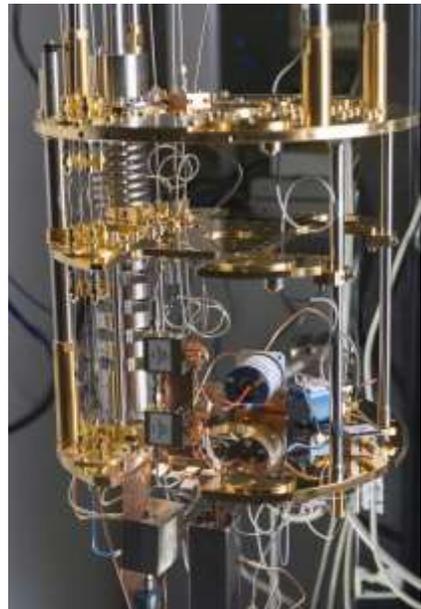
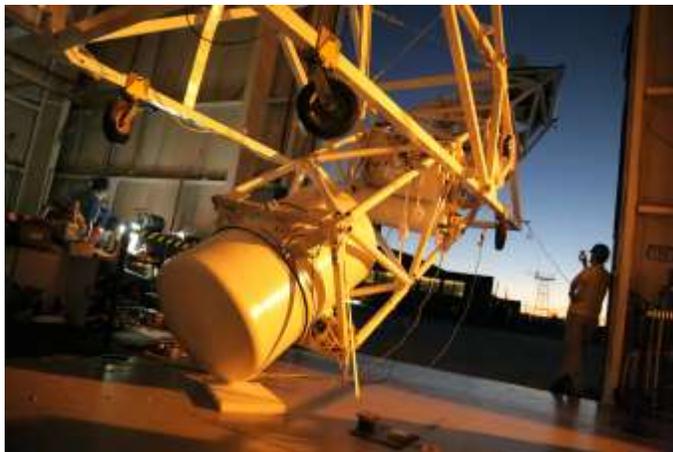


Washington University in St. Louis

Department of Physics

Handbook for Majors and Minors



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The remaining courses can be selected from the other courses offered by the Department, including some at the 500 level. Programs can be tailored to individual needs and interests and should be chosen in consultation with your major advisor. Grades in the seven courses must be C- or better.

Science breadth requirements

Because the physical sciences are inherently interdisciplinary the science-breadth requirement consists of courses in other science departments which complement the Physics curriculum.

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 | (3 units) |
| • General Chemistry II | Chem 112 | (3 units) |
| • General Chemistry Lab I | Chem 151 | (2 units) |
| • General Chemistry Lab II | Chem 152 | (2 units) |
| • Physical Chemistry I | Chem 401 | (3 units) |
| • Physical Chemistry II | Chem 402 | (3 units) |
| • Instrumental Methods: Physical Chemistry | Chem 445 | (3 units) |
| • Computer Science I | CSE 131 | (3 units) |
| • Computer Science II | CSE 132 | (3 units) |

Mathematics and Computing

A good foundation in mathematics and well-developed computer skills are needed for a successful career in physics today. The Physics Department recommends familiarity with at least one modern programming language.

Mathematics requirements

To complete a major in Physics, students must take or place out of Calculus I, II, and III (Math 131, 132, 233); or Math 203 and 204. Students must also take or place out of Differential Equations (Math 217). Concurrent enrollment in, completion or placement out of Calculus I (Math 131) or Math 203 is required for enrollment in Physics 117A and Physics 197. Depending on your interests and future plans, additional math courses may be appropriate.



This information is also available in the Arts & Sciences Undergraduate bulletin:

<http://bulletin.wustl.edu/artsci/physics/#majors>.

Requirements for the Minor in Physics

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

In addition to calculus-based introductory physics, students must also take:

- Introduction to Quantum Physics I Physics 217 (3 units)
- Introduction to 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 341, 342, 441, 442, 499 and 500) with a grade of C- or better. 17 units required.

Mathematics requirements

Concurrent enrollment in, completion or placement out of Calculus I (Math 131) or Math 203 is required for enrollment in Physics 117A and Physics 197. Calculus II is also necessary to provide adequate preparation for Physics 217/318 (Quantum Physics I, II). Note that for some advanced courses Calculus III (Math 233) and Differential Equations (Math 217) are pre-requisites.

