The Physics Department

The Department of Physics at Washington University includes 28 professors in tenured or tenure-track positions, 10 research professors, 2 joint professors, 22 adjunct professors, and 90 graduate students, virtually all of whom are Ph.D. candidates. In addition, there are 18 departmental support staff, as well as 8 technical staff and 21 post-doctoral fellows and researchers affiliated with research groups.

The department is situated mainly in two buildings: Crow Hall, built in 1934, and Compton Physics Laboratory, built in 1964. The Compton Laboratory houses the Pfeiffer Library of Physics, the Laboratory for Space Sciences, the Laboratory for Ultrasonics, the NMR Laboratory, the Laboratory for Materials Physics, machine shops, seminar rooms, and many research laboratories and offices. Crow Hall has two floors devoted to research and includes the Center for Materials Innovation, as well as the Laboratory for High-Pressure Physics, and laser and biophysics labs. The other floors are occupied by lecture rooms, teaching laboratories, and offices.

All regular courses in the department are taught by the faculty, and the department's teaching exceeds the university average, as determined from student evaluations. The laboratories of Introductory Physics (117-118 and 197-198) are run by Physics Graduate Teaching Assistants, with faculty and staff oversight. Classes tend to be small, and the faculty-to-majors ratio of about 1.5 is quite high, making faculty very accessible to students. Research with faculty during the semester or during the summer is strongly encouraged. It can be a rewarding and exciting supplement to regular coursework, as well as an important preparation for graduate school or employment.

The faculty publishes over 100 research articles per year, and receives approximately $5,000,000 in Federal research funds. It includes 8 former Sloan Foundation Fellows, three former Guggenheim fellows, four recipients of Outstanding Junior Investigator Awards from the U.S. Department of Energy, one recipient of an NSF Early Career Award, one members of the National Academy of Sciences, ten Fellows of the American Physical Society, one Fellow of the Institute of Physics (UK), one Fellow of the Acoustical Society of America, and two Senior Members of the American Institute for Ultrasound in Medicine.
Several of the faculty have also received rewards for excellence in teaching. Professor Carl Bender received the Burlington Northern Faculty Achievement Award, while Professors Willem Dickhoff and Michael Friedlander received Kemper awards for teaching innovation. In 2007, Professor James Miller was honored with the Emerson Award for Excellence in Teaching. In 2009, Professor Thomas Bernatowicz received the David Hadas Teaching Award.

The exceptional academic and scientific leadership demonstrated by five of our faculty have been recognized in their appointment to endowed chairs: Carl Bender is the Wilfred R. and Ann Lee Konneker Professor of Physics, John Clark is the Wayman Crow Professor of Physics, Kenneth Kelton is the Arthur Holly Compton Professor of Physics, James Miller is the Albert Gordon Hill Professor of Physics and Stuart Solin is the Charles M. Hohenberg Professor of Experimental Physics.

During the 2005 World Year of Physics, the American Physical Society designated Washington University and our department as one of the first five institutions to be entered into the registry of historical sites of American physics. This designation recognizes the fundamental importance of Compton's experiment demonstrating the particulate character of light, performed on this campus in the early 1920's.

The Physics library is one of the outstanding resources available to all students. The collection contains over 50,000 books and bound periodical volumes. The library subscribes to thousands of print and electronic journals. It has an online catalog that is linked to all academic libraries in the state of Missouri with borrowing privileges from all of them. Terminals are available in the library for Internet access and students can also do their own searching on comprehensive electronic databases such as INSPEC and Web of Science.

The Physics Department has extensive computer resources, from desktop workstations to high-performance clusters. All undergraduate majors, graduate students, staff and faculty have access to departmental computing resources, including email and web access, as well as software tools such as Matlab, Maple, and Mathematica. There are a number of research-group computer systems in the department, and a High Performance Computing Center (HPCC) comprising more than 120 64-bit processors running the Red Hat GNU/Linux operating system. The HPCC is available to all Physics Department faculty, researchers, and students, and is used for data analysis, instrument simulation,
astrophysical simulation, numerical general relativity, lattice gauge calculations, and more. Many faculty members are engaged in strong research programs in scientific computing, making extensive use of these resources, as well as national supercomputer facilities. Undergraduate participation in these projects is encouraged.

The Department of Physics at Washington University is strongly committed to fundamental research and excellence in teaching. The goal of the major program is to provide undergraduate students with an outstanding education in physics as preparation for successful careers in graduate school or in the workplace.

Requirements for the Major in Physics

Physics requirements
Specific requirements for the Major in Physics include successful completion of two semesters of calculus-based introductory physics:

- General Physics I      Physics 117A   (4 units)
- General Physics II     Physics 118A   (4 units)

OR

- Physics I              Physics 197    (4 units)
- Physics II             Physics 198    (4 units)

Additionally, students will need to take at least seven courses at the 300 level or above (with the exception of Physics 303, 304, 341, 342, 441, 442, 499, 500). Specifically required courses include:

- Physical Measurements Lab                     Physics 322   (3 units)
- Mechanics                                    Physics 411   (3 units)
- Electricity and Magnetism I                   Physics 421   (3 units)
- Quantum Mechanics                             Physics 217, 318 or 471 (3 units)

One of these seven courses must be an additional upper level laboratory course. Students may select one of the following upper level labs: Optics & Wave Physics Lab (Physics 316), Electronics Lab (Physics 321), Biophysics Lab (Physics 360), or Advanced Lab (Physics 451 / 452), or Radiochemistry Lab (Phys 435).
The remaining courses can be selected from the other courses offered by the Department, including some at the 500 level.

The package of courses selected can be quite different for a student planning to enter the work force after graduation and one who wishes to enter a graduate program in physics. Several examples of typical programs with different emphasis are provided below. Programs can be tailored to individual needs and interests and should be chosen in consultation with your major advisor. Grades in the 300 level courses or above must be C- or better.

**Science-Breadth Requirement**
Because the physical sciences are inherently interdisciplinary, the Physics faculty believe that an undergraduate education in Physics should be broader than the traditional boundaries of Physics. The science-breadth requirement consists of courses in other science departments which complement the Physics curriculum and offer insight into the truly interdisciplinary nature of science.

Students should select 3 courses from the following list to satisfy the science-breadth requirement. One of the courses must be Chem 111, 112, 401 or 402.

- General Chemistry I (Chem 111)
- General Chemistry (Chem 112)
- General Chemistry Lab I (Chem 151)
- General Chemistry Lab II (Chem 152)
- Physical Chemistry I (Chem 401)
- Physical Chemistry II (Chem 402)
- Instrumental Methods: Physical Chemistry (Chem 445)
- Introduction To Computer Programming (CSE 126)
- Computer Science I (CSE 131)
- Computer Science II (CSE 132)
- Engineering and Scientific Computing (CSE 200)

**Mathematics requirement**
To complete a major in Physics, students will also need to take Calculus I, II, and III (Math 131, 132, 233) and Differential Equations (Math 217). Depending on your interests and future plans, additional math courses may be appropriate. Other recommended mathematics courses are discussed on pages 6 and 20.
Requirements for the Minor in Physics: General Studies

Science majors and other students who are already required to take calculus-based introductory physics (Physics 117A/118A or 197/198) and who have an interest in modern physics and its applications are encouraged to consider a Minor in Physics.

