

# PHYSICS, PHD

for the degree of Doctor of Philosophy in Physics

The Department of Physics offers graduate programs leading to the degrees of Master of Science and Doctor of Philosophy in Physics and Master of Science in Teaching Physics. The Department is actively developing a new paradigm for graduate physics education and research for the 21st century, aimed at enhancing interdisciplinary interactions and creating an integrated approach to educational and research training. Outstanding graduate research opportunities are available in many subdisciplines of physics, including condensed matter physics, high energy and nuclear physics, astrophysics, atomic physics, molecular and optical physics, complex systems, quantum information, biological physics, physics education research.

Students may select experimental, theoretical, or computational thesis projects. Multidisciplinary projects are especially encouraged, and, with the consent of other departments, students may earn master's degrees in areas such as materials science and engineering, or computer science, simultaneously with their PhD degrees in physics.

Opportunity exists for specializing in computational science and engineering via the Computational Science & Engineering (<http://catalog.illinois.edu/graduate/engineering/concentration/computational-science-engineering/>) optional graduate concentration.

## Department Research

The research specialties of Physics faculty fall into the broad categories described in the graduate programs section of this document. Details of each individual's specific interests are available at the department's faculty research Web site. (<http://physics.illinois.edu/research/>) Included are faculty whose primary appointments are in other departments but who supervise Physics students.

The Department of Physics offers world-class research facilities in traditional areas of physics, including condensed matter, nuclear, particle, and optical physics, as well as state-of-the-art instruments for quantum information, nanoscale science and engineering, and biological physics. For a complete description of physics facilities, please consult the department's research facilities Web site (<https://physics.illinois.edu/research/facilities/>).

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For additional details and requirements refer to the department's Degree Requirements (<http://physics.illinois.edu/grad/degree-requirements.asp>) and the Graduate College Handbook (<http://grad.illinois.edu/gradhandbook/>). Learn more about the Qualifying Exam (<https://physics.illinois.edu/academics/graduates/qualifying-examination/>).

## Entering with approved M.S. degree

Code	Title	Hours
PHYS 599	Thesis Research (min applied toward the degree)	6
Select two of the following breadth courses:		
PHYS 513	Quantum Optics & Information	8

or PHYS 514	Modern Atomic Physics	
PHYS 540	Astrophysics	
PHYS 550	Biomolecular Physics	
PHYS 560	Condensed Matter Physics I	
or PHYS 569	Emergent States of Matter	
PHYS 570	Subatomic Physics	
PHYS 597	Individual Study (prior to the preliminary exam)	1-16
Elective courses – chosen in consultation with advisor (subject to Other Requirements and Conditions below)		49 max
<b>Total Hours</b>		<b>64</b>

## Other Requirements and Conditions

Requirement	Description
Other Requirements and Conditions may overlap	
Recommended elective courses: PHYS 504, 505, 508 & 509, 580 & 581 (& denotes sequence)	
PHYS 599 (thesis research) cannot be taken until after the preliminary exam is passed.	
Ph.D. exam and dissertation requirements:	
Qualifying exam: <sup>2</sup>	
Preliminary exam	
Final exam or dissertation defense	
Dissertation deposit	
Minimum GPA:	2.75

## Entering with approved B.S. degree

Code	Title	Hours
PHYS 599	Thesis Research (min applied toward the degree)	6
Select two of the following breadth courses:		
PHYS 513	Quantum Optics & Information	8
or PHYS 514	Modern Atomic Physics	
PHYS 540	Astrophysics	
PHYS 550	Biomolecular Physics	
PHYS 560	Condensed Matter Physics I	
or PHYS 569	Emergent States of Matter	
PHYS 570	Subatomic Physics	
PHYS 597	Individual Study (prior to the preliminary exam)	1-16
Elective courses – chosen in consultation with advisor (subject to Other Requirements and Conditions below)		81 max
<b>Total Hours</b>		<b>96</b>

## Other Requirements and Conditions

Requirement	Description
Other Requirements and Conditions may overlap	
Recommended elective courses: PHYS 504, 505, 508 & 509, 580 & 581 (& denotes sequence)	

A minimum of 12 500-level credit hours applied toward the degree.

A minimum of 16 PHYS credit hours, with 8 at the 500 level.

PHYS 599 (thesis research) cannot be taken until after the preliminary exam is passed.

An additional maximum of 8 hours of PHYS 597 (or other individual study) may be applied toward the elective course work requirement.

These students may earn a Master of Science degree during the Ph.D. program

Ph.D. exam and dissertation requirements:

Qualifying exam:<sup>2</sup>

Preliminary exam

Final exam or dissertation defense

Dissertation deposit

Minimum GPA: 2.75

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Illinois Physics PhD graduates will have:

1. a firm foundation in core physics, math, and current physics research topics;
2. an ability to design and conduct original experiments, model physical phenomena, and analyze and interpret data;
3. an ability to work collaboratively with a diverse team;
4. a mastery of the concepts, techniques, and literature associated with the student's specific research subfield (e.g., theoretical condensed matter physics, experimental high energy physics, etc.);
5. an ability to teach and mentor others effectively;
6. an ability to communicate—both orally and in writing—scientific topics effectively to specialists in the student's research subfield, to scientifically literate non-specialists, and to the general public(outreach);
7. an understanding of the student's professional and scientific ethical responsibilities;
8. an ability to identify important scientific problems and to use modern experimental, computational, and/or analytical techniques to solve scientifically and societally relevant problems.