Advisor: Patrick Gibbons (935-6271, pcg@physics.wustl.edu)

Requirements for the Astrophysics and Astroparticle Physics Minor

The department offers a minor in Astrophysics and Astroparticle Physics. Astrophysics deals with observing celestial phenomena and explaining them based on physical laws and/or deriving new physical laws with the help of celestial phenomena. Astroparticle physics focuses on using the cosmos as a laboratory for doing particle physics and for testing and expanding particle physics theories. 20 units required.

Physics requirements

In addition to calculus-based introductory physics, students must also take:

- Introduction to Quantum Physics I Physics 217 (3 units)
- Introduction to Astrophysics Physics 312 (3 units)

The minor also requires at least two of the following six electives:

- Introduction to Quantum Physics II Physics 318 (3 units)
- Stellar Astrophysics Physics 456 (3 units)
- X-Ray and Gamma-Ray Astrophysics Physics 460 (3 units)
- Introduction to Nuclear & Particle Physics Physics 474 (3 units)
- Astrophysics Physics 476 (3 units)
- From Black Holes to the Big Bang Physics 478 (3 units)

Mathematics requirements (see Physics Minor)

Advisor: Henric Krawczynski (935-8553, krawcz@physics.wustl.edu)

Requirements for the Biomedical Physics Minor

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. 17 units required.

Physics requirements

In addition to calculus-based introductory physics, students are also required to take two courses from the following five:

- Physics of the Heart Physics 314 (3 units)
- Physics of the Brain Physics 350/450 (3 units)
- Introduction to Biomedical Physics Physics 351 (3 units)
- Physics of Living Systems Physics 354/454 (3 units)
- Physics of Vision Physics 355/455 (3 units)

One advanced laboratory course is required. Any of the following five courses can be chosen:

- Optics & Wave Physics Lab Physics 316 (3 units)
- Electronics Lab Physics 321 (3 units)
- Physical Measurements Lab Physics 322 (3 units)
- Biophysics Lab Physics 360 (3 units)
- Nuclear & Radiochemistry Lab Physics 435 (3 units)

Mathematics requirements (see Physics Minor)

Advisor: Zohar Nussinov (935-6272, zohar@physics.wustl.edu)



This information is also available in the Arts & Sciences Undergraduate Bulletin:
<http://bulletin.wustl.edu/artsci/physics/#minors>.

The Physics Major

The A.B. degree in Physics is awarded by the College of Arts and Sciences. The physics courses build on each other and it is therefore important to take them in the right order.

Freshman and Sophomore Years

All students interested in majoring in the Physical Sciences as well as pre-medical students are strongly encouraged to take two semesters of calculus-based introductory physics (Physics 117A/118A or Physics 197/198) in their freshman year.

In the sophomore year, most physics majors take Introduction to Quantum Physics I and II (Physics 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. Two common paths for the first two years of a Physics major are listed below. Students are encouraged to take the courses in the order presented.

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:

1st year Fall	Credits	1st year Spring	Credits
Phys 197 (Phys I)	4	Phys 198 (Phys II)	4
Math 132 (Calculus II)	3	Math 233 (Calculus III)	4
Chem 111 (Gen. Chem I)	3	Chem 112 (Gen. Chem II)	3
Chem 151 (Chem Lab)	2	Chem 152 (Chem Lab)	2
Elective or English Comp	3	Elective or English Comp	3
2nd year Fall	Credits	2nd year Spring	Credits
Phys 217 (Quantum Phys I)	3	Phys 318 (Quantum Phys II)	3
Upper Level Physics Lab	3	Phys 411 (Mechanics)	3
Math 217 (Diff. Eq.)	4	ESE 318 (Engineering Math A)	4
Electives	6	Electives	6

Students are encouraged to sample other introductory science courses during their first two years.

Pre-medicine students majoring in Physics

Students can fulfill the pre-medicine requirements while pursuing a Major in Physics. 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. In particular, general chemistry could be put off until the sophomore year.