Physics requirements

Specific requirements for the Minor in Physics include successful completion of:

- General Physics I and II  Physics 117A/118A (4 units/4 units)
  OR
- Physics I and II  Physics 197/198 (4 units/4 units)

Additionally, students must also take:

- Intro Quantum Physics I  Physics 217 (3 units)
- Intro Quantum Physics II  Physics 318 (3 units)

followed by at least one elective course at the 300 level or above (with the exception of Physics 303, 304, 341, 342, 441, 442, 499 and 500) with a grade of C- or better.

Mathematics requirements

Co-requisite for taking General Physics I (Phys 117A) is enrollment in or placement out of Calculus I (Math 131). Calculus II (Math 132) is a co-requisite for Physics I (Phys 197). Calculus II is also necessary to provide adequate preparation for Phys 217/318 (Quantum Physics I, II) and Calculus III (Math 233) is a co-requisite of Phys 217. Note that for some advanced courses Differential Equations (Math 217) are pre-requisite.

Advisors: Patrick Gibbons (Compton 366, pcg@wustl.edu)
Requirements for the Minor in Physics: Biomedical

The Physics Department offers a minor for students interested in the methods and techniques of physics as applied to topics in the area of biology and medicine. The program is of interest to the research oriented science major or the pre-medicine student.

Physics requirements
Specific requirements for the Minor in Biomedical Physics include successful completion of:

- **General Physics I and II** Physics 117A/118A (4 units/4 units)
- OR
- **Physics I and II** Physics 197/198 (4 units/4 units)

Two courses from the following five are required:
- **Physics of the Heart** Physics 314 (Spring)
- **Physics of the Brain** Physics 350/450 (Fall or Spring)
- **Intro Biomedical Physics** Physics 351 (Fall)
- **Physics of Vision** Physics 355/455 (Fall or Spring)

In addition, one advanced laboratory course is required. At present any of the following four courses can be chosen:
- **Optics & Wave Physics Lab** Physics 316 (Spring)
- **Electronics Lab** Physics 321 (Fall)
- **Biophysics Lab** Physics 360 (Fall)
- **Physical Measurements Lab** Physics 322 (Spring)
- **Radiochemistry Lab** Physics 435 (Fall)

The last requirement is intended to give students hands-on experience. For further information, contact Anders Carlsson.
(x5-5739; aec@wuphys.wustl.edu) in the Physics Department.

Mathematics requirements (see Physics Minor)
Advisor: Anders Carlsson (x5-5739; aec@wuphys.wustl.edu)
The Physics Major

The A.B. degree in Physics is awarded by the College of Arts and Sciences.

Freshman and Sophomore Years

Any student interested in majoring in the Physical Sciences is strongly encouraged to take two semesters of calculus-based introductory physics (Phys 117A/118A or Phys 197/198) in their freshman year. For research oriented students in the life sciences this may also be considered appropriate advice. The course structure in the science departments is such that the Biology curriculum explicitly builds on the introductory chemistry sequence, while the introductory chemistry courses are much better understood by the concurrent enrollment in introductory physics (Phys 117A/118A or Phys 197/198). Although it is difficult for some pre-medicine students to include the introductory physics course in their freshman or sophomore year, it is the view of the department that the study of chemistry and subsequently biology is greatly enhanced by a solid background in physics.

Concurrent enrollment in Calculus I (Math 131) is required for enrollment in Physics 117A while concurrent enrollment in Calculus II (Math 132) is required for Physics 197. For further discussion of the role of Math courses for the Physics Major see p 5. The contents of the introductory courses in Chemistry and Physics are coordinated in such a way that optimal preparation for the Physics Major (and Chemistry Major) is obtained by enrolling in both courses simultaneously. A student who majors in physics is required to take Phys 117/118 or Phys 197/198.

In the sophomore year, most physics majors take Intro to Quantum Physics I and II (Phys 217 and 318). This yearlong sequence should be regarded as the continuation of the freshman course and provides students with a solid introduction to quantum mechanics and its applications.

Courses in the Physics Department are offered either in the spring or in the fall, not both semesters. A list of courses and the semester in which they are offered is given on page 25-26. One of the strengths of the Physics major at Washington University is that it can be tailored to one’s individual interests. Two common paths for the first two years of a Physics major are listed below (many different versions are possible):
Program for a Physics Major

A typical program for a Physics Major with some high school preparation in Calculus (that permits placement out of Calculus I) will consist of:

<table>
<thead>
<tr>
<th>1st year Fall</th>
<th>Credits</th>
<th>1st year Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phys 197 (Phys I)</td>
<td>4</td>
<td>Phys 198 (Phys II)</td>
<td>4</td>
</tr>
<tr>
<td>Math 132 (Calculus II)</td>
<td>3</td>
<td>Math 233 (Calculus III)</td>
<td>4</td>
</tr>
<tr>
<td>Chem 111 (Gen. Chem I)</td>
<td>3</td>
<td>Chem 112 (Gen. Chem II)</td>
<td>3</td>
</tr>
<tr>
<td>Chem 151 (Chem Lab)</td>
<td>2</td>
<td>Chem 152 (Chem Lab)</td>
<td>2</td>
</tr>
<tr>
<td>Elective or English Comp</td>
<td>3</td>
<td>Elective or English Comp</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2nd year Fall</th>
<th>Credits</th>
<th>2nd year Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phys 217 (Quantum Phys I)</td>
<td>3</td>
<td>Phys 318 (Quantum Phys II)</td>
<td>3</td>
</tr>
<tr>
<td>Upper Level Physics Lab</td>
<td>3</td>
<td>Phys 411 (Mechanics)</td>
<td>3</td>
</tr>
<tr>
<td>Math 217 (Diff. Eq.)</td>
<td>4</td>
<td>ESE 317 (Engineering Math)</td>
<td>4</td>
</tr>
<tr>
<td>Electives</td>
<td>6</td>
<td>Electives</td>
<td>6</td>
</tr>
</tbody>
</table>

Note: The upper level lab suggested in Fall of the sophomore year could instead be taken in the Spring semester of that year.

Students are encouraged to sample other introductory science courses during their first two years. Principles of Biology I and II (Bio 2960, 2970) are relevant for majors interested in applications of Physics to medicine and biology. Bio 2960 can then be taken in the spring of the sophomore year. A student more interested in the physical sciences may consider Earth and the Environment (EPSc 201), which is offered both in the fall and in the spring by the Earth and Planetary Science department. In general, it makes sense to pursue a broad introduction and survey all fields of science. This broad introduction is not a prerequisite for all careers in physics but is becoming more important for current research in interdisciplinary fields.

Pre-medicine students majoring in Physics

Students can fulfill the pre-medicine requirements while pursuing a Major in Physics. Medical school admission committees consider a Physics Major an excellent preparation for students applying to medical school. In general, the exposure to hands-on applications of physics techniques in the laboratory can
be a great advantage for research-oriented students interested in medical school. The program listed below assumes that the incoming student places directly into Calculus II. Other schedules can be devised based on individual needs and preparation.

