Syllabus: Galactic, Extra-Galactic Astronomy & Cosmology
ASTR 400B Spring 2025

Instructor: Prof. Gurtina Besla
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Office: Steward Observatory N312
Office Hours: Thursdays 12:30-1:30 PM N312

TA: Himansh Rathore
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Office Hours: Wednesdays 3-5 PM in Steward 3rd floor Library

Course Website: All handouts, homework/in class worksheets and solutions will be posted on GitHub: https://github.com/gurtina/ASTR400B_2025

Classes: Tuesday & Thursday 2:00-3:15 PM SO 204

Recommended Textbooks:

Introduction to Cosmology. 2nd Edition. Barbara Ryden

Galaxies in the Universe 2nd Edition L.S. Sparke & J.S. Gallagher, III
Errata for the book: http://www.astro.wisc.edu/~sparke/book/errata.html

The Pragmatic Programmer Andrew Hunt, David Thomas

Course Prerequisites:
Students should have taken or are currently taking Phys 305 OR already have proficiency in coding in some language. The course is targeted to astronomy majors graduating in 2025.

Description of the Course:
This course instructs students in the physics of galaxy structure and evolution, and cosmology (the origin, evolution and the fate of the universe). Students write a research paper on the results of a semester long coding project that instructs students in best coding practices for astronomical research and utilizes a real N-body simulation of the future fate of the Milky Way and its nearest massive galaxy neighbors, the Andromeda and Triangulum galaxies. Student inquiry will involve studying how the various components of a galaxy (stellar disk, stellar bulge, dark matter halo) transform and evolve (in shape or kinematics) through the process of galaxy collisions and mergers, which are fundamental processes in cold dark matter cosmology.

Lecture Topics Covered:
1) The Milky Way (~Jan)
2) Our Local Group of Galaxies (~Jan/Feb)
3) Galaxy Types and Profiles of Light and Dark Matter (~Feb/March)
4) Processes that Govern Galaxy Evolution: Mergers, AGN, Black Holes (~March/April)
5) Cosmology and the Early Universe (~April/May)

Course Goals and Objectives:
Class lectures will provide an overview of the equations and processes that describe galaxy evolution over cosmic time. Computational homework is designed to illustrate how those equations are used to study galaxy structure and evolution in practice, using code and industry standard practices (Github, version control, code documentation).

Course Learning Outcomes:

1. Demonstrate the ability to meaningfully analyze, apply and integrate the principle findings, common applications, current problems, fundamental techniques, and underlying theory of the astronomy discipline.

2. Employ discipline skills related to the computational methods and theoretical approaches used to investigate modern astrophysical phenomena and problems.

3. Develop proficiency with communicating, translating and interpreting fundamental astronomical concepts and research results in written formats.

4. Conduct guided research and/or develop mastery-knowledge of a specific area of the discipline of astronomy.

5. Participate in the scholarly, ethical, and discipline specific practices of the field at an emergent level.

Course Evaluation:

Computational Homeworks	40%	~ Weekly
In-Class Computational Labs	10%	~ Weekly
Participation (e.g. Hack Days)	5%	~ April/May
Project Proposal	15%	March 16th 2023
Final Report (3-5 pgs. LaTex)	30%	May 5th 2023

You are required to submit all code/assignments on Github. Grades will appear on D2L. It is your responsibility to notify the TA of any grading errors within 72 hrs of the grades being posted.

Late Assignment Policy: All homeworks and labs are due by 5 PM the date marked on the assignment. Late assignments will be accepted until midnight of the due date, with a -2 penalty. If extensions are needed these must be communicated to Prof. Besla and the TA in advance of the deadline.

Course Communications:
All information about this course is communicated through a combination of the Syllabus, announcements/pdfs posted on the classroom Github repository, announcements on D2L, Powerpoint slides, and announcements made in-class.

Absence and Class Participation Policy:

As outlined in the Course Format and Teaching Methods section above, a significant amount of the course content and course work will be presented and done in-class. Participation in class hack days are part of participation grades. **If you know you will be missing a class, you are required to communicate the date and circumstances for your absence via an email to the professor at least one week in advance.**

Classroom Behavior

- **Academic Integrity**: All students in this course are expected to abide by the University of Arizona's Code of Academic Integrity http://dos.web.arizona.edu/uapolicies/

- **Cheating is not tolerated in any form.** If a student is caught cheating on any assignment or presentation the penalty will be failure in the course. In all cases a letter will be sent to the Dean of Students describing the incident. If you are aware that someone else is cheating, it is your obligation to inform the instructor.

- We allow, even encourage, collaboration on assignments. However, **you must always write the final version of an assignment yourself** and use your own words to describe what you have concluded. You must indicate anyone you worked closely with in the code documentation at the top of your code. All code documentation, however, must be your own. Note that the final research project is expected to be done **independently.**

- It is fine to make use of reference books or websites. But if you do so, make sure to add appropriate citations and put text taken verbatim in quotes, otherwise make sure to rewrite things in your own words. In all cases you must list the source of your information. **Plagiarism is strictly prohibited**. If you are uncertain as to what constitutes plagiarism see: http://deanofstudents.arizona.edu/codeofacademicintegrity. Plagiarized code or writing for the final project will result in a Fail for the entire course.

- **Cell Phones:** The use of cell phones is not allowed in the class.

- **Note on Generative AI**: The final project is designed to enable students to apply concepts learned in class to engage with the current scientific literature and develop science communication skills. The use of generative artificial intelligence (AI)/large language model tools such as ChatGPT, Dall-e, Google Bard, Microsoft Bing, etc. for the final project is discouraged, as LLMs may make up or hallucinate information. These tools may also reflect misconceptions and biases of the data they were trained on and the human-written prompts used to steer them. You are responsible for checking facts, finding reliable sources for, and making a careful, critical examination of any work that you submit. Any use of AI tools or content must be acknowledged or cited (see https://style.mla.org/citing-generative-ai/). If you do not acknowledge or cite your use of an AI tool, what you submit will be considered a form of cheating or plagiarism. If you have any questions about this policy, please contact Prof. Besla.

Students with Disabilities:
If you anticipate barriers related to the format or requirements of this course, please meet with me so that we can discuss ways to ensure your full participation in the course. If you determine that disability-related accommodations are necessary, please register with Disability Resources (621-3268; drc.arizona.edu) and notify Dr. Besla of your eligibility for reasonable accommodations. We can then plan how best to coordinate your accommodations.

Additional Resources for Students:
UA Academic policies and procedures are available at:
http://archive.catalog.arizona.edu/2015-16/policies/aaindex.html

Student Assistance and Advocacy information is available at:
http://deanofstudents.arizona.edu/student-assistance/students/student-assistance

For career advice and direction (particularly for graduating students) please see the TIMESTEP website https://timestep.arizona.edu/

The University of Arizona provides a wide variety of resources to help you feel more at home in the UA environment. Examples of student resource/cultural centers include:

- The African American Student Affairs
- The Asian & Pacific American Student Affairs
- The Guerrero Student Center
- The Immigrant Student Resource Center
- The LGBTQ+ Affairs
- The Native American Student Affairs
- The Transfer Student Center
- The Veterans Education and Transition Services Center
- The Women & Gender Resource Center

We encourage you to take advantage of the community, support, and learning opportunities afforded by these centers, and to encourage your friends and colleagues to do the same.