T3: Astrophotography

Purpose:

- To obtain images of astronomical objects using a CCD camera.
- To compare and contrast images with different exposure times with visual observations through the telescope.
- To learn about color imaging with a CCD camera

Duration: ~90min at the Observatory

Materials: 14″ telescope + CCD camera + computer + planisphere

Report due: 4/30

Number of points: 30

Make sure to read through these instructions before starting your observations. During your visit take as many notes as you think you'll need to answer each question. You should type up your answers to every question in a complete and grammatical fashion, and turn the report in by the due date. There are 12 questions, for a total of 30 points.

First, PREPARE:

1. Notice your observing conditions. Is the moon up? If so where and what phase is it in? Is it windy or calm? Do the skies seem clear? How much twinkle do you see in the stars? That is what astronomers call the "seeing", and it is going to affect how blurry your pictures turn out. How is the level of light pollution on your night? Are there important sources nearby? (e.g. parking lot lights, streetlights, football field lights, cars passing by, the moon???, etc). ***Write a paragraph describing the conditions on your night.*** **[2pts]**

2. Then decide, with the help of the instructor, which objects you will try to image. Find them on a planisphere, and then locate them on the sky. Write down the approximate alt/az coordinates for each object you plan to observe (you'll need to copy these numbers onto your final report) [**3pts**]

OBJECT	TYPE	CONSTELLATION	ALT/AZ
M46	OC	Puppis	
M1	SNR	Taurus	
NGC 2392	PN	Gemini	
M51	G	Canes Venatici	
M104	G	Virgo	
M42	SF	Orion	
M3	GC	Canes Venatici	
NGC 457	OC	Cassiopeia	
NGC 2477	OC	Puppis	
M82	G	Ursa Major	

3. Now, step into the dome and, with the help of the instructor, point the telescope at your object, and move the slit. Then, run a focus sequence with the camera software to make sure the telescope is in focus. *What is the software doing and why? What happens to the image when the telescope is out of focus? How can you tell if the telescope is in focus?* ***[3pts]***

Then, OBSERVE:

4. Set the exposure time and number of exposures, and take your data! The CCD camera software automatically takes dark images, then on-sky exposures. It then processes each image and stacks the images for you, to produce a final combined image. *How do the images you get with the camera compare to the visual observations you made during T1? Be specific, and focus on the objects you were able to observe on both visits.* ***[3pts]***

5. For one of the objects you look at, try to make a color image - that involves taking exposures with 3 different filters that let red, green and blue light in. The software then combines the three different filter images to produce a final RGB color image. *What colors do you see in your final image?* ***[1pt]***

6. For an object with many distinct stars, e.g. a star cluster, take three different images with different exposure times - e.g. 3x1 second, 3x10 seconds, 3x30 seconds. *How do you think the different exposure times are going to affect the images you produce?* ***[1pt]***

7. Finally, ask your instructor to turn off the tracking on the telescope (ideally, you should be close to dec=0 degrees). Then, take a single 10 second exposure and look at the image. *What is happening to the stars in the image?* ***[1pt]***

At home, ANALYZE AND INTERPRET:

The day after your visit to the telescope, your images will be uploaded to this website:

www.mjpereira.org/ast102s15/lab/t3_images

Follow the link for your observation date and time and download the images taken during your session to a computer. Examine them carefully, then answer the following questions:

8. In what ways did increasing the exposure time affect the images you obtained? Be specific. ***[4pts]***

9. How do the 3 color images compare to each other? How are they different, and how are they the same? How do they relate to the final RGB image? ***[4pts]***

10. What new information have you obtained about your object by looking at it in color? How might that help you understand the object better? Name a couple of ways astronomers can use color to deduce important physical characteristics of faraway objects. ***[4pts]***

11. When tracking on the telescope was turned off, what did you observe in your exposure? What is this a consequence of? What does "tracking" mean? ***[4pts]***

12. BONUS question: use the "tracking off" image to calculate the approximate field of view of the camera in arcminutes. ***[2pts]***

Additional References:

http://hubblesite.org/gallery/behind_the_pictures/meaning_of_color/index.php
http://www.spacetelescope.org/projects/fits_liberator/improc/