<table>
<thead>
<tr>
<th>1st year Fall</th>
<th>Credits</th>
<th>1st year Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phys 197 (Phys I)</td>
<td>4</td>
<td>Phys 198 (Phys II)</td>
<td>4</td>
</tr>
<tr>
<td>Math 132 (Calculus II)</td>
<td>3</td>
<td>Math 233 (Calculus III)</td>
<td>4</td>
</tr>
<tr>
<td>Chem 111 (Gen. Chem I)</td>
<td>3</td>
<td>Chem 112 (Gen. Chem II)</td>
<td>3</td>
</tr>
<tr>
<td>Chem 151 (Chem Lab)</td>
<td>2</td>
<td>Chem 152 (Chem Lab)</td>
<td>2</td>
</tr>
<tr>
<td>Elective or English Comp</td>
<td>3</td>
<td>Elective or English Comp</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2nd year Fall</th>
<th>Credits</th>
<th>2nd year Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phys 217 (Quantum Phys I)</td>
<td>3</td>
<td>Phys 318 (Quantum Phys II)</td>
<td>3</td>
</tr>
<tr>
<td>Math 217 (Diff. Eq.)</td>
<td>4</td>
<td>Bio 2960 (Princ. Biology I)</td>
<td>4</td>
</tr>
<tr>
<td>Chem 251 (Org. Chem I)</td>
<td>3</td>
<td>Chem 252 (Org. Chem II)</td>
<td>3</td>
</tr>
<tr>
<td>Phys 3XX (Biological Phys)</td>
<td>3</td>
<td>Chem 257 (Org. Chem Lab)</td>
<td>2</td>
</tr>
<tr>
<td>Elective</td>
<td>3</td>
<td>Elective</td>
<td>3</td>
</tr>
</tbody>
</table>

**Advanced Placement**

If a student has taken AP Physics exams in high school and submitted the results to Washington University Admissions, the appropriate AP credit will automatically be added to your internal record. A detailed description of the Physics AP policy can be found in the Undergraduate Programs document.

A score of 5 on the AP Physics C - Mechanics exam earns 4.0 units of credit for Physics 117. This corresponds to the first semester in a two semester, calculus-based introductory physics sequence. A score of 5 on the AP Physics C - Electricity & Magnetism exam earns 4.0 units of credit for Physics 118. This corresponds to the second semester in a two semester, calculus-based introductory physics sequence. Although students may place out of the first year of calculus-based introductory physics with AP credit, potential majors are strongly encouraged to enroll in Physics 197 (Fall semester) and Physics 198 (Spring semester) during their freshman year.

Contact Dr. Mairin Hynes (khynes@physics.wustl.edu) with questions regarding AP credit or course enrollment.
Laboratories

Laboratory courses provide hands-on opportunities for students to connect experimental observations with the knowledge and mathematical formalism obtained in traditional lecture courses. Moreover, many students report that laboratory courses provide them with a set of experiences upon which to hang the more abstract results from the classroom. Many students speak of the intellectual fun of witnessing abstract theories turn into concrete meter readings. Students often report that laboratory courses empower them because they now understand more of what they observe around them (being confident that they could learn about the rest).

The upper level laboratory courses are Optics & Wave Physics Lab (Phys 316), Electronics Lab (Phys 321), Physical Measurements Lab (Phys 322), Biophysics Laboratory (Phys 360), and Nuclear & Radiochemistry Lab (Phys 435). The optics course provides the student with an introduction to ray and especially wave optics. Given the explosion of interest in optics driven by light-wave (fiber optics) communication, the optics laboratory is an important course. The electronics laboratory aims to make the student capable of using electronic circuitry and instruments. The biophysics laboratory course consists of “tabletop” experiments in biological physics designed to introduce the student to the concepts, methods, and biological model systems in biophysics. The physical measurements laboratory is about one-half “great experiments” (Einstein photoelectric effect, Millikan oil drop, etc.) and one-half modern experiments that may relate to other disciplines. One such experiment involves nuclear magnetic resonance (referred to as Magnetic Resonance Imaging or MRI), which connects to quantum physics by the Zeeman effect and has applications in chemistry, biology, and medicine. The experiments in this course are pursued in greater depth than in the other laboratory courses, so physical measurements laboratory has some of the feel of actual research. The radiochemistry lab (Phys 435) explores the role of nuclear physics in scientific and biological applications.

All majors are required to take Physical Measurements Lab (Phys 322), and at least one other upper level lab course. Students who double major in Electrical Engineering (EE) and Physics need not take Phys 321 (Electronics Lab), but instead should take either Optics & Wave Physics Lab (Phys 316) or Biophysics Laboratory (Phys 360). EE lab courses are not acceptable as substitutes for Phys 321.
Students who are not planning to continue to graduate school are strongly encouraged to take as many laboratory courses as possible. It is possible to take Advanced Labs 1 and II (Phys 451 and 452), as well as the Nuclear and Radiochemistry Laboratory (Chem 435). Other experiments in the advanced chemistry labs are also of great interest. Students who prepare for graduate school are reminded that the vast majority of Ph.D. degrees in physics are awarded for work in experimental physics.

**Junior and Senior Years**

When a student reaches junior standing it should be clear what kind of physics major the student wants to pursue. The range of possibilities is very broad and includes a major with a large number of graduate courses that are offered by the department, as well as a major more geared towards applications of physics, for example in Biology and Medicine or Earth and Planetary Science.

**Physics 582 Research Seminar**

This is an optional course designed to introduce students to current developments in physics and to research carried out by faculty (topics vary each year). Members of the department address issues in their particular specialties. Interested undergraduates are advised to take this seminar in their junior year.

Credit: 1 unit.

**Standard preparation for Graduate School in Physics**

A typical program is shown below assuming that Mechanics (Phys 411) has been taken in the spring of the sophomore year (can also be taken junior year).

<table>
<thead>
<tr>
<th>3rd year Fall</th>
<th>Credits</th>
<th>3rd year Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phys 421 (Elect &amp; Mag I)</td>
<td>3</td>
<td>Phys 422 (Electr &amp; Magn II)</td>
<td>3</td>
</tr>
<tr>
<td>Phys 321 (Electronics Lab) or</td>
<td></td>
<td>Phys 322 (Phys Meas Lab)</td>
<td>3</td>
</tr>
<tr>
<td>Phys 463 (St Mech&amp;Thermo) or</td>
<td></td>
<td>Science, Math, or Phys course</td>
<td>3</td>
</tr>
<tr>
<td>Phys 471 (Quantum Mech I)</td>
<td>3</td>
<td>Electives</td>
<td>6</td>
</tr>
<tr>
<td>Science, Math, or Phys course</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A large selection of advanced courses is available to complement your preparation for graduate school during the Fall and Spring Semester of your senior year. Note, however, that courses like Phys 472 (Intro Solid State Physics) and Phys 474 (Intro Nuclear & Particle Phys) have Phys 471 as a prerequisite, and they are not necessarily offered every year. Also courses at the graduate level like Phys 501/502 (Methods of Theoretical Physics I / II) and many others are available. Students preparing for graduate school in physics should take more physics courses than the minimum required for the major. Consult your major advisor for advice on courses that will best prepare you for your future studies.

