

# Doctor of Philosophy in Physics

Our goal is to understand the physical universe. The questions addressed by our department's research and education missions range from the applied, such as an improved understanding of the materials that can be used for solar cell energy production, to foundational questions about the nature of mass and space and how the Universe was formed and subsequently evolved, and how astrophysical phenomena affected the Earth and its evolution. We study the properties of systems ranging in size from smaller than an atom to larger than a galaxy on timescales ranging from billionths of a second to the age of the universe. The courses and laboratory/research experiences in the department's doctor of philosophy program are aimed at shaping and training students to be professional scientists capable of carrying out important scientific research and/or teaching at the highest levels of educational institutions. The program more specifically prepares students for a wide variety of professions, including at academic institutions, in industry, or at government laboratories. Graduates of this degree program can be found in key positions regionally, nationally, and internationally.

## Admission to Graduate Studies Admission Requirements

- All applicants must meet the requirements outlined in the Admission to Graduate Study (<https://policy.ku.edu/graduate-studies/admission-to-graduate-study/>) policy.
- Bachelor's degree: A copy of official transcripts showing proof of a bachelor's degree (and any post-bachelor's coursework or degrees) from a regionally accredited institution, or a foreign university with equivalent bachelor's degree requirements is required.
- English proficiency: Proof of English proficiency (<https://gradapply.ku.edu/english-requirements/>) for non-native or non-native-like English speakers is required. There are two bands of English proficiency, including Admission and Full proficiency. For applicants to online programs, Full proficiency is required.

## Admission to the Physics and Astronomy Graduate Program

Most admitted students have an undergraduate grade-point average of at least a B (3.0 on a 4.0 scale), overall and in the major. A baccalaureate degree with a major in physics is desirable but not required. Recommended preparation consists of courses in mechanics, electromagnetic theory, thermal physics, introductory quantum mechanics, advanced laboratory, and at least one course in mathematics beyond differential equations. Working knowledge of computers and of an advanced programming language is helpful. A student with less than the recommended preparation may enroll in these courses for graduate credit.

The following materials are required and must be submitted before the application deadline in order for the application to be considered:

- **Transcripts** A scanned version of the transcript from your undergraduate and any post-Bachelor institution(s). If admitted, you will be required to submit official transcripts by the end of your first semester at KU to avoid having a hold placed on your student account. Review the KU Transcript requirement for more information,

especially for International Applicants who may need to provide additional documentation.

- **Statement of Purpose** A single document also including: academic interests and professional goals.
- **Resume or Curriculum Vitae**
- **Recommendations.** You will be asked for the names and email addresses of three people who can write a recommendation letter describing your qualifications for graduate school in physics and astronomy. Once you submit the application, an email will be sent to each recommender requesting a letter and electronic survey from each person that you name.

The General and Subject GRE are not required for admission to the Physics and Astronomy graduate program. Submit your graduate application online (<https://gradapply.ku.edu/apply/>). The deadline to apply for Fall 2025 admission is December 16th, 2024. The deadline to apply for Spring 2026 admission is October 1st, 2025.

**The University of Kansas  
Department of Physics and Astronomy  
Malott Hall  
1251 Wescoe Hall Dr., Room 1082  
Lawrence, KS 66045**

## Ph.D. Degree Requirements Undergraduate Preparation

All students must adhere to the General Requirements for all Graduate Degrees (<https://physics.ku.edu/graduate-program/additional-requirements/>), which are part of each student's Individualized Plan for ensuring student preparation.

### Course Requirements:

| Code   | Title  | Hours    |
|--|--|----------|
| <b>Core Courses</b>  |  |          |
| PHSX 711   | Quantum Mechanics I  | 3        |
| PHSX 811   | Quantum Mechanics II   | 3        |
| PHSX 821   | Classical Mechanics  | 3        |
| PHSX 831   | Electrodynamics I  | 3        |
| <b>Other Required Courses</b>  |  |          |
| PHSX 717   | Graduate Seminar (Fulfills Responsible Scholarship requirement)  | 1        |
| PHSX 815   | Computational Methods in Physical Sciences (Default option to fulfill the Research Skills Requirement) | 3        |
| PHSX 871   | Statistical Physics I  | 3        |
| <b>Three additional 3 credit hour lecture courses. At least one must be a PHSX/ASTR course numbered 700 or above. Students who wish to pursue a more multidisciplinary plan of study, please see the multidisciplinary plan description below.</b> |  | <b>9</b> |
| ASTR 794   | Interiors and Atmospheres<br>or PHSX 794Interiors and Atmospheres                                      |          |
| ASTR/PHSX 795  | Space Plasma Physics   |          |
| ASTR 796   | Radiation and the Interstellar Medium<br>or PHSX 796Radiation and the Interstellar Medium              |          |
| ASTR 797   | Galaxies<br>or PHSX 797Galaxies  |          |
| ASTR 798   | High Energy Astrophysics   |          |

