Introductory Astronomy
Physics 177
Laboratory Manual
Fall 2012

Physics Department
William and Mary

http://physics.wm.edu/~labs/astro

Laboratory Manual: Introductory Astronomy Physics 177

Contents

Introductory Astronomy Lab Schedule for Fall 2012

No.	**Lab Name**	**Week**
*	**No Lab** Partial Week	August 29-31
1	Introduction to the Astronomy labs	September 3-7
2	Orientation to the Sky: Apparent Motions	September 10-14
3	Math for Astronomy Review	September 17-21
4	Introduction to the Meade LX-10	September 24-28
5	Kepler's Laws	October 1-5
*	**No Lab**	October 8-12
*	**No Lab** Fall Break	October 15-19
6	Spectroscopy	October 22-26
7	The Optics of Thin Lenses	October 29 - November 2
8	The Telescope	Novermber 5-9
9	Parallax and Distance to Stars	November 12-16
*	**No Lab** Thanksgiving	November 19-23
10	Hertzspring-Russel Diagrams and Distance to Stars	November 26-30
*	**No Lab** Last Week of Class	December 3-7

Introduction

Our earliest memory of nighttime is probably that it's quite dark. And as children, dark represented our fear of the unseen and unknown. But as we took our parents' hands and gazed up into that infinite darkness above us, we started to see small specks of light. Our eyes grew wide with the excitement of discovery as we pointed at the Big Dipper and wondered what a dipper really was. Years later, we can still stare up into infinity and allow our minds to meander and ponder the deep, big questions of life.

To our ancestors, the night sky represented a storybook filled with god-like heroes and epic adventures. But more than that, it provided an accurate navigation system to the explorers and sailors. Later, the study of the stars was an important central figure in effecting the Scientific Revolution.

While we cannot expect to understand all that is astronomy in a one-semester course, we can hope to get a glimpse of some of the major mechanisms within it. Above all, astronomy is an observational science. We can't very easily perform repeatable experiments on planets, stars or galaxies. But if we keep our eyes wide open, the phenomena that we observe will fuel our curiosity and enable us to achieve a deeper understanding of how this stuff called *the universe* works.

Course Purpose: In conjunction with the lecture portion of the course, the lab is intended to give the student a basic understanding of astronomy and an appreciation of the broader context of that knowledge. A knowledge of astronomy will allow the student to understand the type of questions which can be answered by astronomy and how those questions are answered, how physical theories are developed and tested, and the nature of science and the limits of scientific knowledge. The application of this knowledge of astronomy allows the student to understand the characteristic scales and relationships of the physical universe, the importance of cause and effect, the character of physical laws and the role of mathematics in natural science.

Contact Information

Lab Director:	Dr. A. Dayle Hancock
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Office Hours:	by appointment

Please contact me for any general questions regarding the course or if you have a conflict that the TA cannot solve. All questions related to lab material, expectations, *etc.*, should be directed to your TA. Contact information about your TA can be found at **http://physics.wm.edu/~labs/astro**

Course Description

This laboratory course consists of weekly labs and an observational component which will allow the students to test their knowledge of the night sky. The labs can be broken down into five types:

1. Computer measurements on the computer planetarium program *Stellarium*.

2. Hands-on instrumental measurements: (a) spectroscope, (b) optics of thin lenses and (c) small telescope

3. Computer simulations of astronomical measurements using the naap software.

4. Background information and skill building such as the introduction to operating the Meade telescopes and the math review for astronomy.

5. Outside observations. These will take place on the roof of Small Hall and mainly use the 8-inch Meade telescopes. Various celestial objects such as the Moon, planets, star clusters, and nebulae will be observed. **Note:** The outside observation take place in the evening observation period.

When taken with the associated lecture course (Physics 176), this laboratory class can fulfill the laboratory component of the GER 2A, as set forth in the William & Mary course catalog.

There is **no final** examination for this laboratory course.

Lab Grading Policy

The laboratory grade will be weighted as follows:

Afternoon Labs and Outside Observations	85%
Observational Exam	15%

Lab reports for the afternoon labs and are due at the end of the lab period. Any outside observations report will be due according the the instructions of of your TA. Lab reports not completed or missing will receive a grade of zero (0) unless the student has a valid excuse. Because different TAs will usually have slightly different and unique grading techniques, the final grades from all lab sections may be normalized to a common grading scale at the end of the semester. Outside observations will count the same as an afternoon lab. Since the number of outside observations is determined by weather conditions, some sections may have more outside observations than others. It is possible that some weeks you will have both an afternoon lab and an outside observations.

