

ASTR 21200: Observational Techniques in Astrophysics

Spring 2022, University of Chicago

Class Hours: T/Th 5.00-6.20pm

Class Room: TBD

Instructor: Bradford Benson

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Office: Eckhardt Research Center (ERC) 589

Course Website: <https://github.com/bradfordbenson/ASTR21200>

Course Description

Astronomers explore the universe by detecting and analyzing light from all over the electromagnetic spectrum. This is an observational lab course, focused on obtaining and analyzing astronomical data with optical telescopes, namely the Stone Edge Observatory.

Students will work in groups of 3-4 students to conduct observational experiments via labs. For all the labs, the students will be responsible for scheduling the observations, analyzing the resultant data, and reporting their work in lab reports.

1. Lab 1: Students will measure properties of astronomical CCD cameras and develop a calibration scheme for optical imaging.
2. Lab 2: Students will acquire images of galaxies, to measure the expansion rate of the Universe. Or Students will measure a HR diagram of a nearby star cluster.
3. Lab 3: Students will propose their own project and undertake observations.

The course will include a lecture component, that is intimately intertwined with the experimental aspects of the course. The students will learn the basics of practical observational astronomy, such as determining the observability of selected targets, telescope and detector technology, the use of photometric and spectroscopic techniques, and methods of error, statistical, and time-series analysis. A limited number of homework sets will be assigned to facilitate comprehension of the lecture material. Data analysis will be performed using standard astronomy software packages, as well as one general-purpose programming language such as python. In addition, students will need to familiarize themselves with standard Linux tools. Tutorials will be provided during class-time and/or as homework. Towards the end of the course, the students will prepare a final oral presentation on their final Lab Project.

Course Website and Textbooks

All course materials will be available on the class webpage:

<https://github.com/bradfordbenson/ASTR21200>

There is no official textbook for this course, however I'll be drawing material from a range of textbooks. I do not expect that there will be any assigned reading, however these will be useful references to learn about specific topics and I can potentially make pdf version of some of them available to you.

1. Practical Statistics for Astronomers, J.V. Wall & C.R. Jenkins (Cambridge University Press, 2008)
2. Data Reduction and Error Analysis for the Physical Sciences, P.R. Bevington & D. K. Robinson (McGraw-Hill Higher Education, 2003)
3. Measuring the Universe, G. Rieke (Cambridge University Press, 2012)

Grading Policy

The final course grade will be based on three homeworks, four lab reports, and a final presentation, using the following weighting:

1. Homeworks: 30% (10% each)
2. Lab Reports: 60% (20% each)
3. Final Presentation: 10%

The overall course grade will range from 0-100, however a curve will be applied to assign letter grades.

Lab Report Grading

Lab reports are also scaled on a scale of 0-100. For Labs 1-2, the lab reports are to be submitted as a jupyter notebook, including documentation, code, and plots. For Lab 3, the lab reports must be submitted in the style of a scientific paper, written in using the AASTex package. In addition, for Lab 3, the students will present a final presentation about their project.

Attendance

Class attendance is mandatory, unless a student is feeling sick or in isolation / quarantine. In this case, the student MUST inform the instructor ahead of time, so that attendance / recording through zoom can be arranged. For every lecture or data analysis class missed, one point (on a scale of 100) will be subtracted from your final score.

Syllabus

Week	Day	Lecture	Homework		Lab	
			Assign	Due	Assign	Due
1	Tue. Thu.	Intro to Astronomical Observations Practical Obs.: Telescopes, Mags., Atmosphere	HW1			
2	Tue. Thu.	CCDs and Astronomical Images Intro to Stone Edge	HW2	HW1		
3	Tue. Thu.	Introduction to Lab1 and Lab Groups (Analysis and Help Session)	HW2		Lab1	
4	Tue. Thu.	Statistics-1 Statistics-2	HW3			
5	Tue. Thu.	Introduction to Lab 2: Scientific Papers (Analysis and Help Session)	HW3		Lab2	Lab1
6	Tue. Thu.	(Analysis and Help Session) (Analysis and Help Session)				
7	Tue. Thu.	Introduction to Lab 3: (Analysis and Help Session)			Lab3	Lab2
8	Tue. Thu.	Scientific Presentations (Analysis and Help Session)				
9	Tue. Thu.	Class Presentations Class Presentations			Lab3	

Table 1: Preliminary Course Schedule