PHYSICS, PHD

DEPARTMENT OVERVIEW

The Department of Physics has a strong tradition of graduate study and research in astrophysics; atomic, molecular, and optical physics; condensed matter physics; high energy and particle physics; plasma physics; quantum computing; and string theory. There are many facilities for carrying out world-class research (https://www.physics.wisc.edu/research/areas/). We have a large professional staff: 45 full-time faculty (https://www.physics.wisc.edu/people/faculty/) members, affiliated faculty members holding joint appointments with other departments, scientists, senior scientists, and postdocs. There are over 175 graduate students in the department who come from many countries around the world. More complete information on the graduate program, the faculty, and research groups is available at the department website (http://www.physics.wisc.edu).

Research specialties include:

THEORETICAL PHYSICS

Astrophysics; atomic, molecular, and optical physics; condensed matter physics; cosmology; elementary particle physics; nuclear physics; phenomenology; plasmas and fusion; quantum computing; statistical and thermal physics; string theory.

EXPERIMENTAL PHYSICS

Astrophysics; atomic, molecular, and optical physics; biophysics; condensed matter physics; cosmology; elementary particle physics; neutrino physics; experimental studies of superconductors; medical physics; nuclear physics; plasma physics; quantum computing; spectroscopy.

PHD DEGREE DETAILS

The PhD degree requires successful completion of advanced course work in physics (required core coursework), completion of a minor, and passage of the qualifying and preliminary examinations. However, the PhD is primarily a research degree, awarded only upon completion of substantial original research. This broad range of research opportunities makes the department especially attractive to beginning students who have not yet chosen a field of specialization. The program provides the background, experience, and credentials needed for employment as a professional physicist in research or education. All admitted PhD students typically receive financial support in the form of teaching or research assistantships and fellowships.

ADMISSIONS

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Please consult the table below for key information about this degree program's admissions requirements. The program may have more detailed admissions requirements, which can be found below the table or on the program's website.

Graduate admissions is a two-step process between academic programs and the Graduate School. ***Applicants must meet* the minimum requirements *(https://grad.wisc.edu/apply/requirements/) of the Graduate School as well as the program(s).*** Once you have researched the graduate program(s) you are interested in, apply online (https://grad.wisc.edu/apply/).

Requirements	Detail
Fall Deadline	December 15
Spring Deadline	This program does not admit in the spring.
Summer Deadline	This program does not admit in the summer.
GRE (Graduate Record Examinations)	Not required but may be considered if available.
English Proficiency Test	Every applicant whose native language is not English, or whose undergraduate instruction was not exclusively in English, must provide an English proficiency test score earned within two years of the anticipated term of enrollment. Refer to the Graduate School: Minimum Requirements for Admission policy: https://policy.wisc.edu/library/UW-1241 (https://policy.wisc.edu/library/UW-1241/).
Other Test(s) (e.g., GMAT, MCAT)	n/a
Letters of Recommendation Required	3

The Department of Physics does not require the subject GRE for admission. However, if students submit the score, the admissions committee will review it as part of the application.

The general GRE will not be considered even if submitted. The subject GRE is recommended in these circumstances:

- If your transcript does not accurately reflect your academic strengths.
- If including the score would significantly strengthen your application.
- If you are particularly interested in pursuing Physics Theory as a research focus.

Admission is competitive. All applicants are reviewed and evaluated on the basis of previous academic record, three letters of recommendation, statement of purpose for graduate studies, and resume. All eligible applicants with complete files are considered for teaching or research assistantships and fellowships. To be considered for admission, students must submit all application materials via the Graduate School electronic application site (https://grad.wisc.edu/apply/) by the application deadline.

FUNDING

FUNDING

GRADUATE SCHOOL RESOURCES

Resources to help you afford graduate study might include assistantships, fellowships, traineeships, and financial aid. Further funding information (https://grad.wisc.edu/funding/) is available from the Graduate School. Be sure to check with your program for individual policies and restrictions related to funding.

FINANCIAL SUPPORT FOR PHD STUDENTS IN PHYSICS

All admitted PhD students are provided with a guarantee of financial support. Typically, a graduate student is first appointed as a teaching assistant. Teaching assistants assist faculty members in the introductory

physics courses, generally by teaching discussion and laboratory sections. Later, as a research assistant, the student works with a major professor on a mutually agreed research program. Tuition is remitted for teaching assistant and research assistant appointments greater than one-third time or greater. However, all students must still pay the segregated fees and any additional university fees each semester.