1st year Fall	Credits	1st year Spring	Credits
Phys 197 (Phys I)	4	Phys 198 (Phys II)	4
Math 132 (Calculus II)	3	Math 233 (Calculus III)	4
Chem 111 (Gen. Chem I)	3	Chem 112 (Gen. Chem II)	3
Chem 151 (Chem Lab)	2	Chem 152 (Chem Lab)	2
Elective or English Comp	3	Elective or English Comp	3
2nd year Fall	Credits	2nd year Spring	Credits
Phys 217 (Quantum Phys I)	3	Phys 318 (Quantum Phys II)	3
Math 217 (Diff. Eq.)	4	Bio 2960 (Princ. Biology I)	4
Chem 261 (Org. Chem I with Lab)	4	Chem 262 (Org. Chem II with Lab)	4
Phys 3XX (Biological Phys)	3	Elective	3
Elective	3		

Junior and Senior Years

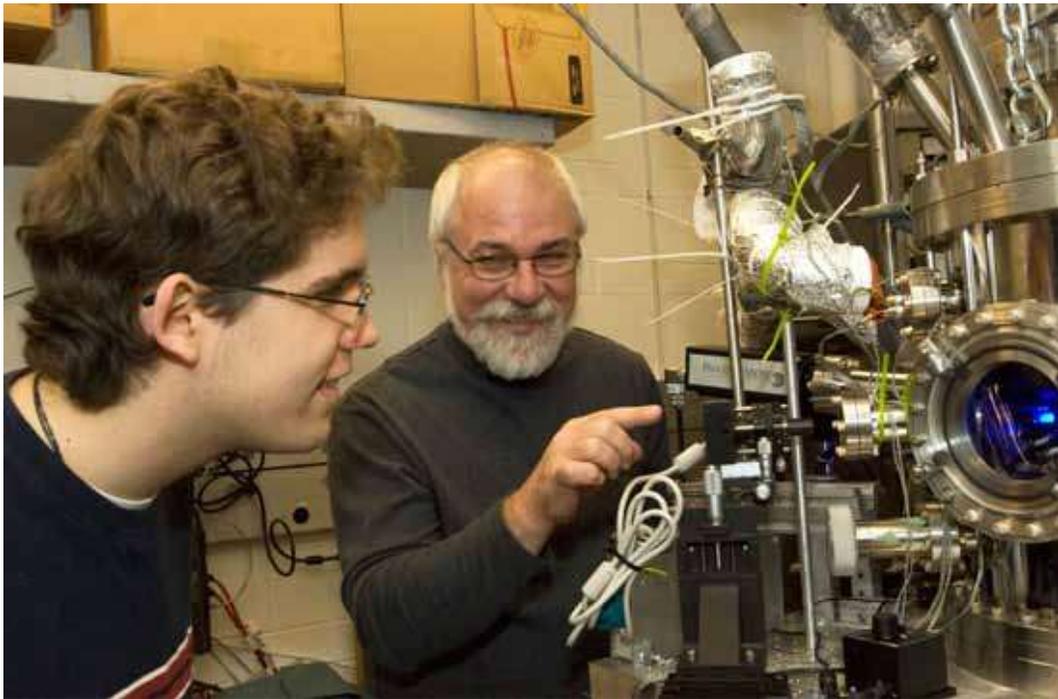
Students Preparing for Graduate School in Physics

During your senior year, advanced courses are available to prepare you for graduate school. A typical program is shown below assuming that Mechanics (Physics 411) was taken in the spring of the sophomore year (can also be taken junior year).

3rd year Fall	Credits	3rd year Spring	Credits
Phys 421 (Elect & Mag I)	3	Phys 422 (Electr & Magn II)	3
Phys 321 (Electronics Lab) or	3	Phys 322 (Phys Meas Lab)	3
Phys 463 (Stat Mech & Thermo) or		Science, Math, or Phys course	3
Phys 471 (Quantum Mech I)		Electives	6
Science, Math, or Phys course	3		
Electives	6		

Some courses such as Physics 472 (Introduction to Solid State Physics) and Physics 474 (Introduction to Nuclear & Particle Physics) have Physics 471 as a prerequisite, and are not necessarily offered every year. Physics 501/502 (Methods of Theoretical Physics I/II) and many other graduate level courses are available. Students preparing for graduate school in physics should take more physics courses than the minimum required for the major, including 422, 463, and 471. Consult your major advisor for advice on courses that will best prepare you for your future studies.

