

# Galaxies & Extragalactic Astronomy

## Astronomy 2580/Physics 3580

### Fall 2009 Syllabus

Lecture: Tuesday, Thursday: 11:00-12:15, 105 Allen / 210 Thaw  
3 Credits

#### **Instructor**

Professor Michael Wood-Vasey  
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#### **Office Hours**

406 Allen Hall  
By Appt.

## **Course Objectives**

This course will introduce you to the fundamentals of galaxies, their nature and their context. We will cover basic stellar and galactic astronomy and tie those together with actual observations ranging from our basic telescopes at the Allegheny Observatory, large surveys such as SDSS, to the great orbiting observatories such as the Hubble Space Telescope.

You will become proficient in software such as UNIX-based shells, IDL, SQL, and python, while learning how to obtain and quantitatively analyze astronomical images and databases to support the textbook learning.

This is a large field of study. Most of the topics below will be discussed at an introductory level, though some will be covered in more depth. Topics which will be included are: galactic kinematics and dynamics; globular clusters; The Milky Way; galaxies; clusters of galaxies; dark matter; active galaxies; quasars; the intergalactic medium; gravitational lensing; galaxy formation and evolution.

## **Grading**

This will be a project-based course woven in with reading and weekly homework assignments and presentations of the latest literature on a topic.

Much of the learning in this class is based on activities and working with other people. You will be grading on your participation and peer evaluated on your teamwork skills and contributions. All projects will be taken by teams of generally two students assigned by the instructor. You will have a different teammate for each assignment. Collaboration on homework is encouraged; collaboration on projects is fundamental. Relevant contributions and collaboration shall be acknowledged on all assignments. Participation will count for 20%, homework 20%, each project 10%, except the final project which will be 20%.

# Textbook

Galactic Astronomy  
Binney & Merrifield  
University of Princeton Press  
ISBN 9780691025650  
1998  
\$70 new

This textbook is available at the bookstore and you should already have one by the time you read this syllabus. Please let me know if you have difficulties obtaining this book as it will serve as the main resource for reading and homework assignments. In addition to the textbook we will be using a variety of online sources to access the latest images and databases in astronomy.

Binney & Merrifield is comprehensive in its time, but is now a decade old. Many of the topics introduced theoretically now have supporting or conflicting observational evidence. An important part of this course will be a series of seminars that you develop to update the class on the latest research on a particular chapter in the past decade. This will be an opportunity to develop your presentation skills, as well as the very important skill of learning about and coming up to speed with the latest in a new field.

## Additional References

- *The Large-Scale Structure of the Universe* by Peebles, Princeton University Press, 1980
- *Galactic Dynamics* by Binney & Tremaine, Princeton University Press, 1987
- *Galaxies in the Universe*, by Sparke & Gallagher, Cambridge University Press, 2000
- *Astrophysics of Gaseous Nebulae and Active Galactic Nuclei* by Osterbrock and Ferland, University Science Books, 2005.
- “The Milky Way Explorer” by Kevin Jardine. A pretty impressively useful navigation of available data about our own galaxy. <http://galaxymap.org/>
- “The Broadband Optical Properties of Galaxies with Redshifts 0.02<math>z</math>0.22”, Michael Blanton et al., *Astrophys. J.*, 2003, vol 594, p. 186.
- “The Resolution of Messier 32, NGC 205, and the Central Region of the Andromeda Nebula”, Walter Baade, *ApJ*, 1944, vol 100, p. 137.
- “NGC 147 and NGC 185, Two New Members of the Local Group of Galaxies”, Walter Baade, *ApJ*, 1944, vol 100, p 147.

## Schedule of Topics

- Week 1: Introduction & Overview: *Galactic Astronomy* Chapters 1 & 2
- Week 2: The Properties of Stars: *Galactic Astronomy* Chapter 3
- Weeks 3 & 4: Galaxy Morphologies & Scaling Relations: *Galactic Astronomy* Chapter 4 and *Galactic Dynamics* Chapter 6
- Week 5: Gravitational Dynamics: *Galactic Dynamics* Chapter 2
- Week 6: Collisionless Systems: *Galactic Dynamics* Chapters 4 & 7
- Week 7: Stellar Populations: *Galactic Astronomy* Chapter 5
- Week 8: An Introduction to Cosmology & the Cosmic Distance Scale: *Galactic Astronomy* Chapter 7
- Week 9: Galactic Interstellar Media: *Galactic Astronomy* Chapters 8 & 9
- Week 10: Galactic Evolution & Environments
- Week 11: An Introduction to Spatial Clustering Statistics: *The Large-Scale Structure of the Universe* Chapters 29-38
- Week 12: Dark Matter in Galaxies
- Week 13: The Growth of Cosmological Structure: *The Large-Scale Structure of the Universe* Chapters 6-16
- Week 14: Nonlinear Cosmological Structure Growth
- Week 15: Dark Matter Halos and the Halo Model of Clustering

## ADA

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and Disability Resources and Services, 140 William Pitt Union, 412-648-7890 or 412-383-7355 (TTY) as early as possible in the term.

## Acknowledgments

The material in this course is partially based on materials from Željko Ivezić, Steve Majewski, Beth Willman, and Andrew Zentner. Additional materials presented in the course are as by attribution; please call me on non-attributed slides, figures, and plots.