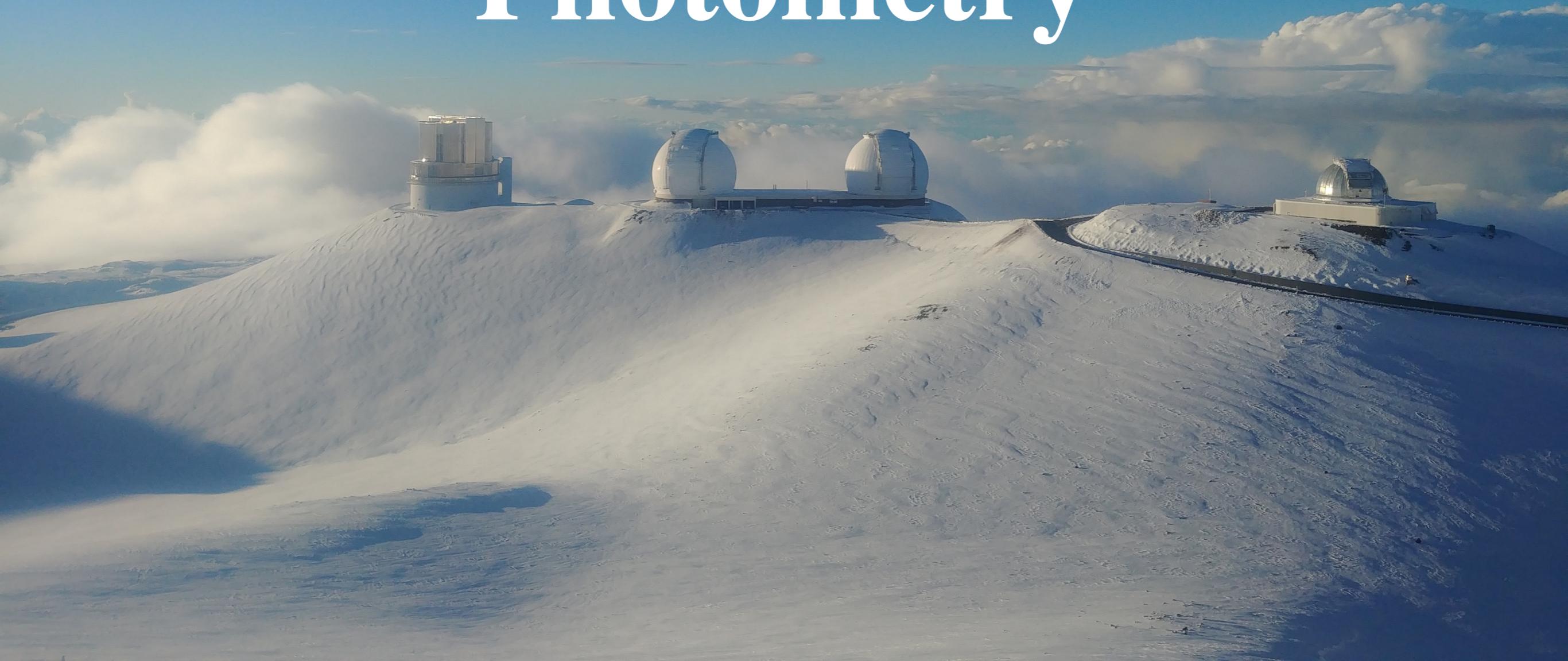


Introduction to Photometry

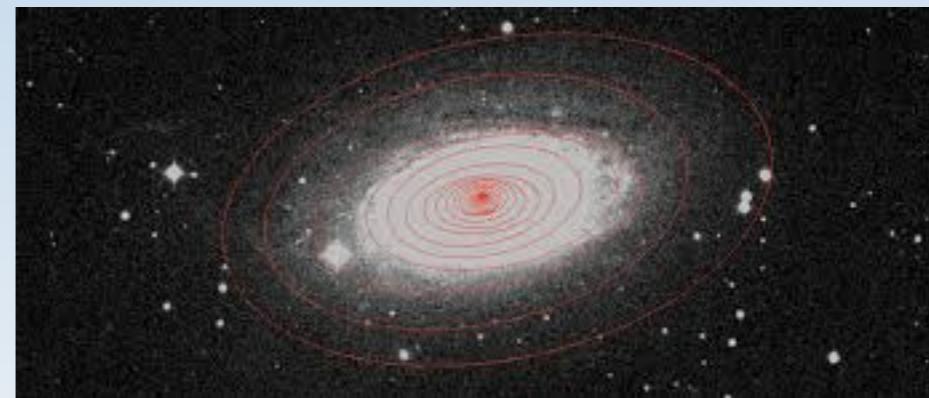
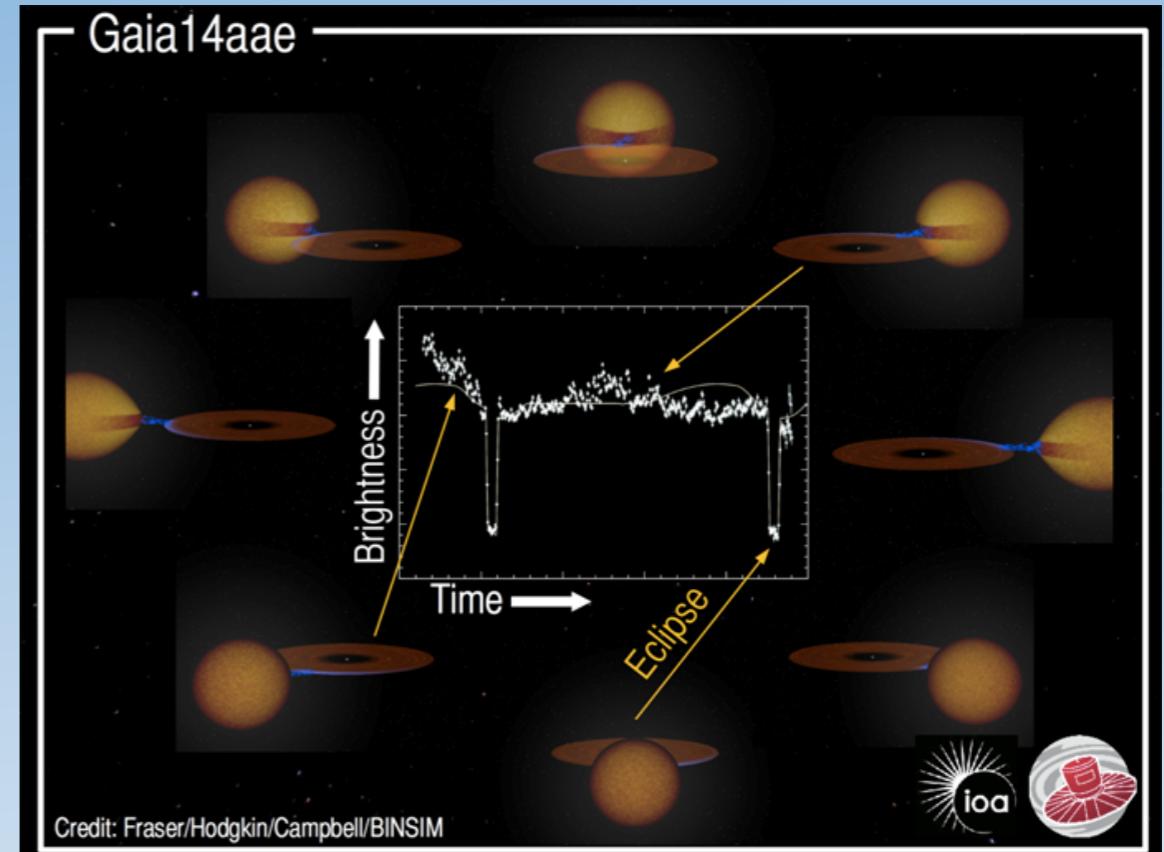
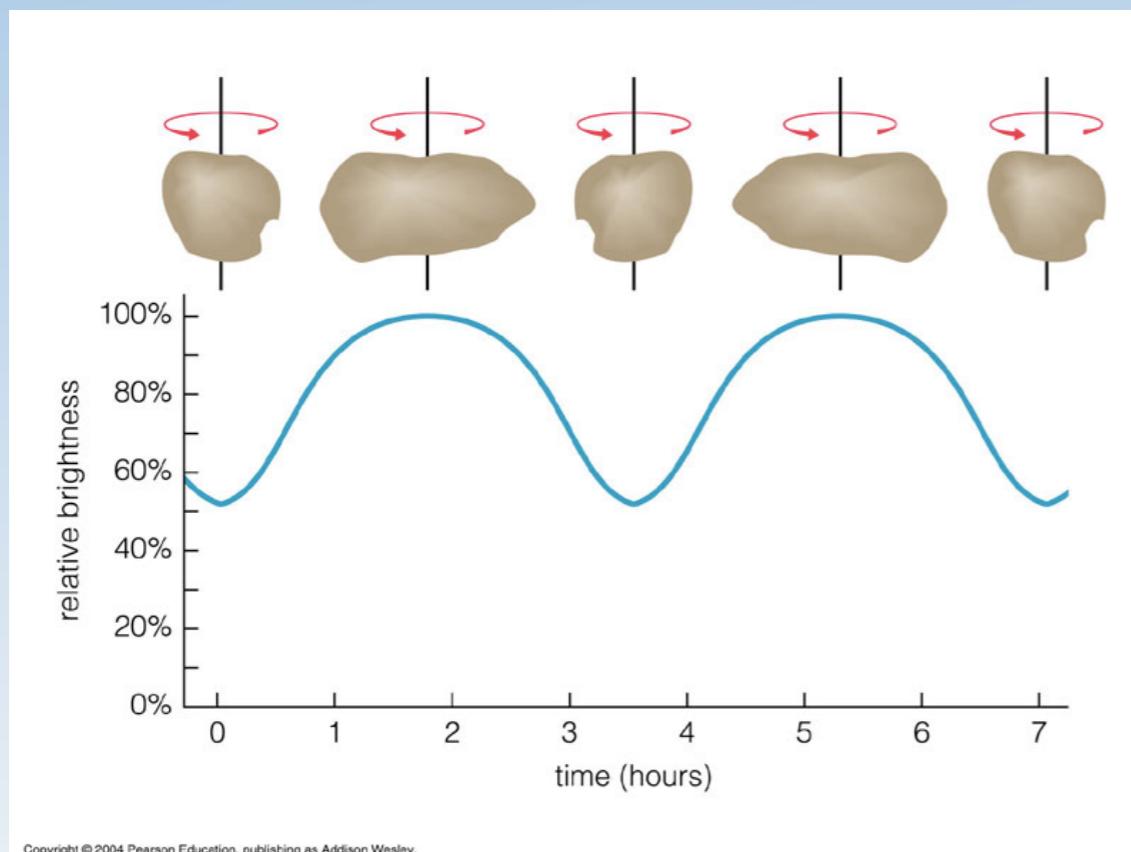
