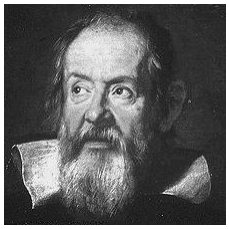

Astronomy 200/210
Lab Project #2: In Galileo's Footsteps

Project Start Date: October 7, 2015
Completion Date: November 15, 2015

The telescopic discoveries made by Galileo early in the 17th century and beautifully described in *Sidereus Nuncius* have inspired generations of astronomers - professional and amateur. In this project you will try to re-trace Galileo's footsteps and, along the way, experience some of the thrill of discovery that was Galileo's.

Part One: Reading Sidereus Nuncius
In order to complete this lab it is crucial that you read the Van Helden edition of *Sidereus Nuncius*. In fact, the book is a delight to read and so short that you will probably have read it several times by the time you have completed all parts of the lab. You are also encouraged to read the very helpful preface and end-notes by Albert Van Helden.

Questions for Part One

1. Imagine that you are the science writer and literary reviewer for the Vatican Times and that the year is 1610. In period style, write a review of *Sidereus Nuncius* and have fun doing it!

Part Two: Constructing a "Galilean Telescope"
In this very simple day-time activity you will construct a telescope that is roughly analogous to one of Galileo's original telescopes. Construction time is really only a matter of a few minutes (everything is pre-made for you!). The major problem that you and two partners face is the measurement of the focal lengths of the objective and eyepiece lens. This is quite easy. Follow these steps:

1. Collect the following equipment:

    - telescope kit and masking tape
    - a meter stick
    - paper card and holder

2. Set up the equipment as done on the front lab bench. Assemble each of the two tubes of your telescope. Try to avoid touching the lens surfaces with your fingers.
3. Tape the tube holding the objective (front) lens along a meter stick. Estimate to the nearest mm and record the position of the lens (front end of tube). Point the lens toward one of the filament lamps that has been set up in the lab. Choose the lamp that is **farthest from you**. Next, slide the paper card along the meter stick toward or away from the objective lens until you see a sharp image of the filament in the bulb projected onto the card. Write down the position of the card along the meter stick. Assuming that the bulb was far enough away, the distance at which the image formed as measured from the objective lens is the same as the focal length for the lens. Do this 3 times and average the measurements. Call this average value the focal length for the lens. Repeat the steps for the small eyepiece lens. This distance will be much smaller than the values found for the objective lens.
4. The magnification power of your telescope is simply defined as the ratio of these two focal lengths. That is **magnification = (objective focal length)/(eyepiece focal length)**

* Be sure to write down the magnification power for your telescope.

5. Show this to your lab instructor for confirmation and complete the construction of your telescope. This ends the "construction" phase of the project.

Questions for Part Two

1. What was the focal length of each lens and the final magnification for your telescope? How does this compare with the telescope used by Galileo in *Sidereus Nuncius*?
2. What did you notice that was unusual about the image formed by your telescope?
3. On page 35-36 of *Sidereus Nuncius* Galileo describes the magnification of his telescope in three different ways. Do the same (even use Galileo's style if you wish) for your telescope. What is different about each of these ways of reporting "magnification"? The conventional way to describe magnification is the way you did in part one. Which of Galileo's ways agrees with this convention?

Part Three: Observing the Moon

The moon is a spectacular sight - even through a simple telescope. You should do this part of the lab either during the 1st or 3rd quarter phases of the moon. A full moon, though bright, lacks enough shadows to make craters and other features readily visible.

For this part of the lab you are encouraged to use your artistic talents and produce drawings or pen-washes of the moon (see *SN* pages 44-46). Drawings done in ball-point pen or felt-tip pen are not acceptable! You may wish to consult an especially enjoyable article on sketching the moon which appears in *Sky & Telescope* magazine, September 1991, page 313. A copy of this magazine is on reserve in the library.

Questions for Part Three

1. What do your observations of the moon lead you conclude about the lunar surface? How does this conflict with Aristotelian ideas about the moon and planets? Be sure to re-read *SN*, pages 39-49.

Part Four: Observing the Pleiades and Milky Way

For this part of the project you will need to be able to locate the Pleiades cluster. Also, you may want to observe from a dark site (TKUC observatory or other rural location). Try to sketch what you see - remember the Pleiades has a very easily recognizable shape. Sketch what you see with your un-aided eye first and then, on the same sketch what you see with the telescope.

(The Pleiades are 18 degrees above the NE horizon at 10:00 p.m. on October 7, 2013 - use Stellarium to locate the altitude and direction on other nights during the project.)

Questions for Part Five

1. What do your observations of the Pleiades and the Milky Way suggest about the night sky and stars? Imagine that you are Galileo - explain the significance of your discovery.

Special Bonus! Up to a 10% bonus for observing Jupiter and accurately describing what you see and how Jupiter was important to Galileo's support for the Copernican Model. Consult Stellarium to find Jupiter and to determine the best time to observe.