**Students preparing for employment after the A.B.**

Students who are not planning to continue to a graduate program in physics are also required to take Phys 411 (Mechanics), Phys 421 (Electricity & Magnetism I) and Phys 322 (Physical Measurements Lab). In addition to these courses you are advised to focus on course work involving the applications of physics in a more or less practical setting. Special emphasis should be placed on the laboratory courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 316</td>
<td>Optics &amp; Wave Physics Lab</td>
</tr>
<tr>
<td>Physics 321</td>
<td>Electronics Lab</td>
</tr>
<tr>
<td>Physics 360</td>
<td>Biophysics Lab</td>
</tr>
<tr>
<td>Physics 45</td>
<td>Nuclear &amp; Radiochemistry Lab</td>
</tr>
</tbody>
</table>

Other courses that have particular relevance are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 314</td>
<td>Physics of the Heart</td>
</tr>
<tr>
<td>Physics 350</td>
<td>Physics of the Brain</td>
</tr>
<tr>
<td>Physics 351</td>
<td>Intro Biomedical Physics</td>
</tr>
<tr>
<td>Physics 352</td>
<td>Physics of Biomolecules</td>
</tr>
<tr>
<td>Physics 355</td>
<td>Physics of Vision</td>
</tr>
<tr>
<td>Chemistry 401</td>
<td>Physical Chemistry I</td>
</tr>
<tr>
<td>Physics 422</td>
<td>Electricity &amp; Magnetism II</td>
</tr>
<tr>
<td>Physics 427</td>
<td>Intro Computational Physics</td>
</tr>
<tr>
<td>Chemistry 435</td>
<td>Nuclear &amp; Radiochemistry Lab</td>
</tr>
<tr>
<td>Chemistry 436</td>
<td>Radioactivity &amp; Applications</td>
</tr>
<tr>
<td>Physics 452</td>
<td>Advanced Laboratory II</td>
</tr>
<tr>
<td>Physics 463</td>
<td>Statistical Mechanics &amp; Thermodynamics</td>
</tr>
</tbody>
</table>
Physics 464  Physics of Continuous Media  
Physics 471  Quantum Mechanics I  
Physics 472  Intro Solid State Physics  

Some packages will prepare students very well for graduate school in other sciences as well as medical school (see below).

**Students preparing for Medical School**

Pre-medicine students still face some required courses in their junior year. These include the continuation of the Fundamentals of Biology sequence. A possible schedule would then be as follows:

<table>
<thead>
<tr>
<th>3rd year Fall</th>
<th>Credits</th>
<th>3rd year Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phys 360 (Biophysics Lab)</td>
<td>3</td>
<td>Phys 314 (Phys of the Heart)</td>
<td>3</td>
</tr>
<tr>
<td>Phys 421 (Electr. &amp; Magn I)</td>
<td>3</td>
<td>Phys 322 (Phys Meas Lab)</td>
<td>3</td>
</tr>
<tr>
<td>Bio 2970 (Princ. Biol II)</td>
<td>4</td>
<td>Phys 411 (Mechanics)</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td>6</td>
<td>Electives</td>
<td>6</td>
</tr>
</tbody>
</table>

In the senior year at least one additional course, for example Phys 350 (Physics of the Brain), Phys 352 (Physics of Biomolecules), or Phys 355 (Physics of Vision). Phys 427 (Intro Computational Physics), Phys 463 (Statistical Mechanics & Thermodynamics), and Phys 471 (Quantum Mechanics I), are also relevant courses to complement your program. Depending on your individual interests and preparation, many different schedules can be devised in consultation with your advisor.

**Research Projects for Undergraduates**

The Washington University Physics Department hosts strong research groups in the fields of Astrophysics, Biophysics, Condensed Matter Physics, Materials, Medical Physics, Nuclear Physics, Particle Physics, and Space Materials. All undergraduate students are strongly encouraged to take advantage of the presence of these research groups and to participate in the cutting-edge research that is carried through at the department. Engaging actively in research as an undergraduate student is highly recommended for students planning to do a PhD in Physics or in another science.
Undergraduate students are invited to participate in research at all levels of the undergraduate career. Active involvement in research at an early stage (freshman and sophomore standing) will broaden your perspective of how physics research actually works. Research at the junior and senior level is highly encouraged so that students can apply the techniques they have studied in their physics classes. The research can be carried through while classes are in session, or, during the summer. It can count for credit after approval of an advising professor (enroll in Physics N41 or N42 where N is your year in college), or alternatively, can be rewarded with an hourly salary. Most professors welcome students interested in doing research for one semester or several semesters. Please note that research requires a substantial time investment. Students interested in doing research while classes are in session should set aside between 6 and 12 hours per week for the research. Summer research usually takes as much time as a full-time job (40 hrs per week) or a half-time job (20 hours per week). Students in their senior year are encouraged to do a senior thesis or a honors thesis (the latter requires a projected >3.65 GPA). Usually, professors ask their advisees to summarize their research findings in a report, and/or to report the results on a conference or in a Physics journal.

How do you find the research group which is right for you? As a starting point, please investigate the descriptions on the departmental research web site (http://physics.wustl.edu/research). The next step is either to directly contact professors whose research interests you, or to schedule a meeting with Professor Francesc Ferrer (email: Francesc Ferrer ferrer@physics.wustl.edu) who will advise you about research opportunities that match your interests. Eventually, all students wishing to do a research project have to make one-on-one contact with the advising professor. You should contact the professor by email and ask for a meeting to discuss possible research projects. A good preparation for this meeting is to read about the professor’s research on the world-wide web, and to bring a resume and/or a list of courses completed along with any relevant skills.

Areas of active departmental research include theoretical and observational astrophysics and space science; mathematical physics; theoretical studies in solid state, elementary particles, and many-body systems; experimental research in materials, solid state, high pressure, NMR, and ultrasonic physics, and in applications of physics to biological and medical problems.
Research groups that have welcomed undergraduate participants recently include Professor Miller’s Laboratory for Ultrasonics, in which ultrasound is used to characterize and image composite materials ranging from graphite-epoxy airplane parts to heart muscle (see cover). Professor Wessel studies the biophysics of computation in brains, applying methods from electrophysiology, pharmacology, and imaging to functional brain slices. Professor Carlsson uses a combination of Brownian-dynamics simulation and analytic theory to elucidate the nanoscale processes underlying the motility of biological cells. Professor Wang welcomes undergraduate students to participate in single molecule biophysics research that uses quantitative experimental methods to address fundamental biological questions at the molecular level. One major project is to study gene regulations by directly imaging the interactions of single gene regulator proteins with DNA.