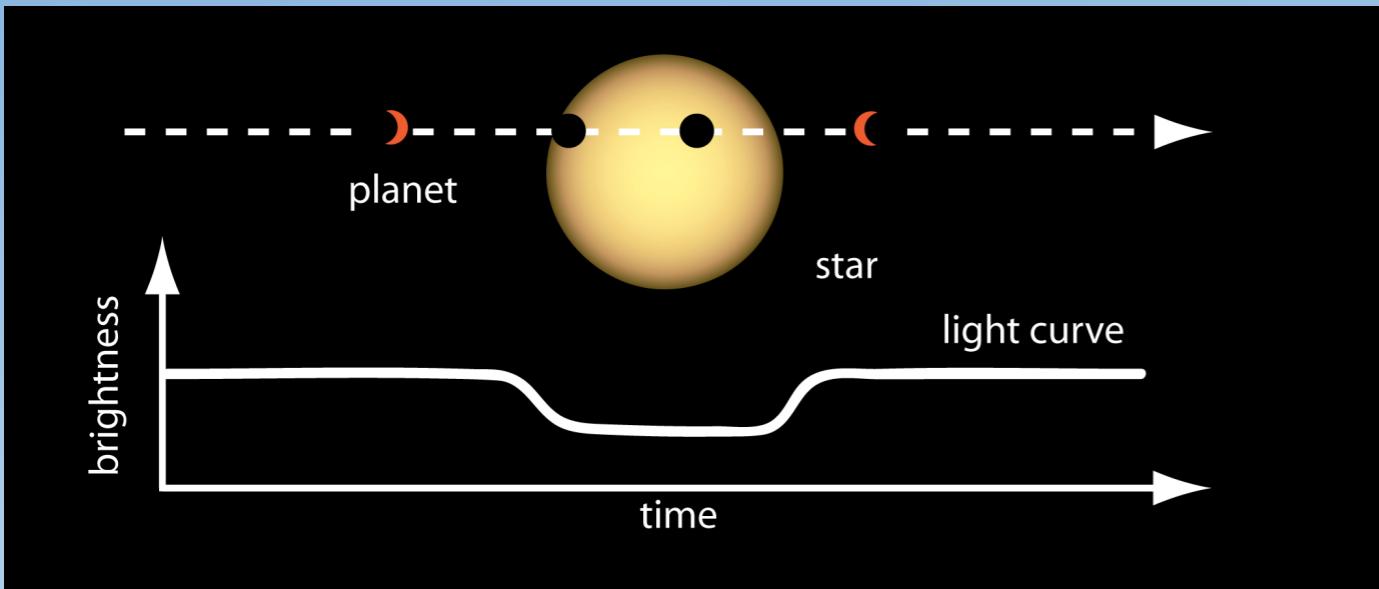


What is photometry?

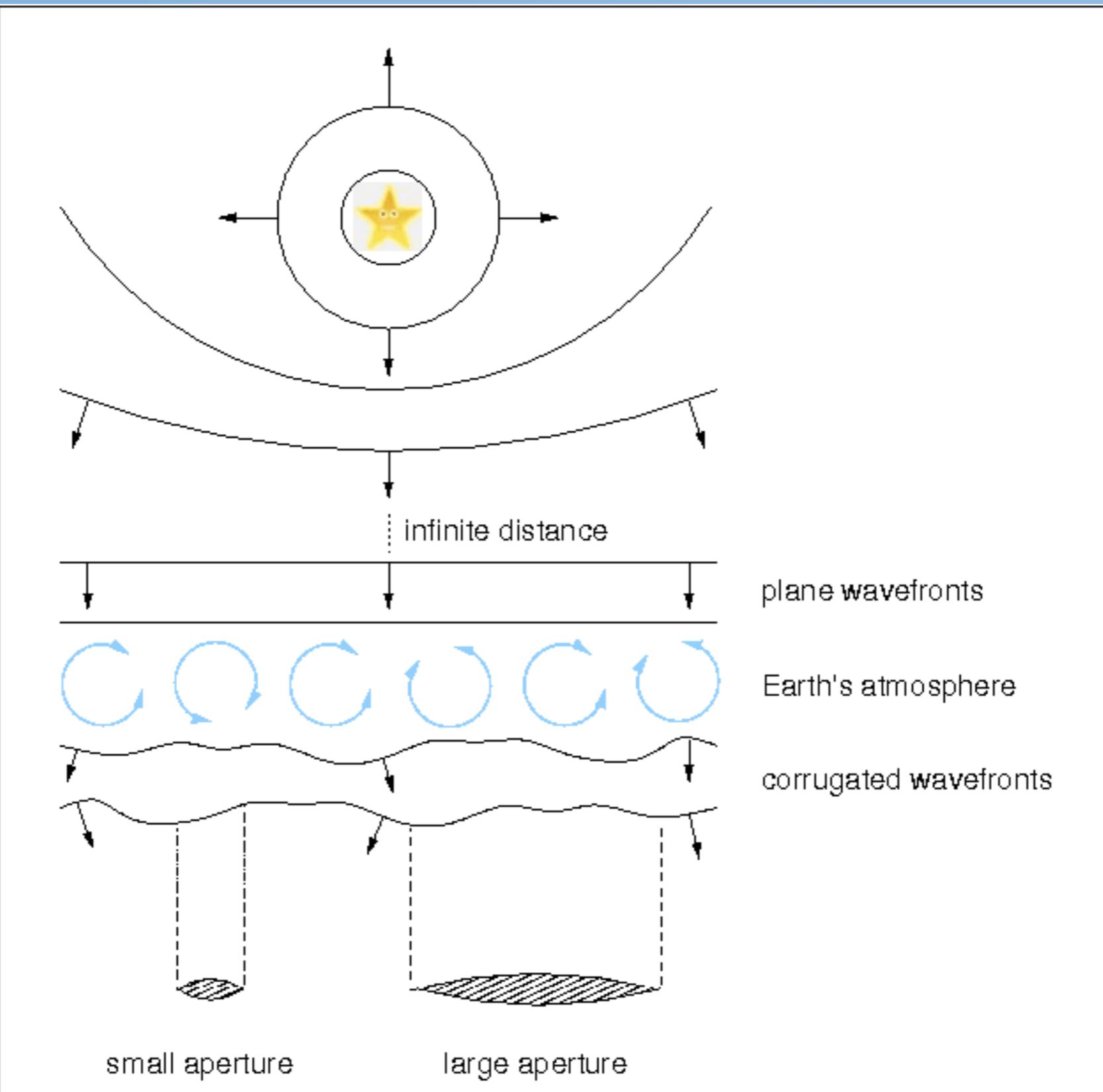
- Photometry: measurement of light
- How much? What colour?



