Tips for GeMS/GSAOI photometry: image reduction and profile fitting introduction

Paolo Turri
University of Victoria
turri@uvic.ca

The image reduction (flat fielding) has been performed using the Gemini/IRAF package. Although we have taken an image of the sky every two exposures on the target, we have chosen to not use them for sky subtraction. The reason is that we use the DAOPHOT program for the photometry, which during the profile fitting of every star estimates (and subtracts) a constant sky value calculated in an annulus around the star. And because the sky flux is expected to vary on a spatial scale larger than the size of the PSF, there is no need to remove it from the image.

Precise photometry in a crowded stellar field is achieved by profile fitting since aperture photometry does likely incorporate part of the flux of many other contaminating sources. A point spread function can be modelled in the form of an analytical function (that has "infinite" resolution) plus a look-up table that accounts for residuals on a grid. This empirical PSF is calculated for each image using point-like sources ("PSF stars"); a large number of them reduces the adverse effects of noise, detector cosmetics and contamination from nearby objects, resulting in a more accurate PSF model.

The PSF stars are select as uniformly as possible on the images to avoid having to extrapolate the PSF on large regions. Having a Galactic globular cluster as a target facilitates the task because of the abundance of stars. But on the other side, in the case of a particularly bright GC, the core could be over-crowded causing a difficult measurement of the background of central PSF stars and, consequently, of the PSF model. If such measurements are allowed to participate in the modelling of the PSF, not only the photometry will have large systematic photometric error in the core but those will also propagate to the rest of the image. It is therefore advisable to avoid PSF stars in the center of bright GCs (Fig. 1) in order to preserve the quality of the photometry everywhere else in the image. Use a large number of bright stars to generate the empirical PSF with a suggested minimum number of 50 in case of a cubic PSF variability (see the next upcoming section).

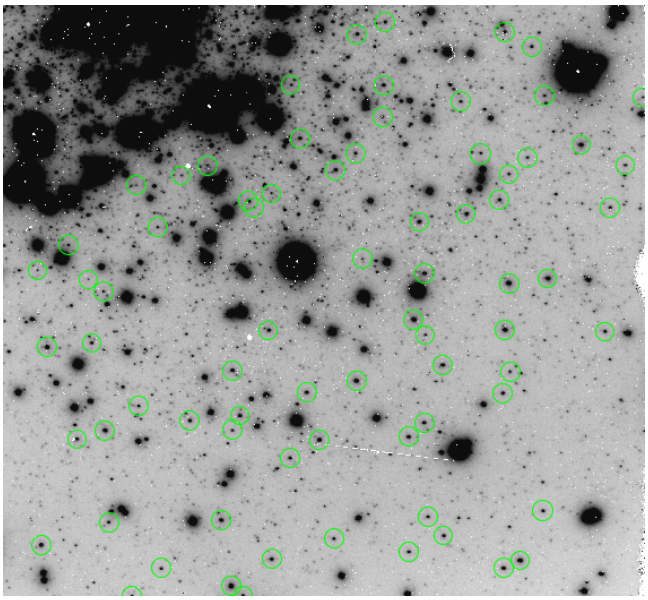

Figure 1: the PSF stars selected in one of the images are circled in green. Note how the crowded core of the cluster is avoided.