

## Chapter 7 : Direct Imaging- Error Analysis and Light Curve Production

### 7.1 : Discussion of Non-Formal Errors

In this section we discuss some of the errors in our relative light curve data points which are not associated with Poisson counting statistics.

#### 7.1.1 Error due to the Different Colors of the Comparison Stars and the Different Airmasses of the Observations

Due to atmospheric extinction, the flux from an object changes with the airmass of the observation. If the extinction function were constant across the bandpass of the filter or if the slope of the spectrum of the comparison star and the QSO were identical across the bandpass, then this change would exactly cancel when we consider the ratio between the flux of the QSO and the star. However, since neither of these conditions exist, a small deviation is introduced in this ratio which will depend on the spectra of the QSO and the star, the airmass, the extinction curve, the filter transmission curve, and the response function of the telescope and detector. In principle, if we know all these quantities, a correction can be applied to each star or QSO for each observation. However, for our goal of  $\sim 1\%$  ( $\sim 0.01$  magnitudes) accuracy in the (differential) light curve, this correction is negligible (as will be shown below) for essentially all our observations.

To calculate the expected error due to this effect, we use filter curves measured with the 3 m spectrograph, and extinction and quantum efficiency (TI CCD) curves taken from the literature. We neglect any change in the telescope response across the bandpass. Spectra were selected for three QSOs of different emission-line redshifts (PG 0946+301:  $z_e=1.22$ , CSO 203:  $z_e=2.13$ , and H0846+1540:  $z_e=2.93$ ). The spectra of main sequence dwarfs (luminosity class V) stars are taken from Silva and Cornell (1992). For the two filters, V2 and  $R_s$ , and these three QSOs, the largest deviations occurred for CSO 203 with  $R_s$ . The results of four of these six trials are shown in figure 7-1 . It is evident that