Werkcollege, Observational Astronomy 2016/2017
Week 4

4.1 IRAF

This assignment is based on the CCD images from the EMMI instrument on the ESO New Technology Telescope that are described in the *IRAF notes for Observational Astronomy*. It is assumed that you have downloaded and unpacked the data file with the CCD images. Work your way through the IRAF notes, and then answer the following questions.
The answers to the questions below constitute the *hand-in* assignment for Week 4.

- Use the "m" command in the `imexamine` task in IRAF to examine the statistics of the following EMMI bias images:

  - A single raw bias frame (`bias_1.fits`)
  - The sum of two bias frames (`bias_1.fits` and `bias_2.fits`). You can use the `imarith` task in IRAF to add/subtract images from each other
  - The difference between the same two bias frames
  - The average of all ten bias frames (here you can use the `imcombine` task as demonstrated in the lecture)

  For a location near the center of the CCD mosaic (CCD coordinates $x, y \approx 1200, 1000$), what is the MEAN and STANDARD DEVIATION of the pixels in each of these images? Move the cursor around to sample the statistics at a few different points in the images, then write down typical numbers.

- Are the measured standard deviations consistent with the CCD parameters given in the IRAF notes (read noise of 9 e^- per pixel, gain of 1.25 e^- per D.N.)?

- Now do the same for

- A single flatfield frame (`skyflat_v1.fits`)
  What is the average count level (in D.N.)?
  What does this correspond to, in e^-?
  If the standard deviation of the pixel values in the flatfield images is due to random (poisson) noise from the photon counts, then the noise (in e^-) should be $\sigma(e^-) = \sqrt{e^-}$. Does this agree with the output from `imexam`?

- The sum of two skyflats (`skyflat_v1.fits` and `skyflat_v2.fits`)

- The difference between two skyflats.
  Now comment on the standard deviations measured in the sum and difference images. Are they similar or not? Please comment!
  If the noise is purely Poisson noise, how much noise would you expect in either image?

- Apart from Poisson noise, why might the counts in different pixels in the flatfield images differ?