# Physics, PhD

Graduate study in physics and astronomy is highly individualized. The department does not offer a PhD in astronomy, but students may pursue a PhD in physics with an astronomy subprogram and a dissertation in astronomy.

Each entering graduate student is assigned a faculty advisor, who assists in preparing a plan of study and in guiding the student's progress.

## Learning Outcomes

Graduates will:

- understand the foundational principles that transcend many distinct areas, and learn the technical language, problem-solving skills, and training in technical listening and discussion;
- learn, practice, and discover advanced discourse in mathematical aspects that translate to physics;
- become familiar with the state-of-the-art experimental tools and equipment in the field;
- develop skills for creativity and originality in the field and promote communication of new discoveries;
- learn and practice advanced discourse in experimental and observational aspects, including data and information mining, translating experimental observations to physical principles and vice versa; and
- learn analysis of data and computational skills as well as become familiar with state-of-the-art techniques for data processing.

## Requirements

The Doctor of Philosophy program in physics requires a minimum of 72 s.h. of graduate credit. At least 39 s.h. must be earned at the University of Iowa to complete the residency requirement. For students interested in doing doctoral work in astronomy, the department offers an astronomy subprogram, including a dissertation, within the PhD program in physics. All students must maintain a program grade-point average of at least 3.00.

All students must earn at least 24 s.h. in departmental courses numbered 5000 or above. They may not count credit earned in PHYS:7990 Research: Physics, PHYS:7992 Individual Critical Study, ASTR:7991 Research: Astronomy, or seminars.

All students must take comprehensive examinations; participate in advanced seminars; do original research in experimental physics, theoretical physics, or astrophysics; and prepare and defend a written dissertation based on this work.

PhD students in physics without the astronomy subprogram must complete the following courses.

| Course # | Title | Hours |
|---|---|---|
| PHYS:4761 & PHYS:4762 | Mathematical Methods of Physics I and Mathematical Methods of Physics II (students who pass a written examination are exempt from this requirement) | 6 |
| PHYS:5710 | Classical Mechanics | 3 |
| PHYS:5730 | Statistical Mechanics I | 3 |
| PHYS:5741 & PHYS:5742 | Quantum Mechanics I and Quantum Mechanics II | 6 |
| PHYS:5811 & PHYS:5812 | Classical Electrodynamics I and Classical Electrodynamics II | 6 |

These courses freely use advanced mathematics (e.g., complex variables, tensor analysis). An introduction is provided in PHYS:4761 Mathematical Methods of Physics I and PHYS:4762 Mathematical Methods of Physics II. The selection of less advanced coursework depends on the adequacy of a student's preparation for graduate work; students' choice of more advanced and specialized courses depends on the direction in which their interests develop.

PhD students in physics with the astronomy subprogram must complete a total of six courses from the following.

| Course # | Title | Hours |
|---|---|---|
| Four of these: | | |
| ASTR:6782 | Extragalactic Astronomy | 3 |
| ASTR:6785 | The Interstellar Medium | 3 |
| ASTR:6790 | Stellar Astrophysics | 3 |
| ASTR:6870 | Radiative Processes in Astrophysics | 3 |
| ASTR:6880 | High Energy Astrophysics | 3 |
| ASTR:7775 | Special Topics in Astrophysics | 3 |
| ASTR:7830 | Space and Astrophysical Plasma Physics | 3 |
| PHYS:7760 | General Relativity | 3 |
| PHYS:7761 | Cosmology | 3 |
| Two of these: | | |
| PHYS:5710 | Classical Mechanics | 3 |
| PHYS:5730 | Statistical Mechanics I | 3 |
| PHYS:5741 | Quantum Mechanics I | 3 |
| PHYS:5742 | Quantum Mechanics II | 3 |
| PHYS:5811 | Classical Electrodynamics I | 3 |
| PHYS:5812 | Classical Electrodynamics II | 3 |

After a student has chosen a research specialty, the student must submit a formal thesis proposal and defend the proposal in an oral comprehensive exam. The appropriate thesis advisor then becomes the candidate's general advisor and the chair of the comprehensive and final examination committee. The comprehensive exam must be taken before the beginning of the fourth year of graduate study.

## Admission

Applicants must meet the admission requirements of the Graduate College; see the Manual of Rules and Regulations on the Graduate College website.

## Career Advancement

Graduates have opportunities for employment in universities, colleges, and research laboratories in government and industry. Physics graduates have mastered skills that are readily transferable to a number of fields. They might choose to work in engineering, software development, finance, or consulting.

The Pomerantz Career Center offers multiple resources to help students find internships and jobs.

## Academic Plans

# Sample Plan of Study

Sample plans represent one way to complete a program of study. Actual course selection and sequence will vary and should be discussed with an academic advisor. For additional sample plans, see MyUI.

## Physics, PhD

| Course | Title | Hours |
|---|---|---|
| **Academic Career** | | |
| **Any Semester** | | |
| 72 s.h. must be graduate level coursework; graduate transfer credits allowed upon approval. More information is included in the General Catalog and on department website. [a, b] | | |
| Students must maintain a Graduate College program GPA of 3.00 or higher. [c] | | |
| | **Hours** | **0** |
| **First Year** | | |
| **Fall** | | |
| PHYS:4761 | Mathematical Methods of Physics I [d] | 3 |
| PHYS:5710 | Classical Mechanics | 3 |
| PHYS:5730 | Statistical Mechanics I | 3 |
| | **Hours** | **9** |
| **Spring** | | |
| PHYS:4762 | Mathematical Methods of Physics II [d] | 3 |
| PHYS:5741 | Quantum Mechanics I | 3 |
| PHYS:5811 | Classical Electrodynamics I | 3 |
| | **Hours** | **9** |
| **Second Year** | | |
| **Fall** | | |
| PHYS:5742 | Quantum Mechanics II | 3 |
| PHYS:5812 | Classical Electrodynamics II | 3 |
| Elective course [e] | | 3 |
| | **Hours** | **9** |
| **Spring** | | |
| Elective course [e] | | 3 |
| Elective course [e] | | 3 |
| Elective course [e] | | 3 |
| | **Hours** | **9** |
| **Third Year** | | |
| **Any Semester** | | |
| Comprehensive Exam | | |
| | **Hours** | **0** |
| **Fall** | | |
| PHYS:7990 | Research: Physics | 9 |
| | **Hours** | **9** |
| **Spring** | | |
| PHYS:7990 | Research: Physics | 9 |
| | **Hours** | **9** |
| **Fourth Year** | | |
| **Fall** | | |
| PHYS:7990 | Research: Physics | 9 |
| | **Hours** | **9** |
| **Spring** | | |
| PHYS:7990 | Research: Physics | 9 |
| Final Exam [f] | | |
| | **Hours** | **9** |
| | **Total Hours** | **72** |

a Students must earn at least 24 s.h. in departmental courses numbered 5000 or above, and may not include credit earned in PHYS:7990, PHYS:7992, ASTR:7991, or seminars.

b Students must complete specific requirements in the University of Iowa Graduate College after program admission. Refer to the Graduate College website and the Manual of Rules and Regulations for more information.

c Graduate College program GPA is comprised of all courses that are approved degree requirements. If a student takes more than the minimum required number of semester hours to complete the degree, but all courses taken are eligible to count toward the degree, those courses will be included in the Graduate College program GPA.

d Students who pass a written examination are exempt from this requirement.

e Work with faculty advisor to determine appropriate coursework and sequence.

f Dissertation defense.