

# Astro 589

## Physics for Astronomy

**Course modality:** This class is scheduled to be taught in person

**Lectures:** 2:00 PM - 3:15 PM TuThu in Steward Observatory 208

**Instructor:** Prof. Vasileios (Vasilis) Paschalidis

**Offices:** SO 338, PAS 356

**Email:** vpaschal@email.arizona.edu

**Prof. Paschalidis' Office hours:** TBD

**Textbook:** No standard textbook will be adopted. Material will be drawn from Rybicki & Lightman *Radiative processes in Astrophysics*, and Frank Shu "The Physics of Astrophysics" vol's I and II. The former book exists as an ebook at the UA on-line library <http://ezproxy.library.arizona.edu/login?url=http://dx.doi.org/10.1002/9783527618170>, and copies of the latter can be found in the Steward Observatory Parker library. Class notes will be posted on the course's D2L site.

**Course description:** This is a graduate-level introduction to the Physics of Astrophysics. We will cover the following topics: basic elements of radiative transfer, radiative processes, fluid mechanics, gas physics, and some elementary dynamics.

The goal is for you to gain competency with Theoretical Astrophysics that will serve as a basis for numerous core classes in the graduate program and for research in astronomy and astrophysics.

**Prerequisites:** Multivariate differential and integral calculus are important for the class. Undergraduate level physics is the most important preparation for this class. Two semesters of quantum mechanics (at least through the hydrogen atom), two semesters of E&M, and one semester of upper level mechanics is a solid preparation for a PhD in astronomy. The more physics and math you have mastered, the smoother and more beneficial the course is going to be for you.

**Course format:** This is a traditional lecture course, except that I will sometimes ask you to do short order-of-magnitude calculations in class. I will be providing lecture notes on D2L.

**Assignments and exam:** There will be homework (6-8 problem sets total, about once every one to two weeks), a mid-term and a take-home final exam. The **homework will be due on Thursdays at the end of class**. We will use some of the class time to solve problems and examples. Almost none of these are for grade, but some homework problems will build on the in-class examples. You are encouraged to work together, especially in figuring out how to approach the problems and even solve them collaboratively. Collaborative effort will not be encouraged for the exams, on which you are expected to work on your own.

### Course Objectives:

- Solve simple radiative problems using analytic and semi-numerical methods;

- Perform calculations of radiative processes that are relevant for the variety of conditions found in the Universe;
- Solve simple hydrodynamics problems and carry out complete stability analyses of equilibrium systems;
- Understand mass loss from and accretion onto stars and compact objects;
- Apply basic concepts in dynamics to stellar systems;

**Learning Goals:** At the end of this course, students will be able to:

- Exhibit an expert-level facility to engage with the principle findings, common applications, current problems, fundamental techniques, and underlying theory of the astronomy discipline.
- Demonstrate advanced discipline skills and knowledge necessary to utilize the observational techniques, instrumentation, computational methods, and software applications used to investigate modern astrophysical phenomena and problems.
- Develop expertise with communicating, translating and interpreting fundamental astronomical concepts and research results in oral and/or written formats.
- Conduct independent research and/or gain mastery-level knowledge of a specific area of the discipline of astronomy.
- Engage in the scholarly, ethical, and discipline specific practices of the field at a professional level.

**Grading:** Your course grade will be based on homeworks (50%), a mid-term and take-home final exam (each worth 25% of the total grade). A total score of 90% will guarantee an A. The final distribution of scores will determine the exact grade breakdown but you need 70% to pass the class.

**Incomplete/Withdrawal:** Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at <http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal> respectively.

**Attendance:** Class attendance is optional but strongly recommended. If you feel that you already know all the material and can complete all the work on your own, you are free to not join. However, if you do join the class, please give your full attention and participate in the discussion. You will benefit from coming to class in order to ask questions about parts of the material you do not understand. By not coming to class you will miss out on any help other students will be benefit from. In addition, your instructors are not required to explain to you what you missed by deliberately not coming to class. You are responsible for knowing everything that goes on in class, including announcements, course materials, handouts, what has been assigned as homework, as well as any hints, help, due dates, extensions, etc. Especially due dates could be changed, if the majority of the class has found a problem set particularly challenging.