Teaching Assistantships

The typical first appointment for a beginning graduate student is a teaching assistantship (TA). A teaching assistantship is both a teaching position and a means of support for graduate study. It is normally advantageous for a graduate student to hold a TA position for at least a semester during graduate studies, since the teaching activity solidifies and deepens the teaching assistant's undergraduate education in physics and also helps prepare for a possible career in teaching.

Research Assistantships

Research assistantships are made available by individual professors to students who have decided on their field of research. Most departmental RA appointments are made for an annual (12-month) period. Students who wish to be considered for an RA appointment should contact the faculty (https://www.physics.wisc.edu/people/faculty/) directly.

Fellowships

Fellowships, including University Fellowships and Advanced Opportunity Fellowships, are awarded by the College of Letters & Science and the Graduate School upon recommendation of the Department of Physics. In addition, the department may have additional fellowships – funded by endowments from physics department alumni – available for first-year graduate students.

REQUIREMENTS

MINIMUM GRADUATE SCHOOL REQUIREMENTS

Review the Graduate School minimum academic progress and degree requirements (http://guide.wisc.edu/graduate/#policiesandrequirementstext), in addition to the program requirements listed below.

MAJOR REQUIREMENTS

MODE OF INSTRUCTION

Face to Face	Evening/ Weekend	Online	Hybrid	Accelerated
Yes	No	No	No	No

Mode of Instruction Definitions

Accelerated: Accelerated programs are offered at a fast pace that condenses the time to completion. Students typically take enough credits aimed at completing the program in a year or two.

Evening/Weekend: Courses meet on the UW–Madison campus only in evenings and/or on weekends to accommodate typical business schedules. Students have the advantages of face-to-face courses with the flexibility to keep work and other life commitments.

Face-to-Face: Courses typically meet during weekdays on the UW-Madison Campus.

Hybrid: These programs combine face-to-face and online learning formats. Contact the program for more specific information.

Online: These programs are offered 100% online. Some programs may require an on-campus orientation or residency experience, but the courses will be facilitated in an online format.

CURRICULAR REQUIREMENTS

Requirement	Detail
Minimum Credit Requirement	51 credits
Minimum Residence Credit Requirement	32 credits
Minimum Graduate Coursework Requirement	26 credits must be graduate-level coursework. Refer to the Graduate School: Minimum Graduate Coursework (50%) Requirement policy: https://policy.wisc.edu/library/UW-1244 (https://policy.wisc.edu/library/UW-1244/).
Overall Graduate GPA Requirement	3.00 GPA required. Refer to the Graduate School: Grade Point Average (GPA) Requirement policy: https://policy.wisc.edu/library/UW-1203 (https://policy.wisc.edu/library/UW-1203/).
Other Grade Requirements	Must have a grade of B or better in all coursework.
Assessments and Examinations	Physics doctoral students are required to pass the qualifying examination at the PhD level by the end of their fourth semester. Students are also required to take a comprehensive preliminary/oral examination. It is recommended that this is completed by the end of the fifth semester. All Incomplete and Progress grades (other than research and thesis) must be cleared from the student's record prior to taking the preliminary examination. A final oral defense and deposit of the doctoral dissertation in the Graduate School is required.
Language Requirements	Contact the program for information on any language requirements.
Graduate School Breadth Requirements	All doctoral students are required to complete a doctoral minor or graduate/professional certificate. Refer to the Graduate School: Breadth Requirement in Doctoral Training policy: https://policy.wisc.edu/library/UW-1200 (https://policy.wisc.edu/library/UW-1200/).

REQUIRED COURSES

Code	Title	Credits
Core		
Students must complete the following courses. Courses must be repeated until at least a B is earned.		
PHYSICS 711	Theoretical Physics-Dynamics	3
PHYSICS 715	Statistical Mechanics	3
PHYSICS 721	Theoretical Physics-Electrodynamics	3

PHYSICS 731	Quantum Mechanics	3
PHYSICS 732	Quantum Mechanics	3
Seminars		
PHYSICS 701	Graduate Introductory Seminars	1
Additional Coursework		**35**
In consultation with advisor, students must complete additional coursework to meet the minimum credit requirement. All Physics courses meeting degree requirements must be numbered 500 and above.		
Total Credits		**51**

POLICIES

GRADUATE SCHOOL POLICIES

The Graduate School's Academic Policies and Procedures (https://grad.wisc.edu/acadpolicy/) provide essential information regarding general university policies. Program authority to set degree policies beyond the minimum required by the Graduate School lies with the degree program faculty. Policies set by the academic degree program can be found below.

