

UNIVERSITY OF KANSAS
DEPARTMENT OF PHYSICS AND ASTRONOMY
ASTROPHYSICS I – ASTR 691 – FALL 2026
INSTRUCTOR: PROF. IAN CROSSFIELD
COURSE WEBSITE: [HTTPS://CROSSFIELD.KU.EDU/A691_2026B/](https://crossfield.ku.edu/A691_2026B/)

COURSE SYLLABUS AS OF AUGUST 24, 2026

An introduction to radiation & thermal processes, radiative transfer, and stellar atmospheres & the interstellar medium.

This is the first half of a two-semester, upper-division, calculus-based astrophysics sequence designed for students intending to pursue future studies in this area and/or for those interested in exploring a deeper, more rigorous treatment of the relevant subject matter. Topics will include an introduction to radiation processes, thermal processes, and radiative transfer in stellar atmospheres and the interstellar medium, stellar spectroscopy, and planetary atmospheres and related topics. The course also aims to set the groundwork for Astrophysics II (ASTR 692, which treats the formation and evolution of stars, nucleosynthesis of the elements, and the physical processes of high energy physics). The course is structured and paced for undergraduate students who have already passed PHSX 313 (Introduction to Modern Physics), calculus and differential equations, and the usual prerequisites for those courses. Pending a survey of the course members, the course presentations assumes a general familiarity with basic astronomical concepts and background equivalent to a KU junior with previous exposure to the coursework described above. **You should never hesitate to reach out to Prof. Crossfield if you have questions about course material!**

Office hours will be in Prof. Crossfield's office (MAL 2058D), Wed 2-3pm and Thur 1-2pm. But if you want another meeting, just email him at ianc@ku.edu !

Grade Breakdown:

- **40%:** There will be a combination of in-class and take-home Problem Sets (PSets), in total comprising 40% of the total course grade. Assignments and due dates for take-home assignments will be posted on the course website. Any take-home problem sets are to be turned in: On time; typed; printed; showing complete work; and with final answers circled, boxed, or otherwise highlighted.

Late assignments can be turned in anytime during the semester, up until the last day of class (i.e., before Stop Day), for a maximum of 70% of their initial credit value.

- **10%:** Students will complete a 500-word summary and report on a professional **astronomy** research talk deliver **in-person** (not recorded online). This may be a talk given at KU's Physics & Astronomy Department colloquium series, at the Astronomy/Space Seminar series, or other local presentation given during this semester. Due on or before the last day of class.
- **10%:** Journal Club: you will give a 10-minute presentation to the class briefly summarizing an astronomy paper of your choice that was posted on <https://arxiv.org/list/astro-ph/> during the semester. Check with Prof. Crossfield first to confirm that the paper topic is appropriate for A691.
- **15%:** There will be one in-class exam during the semester, provisionally scheduled for **Tuesday, 20 October** (though stay tuned in case that date changes).
- **25%:** A comprehensive final exam worth 25% of the total grade, held on **Friday, 18 December from 1330–1600**.
- **BONUS:** An additional 10% of course grade (i.e., a full letter grade) is available to any student who writes a quality, submittable application for a major scholarship or fellowship (e.g. NSF GRFP, Goldwater, Astronaut, etc.). The application must be submitted to Prof. Crossfield at least two weeks before the official submission deadline (so he can give you feedback to help improve it). Drafts for fellowships due after the last day of class must be turned in one week before the last day of class. A large (though non-exhaustive) list of such fellowships is available at <https://fellowships.ku.edu/search-fellowships-scholarships>.

Course Outline

The course will be divided roughly equally across four main topical areas. The text below lists the material to be discussed in each topic for ASTR 691 in Fall 2026. This is a general outline and will likely be updated from time to time to adjust depending on how well we cover the material that I am initially planning to cover.

1. **Radiative Transfer:** Flux, absorption, emission, and the equation of radiative transfer.
2. **Emission & Absorption Mechanisms:** Atomic and molecular transitions, line formation, line broadening.
3. **Stellar Atmospheres:** Basic photospheric quantities, gray atmospheres, limb darkening, turbulence and convection.
4. **Planetary Atmospheres:** Transmission and emission spectra, thermal profiles, the greenhouse effect, atmospheric circulation.

Contacting the Professor

The best way to contact Prof. Crossfield is always by visiting his office hours in MAL 2058D (hours above), and/or by email at ianc@ku.edu. Emails should contain “ASTR 691” in the subject line so that I know to respond promptly to them. Note that “Hey” is not an appropriate salutation in formal communication

Other Resources

Finally, KU also has a large number of additional resources available; see KU Syllabus Policies for more info. As of this year, this includes:

- Explanation of instructional time expected for out-of-class student work per credit (see Credit Hour Definition policy)
- Statement on accommodations and/or information for students with disabilities (see or use):
 - KULC: Student Access Center Syllabus Statement
 - KUMC: Syllabus Statement for Accommodations
- Links to the following policies:
 - Sexual Harassment
 - Nondiscrimination, Equal Opportunity, and Affirmative Action
 - KU Statement on Diversity and Inclusion
 - Academic Misconduct
 - * KULC: Academic Misconduct (USRR 2.7.1)
 - * KUMC: Academic Misconduct
 - Change of Grade
 - * KULC: Change of Grade Policy and Change of Grade (USRR 2.4.1) (i.e., grade appeal)
 - * KUMC: School of Health Professions Grade Policy; School of Nursing Grade Policy; School of Medicine (MD) Grade Policy; and Graduate Studies Grade Policies
 - KULC: Code of Student Rights and Responsibilities
 - KULC: Commercial Note-Taking
 - KULC: Mandatory Reporting
 - KULC: Racial and Ethnic Harassment Policy