Physics

Degrees Offered

- Master of Science
- Doctor of Philosophy

Nature of the Program

The graduate program is designed to provide a solid background in classical and modern physics, a broad understanding of major research fields, and concentrated research experience in one area. Applicants normally enter with a bachelor of science degree in physics. A student whose background is weak in a particular area is encouraged to register for the appropriate undergraduate course. The normal first-year courses include PHYS 611, PHYS 651, PHYS 631, and PHYS 633 plus possible electives. In the courses, no distinction is made between those students who intend a terminal M.S. degree and those who intend a Ph.D. degree. The minimum grade for credit in graduate courses is C, and a grade point average of 2.75 must be maintained.

Financial Aid

With rare exceptions, all students who are admitted receive financial support. Beginning students usually receive teaching assistantships; more advanced students receive research assistantships. Several fellowships are available for outstanding students, allowing full-time concentration on coursework and research and a more rapid progress toward the degree.

FACULTY

CHAIR

- Earl Scime - Ph.D. (University of Wisconsin-Madison)
  Oleg P. Jefimenko Professor, Experimental Plasma Physics

PROFESSORS

- Wathiq Abdul-Razzaq - Ph.D. (University of Illinois at Chicago)
  Physics Education
- Leonardo Golubovic - Ph.D. (University of Belgrade)
  Theoretical Condensed Matter Physics and Statistical Physics
- Matthew B. Johnson - Ph.D. (California Institute of Technology)
  Experimental Condensed Matter Physics
- Mark E. Koepke - Ph.D. (University of Maryland)
  Plasma Physics, Experiment
- Duncan Lorimer - Ph.D. (University of Manchester)
  Astrophysics
- Maura McLaughlin - Ph.D. (Cornell University)
  Eberly Family Professor, Astrophysics
- Earl E. Scime - Ph.D. (University of Wisconsin - Madison)
  Oleg Jefimenko Professor, Plasma Physics, Experiment
- Gay Stewart - Ph.D. (University of Illinois)
  Eberly Family Professor, Physics Education Research

ASSOCIATE PROFESSORS

- Alan Bristow - Ph.D. (University of Sheffield)
  Experimental Condensed Matter Physics
- Paul Cassak - Ph.D. (University of Maryland)
  Plasma Physics, Theory
- James P. Lewis - Ph.D. (Arizona State University)
  Computational Condensed Matter Physics
- Paul Miller - Ph.D. (West Virginia University)
  Physics Education Research
- D.J. Pisano - Ph.D. (University of Wisconsin - Madison)
  Astrophysics
- Aldo Romero - Ph.D. (University of California - San Diego)
Theoretical Condensed Matter Physics
• Tudor Stanescu - Ph.D. (University of Illinois)
• John Stewart - Ph.D. (University of Illinois)

Physics Education Research
• Loren Anderson - Ph.D. (Boston University)
• Sarah Burke Spolaor - Ph.D. (Swinburne Institute of Technology)
• Cheng Cen - Ph.D. (University of Pittsburgh)
• Edward Flagg - Ph.D. (University of Texas - Austin)
• Mikel Holcomb - Ph.D. (University of California - Berkeley)
• Sean McWilliams - Ph.D. (University of Maryland)
• Julian Schulze - Ph.D. (Ruhr University - Bochum)
• Weichao Tu - Ph.D. (University of Colorado-Boulder)
• Kathryn Williamson - Ph.D. (Montana State University)

Experimental Condensed Matter Physics
• Edward Flagg - Ph.D. (University of Texas - Austin)
• Mikel Holcomb - Ph.D. (University of California - Berkeley)
• Sean McWilliams - Ph.D. (University of Maryland)

Astrophysics
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• Edward Flagg - Ph.D. (University of Texas - Austin)
• Julian Schulze - Ph.D. (Ruhr University - Bochum)
• Weichao Tu - Ph.D. (University of Colorado-Boulder)

Plasma Physics, Experiment
• Weichao Tu - Ph.D. (University of Colorado-Boulder)

Admission
Applicants are expected to have a bachelor’s degree in physics with upper-division courses in electricity and magnetism, mechanics, quantum mechanics, thermodynamics, and mathematical methods. Students lacking some of these courses may be admitted provisionally and will be allowed to remedy the deficiencies by taking the appropriate undergraduate courses. Both the GRE General Test and the GRE Physics Subject Test are required. If English is not the student’s native language, TOEFL or IELTS scores are also required. The application deadline is January 15. Contact the department for additional information.

