Astronomy 101 Laboratory
Fall 2008

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Introduction:

Welcome to the laboratory for Introductory Astronomy. We are about to embark on a semester-long journey into the farthest reaches of the universe. We will learn the names of the constellations and how ancient astronomers observed the heavens and tried to understand the motions of the Moon and planets. We will construct a small telescope and learn how it works. We'll even remotely use a modern observatory in Arizona to observe distant nebulae. Astronomy is also a study of light. Except for a few objects in our solar system, astronomers can't touch any of the actual objects they study. Instead, astronomers study the light emitted by these objects. We can determine distance by studying a star's apparent motions. We can measure a star's brightness directly. We can even pass starlight through a prism and determine the star's chemical composition, temperature, and velocity. Using these observations and principles studied by physicists and other scientists, we can learn about a star's internal structure, age, and whether a star will shed its atmosphere and fade into obscurity, or explode in blinding flash, never again to illuminate the sky. Is the universe expanding? How old is the universe? How large is the universe? What is its eventual fate? How do we know? You will be able to answer these questions for yourself by the final lab.

General Information:

Astronomy is a physical science. At its fundamental level, astronomy (and science in general) is a dynamic process of asking questions, pursuing answers, and demonstrating the validity of the answers when you find them. A "correct" answer arrived at by "incorrect" methods is worthless. It is worthless because there is no way of knowing how that answer relates to what is already known. Thus it is important that you use and show correct methods and not just show the "correct" answer.

The purpose of the laboratory is to gain "hands-on" experience with real astronomical data, gain experience with instrumentation, and make real observations and measurements. We hope that you will come to appreciate how astronomers devise and conduct experiments to study the universe. In addition to learning actual techniques and methods used in astronomical research, we also want to expose you to a scientific decision-making process.

Lab Period and Preparation:

The laboratory assignment contains two parts: a pre-lab and the actual lab. The **pre-lab assignmen**t contains reading and exercises crucial to your understanding of the lab and **must** be completed before coming to class. You should also **read the actual lab exercise before class** and mark any sections where you have questions. We will briefly discuss the pre-lab at the beginning of lab-period, so have any questions ready. The goal of the pre-lab preparation is to expose you to the main ideas in the lab and to prepare you to carry out the exercise with assistance from the lab instructor. When you have questions about a particular lab, see the instructor for that lab. Profs. Hillwig and Doering will both be teaching the lab so either will be able to answer general lab questions that you may have.

After discussing the pre-lab material, we will go over the main points and procedures of the lab exercise. After the discussion, everyone may begin working. Periodically, the instructor will interrupt class to discuss important concepts that will aid everyone in completing the lab. Most of the labs are designed to be worked on in groups of two people. Lab-related discussion and task sharing are encouraged. However, each person is responsible for completing his/her own work to turn in. All labs can

be completed during the lab period, assuming that you come prepared. Some labs will require that work be shared among the members of your lab group in order to finish on time. **All lab work will be turned in at the end of each session.**

Science involves working toward discovering something that is not known. You may be unsure of your progress, but that is normal. You may also be unsure of the correctness of your final result. Questioning the validity of an experimental result, or testing a theoretical result is a necessary part of learning science. One important question that must always be answered is, "Given what I know before I started, **does this answer make sense?**" If you can remember to ask this question and proceed on a course of action to answer it, you have had a "scientific experience."

Equipment:

You will need (1) **a clear ruler with a metric scale and (2) an inexpensive scientific calculator.** Everything that we do in this lab can be done with a basic scientific calculator that can be purchased for less than about $25. Avoid programmable calculators if you are buying a new calculator. (The instructor will give some suggestions of what to look for if you ask him.) **Don't borrow a calculator** from your friend in engineering. **Bring your own each week.** Computers are available in the lab room. The labs contain instructions on how to use the software. If you're quite familiar with computers, please be patient with others who are not.

How much math do I have to know?

