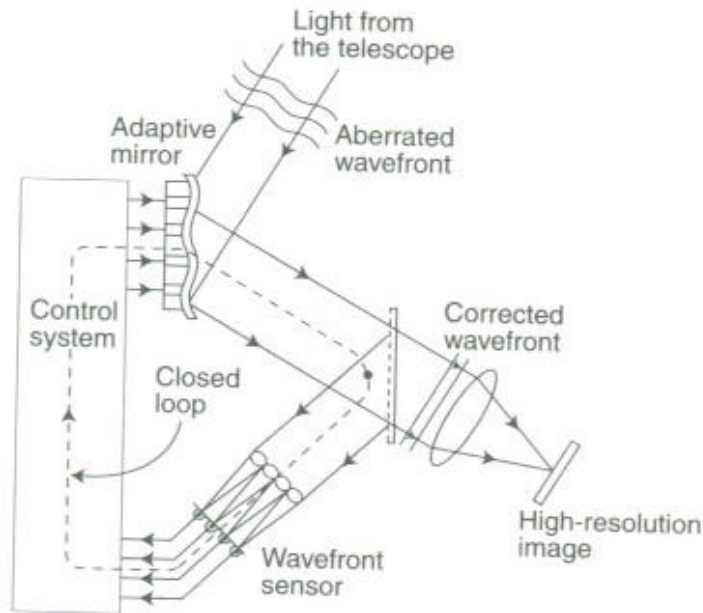


Observation exam #2 03/30/2009

1. In the 80's observational Astronomy was revolutionized by the use of CCDs. Discuss the advantages of CCDs compared to other detectors used at the time (photographic plates and photomultiplier tubes). Explain the working principles of a 3-phase CCD and discuss the advantages of using a backside illuminated CCD.
2. Specific detector characteristics: What is?
 - a. Dark current
 - b. Cross-Talk or bleeding
 - c. Dynamic range
 - d. Full Well Capacity
 - e. Read Out Noise
 - f. ADU and relation with Gain
3. What is the signal to noise ratio (S/N)? What does it mean to have a 1-sigma detection? What is the expression of S/N in the case of source photon noise limited? In this case how does vary the exposure time? What is the expression of S/N for background (or sky) noise limited? Assume the background signal to be proportional to exposure time $B \approx f_{bkgd} \mathbf{s}^2 A t$, where f_{bkgd} , is the background flux per arcsecond square, \mathbf{s} is the angular diameter on the sky of the image of the source A is the area of the telescope. In this case, explain how you could increase the S/N. Base on this, show what is the advantage of placing a large telescope in space (hint: the telescope is diffraction limited)?
4. Photometry terms: explain what is?
 - a. Pogson's scale
 - b. Multiplexing
 - c. Differential vs. absolute photometry
 - d. Standard photometric system
 - e. Wide band vs. intermediate and narrow band filters
 - f. Strömrgren system
5. What kind of information can be retrieved from spectroscopy (4 kinds - give example)?
6. Using graphics, illustrate and explain what are these quantitative features of a spectrum:
 - a. Core – flank or edges - wings
 - b. FWHM
 - c. EW
 - d. Continuum
 - e. Line intensity – relative intensity – saturated
 - f. Spectral resolution

7. How do you determine the redshift of an object? This redshift is composed of different effects. Explain the differences between Doppler shift, Hubble flow and peculiar motion. How do you determine the S/N of a spectrum?
8. The grating relation for a spectrograph is $\sin i + \sin i' = m \frac{\lambda}{a}$. What is the expression of the angular dispersion? Knowing that the angular width of diffraction pattern which form at the pupil is $(di')_{pupil} = \frac{\lambda}{Na \cos i'}$, deduce the expression for the resolution and explain what it means. What would be typical values for an échelle spectrograph? Explain the effect of increasing the width aperture on resolution knowing that the beam etendue is given by the expression: $U = bA \cos i di = Q \frac{A}{R}$, where A = area of grating, and b = the angular height of the slit.
9. Based on the diagram below, explain the principle of Adaptive Optic (AdO). What are the limits of such technique?



10. The graphic below illustrates the advantages of AdO. Explain the differences between uncompensated and compensated 8m telescope. Explain the differences between compensated 8m and Hubble telescope – why is the advantage greater in the IR? What would you expect for the James Web Telescope?