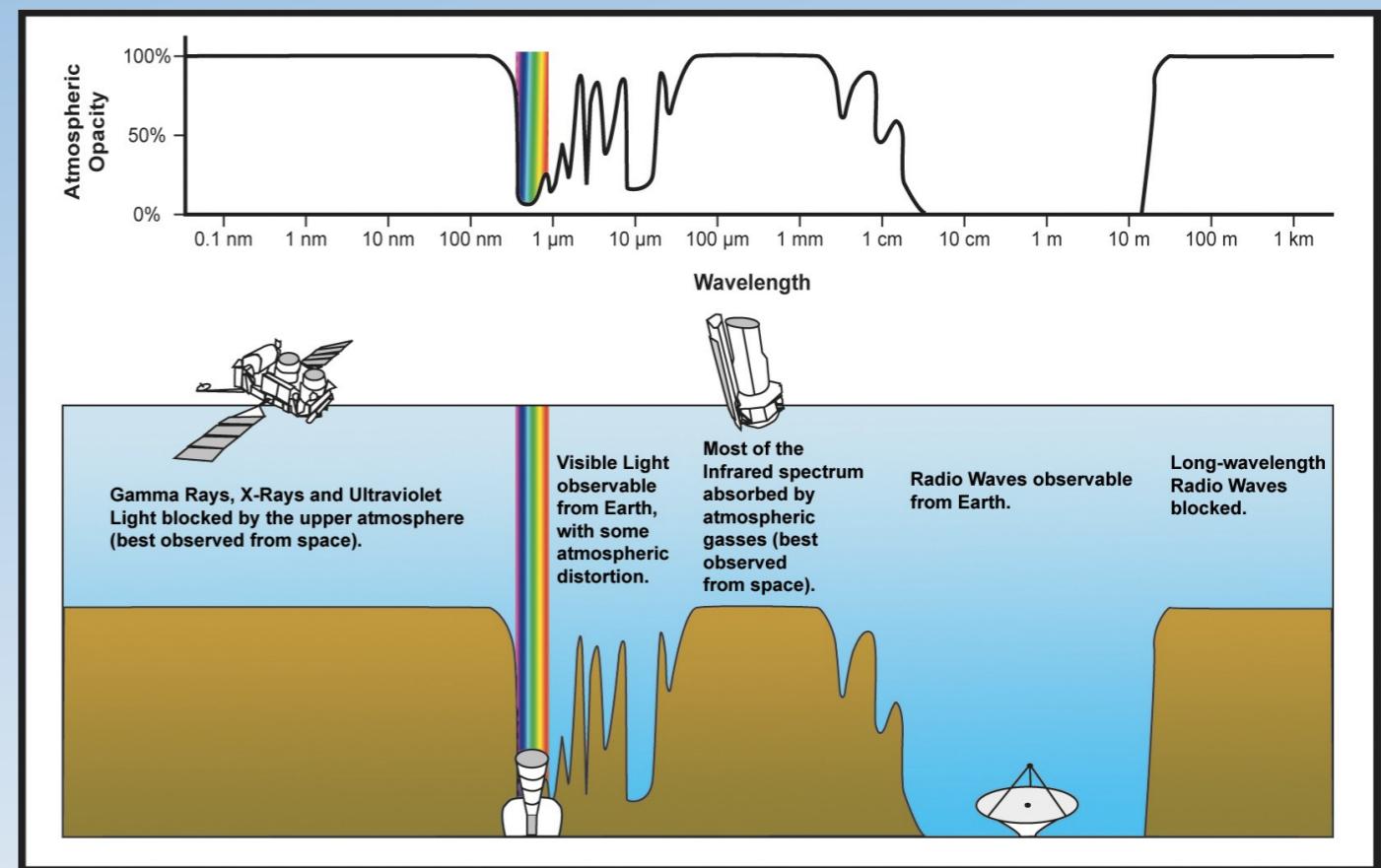
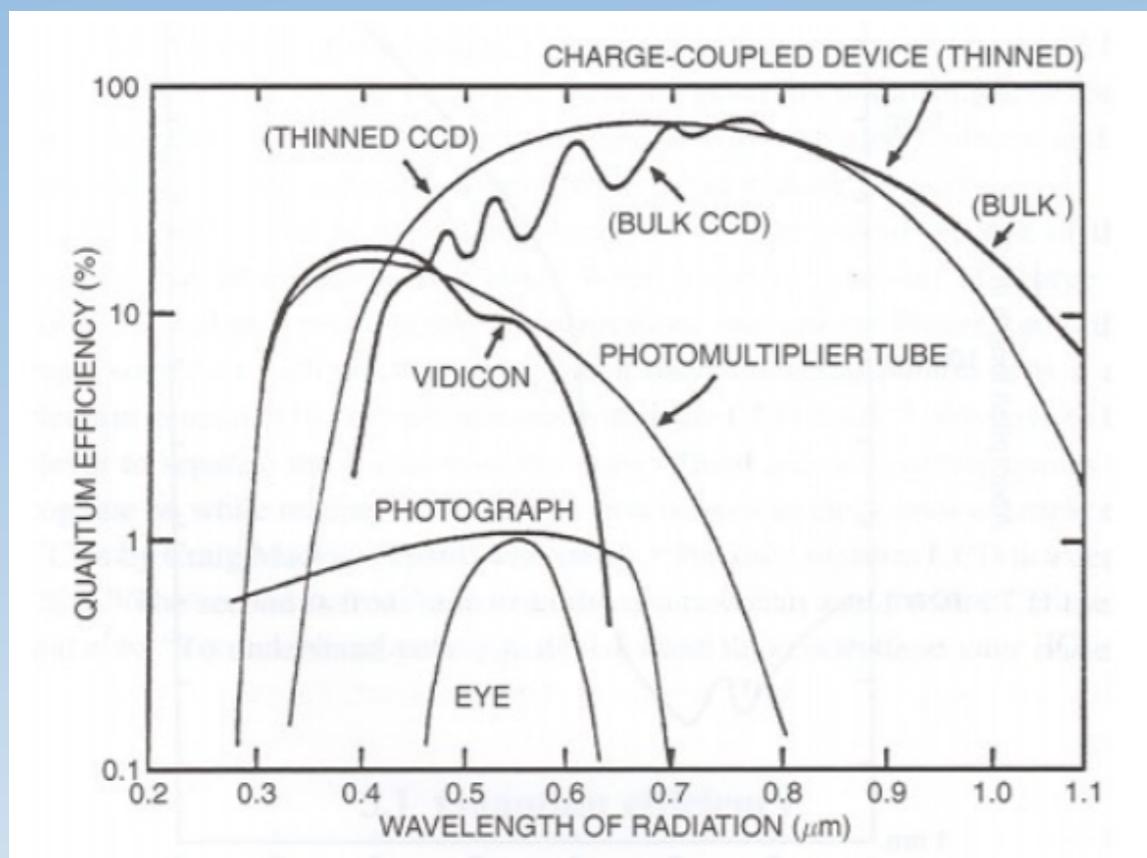
Examples of photometry