Attendance Policy

Students must attend *and be punctual to* all labs. In general, the only acceptable excuse for missing a lab is an emergency or serious illness. In these cases, documentation from either the Dean of Students or the Student Health Center will be required to excuse the absence. The decision to allow a make-up for a missed lab will be made by the your TA in coordination with the Lab Director. Students may not change lab sections without the permission of your TA and the Lab Director. For these reasons, it is imperative that you are registered for a lab section that your schedule accommodates for the entire semester.

Laboratory Materials

You are expected to bring the following materials to *each* lab meeting:

1. Lab Manual. The lab manual is available from the bookstore. The manual is also available from the class web site as 'pdf' files. You must bring a hard copy of the experiment to your lab section.
2. Your laptop computer.
3. a $10'' \times 8.5''$ Planisphere. The Planispheres can be purchased from the bookstore.
4. a Scientific Calculator with:
   (a) Scientific notation
   (b) Trigonometric Functions
   (c) Logarithmic Functions
   (d) Powers and Roots

Observational Exam

Because Astronomy is an *observational science*, every student enrolled in the lab must pass a **night sky observing test** sometime during the semester. The test consists of visual identification of a list of stars, constellations, planets, and clusters in the night sky. You are expected to use your planisphere to study the night sky on your own time on clear nights throughout the semester to prepare for the observational exam.

Here are the specifications regarding the Observing Exam:

- You **cannot** use your planisphere for this exam.
- The observational exam is worth 15% of your grade. It's pass/fail, and can be taken multiple times, but only once per night. You will take the observational exam on the roof of Small Hall.

- You must correctly identify 15 objects total. At least eight of these must be constellations that you can see. The other seven can be clusters, planets, or stars listed on your planisphere.
- You **cannot** simply point to an area of the sky and say something like "Lacerta is in that direction." Lacerta is an example of a constellation that's comprised of stars that are too dim to see in a typical Williamsburg sky.
- You should identify constellations whose stars are visible in Williamsburg's skies. On your planisphere, brighter stars are depicted as bigger dots.
- You may "double-up" on a constellation by naming *it* and *one of its major stars*, but only if that star is listed on the planisphere. *e.g.,* you can identify Gemini and Pollux (or Castor), for two objects. But you cannot use Gemini, Castor, *and* Pollux for three.
- You may take the observational exam at any point in the semester (*e.g.,* after an observing session) in the evening. Just let your TA know when you're ready.
- You must pass this exam by the last day of classes. No exceptions!
- Bad weather is to be expected. Since you have all semester to fulfill this requirement, weather will not be considered a valid excuse for not taking the exam.

Outside Observations

The outside observations should greatly enhance your laboratory experience and make it possible for you to gain a deeper understanding of astronomical phenomena and the night sky. The outside observations can be found at the back of the manual.

Because of the unpredictable nature of the weather in Williamsburg, a great degree of flexibility is needed in scheduling the outside observations. Therefore, weather will dictate whether or not a outside observation can be carried out. Your TA will announce during the afternoon lab when weather reports indicate an outside observation is possible. Your TA will send a email by 5:00 pm confirming that an outside observation will be that evening. **Be sure and check your email** when an outside observation is possible. This also means that different lab section may do a different number of outside observation over the course of the semester.

Lab Quiz

A short quiz will be given before each afternoon lab to insure the student is prepared for the lab. The quiz will count four (4) points. Outside observations will not have a quiz.

The quiz is intended to make the student study and understand the lab to be performed. The quiz will be given at the start of each lab period. **The first lab of the semester will not have a quiz.** Your teaching assistant for the lab will explain the quiz in detail at the first lab meeting.

Without reading and understanding the lab before coming to lab class, you can not hope to complete the lab in the required time and make sense of the data. Putting the required time into reading the lab manual before class will make your lab experience a more enjoyable learning experience.

The Lab Report

- Your **lowest lab grade will be dropped** when calculating your final lab average.
- Each afternoon lab will count 25 point. The report will count 21 points and the quiz 4 points. Outside observations will count 25 points and will not have a quiz.
- Even though you collect data with your lab partner, the **entire** lab report must be your own work. William and Mary has a clear and reasonable policy about cheating; this policy will be strictly enforced in lab. There will be **zero tolerance** regarding any cheating, illegal copying, or plagiarism. All parties involved will receive a zero on the assignment and will not be able to drop that grade. Pleading ignorance is no excuse.
- Afternoon Lab reports and outside observations are due at the end of the lab period unless otherwise directed by by TA.
- Grammar, neatness, spelling, format, *etc.*, do matter.

To earn a successful grade for your lab, you must complete all steps of the experiment, exploration, or observation. You must write clear, concise responses to the lab questions, and display your data, calculations, and analysis in a neat and clean fashion. Additional creativity, effort, and useful input will be duly noted. Poorly written answers (including grammar and spelling), lack of effort, incomplete responses, incorrect analysis, failure to label drawings or graphs, and unit-less numbers will cost you points.