

ASTRON 3101: Special Topics – Introduction to Astrophysics

Term: 2231 (Fall 2022)

Credits: 3

Meeting Time: Mondays and Wednesdays, 1:00 PM - 2:15 PM

Meeting Location: 103 Allen Hall

Instructor: Prof. Evan Schneider (she/they)

eschneider@pitt.edu (email is the best way to get in touch with me)

Office: 304 Allen Hall

Logistics:

We will meet in person in our assigned classroom unless otherwise announced. I will hold office hours by appointment - please don't be shy about asking to meet!

Course Description:

While astronomy is often considered the oldest science, the modern field of astrophysics is primarily comprised of applications of physics to astronomical phenomena. Most modern astrophysicists use the terms astronomy and astrophysics interchangeably. This class will provide a broad survey of the field of astrophysics. Topics may include stars, extrasolar planets, the interstellar medium and star formation, galaxies, and cosmology, and may vary according to our pace and student interest.

Course Objectives:

This course is intended to prepare students to read and evaluate scientific literature, attend and understand research talks in the astrophysics group at Pitt, excel in upper level and focused advanced graduate courses, and carry out independent research projects in the field.

Textbook:

The subject matter for this course will follow “Astrophysics in a Nutshell, 2nd Edition” by Dan Maoz. The book is available in both hard copy and electronic versions. In addition, I will assign Annual Review articles for each unit of the course. These can be obtained from the astrophysics data system (ADS): <https://ui.adsabs.harvard.edu> and will also be available on Canvas.

Course Organization:

Pedagogy indicates that active participation is the best way to learn. I will endeavor throughout this course to keep traditional lecturing to a minimum, and focus instead on in-class problem solving and participation. That said, this course will cover a large breadth of subject matter. In order to keep us moving at a reasonable pace, prior to each class, I expect students to read the appropriate sections of the Maoz textbook (see schedule below), take notes, and come with any questions. *This is particularly important if you do not have an undergraduate background in astrophysics.* Class activities will focus on conceptual and/or quantitative problem solving intended to solidify your understanding of the material.

This class will have a heavy focus on becoming familiar with astrophysics literature. I will assign ~4-6 annual review articles throughout the term, and there will be a short writing assignment associated with each. I also expect students to regularly attend astro coffee on Monday/Thursday at 2:30pm. Over the course of the semester, each student is expected to present at least three papers. You will research and write a mock HST proposal in lieu of a final exam.

Course Schedule:

		Topics discussed	Textbook Reading (before class)
Week 1:	(1) Aug 29 (2) Aug 31	Introduction: terminology, positions, and observations Stars: as blackbodies, spectra and spectral types	Maoz §1, 2.1
Week 2:	Sep 5 (3) Sep 7	Labor Day - no class Stars: physical properties (mass, luminosity), H-R Diagram	Maoz §2.2-2.3
Week 3:	(4) Sept 12 (5) Sept 14	Stars: hydrostatic equilibrium, mass continuity, radiative transfer Stars: radiative transfer, equation of state, opacity	Maoz §3.1-3.4 Maoz §3.5-3.7
Week 4:	(6) Sept 19 (7) Sept 21	Stars: scaling relations, energy production Stars: nuclear reaction rates, energy transport (radiative/convective)	Maoz §3.8-3.9 Maoz §3.10-3.12
Week 5:	(8) Sept 26 (9) Sept 28	Stars: stellar evolution - beyond the main sequence, white dwarfs Stars: supernovae, neutron stars, pulsars	Maoz §4.1-4.2 Maoz §4.3-4.4
Week 6:	(10) Oct 3 (11) Oct 5	Stars: black holes, binary systems ISM: cloud collapse and star formation	Maoz §4.5-4.6 Maoz §5.1
Week 7:	(12) Oct 10 (13) Oct 12	ISM: HII regions, components of the ISM ISM: shocks, supernova remnants, cosmic rays	Maoz §5.2-5.3 Maoz §5.4
Week 8:	(14) Oct 17 (15) Oct 19	Galaxies: the Milky Way Galaxies: demographics	Maoz §7.1 Maoz §7.2
Week 9:	(16) Oct 24 (17) Oct 26	Galaxies: active galactic nuclei (AGN) Galaxies: environment and large scale structure	Maoz §7.3 Maoz §7.4
Week 10:	(18) Oct 31 (19) Nov 2	How to write a proposal Mock HST TAC	
Week 11:	(20) Nov 7 (21) Nov 9	Cosmology: Olbers paradox and the distance ladder Cosmology: Hubble Law, age	Maoz §8.1-8.2 Maoz §8.3-8.5
Week 12:	(22) Nov 14 (23) Nov 16	Cosmology: FLRW, Friedmann equations Cosmology: special cases of FLRW - cosmic history	Maoz §9.1-9.2 Maoz §9.3
Week 13:	(24) Nov 28 (25) Nov 30	Cosmology: Newtonian Friedmann equations, dark energy Cosmology: observational tests (1) - Hubble Law, CMB	Maoz §9.4-9.5 Maoz §10.1-10.3
Week 14:	(26) Dec 5 (27) Dec 7	Cosmology: observational tests (2) - BAO, big bang nucleosynthesis, distant objects Exoplanets: occurrence and architecture, formation, search for life	Maoz §10.4-10.6 Maoz §6.1 - 6.4