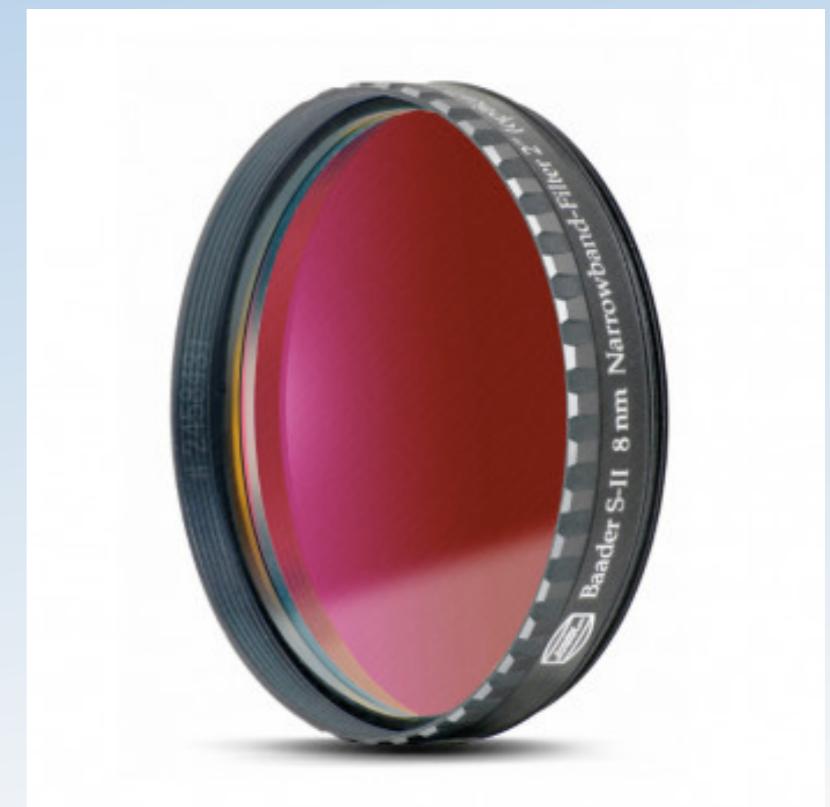
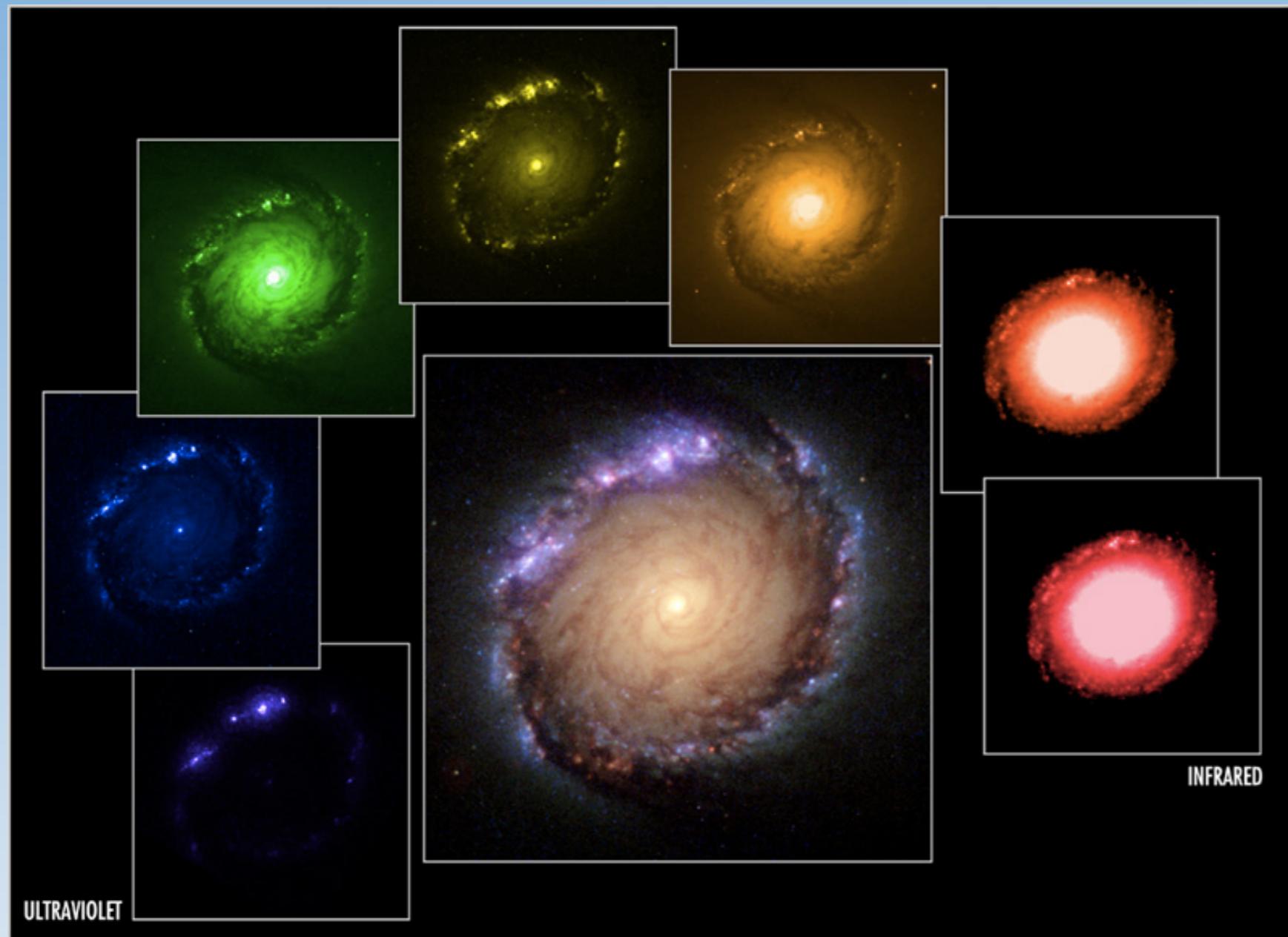
Light From a Source



