

ASTRONOMY 300B
Radiative Processes in Astrophysics
SO 204
MWF: 2pm-2:50pm
S'2022

Description of Course

ASTR 300B is a class studying the physical processes that emit, absorb, and scatter light in the context of the astrophysics. In this class you will learn radiative transfer in one dimension, learn the fundamental physics of thermal and non-thermal emission processes, and the basics of atomic and molecular spectroscopy. We will also cover applications of radiative processes, including (exo)planets, stars, and the interstellar medium, as well as outside of the field of astronomy.

Course Prerequisites or Co-requisites

Completed ASTR 300A and have completed or are currently taking PHYS 331 (E&M I) and PHYS 371 (Quantum Mechanics I).

Instructor and Contact Information

Instructor:

Ewan S Douglas, SO 402, douglase@arizona.edu, Office Phone: (520) 621-1624.
(He/Him.They/them/xem..., fine too.)

Teach Assistant:

Rachael Amaro, Steward Observatory Graduate Student. rcamaro@email.arizona.edu

Office Hours

- Ewan:
 - Wednesday 3-4pm, Monday 4-5pm. Zoom: <https://arizona.zoom.us/my/douglas.e> or in person by appointment and subject to change.
 - due to the pandemic my time in my office will likely be limited, please make an appointment to speak outside of office hours and specify Zoom preference for Zoom and in person and I will accommodate if possible.
- Rachael: will be ATOMM tutor, see ATOMM schedule below

Communications will be conducted via email, D2L, [or the class Microsoft Teams](#).

Assignments and readings will be posted on D2L.

Astronomy Tutoring for Majors and Minors:

ATOMM tutors are available to help you with problem solving:

Andrew Sevrinsky: sevrinsky@email.arizona.edu

- in-person [Mondays 3:30-5 pm]
- in-person [Tuesdays 3:30-5 pm]

Rachael Amaro: rcamaro@email.arizona.edu

- in-person [Wednesdays 3:30-5 pm]
- ZOOM [Thursdays 4:30-6 pm], <https://arizona.zoom.us/j/85386891006>

Course Format and Teaching Methods

The course will be a hybrid of lecture and in-class group problem solving.

Group problem solving sessions will consist of students working together through physical concepts in small groups on whiteboards/chalkboards.

Course Objectives

This course will cover a broad range of "Radiative Processes in Astrophysics."

COVID19 impact and mitigation

For the latest COVID19 information see <https://covid19.arizona.edu/>.

Updates are typically shared on <https://twitter.com/uarizona>

Classroom attendance IN CONTEXT OF COVID19:

- **If you feel sick, or may have been in contact with someone who is infectious, 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, you should contact the Dean of Students Office DOS-deanofstudents@email.arizona.edu to share documentation about the challenges you are facing.
- Voluntary, free, and convenient [COVID-19 testing](#) 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](#).
- COVID-19 vaccine is available for all students at [Campus Health](#).
- Visit the [UArizona COVID-19](#) page for regular updates.

Expected Learning Outcomes

- Demonstrate the ability to meaningfully analyze, apply and integrate the principle findings, common applications, current problems, fundamental techniques, and underlying theory of the astronomy discipline.
- Employ discipline skills related to the observational techniques, instrumentation, computational methods, and software applications used to investigate modern astrophysical phenomena and problems. Participate in the scholarly, ethical, and discipline specific practices of the field at an emergent level.

Land Acknowledgement

We respectfully acknowledge the University of Arizona is on the land and territories of Indigenous peoples. Today, Arizona is home to 22 federally recognized tribes, with Tucson being home to the O'odham and the Yaqui. Committed to diversity and inclusion, the University strives to build sustainable relationships with sovereign Native Nations and Indigenous communities through education offerings, partnerships, and community service.

Absence and Class Participation Policy:

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: <http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop>

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, <http://policy.arizona.edu/human-resources/religious-accommodation-policy>.

