PHYS 632: The Physics of Astrophysics II

Prof. Adi Foord

Fall, 2026

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Class Hours: M/W 1-2:15pm
Office: PHYS 316
Classroom: PHYS 432

Course Description

This course provides an introduction to high-energy astrophysics with a focus on X-ray astronomy. We will cover the physics of high-energy emission in an astrophysical context, as well as learn about the observational techniques used to detect and analyze X-rays. We will discuss some of the most extreme objects in our universe, including neutron stars, black holes, supernovae, and galaxy clusters. At the end of the course, you should:

- apply the physics of X-ray emission and absorption processes in an astrophysical context
- describe how high-energy telescopes and detectors work
- describe the properties of X-ray bright objects and perform relevant calculations
- analyze data from an X-ray telescope including fitting basic models to spectra

Course Materials

Introduction to High-Energy Astrophysics
Stephan Rosswog, and Marcus Brüggen
Cambridge Univeristy Press, ISBN 978-0-521-85769-7

Exploring the X-ray Universe
Frederik D. Seward and Philip A. Charles
Cambridge University Press, ISBN 978-0-521-88483-9

Supplementary Materials

Accretion Power in Astrophysics
Juhan Frank, Andrew King, and Derek Raine
Cambridge University Press, ISBN-10 0-521-62053-8

Radiative Processes in Astrophysics
George B. Rybicki and Alan P. Lightman
WILEY-VCH, ISBN 978-0-471-82759-7

Prerequisites

Prerequisites: PHYS 631 (The Physics of Astrophysics I)

Course Structure and Policies

PHYS 632 will be a traditional lecture course. Individual reading will play an important role in understanding material. Feel free to ask questions during lecture, whether you have difficulty with a concept, notice an error, or want to hear more details about an aspect of the material. Students are responsible for checking their academic e-mails and the Blackboard page daily for getting updates about the course, grades, homeworks and class notes. Please refrain from using computers in class, with the exception of electronic tablets for taking notes. Phones are prohibited during lecture. Eating and drinking are allowed in class (if extremely necessary) but please refrain from it affecting the course

Lecture

In order to be successful in this course, you should attend all classes. Please be attentive and take notes during lectures. Bring calculators to lecture to be able to work on in-class problems. You are welcome to ask questions to clarify any point that is not clear, either during class or during my office hours.

Lecture Summaries

Since there are no exams in this course, students are required to submit a lecture summary ($\sim$one paragraph) after each class prior to midnight of that day. These summaries allow me to gauge the classes understanding of topics covered, **and** research shows that reviewing notes after class increases student retention of information. The summaries must be the original work of the student without the use of AI. Up to five lecture summaries can be turned in late without penalty. All other late submissions will be given a grade of 0.

Homework

Homework assignments will be posted on Blackboard on Mondays and will be due by the beginning of class the following Monday, unless you are told otherwise. Peer-learning is encouraged, and you should feel free to work in groups and discuss the material and homework questions

among yourselves. However, the homework solution should be your own work, not a group product. No credit will be given for direct copies. **Please cite any resources used to complete homework assignments (including online resources and in-person conversations) at the bottom of each assignment.** Up to two homework assignments can be turned in up to 1 week late without penalty. All other late work will be given a grade of 0.

Final Project

The project will run throughout the semester and involve students writing a faux telescope proposal to a high-energy observatory of their choice. The class will hold a "TAC" (Time Allocation Committee), where we will discuss and evaluate each proposal, with one winner selected at the end of the semester! The goal is for students to develop enough familiarity with the capabilities and specifications of their chosen observatory, as well as the science it enables, to write a proposal that they could realistically submit during the observatory's proposal submission window. You will be graded on the strength of your proposal, as evaluated by the professor; the TAC ranking will not affect your final grade. You final project will be due **Wednesday, December 2nd** and we will hold our TAC on **Monday, December 7th**.

Communication

Email is the best way to contact me outside of class. Please include **"PHYS 632"** in the subject line to ensure your email is routed to the correct folder. I respond to emails during regular working hours, Monday–Friday, between 9:00 AM and 5:00 PM. I do not typically respond to emails sent in the evenings, on weekends, or during university breaks. Please allow up to 24 hours for a response during the work week. Emails sent after 5:00 PM, on weekends, or during breaks will be answered on the next business day.

Grading Policy

The grade will count the assessments using the following proportions:

- **40%** of your grade will be determined by your lecture summaries.
- **45%** of your grade will be determined by homework
- **15%** of your grade will be determined by the final project

Your letter grade will depend on the total score. If your total grade is:

- $\geq$ **90**, your letter grade will be "A"
- **90**$>$ **X** $\geq$ **80**, your letter grade will be "B"
- **80** $>$ **X** $\geq$ **70**, your letter grade will be "C"
- **70** $>$ **X** $\geq$ **60**, your letter grade will be "D"
- **60** $>$ **X**, your letter grade will be "F"

Material

Topics that will be covered in this course are listed below, with a rough schedule. **The exact topics that we cover will depend on the pace of the course, some material may be excluded or additional material may be included.**

Week	Topic
1	Introduction to HE Astronomy
2	HE Instrumentation and Observatories
3 – 4	Radiative processes and interaction w/ matter
5	X-ray absorption and scattering in the ISM
6	Supernovae and supernova remnants
7 – 8	Neutron stars, pulsars, and magnetars
9	X-ray binaries
10	The diffuse X-ray background & galaxy clusters
11 – 12	Accretion power in astrophysics
13 – 14	SMBHs & AGN
15	Mergers
16	TAC

Course Policies

Please see UMBC's Current Official Syllabus Statements for the 2026-2027 Academic Year.