ASTRONOMY 288C

SPECIAL PROJECTS IN ASTRONOMY: ASTRONOMY RESEARCH TECHNIQUES

Fall 2010 Syllabus

Time and Place: Monday 3:30-5:15, CSS 1220
Office hours: Monday 2:00-3:00, and by appointment
Textbook: none
Class website: http://www.astro.umd.edu/academics/instructorpages.html

Instructors		
	Dr. Tracy Huard	Dr. Mike Loewenstein
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Course Description

Astronomy 288C is a two-credit course designed as a hands-on introduction to astrophysical research. Typically, each class will consist of a lecture during the first half of the class time and a lab during the last half. The labs are meant to demonstrate how the material in the lecture is applied. In addition to normal class discussions and labs, each student will work in a team on a final research project, which will include written and oral components. The last two classes are reserved for final research projects.

This course is an intermediate level course for astronomy majors. Students should have basic computer skills, and be familiar with first-year mathematics and physics, and basic astronomical concepts. Topics that will be discussed include:

- scientific method and ethics
- databases, data formats, and catalogs
- statistics and signal detection
- detector characteristics
- science communication and literature searches
- data and error analysis
- multiwavelength studies

Course Philosophy

There is no standard recipe for conducting astronomical research. There are as many ways of doing research as there are researchers, and investigating the universe is an art as well as a science. This may be more true of astronomy than other sciences since, for the most part, it is an observational – rather than a laboratory – discipline where one has limited control over one's "experiment."

Astronomers learn and hone their craft by virtue of extensive experience and mentoring. The instructors will give you a feel for astronomical research and guide you as you learn some of the techniques used by astronomers. If you wish to pursue astronomy as a profession, this course may serve as an entry point into research, especially observational studies.

Observational research is conducted in similar ways across most fields of expertise. Astronomers must acquire observations, and then construct data products (such as images and spectra) from which to extract physical properties of astronomical objects. To extract these physical properties requires data analysis, including an assessment of uncertainties, and finally interpretation of these results in the context of a theoretical framework. Last, but not least, astronomers must communicate these observations, results, and interpretations in a concise and comprehensible manner to various audiences that include advisors, peers, and the public.

During the semester, the instructors will present the topics in an illustrative, but not comprehensive, manner, utilizing their different research backgrounds and expertise to demonstrate some common, as well as differing, approaches that researchers use to tackle problems in astronomy.

Coursework and Grading

The course grade will include the following components:

- 10% Participation
- 50% Homework Assignments
- 40% Research Project (20% Report, 20% Presentation)

Participation: Students are expected to attend class. No more than one absence is permitted; please use this one "free pass" wisely. If absent from class, a student should still try to complete the lab as it will directly help with the associated homework assignment.

Homework Assignments: Each lecture will be accompanied by a homework assignment that delves into the day's subject matter in more detail than the lab, and is due by 3:30PM Wednesday the following week, unless otherwise indicated. Late assignments may be turned in, but with a penalty of 20% each day, with a weekend counted as a single day. Under no circumstance will late assignments be accepted more than three days late, or two weeks after the assignment has been given. Similar to the one "free pass" for attendance, each student will have one "free pass" for homework assignments: the lowest of assignment grades will be dropped, and not included in computing the final grade. This policy allows each student to skip one assignment, for any reason (e.g., illness, juggling too many responsibilities), without adversely affecting the final grade.

Research Project: Astronomy is very much a collaborative science, and each student will work with a partner on a research project, which will culminate in a written report and oral presentation. The projects are designed to enable students to apply and integrate the skills covered in the lectures, labs, and homework. These projects will require extensive analysis over a significant part of the semester, and should begin after the October 4th class. In addition, students will have opportunity to work intensively on these projects during the final two class periods, with the instructors available for consultation and feedback. The written reports will be due, and oral presentations conducted, during the Finals Week session (date and time, to be determined). Draft versions of the reports are due Friday, December 10th by 5pm.

Exams: None.

Academic Integrity: Students must be fully familiar and comply with the University Code of Academic Integrity, as detailed at http://www.studenthonorcouncil.umd.edu/code.html. There is a zero tolerance policy with respect to incidents of academic dishonesty, including cheating, fabrication, facilitation, and plagiarism.

Course Schedule	
August 30	Introduction and Overview, Astronomy Basics
September 6	Labor Day: No Class
September 13	Optical/Infrared Databases and Catalogs
September 20	High Energy Databases and Catalogs
September 27	Statistics, Source Detection, and Noise in the Optical/Infrared
October 4	Statistics, Source Detection, and Noise at High Energies
October 11	Signal Transmission, Resolution, Detectors
October 18	Science Communication and Literature Searches
October 25	Data Analysis I: Optical/Infrared
November 1	Data Analysis II: High Energy
November 8	Data Analysis III: Optical/Infrared
November 15	Data Analysis IV: X-ray Spectroscopy
November 22	Multiwavelength Studies and the Future
November 29	Dedicated Time for Research Projects
December 6	Dedicated Time for Research Projects
Finals Week	Presentation of Research Projects