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: <https://deanofstudents.arizona.edu/absences>

Participating in the course and attending lectures and other course events are vital to the learning process. As such, attendance is required at all lectures and discussion section meetings. Absences may affect a student's final course grade. If you anticipate being absent, are unexpectedly absent, or are unable to participate in class online activities, please contact me as soon as possible. To request a disability-related accommodation to this attendance policy, please contact the Disability Resource Center at (520) 621-3268 or drc-info@email.arizona.edu. If you are experiencing unexpected barriers to your success in your courses, the Dean of Students Office is a central support resource for all students and may be helpful. The Dean of Students Office is located in the Robert L. Nugent Building, room 100, or call 520-621-7057.

Makeup Policy for Students Who Register Late

Statement on whether students who register after the first class meeting may make up missed assignments/quizzes and the deadline for doing so is Sept 3rd.

Required Texts or Readings

Required:

- ~~Judith Irwin, Astrophysics Decoding the Cosmos, 2e. ISBN: 9781119623687~~
- Judith Irwin, Astrophysics Decoding the Cosmos, 1st Ed. ISBN:



- Online supplement (also available on D2L): <https://bcs.wiley.com/he-bcs/Books?action=resource&bcsId=12073&itemId=1119623685&resourceId=47810>

Suggested (also available as ebooks through UA library):

- Seager, Sara. *Exoplanet Atmospheres : Physical Processes*, Princeton University Press, 2010. *ProQuest Ebook Central*, <https://ebookcentral.proquest.com/lib/UAZ/detail.action?docID=574447>.
- Draine, Bruce T.. *Physics of the Interstellar and Intergalactic Medium*, Princeton University Press, 2011. *ProQuest Ebook Central*, <https://ebookcentral.proquest.com/lib/uaz/detail.action?docID=664587> .

Other resources:

- UC Berkeley Radiative Processes Wiki: https://casper.astro.berkeley.edu/astrobaki/index.php/Radiative_Processes_in_Astrophysics

Assignments and Examinations: Schedule/Due Dates

Homework assignments are due at the beginning of Friday classes, as digital PDFs uploaded on D2L.

A midterm will be held March 16th (subject to revision).

Final Examination or Project

The final exam is scheduled

Grading Scale and Policies

Grading: Homework (70%), Mid-term (15%), Final Exam (15%).

The final grade maximum scale is set at: A(>88%), B(>75%), C(>62%), D(>50%).

Your grade in this course will depend on your performance on the homework and the final exam. We will be working on homework in class. I will not be handing out solutions to the homework. It is expected that you will solve all of the problems yourself. The final homework score for the class is the average of all homework problem grades with the lowest dropped. Late homework will only be accepted in conjunction with an excused absence or with prior approval.

Incomplete (I) or Withdrawal (W):

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.

Dispute of Grade Policy:

Grades for homework may be disputed up to one week after they have been graded.

Honors Credit

This course is eligible for an Honors contract. For example, past years contracts have involved 5 page research topic reviews. Honors contract information is available at <https://www.honors.arizona.edu/honors-contracts>.

Scheduled Topics

Planned topics 300B will cover include:

1. Intensity, Flux, and Energy Density
2. thermal emission
3. Maxwell's equations and emission from moving charges
4. polarization and optical depth
5. dust properties and photon scattering, emission and loss processes
6. 1D equation of radiative transfer
7. spectroscopic lines
8. other emission processes and photochemistry
9. Plasma effects, forbidden emission lines, Auroral and dayglow processes
10. extinction laws
11. Einstein Coefficients
12. absorption lines and molecular spectroscopy
13. stellar atmospheres
14. planetary atmospheres
15. Applications to fields outside of astronomy

Bibliography

(available for reference in Parker Library, for more information on the library see:

<https://plso.arizona.edu/>) :

- Rybicki, George B, and Alan P Lightman. *Radiative Processes in Astrophysics*. 1. Aufl. ed. Wiley-VCH, 2008. Web. Available online: https://arizona-primo.hosted.exlibrisgroup.com/permalink/f/1h28lag/TN_cdi_askewsholts_vlebooks_9783527618187
- Shu, Frank H. *The Physics of Astrophysics, Vol 1. Radiation*. 1991.
- Chandrasekhar, S. *Radiative Transfer*. New York: Dover, 1960. (available in Parker Library)

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.).