Professor Kelton and Professor Gibbons’s materials physics group makes, characterizes, and studies the unique properties of complex metal alloys. Professor Solin's research is focused on the fundamental physics of novel materials, such as semiconductor-metal composites, with a particular interest in the effect of external perturbations (electric fields, magnetic fields, temperature, stress/strain, etc.) on the structural and transport properties of mesoscopic systems (typical size < 100 nm). Professor Conradi’s experimental nuclear magnetic resonance group poses and answers a variety of physical and chemical questions about molecular solids, hydrogen-storage alloys, and other materials. They are also developing new methods and applications of magnetic resonance imaging of human lungs.

The McDonnell Center for the Space Sciences, which partly resides on Compton’s fourth floor, involves undergraduates in the study of extraterrestrial materials using state-of-the-art microscopic probes and isotope-resolving mass spectrometers. The faculty involved are Professors Bernatowicz, Hohenberg, and Zinner. The cosmic ray, X-ray and gamma-ray groups of professors Binns, Buckley, Israel, and Krawczynski design, make, and use sophisticated detectors for balloon, satellite, and shuttle flights. Professor Krawczynski welcomes undergraduate students to work on the analysis of X-ray observations of the collimated plasma outflows from supermassive black holes. Professor Cowsik's research is in high-energy astrophysics, cosmic rays and dark matter-cosmology; he is also setting up a laboratory for studying the behavior of gravitation at short distances and for searching for new forces of nature.
Professor Alford calculates properties of ultra-dense quark matter, and investigates how it may affect the observable features of neutron stars. Professor Schilling's experimental group uses a diamond-anvil cell to study high-temperature superconductors under pressures approaching one million atmospheres. Professor Bender applies sophisticated mathematical techniques to a range of interesting problems in physics, field theory in particular, and mathematics. Professor Clark involves undergraduates in studying the properties and applications of neural nets after you have taken his Physics of the Brain course. Professors Ogilvie and Bernard study the theory of the strong interaction, in some cases involving heavy number crunching. Professor Dickhoff studies the quantum effects of particles embedded in a medium of strongly interacting particles like electrons, nucleons, or strange particles.

Undergraduate Research Fellowships: There are several Physics summer research fellowships and a Delos summer research fellowship that are awarded to students for undergraduate research within one of the department's research groups during a summer. Each spring, applications are solicited by the department and by the Undergraduate Research Office, and selections are made by a joint committee. Students who have received these fellowships often continue to pursue the research during the school year and beyond, which has led to peer-reviewed publications in many cases. Please refer to the web-site http://physics.wustl.edu/undergraduate/summer-fellowships for more detailed information and the actual deadlines.

Latin Honors and Senior Honors Thesis

The Physics department encourages all students to engage in undergraduate research and to write a report about their research (see http://physics.wustl.edu/undergraduate/research-projects for information about how to find a research project and a faculty advisor).

Students with a >3.65 GPA are encouraged to write a formal senior honors thesis that will qualify them to receive a diploma with Latin Honors:
• cum laude, with praise,
• magna cum laude, with great praise,
• summa cum laude, with the highest praise.

The thesis is a proof that you have a deep understanding of the concepts acquired as a Physics major, and that you can use these concepts to do original research. The thesis should describe research performed by you in the Physics
Department or elsewhere. The writing should attest to your ability to write a scientific paper. The thesis should include an introduction giving the motivation for the research project and background information, describe the methods applied and the results of the research, include a discussion section, and include appropriate citations throughout the thesis. You will receive faculty feedback to your thesis which help you to improve your scientific writing skills.

Each year the deadline for seniors to turn in their finished theses is in March by 5:00 PM on the Monday that is the first class day after the end of spring break. This is a firm deadline that cannot be extended.

All students writing a senior thesis need to report their intent to do so to the department secretary Sarah Hedley (Sarah Hedley <sarahj@wuphys.wustl.edu>) with the form given at the end of this document. If the research was done and supervised in another department, you must find a physics faculty member to be a thesis supervisor, read your thesis and certify that it is substantial and well written. In this case, please give the names of both advisors.

A successful thesis usually contains between twelve to twenty pages of text (single-spaced) plus figures, tables, and references. Writers should consult the advisors frequently to ensure high scientific and writing quality. The librarian Alison Verbeck has theses from recent years in a box in the library, so you can look at examples there, or in the electronic repository described below.

All students writing a senior thesis are encouraged to give a short (10-15min) presentation about their work to fellow undergraduate students, and professors. The Undergraduate Studies Committee will contact all senior thesis writers to schedule the presentation within the framework of a few 1hr long seminars with 3-4 similar presentations. The Undergraduate Studies Committee will try to schedule these meetings before the due-date of the senior thesis, so that the students can use the feedback from the audience to address shortcomings of the thesis. We also recommend that a poster describing the research will be presented at one of the two Undergraduate Research Symposia held each year.

We ask that students post electronic copies of their theses at the Washington University Libraries Open Scholarship repository. The repository is a service of the Libraries to provide free access to the scholarly output of the university. More information about the repository is available on the “About” page at openscholarship.wustl.edu. Open Scholarship already contains several senior
honors projects. You can find examples listed under Student Publications in two folders – Undergraduate Theses–Restricted and Undergraduate Theses–Unrestricted. Find out more about submission guidelines, policies, forms and the necessity for the two distinct areas at this site: libguides.wustl.edu/undergrad_open_schol.

Students may perform the research work on which they will report as volunteers, for pay, or for academic credit. An hour of work may not earn both money and credit. Students should not be paid for time spent writing theses, but may count that time toward academic credit. Seniors may use Physics 499 and Physics 500 to sign up for credit. The only way to enroll in these courses is to have the advisor ask Sarah to make the registration and tell her how many units should be earned. A University-wide guideline is one unit of credit for three hours per week of research work.

**Double Majors**

Many students have the interests and ability to major in two subjects. This takes some planning, and should be discussed with your advisor. A variety of double major combinations are possible. We have had students major in physics and chemical engineering, electrical engineering (quite frequently), computer science, biology, chemistry, drama, economics, English, French, history, Japanese, philosophy, music and quite often mathematics.

**Society of Physics Students**

The Washington University chapter of the Society of Physics Students is a student-run organization that promotes interest in science and provides opportunities for undergraduates to develop and enhance skills that are necessary to become successful members of the scientific community. SPS sponsors monthly events that range from professional development sessions on how to get involved in research and career opportunities for physics majors to social networking events like liquid nitrogen ice cream socials. To encourage involvement in our local SPS chapter and student participation in a professional society, the physics department pays the first year membership fee when students join the national SPS organization. **SPS Advisor:** Dr. Francesc Ferrer (ferrer@wustl.edu).
Advising

If you have indicated during your application process to Washington University that you are interested in pursuing a physics major, it is quite likely that your freshman advisor is a physics faculty member. If this is not the case, it is always relatively easy to switch to one. Students who declare themselves Physics majors will be assigned a faculty advisor. See Patrick Gibbons for an assignment from among the Department's major advisors. Currently, the department has the following faculty who are involved with advising physics majors:

