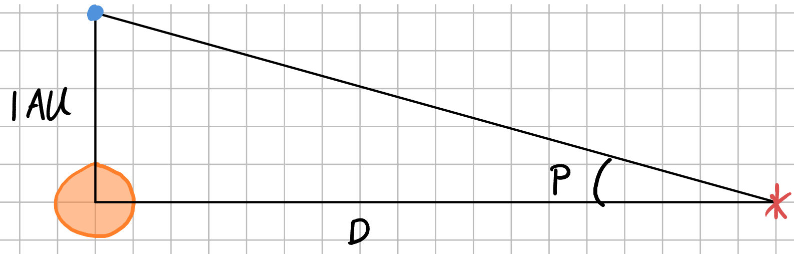
Space Velocity

Given proper motion, radial velocity, and DISTANCE
we can measure the object's true motion through space.









p = parallactic angle in arcseconds

D = distance to star

1 parsec = object distance where $p = 1''$

$$1\,\text{pc} = 3.1 \times 10^{16}\,\text{m}$$
$$= 206205\,\text{AU}$$
$$= 3.26\,\text{ly}$$

$$\tan(p) = \frac{1\,\text{AU}}{D} \xrightarrow{\text{S.A.O}} p = \frac{1\,\text{AU}}{D}$$

Other factors in measuring stellar coordinates
- refraction of light through Earth's atmosphere
- aberration of starlight

your motion affects apparent motion of rain

same for star light