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>.

Accessibility and Accommodations

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.

Code of Academic Integrity

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. 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>.

The University Libraries have some excellent tips for avoiding plagiarism, available at <http://new.library.arizona.edu/research/citing/plagiarism>.

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

Nondiscrimination and Anti-harassment Policy

The University of Arizona is committed to creating and maintaining an environment free of discrimination. In support of this commitment, the University prohibits discrimination, including harassment and retaliation, based on a protected classification, including race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, or genetic information. For more information, including how to report a concern, please see <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

Additional Resources for Students

UA Academic policies and procedures are available at <http://catalog.arizona.edu/policies>

- 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>). For astronomy as of August 2021, this is Michelle Cournoyer, michelle@email.arizona.edu. 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
- 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 can be reached at (520) 621-2057 or 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.**

The Dean of Students Office's Student Assistance Program

<http://deanofstudents.arizona.edu/student-assistance/students/student-assistance>

Student Assistance helps students manage crises, life traumas, and other barriers that impede success. The staff addresses the needs of students who experience issues related to social adjustment, academic challenges, psychological health, physical health, victimization, and relationship issues, through a variety of interventions, referrals, and follow up services.

Email: DOS-deanofstudents@email.arizona.edu

Phone: 520-621-7057

Survivor Advocacy Program

<https://survivoradvocacy.arizona.edu/>

The Survivor Advocacy Program provides confidential support and advocacy services to student survivors of sexual and gender-based violence. The Program can also advise students about relevant non-UA resources available within the local community for support.

Email: survivoradvocacy@email.arizona.edu

Phone: 520-621-5767

Campus Pantry

Any student who has difficulty affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live and believes this may affect their performance in the course, is urged to contact the Dean of Students for support. In addition, the University of Arizona Campus Pantry is open for students to receive supplemental groceries at no cost. Please see their website at: campuspantry.arizona.edu for open times.

Furthermore, please notify me if you are comfortable in doing so. This will enable me to connect you to additional resources.

Preferred Gender Pronoun

This course affirms people of all gender expressions and gender identities. If you prefer to be called a different name than what is on the class roster, please let me know. Feel free to correct instructors on your preferred gender pronoun. If you have any questions or concerns, please do not hesitate to contact me directly in class or via email (instructor email). If you wish to change your preferred name or pronoun in the UAccess system, please use the following guidelines:

Preferred name: University of Arizona students may choose to identify themselves within the University community using a preferred first name that differs from their official/legal name. A student's preferred name will appear instead of the person's official/legal first name in select University-related systems and documents, provided that the name is not being used for the purpose of misrepresentation. Students are able to update their preferred names in UAccess.

Pronouns: Students may designate pronouns they use to identify themselves. Instructors and staff are encouraged to use pronouns for people that they use for themselves as a sign of respect and inclusion. Students are able to update and edit their pronouns in UAccess.

More information on updating your preferred name and pronouns is available on the Office of the Registrar site at <https://www.registrar.arizona.edu/>.

Safety on Campus and in the Classroom

Familiarize yourself with the Steward Observatory Evacuation and Active Shooter plans specific to SO 204.

See also Risk Management: <https://risk.arizona.edu/emergency-info/active-shooter-armed-individual> and watch the video available at <https://ua-saem-aiss.narrasys.com/#/story/university-of-arizona-cert/active-shooter>

Confidentiality of Student Records

<http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa?topic=ferpa>

Diversity and Inclusion in Astronomy

The Astronomy Department includes many initiatives and groups to promote diversity and inclusion, for an up-to date list see: <https://www.as.arizona.edu/diversity-inclusion> and particularly note the **TIMESTEP: Tucson Initiative for Minority Engagement in Science and TEchnology Program** (<https://lavinia.as.arizona.edu/~timestep/>). TIMESTEP is a alternatig-weekly discussion group about topics of professional development for undergraduates in STEM fields at U. Arizona. Meetings are open to all students.

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.