Sec.3 – Question 3, 9

McLean seminar
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Sec.3 – Question 3

The 3m reflector at Lick Observatory has an f/5 prime focus and an f/17 Cassegrain (Cass) focus.
(a) Which focus give the fastest exposure on an extended source and by what factor?

Answer)
f-number is a measure of the light-gathering ability of an optical system

For extended sources: exposure time $\propto$ (f-number)^2
Here, f-number means focal ratio
f-number is given by the ratio of the focal length to the aperture diameter.
(reason: more light is gathered per unit area)

f-number:
- Prime focus: f/5
- Cassegrain focus: f/17

Factor $= \left(\frac{17}{5}\right)^2 = \frac{289}{25} = 11.56$

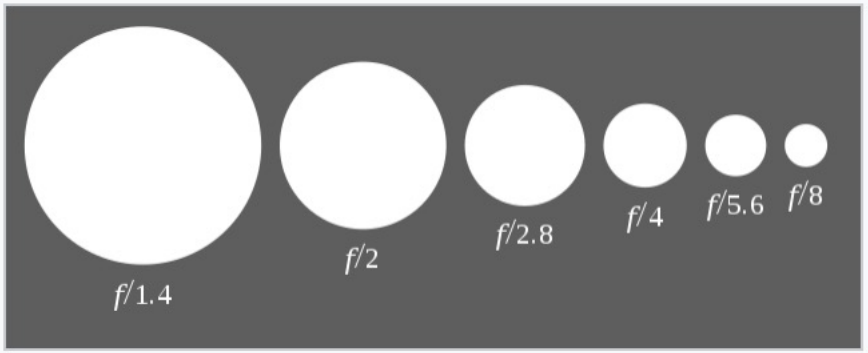

Diagram of decreasing apertures, that is, increasing f-numbers, in one-stop increments; each aperture has half the light-gathering area of the previous one.

Sec.3 – Question 3

The 3m reflector at Lick Observatory has an f/5 prime focus and an f/17 Cassegrain (Cass) focus.
(b) Which mode gives the fastest exposure on an unresolved point source?

Answer)
In practice, Cassegrain focus can be better for observing unresolved point sources despite the theoretical advantage of a lower f-number.

1. Aberrations:
- Prime focus: can suffer more from optical aberrations especially off-axis.

- Cassegrain focus: can correct these aberrations better, providing sharper images across a wider field.

2. Background noise:
- Prime focus: the light from a point source is concentrated onto fewer pixels.
While this can theoretically lead to faster exposure times, in practice, it also means higher background noise per pixel because of the smaller area over which the light is spread.

- Cassegrain focus: spreads the light over more pixels, potentially reducing the per-pixel noise and improving the signal-to-noise ratio for faint point sources.

Sec.3 – Question 9

9 Suppose you plan to construct a robotic observatory that will take observations while you are fast asleep at home, or curled up in front of your television set watching re-runs of old science fiction movies. Make a list of the equipment you would need and the steps that the computer program would have to execute from start to finish to ensure both good quality of data and safe operating conditions.

Section 3.3 **automated** telescopes and **remote** observing

- Mirror, spectrograph, etc.
- CCD cameras for imaging and guiding
- Weather-monitoring equipment
- Hardware and software which monitor the temperature, relative humidity (RH), wind speed
- Raindrop sensor
- Infrared sensor which a 12 μm - 13μm filter pointing at the sky serves as a "cloud" monitor
- Dome shutter and Dome shutter motor
- Solar cell which prevents opening when the Sun is above a 10° altitude

- Moving Object and Transient Event Search System (MOTESS) of robotic imaging telescope,
- Scan mode program: allowing the Earth's rotation to scan the field of view across each instrument.
- A Program: execute that images are aligned.
- A Program: display moving objects immediately
- Highly efficient image-processing software
- Telescope control software (ex. Stellarium, Cartes du Ciel, TheSkyX)
- Remote control software (ex. Remote Desktop, TeamViewer)