PHYSICS, PHD

The Physics Department exhibits exceptional strength in several areas. We invite applications from able students interested in experimental and theoretical surface physics and condensed matter physics; in structural biophysics and protein dynamics and function; in quantum field theory, cosmology, relativistic astrophysics, and gravitational-wave/multimessenger astronomy; in medical imaging. 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. We play a leading role in the use of pulsars to measure gravitation waves from supermassive black holes. In relativistic astrophysics we 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, and phenomenology of neutron stars and white dwarfs.

Experimental work in condensed matter and surface physics includes electron microscopy, electron and x-ray diffraction, atomic force microscopy, infrared spectroscopy, synchrotron radiation, molecular beam epitaxy, and atomic layer deposition. Experimental work is also being done in the areas of low-temperature physics, unconventional superconductivity (including high Tc), heavy fermions, topological insulators, materials synthesis and floating zone single crystal growth, oxides, magnetism, ultrasonics, and neutron diffraction. These efforts are all aimed at creating and analyzing novel materials.

Theoretical work in condensed matter physics and surface physics includes research in quantum transport phenomena, superconductivity, magnetism, novel states of matter, and first-principles electronic structure calculations.

Experimental work in biophysics includes advanced optical and electrical methods for probing protein-protein interactions and protein complex structure and dynamics in vivo. Other efforts are in structural biophysics, static and time-resolved macromolecular crystallography, and XFEL-based femtosecond crystallography. Molecular biophysics studies include protein mechano-chemistry and single-molecule force spectroscopy.

Theoretical and computational work in biophysics includes advanced algorithms for signal extraction in the presence of extreme noise and timing uncertainty (XFEL and cryo-electron microscopy data) for protein crystallography, biostructure, dynamics, and function.

Experimental and theoretical efforts in medical imaging revolve around image reconstruction using Radon transformations, and novel imaging modalities such as thermo/opto-acoustic tomography.

Graduate Minor in Physics

A doctoral student in another department wishing to minor in Physics must choose a minor professor from among the Physics 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 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 plus departmental requirements as given for admission to the master's program. 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 720	Electrodynamics I	3
Additional credits 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.

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.