MAJOR-SPECIFIC POLICIES

PRIOR COURSEWORK

Graduate Credits Earned at Other Institutions

Refer to the Graduate School: Transfer Credits for Prior Coursework (https://policy.wisc.edu/library/UW-1216/) policy.

Undergraduate Credits Earned at Other Institutions or UW-Madison

Up to 7 credits in courses numbered 500 or above from UW-Madison may transfer to satisfy minimum degree requirements. Credits to not transfer from other institutions.

Credits Earned as a Professional Student at UW-Madison (Law, Medicine, Pharmacy, and Veterinary careers)

Refer to the Graduate School: Transfer Credits for Prior Coursework (https://policy.wisc.edu/library/UW-1216/) policy.

Credits Earned as a University Special Student at UW–Madison

With program approval, students are allowed to transfer no more than 15 credits of coursework numbered 500 or above taken as a UW-Madison University Special student. Coursework earned ten or more years prior to admission to a doctoral degree is not allowed to satisfy requirements.

PROBATION

Refer to the Graduate School: Probation (https://policy.wisc.edu/library/UW-1217/) policy.

ADVISOR / COMMITTEE

All incoming students are assigned a faculty mentoring committee upon matriculation. The responsibility to acquire (choose and be accepted by) a major professor (permanent advisor) is entirely with the student. Acceptance for PhD research by a professor depends on the professor's appraisal of the student's potential for research and on the ability/willingness of the professor to accept a student at that time. Often the major professor will offer support in the form of a research assistantship, but this is not always possible, and students may need to work as a teaching assistants while performing thesis research.

Graduate students should begin research work as early as possible. Students are encouraged to acquire a major professor (advisor) and begin research by the end of the second semester. Summer is the ideal time to begin research unencumbered by coursework or teaching.

At the time of the preliminary examination, the major professor and at least two additional faculty members will form a committee that will evaluate and advise the student.

At the time of the final oral defense, the major professor and at least two additional faculty members will form a committee that will evaluate the student. All PhD Committee members will serve as readers of the student's thesis.

CREDITS PER TERM ALLOWED

15 credits

TIME LIMITS

Refer to the Graduate School: Time Limits (https://policy.wisc.edu/library/UW-1221/) policy.

GRIEVANCES AND APPEALS

These resources may be helpful in addressing your concerns:

- Bias or Hate Reporting (https://doso.students.wisc.edu/bias-or-hate-reporting/)
- Graduate Assistantship Policies and Procedures (https://hr.wisc.edu/policies/gapp/#grievance-procedure)
- Hostile and Intimidating Behavior Policies and Procedures (https://hr.wisc.edu/hib/)
  - Office of the Provost for Faculty and Staff Affairs (https://facstaff.provost.wisc.edu/)
- Dean of Students Office (https://doso.students.wisc.edu/) (for all students to seek grievance assistance and support)
- Employee Assistance (http://www.eao.wisc.edu/) (for personal counseling and workplace consultation around communication and conflict involving graduate assistants and other employees, post-doctoral students, faculty and staff)
- Employee Disability Resource Office (https://employeedisabilities.wisc.edu/) (for qualified employees or applicants with disabilities to have equal employment opportunities)
- Graduate School (https://grad.wisc.edu/) (for informal advice at any level of review and for official appeals of program/departmental or school/college grievance decisions)
- Office of Compliance (https://compliance.wisc.edu/) (for class harassment and discrimination, including sexual harassment and sexual violence)
- Office of Student Conduct and Community Standards (https://conduct.students.wisc.edu/) (for conflicts involving students)
- Ombuds Office for Faculty and Staff (http://www.ombuds.wisc.edu/) (for employed graduate students and post-docs, as well as faculty and staff)
- Title IX (https://compliance.wisc.edu/titleix/) (for concerns about discrimination)

Students should contact the department chair or program director with questions about grievances. They may also contact the L&S Academic

Divisional Associate Deans, the L&S Associate Dean for Teaching and Learning Administration, or the L&S Director of Human Resources.

OTHER

Typical funding is through 50% assistantships. Typically, all enrolled PhD students are funded for the duration of their degree. All programs are full-time and require full-time student enrollment during fall and spring terms.

PROFESSIONAL DEVELOPMENT

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GRADUATE SCHOOL RESOURCES

Take advantage of the Graduate School's professional development resources (https://grad.wisc.edu/pd/) to build skills, thrive academically, and launch your career.

PROGRAM RESOURCES

Students are encouraged to attend Graduate School sponsored Professional Development events and participate in Graduate School Professional Development resources, such as the Individual Development Plan (IDP).