or PHSX 798 High Energy Astrophysics

|                    |   |
|--------------------|---|
| PHSX 718           | Mathematical Methods in Physical Sciences |
| PHSX 721           | Chaotic Dynamics                          |
| PHSX 723           | Seismology                                |
| PHSX 727           | Advanced Geophysics: _____                |
| PHSX 741           | Nuclear Physics I                         |
| PHSX 761           | Elementary Particles I                    |
| PHSX 781           | Solid State Physics I                     |
| PHSX 793           | Physical Cosmology                        |
| PHSX 801           | Advanced Topics                           |
| PHSX 841           | Nuclear Physics II                        |
| PHSX 855           | Advanced Optics                           |
| PHSX 861           | Elementary Particles II                   |
| PHSX 881           | Solid State Physics II                    |
| PHSX 885           | Materials Modeling                        |
| PHSX 886           | Materials Characterization                |
| PHSX 895           | Plasma Physics                            |
| PHSX 911           | Quantum Mechanics III                     |
| PHSX 912           | Quantum Field Theory                      |
| PHSX 915           | Relativity                                |
| PHSX 931           | Electrodynamics II                        |
| PHSX 971           | Advanced Statistical Mechanics            |
| <b>Total Hours</b> | <b>28</b>                                 |

### Colloquium Requirement

All Ph.D. students are required to attend at least 75% of the regularly scheduled colloquia during their first six semesters. See Department website (<https://physics.ku.edu/graduate-program/physics-PhD/course-requirements/>) for details and schedule.

### Oral Presentation Requirement

All graduate students, after their first semester, will deliver at least one oral presentation per semester. Presentations must cover a topic in physics or astronomy and typically relate to the student's research. See the Communication Skills (<https://physics.ku.edu/graduate-program/additional-requirements/>) explanation for procedures.

The courses listed above comprise the department course requirements common to all students except those pursuing a multidisciplinary plan of study, which is described below. Subsequent work, consisting of advanced courses in appropriate fields and seminars, will be selected by the student and the advisor on the basis of the student's need and intended research interest. The student's dissertation committee will determine the adequacy of the student's courses and seminars and will specify the total course requirements.

Students who wish to pursue a more multidisciplinary plan of study may incorporate coursework from up to two other natural science, engineering, or mathematics (SEM) departments at KU by substituting non EPHX/PHSX/ASTR courses at the 600 level and above from these other disciplines for the two additional electives previously described. The research advisor, or in the absence of one, the Departmental Graduate Advisor (who is the default advisor for all students without a research advisor), shall approve all such outside course choices and provide documentation for the student file on the approved courses and their rationale.

Students who wish to take courses in the social sciences, humanities, or professional schools must submit a detailed plan of study that must be approved by the Physics and Astronomy Graduate Committee. Please note that while these unique plans involving non-STEM fields will be considered, there is no guarantee that the plan of study will be approved.

## Preliminary Candidacy

To be admitted to preliminary candidacy, each graduate student must satisfy the following department requirements:

1. Within 12 months of entering the program the student must fulfill the requirements of the individualized plan of study (<https://physics.ku.edu/graduate-program/additional-requirements/>) for all graduate degrees to certify an undergraduate knowledge of Physics. To develop the individualized plan of study, students will be required to attend an advising session with the Departmental Graduate Advisor. This session will include a discussion of the student's transcripts, potential course enrollment, and administration of a diagnostic exam. Results of this exam will help determine a suggested course schedule. Following the development of the individualized plan, the advising process will continue through regular check-ins and reviews of student progress. These reviews will include looking at student grades, research progress, and general progress toward meeting departmental milestones.
2. Achieve a minimum core course grade point average of 3.2. The core course GPA is computed from the following equally weighted elements:
  - a. Grade obtained in PHSX 711 Quantum Mechanics I
  - b. Grade obtained in PHSX 811 Quantum Mechanics II
  - c. Grade obtained in PHSX 821 Classical Mechanics
  - d. Grade obtained in PHSX 831 Electrodynamics I
  - e. Average grade of 2 other PHSX lecture course electives, chosen from the course grid above.
3. Students may repeat any of the core courses (PHSX 711, PHSX 811, PHSX 821, and PHSX 831) once for the purpose of improving the core GPA. In calculating the core GPA, the Department will use only the better of the two grades.
4. The two elective courses must be taken at KU, but students entering with graduate credit from other institutions may petition the Graduate Committee for a waiver for any of the 4 named core courses. For the purposes of the core GPA, grades (of "B" or better) from the previous institution may be used for at most 3 of the 4 named courses.
5. Graduate students are normally expected to complete all core courses by the end of their second year of enrollment.

Once requirements for Preliminary Candidacy have been met, the Graduate Committee will decide whether or not to admit the student to Preliminary Candidacy. Once confirmed by the Graduate Committee, the Graduate Committee Chair will report this result to the Graduate Faculty.

## Research Skills and Responsible Scholarship

Before being able to schedule the comprehensive exam, the student must complete the Research Skills and Responsible Scholarship requirements. The University requires that every doctoral student receive training in responsible scholarship pertinent to the field of research and obtain research skills pertinent to the doctoral level of research in their field(s). These requirements must be completed by the end of the semester that

the student takes the oral comprehensive exam. The Research Skills requirement can be satisfied with a B or better grade in a non-core, physics or astronomy graduate course, that covers material (i.e., skills) appropriate for the research specialty of the student. The course shall be chosen in consultation with the student's advisor, who will inform the graduate coordinator. The course will typically be an elective course. The default option for satisfying this requirement will be PHSX 815, unless the student elects to use another eligible course in its place. The Responsible Scholarship requirement is filled via completion of the PHSX 717 Graduate Seminar.

## Pedagogical Instruction

Every student who receives a GTA appointment will be required to complete PHSX 702 at the first offering of the course starting with the semester of the student's initial GTA appointment. Failure to complete this class at the first opportunity may affect consideration for subsequent GTA appointments.

## Oral Comprehensive Examination

After completing a major portion of the required course work and satisfying the Research Skills and Responsible Scholarship requirement, the student must pass the comprehensive examination.

As a written component of the exam, the student will write a 2,000 to 4,000 word paper on a topic in their field of research that is relevant to their thesis work. There is also an oral component of the exam in which the student makes an oral research presentation to a committee of faculty. This committee then asks the student questions both on their presentation and on general physics and astronomy knowledge.

## Post-Oral Comprehensive Exam Requirements

Upon passing the comprehensive examination, the student becomes a candidate for the Ph.D. degree. Each candidate must complete a research project that has been approved by the dissertation committee. The committee establishes the candidate's course requirements and directs the research.

At least once each year after passing the comprehensive examination, the student must schedule a meeting with their dissertation committee to discuss progress toward the completion of the dissertation and any other concerns. Starting the semester following successful completion of the oral comprehensive exam, students must enroll in accordance with the Doctoral Candidacy Policy (<https://policy.ku.edu/graduate-studies/doctoral-candidacy/>). This enrollment includes, but is not limited to, at least 1 dissertation hour every semester until graduation.

## Final Oral Examination

To be awarded the Ph.D. in Physics, a candidate for the degree must complete a dissertation and pass a final oral examination. Possible outcomes of the final exam include Honors, Satisfactory, and Unsatisfactory.

Please consult the departmental web page (<https://physics.ku.edu/graduate-program/>) for additional information and to access the Graduate Student Handbook (<https://physics.ku.edu/graduate-program/important-information/>).

Please visit the Graduate Studies section of the University Policy Library (<https://policy.ku.edu/office/Graduate-Studies/>) for information regarding additional requirements that may apply.

At the completion of this program, students will be able to:

- Display knowledge of graduate level physics and astronomy.
- Display successful (oral and written) communication of scientific results.
- Display acquisition of discipline specific research skill.
- Display ability of independent research in physics and astronomy.