<table>
<thead>
<tr>
<th>Professor</th>
<th>Office</th>
<th>Telephone</th>
<th>e-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>James Buckley</td>
<td>Compton 253</td>
<td>5-7607</td>
<td>buckley@wuphys</td>
</tr>
<tr>
<td>Mark Conradi</td>
<td>Compton 372</td>
<td>5-6418 or 64-75</td>
<td>msc@wuphys</td>
</tr>
<tr>
<td>Patrick Gibbons</td>
<td>Compton 366</td>
<td>5-6271</td>
<td>pcg@wuphys</td>
</tr>
<tr>
<td>Martin Israel</td>
<td>Compton 250</td>
<td>5-6263</td>
<td>mhi@wuphys</td>
</tr>
<tr>
<td>Zohar Nussinov</td>
<td>Compton 353</td>
<td>5-6272</td>
<td>Zohar@physics</td>
</tr>
<tr>
<td>Michael Ogilvie</td>
<td>Compton 356</td>
<td>5-6256</td>
<td>mco@wuphys</td>
</tr>
<tr>
<td>Alexander Seidel</td>
<td>Compton 355</td>
<td>5-8933</td>
<td>seidel@physics</td>
</tr>
<tr>
<td>Li Yang</td>
<td>Compton 369</td>
<td>5-9453</td>
<td>lyang@physics</td>
</tr>
</tbody>
</table>

Note that the complete e-mail addresses still require the addition of “.wustl.edu” in addition to the user name and local computer given in the table. All physics majors are strongly encouraged to discuss their plans for the major with their advisor in great detail. Some general advice is contained in this handbook but your advisor has access to additional resources and information.

Mathematics and Computing

A good foundation in mathematics and well-developed computer skills are needed for a successful career in physics today. In addition, a background in physics and computing can lead to careers in many technical fields. Your interests and objectives will determine the precise courses in mathematics and computing you will take. For those who are interested in computational aspects of physics, we have a number of faculty members who will be able to describe the role of computers in modern physics research and opportunities for undergraduate research, honor theses, and summer employment. Courses are available in the Department of Mathematics, the Department of Computer
Science and Engineering (CSE) and the Department of Electrical and Systems Engineering (ESE).

**Computer and computing skills**

Students' computing backgrounds vary greatly. At a minimum, the Physics Department recommends familiarity with at least one modern programming language, preferably C, C++, LabView, or Java, although Fortran is still used frequently in physics. CSE 200 (Engineering and Scientific Computing) is a one semester introduction to numerical methods with an emphasis on applied physics and engineering problems. The CSE 131-132 sequence is more suited for those with a strong interest in computer science. The physics department offers Physics 427 (Introduction to Computational Physics) which provides a broad introduction to the relationship of physics, computing and mathematics. Although no previous computer programming experience is required, some exposure to simple programming is helpful.

**Courses in Mathematics**

The Mathematics department offers extensive options for calculus. Students who have had a year of high school calculus will normally enroll in Math 132, but the precise placement is best determined by taking the on-line calculus placement exam offered by the Math department (http://math.wustl.edu/placement/).

Math 217 (Differential Equations) is required for Physics 411 and 421, which are both required for a physics major. We recommend that students complete Math 217 prior to taking physics 411. Students should also take Math 233 (Calculus III), which is a co-requisite for Math 217, and seriously consider ESE 317 (Engineering Mathematics) or Math 308 (Mathematics for the Physical Sciences), which provide a broad survey of advanced mathematics. We recommend students take ESE 317 or Math 308 prior to Physics 421. We also recommend taking Math 309 (Matrix Algebra) prior to enrolling in Phys 471. Students with a strong interest in mathematics or theoretical physics should also consider Physics 501-502 (Methods of Theoretical Physics), which are cross-listed as Math 501-502.

**Putnam Mathematical Competition**
Professor Bender of the Physics Department and Professors Rochberg and of the Mathematics Department coach the students who are preparing to enter the Putnam Mathematical Competition. Students prepare for the Putnam during Friday afternoon practice sessions in the fall semester. The practices featured free pizza, paid for by the mathematics department from money won by past Putnam teams. (The top team can win as much as $25,000.) If you would like to learn techniques of problem solving and would enjoy interacting with this peer group of bright students you are most warmly invited to attend the practice sessions.

During the last twenty years, Washington University has had four first-place and four second-place finishes. We typically place about half a dozen students in the top 100 and about a dozen students in the top 200. The Washington University team has been one of the top three teams in the country for the last twenty years (of the many hundreds of colleges and universities from the US and Canada that participate). This past year, the WUSTL team, consisting of senior Alex Anderson and juniors Tom Morrell and Ari Tenzer, placed 28th out of 460 teams. Last year the university fielded 16 students in the competition, which was held on the first Saturday in December 2011. Altogether, 572 colleges and universities in the United States and Canada took part. Three students must be designated in advance as the school team, and the team score is based on the three individual scores.

An archive of Putnam problems can be found at the Putnam Competition Directory.

http://amc.maa.org/a-activities/a7-problems/putnamindex.shtml
Physics Library

The Pfeiffer Physics Library is located on the third floor of Compton Hall. This is an outstanding facility, with subscriptions to thousands of print and electronic journals and a first-rate book collection. The Librarian is available during normal hours to provide professional help. All full-time students who have declared as physics majors may, however, enter the library at any other time - access is controlled by a card-reader that will accept all university ID cards that the Department has validated.

Course books are frequently placed on reserve in the Physics Library office. They can be used in the Library, or checked out at the end of the day for overnight use.

The professional journals constitute the core of the research arm of the library, and it has all of the major journals in the department’s research areas, from the Astrophysical Journal through to Solid State Physics. Some of these come out weekly, others are monthly, and there are also publications such as the Annual Reviews of Nuclear and Particle Physics that contain broad surveys of recent developments in each sub-field.

Weekly publications such as Nature and Science contain both short original research reports that require rapid publication as well as general reports of happenings that affect the scientific community: debates in the Congress on the science budget, international scientific congresses, and ethical issues in science. Other publications deal with the history of science and with science teaching.

The university's main library, Olin Library, contains the major part of the collection in the history and philosophy of science, while other areas of science are housed in separate libraries in the Departments of Chemistry and Earth and Planetary Science.

Students are encouraged to make use of the library and to seek the help of the Librarian as may be needed.
Prizes

The Department of Physics awards prizes to students who have excelled in various ways.

Robert N. Varney Prize
This prize is awarded each year to the best student in the introductory courses (Phys 117-118, Phys 197-198). Professor Varney was a member of the faculty for many years, carrying out research in gaseous electronics. This prize was established to commemorate his deep and long-time interest in physics instruction. The Varney prize is presented each fall semester at a mid-week department colloquium before a distinguished visitor delivers the annual Feenberg Lecture, in memory of one of our faculty colleagues.

Greg Delos Prize
Greg Delos was an excellent student who unfortunately passed away during his junior year. In his memory, the Delos family has generously set up the fund that supports an annual award, which takes the form of a stipend to support a student working with one of the research groups during the summer. The availability of this prize is publicized each spring semester and the winner is selected by the departmental prize committee from among the applicants, with selection based on performance in the physics courses (and possibly research) thus far.

The Senior Prize
Awarded each year, the prize is in the form of a plaque and a check. Selection is based on performance in physics courses and is made by the department's major advisors. This Prize is awarded in a ceremony in the Department after Commencement.