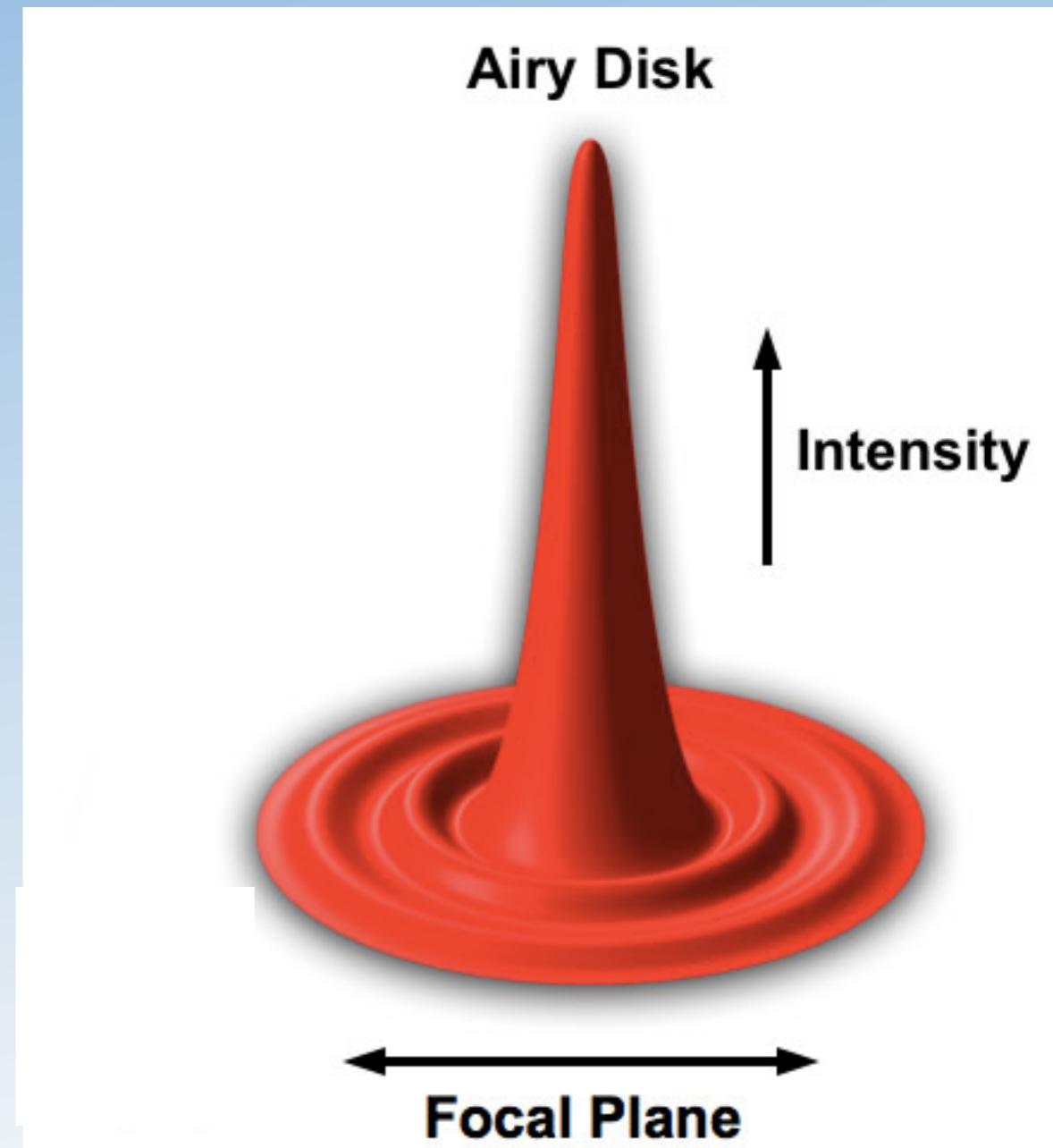
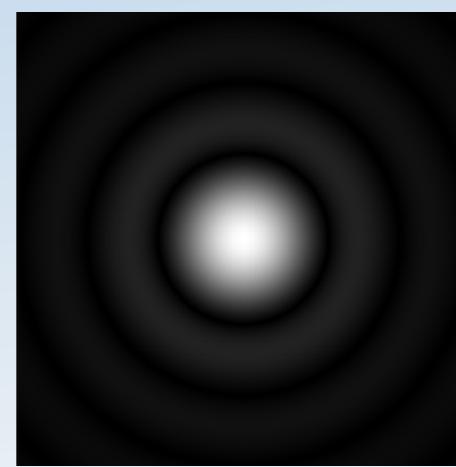
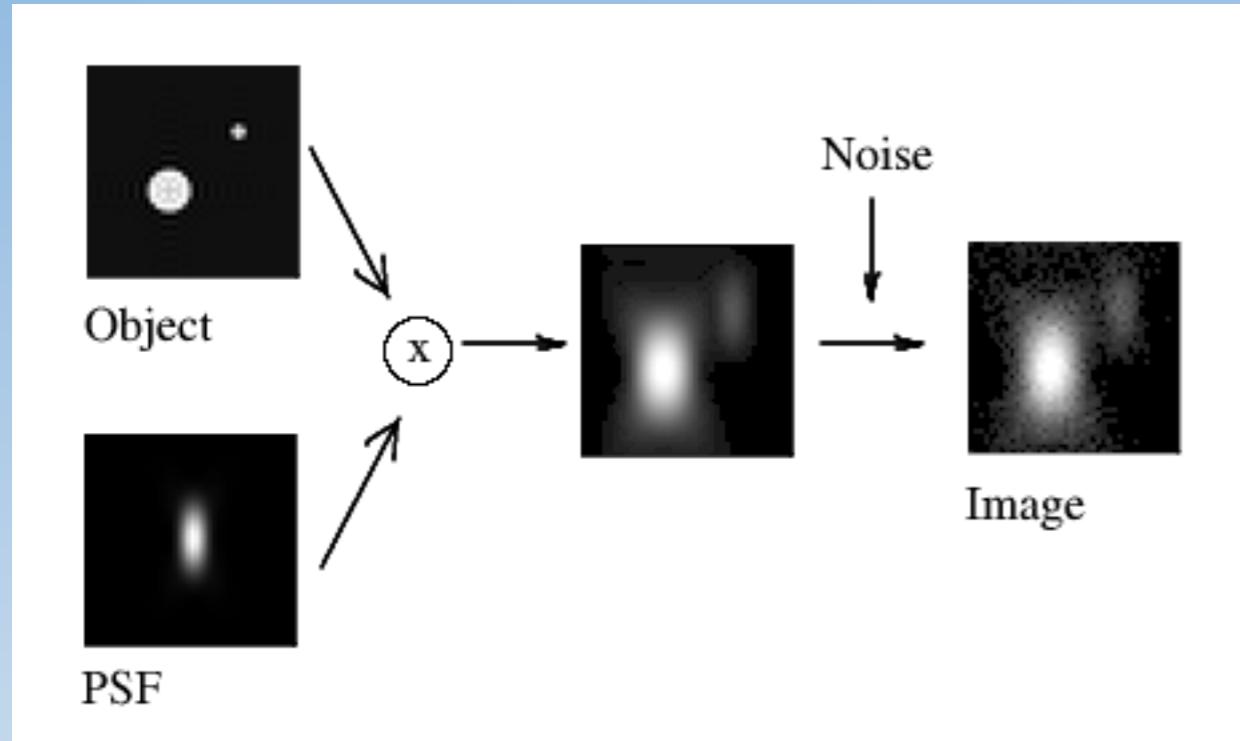
Transmission Curves



