PHYSICS, PHD

Banner Code: SC-PHD-PHYS

Graduate Advisor

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The degree program contains a Standard concentration for traditional physics programs that focus on Astrophysics, Condensed Matter Theory, Dynamical Systems/Biological Physics, High Energy Physics, Materials Physics, Space Sciences, and an Engineering Physics concentration that combines the disciplines of physics, mathematics, and engineering. The doctoral students accepted into each concentration of the Physics PhD program take a required set of core courses for the given concentration (see Requirements tab).

By working with the dissertation committee, a student in the Standard concentration may choose to specialize in an emphasis area such as Astrophysics, Atomic Molecular and Optical Physics, Condensed Matter Experiment, Condensed Matter Theory, Dynamical Systems/Biological Physics, High Energy Physics, Materials Physics, Space Sciences, or others according to his or her particular interests. A student in the Engineering Physics concentration may choose to specialize in Applied Mechanics (Fluids and Solids), or other applied and engineering physics areas. By the end of their first year, all students should pair with a faculty advisor who will guide them toward doctoral candidacy.

Admissions & Policies

Admissions

University-wide admissions policies can be found in the Graduate Admissions Policies (https://catalog.gmu.edu/admissions/graduate-policies/) section of this catalog. International students and students having earned international degrees should also refer to Admission of International Students (https://catalog.gmu.edu/admissions/international-students/) for additional requirements.

Eligibility

Those holding a baccalaureate degree in physics, astronomy, or engineering from an institution of higher education accredited by a Mason-recognized U.S. institutional accrediting agency or international equivalent who earned a GPA of 3.00 (out of 4.00) or higher are invited to apply for admission.

Application Requirements

To apply for this program, prospective students should submit the George Mason University Admissions Application (https://www2.gmu.edu/admissions-aid/apply-now/) and its required supplemental documentation, and three letters of recommendation, preferably from former professors.

The GRE-GEN is optional and the GRE subject test in physics is not required.

A degree-seeking graduate applicant with a baccalaureate degree who has not met all admission requirements may be offered provisional admission if sufficient evidence is presented to suggest that the applicant has the ability to pursue graduate work.

Policies

For policies governing all graduate programs, see AP.6 Graduate Policies (http://catalog.gmu.edu/policies/academic/graduate-policies/).

Transferring Previous Graduate Credit into this Program

Previously earned and relevant graduate credits may be eligible for transfer into this program; details can be found in the Credit by Exam or Transfer (http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-5) section of this catalog.

Requirements

Degree Requirements

Total credits: 72

Students should refer to the Admissions & Policies tab for specific policies related to this program.

In consultation with a faculty advisor, students must complete the Core Courses, the requirements for one concentration, General Science Electives, pass qualifying exams, and complete a dissertation.

Core Courses

Code	Title	Credits
Select one course from each grouping:		
Group One: Mechanics I		**3**
PHYS 694	Applied Mechanics of Solids	
PHYS 695	Applied Fluid Mechanics	
PHYS 705	Classical Mechanics	
Group Two: Mechanics II		**3**
PHYS 620	Continuum Mechanics	
PHYS 684	Quantum Mechanics I	
Group Three: Electricity and Magnetism		**3**
PHYS 513	Applied Electromagnetic Theory	
PHYS 685	Classical Electrodynamics I	
Group Four: Statistical and Thermal Physics		**3**
PHYS 690	Engineering Thermodynamics	
PHYS 711	Statistical Mechanics	
Total Credits		12

Standard Physics Concentration (STND)

Code	Title	Credits
Specialty Science Courses		
Select 9-10 credits of the following courses:		9-10
ASTR 601	Computer Simulation in Astronomy	
ASTR 602	Methods of Observational Astronomy	
ASTR 680	Physics of Interstellar Media	
ASTR 730	Stellar Astrophysics	

PHYS 510	Computational Physics I	
PHYS 512	Solid State Physics and Applications	
PHYS 683	Mathematical Methods in Physics	
PHYS 784	Quantum Mechanics II	
PHYS 785	Classical Electrodynamics II	
Seminar		**3**
PHYS 703	Seminar in Physics (must be taken three times)	
Total Credits		12-13

Engineering Physics Concentration (ENGP)

