Course: PHSC 12710/ASTR 12710: “Galaxies”

Lectures: M/W/F 10:20-11:10

Room: Gathertown (Password: Hubble)

Website: https://canvas.uchicago.edu/courses/25121

Slack Channel

PollEverywhere: https://pollev.com/phsc12710

Instructor: Prof. Jeff McMahon <jeff@astro.uchicago.edu>

Lab Manager: Dr. Brent Barker <bbarker@uchicago.edu> (ERC 573)

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(ERC 599A)**Teaching Assistants:**

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Office hours:
Prof. McMahon: Tuesdays at 4:30PM in Gathertown
TAs: Wednesdays from 11AM-12:30PM in ERC 517

Course Description: Our Universe and our understanding of it are continuously evolving. While we take it for granted that our universe is filled with innumerable galaxies, this has not always the case. It is only in the past hundred years that we have understood that our universe began in a big bang and that the galaxies only formed later. This modern understanding is a major intellectual triumph which unites our knowledge of gravity (general relativity) and physics with a vast array of astronomical observations to paint a detailed picture of both the structure and history of our Universe.

In this course we will explore both our present understanding of the Universe and the development of our knowledge about it. Galaxies, which have been called “island universes” will frame this discussion. These collections of stars are among the most diverse, beautiful, and interesting objects in the Universe and they trace its history.

Astronomy in general, and the study of galaxies as a specific example are observationally driven disciplines. As such, advances in technology (e.g. improving telescopes and instruments) have led to improved theoretical understandings. This history of discovery stretches from Galileo’s first use of a telescope to resolve stars in the milky way, to Hubble’s

images of distant galaxies which first showed that the Milky-Way was not alone, to Vera Rubin's measurements that revealed galaxies are mostly composed of a mysterious substance we call dark matter. Understanding galaxies, cosmology, and this history of discovery is the goal for this course.

Quantitative analysis will be an important part of the course in both laboratory work and lectures, but mathematics beyond algebra and some geometric understanding will not be required. This course will feature several observationally-oriented labs that will allow students to directly experience how some of the modern understanding of galaxies has arisen.

Learning Goals

1. Understand how our scientific understanding evolves;
2. Gain experience making and using quantitative models;
3. Develop the ability to evaluate strengths and weaknesses of arguments based on the use of data, technical claims, and scientific theories;
4. To gain an understanding of the intellectual beauty of this subject, that is, understanding why some people devote their lives to the field;

Course Format – This course will be flipped. You will be responsible for watching the pre-recorded lecture videos before coming to class. The class meetings will be held in Gathertown to facilitate group interaction and collaboration. These meetings will consist of a quick review and class wide discioss, before breaking up into small groups where we will work example problems. The problems worked in class will be drawn from the homework. The professor and TAs will circulate and assist these groups in their learning. The best thing about the University of Chicago is working with and getting to know the people who make this institution special. This format is an attempt to get all of you talking and give you the opportunity to interact directly with your instructors and classmates. We look forward to getting to know you and work closely with you as you learn this subject.

Assignments: Homework will be assigned on Monday and will be due before class on the following Monday. Please submit a legible copy of your assignment as a PDF through Canvas. Expect homework to be assigned most weeks and to be challenging at times.

Exams: There will be a midterm and a cumulative final exam. We format will be decided after a discussion in class.

Final Project: There will be a final project. The details will be announced midway through the course. Anticipate writing a 5 page paper explaining a major discovery. The paper should describe the advance, explainin what made it possible, and explainin what if anything was missed at the time and why.

Grading Breakdown: Homework assignments (**15%**); lab participation and reports (**30%**); in-class midterm (**15%**), final paper (20%), final exam (**20%**). Late assignments and reports will get 10% off per day. Late work will not be accepted after the solutions are posted.

Group Work: Group work on the assignments and labs is encouraged. Collaboration is sharing of ideas, as you teach one another. We strongly encourage collaboration! For submitted work, each person must use their own words, and give credit to those who collaborated. Copying will could result in disciplinary action, but will certainly hurt your ability to learn. Please don't copy.

Attendance: Attendance is important for your success in this class! Please attend so we can work through the problems together. We don't plan on taking attendance, but please attend so you can support your peers and they can support you in your mastry of the material and the extension of the University of Chicago community to this online environment.

Lab Section: The laboratory sessions are an essential component of this class.They are designed to complement the other parts of the course with computer and hands-on experiments that demonstrate the observations and analyses that underpin our understanding of galaxies. Labs will start in Week 02 and more information can be found in the lab syllabus on Canvas.
Reference Text: The lecture notes will serve as the primary written reference. "The Cosmic Perspective" by Bennett et al. (7th edition or more recent) will be used as a secondary text. Purchase of this textbook is not required. Some excerpts will be available on Canvas, a copy is on reserve at the library, and used copies can be rented/purchased on Amazon.

Rough Schedule of Topics (slides will be available on Canvas)

Week 01 - Light, Distance, and Telescopes

Week 02 - Stars, Stellar Populations, Star Clusters

Week 03 - The Motion of the Stars

Week 04 - Our Milky Way Galaxy

Week 05 - **Exam 1** / The Local Group

Week 06 - Distant Galaxies

Week 07 - Galaxy Evolution & Black Holes

Week 08 - Expansion of the Universe

Week 09 - Dark Matter

Week 10 (- Dark Energy

Final Exam: Tuesday March 17, 4PM - 6PM (Hinds 101)