

School of Arts and Science

# PHYSICS & PHYSICS AND ASTRONOMY

www.phyast.pitt.edu

Physics and astronomy are the study of those laws of nature which govern the entire range of physical phenomena. Beginning at the subatomic level, and on to the universe at large, physicists and astronomers explore and attempt to explain the sequence of events surrounding us.

The physics and astronomy program at the University of Pittsburgh offers you the flexibility to prepare yourself for the varied opportunities in the science world. You may want to make a career of physics, as a research worker, as a teacher, or as an applier of physics to problems outside of physics itself. If the stars interest you, Pitt's program is designed to give the right balance of training for students interested in careers in astronomy. On the other hand, you may want to understand the fundamental principles of physics and astronomy, and the ways in which research scientists work, not to prepare for a career in science or technology, but as background for the many other fields where science and technology have an important impact. Even if you are planning careers in other fields, such as medicine, law or history, or philosophy of science, majoring in physics or/and astronomy as an undergraduate provides you with a rich background in basic science and the rigorous habits of thought that stem from such training.

The University of Pittsburgh also has unique opportunities to offer a physics and/or astronomy major. The department's Allegheny Observatory is located only a short distance from the campus and houses the Thaw refractor, one of the world's finest telescopes for astrometrical research. Pitt students can also obtain access to the Pittsburgh Supercomputing Center. Undergraduates in this program also have the opportunity to conduct their own original research.

The career options for a physics major are endless. Job opportunities exist in universities and colleges worldwide, museums, planetariums, various industries, the federal government, airports, NASA, the military, and non-profit research centers and foundations.

The Physics and Astronomy program offers three degree options: a B.S. in Physics, a B.S. in Physics and Astronomy, and a B.A. in Physics and Astronomy as well as an honors program in Physics and an honors program in Physics and Astronomy.

1. **Requirements for a B.S. in Physics.** A B.S. in Physics gives a broad background in all of physics with enough depth to enable the graduate to seek employment at the bachelor's level.

*Choose one of the following two physics sequences:*

PHYS 0174 and 0175 Basic Physics for Science and Engineering (three credits)

This is a two-term introduction to both classical and modern physics with the use of calculus.

PHYS 0475 and PHYS 0476 Honors Introductory Physics for Science and Engineering (three credits)

This course is the honors version of PHYS 0174 and 0175. The topics covered include waves, thermodynamics, relativity, and electricity.

PHYS 0219 Basic Laboratory Physics for Science and Engineering (two credits)

An introductory laboratory associated with Physics 0104, 0105 and 0106. Experiments from many areas of physics are performed.

PHYS 1150 Mechanics (three credits)

Classical mechanics with vector calculus and differential equations as tools of analysis.

PHYS 0160 Electricity and Magnetism (three credits)

Electromagnetic theory is formulated with the use of vector calculus.



PHYS 0167 Undergraduate Seminar (zero credit)

An informal, weekly meeting on various topics of interest.

PHYS 0368 Wave Motion and Optics (three or four credits)

This class is an intermediate course that includes a laboratory.

PHYS 1119 Principles of Modern Physics I (three credits)

A survey of basic principles of relativity and quantum physics with applications to the physics of atoms.

PHYS 1120 Principles of Modern Physics II (three credits)

This course is a continuation of Physics 1119 and includes treatments of multi-electron atoms, molecules, solids, nuclei, and particles.

PHYS 1225 Modern Electronics (three credits)

This class is a laboratory course in semiconductor electronics.

PHYS 1226 Modern Physics Laboratory (two or three credits)

This course provides an introduction to the research laboratory environment.

PHYS 1151 Computational Methods in Physics (three credits)

This course will cover problems solving techniques using a computer.

PHYS 1141 Thermodynamics and Statistical Mechanics (three credits)

This course presents the properties of matter as described by thermodynamics, in which atomic structure is irrelevant, and by statistical mechanics, which is based on an atomic point of view.

MATH 0220 Analytic Geometry and Calculus 1 (four credits)

This course covers the derivative and integral of functions of one variable and their applications. It includes a computer lab where you apply numeric, algebraic and graphing technologies to calculus problems.

MATH 0230 Analytic Geometry and Calculus 2 (four credits)

This course covers the calculus of transcendental functions, techniques of integration, series of numbers and functions, polar coordinates and conic sections. It also includes a computer lab where you continue to solve problems applying various programs.