Only elementary mathematics at the level of Math 110 will be used. **Math 110 or higher placement** on the math placement exam is a **prerequisite** for this course. This involves addition, subtraction, multiplication and division, and problems in which all of these operations are performed successively. We will also use logarithms and exponential functions. These will be discussed in the lab as needed. Astronomy is not only descriptive (looking at constellations and pictures of nebulae and galaxies), but also quantitative (values for mass, size, and distance of celestial objects). Working with numbers is an essential part of science, and will be carried out in these weekly labs.

Grading:

There are a total of 13 labs. Each lab is worth 25 points. Your lab score will be based on your total score for the labs and our evaluation of your participation in the lab.

Scale: 100%-90%=A outstanding,
89%-80%=B
79%-70%=C
69%-60%=D

The plus/minus system is applied at the end of the semester. Labs will be completed during the lab period and handed in at the end of each lab.

This course is closely related to the lecture course Astronomy 101. However, it is important to remember that this course is separate from the lecture and that your performance in the lab has no direct bearing on your grade in the lecture course.

Three of the labs are take-home labs. They are part of the course requirements. The time it takes to complete these labs has been included in the time required for a one-credit-hour lab. You will see that there are three weeks in which the lab does not meet to compensate for these. **If you are a commuting student or are involved in an official university function and are having difficulty coming to the Observatory at night to carry out the Telescopic Observing lab, it is important that you discuss this with the instructor immediately.**

Absences:

Speak to the instructor as soon as possible if you miss a lab or need to miss a lab for a good reason. Unexcused absences count as a 0 for that lab grade. There will be no make-up labs for unexcused absences. If you know in advance that you are going to miss a laboratory meeting, contact (telephone or email) the appropriate instructor notifying him of your absence and the reason for it.

Observatory:

The Observatory schedule will be announced in class when possible. You will also need to keep an eye on the weather. Whether or not the observatory is open will depend on the weather.

We will attempt to be open every clear evening, Monday through Thursday, and the Friday nights listed below. You can get nightly updates by calling **464-5202** after 5 pm and listening to the recorded message. We will also send out an email notice by 5 pm. The take-home lab Telescopic Observing requires that you go to the observatory at least four times (4) during the semester.

The following schedule is for Public Open House observing, weather permitting. You are welcome to attend. These times are all **Friday** nights. Again call 464-5202 after 5 pm to confirm.

Public Open House Schedule : Fall 2008

September	05	8:30 to 9:30 p.m.
	19	" "
October	03	" "
	17	" "
	31	" "
November	07	" "
December	05	" "

Laboratory Write-up Guidelines:

1. Complete answers: All verbal answers should be written so that they are legible and express a complete thought or statement. Secondly, all answers should be in your own words. It is the student's responsibility to demonstrate that he/she understands what he/she is writing and is not merely copying definitions or passages from the textbook or the instructor. (This requirement is an accurate representation of what scientists are required to do when conducting research.)

2. Show your work: If you are doing a repetitive calculation on your calculator it is sufficient to demonstrate one calculation, provided that it is clearly labeled as an example calculation.

3. Units: Numbers should have units or labels where appropriate. If the answer is a final result, you should also say something about its significance.

4. Hand in all work: Work that will not fit in the space provided should be done on separate sheets of paper and attached to the end of the lab worksheet. This work should be labeled clearly so that the person grading will not have to guess what it is. A statement describing where the work is located should be included under the appropriate question on the handout.

5. Neatness: Try to be as neat as possible.

6. Ask questions (be curious): Take the time to ask questions of your instructor. His job is to help you learn more than just what's written in the lab manual. There's much more to all of the labs than what's written. Asking questions will help you identify new things and develop insight into what you've accomplished in the lab. Include these things in your lab write-up.

7. Old lab write-ups: Skills and procedures learned in lab one week will often appear in labs that follow. Keep your old write-ups in the binder provided and bring them with you so you can refer to them. Doing this can really save you time. In fact, you could do this during the pre-lab preparation.

8. Expectations: Our expectation is that the level of your ability to do the experiments correctly and to demonstrate your understanding of physical principles will increase during the semester as you gain experience in the laboratory.

9. Participation: Participation in labs requires working with your lab partner(s), working on the computers, making measurements, answering/asking questions, etc. Your participation will be noted by the instructor.