OBSERVATIONAL ASTRONOMY – I

Lecture 14

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Calibration

Calibrations

- The first stage of calibration is to calibrate the detector, and the steps in doing this are exactly the same as for photometric observations.
  - Subtract off the CCD bias signal, either as a constant value or as a frame. This step is not needed for photon counting detectors
  - Subtract off the dark current, either as a constant value or as a frame. As spectroscopic exposure times are longer than photometric exposure times, this step is now more often needed.
  - Divide by the flat field frame to correct for variations in the sensitivity of the detector.

Calibrations

- **Wavelength calibration** – a comparison spectrum usually of a hollow cathode discharge lamp, gives a series of emission lines of the gas in the lamp, plus the metal or metals that the cathode is made from.
- Typically the gas is a noble gas (helium, argon, neon etc.) and the metal is copper, iron or thorium.
- Using the laboratory determined wavelengths of these lines a functional fit of wavelength against position on the detector is made.
- In principal this is a two dimensional fit, although in practice the dispersion direction is usually accurately aligned with one of the principal axes of the detector (usually vertical on a CCD), so this reduces to a series of one dimensional fits, one per CCD column.

Calibrations

- **Spectrophotometric calibration or Flux calibration.** This is a calibration of sensitivity and efficiency, and is carried out in the same way as the photometric calibration, by observing a number of standard stars whose flux as a function of wavelength is accurately known, at a variety of airmass values. There is one extra quite serious problem.
  - The slit size α is set so that the size projected on the detector p is of order 2 detector pixels, this gives the maximum spectral resolution. α is normally smaller than the resolution set by seeing, so light is lost at the entrance slit.
  - The amount of light lost varies between exposures, making an absolute flux calibration very difficult.
  - The amount of light lost is also wavelength dependent, due to the weak dependence of seeing on wavelength, and due to atmospheric dispersion.