MATH 0240 Analytic Geometry and Calculus 3 (four credits)

This course covers vectors and surfaces in space and the calculus of functions of several variables including partial derivatives and multiple integrals, Stokes' Theorem and first order differential equations.

MATH 0250 Matrix Theory and Differential Equations (four credits)

This course's main subject is ordinary differential equations. Topics include first order differential equations, higher order linear differential equations and systems of first order linear and nonlinear differential equations.

**Choose one of the following sequences:**

CHEM 0110 and 0120 General Chemistry 1 and 2 (four credits)

This is a general chemistry sequence. The class covers topics from stoichiometry to nuclear chemistry.

CS 0401 and 0445 Intro to Computer Science (three to four credits)

These courses introduce students to fundamental topics in computer science.

**Honors B.S. in Physics.** This degree gives the student additional depth in physics to enable him or her to go on to graduate school in the field.

The following courses are added to the standard B.S. program:

PHYS 1170 and PHYS 1171 Introduction to Quantum Physics (three credits each)

PHYS 1172 Electromagnetic Theory (three credits)

MATH 1550 Vector Analysis and Applications (three credits)

MATH 1560 Complex Variables and Applications (three credits)

*Although it is not required, the introductory-level honors course and the honors laboratory are particularly appropriate for honors majors. PHYS 1173, Mathematical Methods in Physics (three credits), is also strongly recommended as an elective for students in this program.*

2. **Requirements for a B.S. in Physics & Astronomy.** The B.S. in physics and astronomy is designed for the student whose interests and career goals point more toward astronomy or related areas of space science.

The requirements of a B.S. in Physics & Astronomy are as follows:

PHYS 0174, 0175 or PHYS 0475, 0476 Physics for Science and Engineering

PHYS 0219 Basic Laboratory Physics for Science and Engineering

PHYS 0160 Intermediate Electricity and Magnetism

PHYS 0167 Undergraduate Seminar

PHYS 0368 Wave Motion and Optics

PHYS 1150 Mechanics

PHYS 1151 Computational Methods

PHYS 1119 and 1120 Principles of Modern Physics 1 and 2  
PHYS 1225 Analog and Digital Electronics  
MATH 0220, 0230, 0240 Analytic Geometry and Calculus 1, 2, 3  
MATH 0250 Matrix Theory and Differential Equations  
CHEM 0110, 0120 General Chemistry 1 and 2 OR CS 0401, 0445 Introduction to Computer Science  
ASTR 0113 Introduction to Astronomy (three credits)

An introduction to the study of the solar system, stars, galaxies, extragalactic objects and the universe at large.

ASTR 1120 Stars, Stellar Structure and Stellar Evolution (three credits)

This course is a study of the properties, formation, structure and evolution of stars.

ASTR 1121 Galaxies and Cosmology (three credits)

You will study the nature of our Milky Way Galaxy, objects outside the galaxy and the structure/evolution of the universe.

ASTR 1263 Techniques of Astronomy (three credits)

This course offers an introduction to the use of astronomical instruments and techniques to process and analyze data.

GEOL 1701 Geology of the planets (three credits)

You will examine the morphology and nature of the features found on the surfaces of the planets and discuss the processes by which they were formed, along with our present understanding of the reasons for the similarities and differences.

**Honors B.S. in Physics and Astronomy.** This degree gives the student a background appropriate for graduate study in astronomy or astrophysics.

The following classes are added to the standard B.S. in Physics and Astronomy:

PHYS 1141 Thermodynamics and Statistical Mechanics (three credits)

PHYS 1170 and 1171 Introduction to Quantum Physics (three credits each)

PHYS 1172 Electromagnetic Theory (three credits)

MATH 1550 Vector Analysis and Applications (three credits)

MATH 1560 Complex Variables and Applications (three credits)

**3. Requirements for a B.A. in Physics & Astronomy.** The B.A. in Physics and astronomy provides a liberal education and enables students to understand and evaluate the influence of physics and astronomy on other fields.