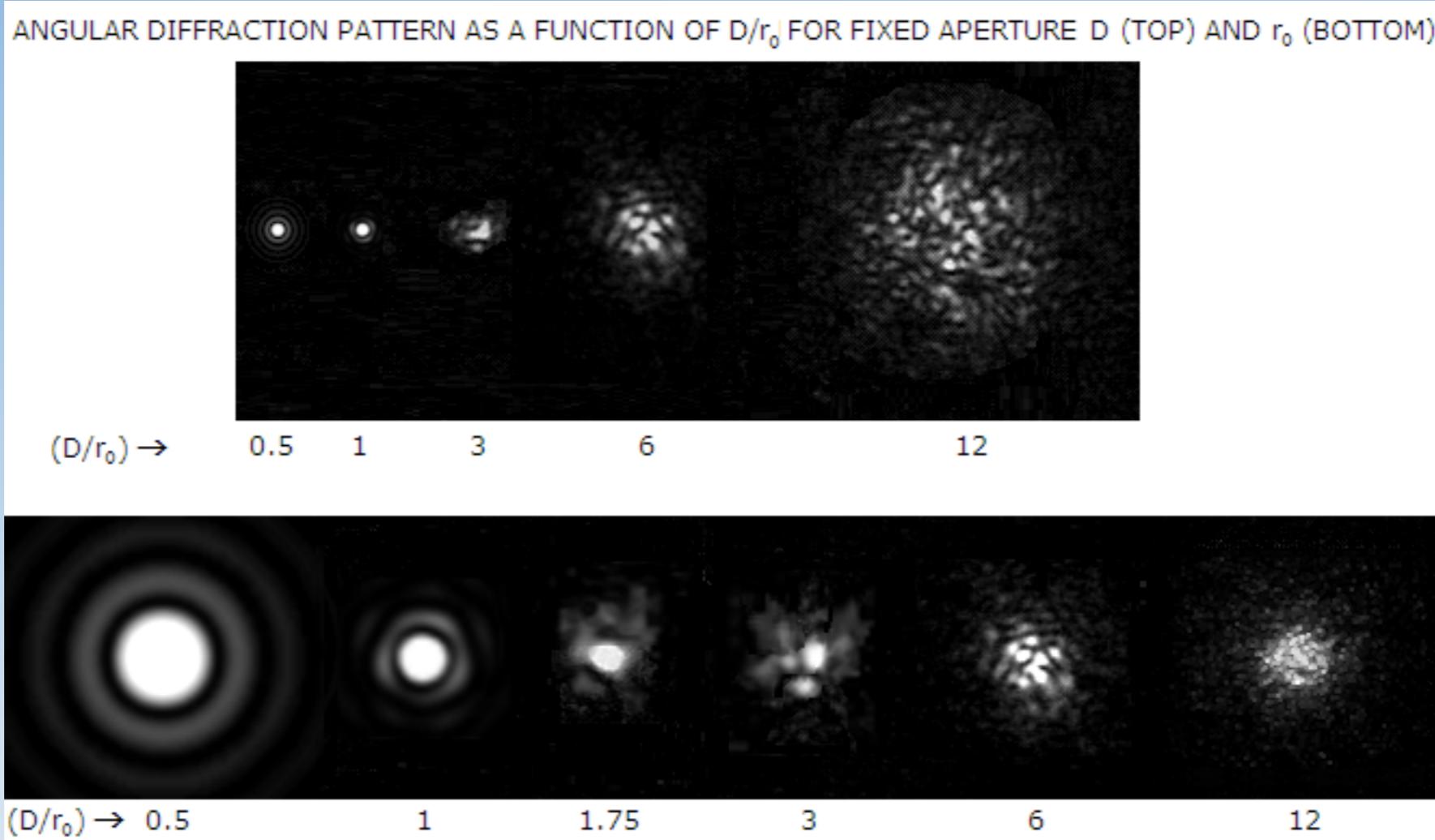
Filters



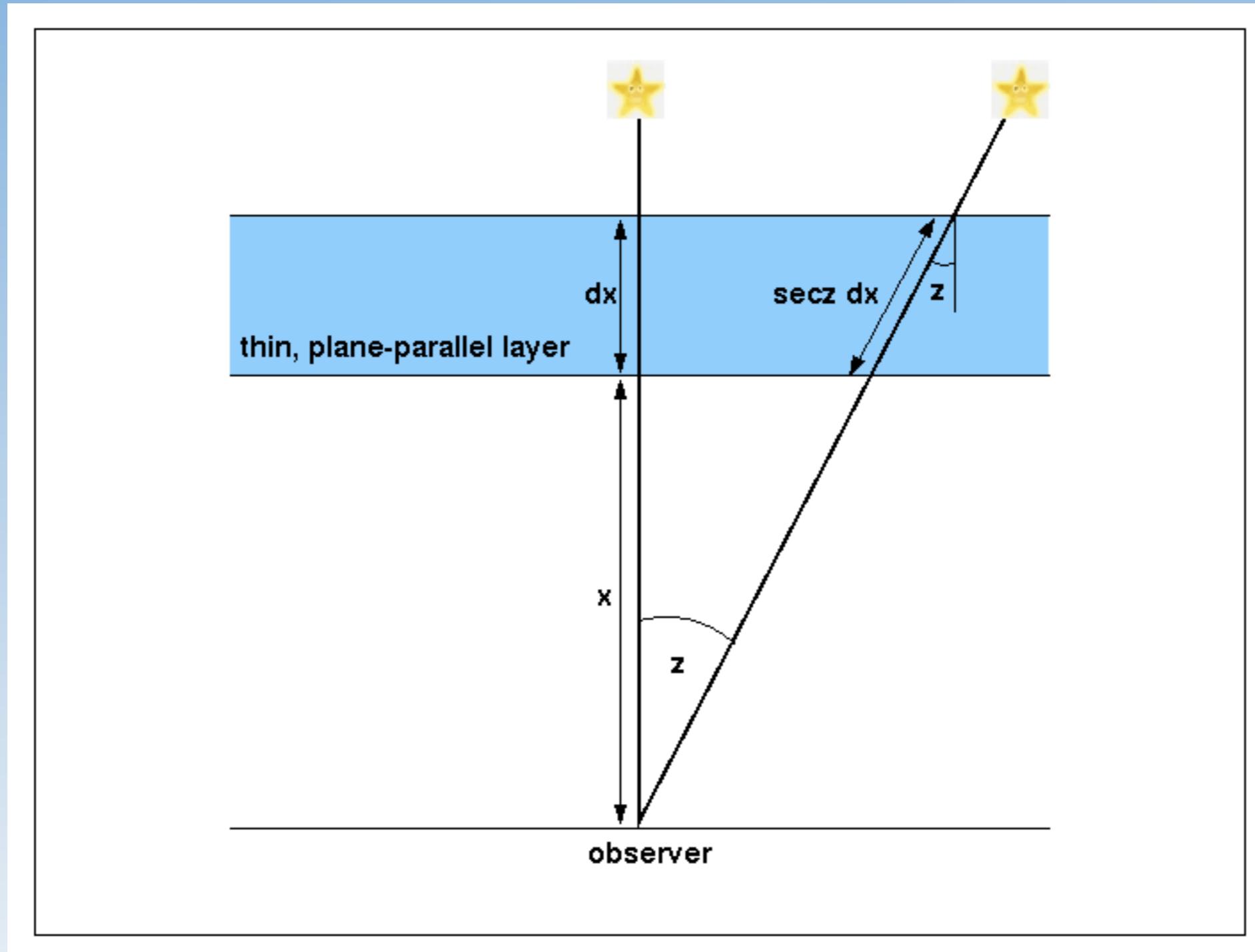
Point Spread Function



Atmospheric Effects

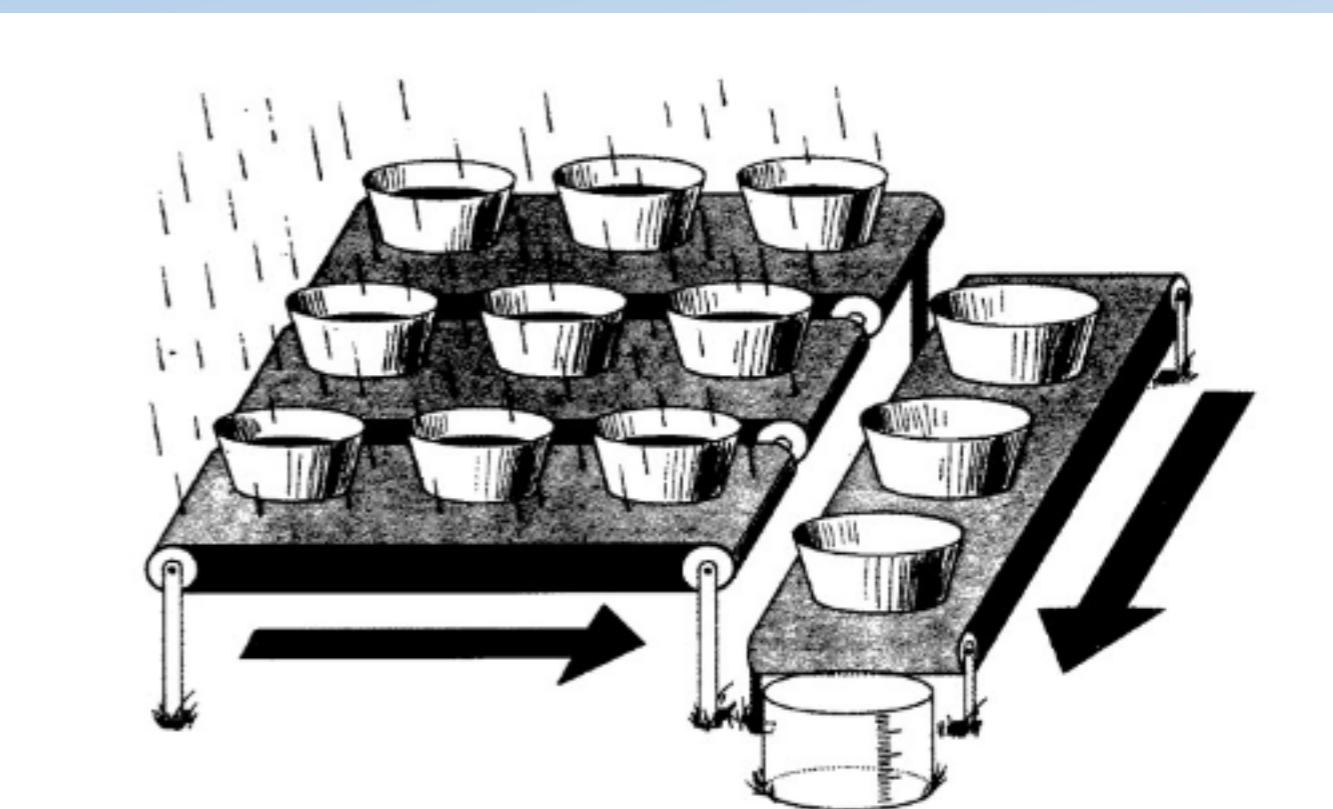


Extinction



Detector Response

- GAIN = the number of required electrons to produce 1 ADU ($-e/ADU$)



(Janesick & Blouke 1987, Sky and Telescope Magazine, September, 74, 238)

Calibrating Photometric Data

- Once the sky-subtracted signal of a star has been extracted from a CCD image, it is usually desirable to calibrate the signal by converting it to a magnitude tied to a photometric system. Unless very accurate photometry is required, this involves only 5 steps:
- Convert the signal from the target star, which is usually in units of counts, to a signal per unit time interval. This can be achieved by dividing the signal by the exposure time in seconds, giving units of counts per second.
- Calculate the instrumental magnitude from the number of counts per second.
- Determine the extinction coefficient, and then correct the instrumental magnitude to the above-atmosphere value.
- Repeat the above steps for a standard star and use the resulting above-atmosphere instrumental magnitude of the standard star to calculate the zero point.
- Use the zero point to transform the above-atmosphere instrumental magnitude of the target star to the required photometric system.