Master of Science
MAJOR REQUIREMENTS
Minimum grade of C or higher is required in all courses applied toward degree.
### Major Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 611</td>
<td>Introduction to Mathematical Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 631</td>
<td>Advanced Classical Mechanics 1</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 633</td>
<td>Electromagnetism 1</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 651</td>
<td>Quantum Mechanics 1</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 761</td>
<td>Statistical Mechanics</td>
<td>3</td>
</tr>
</tbody>
</table>

Select either non-thesis or thesis option

**Non-Thesis Option:**
- Physics Electives

**Thesis Option:**
- Physics Elective
- PHYS 697 Research

Total Hours 24

### Doctor of Philosophy

The Ph.D. requires 36 hours of courses at the 600 or 700-levels. These twelve courses must include seven of the following basic courses:

#### MAJOR REQUIREMENTS

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</tr>
<tr>
<td>PHYS 633</td>
<td>Electromagnetism 1</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 634</td>
<td>Electromagnetism 2</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 651</td>
<td>Quantum Mechanics 1</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 652</td>
<td>Quantum Mechanics 2</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 761</td>
<td>Statistical Mechanics</td>
<td>3</td>
</tr>
</tbody>
</table>

Select at least two from the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 772</td>
<td>Semiconductor Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 773</td>
<td>Collective Phenomena in Solids</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 774</td>
<td>Optical Properties of Solids</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 783</td>
<td>Advanced Kinetic Theory of Plasmas</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 784</td>
<td>Advanced Magnetohydrodynamic Theory of Plasmas</td>
<td>3</td>
</tr>
</tbody>
</table>

and/or

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 791</td>
<td>Advanced Topics</td>
<td>3</td>
</tr>
<tr>
<td>ASTR 702</td>
<td>Stellar Structure and Evolution</td>
<td>3</td>
</tr>
<tr>
<td>ASTR 703</td>
<td>Galactic Astronomy</td>
<td>3</td>
</tr>
<tr>
<td>ASTR 704</td>
<td>General Relativity</td>
<td>3</td>
</tr>
</tbody>
</table>

Plus three additional graduate courses in physics or astronomy 9

Comprehensive Examination

Dissertation Proposal

Dissertation

Dissertation Defense

Total Hours 36

### PH.D. CANDIDACY EXAMINATIONS

To be admitted to candidacy for the Ph.D., a student must pass both a written and an oral candidacy examination. The written examination consists of three parts: a quantum mechanics exam in May, an electromagnetism exam in August, and a classical mechanics exam in January. To be eligible to take any candidacy exam, the student must be in good standing (see below).

The oral part of the candidacy exam is a presentation to the five faculty on the student’s doctoral committee. The student gives a lecture on some published research that has been assigned by his or her research advisor.
RESEARCH REQUIREMENTS

Research is the central focus of the degree and is directed by a faculty advisor over a period of several years. When the research is completed, the student must write a dissertation and defend it before the doctoral committee of five faculty. The average completion time for the Ph.D. is five years beyond the B.S. Research specialties within the department include astrophysics, computational physics, condensed matter physics, fluid mechanics, nonlinear dynamics, and plasma physics.

Major Learning Goals

PHYSICS

The central missions of the Graduate Program in Physics and Astronomy are to train the next generation of Physicists and Astronomers for productive careers in the global economy and to expand the scientific boundaries of physics and astronomy.

Students earning a M.S. or Ph.D. in Physics and Astronomy will be able to:

• Explain physics and astronomy principles as they pertain to their specific field of research.
• Demonstrate the ability to understand and critically evaluate the existing literature published within their field.
• Independently design and execute new experimental, theoretical, or computational studies that can address important scientific questions in physics and astronomy.
• Effectively communicate their research in oral and written formats, including the ability to author manuscripts suitable for publication in peer reviewed scientific journals.
• Understand the ethical impact of personal and professional behavior.

Academic Standards

To be a graduate student in good standing requires the following:

• Maintain a GPA of 2.75 or better in graduate physics courses taken at WVU, excluding PHYS 797.
• Pass two sections of the written candidacy examination by the end of three years.
• Pass the remaining third section of the written candidacy examination by the end of four years.
• Select a Ph.D. committee of five faculty.
• Complete the oral candidacy examination within three semesters (after completing the third section of the written candidacy examination).

Students admitted as M.S. degree candidates are not expected to take the graduate qualifying exams but must maintain a GPA of 2.75 and complete their M.S. degree within three years.