Lecture 6

More Detectors and What They See

Feb 11 2003
8:00 PM
BMPS 1420

This weeks topics

- More on detectors
  - CCD Saturation and Charge Bleeds
  - Filters
  - Multicolor imaging
  - Spectrograph
    - Example spectra
- Web resources

Quiz Time!!!

- Put away **<u>all</u>** books and notes.
- Take out a blank piece of paper.
- Answer the questions that are on the next slide.
- This quiz is not worth a lot of points, it is just to see if you have been following everything in lecture.

Quiz One (2/11/2003)

1. Why don't we build large refracting telescopes?

2. How might we figure out what the field of view of a particular telescope is?

3. When looking through a telescope, why isn't a star actually a point? (Try to give two reasons)

4. Name two types of telescope mounts that we discussed in class.

5. Give two reasons that a CCD might be preferred over photographic plates.

As mentioned last time:

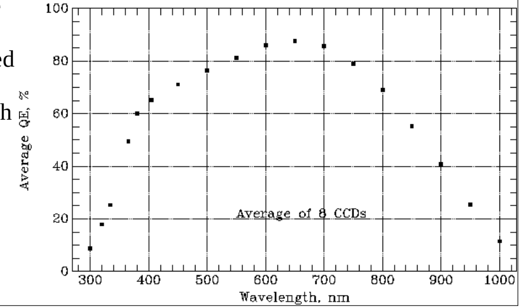
CCDs can have charge bleeds and saturation

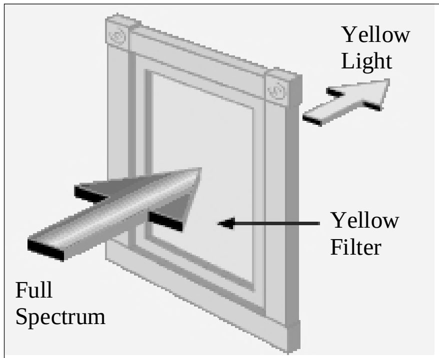
Since the amount of light that was incident on these areas can only be described as "more than the saturation value" they are of little use scientifically. Because the charge spills over to adjacent pixels, entire regions can be rendered unusable.

CCDs react to incident photons; but they don't care about the wavelength of the photon....

CCDs react to different wavelengths with slightly different efficiency, but do extend beyond visual.

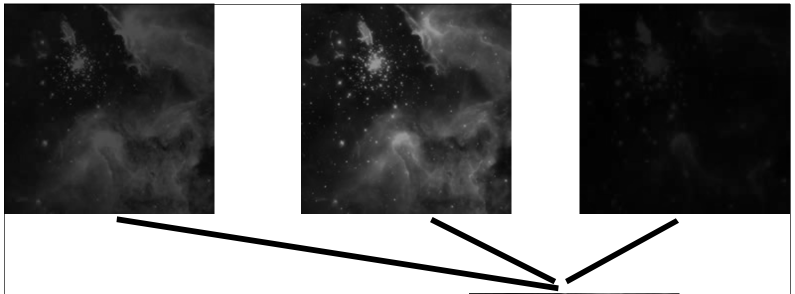
In order to measure just the light at a specific wavelength, a filter is placed in the system to allow only certain wavelengths to reach the CCD.





Filters work by subtraction. They block all of the light except for the wavelengths you want.

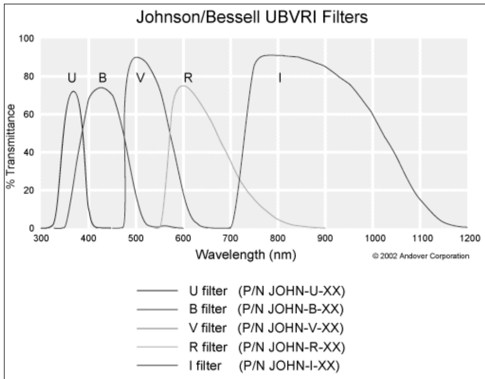
Filters are typically rated for a the peak wavelength transmitted and the "bandwidth" or how much on either side of the peak wavelength is also transmitted.