Students interested in graduate school are strongly advised to do an undergraduate research project (see [Research Projects for Undergraduates](#) in this handbook). This will help you to confirm that you like doing research. Furthermore, knowing you from a research project will allow your research advisor to write you a strong recommendation letter. Your undergraduate research advisor, faculty advisor or course instructor 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 Preparing for Graduate School in Astrophysics and Astroparticle Physics

Although the department does not offer a major in astrophysics, the regular physics major can be tailored so that interested students get an excellent preparation for a PhD program in astrophysics and astroparticle physics.

Interested majors should take Intro Astrophysics (Physics 312) in the fall semester of their third year, followed by one or more 400-level astrophysics electives, i.e. Galactic Astrophysics (Physics 446), Stellar Astrophysics (Physics 456), X-Ray and Gamma-Ray Astrophysics (Physics 460), Introduction to Nuclear & Particle Physics, (Physics 474), Astrophysics (476), and From Black Holes to the Big Bang (Physics 478). Doing a research project in one of the many astrophysics groups in the department is highly recommended.

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:

3rd year Fall	Credits	3rd year Spring	Credits
Phys 360 (Biophysics Lab)	3	Phys 314 (Phys of the Heart)	3
Phys 421 (Electr. & Magn I)	3	Phys 322 (Phys Meas Lab)	3
Bio 2970 (Princ. Biol II)	4	Phys 411 (Mechanics)	3
Electives	6	Electives	6

In the senior year at least one additional course, for example Physics 350 (Physics of the Brain), Physics 351 (Introduction to Biomedical Physics), Physics 352 (Physics of Biomolecules), or Physics 355 (Physics of Vision). Physics 427 (Intro Computational Physics), Physics 463 (Statistical Mechanics & Thermodynamics), and Physics 471 (Quantum Mechanics I) are also relevant courses to complement your program.

Students preparing for employment after the A.B.

Students who are not planning to continue to a graduate program in physics are encouraged to take additional laboratory courses such as the following:

Physics 316	Optics & Wave Physics Lab
Physics 321	Electronics Lab
Physics 322	Physical Measurement Lab
Physics 360	Biophysics Lab
Physics 435	Nuclear & Radiochemistry Lab

Other courses that have particular relevance are:

Physics 314	Physics of the Heart
Physics 350	Physics of the Brain
Physics 351	Introduction to Biomedical Physics
Physics 352	Physics of Biomolecules
Physics 355	Physics of Vision
Chemistry 401	Physical Chemistry I
Physics 422	Electricity & Magnetism II
Chemistry 436	Radioactivity & Applications
Physics 463	Statistical Mechanics & Thermodynamics
Physics 471	Quantum Mechanics I
Physics 472	Introduction to Solid State Physics

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

The American Institute of Physics provides useful information in its publications and reports, as well as a career resources on its web site <https://www.spsnational.org/career-resources>. The College of Arts and Sciences, through its Career Center, also provides information, support and advice.



Double Majors

Many students have the interest and ability to major in two subjects. This takes some planning, and should be discussed with your advisor.

Upper Level Laboratories

Laboratory courses provide hands-on opportunities for students to connect experimental observations with the knowledge and mathematical formalism obtained in traditional lecture courses.

All majors are required to take Physical Measurements Lab (Physics 322), and at least one other upper level lab course. Students who double major in Electrical Engineering (EE) and Physics need not take Physics 321 (Electronics Lab), but instead should take either Optics & Wave Physics Lab (Physics 316) or Biophysics Laboratory (Physics 360). EE lab courses are not acceptable as substitutes for Physics 321.



The upper level laboratory courses are:

- Optics & Wave Physics Lab (Physics 316) - The optics course provides the student with an introduction to ray and wave optics. Given the explosion of interest in optics driven by light-wave (fiber optic) communication, the optics laboratory is an important course.
- Electronics Lab (Physics 321) - The electronics laboratory aims to make the student capable of using electronic circuitry and instruments.
- Physical Measurements Lab (Physics 322) – In the physical measurements laboratory the student chooses from relatively sophisticated experiments, including: nuclear magnetic resonance, diode laser spectroscopy, positronium decay, superconductivity and other low temperature phenomena, ultrasonics, x-ray scattering, and scanning tunnel microscopy. The experiments in this course are pursued in greater depth than in the other laboratory courses, giving the student some of the feel of actual research.
- Biophysics Laboratory (Physics 360) - 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.
- Nuclear & Radiochemistry Lab (Physics 435) - The radiochemistry lab explores the role of nuclear physics in scientific and biological applications.