#### Admission Requirements

Admission to the physics graduate program requires an outstanding record of accomplishment in an undergraduate physics program and clear evidence of considerable academic promise, as judged by test scores, letters of recommendation, and strong intellectual achievements. A bachelor's degree or its equivalent from an accredited college or university in the U.S. or an approved institution of higher learning abroad, with at least 20 semester hours (30 quarter hours) of intermediate and advanced undergraduate physics course work, is required for admission. Course preparation in electricity and magnetism, optics, mechanics, atomic and nuclear physics, quantum mechanics, mathematical physics, differential equations, and analysis is essential. Any deficiency in these

areas may delay degree completion by as much as a year. (Students are expected to make up deficiencies during the first graduate year.)

A minimum GPA of 3.00 (A = 4.00) for the last two years of undergraduate work is required; however, because of space limitations, applicants with GPAs below 3.50 are rarely admitted. Students with prior graduate course work must have a minimum GPA of 3.50 for those courses. All applicants must provide test scores from the General GRE Graduate Record Examination (GRE) (<http://www.ets.org/>). The Physics GRE subject test is optional.

Graduates of curricula in the physical and biological sciences, mathematics, or computer science may be admitted with limited standing if they are judged to have the necessary aptitudes to profit from graduate work in physics. Such students are admitted to full standing after completing course work to remove deficiencies in physics preparation.

All applicants whose native language is not English are required to submit TOEFL (<http://www.toefl.org/>) or International English Language Testing System (IELTS) (<http://www.ielts.org/>) scores as evidence of English proficiency. Minimum admission requirements (<https://grad.illinois.edu/admissions/instructions/04c/>) are set by the Graduate College.

A few applicants may be admitted for the spring semester, in addition to the customary fall semester admissions. See the Physics graduate admissions Web site (<http://physics.illinois.edu/grad/apply.asp>) for lists of deadlines and application materials.

#### Financial Aid

Fellowships, research assistantships, and teaching assistantships (all of which include waivers of tuition and some fees) are available for the majority of admitted students. Starting in Fall 2020, Grainger Engineering PhD students in their first five years of enrollment who meet the minimum eligibility requirements (<https://grainger.illinois.edu/academics/graduate/phd-funding-guarantee/>) are guaranteed a funded appointment for fall and spring that includes a full tuition waiver, a partial fee waiver, and a stipend.

All applicants, regardless of US citizenship, whose native language is not English and who wish to be considered for teaching assistantships must demonstrate spoken English language proficiency (<http://grad.illinois.edu/admissions/taengprof.htm>) by achieving a minimum score of 24 on the speaking subsection of the TOEFL iBT or 8 on the speaking subsection of the IELTS. For students who are unable to take the iBT or IELTS, a minimum score of 4CP is required on the EPI test ([http://cte.illinois.edu/testing/oral\\_eng/epi\\_overview.html](http://cte.illinois.edu/testing/oral_eng/epi_overview.html)), offered on campus. All new teaching assistants are required to participate in the Graduate Academy for College Teaching (<https://citl.illinois.edu/citl-101/teaching-learning/grad-academy-for-college-teaching/>) conducted prior to the start of the semester.

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#### Graduate Programs in the Department of Physics

- Majors
  - Physics, MS (<http://catalog.illinois.edu/graduate/engineering/physics-ms/>)
  - Engineering: Instrumentation and Applied Physics, MEng (<http://catalog.illinois.edu/graduate/engineering/engineering-meng/instrumentation-applied-physics/>)
  - Physics, PhD (p. 1)

- optional concentrations
  - Computational Science and Engineering (<http://catalog.illinois.edu/graduate/engineering/concentration/computational-science-engineering/>)
- Teaching of Physics, MS (<http://catalog.illinois.edu/graduate/engineering/teaching-physics-ms/>)

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### **Physics**

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Director of Graduate Studies: Lance Cooper ([slcooper@illinois.edu](mailto:slcooper@illinois.edu))

Physics Department website (<http://physics.illinois.edu>)

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Physics Graduate Office email ([grad@physics.illinois.edu](mailto:grad@physics.illinois.edu))

Physics Department Faculty (<https://physics.illinois.edu/people/directory/>)

### **Grainger College of Engineering**

Grainger College of Engineering website (<https://grainger.illinois.edu/>)

### **Admissions**

Physics Graduate Admissions & Requirements (<https://physics.illinois.edu/admissions/graduates/admissions-requirements.html>)

Graduate College Admissions & Requirements (<https://grad.illinois.edu/admissions/apply/>)