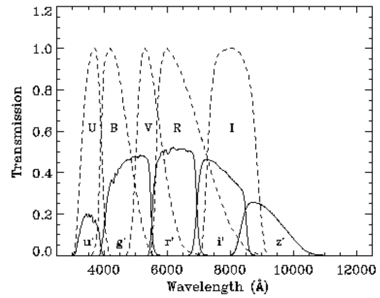


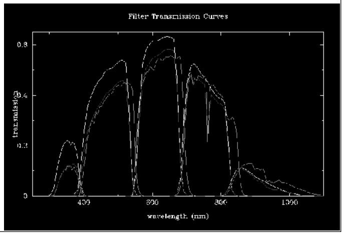
Combining images in different colors, you can re-create what the object looks like.

Using this method, you can compensate for the CCD's color preference. If it is less sensitive in green than in blue or red, then expose longer in green to compensate.

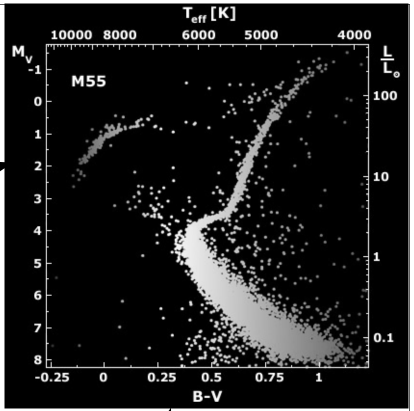
Images from Hubblesite.org







Color-Magnitude diagram for the globular cluster M55.

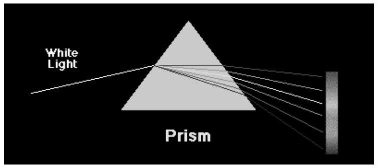


Magnitude in Johnson V (green or visual filter)

"Color", in this case magnitude in Johnson B (Blue) - magnitude in Johnson V

As you can seen different types of stars fall in different places on the diagram. "Color" is an indication of the temperature of the star, in this case with the cooler stars being on the right side of the diagram.

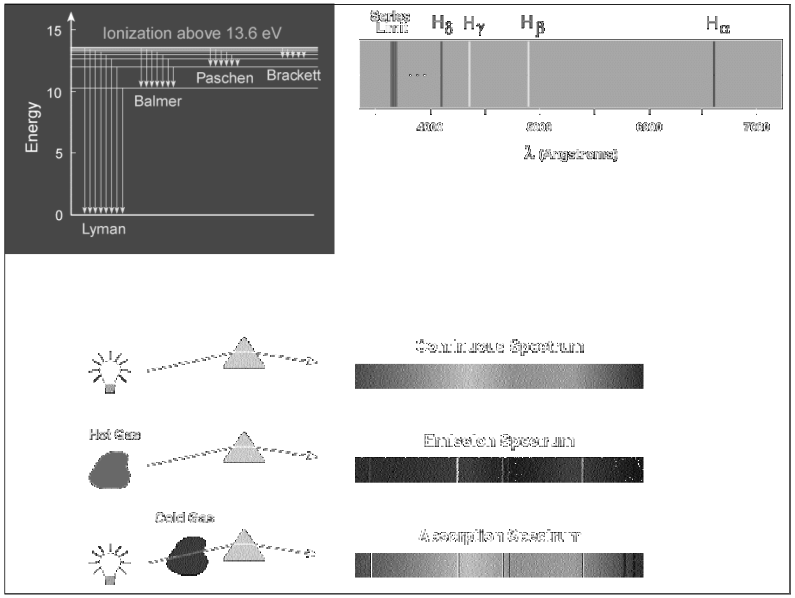
A spectrograph can seperate light out into individual wavelengths. You can then measure the distribution of light for an object. It works just like a prism.