In addition, PhD students in Physics have multiple opportunities for professional development throughout their graduate careers. As an integral part of the research experience, students regularly work at places such as CERN, national laboratories (Argonne, FermiLab), and the IceCube Neutrino observatory at the South Pole to name a few.

Students are encouraged to travel to relevant conferences across the U.S. and around the world. Students regularly attend the annual American Physical Society (APS) March Meeting and are encouraged to attend APS meetings in their sub-field throughout the year. Often students attend summer schools at various host institutions to expand their knowledge and to interact with fellow scientists in the field.

LEARNING OUTCOMES

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1. Demonstrate mastery of the core physical concepts (Classical Mechanics, Electricity & Magnetism, Quantum Mechanics, and Statistical Mechanics).
2. Evaluates or synthesizes information pertaining to questions or challenges in physics.
3. Engages appropriately and communicates clearly with other research professionals in physics.
4. Formulates and plans original research.
5. Creates research, scholarship, or performance that makes a substantive contribution to the field of physics.
6. Gains a broad awareness of the status of contemporary research beyond the student's area of specialization.

PEOPLE

PEOPLE

FACULTY

More detail about each faculty member (https://www.physics.wisc.edu/people/faculty/) and the research areas (https://www.physics.wisc.edu/research/areas/) can be found on the Physics website.

Yang Bai, Professor
Baha Balantekin, Eugene P. Wigner Professor
Vernon Barger, Van Vleck Professor and Vilas Research Professor
Keith Bechtol, Associate Professor
Kevin Black, Professor
Stanislav Boldyrev, Professor
Uwe Bergmann, Martin L. Pearl Professor in Ultrafast X-Ray Science
Tulika Bose, Professor
Victor Brar, Van Vleck Associate Professor
Duncan Carlsmith, Professor
Daniel Chung, Professor
Susan Coppersmith, Emeriuts Robert E. Fassnacht Professor and Vilas Research Professor
Kyle Cranmer, Professor & Data Science Institute Director
Sridhara Dasu, Professor
Jan Egedal, Professor
Mark Eriksson, John Bardeen Professor and Department Chair
Ilya Esterlis, Assistant Professor
Lisa Everett, Professor
Ke Fang, Assistant Professor
Cary Forest, Prager Professor of Experimental Physics
Pupa Gilbert, Vilas Distinguished Achievement Professor
Francis Halzen, Gregory Breit Professor, Hilldale Professor, & Vilas Research Professor
Kael Hanson, Professor
Aki Hashimoto, Professor
Matthew Herndon, Professor
Robert Joynt, Emeritus Professor
Albrecht Karle, Professor
Roman Kuzmin, Dunson Cheng Assistant Professor
Alex Levchenko, Professor
Lu Lyu (aka Lu Lu), Assistant Professor
Dan McCammon, Professor
Robert McDermott, Professor
Moritz Muenchmeyer, Assistant Professor
Yibin Pan, Associate Professor
Brian Rebel, Professor
Mark Rzchowski, Associate Chair and Professor
Mark Saffman, Professor
John Sarff, Professor
Gary Shiu, Professor
Paul Terry, Professor
Peter Timbie, Professor
Justin Vandenbroucke, Associate Professor
Maxim Vavilov, Professor
Thad Walker, Vilas Distinguished Achievement Professor
Sau Lan Wu, Enrico Fermi Professor, Hilldale Professor, and Vilas Research Professor
Deniz Yavuz, Professor
Ellen Zweibel, William L Kraushaar Professor of Astronomy & Physics

AFFILIATED FACULTY

David Anderson, Professor, Electrical & Computer Engineering
Paul Campagnola, Professor, Biomedical Engineering
Jennifer Choy, Assistant Professor, Engineering Physics
Elena D'Onghia, Professor, Astronomy
Chang-Beom Eom, Professor, Materials Science & Engineering
Chris Hegna, Professor, Engineering Physics
Sebastian Heinz, Professor, Astronomy
Mikhail Kats, Associate Professor, Electrical & Computer Engineering
Jason Kawasaki, Associate Professor, Materials Science & Engineering
Irena Knezevic, Professor, Electrical & Computer Engineering
Alexandre Lazarian, Professor, Astronomy
Daniel Rhodes, Assistant Professor, Materials Science & Engineering
Oliver Schmitz, Professor, Engineering Physics
Micheline Soley, Assistant Professor, Chemistry
Carl Sovinec, Professor, Engineering Physics
Richard Townsend, Professor, Astronomy
Ying Wang, Assistant Professor, Materials Science & Engineering
Jun Xiao, Assistant Professor, Materials Science & Engineering