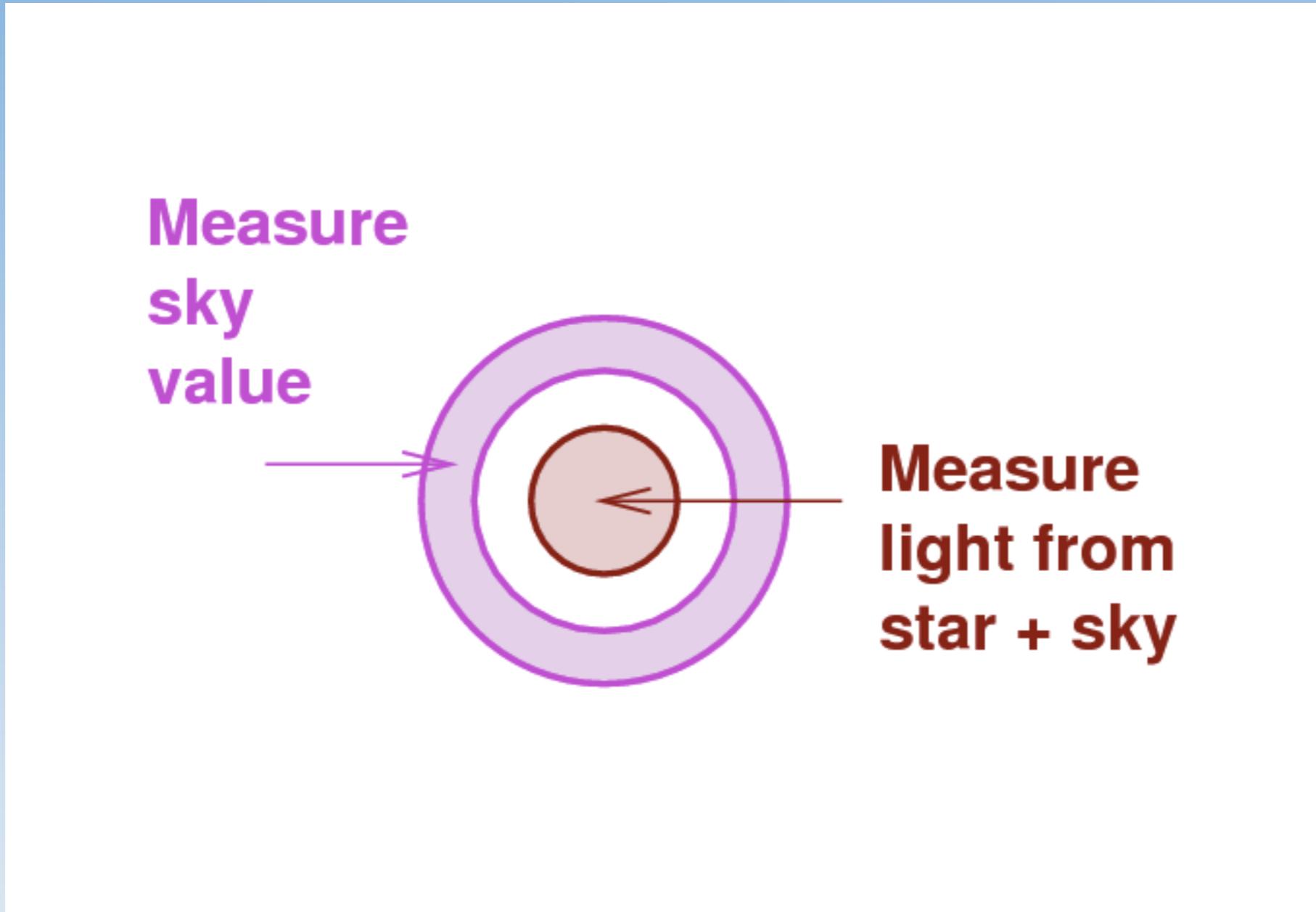
Magnitudes

Hipparchus ~120 BC

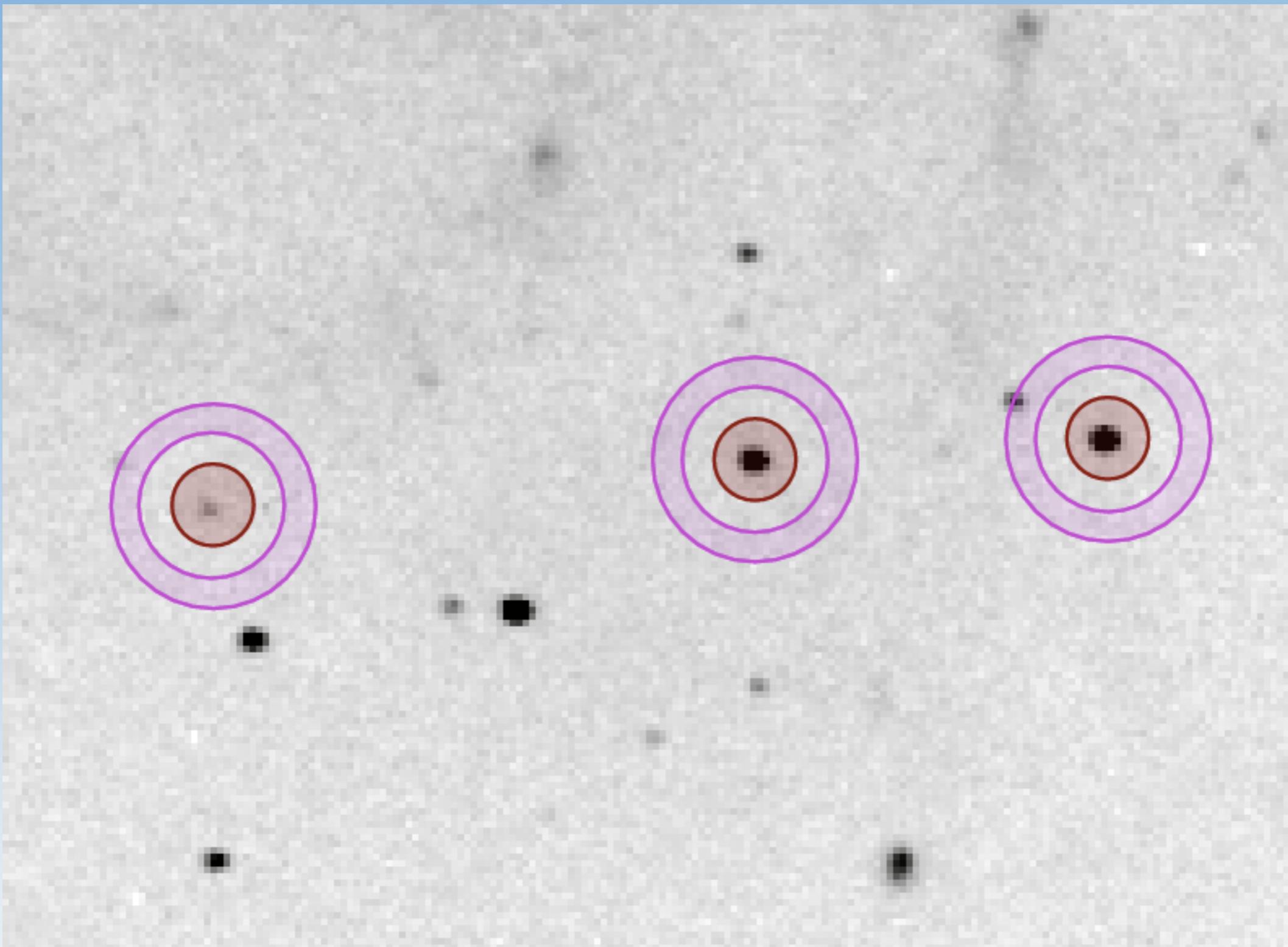
The magnitude difference between two source is the ratio of the fluxes:

$$m_1 - m_2 = -2.5 \log \left(\frac{B_{Star1}}{B_{Star2}} \right)$$

Aperture Photometry



Aperture Photometry



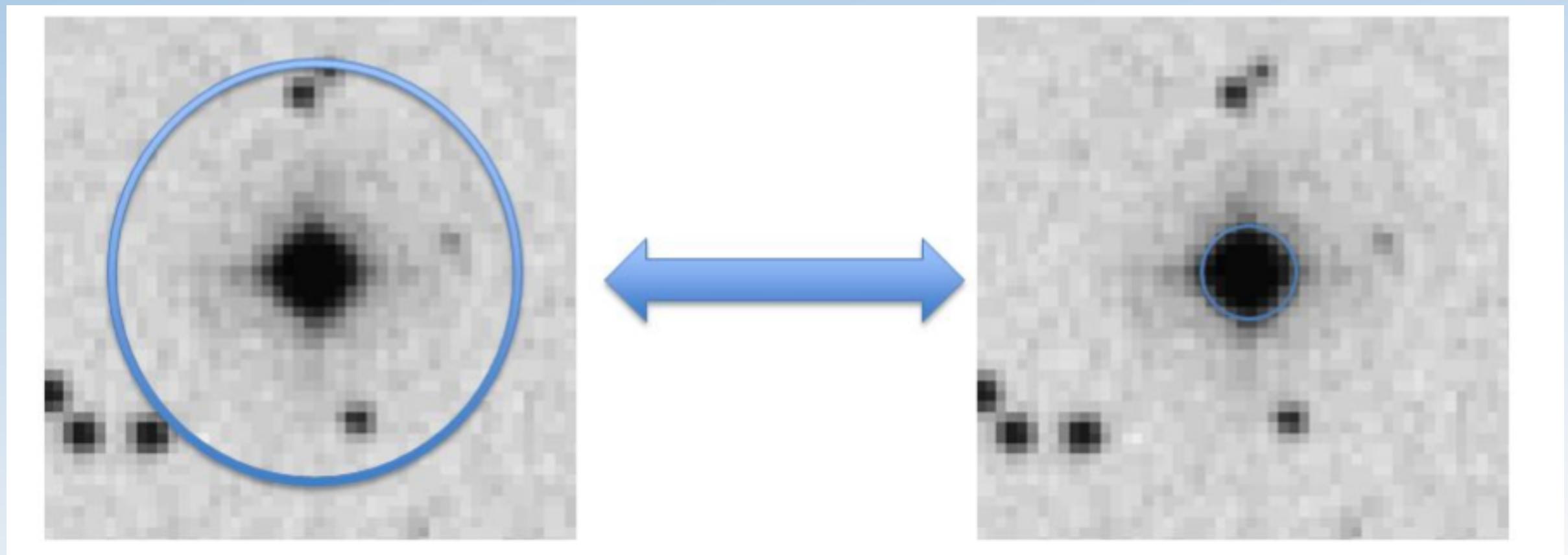
Signal-to-Noise Ratio

$$\text{SNR} = \frac{\mathbf{S}_{\text{object}}}{\sqrt{[\mathbf{S}_{\text{object}} + \mathbf{S}_{\text{sky}} + \mathbf{S}_{\text{Darkcurr't}} + \mathbf{R}_n^2]}}$$

S_{object} Signal from the object
S_{sky} Signal from the sky ie light pollution
S_{Darkcurr't} Dark Current Signal
R_n Read Noise of the camera

Best Aperture Size?

- Large aperture:
 - include more light -> more signal
 - more contamination
 - more noise from sky
 - -> lower S/N
- Small aperture:
 - less contamination
 - lose signal from source
 - -> lower S/N



Standard Stars



European
Southern
Observatory

ESO — Reaching New Heights in Astronomy



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Standard Stars Catalogues

Standard Stars Data

Below follows a non-exhaustive list of on-line standard star catalogues. Note that the information might not be fully up-to-date and that some further improvements may be needed.

Optical

- [Landolt's Standard Fields](#), with finding charts scanned
- [The General Catalogue of Photometric Data \(GCPD\)](#)
- [Optical and UV Spectrophotometric Standards](#)
- [Spectrophotometric Calibration OBs for EMMI \(gZipped PostScript, 1.6 Mb\)](#)

Infrared

- Photometric Standard Stars: [NICMOS](#) and [ARNICA](#)
- Spectrophotometric Standards
 - [Mid-IR spectrophotometric standard stars](#)
 - [List of InfraRed Telluric Standards](#)
 - [Sky map of InfraRed Spectrophotometric standard](#)
 - [UVESPOP: A Library of High-Resolution Spectra of Stars across the Hertzsprung-Russell Diagram](#)
- [Siebenmorgen MidIR Standards](#), and [Siebenmorgen/Sterzik list](#)

Adaptive Optics Guide Stars

- [Guide Star Finder](#): A Web tool aimed at searching for suitable adaptive optics guide stars, either for single objects as for a list of observing targets.

The tool is based on the USNO-SA2.0 catalogue. Work is in progress to use USNO-B catalogue as an option. The tool also offers the possibility to choose the selection criteria from a short list of different strategies.

Image Centering

Background Level Estimation

