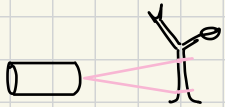
8/20 Class Notes

→ have to measure FOV!

→ for pixel/arcsec, have to use image on display to make estimate.
- RAW format ⟶ prevents automatic camera corrections.
- python script on ELC.



use stationary object to measure.
↳ use Aiden (6'4") and measure distance he needs to stand in order to span diameter of FOV.

→ choose + submit term project; create LaTeX template to have more structure in goals and methods.

→ Thursday: Nandana guest speaker!

---

→ What is observational astronomy? ⟶ theoretical (incl. simulational) astronomy is on the other end of the astro spectrum.
- four main areas:

↳ temporal monitoring
- photometric, spectroscopic, astrometric monitoring

→ photometry:
- measure of brightness, color : imaging, filters, etc.

→ astrometry
- measurement of position

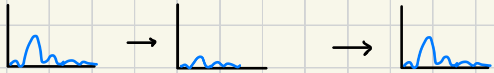
→ spectroscopy
- measurement of photons as $f(\lambda)$.

→ 3 major branches of astronomy as a whole:
- observational ⟶ advancing theory thru. observation.
- theoretical (Princeton, Harvard) ⟶ astrophysics, simulations
- instrumentation (Arizona, Texas) ⟶ building instruments

↳ institutions who are instrumental to engineering also get preferential access.

→ which requires longer exposures/ takes more time to capture?
- it may seem intuitive to assume photometry is more intensive, but spectroscopy exceeds it by a mile.
- spectroscopy looks at much narrower $\lambda$ intervals — takes much more time to tune out noise.

→ spectroscopy, to a degree, is more straightforward than photometry:
- photometry is contingent on compliant weather.
- spectroscopy is affected less by phenomena by clouds because wavelengths are suppressed proportionally when obscured.




magnitudes stay proportional!

→ with our current technology, we care a lot more about precision:
- crucial to retain precise measurements due to distance of phenomena.
- only minor clues to show major motion!
- miniscule deviations we notice could be indicative of, for example, a hidden binary or exoplanet.
  - ↳ measurements of 1E-8 arcseconds!!
  - → equivalent to looking at a human hair on the moon.

hence, astrometry is becoming more significant!

→ temporal monitoring is more general: change of parameters as a function of time.

→ photometric data is much easier to obtain outside of atmosphere.
- still susceptible to dust.

→ spectroscopy can extend beyond visible light spectrum, but tools are still limited:
- e.g. cannot detect VLS & x-ray @ same time?
- heavy metals ⟶ VLS
- different materials ⟶ xray

each spectrum domain utilizes specific & distinct detection methods.

→ carriers of information:
- electromagnetic radiation ⟶ photons!
- particles ⟶ cosmic rays, neutrinos, etc.
- gravitational waves

neutrinos let us see the inside of things: the sun, supernovae, etc.

becoming more popular.

nowadays, multiple carriers are being considered simultaneously.

→ several parameters need to be considered:
- measurement sensitivity & noise
- energy ($\lambda$) coverage
- resolution: temporal, spectral, spatial
- variability: temporal, spectral, spatial
- and more exotic things like polarization.

sensitivity: dependent on size of tool, signal / noise ratio.
→ ideal $S/N \approx 10\%$.

→ our goal / "the process" behind observation:

i) a spectrum S is emitted by a source at distance $\vec{r}$ and time t: $S(t_0, \lambda, \vec{r})$

ii) spectrum passes through medium/instrument. Degree of alteration is wavelength-dependent and the alteration can be expressed as a function M (matrix).

iii) finally, altered spectrum is obtained by observer O at time $t_1$: $O(t_1, \lambda, \vec{r})$

→ we want to recover $S(t_0, \lambda, \vec{r})$ from $O(t_1, \lambda, \vec{r})$

- $O(\lambda) = S(\lambda) \times m(\lambda)$ } element-wise multiplication.

$= S(\lambda) \times IGm(\lambda) \times ISm(\lambda) \times A(\lambda) \times T(\lambda) \times I(\lambda)$