

# PHYSICS, MS

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/physics-ms/#acceleratedtext>), except in unusual circumstances. Please apply for the PhD program (<https://catalog.uwm.edu/letters-science/physics/physics-phd/>) instead. If you are interested in applying for the MS please contact the Physics Graduate Admissions committee ([physgradadmissions@uwm.edu](mailto: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

An 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 course deficiencies provided that the deficiencies amount to no more than two courses.
4. Submission of their curriculum vitae (CV).

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.

## Credits and Courses

### Option 1: Thesis Option

Minimum degree requirement is 30 graduate credits, 18 of which must normally be in physics and 12 of which may be in related fields. Of the 18 credits earned in the Department, at least 6 must be in physics courses numbered above 700, with the remainder in courses at least above 500; research, seminar, and independent study credits do not satisfy the 700 requirement. Six credits are earned through the thesis.

Code	Title	Credits
Physics Courses		12
At least 6 numbered above 700 *		
Remainder at least above 500		
Physics or Related Fields		12
PHYSICS 890	Master's Thesis **	6
<b>Total Credits</b>		<b>30</b>

\* Not including research, seminar, and independent study

\*\* Only 6 credits of PHYSICS 890 may be counted toward the 30-credit requirement, though a student may enroll in the course more than once and may take more than 6 credits.

### Option 2: Non-Thesis Option

Minimum degree requirement is 30 graduate credits, 18 of which must normally be in physics and 12 of which may be in related fields. Of the 18 credits earned in the Department, at least 6 must be in physics courses numbered above 700, with the remainder in courses at least above 500;

research, seminar, and independent study credits do not satisfy the 700 requirement.

Code	Title	Credits
Physics courses		18
At least 6 numbered above 700 *		
Remaining 12 at least above 500		
Related Fields		12
<b>Total Credits</b>		<b>30</b>

\* Not including research, seminar, and independent study

## Comprehensive Examination

The student must pass a thesis defense, pass a comprehensive oral examination, or complete and present an acceptable capstone project. The non-thesis master's comprehensive oral examination should evaluate the student's achievements in graduate courses and fulfillment of the goals of the student's program of study. In particular, students should be familiar with the materials in the "core" courses:

Code	Title	Credits
PHYSICS 515	Statistical Mechanics	3
PHYSICS 531	Principles of Quantum Mechanics I	3
PHYSICS 532	Principles of Quantum Mechanics II	3
PHYSICS 711	Theoretical Physics-Dynamics	3
PHYSICS 722	Advanced Classical Electromagnetism	3

## Additional Requirements

### Major Professor as Advisor

The student must have a major professor to advise and supervise the student's studies as specified in Graduate School regulations. The newly admitted student is assigned to a temporary advisor.

Students in the master's program who are planning to terminate their physics studies with a master's degree should plan and prepare a program of study with the Department Master's Program Advisor.

### Option 1: Thesis Option

#### Thesis

A student choosing the thesis option must enroll in PHYSICS 890. A maximum of 6 credits of thesis may be counted toward the degree requirements.

#### Comprehensive Examination

The student must pass a comprehensive oral examination, in part a defense of the thesis.

#### Time Limit

The student must complete all degree requirements within five years of initial enrollment.

### Option 2: Non-Thesis Option

#### Thesis

Not required.

#### Examination or Project

Each student who does not elect the thesis option must satisfy one of the following capstone requirements:

1. Pass an oral comprehensive examination.
2. Present a satisfactory oral and written report on a comprehensive project done under the supervision of a faculty advisor.

Students electing the project should register for 1 to 3 credits of PHYSICS 891 and must complete this course with a B or better grade in order for the project to meet the capstone requirement.

#### Time Limit

The student must complete all degree requirements within five years of initial enrollment.

## Physics MS Learning Outcomes

Students graduating from the Physics MS program, with either the thesis or non-thesis options, will be able to:

- Demonstrate comprehensive knowledge of physics topics in the core areas of classical mechanics, quantum mechanics, statistical mechanics, and electromagnetism (both thesis and non-thesis options).
- Effectively communicate the principles of graduate-level physics to professionals in the field (both thesis and non-thesis options).
- Demonstrate advanced knowledge in a specific field of physics or related area (thesis option only).
- Perform research activities under the direction of a supervisor (thesis option only).

## Accelerated Program Option

This program is offered as part of an accelerated graduate program.

For more information, see Accelerated Graduate Degrees (<https://catalog.uwm.edu/opportunities-resources/accelerated-graduate-degrees/>).