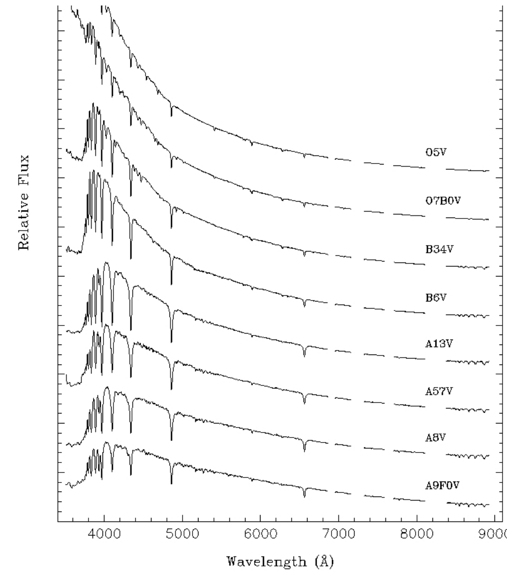
The down side is that while you can image a large number of objects at one time with a normal CCD image, spectra take a long time.

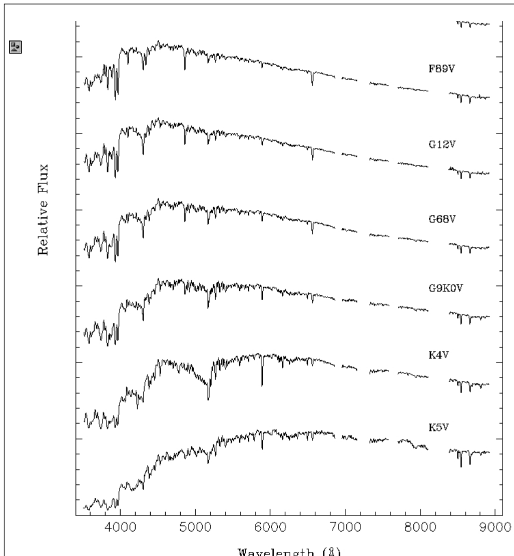
Although you are still using a CCD, you are now taking all of the light that used to hit in a small area and spreading it out. Exposures must be much longer and you (in general) get one object per exposure.

There are ways to get more than one object simultaneously using a fiberoptics, but we won't discuss that at this time.



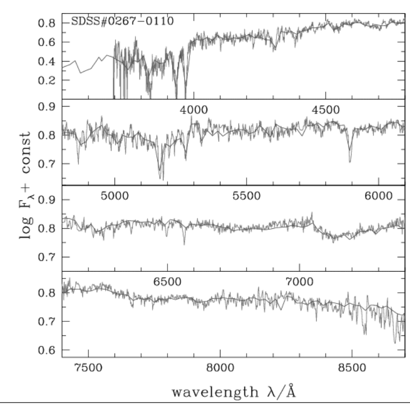
Hot Stars





Cooler Stars

Galaxy Spectra



Quasars

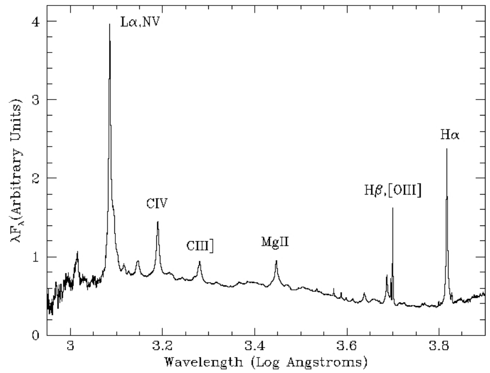


FIG. 1.— FBQS composite spectrum plotted as λF_λ vs. the logarithm of the rest-frame wavelength. Prominent emission features are marked. The y-axis has been normalized such that the spectrum has values on order of unity.

Astronomy Resources On the Web

- Astro-Ph
  - http://xxx.lanl.gov/find/astro-ph
- Astrophysical Data Service (ADS)
  - http://adswww.harvard.edu/
- NASA/IPAC Extragalactic Database (NED)
  - http://nedwww.ipac.caltech.edu/
- SIMBAD
  - http://simbad.u-strasbg.fr/Simbad