AST403 - Galaxies and the Intergalactic Medium

Spring 2026	
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Office location	C4002
Lecture hours	TR 1300 - 1430 PM
Office hours	By appointment

Course Descriptions

The course intends to give an overview of the structure, formation and evolution of galaxies and their observations at different wavelengths. It introduces galaxies within the broader context of intergalactic medium and demonstrates the efficacy of physical laws in describing the largest bound structures of the Universe.

Course Learning Outcomes

1. Describe the properties of the Milky Way.

2. Differentiate between disk and elliptical galaxies.

3. Introduce the Local Group and locate our Galaxy within this group.
4. Comprehend the formation and evolution of clusters of galaxies and the evolution of galaxies within clusters.
5. Understand the intergalactic medium and intra-cluster medium as a source of astronomical information.
6. Explain the formation of galaxies using spherical collapse and equilibrium models.
7. Comprehend the role of galaxy observations in understanding the universe we inhabit.

Required Textbooks

1. *"Carroll & Ostlie, An Introduction to Modern Astrophysics, Cambridge University Press, 2017*
2. *L. S. Sparke & J. S. Gallagher, III, Galaxies in the Universe: An Introduction, Cambridge University, Press, 2007*
3. *Peter Schneider, Extragalactic Astronomy and Cosmology: An Introduction, Springer, 2006*

Additional Resources:

- BagPipes SED fitting (https://github.com/ACCarnall/bagpipes).
- pPXF spectrum and SED fitting (https://pypi.org/project/ppx)
- Galaxy morphology (https://ned.ipac.caltech.edu/level5/Sept11/Buta/frames.html)

Assignments and Assessments

- There will be five homework consisting mostly numerical problems. You are free to work together but write your own solution clearly.
- There will be a term project on deriving galaxy properties.
- Midterm and Final exams will be based on the homework.

Assignment Types	Percent
Homework	25%
Midterm Exam	25%
Term project	25%
Final Exam	25%
Total	100%

Lecture Schedule

Week	Topic
1-2	The Milky Way: structure, kinematics, distance measurements, stellar population
3-4	Morphological classification, scaling relations, extragalactic distance scales
5-6	Formation and evolution of galaxies, galaxy groups, clusters, population synthesis
7-8	Active Galactic Nuclei (AGN): central engine, unified model, quasars.
9-10	Inter-Galactic Medium (IGM): absorption systems, high-redshift galaxies
11-12	Galaxy redshift survey, Baryonic Acoustic Oscillation (BAO), large-scale structure
13-14	Exam week