PHYS 0174, 0175 or PHYS 0475, 0476 Physics for Science and Engineering (three credits each)

PHYS 0219 Basic Laboratory Physics for Science and Engineering (two credits)

ASTR 0113 Introduction to Astronomy (three credits)

MATH 0220, MATH 0230, MATH 0240 Analytic Geometry and Calculus I, II, and III (four credits each)

PHYS 1119 Principles of Modern Physics (three credits)

PHYS 1120 Principles of Modern Physics II (three credits)

**Two of the Following Upper-level Courses:**

ASTR 1120 Stars, Stellar Structure and Stellar Evolution (three credits)

ASTR 1121 Galaxies and Cosmology (three credits)

ASTR 1263 Techniques of Astronomy (three credits)

GEOL 1701 Geology of the Planets (three credits)

**At Least One Course in History or Philosophy of Science**

Some examples of courses from which you can choose:

HPS 0427 Myth and Science (three credits)

HPS 0620 Science and Religion (three credits)

HPS 1502 Astrology and Witchcraft in 17th Century England (three credits)

### Related Area

You may want to use your elective courses to sample a wide variety of subjects or to concentrate on one or two subjects of particular interest to you. While no specific courses in computer science are required, majors are expected to have acquired some knowledge of simple computer programming by the end of their sophomore year. Physics majors whose interests lie in the applied areas of science often supplement the B.S. program with courses in the School of Engineering.

### The Job Market for graduates with a major in physics or physics and astronomy

Many graduates in physics or physics and astronomy are employed by government or educational institutions as well as by industry in technical jobs, for which their physics, or physics and astronomy training is extremely useful. People in the BA program go into fields where a technical background may be useful (e.g., law, education, administration).

**For more information about the Physics and Astronomy major, contact:**

University of Pittsburgh  
Dr. Regina Schulte-Ladbeck  
417 Allen Hall  
Pittsburgh, PA 15260  
412-624-9013  
E-mail: [rsl@vms.cis.pitt.edu](mailto:rsl@vms.cis.pitt.edu)  
[www.phyast.pitt.edu](http://www.phyast.pitt.edu)

**For more information on other majors, contact:**

University of Pittsburgh  
Office of Admissions and Financial Aid  
4227 Fifth Avenue, Alumni Hall  
Pittsburgh, PA 15260-6601  
412-624-PITT  
E-mail: [oafa@pitt.edu](mailto:oafa@pitt.edu)  
[www.oafa.pitt.edu](http://www.oafa.pitt.edu)

## Special Programs and Opportunities

### Seminar and Society of Physics Students

Although the Undergraduate Seminar (Physics 0167) is required only for upper-class majors in the B.S. programs, all interested students are welcome to these weekly meetings. The Pitt chapter of the Society of Physics Students (SPS) meets jointly with the seminar and the SPS officers organize and run the seminar in consultation with a faculty supervisor. Topics at the seminar range through various areas of current research as well as subjects as employment opportunities. There is also a local chapter of Sigma Pi Sigma, a physics honorary society within the SPS.

### Undergraduate Research

As a means of encouraging students' contact with research, the department grants a number of research assistantships to undergraduates. The assistants work closely with faculty members and advanced graduate students. Occasionally, credit on research publications is given to such assistants. These appointments carry an hourly stipend and are very flexible in working hours, including allowances for heavy exam periods.

### Internships

Having an internship can be one of the most enlightening and productive aspects of your undergraduate education. It not only gives you a closer look at working in a particular field, but can help you gain a competitive edge, make contacts in the marketplace, and earn credits towards your degree. Pittsburgh is an exciting place for internship opportunities: internationally known as a renowned center for health care and ground-breaking medical research; home to many corporate headquarters, including H.J. Heinz, Fisher Scientific, PPG Industries, Westinghouse Electric, and Mellon Bank; and a city with a wealth of cultural and entertainment activities, including three professional sports teams and the Carnegie system of museums. Internships are not limited to Pittsburgh.

### Certificate in Photonics

Students majoring in Physics will learn more about the underlying quantum mechanics and relativity which describes light waves. In their senior year, students will be offered special job placement services for jobs in the photonics industry. Visit [www.phyast.pitt.edu/~snoke/photonics](http://www.phyast.pitt.edu/~snoke/photonics).

### Physics as a Minor

This is a program primarily designed for students who are pursuing a major outside of the School of Arts and Sciences. Requirements are PHYS 0174, 0175, 0219 or PHYS 0475, 0476 and PHYS 1119, 1120.