best) accurate to only 2 or 3%. In order to produce a light curve for all observations with errors as low as 1%, we have calculated relative intensities which have no fixed reference point.

Let the intensity of star j of image i be s_{ij} . Define a scale factor, c_i, for each image such that the product $c_i s_{ij}$ is the same for all i. Here we assume that the intensity ratio, $s_{ij}/s_{ij'}$, between any two stars j and j' remains the same, i.e. that the stars are not variable. Once c_i is determined for each image, the QSO relative intensity light curve will be given by the quantities $c_i q_i$, where q_i is the QSO intensity of image i.

In practice, the quantities $c_i s_{ij}$ will vary with i due to measurement error. Our goal is to minimize these deviations. Consider an image i', we assess the error in $c_{i'}$ by comparing $c_{i'} s_{i'j}$ to the weighted mean (m_j) of $c_i s_{ij}$ for all other images. The weighted mean m_j is given by: $\sum c_i s_{ij} v_{ij} / \sum v_{ij}$, where the sums are over $i \neq i'$ and $v_{ij} = 1/\sigma^2_{c_i s_{ij}} = w_{ij}/c_i^2$. Here the variance includes only the formal Poisson error calculated in the original reductions. We define the (unnormalized) χ^2 error as: $E_{i'} = \sum w_{i'j}(s_{i'j} - m_j/c_{i'})^2$, where the sum is over j. The weighting factor (measurement precision) is given by: $w_{ij} = 1/\sigma^2_{s_{ij}}$. Note that we neglect the error in m_j in the minimization.

The minimization of $E_{i'}$, $\partial E_{i'}/\partial c_{i'} = 0$, implies $c_{i'} = \sum w_j m_j^2 / \sum w_j s_{i'j} m_j$, where the sums are over j. The variance (by taking the first term in the standard propagation of errors formula) is given by:
$\sigma^2_{c_{i'}} = \sum (\partial c_{i'}/\partial s_{i'j})^2 \sigma^2_{s_{i'j}} + \sum (\partial c_{i'}/\partial m_j)^2 \sigma^2_{m_j}$, where the sums are over j. The variance of the mean is: $\sigma^2_{m_j} = 1/\sum v_{ij}$, where the sum is over $i \neq i'$.

In practice, we want to adjust the weighting factors w_{ij}. This is because there are errors associated with the intensity measurements which are not accounted for in the calculated formal errors. Some of these errors (discussed above) are nearly impossible to estimate and are often significantly non-Gaussian, and therefore are difficult to include in the above derivations. For example, a field with a faint QSO may have a few moderately bright stars and one very bright comparison star. Since, the weight will be much higher for the bright star than the fainter stars, the measurements of the fainter stars are essentially