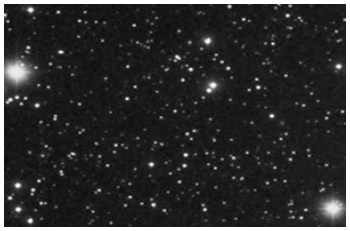
Astronomy 480 Photometry Worksheet and Lecture Supplement

Photometry

01. What is photometry anyway? How is it different from imaging?

02. What is the difference between differential photometry and absolute photometry?

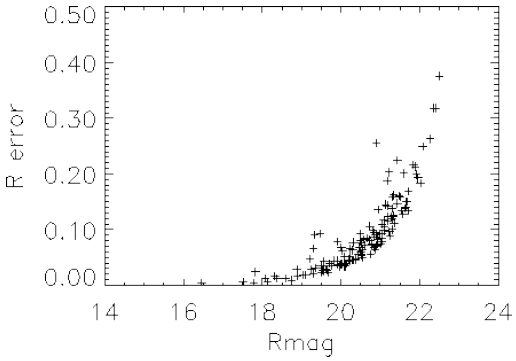
03. Let's say we are monitoring a variable star and a single standard star in the field, doing differential photometry. Is this the best way to determine the changes in magnitude of the variable star? Why or why not?

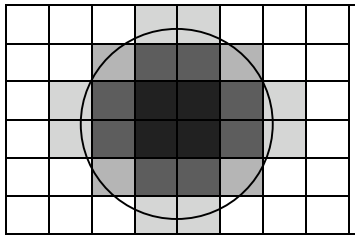


04. Here's a lovely star field covering about 3 x 2 degrees of the sky. The field of view using our 12" Meade LX200 GPS and ST8XE camera is about 26 x 16 arc minutes. Draw a square on any part of this image that represents proportionally the amount of sky we can get on the CCD.

05. What would be the main problem with doing differential photometry on the brightest stars seen in the image (even those in the upper center of the image)?

06. Here's a graph of the R magnitude error versus the measured R magnitude of a set of stars. Why would we expect that the error would increase the fainter the star is?





07. The essentially square star, with square pixels, to which you are fitting a round aperture. What are you going to do with the signal registered in those partial pixels?

08. Why are stars considered point sources?

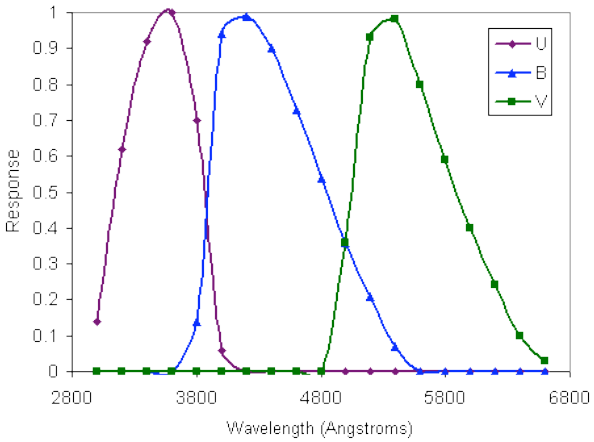
09. a) Explain to a student in Astronomy 101 what a point spread function is. b) Convince yourself that a galaxy can have a point spread function (or can it?).

Filter Systems

10. We will be taking images of celestial objects both with and without filters. If we take an image with no filter, and then use a filter for the next image of the same object, would our second exposure need to be longer, shorter, or the same length of time to get an equal amount of flux? Explain.

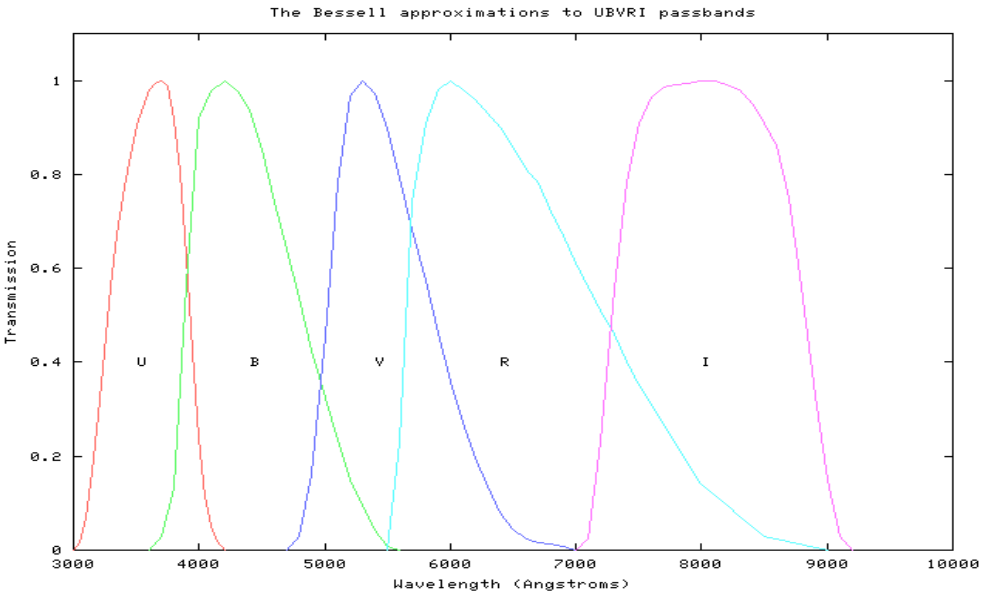
11. Some of you may be observing globular or open clusters and producing a color-magnitude diagram (we usually do V versus V – R). Using the magnitude equation, show that the difference between the measured V magnitude and the measured R magnitude is really a measure of the ratio of the fluxes.

