Physics

The Department of Physics offers AM and PhD programs in physics. Research covers a wide area of experimental and theoretical physics, and benefits from close contacts with nuclear and inorganic chemists in the chemistry department, planetary scientists in the earth and planetary sciences department, applied scientists in the engineering school, and biological scientists both on the Danforth Campus and at the medical school. The department is a major participant in the McDonnell Center for the Space Sciences.

Experimental research areas include:

- astrophysics (observations of cosmic rays, gamma rays, X-rays, high-precision tests of gravity)
- space sciences (laboratory analysis of meteorites, stardust, and interplanetary dust particles)
- condensed matter and materials physics (graphene and other two-dimensional atomic crystals, quantum information, devices, and electrodynamics, amorphous materials, nanostructures, mesoscopic physics, quantum magnetism, metallic glasses, magnetism and superconductivity, high-pressure physics, hydrogen storage solids)
- biological and biomedical physics (hyperpolarized magnetic resonance imaging, ultrasound, biophysics of the brain).

Theoretical research areas include:

- biophysics (nonequilibrium dynamics in biological cells)
- condensed matter physics (strongly correlated electron systems, topological phases, excited states of many-electron systems, density functional theory)
- elementary particle physics (astroparticle physics, dark matter, theoretical cosmology, lattice gauge theory, non-Hermitian Hamiltonians, quark matter)
- many-body theory (nuclear matter, correlations in nuclei).

Students are usually admitted to the PhD program rather than to the AM. They spend their first two years doing graduate course work, finding a dissertation adviser, and starting research. During that time they receive a stipend and have teaching assistantship duties for only two semesters. After achieving the required course grades and passing an oral examination at the end of their second year, students are normally paid from research funds while working on their research and writing a dissertation. The PhD program typically takes between five and six years to complete.

Departmental website: http://physics.wustl.edu

Chair
Mark Alford
PhD, Harvard University
Elementary Particle Physics

Endowed Professors
Carl M. Bender
Wilfred R. and Ann Lee Konneker Professor of Physics
PhD, Harvard University
Elementary Particles

John W. Clark
Wayman Crow Professor of Physics
PhD, Washington University
Many-Body Theory, Biophysics

Ramanath Cowsik
James S. McDonnell Professor of Space Sciences
PhD, University of Bombay
Astrophysics & Space Sciences

Kenneth F. Kelton
Arthur Holly Compton Professor of Physics
PhD, Harvard University
Condensed Matter & Materials Physics

James G. Miller
Albert Gordon Hill Professor of Physics
PhD, Washington University
Physics Applications in Biology & Medicine

Stuart A. Solin
Charles M. Hohenberg Professor of Experimental Physics
PhD, Purdue University
Condensed Matter & Materials Physics

Professors
Claude W. Bernard
PhD, Harvard University
Elementary Particles

Thomas Bernatowicz
PhD, Washington University
Astrophysics and Space Sciences

James H. Buckley
PhD, University of Chicago
Astrophysics & Space Sciences

Anders E. Carlsson
PhD, Harvard University
Biophysics

Mark S. Conradi
PhD, Washington University
Condensed Matter & Materials Physics
Mairin Hynes  
PhD, Washington University  

Professors Emeriti  
Peter A. Fedders  
PhD, Harvard University  
Michael W. Friedlander  
PhD, University of Bristol  
Astrophysics  
Patrick C. Gibbons  
PhD, Harvard University  
Charles M. Hohenberg  
PhD, University of California, Berkeley  
Kazimierz Luszczynski  
PhD, University of London  

Requirements for AM  
1. 36 semester hours of course credits, of which at least 30 semester hours must be in classroom or seminar courses at the 400 level or higher. Classroom and seminar courses include reading courses, for which students should register for 589/590 Selected Topics in Physics; and supervised research, for which students should register for 593/594 Introduction to Methods in Physics. The latter can be used for a maximum of 6 units of credit.  
2. The student must get permission from his or her adviser and the Director of Graduate Studies to take courses outside the department.  
3. The student must maintain an overall grade average of B (GPA 3.0) or better.
4. Among the student’s course work there must be at least 12 semester-hours of the “core” courses required for PhD qualification (see below), passed with an average grade of B (GPA 3.0) or better. A given core course may be taken only once. In the event that more than four different core courses (more than 12 semester-hours) are taken, the average grade will be determined from the best four core-course grades.