It is appropriate to mention another prize that is related to undergraduate courses. The Franklin B. Shull Prize is awarded each year to an outstanding graduate teaching assistant. Frank Shull was the senior faculty instructor in introductory courses for many years, and the prize takes note of both his interest and the importance that the Department attaches to the quality of teaching by graduate teaching assistants.
**Career Paths from a Physics Major**

What can you do with a Physics Major? Just about anything. Physicists are at the forefront of research and innovation in many areas, both industrial and academic. To give a few examples, in industry, physicists develop new technologies to treat diseases and to understand the genome; they invent new generations of electronic equipment and develop technology that will enable us to generate energy from our natural resources more easily, more economically, and more safely. In academia, physicists work on revealing the origin and fate of the universe, understanding the very nature of space, time and matter, and predicting the long-term evolution of the world climate.

Many students go directly from undergraduate studies into a graduate program; others choose jobs in a variety of technical and non-technical fields. Our students often find surprising applications of their physics education to problems that at first glance appear to have little to do with physics. The fundamental reasoning, calculation, and laboratory skills have broad application throughout society.

Physics majors from our department have gone to graduate school in a variety of scientific fields, to business school, and to medical school. With an undergraduate degree in physics, you can pursue graduate studies in:

- Physics
- Chemistry
- Biology
- Earth and Planetary Science
- Mathematics
- Engineering
- Computer Science
- Medical School
- Law School
- Business School

Faculty advisors and instructors in courses will be happy to write letters of recommendation for graduate programs, scholarship opportunities, and fellowships. They will also provide advice on which graduate programs in physics or related subjects will provide the best match with a student's interests.
Most graduate programs in the sciences provide tuition remission and a living stipend in return for work as a teaching assistant or research assistant.

Students who are seeking employment directly from college will find that technical and non-technical positions in many fields are available to physics majors, including:

* Internships and entry-level positions with major corporations
* Computer-related jobs including programming, system administration, and hardware and software maintenance
* Laboratory jobs in industry, hospitals, and universities
* Teaching positions in public and private schools; your major advisor can provide advice on teacher certification

Whatever your plans, physics department faculty members will be happy to discuss them with you and provide guidance and support. The American Institute of Physics provides useful information in its publications and reports, as well as on its web site [http://www.aip.org/statistics/trends/emptrends.html](http://www.aip.org/statistics/trends/emptrends.html). The College of Arts and Sciences, through its Career Center, also provides information, support and advice.

**Courses available 13-14**

Courses that are relevant for the Physics Major and are taught this academic year, are listed in the following tables. Each course is offered either in the fall or spring. From this table together with the information provided in this handbook it should be possible to put a complete program together that fits your needs and interests.

**Fall Semester 2013**

<table>
<thead>
<tr>
<th>Course No</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phys 117A</td>
<td>General Physics I</td>
</tr>
<tr>
<td>Phys 197</td>
<td>Physics I</td>
</tr>
<tr>
<td>Phys 217</td>
<td>Intro to Quantum Physics I</td>
</tr>
<tr>
<td>Phys 312</td>
<td>Intro to Astrophysics</td>
</tr>
<tr>
<td>Phys 321</td>
<td>Electronics</td>
</tr>
<tr>
<td>Phys 355</td>
<td>Physics of Vision</td>
</tr>
<tr>
<td>Phys 360</td>
<td>Biophysics Lab</td>
</tr>
</tbody>
</table>
The Department offers several courses that do not form part of the major requirements. These include for the academic year 13/14:

**Fall Semester 2013**
- Phys 125A  Solar System
- Phys 171  Physics and Society

**Spring Semester 2014**
- Phys 126A  Stars, Galaxies, Cosmology

Although mostly non-science majors take these courses, there is enough interesting material in Phys 125, 126, and 171 to warrant attention from science majors. Phys 171A is also cross-listed as Environmental Studies 272A.
Teaching & Research Faculty

Current active teaching faculty in the physics department are listed below. The list includes e-mail address, phone, office number, as well as websites when appropriate.

Mark G. Alford  Professor, Ph.D., Harvard Univ., 1990
Theoretical particle physics
alford@wuphys; x-5-5034; Compton 358
http://wuphys.wustl.edu/Fac/alfordMark.html

Carl M. Bender  Professor, Ph.D., Harvard University, 1969
Theoretical physics; mathematical physics; particle physics
cmb@wuphys; x5-6216; Compton 360
http://www.physics.wustl.edu/~cmb/

Claude W. Bernard  Professor, Ph.D., Harvard University, 1976
Theoretical physics; particle physics; computational physics
cb@lump; x5-6280; Compton 367
http://www.physics.wustl.edu/~cb/

Thomas J. Bernatowicz  Professor, Ph.D., Washington U., 1980
Mass spectrometry; TEM
tom@wuphys; x5-6274; Compton 468
http://www.physics/mcdonnell/bernatowicz.html

James H. Buckley  Professor, Univ. of Chicago, 1994
Cosmic-ray astrophysics; TeV-gamma-ray Astrophysics
buckley@wuphys; x5-7607; Compton 253

Anders E. Carlsson  Professor, Ph.D., Harvard University, 1983
Condensed matter theory; materials theory; Biophysics
aec@wuphys; x5-5739; Compton 370
http://www.physics.wustl.edu/~aec/
John W. Clark  Professor, Ph.D., Washington University, 1962
Theoretical physics and astrophysics; many-body Theory
jwc@wuphys; x5-6208; Compton 351
http://www.physics/mcdonnell/clark.html

Mark S. Conradi  Professor, Ph.D., Washington University, 1977
Experimental condensed matter physics; Magnetic resonance imaging of human beings
msc@wuphys; x5-6418, x5-6292; Compton 372
http://www.physics.wustl.edu/~msc/

Ramanath Cowsik  Professor, Ph.D., University of Bombay, 1968
Theoretical and observational astrophysics, and experimental tests of fundamental physics
cowsik@wuphys; x5-4493, Compton 473
http://wuphys.wustl.edu/Fac/Cowsik.html

Willem H. Dickhoff  Professor, Ph.D., Free University Amsterdam, 1981
Theoretical physics; many-particle theory
wimd@wuphys; x5-4169; Compton 371
http://www.physics.wustl.edu/~wimd/

Francesc Ferrer  Assistant Professor, Ph.D., Univ. Autònoma Barcelona, 2001
Theoretical cosmology and astroparticle physics
ferrer@physics; x5-7982; Compton 368

Patrick C. Gibbons  Professor, Ph.D., Harvard University, 1971
Solid-state physics, electron scattering
pcg@wuphys; x5-6271; Compton 366
http://www.physics.wustl.edu/~pcg/

Charles M. Hohenberg  Professor, Ph.D., Univ. California-Berkeley, 1968
Experimental space science; astrophysics; rare gas mass spectrosocpy
cmh@wuphys; x5-6266, x5-6257; Compton 451
http://www.physics/mcdonnell/hohenberg.html
Mairin Hynes  Lecturer, Ph. D., Washington University, 2010  Experimental space science, extraterrestrial materials, TEM  khynes@physics.wustl.edu; x5-4495; Crow 214

