

# PHYSICS

The Department of Physics offers majors and minors in physics, astronomy, and astrophysics to prepare students for a broad range of careers in these fields and related disciplines.

The Bachelor of Arts degree with a major in physics, astronomy, or astrophysics provides a traditional liberal arts education with a solid set of core courses in the subject area. The Bachelor of Science degree with a major in physics, astronomy, or astrophysics provides a comprehensive curriculum that prepares students for graduate studies or careers in technology, medicine, education, law, finance, industry, and other professions. Interdisciplinary studies are encouraged, and special concentrations are available for physics majors interested in computational physics, pre-health care, or physics education.

All majors and minors are strongly encouraged to attend Physics Colloquium and become involved in undergraduate research. A highly personalized education is provided by professors who are dedicated to undergraduate education with small classes and state-of-the-art laboratories.

## Program Requirements

Any student pursuing a major or secondary major within the Department of Physics (BA or BS, all concentrations) must complete PHY 1420 General Physics I with a grade of "B-" or better in order to enroll in PHY 1430 General Physics II. A student who fails to make a "B-" or better in the course, yet wishes to continue as a major within the Department of Physics, must petition to repeat PHY 1420 General Physics I. Any student pursuing a major or secondary major within the Department of Physics (BA or BS, all concentrations) must complete PHY 1430 General Physics II with a grade of "C" (2.0) or better to enroll in PHY 2350 Modern Physics. A student who fails to make a "C" or better in the course (where "C-" is insufficient), yet wishes to continue as a major within the Department of Physics, must petition to repeat PHY 1430 General Physics II.

Any student pursuing Astrophysics or Astronomy as a major or secondary major must complete PHY 2455 with a grade of "C" (2.0) or better. A student who fails to make a "C" or better in the course (where "C-" is insufficient) yet wishes to continue as a major within the Department of Physics, must petition to repeat PHY 2455.

## Physics

- Physics, B.A. (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/physics/physics-ba/>)
- Physics, B.S. (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/physics/physics-bs/>)
- Physics (Computational Physics), B.S. (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/physics/physics-computational-physics-concentration-bs/>)
- Physics (Prehealth Care), B.S. (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/physics/physics-prehealth-care-concentration-bs/>)
- Physics (Physics Education), B.S. (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/physics/physics-physics-education-concentration-bs/>)
- Physics - Secondary Major (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/physics/physics-secondary-major/>)

- Physics Minor (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/physics/physics-minor/>)

## Astronomy

- Astronomy, B.A. (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/physics/astronomy-ba/>)
- Astronomy, B.S. (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/physics/astronomy-bs/>)
- Astronomy - Secondary Major (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/physics/astronomy-secondary-major/>)
- Astronomy Minor (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/physics/astronomy-minor/>)

## Astrophysics

- Astrophysics, B.A. (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/physics/astrophysics-ba/>)
- Astrophysics, B.S. (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/physics/astrophysics-bs/>)
- Astrophysics - Secondary Major (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/physics/astrophysics-secondary-major/>)
- Astrophysics Minor (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/physics/astrophysics-minor/>)

## Physics (PHY)

### PHY 1125 Finding Success in Physics (1)

New Student Experience (NSE) course that introduces students in physics, astronomy or astrophysics to the benefits and challenges of studying these subjects. Includes an introduction to research areas and strategies for problem solving in physics.

### PHY 1404 Light, Vision and Optics (4)

A conceptual course on the physics of light, optics, photography, vision, color, and other visual phenomena.

### PHY 1405 Everyday Physics (4)

Concepts and historical development of physics; selected topics as they apply to physics encountered in everyday life. This course is not intended for students pursuing a science major. (Does not apply toward a major in physics.)

### PHY 1407 Sound and Acoustics (4)

Physics of sound and sound production, including the nature of sources of sounds. Introduction to the primary instrumentation used in recording, reproduction, and analysis of the physical properties of sound, and a study of the principal physical properties of architectural acoustics.