12. On the topic of filters: On page 4 you will see an image from the HST that used a series of narrow-band filters. We see an amazing amount of detail that contains a lot of physical information. Why not use narrow band filters for everything then?

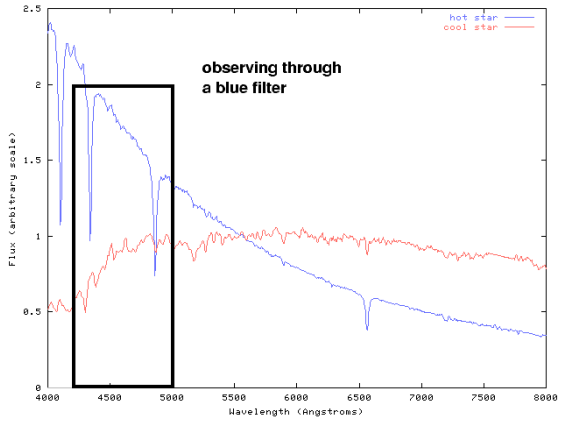


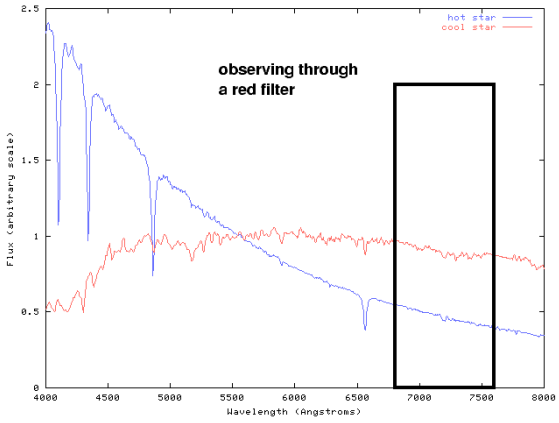
Wide-band filter system

"The B and V response curves are comparatively unaffected by differential absorption across their wavebands; there is only a total reduction of the flux through these filters (see section 3.2). The primary standard stars for the UBV system are listed in Appendix III. The scales are arranged so that the magnitudes through all three filters are equal to each other for A0 V stars. (Kitchin, Ch. 3)"



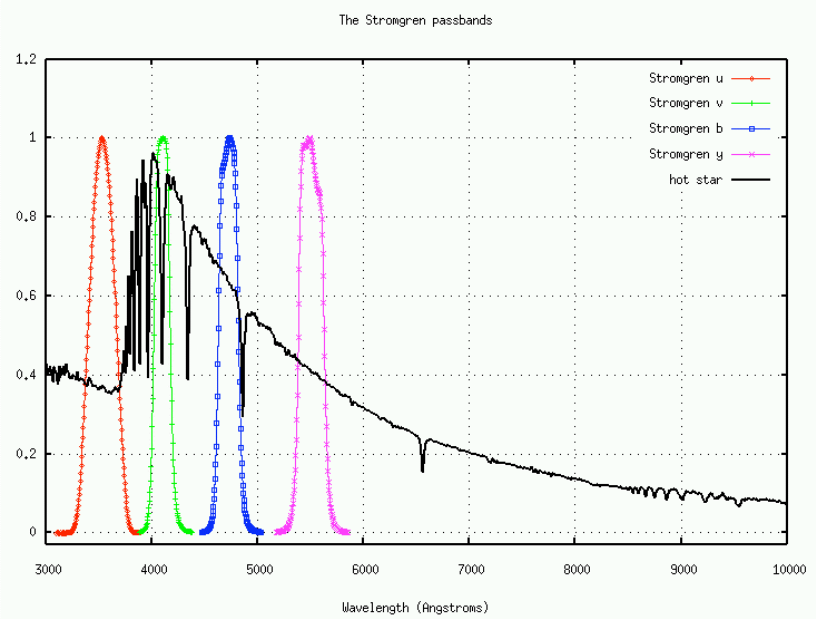
Bessell Filter System: the one we use on our telescopes.





Medium-band filter system

Stromgren photometry isolates specific parts of the spectrum of the star and is a great system for determining metallicity.



Narrow-band filters

Here is an image constructed from HST using narrow band filters. Each filter isolates a specific atomic transition, and may be only a few nm in bandwidth. "…an example of an image composed from narrow-band exposures. This results in very sharply defined wisps of nebulosity since each exposure separates light from only some very specific physical processes and locations in the nebula."

References:
http://www.spacetelescope.org/projects/fits_liberator/improc.html
http://spiff.rit.edu/classes/phys440/lectures/filters/filters.html
http://spiff.rit.edu/classes/phys445/lectures/colors/blink_n.html
http://spiff.rit.edu/classes/phys445/lectures/colors/spec_red_filter.gif
http://spiff.rit.edu/classes/phys445/lectures/colors/spec_blue_filter.gif
Kitchin, C.R., Astrophysical Techniques, 2003 (Institute of Physics Publishing, UK)