Martin H. Israel  Professor, Ph.D., California Institute Technology, 1968  Cosmic ray astrophysics  mhi@wuphys; x5-6263; Compton 250  http://wuphys.wustl.edu/Fac/Israel.html

Jonathan I. Katz  Professor, Ph.D., Cornell University, 1973  Theoretical astrophysics; applied physics  katz@wuphys; x5-6202; Compton 267  http://www.physics.wustl.edu/~katz/

Kenneth F. Kelton  Professor, Chair, Ph.D., Harvard University, 1983  Experimental solid state physics and materials science  kfk@wuphys; x5-6228, x5-4654; Compton 354  http://www.physics.wustl.edu/~kfk/

Henric Krawczynski  Professor, PhD., Hamburg University (Germany), Theoretical and experimental High Energy Astrophysics, krawcz@wuphys, x5-8553, Compton 254,  http://www.physics.wustl.edu/~krawcz/

James G. Miller  Professor, Ph.D., Washington University, 1970  Ultrasonics; biomedical physics; elastic properties of inhomogeneous media  jgm@wuphys; x5-6229; Compton 169  http://128.252.125.77/Personnel/JGM/jgm.html

Zohar Nussinov  Assistant Professor, Ph.D., UCLA, 2000, Condensed matter physics  zohar@wuphys; x5-6272: Compton 353

Michael C. Ogilvie  Professor, Ph.D., Brown University, 1980  Quantum field theory and particle physics; theoretical physics; mathematical physics  mco@morgan; x5-6256; Compton 356  http://www.physics.wustl.edu/~mco/
James S. Schilling  
Professor, Ph.D., University of Wisconsin, 1969  
Experimental solid state physics; high-pressure physics  
schill@wuphys; x5-6239; Crow 215  
http://www.physics.wustl.edu/~schill/

Alexander Seidel  
Associate Professor, Ph.D. Massachusetts Institute of Technology, 2003  
Condensed matter theory, strongly correlated systems  
seidel@physics; x5-8933; Compton 355

Stuart A. Solin  
Charles M. Hohenberg Professor, Ph. D., Purdue University, 1969  
Experimental solid state physics and materials science  
solin@wuphys; x5-5605; Crow 209  
http://www.physics.wustl.edu/~solin/

Wai-Mo Suen  
Professor, Cal Inst Technology, 1985  
General relativity; cosmology; theoretical astrophysics  
wms@wuphys; x5-5843; Compton 373  
http://wugrav.wustl.edu/People/SUEN/HOME.html

Yan Mei Wang  
Assistant Professor, Ph.D., Univ. of California 2002  
Experimental biophysics; single-molecule imaging  
ymwang@wuphys; x5-7478; Crow 213

Ralf Wessel  
Associate Professor, Ph.D., Univ. of Cambridge, 1992  
Biophysics  
rw@wuphys; x5-7976; Crow 216  
http://wuphys.wustl.edu/Fac/Wessel.html

Yang, Li  
Assistant Professor, Ph.D., Georgia Inst. Technology, 2006; Theoretical condensed matter  
lyang@physics; x5-9453, Compton 369
Research Faculty

Matthias Beilicke  
Research Professor, Ph.D., Univ. of Hamburg, 2006  
Experimental High Energy Astrophysics  
beilicke@physics; x5-6254, Compton 272

W. Robert Binns  
Research Professor, Ph.D., Colorado State U., 1969  
Astrophysics; medical and health physics  
wrb@wuphys; x5-6247, x5-8553; Compton 252  
http://www.physics/mcdonnell/binns.html

Slava Bugaev  
Research Professor, Ph.D., Altai State U. 1997  
Experimental High Energy Astrophysics  
bugaev@wuphys; x5-4748, Compton 251

Christine Floss  
Research Associate Professor, Ph.D. Wash U. 1991  
Space physics; cosmochemistry  
floss@wuphys.wustl.edu; x5-6206; Compton 456

Daniel J. Leopold  
Research Associate Professor, Ph.D., Wash.U., 1983  
Semi-conductor physics; electro-optics; materials science; magnetic resonance  
leopold@wuphys; x5-6277; Crow 118

Alex Meshik  
Research Professor, Ph.D., Vernadsky Institute Moscow, 1988  
Space Physics; rare-gas mass spectrometry  
am@wuphys.wustl.edu; x5-5049; Compton 455

Ernst Zinner  
Research Professor, Ph. D., Washington Univ., 1972  
Experimental space science; extraterrestrial materials; astrophysics  
ekz@wuphys; x5-6240; Compton 453  
http://www.physics/mcdonnell/zinner.html

Joint Professors

Lee G. Sobotka  
Professor (Chemistry); Ph.D.; Berkeley, 1982  
Nuclear physics
Shankar Sastry  Professor (Mechanical Engineering); Toronto, 1974
Materials science; metallurgy
smls@mecf; x5-4869; Jolley 305

Staff

Biondo, Anthony  Machine shop, x5-6209, Compton 143, amb@wuphys
Trower, Linda  Secretary 4th floor Compton, x5-6257, Compton 458, trower@physics
Crone, Stanley  Course demonstrations, x5-6255, Crow 202, stan@wuphys
Devine, Tammy  Accounting, x5-6259, Compton 244, tdevine@physic
Flanigan, Dan  Introductory Physics lab coordinator, x-5-6286, Crow 307
Hall, David  Academic/Business administrator, x5-6281, Compton 242, dhall@physics
Hamilton, Julia  Secretary graduate program, x5-6250, Compton 242, jmh@wuphys
Handley, Scott  Advance lab coordinator & Webmaster, x5-6261, Compton 167, smh@wuphys
Hardt, Todd  Machine shop supervisor, x5-6209, Compton 143, tah@wuphys
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Physics Office  Compton 242; x5-6276
Observatory  Crow 501; x5-6278
Library  Compton 340; x5-6215
Fax  x5-6219
Security

Access to Compton and Crow after hours is controlled by a magnetic pass card system. Physics majors with proper authorization from their faculty advisors may be added to the Access List in the Department Office (Compton 242). Access to the library outside of regular working hours and to Crow 302, 303, and 305 at all times is controlled by a magnetic pass card system that records the entrant's name.

Observatory

The Washington University Observatory houses an historic six-inch reflector and is located on the top of Crow Hall. The observatory is open for general viewing, 7 – 10 p.m., every clear weeknight Monday through Thursday, and is closed over the weekend. (During those months with daylight savings time, opening is delayed until 8 p.m.) Access is through the south door of Crow Hall, following the signs up through the 4th floor. With the urban atmosphere and the modest size of our telescope, viewing is best for the Moon, planets and the brightest stars. For information or to arrange for a group visit, call (314) 935-6250. At night call (314) 935-6278.
Form to Report the Intent to Present a Senior Thesis

Your Name:

________________________________

Proposed Title:

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_____________________________________________________________

Name of faculty advisor(s):
(in case of an extramural research project, please list the name of the faculty advisor inside the Physics department, and the name and contact information (telephone number and email address) of the external research advisor):