F. L. Whipple Observatory

M e m o r a n d u m

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Subject: Gain Calculation

To calculate the gain and readout noise of a CCD, do the following. Take 2 biases and 2 flats with levels around 10,000 counts. Call these b1, b2, f1, and f2. Execute these commands in IRAF:
imarith b1 - b2 b12
imarith f1 - f2 f12

which creates two subtracted frames, b12 and f12.

Now using the IRAF imstat command, measure the mean and standard deviations of the above 4 frames, in an image subsection that does not contain any cosmic rays or bad columns. For example:
imstat b1[x1:x2,y1:y2]
where x1 and x2 is the range in columns (e.g., x1=400, x2=600 for a direct CCD; x1=1000, x2=1200 for FAST) and y1 and y2 is the range in rows (e.g., y1=400, y2=600 for a direct CCD; y1=40, y2=60 for FAST)

For the 4shooter, an image extension must also be given, so the command will look something like this for extension 1: imstat b1[1][400:600,400:600].

The output will look like this for each frame:

IMAGE NPIX MEAN STDDEV MIN MAX
b1[400:500,500:600] 10201 7522. 41.58 6657. 7710.

Defining $m_{b1}, m_{b2}, m_{f1}, m_{f2}$ to be the mean values for the raw frames b1, b2, f1, and f2, and σ_{b12} and σ_{f12} to be the standard deviations for the subtracted frames, we now calculate the (inverse) gain via:

$$gain = \frac{(m_{f1}+m_{f2}-m_{b1}-m_{b2})}{(\sigma_{f12}^2-\sigma_{b12}^2)}$$

Then the readout noise is simply $ron = gain * \sigma_{b1}$