PHYSICS, PHD

The Department of Physics and Astronomy exhibits exceptional strength in several areas. We invite applications to the doctoral program from able students interested in experimental and theoretical condensed matter physics; in structural biophysics and protein dynamics and function; and in cosmology, relativistic astrophysics, and gravitational-wave/multimessenger astronomy. The primary goal of our graduate education is the training of creative research scientists.

Our research in gravitational physics is in several areas: In gravitational-wave astronomy, we play a leading role in LIGO, extracting signals of gravitational-waves from the coalescence of binary neutron stars and black holes, as well as searching for electromagnetic counterparts, and in the use of pulsars to measure gravitational waves from supermassive black holes. In relativistic astrophysics we study black hole structure and evolution, have established limits on the spin and mass of rotating neutron stars, and develop computational techniques to model merging stars. Astronomy efforts include studying early galaxy formation and evolution, the phenomenology of neutron stars and white dwarfs, and numerical computation of stellar interactions.

Our condensed matter physics research focuses on quantum materials, including topologically non-trivial materials, altermagnets, superconductors, and antiferromagnetic spintronics candidate materials. Experimental condensed matter research aims to understand the fundamental properties of the materials. Our theoretical condensed matter research uses the predictive power of symmetry and topology to understand electronic correlations in quantum materials with the goal of uncovering new fundamental concepts.

Our biophysics oriented research has an experimental and a theoretical/computational component. On the experimental side, we explore at molecular level how proteins respond to force using magnetic tweezers and design muscle-like biomaterials; we use macromolecular crystallography to study molecular motions of proteins; and we use fluorescence-based methods to investigate the association of membrane proteins on the cellular membrane. Our theoretical and computational work in biophysics includes developing advanced data analytic algorithms to study structural dynamics, conformations, and energy landscapes of biological molecules using X-ray free-electron laser and cryo-electron microscopy data in the presence of extreme data artifacts.

We typically do not accept applications for a separate MS degree outside of the Accelerated Masters Program (https://catalog.uwm.edu/letters-science/physics-astronomy/physics-ms/#acceleratedtext), except in unusual circumstances. Please apply for the PhD program (https://catalog.uwm.edu/letters-science/physics-astronomy/physics-phd/) instead. If you are interested in applying for the MS please contact the Physics Graduate Admissions committee (physgradadmissions@uwm.edu).

Graduate Minor in Physics

A doctoral student in another department wishing to minor in Physics must choose a minor professor from among the Physics and Astronomy Graduate Faculty. The student and the minor professor plan a program of study consisting of 9 to 12 graduate credits in Physics and complete a Graduate Minor Program Plan for the Physics and Astronomy Department files.

Admission Requirements

Application Deadlines

Application deadlines vary by program, please review the application deadline chart (http://uwm.edu/graduateschool/program-deadlines/) for specific programs. Other important dates and deadlines can be found by using the One Stop calendars (https://uwm.edu/onestop/dates-and-deadlines/).

Admission

Applicant must meet Graduate School requirements (http://uwm.edu/graduateschool/admission/) plus these departmental requirements to be considered for admission to the program:

1. Letters of Recommendation. Three letters of recommendation are required from persons familiar with the applicant's academic work.
2. Statement of Purpose. An essential part of your application, the Statement of Purpose is used to determine the appropriateness of your educational and professional goals and serves as an example of your ability to express yourself in writing.
3. Undergraduate major in physics or related fields. Applicants may be admitted with specific program-defined deficiencies provided that the deficiencies amount to no more than two courses.
4. Curriculum Vitae.

The GRE is not required for admission. The student is expected to satisfy deficiency requirements within three enrolled semesters. No course credits earned in making up deficiencies may be counted as program credits required for the degree.

A master's degree is not a prerequisite for this PhD program.

Reapplication

A student who receives the master's degree must formally reapply for admission to the Graduate School before continuing studies toward the PhD.

Credits and Courses

Minimum degree requirement is 54 graduate credits beyond the bachelor's degree, at least 27 of which must be earned in residence at UWM. The student plans an individual program of studies in consultation with the major professor.

Code	Title	Credits
Physics core courses		
PHYSICS 501G	Special Topics: Mathematical Models of Physical Problems I	3
PHYSICS 515G	Statistical Mechanics	3
PHYSICS 531G	Principles of Quantum Mechanics I	3
PHYSICS 532G	Principles of Quantum Mechanics II	3
PHYSICS 711	Theoretical Physics-Dynamics	3
PHYSICS 722	Advanced Classical Electromagnetism	3
Additional credits in Physics courses numbered 700-999 *		6
Other courses and PHYSICS 990		30
Total Credits		**54**

* Not including courses PHYSICS 711, PHYSICS 720, or PHYSICS 990. PHYSICS 651 is included. Independent studies, such as PHYSICS 999, requires approval by the Physics Graduate Academic Committee.

A student may elect to complete one of the following minor programs: a minor of 9 to 12 credits in a single department; a minor of 12 credits in two or more departments. Traditional fields for the minor are mathematics, other natural sciences, computer sciences and engineering. In planning a minor in a single department, the student is advised by the minor professor; in planning a minor in two or more departments, the student is advised by the major professor. The program of study is to be chosen with the major professor and the departmental academic graduate committee.

Additional Requirements

Residence

The student must meet minimum Graduate School residence requirements.

Written Placement Test

At the beginning of the first semester of the doctoral program the student must take a written placement test. The test is designed to assess a student's physics problem solving capabilities assuming a knowledge of physics equivalent to an advanced undergraduate student at a premier institution. The results of the test will be used in advising the student to take either graduate core courses at the 500G/700-level directly or to take the 400G level courses corresponding to those before proceeding to the core courses.

Doctoral Preliminary Examination

The student must pass an oral examination to qualify for formal admission to candidacy for the degree. The oral preliminary examination seeks to determine the student's preparation for independent research. This examination must be taken before the fifth semester of enrollment into the physics doctoral program and passed within five semesters of enrollment into the physics doctoral program.

Doctoral Proposal Hearing

The student must prepare a written proposal and pass an oral examination on the proposal to qualify for formal admission to candidacy for the degree. This oral examination seeks to determine the student's preparation for independent research and the suitability of the proposed dissertation program. This examination must be passed within four years of enrollment into the physics doctoral program.

Dissertation

The candidate must present a dissertation reporting the results of an original and independent research investigation representing substantive creative contribution.

Dissertation Defense

The candidate must, as the final step toward the degree, pass an oral examination in defense of the dissertation.

Time Limit

All degree requirements must be completed within ten years from the date of initial enrollment in the doctoral program.

Physics PhD Learning Outcomes

Students graduating from the Physics, PhD program will be able to:

- Demonstrate comprehensive and advanced knowledge of physics topics in the core areas of classical mechanics, quantum mechanics, statistical mechanics, and electromagnetism.
- Demonstrate expertise in a specific field of physics or related area.
- Apply computational, experimental, observational and/or theoretical methods to conduct independent, original research in a chosen field of specialization.
- Effectively communicate their research findings to academics in their subfield and to the broader Physics community in both oral and written form.
- Make original contributions that demonstrably advances knowledge within their subfield.