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. 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 encouraged to participate in research at all levels of their undergraduate career. 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, or can be rewarded with an hourly salary. Many professors welcome students interested in doing research for one semester or several semesters. Please note that research requires a substantial time investment. Research done while classes are in session typically requires between 6 and 12 hours per week. Summer research can take up to 40 hour per week. Your research findings may be summarized in a report, presented at a conference or published in a Physics journal. Students in their senior year are encouraged to do a senior thesis or an honors thesis. See information on following page.

The next step is either to directly contact professors whose research interests you, or to schedule a meeting with Professor Bhupal Dev (bdev@physics.wustl.edu) who will advise you about research opportunities that match your interests. All students wishing to do a research project should directly contact the advising professor to discuss possible research projects. A good preparation for this meeting is to read about the professor's research and to bring a resume and/or a list of courses completed along with any relevant skills.

To find the research group which is right for you, investigate the descriptions on the departmental research web site (<https://www.physics.wustl.edu/undergraduate/research-projects>) or sign up for Physics 582 Research Seminar.

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.

Undergraduate Research Fellowships

There are several summer research fellowships and an academic year fellowship that are awarded to support Washington University physics undergraduates doing research within one of the department's research groups. Each spring, applications are solicited, and selections are made by a joint committee. For more detailed information and deadlines, please refer to http://www.physics.wustl.edu/undergraduate/fellowships_prizes.

Courses Available 2017-2018

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 2017

<u>Course No</u>	<u>Course Name</u>
Physics 117A	General Physics I
Physics 197	Physics I
Physics 217	Intro to Quantum Physics I
Physics 312	Intro to Astrophysics
Physics 321	Electronics Lab
Physics 355	Physics of Vision
Physics 354	Physics of Living Systems
Physics 360	Biophysics Lab
Physics 400	Physical Science in 12 Problems
Physics 421	Electricity & Magnetism I
Physics 435	Nuclear and Radiochemistry Lab
Physics 446	Galactic Astrophysics
Physics 463	Stat Mech & Thermodynamics

Spring Semester 2018

<u>Course No</u>	<u>Course Name</u>
Physics 118A	General Physics II
Physics 198	Physics II
Physics 216	Intro Relativity
Physics 314	Physics of the Heart
Physics 316	Optics Lab
Physics 318	Intro Quantum II
Physics 322/452	Physics Measurements Lab / Adv Lab II
Physics 411	Mechanics
Physics 422	Electricity & Magnetism II
Physics 436	Intro Atomic Nucleus
Physics 472	Intro Solid State
Physics 474	Intro to Particle Physics
Physics 456	Stellar Astrophysics

The Department offers several courses that do not form part of the major requirements. These include for the academic year 2016/17:

Fall Semester 2017

Physics 125A	Solar System
Physics 171A	Physics and Society

Spring Semester 2018

Physics 126A	Stars, Galaxies, Cosmology
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Although mostly non-science majors take these courses, there is enough interesting material in Physics 125A, 126A, and 171A to warrant attention from science majors. Physics 171A is also cross-listed as Environmental Studies 272A.

Advising

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:



<u>Professor</u>	<u>Office</u>	<u>Telephone</u>	<u>e-mail</u>
James Buckley	Compton 253	935-7607	buckley@wuphys.wustl.edu
Francesc Ferrer	Compton 368	935-7982	ferrer@physics.wustl.edu
Patrick Gibbons	Compton 366	935-6271	pcg@wuphys.wustl.edu
Erik Henriksen	Compton 377	935-7487	henriksen@physics.wustl.edu
Zohar Nussinov	Compton 353	935-6272	zohar@physics.wustl.edu
Michael Ogilvie	Compton 356	935-6256	mco@wuphys.wustl.edu
Ryan Ogliore	Compton 455	935-6140	rogliore@physics.wustl.edu
Alexander Seidel	Compton 355	935-8933	seidel@physics.wustl.edu
Li Yang	Compton 369	935-9453	lyang@physics.wustl.edu

General advice is contained in this handbook but all physics majors are strongly encouraged to discuss their plans for the major with their advisor in great detail.