Canvas:

The University of Pittsburgh provides a web-based resource called Canvas, which is a portal to web sites for individual courses. A Canvas site for this course has been created and there you can view announcements, send email to the instructor, and download course material such as the syllabus and in-class slides or recordings. Reading and homework assignments will all be announced on Canvas. To access Canvas go to <https://canvas.pitt.edu/> and use your Pitt email username and password to login. If you have forgotten your username and password or need to set up an account, contact the help desk at 412-624-4357, or 4-HELP. Once you have logged into the system you should be able to click on the link for this course to access the available material.

Academic Integrity:

The integrity of the academic process requires fair and impartial evaluation on the part of faculty and honest academic conduct on the part of students. To this end, students are expected to conduct themselves at a high level of responsibility in the fulfillment of the course of their study. It is the corresponding responsibility of faculty to make clear to students those standards by which students will be evaluated and the resources permissible for use by students during the course of their study and evaluation. The educational process is perceived as a joint faculty-student enterprise which will perforce involve professional judgment by faculty and may involve - without penalty - reasoned exception by students to the data or views offered by faculty.

Cheating/plagiarism will not be tolerated. Students suspected of violating the University of Pittsburgh Policy on Academic Integrity, from the February 1974 Senate Committee on Tenure and Academic Freedom reported to the Senate Council, will be required to participate in the outlined procedural process as initiated by the instructor. A minimum sanction of a zero score for the quiz or exam will be imposed. For details, refer to the University Guidelines on Academic Integrity (https://provost.pitt.edu/sites/default/files/academic_integrity_guidelines.pdf).

Diversity and Inclusion:

I consider this class to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability - and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. The University of Pittsburgh does not tolerate any form of discrimination, harassment, or retaliation based on disability, race, color, religion, national origin, ancestry, genetic information, marital status, familial status, sex, age, sexual orientation, veteran status or gender identity or other factors as stated in the University's Title IX policy. The University is committed to taking prompt action to end a hostile environment that interferes with the University's mission. For more information about policies, procedures, and practices, see: <https://www.diversity.pitt.edu/civil-rights-title-ix-compliance/policies-procedures-and-practices>. I ask that everyone in the class strive to help ensure that other members of this class can learn in a supportive and respectful environment. If there are instances of the aforementioned issues, please contact the Title IX Coordinator, by calling 412-648-7860, or e-mailing titleix-coordinator@pitt.edu. Reports can also be filed online: <https://www.diversity.pitt.edu/civil-rights-title-ix-compliance/make-report/report-form>. You may also choose to report this to a faculty/staff member; they are required to communicate this to the University's Office of Diversity and Inclusion. If you wish to maintain complete confidentiality, you may also contact the University Counseling Center (412-648-7930).

Disabilities:

If you require special accommodations or classroom modifications, please notify both your instructor and Disability Resources and Services by the end of the first week of the term. The office of Disability Resources and services is located in 140 William Pitt Union, (412) 648-7890, drsrecep@pitt.edu, (412-228-5347 [voice or TDD]), and their website is at <http://www.drs.pitt.edu>. If you have a physical, learning, or emotional disability, please let me know as early as you can so that appropriate accommodations can be made.