

Physics 196 The Cosmic Universe Lab  
Gustavus Adolphus College Fall 2020

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**Course Objectives**

1. Exploration of physical laws relating to mechanics, optics, thermodynamics, and astrophysics
2. Exposure to modern laboratory techniques
3. Introduction to data analysis and uncertainties
4. Familiarization with the Vernier *LabPro* interface and *Logger Pro* software for computerized data acquisition and analysis
5. Familiarization with *SigmaPlot* software and *Modelfit* plug-in for graphical analysis and least-squares fitting
6. Development of writing skills for the preparation of laboratory reports

**Course Policy and Evaluation**

1. **Lab Materials:** Students should bring their personal computer to each lab period. The lab manual section related to each week's experiment will be posted on Moodle.
2. **Lab Attendance:** Regular attendance at all labs (virtual or in-person) is required. Students will be held responsible for informing themselves of all announcements and assignments made in the laboratory classroom as well as in the daily PHY195 class meetings. Any last minute communications will be by email. Each student will register for one lab section. Students must arrange with the instructor in advance to attend another lab section or to schedule another time to perform the lab; they may do so only for a valid health or school-related reason.
3. **Pre-Lab Quizzes:** Students are expected to be thoroughly familiar with the purpose and general procedures of the experiment before coming to lab. Advance preparation is an absolute requirement for the efficient use of the limited lab time. This will be accomplished by reading the section(s) of the Lab Manual relevant to each week's experiment. A pre-lab quiz based upon the information in the Lab Manual will be given each week either via the WebAssign program (<https://webassign.net>). The due date/time for the student's quiz responses will be 15 minutes before lab class begins each Wednesday (or Thursday).
4. **Lab Groups:** Students will work in groups of two (or three). It is essential that **ALL** members of the group are completely familiar with the measurements and the data analysis.

## 5. Work Performed During the Laboratory Period

- a. Class Discussion: At the beginning of each lab period, your instructor will lead a class discussion of the Warm Ups and Predictions sections of each problem.
- b. Lab Group Discussion and Solution Plan: Once it appears that the class understands the warm ups and predictions, each assigned lab group will enter into a small group discussion to plan their solution to the assigned problem. The result of this discussion will be the creation (on the computer word processor) of a group solution and measurement plan as the first section in a Lab Procedure and Analysis document.
- c. Measurements and Recording of Procedures: Once your instructor has approved your measurement/solution plan, your group will take the necessary measurements. In that process, if your procedure deviates from your original plan, explain the needed changes in your Lab Procedure and Analysis document.
- d. Data and Data Tables: In the process of making and analyzing measurements, you will generate data tables and graphs, including perhaps fitting of your data to mathematical models. Print out a copy of each data table or graph and staple it to your Lab Procedure and Analysis document before submitting everything at the end of the lab period.
- e. Data Analysis and Preliminary Results: Once the measurements are complete, analyze your data and document the analysis in your Lab Procedure and Analysis document. A copy of the completed Lab Procedure and Analysis document, with data tables/graphs attached, must be handed in **before you leave the lab**. Your group will receive a single (shared) grade for the Lab Procedure and Analysis document. You should also save a copy of that document so that each member of your group can attach a copy to their one-page Problem Summary report.

## 6. Lab Summaries:

At the end of every lab each student will be assigned to write up a summary of one of the experimental problems. Your Problem Summary must present a clear and accurate account of what you and your group members did, the results you obtained, and what the results mean. A Problem Summary must not be copied or fabricated. (That would be scientific fraud.) Copied or fabricated problem summaries will be treated in the same manner as cheating on a test. Your Problem Summary should describe your experiences, your observations, your measurements, and your conclusions. A description of the Problem Summary format is given in the Lab Manual.

(Wednesday lab summaries are due by Friday; Thursday lab reports are due by Saturday.) *There will be a two-point-per-day penalty for summaries.*

## 7. Evaluation:

There are three parts of your grade for each laboratory: (a) your online WebAssign pre-lab score; (b) your group's Lab Procedure and Analysis document; and (c) your One-Page Problem Summary. Your Lab Procedure and Analysis document and Problem Summary will be graded and returned to you before your next lab session.

**8. Grades:**

Lab Reports	100%	A	94 - 100	C+	74 - 78
(Including Pre-Lab Quizzes)		A-	90 - 94	C	70 - 74
Observing Labs Included		B+	86 - 90	C-	66 - 70
		B	82 - 86	D+	62 - 66
		B-	78 - 82	D	58 - 62

9. **Incompletes:** A grade of incomplete will be given only for work not completed due to circumstances beyond the control of the student.

**Laboratory Schedule****Experiment**

Modeling Reality  
 Kinematics in Two Dimensions  
 Jupiter's Moons  
 Light, Brightness and Distance  
**NO LAB – Nobel Conference**  
 Spectroscopy  
 Stellar Spectra  
 The Greenhouse Effect  
 HR Diagram of Star Clusters  
 Hubble's Law  
 Reflection and Refraction  
**NO LAB – Thanksgiving**  
 Interference and Diffraction

**Class Dates**

September 9, 10  
 September 16, 17  
 September 23, 24  
 September 30, October 1  
**October 7, 8**  
 October 14, 15  
 October 21, 22  
 October 28, 29  
 November 4, 5  
 November 11, 12  
 November 18, 19  
**November 25, 26**  
 December 2, 3