Latin Honors and Senior Honors Thesis

Physics majors can earn Latin Honors and Departmental distinctions. The eligibility criteria are described at the website: <http://bulletin.wustl.edu/artsci/physics/#majors>. Note that completion of undergraduate research and writing of a senior thesis are prerequisites for the higher departmental distinctions. See <http://www.physics.wustl.edu/undergraduate/senior-honors-thesis> for detailed information and a form for applying for a senior thesis.

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 (Physics 117-118, Physics 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.

The Nishi Luthra Senior Prize

Each year, the selection is based on performance in physics courses and is made by the department's major advisors. Drs. Chaman and Adarsh Luthra established the Nishi Luthra Prize in Physics in memory of their daughter, Nishi. This Prize is awarded in a ceremony in the Department after Commencement.



Society of Physics Students

The Washington University chapter of the Society of Physics Students (SPS) is a student-run organization that promotes interest in science and provides opportunities for under-graduates 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, <http://www.spsnational.org>.

SPS Advisor: Dr. Kater Murch (murch@physics.wustl.edu).

Putnam Mathematical Competition

Professor Bender of the Physics Department and Professor Kerr 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 with free pizza in the fall semester. If you would like to learn techniques of problem solving and would enjoy interacting with this peer group of bright students, you are invited to attend the practice sessions.

In December 2016, 4,275 students from 554 colleges and universities throughout North America participated in the contest, which is held each year on the first Saturday in December. The Putnam consists of two three-hour sessions, during each of which competitors work on six problems.

The Washington University team finished thirteenth overall. The three members of the Washington University team were Alex Mason, a junior majoring in mathematics and a minor in physics in Arts & Sciences; Patrick Chao, a senior majoring in mathematics in Arts & Sciences; and Caleb Ji, a sophomore majoring in mathematics in Arts & Sciences.



More information about the Putnam competition can be found at: <http://math.scu.edu/putnam/>.

Security

Access to Compton and Crow after hours is controlled by a magnetic pass card system using the student ID card. 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 also controlled by the magnetic pass card system that records the entrant's name.

Useful Links

- Physics Department: <https://www.physics.wustl.edu>
- Description of the department's research: http://physics.wustl.edu/areas_current_research
- Description of the department's research centers (including the Institute for Materials Science and Engineering (IMSE) and the McDonnell Center for the Space Sciences): http://physics.wustl.edu/research_centers.

Physics Library

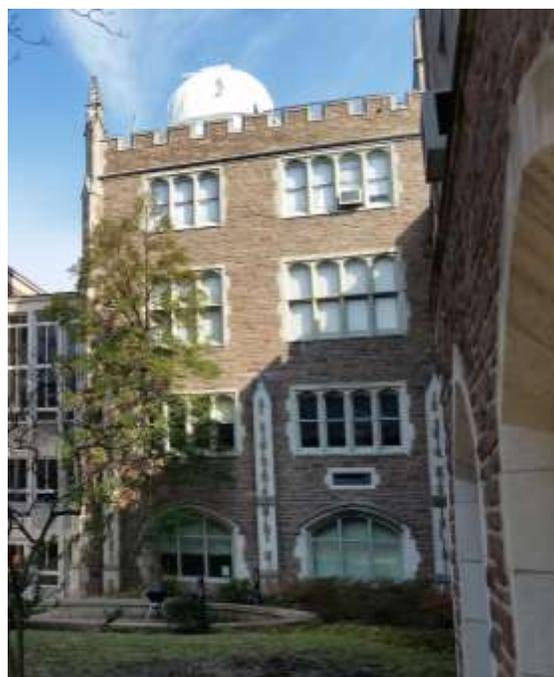
The Pfeiffer Physics Library is located on the third floor of Compton Hall. This is an outstanding facility, with subscriptions to thousands of journals and an extensive book collection. Course books are placed on reserve in the Physics Library office. The Librarian is available during normal hours to provide professional



help and students who have declared as physics majors are given 24 hour access to the Physics Library's collection and reading room.

