## Chapter 10 : Spectra - Reduction Methods and Software Development

From the two-dimensional long-slit CCD spectra acquired at the Lick 3 meter, we created one-dimensional spectra of flux intensity ($f_\lambda$ in ergs $s^{-1}$ $cm^{-2}$ $Å^{-1}$) versus wavelength in Angstroms. As with the imaging reductions, the principle software was a modified version of Vista, running both on the $\mu$Vax and Sun SparcStation computers. In this case, we will refer to everything up to the creation of the flux calibrated spectra (for each observation) as *reduction* and everything afterwards as *analysis*.

### 10.1 : Standard Reductions

The flat-field division, bias subtraction, gain and read-out noise determination, and baseline correction are essentially the same as described in section 6.1 except as described below. Because there are very few high dark current pixels (hot pixels) and minimal overall dark current in the spectrographic CCDs used, there was no need to do long dark corrections. The one exception was during an observing run in April 1992, when the blue side CCD on the Kast spectrograph had a dark pattern with a non-negligible count rate, which depended on exposure time. Another difference in the spectral reductions was that during calculation of the $e^-/DN$, smaller regions of the image must be used since the intensity of the flat-field image varies as a function of wavelength.

### 10.2 : Optimal Spectral Extraction

The standard extraction of a one-dimensional spectral array from a two-dimensional image involves summing up ~10 pixels in the spatial direction (~3-4 times the FWHM of the stellar profile in the spatial direction) after subtracting off the contribution of the background determined from adjacent pixels in the spatial direction.

To optimize the S/N of the spectral array, we have used an optimal extraction routine (Horne 1986) included within Vista. This routine determines a model for the profile by first calculating a profile for each spectral (wavelength) point and then fitting polynomials to the profile at each spatial point as a function of spectral points. This fitting is valid as