Code	Title	Credits
Specialty Science Courses		
PHYS 510	Computational Physics I	3
PHYS 613	Computational Physics II	3
PHYS 640	Finite Element Analysis of Solids and Fluids	3
Seminar		**3**
Select 3 credits of seminar from the following courses:		
PHYS 703	Seminar in Physics (at least one credit required)	
Any other graduate-level PHYS or CEIE or MECH or MATH or CSI-prefixed seminar courses		
Total Credits		12

General Science Electives

Code	Title	Credits
Students in either concentration must complete approved general electives and/or preliminary research credits: [1]		23-24
ASTR 796	Directed Reading and Research	
ASTR 798	Research Project	
PHYS 796	Directed Reading and Research	
PHYS 798	Research Project	
Any graduate-level PHYS or ASTR-prefixed courses [2]		
Total Credits		23-24

1

PHYS 796 Directed Reading and Research/ASTR 796 Directed Reading and Research may be repeated as needed.

2

General elective courses may be chosen from PHYS/ASTR courses, and/or other related disciplines as approved by the student's advisor or dissertation committee.

Qualifying Examination

Every student must pass a four-section qualifying examination by the end of the third year from the start of PhD program enrollment. The sections depend upon the chosen concentration:

For the Standard Physics Concentration, the four sections are on material covered in PHYS 684 Quantum Mechanics I, PHYS 685 Classical Electrodynamics I, PHYS 705 Classical Mechanics, and PHYS 711 Statistical Mechanics.

For the Engineering Physics Concentration, students may choose sections on material covered in the following courses: PHYS 690 Engineering Thermodynamics or PHYS 711 Statistical Mechanics, PHYS 620 Continuum Mechanics or PHYS 705 Classical Mechanics, PHYS 694 Applied Mechanics of Solids or PHYS 695 Applied Fluid Mechanics, and both PHYS 510 Computational Physics I and PHYS 613 Computational Physics II.

All four sections of the qualifying exam are offered twice a year, typically in the week before the fall and spring semesters. A student may choose to take one or more exam sections at any sitting. Each section is graded pass/fail, and students may retake individual sections as needed within the three-year time limit.

Students may waive the requirement to take a particular core or specialty science course if they pass the corresponding qualifying exam section.

Dissertation Committee and Program of Study

Upon successful completion of the qualifying examinations, a dissertation committee should be formed by the student as soon as possible. General details on dissertation committee formation can be found in the AP.6.10.5 section of this catalog (http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-10-5). In addition, the Department of Physics and Astronomy requires one committee member to be from outside the department. The dissertation committee is responsible for directing the student in their chosen field of research. The student should work closely with their committee to select specialty courses and electives that form a cohesive program of study. The student's program of study must be approved by the associate dean for undergraduate and graduate student affairs before advancement to candidacy.

Advancement to Candidacy

Before a student may be advanced to doctoral candidacy, he/she needs to complete all required coursework, pass the qualifying examination, have the program of study and dissertation proposal approved by the dean, and be recommended by the dissertation committee. Advancement to doctoral candidacy implies that the student has demonstrated adequate breadth and depth of knowledge in the field of study and is capable of conducting research on the boundaries of knowledge.

Dissertation Research

Note: No more than 24 combined credits from PHYS 998 Doctoral Dissertation Proposal/ASTR 998 Doctoral Dissertation Proposal and PHYS 999 Doctoral Dissertation/ASTR 999 Doctoral Dissertation may be applied toward satisfying the doctoral degree requirements, with no more than 21 credits of PHYS 998 Doctoral Dissertation Proposal/ASTR 998 Doctoral Dissertation Proposal.

Code	Title	Credits
Select 24 credits from the following:		24
ASTR 998	Doctoral Dissertation Proposal	
ASTR 999	Doctoral Dissertation	
PHYS 998	Doctoral Dissertation Proposal	
PHYS 999	Doctoral Dissertation	
Total Credits		24

Doctoral Dissertation

After advancing to doctoral candidacy, the student works with their dissertation committee to develop their preliminary research into a doctoral dissertation. The dissertation research should represent a significant contribution to its scientific field and should be deemed publishable in a refereed scientific journal. The dissertation must be

defended in a public forum before the dissertation committee and other interested faculty.