Observatory

The Washington University Observatory houses an historic six-inch telescope 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) 935-6276. At night call (314) 935-6278.



Physics Office
Observatory
Library

Compton 242; 935-6276; FAX 935-6219
Crow 501; 935-6278
Compton 340; 935-6215

FACULTY

Alford, Mark G., Professor, PhD, Harvard, 1990. Chair of Department of Physics. Quantum field theory and particle physics; color superconductivity.
alford@wuphys.wustl.edu; 935-5034; Compton 358

Bender, Carl M., Professor, PhD, Harvard, 1969. Theoretical physics; mathematical physics; particle physics.
cmb@wuphys.wustl.edu; 935-6216; Compton 360

Buckley, James H., Professor, PhD, Chicago, 1994. High-energy astrophysics, gamma-ray astronomy; direct detection of dark matter.
buckley@wuphys.wustl.edu; 935-7607; Compton 253

Carlsson, Anders E., Professor, PhD, Harvard, 1981. Theoretical biophysics of cells.
aec@wuphys.wustl.edu; 935-5739; Compton 370

Cowsik, Ramanath, Professor, PhD, Bombay, 1968. Director of the McDonnell Center for the Space Sciences. Theoretical astrophysics; dark matter; experimental astroparticle physics, experimental gravitation.
cowsik@wuphys.wustl.edu; 935-4493, Compton 473

Dev, Bhupal, Assistant Professor, PhD, Maryland, 2012. Elementary particle physics, particle astrophysics, cosmology, and theoretical physics.
bdev@physics.wustl.edu, 935-5843, Compton 373

Dickhoff, Willem H., Professor, PhD, Free University of Amsterdam, 1981. Theoretical physics; many-particle theory, nuclear physics.
wimd@wuphys.wustl.edu; 935-4169; Compton 371

Duvvuri, Vikram, Lecturer, Ph.D., Chicago, 2005, General relativity & cosmology (theory); physics education.
vduvvuri@physics.wustl.edu, 935-9305, Crow 211

Errando, Manel, Lecturer, Ph.D., Universitat Autònoma de Barcelona, 2009. High energy astrophysics.
errando@physics.wustl.edu, Compton 156

Ferrer, Francesc, Associate Professor, PhD, Universitat Autònoma de Barcelona, 2001. Particle cosmology; the nature of dark matter and dark energy.
ferrer@physics.wustl.edu; 935-7982; Compton 368

Gibbons, Patrick C., Professor Emeritus, PhD, Harvard, 1971. Solid-state physics, electron scattering.
pcg@wuphys.wustl.edu; 935-6271; Compton 366

Henriksen, Erik, Assistant Professor, PhD, Columbia, 2008. Solid state physics, electronic structures of layered graphene.
henriksen@physics.wustl.edu; 935-7487; Compton 377

Hynes, Mairin, Senior Lecturer, Ph. D., Washington (St. Louis), 2010. Physics education.
khynes@physics.wustl.edu; 935-4495; Crow 214

Israel, Martin H., Professor, PhD, Caltech, 1968. High-energy astrophysics, cosmic-ray and neutrino astronomy.
mhi@wuphys.wustl.edu; 935-6263; Compton 250

Katz, Jonathan I., Professor, PhD, Cornell, 1973. Theoretical astrophysics: applied physics, fast radio bursts, climate change.
katz@wuphys.wustl.edu; 935-6202; Compton 267

Kelton, Kenneth F., Professor, PhD, Harvard, 1983. Experimental solid-state physics and materials science.
kfk@wuphys.wustl.edu; 935-6228, 935-4654; Compton 354

Krawczynski, Henric, Professor, PhD, Hamburg, 1997. High-energy astrophysics; gamma-ray astronomy, x-ray astronomy.
krawcz@wuphys.wustl.edu; 935-8553, Compton 254

Miller, James G., Professor, PhD, Washington (St. Louis), 1969. Ultrasonics; biomedical physics; elastic properties of inhomogeneous media.
jgm@wuphys.wustl.edu; 935-6229; Compton 169

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