If you have a legitimate reason for not attending on a given day, please let us know in advance. We may be able to give you the appropriate class notes. If you have cleared your absence with us in advance, make sure that you contact us promptly upon return to find out what you may have missed.

All holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion.

If you feel sick, or if you need to isolate or quarantine based on University protocols <https://covid19.arizona.edu/self-quarantine>, stay home. Except for seeking medical care, avoid contact with others and do not travel.

Notify your instructor(s) if you will be missing a course meeting or an assignment deadline.

Non-attendance for any reason does not guarantee an automatic extension of due date or rescheduling of examinations/assessments. Please communicate and coordinate any request directly with your instructor.

If you must miss the equivalent of more than one week of class, please contact the Dean of Students Office [DOS-deanofstudents@email.arizona.edu](mailto:DOS-deanofstudents@email.arizona.edu) to share documentation about the challenges you are facing.

Voluntary, free, and convenient COVID-19 testing <https://covid19.arizona.edu/test-trace-treat> is available for students on Main Campus.

If you test positive for COVID-19 and you are participating in on-campus activities, you must report your results to Campus Health. To learn more about the process for reporting a positive test, visit the Case Notification Protocol <https://covid19.arizona.edu/positive-case-protocol-students>.

The COVID-19 vaccine and boosters are available for all students at Campus Health <https://health.arizona.edu/covidvaccine>.

Visit the UArizona COVID-19 page <https://covid19.arizona.edu/> for the most up-to-date information.

**Statement on compliance with COVID-19 mitigation guidelines:** As we enter the Fall semester, your and my health and safety remain the university's highest priority. To protect the health of everyone in this class, students are required to follow the university guidelines on COVID-19 mitigation. Please <https://covid19.arizona.edu/>.

**Course Website:** In this class we will make use of D2L. It is your responsibility to check D2L regularly for course announcements/updates and assignments.

**Academic advising:** If you have questions about your academic progress this semester, please reach out to your academic advisor (<https://advising.arizona.edu/advisors/major>). Contact the Advising Resource Center (<https://advising.arizona.edu/>) for all general advising questions and referral assistance. Call 520-626-8667 or email to [advising@arizona.edu](mailto:advising@arizona.edu)

**Life challenges:** If you are experiencing unexpected barriers to your success in your courses, please note the Dean of Students Office is a central support resource for all students and may be helpful. The Dean of Students Office <https://deanofstudents.arizona.edu/> can be reached at (520) 621-2057 or [DOS-deanofstudents@email.arizona.edu](mailto:DOS-deanofstudents@email.arizona.edu).

**Physical and mental-health challenges:** If you are facing physical or mental health

challenges this semester, please note that Campus Health provides quality medical and mental health care. For medical appointments, call (520) 621-9202. For After Hours care, call (520) 570-7898. For the Counseling & Psych Services (CAPS) 24/7 hotline, call (520) 621-3334.

**Classroom Behavior Policy:** To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

Students are asked to refrain from disruptive conversations with people sitting around them during lecture. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave lecture or discussion and may be reported to the Dean of Students.

Some learning styles are best served by using personal electronics, such as laptops and iPads. These devices can be used ONLY for note taking. NO cellphones in class. Cellphones must be kept in a bag or pocket and on silent.

**Threatening Behavior Policy:** The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See <http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

**Code of Academic Integrity:** Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: <http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity>.

**UA Nondiscrimination and Anti-harassment Policy:** The University is committed to creating and maintaining an environment free of discrimination; see <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>.

**Accessibility and Accommodations:** At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, <https://drc.arizona.edu/>) to establish reasonable accommodations.

**Subject to Change Statement:** Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.