Observational Astrophysics

Practice 3: Aperture Photometry

1 Introduction.

The purpose of this practice is to get acquainted with the IRAF tools for obtaining aperture photometry from calibrated astronomical images. We will use the images we have calibrated in practice 2.

2 Previous data.

Before running the aperture photometry tools we need to know a series of data from our images, in order to properly configure the parameter files of the programs to be used. They are the following:

- CCD gain. The conversion factor between the number of accumulated electrons and the number of counts in each pixel. This datum and the one below are usually specified in the camera documentation. For the Finger Lakes Instruments CCD with which the images were obtained, it is 4.0 e^-/ADU.
- CCD read noise. For this camera it is 10.0 e^-.
- Width at half-height (FWHM) of the star profiles in the images. We obtain it with the *imexamine* r option, applying it to several stars and averaging.
- Maximum value of the camera's linearity range. We also determine it with *imexamine* and r, or we use 60 000 if we know that the response is linear throughout the range. The latter is usual if we use binned images, as in our case.
- Average value and standard deviation of the sky background. We obtain them by sampling several areas of the sky in the image, using *imexamine*, with the m or h options.

3 Aperture photometry.

We will obtain aperture photometry with the *phot* program. First we have to move through the directory structure until we reach the package location:

```
noao
digiphot
apphot
```

Next we have to edit several parameter files, to configure the photometry extraction:

- `epar datapars`

  We edit the following parameters:

  - $fwhmpsf$: the FWHM previously obtained.
  - $sigma$: the standard deviation of the sky background, in number of counts.
  - $datamin$: we use $nsky - 8 * sigma$, where $nsky$ is the mean number of sky counts previously obtained.
  - $datamax$: maximum value of linearity.

  - *readnoi*: the CCD read noise.
  - *epadu*: the CCD gain.
  - *exposur*: keyword denoting the exposure time in the header. In our case it is EXPTIME.
  - *filter*: keyword denoting the filter used in the header. In our case FILTERS.
  - *obstime*: keyword denoting the date and time of the observation. In our case DATE-OBS.

- `epar centerpars`
  - *calgorim*: algorithm for centering the aperture. We use *centroid*.
  - *cbox*: Width of the centering box, in pixels. We use 10.

- `epar photpars`
  - *aperture*: size of the aperture radius for photometric extraction, in pixels. We use a value two or three times larger than the FWHM.

- `epar fitskypars`
  - *annulus*: inner radius of the circular annulus around the star in which the sky background will be measured. We use a value between two and four times larger than the FWHM. The value adopted must be larger than the aperture radius.
  - *dannulus*: width of the circular annulus, in pixels. We use between 5 and 8.

- `epar phot`
  - *interactive*: yes.
  - *radplot*: yes.

Once all parameters have been configured, we are ready to start the photometry. To do this, first we display the image we want to analyse:

```
display image_name.fit
```

Next we run the photometry program:

```
phot image_name.fit
```

We move the cursor over the image, and place it on the star to be measured. Then we press the space bar. The coordinates and the instrumental magnitude will appear on the *xgterm* window.

A graphic window will also appear in which we will see the radial distribution of the pixels illuminated by the star and the limits of the extraction aperture and the annulus for the measurement of the sky background.

To finish we press *q*. A file will automatically be created, called *image_name.fit.mag.n*, which contains the photometry of all the stars analysed.

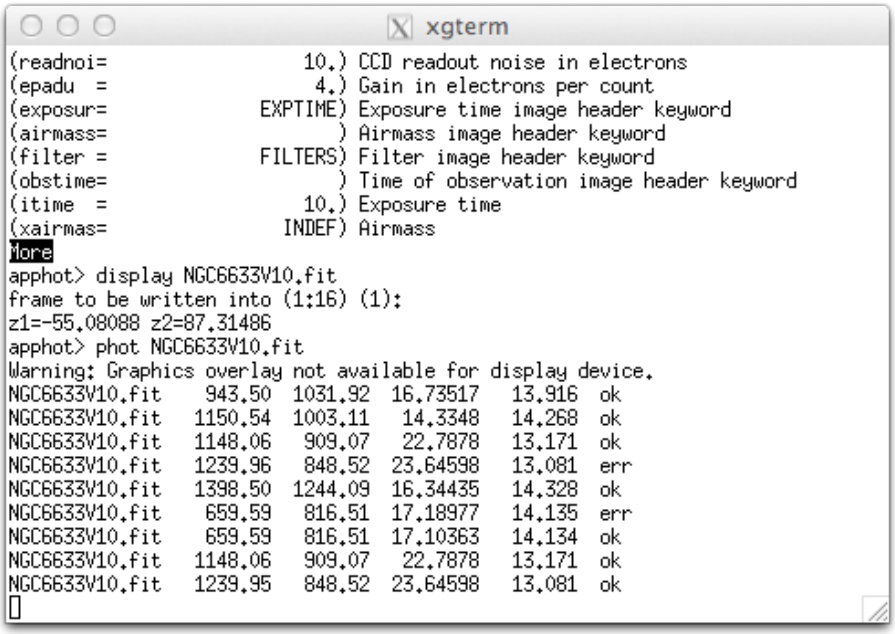

Figure 1: List of coordinates and instrumental magnitudes.

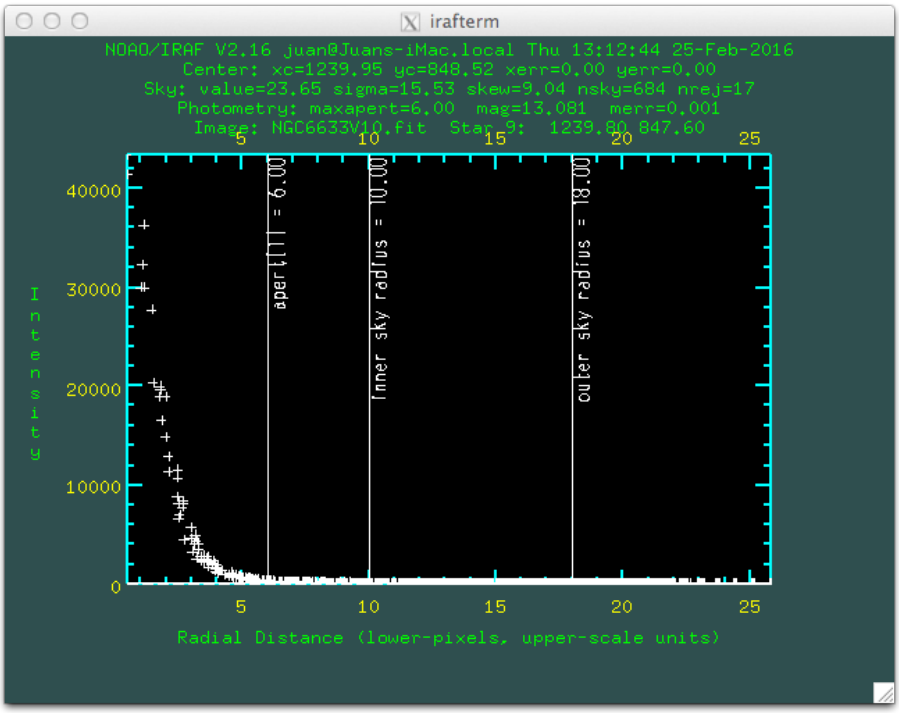

Figure 2: Radial profile and apertures for photometry extraction.