v. 4, Aug. 14, 09

Astro 103/104 lab Name: _____ Date: ___/__/200_ Sec. __

The Paramount Lab

This lab is preparation for actual image taking with the instrument in the little dome of Kennon Observatory. The pre-lab must be done on the day before (barring a sudden weather change), and the students must receive an acceptable grade on it before they may proceed to the work in the little dome. Two students must work together at a time, and their activity in the little dome will be supervised by an instructor at all times.

1. Reading

Read Sect. 6 ("*LEARN HOW TO USE THE CAMERA"*) in the CCD booklet, and review Secs. 1, 2, and 5.

Answer the following questions and turn in the answers. Use a separate sheet.

1. Why do you need to cool the camera, and what is an acceptably cold temperature for the chip?
2. Explain what happens to stars whose pixel reading goes beyond 40,000 on an image.
3. What is the image depth of a decent astronomical CCD, and of a regular digital camera? How does this difference show up in the number of shades of gray that can be contained in an image?
4. What happens if (by mistake) you flat field an image before dark subtraction?
5. What does the tracking chip do?
6. How precisely (in millimeters) do you have to focus the telescope?
7. What is the expected star size, and what is the size of a pixel?
8. What does the "focusing" utility do in CCDops?
9. What does "dual CCD view do in CCDops?
10. Why do you need to use self-guide for longer-than-a-minute exposures?
11. How long is an acceptable guiding exposure?

Each student must answer these questions individually. Do not work them in groups; it is not appropriate to accept help for these. During the lab the instructor will evaluate how well you understand your own answers. He or she will modify your grade, up to a full letter grade up or down, based on your performance.

2: Preparation

Start up TheSky 6 on a Windows computer (you have access to the computers in Lewis Hall astro lab where you can use Parallel, or to the Windows computer in the tutoring room). Open the settings file called *ParamountLab.sky*.

1. On the time panel (DATA→TIME…) check that the date is Sept. 12, 2007, 8:10 pm, and the clock is not going.

2. Click on Pluto to bring up the information panel. Find some of Pluto's data:
RA: ___ DEC: ___ Brightness: ___ Altitude: _____
Airmass: ____ Transit time: _____ Hour angle: _____
Notice that the hour angle indicates how many hours Pluto is after transit. You want to take all your images as close to transit as you can, but you cannot take images during transit (you'll work either before transit or after transit).

3. Notice the red vertical dashed line towards the South (the *meridian*). An object that is just crossing is called *transiting*. Click on an object close to the meridian. What is its hour angle? _____.

4. Set the time at 10 pm. Which way (E, W, S, N) did the sky turn? _____ Read off Pluto's hour angle now (click on it again): _____.

5. Use find (hit letter F) to find M27, and center it using the object panel's bottom left "center" icon. Change the view to "telescope view" (hit CTRL-T). Notice that you must select the sky; if the object panel is selected, CTRL-T won't work. Scroll the mouse to zoom so that the field all fits on the screen.
On the SE from the nebula, inside the donut between the two concentric red circles, there is a reasonably bright star (SAO 88047). Turn the FOVI position angle towards that star, so it ends up inside the rectangle that represents the guide chip. (Click the red lines to reveal the turning orange handle of the FOVI indicator). You find the position angle of this star at _____ degrees, and its brightness is ____. You can use it as a guide star (any star brighter than 9-10^{mg} will do).

6. Now turn the whole field so that the picture is horizontal, and the guide chip is up. Use the ROTATE TOOL on the toolbar (in the shape of a circular arrow). Read off the position angle of the sky (this is the way the camera needs to be oriented). It is in red letters in the middle of the field, but you'll see it only if you zoom out strongly by scrolling. You find the position angle: _____. Now zoom back by CTRL-T again.

7. On the time panel, set TheSky to use the computer's clock (hit the little yellow clock icon.) Read off M27's data. Date&time now: _____,
RA: _____ DEC: _____ Brightness_____, Altitude: _____ Size: _____
Hour angle: _____. Based on these data, if it were dark now, would it be possible to take images of it now? Explain your yes/barely/no answer in a sentence or two:
_____
_____.

8. Zoom back out by CTRL-B ("binocular view"). Then, hit "*ZENITH UP*" (the little icon on the toolbar with a Z in it) and scroll and use the green up-down-left-right arrows to move around a bit. Stop the clock and set the time to 10:30 pm tonight. Record the date: _____. Navigate to looking just over the horizon line in the south, then move up and find a Messier object (such as M113). Click on it, center, and zoom in. Find the brightest guide star around it, set the guide chip in its direction, and turn the field upside up as you did in part 5. Read off the camera orientation (*not the FOVI position!*)
Your object is ____; Altitude ___, Hour angle ___, brightness: _____, guide star's name: _____, brightness: ___, camera orientation needed:_____.

3: The actual lab

The lab will be done in the little dome of Kennon Observatory with an instructor's help. It must be clear sky. You'll take one picture of a rather bright object, and will do the image processing at a later time. Your instructor will guide you through the following steps:

1. Start up the computer; open the dome slit; remove the telescope cover and lens cap; switch on the telescope, camera and water pump Start CCDops and TheSky. Set up the camera and switch on the camera cooling (decide on an appropriate temperature). Make a folder in "Raw" with today's date as its name, and copy in the sample "Notes….xls" file. Change your data to your own.
2. Link TheSky to the telescope, and home the mount. Homing will precisely set the origin of the coordinates (RA and DEC).
3. Slew the telescope to an object before transit, and observe the motion of the telescope. The telescope does not move across the meridian. Switching between *before transit* and *after transit* views during observation is very inconvenient: the telescope must be refocused, the autoguider direction flipped, and the field will turn upside down (so you cannot use the same guide star).
4. Aim the telescope at a very bright star, and set the H-alpha filter. Click the green telescope sign on the object panel to slew the telescope to it. Check TheSky's orientation. (Correct by turning the view if you need to.) Use TheSky's "MOTION CONTROL" to center the star, while running CCDops' "FOCUSING" utility to take pictures.
5. With CCDops' "FOCUSING" utility in "PLANET MODE", use the electronic focuser to carefully focus on the star. Save one focusing image and record it in the "Notes…xls" file. Measure the star size with the crosshair.
6. Slew the telescope to a bright deep sky object that is high up in the sky.
7. With "MOTION CONTROL", move the telescope to get a guide star onto the guide chip, while taking Dual-CCD images.
8. Set up self-guiding with a short tracking exposure, and take three 300-sec imaging exposures, one with each of red, green, blue filters. Record the amount of wander. If self-guiding is in the wrong direction, you may have to flip the x-direction of the guider under autoguider parameters. Save the three files, and record them in the "Notes…xls" file.
9. Park the telescope and shut down everything carefully. Ask your instructor to copy the day's files on the server.

The instructor will evaluate your performance, including your understanding the answers to the pre-lab questions, and award a grade for the lab.

Do the image processing in the regular laboratory room within a few days; ask for help in you need to. Turn in the pictures in an email and sign up for telescope time to take your project's images.