Astronomy 16 – Modern Astrophysics

Fall 2014

Lab 1

Wednesday, September 10, write-up due by Monday, September 15 at 10 AM

The goals of this lab are to teach you the step-by-step process for reducing images taken with the Peter van de Kamp Telescope:

http://www.swarthmore.edu/peter-van-de-kamp-observatory

and to make a color composite image of the Whirlpool Galaxy.

The data reduction will follow the instructions in the "Image Reduction and Analysis" document you've already been working with. The Whirlpool data are here:

http://astro.swarthmore.edu/~cohen/telescope/M51.zip

and include B, V, and R images as well as all the necessary calibration files. Note that these filters are blue, green, and red, respectively, so that's the most reasonable color-cording for you to use.

Note also – as described, albeit briefly, in the Guide – that there are three different types of calibration files that you apply to the data via *AstroImageJ*:

1. Bias frames (in the *Calibration* folder): these are zero-second long exposures that measure a kind of "zero-point" of voltage applied to the detector;
2. Dark frames (in the *Calibration* folder): these are exposures the same length (i.e. detector on for the same amount of time) as

the data, but the camera shutter is never opened. These measure the noise induced by heat – rather than light – in the detector; and

3. Flat frames (in the *AutoFlat* folder) that are images of the dusk sky taken to measure the pixel-to-pixel variation of the detector sensitivity. There are separate sets of flats for each filter.

Your write-up should include a very brief description of the steps you perform in order to reduce the data and create your final, multi-color image, and you should also include images (screen shots are fine) of the following:

- A representative flat field image from one of the three filters;
- Each of the three master flats;
- A representative bias and dark image;
- The master bias and the master dark;
- One representative data frame (any filter);
- The master data frame for each of the three filters;
- A final, color composite image of the Whirlpool.

You should pick some feature (a star, a bright "knot" in one of the galaxy's spiral arms) and note how many counts are in a representative pixel on which that feature falls in a representative unreduced data frame and then in the master image (in the same filter). Comment on how the reduction process changes the number of counts in a representative feature of an image.

You should also open up one representative data frame and explore its header (use the Edit > FITS Header command available when you have an image open) and in your write-up, you should give the file name of the representative image you chose and then include the following image from the header:

- The time and date the observation was taken
- The coordinates of the center of the field of view (recall that the sky coordinates are "RA" and "Dec" for Right Ascension and Declination)
- The exposure time
- The longitude and latitude of our observatory

Finally, you should look up on-line (Astronomy Picture of the Day, perhaps) an image of the Whirlpool taken with a bigger telescope than ours and from a better site than ours. And you should place that image in your report next to your final image, and you should indicate a couple of features in or near the galaxy that you can identify in both images.