The University of Western Ontario
Department of Physics and Astronomy

Astronomy 331a
Galactic Structure and Interstellar Matter
Fall 2003

Description

This course covers the astrophysics of the stellar population and interstellar medium in galaxies, particularly our own Milky Way Galaxy. Proficiency in basic physics and calculus is assumed. There will also be some computer projects and an end-of-term report that will be presented orally and in written form.

Lectures: 232 Physics and Astronomy Building, T 9:00am-10:50am, Th 10:00am-10:50 am.

Instructor

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Office hours: Meetings are by appointment.

Prerequisites

The official prerequisites for this course are Calculus 250a/b and 251a/b. In practice, a first-year physics course (Physics 020, 024, or 026) provides extremely important background for this class. The first-year course Astronomy 020 is also excellent preparation.

Course Topics

I. Summary of Some Current Research

1. The Canadian Galactic Plane Survey
2. Star Formation

II. Basic Physics

1. N-body versus Fluid approximation
2. Properties of Stellar Clusters
3. Fluid equations and Magnetohydrodynamics

III. Astronomical Background

1. Discovery of Galactic Structure
2. Discovery of the Interstellar Medium
3. History of Star Formation Studies

IV. Astronomical Observations and Theory

1. Galactic Motions and the Local Standard of Rest
2. Vertical Structure of the Galaxy
3. Radial Structure and Rotation Curve
4. Spiral Density Waves
5. Inventory of the Interstellar Medium
6. Star Formation
7. Shock Waves, Supernovae, and Superbubbles
8. Ionized Nebulae – HII regions
9. Magnetic Fields
10. Cosmic Rays

Textbook and Other Materials

I could find no single textbook that is appropriate for a senior undergraduate course on these topics. Your main reference will be the class lectures. I do strongly recommend that you buy the following book, available in the university bookstore, but it is not required:

The Fullness of Space, by Gareth Wynn-Williams, Cambridge University Press, 1992, ISBN 0-521-42638-3.

This book does *not* correspond to the lecture material. It is confined to a qualitative explanation of processes in the interstellar medium, whereas lectures will cover the stellar component of the Galaxy as well, and usually be quantitative. However, this book makes for excellent supplementary (bedtime!) reading, is a very useful reference for the future, and will give you ideas for your written and oral presentations.

The following *graduate-level* books contain quantitative discussion, and parts of them may be similar to class lectures.

1. Galactic Astronomy, Mihalas and Routly, Freeman, 1968
2. Galactic Astronomy, Structure, and Kinematics, Mihalas and Binney, Freeman, 1981
3. Galactic Astronomy, Binney and Merrifield, Princeton University Press, 1998

4. Galactic Dynamics, Binney and Tremaine, Princeton University Press, 1987
5. The Physics of the Interstellar Medium, Dyson and Williams, IOP Press, 1997

The first book, by Mihalas and Routly, is at the most appropriate level for this course. It is currently out of print. Two copies are in the Chart Room. The second and third books are successors to the first one. The fourth book is an advanced book on theoretical topics in galactic dynamics. The fifth book is a graduate level introduction to the interstellar medium, but is appropriate in parts for an undergraduate course.

The following *undergraduate-level* books also contain valuable discussion relevant to this course, as part of a larger survey of astrophysics:

1. Carroll and Ostlie, An Introduction to Modern Astrophysics, Addison-Wesley, 1996
2. The Physical Universe, Shu, University Science Books, 1982

You can find copies of all these books in the library, and certain ones in the Astronomy Chart Room. Books in the Chart Room should never leave that room.

Assignments/Exams/Grading

I view this class as a unique opportunity to learn through hands-on projects and assignments. Every assignment should be like a mini-research project – that is my goal! The art of giving oral presentations and writing clear reports are also an important part of the scientific profession as well as many others. Computer skills are an essential part of today's world, and I will encourage you to develop these through the computer assignments.

A final exam will be given during the university scheduled examination period in December. Note that doing the assignments will be your best preparation for the final exam. You will need a calculator for the assignments and final exam.

You are considered responsible for all material presented in the lectures.

Your final grade will be calculated on the following basis:

Assignments	20%
Computer projects (2)	30%
Oral report	10%
Written report	10%
Final exam	30%

Other policies

1. Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar). The University of Western Ontario uses software for

plagiarism checking. Students may be required to submit their work in electronic form for plagiarism checking.

2. If illness (or some similar disruption) prevents you from writing a quiz or examination, or completing an assignment, you must contact the Physics and Astronomy department or myself *before* the exam or due date. If your affliction is sufficiently serious that other courses are affected, you should contact the office of the dean of your faculty. That office will coordinate documentation and notification of instructors. You must also contact me to arrange any possible make-up work.