Requirements for PhD

1. Outline of requirements

• Complete 72 units of course work, maintaining an average grade of B (GPA 3.0), including at least 36 units of academic credit (see below). Once the academic credit is completed, the remaining units (up to a total of 72) can include more lecture courses, but are typically research for which students should register for Physics 595/596.

• Pass the PhD qualification procedure. This must be done before a student can formally join a research group, and is normally completed before the start of the third year.

• Teaching requirements. Write a thesis (“doctoral dissertation”).

• Pass an oral dissertation defense examination.

2. 36 unit academic credit course requirement. Courses that count toward academic credit:

• any regular 400- or 500-level lecture courses in the physics department, including Physics 597/598 Teaching Methods and Physics 582 Research Seminar

• courses outside the physics department, if approved by the student’s adviser and the Director of Graduate Studies

• reading courses, for which students should register for Physics 589/590 Selected Topics in Physics

• supervised research, for which students should register for Physics 593/594 Introduction to Methods in Physics. This can be used for a maximum of 6 units of academic credit.

3. PhD qualification: course requirements

For qualification, students must pass six core 500-level physics courses. In those courses the student must maintain an average of a B (GPA 3.0), with no more than one grade lower than B–. A given core course may be taken only once. In the event that more than six different core courses are taken, the average grade will be determined from the grades in the four required core courses and the best two other core courses.

Must take:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 501</td>
<td>Theoretical Methods I</td>
</tr>
<tr>
<td>Physics 505</td>
<td>Electricity and Magnetism I</td>
</tr>
</tbody>
</table>

plus at least two of:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 502</td>
<td>Theoretical Methods II</td>
</tr>
<tr>
<td>Physics 506</td>
<td>Electricity and Magnetism II</td>
</tr>
<tr>
<td>or Physics 509</td>
<td>Nonlinear Dynamics</td>
</tr>
<tr>
<td>Physics 524</td>
<td>Quantum Mechanics II</td>
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</tbody>
</table>

These requirements can be modified or waived for students with previous graduate work, e.g., a master’s degree in physics.

4. PhD qualification: oral examination requirement

To qualify, the student must give a presentation to a committee of three physics faculty members (the prospective research adviser and two others). The student should demonstrate a basic understanding of a major topic of current research in the selected area of study.

The committee must be chosen and approved by the department chair by the end of a student’s third semester (typically in December of the second year). The oral examination should be taken by the end of a student’s fourth semester (typically in May of the second year). If a student fails it, then they can take it again one more time.

5. Teaching requirements

These requirements must be completed before the student submits her or his doctoral dissertation to the Graduate School.

a. Take Physics 597

Graduate students are required to take Physics 597 (Teaching Methods in Physics) prior to serving as a teaching assistant. Students typically take Physics 597 in their first fall semester.

b. TA for two semesters

Each graduate student is required to serve as a teaching assistant for at least two semesters. The department chair may require a student to serve as a TA for an additional one or two semesters, if this is necessary to meet departmental teaching needs. Graduate students are required to carry out their teaching duties conscientiously and to complete all grading tasks accurately and promptly. Failure to perform adequately as a teaching assistant may result in withdrawal of financial support and/or dismissal from the program.

c. Four hours of oral presentations

Graduate students must give a total of 4 hours of “specialized oral presentation.” For example, teaching a class (e.g., when substituting for a professor); giving seminars, such as the weekly graduate seminar; or giving oral presentations at conferences.
journal clubs, etc. Certain outreach activities sponsored by the department may also count toward this requirement.

Each student must submit to the Graduate Studies Committee a form (available from the Graduate Secretary) detailing how the teaching requirement was completed. Students with substantial teaching experience who have received a master’s degree prior to entering the program may petition the graduate studies committee to be excused from one or both of the first two requirements.

6. Dissertation requirements

See the Graduate School’s Doctoral Dissertation Guide on their Policies and Guides page. (http://graduateschool.wustl.edu/policies-and-guides)

7. Oral defense of the dissertation

See the Graduate School’s Doctoral Dissertation Guide.

Note: The rules for the oral defense committee changed on January 1, 2014. In brief, committees that meet after that date are only required to have a total of five members, at least three of whom must be from the student’s department, and at least one of whom must be from outside the department. This is a reduction from the pre-2014 requirements, which call for six committee members, with at least two from outside the department. A student may use the new rules, but it is not necessary to change a committee already set up under the old rules.