### PHY 1408 General Physics for Natural and Behavioral Sciences I (4)

Pre-requisite(s): MTH 1320, 1321 or 1322, or equivalent or concurrent enrollment in MTH 1321 or 1322

The fundamentals of mechanics, heat, and sound, with emphasis on physical concepts, problem solving, notation, and units. (PHY 1408 and 1409 or PHY 1420 and 1430 satisfy premedical, pre dental, and liberal arts requirements.)

**PHY 1409 General Physics for Natural and Behavioral Sciences II (4)**

Pre-requisite(s): PHY 1408 or 1420

The fundamentals of electricity, magnetism, light, and modern physics, with emphasis on physical concepts, problem solving, notation, and units. (PHY 1408 and 1409 or PHY 1420 and 1430 satisfy premedical, pre dental, and liberal arts requirements.)

**PHY 1420 General Physics I (4)**

Pre-requisite(s): MTH 1321 or concurrent enrollment

Principles and applications of mechanics, wave motion, sound, and heat with emphasis on fundamental concepts, problem solving, notation, and units.

**PHY 1430 General Physics II (4)**

Pre-requisite(s): PHY 1408 or 1420; and MTH 1322 or concurrent enrollment

Principles and applications of electricity, magnetism, light, and modern physics, with emphasis on fundamental concepts, problem solving, notation, and units.

**PHY 1455 Descriptive Astronomy (4)**

A survey course on the fundamentals of astronomy including night-sky viewing, the history of astronomy, the solar system, stars and galaxies, and the Big Bang cosmology.

**PHY 1V95 Independent Study in Physics (1-3)**

Pre-requisite(s): Consent of instructor

Independent study under the supervision of a faculty member in the department. May be repeated once for credit up to a maximum of six semester hours.

**PHY 1V9R Research (3)**

Pre-requisite(s): Consent of the instructor

Undergraduate research undertaken with the supervision of a faculty member. May be taken for a maximum of 6 hours.

**PHY 2135 Basic Electronics Laboratory (1)**

Pre-requisite(s): PHY 1430

Principles and applications of electrical circuits and electronics for physical science majors.

**PHY 2190 Introduction to Research in Physics (1)**

Pre-requisite(s): PHY 2350

Preparation for undergraduate research. Includes an introduction to research techniques, identification of a research supervisor, and completion of a research prospectus.

**PHY 2350 Modern Physics (3)**

Pre-requisite(s): PHY 1430 and MTH 1322

Special relativity, introduction to quantum mechanics, atomic and molecular structure, nuclear and particle physics.

**PHY 2360 Mathematical and Computational Physics (3)**

Co-requisite(s):

Pre-requisite(s): PHY 1430 and MTH 2321; and MTH 2311 or concurrent enrollment

Topics normally include matrices and vector calculus, coordinate transformations, numerical solutions using Matlab and Mathematica, chaos and fractals, special functions defined by solutions to differential equations.

**PHY 2455 Foundations of Astronomy (4)**

Pre-requisite(s): PHY 1420 and MTH 1321

Physical and mathematical foundations of modern astronomy emphasizing techniques, history, and development of our current picture of the universe including galaxies, stars, planet, planetoids, and comets.

**PHY 2V9R Research (3)**

Pre-requisite(s): Consent of the instructor

Undergraduate research undertaken with the supervision of a faculty member. May be taken for a maximum of 6 hours.

**PHY 3175 Intermediate Physics Laboratory I (1)**

Pre-requisite(s): PHY 2350 and 2360

Study of experimental planning, data analysis, and elementary error analysis. Experiments include the Millikan oil-drop experiment, the determination of the Faraday constant, bubble chamber photographic measurements, the study of GM counters, and radioactive half-life determination.

**PHY 3176 Intermediate Physics Laboratory II (1)**

Pre-requisite(s): PHY 3175

Continuation of PHY 3175 with emphasis on nuclear counting and measurements.

**PHY 3305 History of Invention and Technology (3)**

History of invention and technology including biographical study of scientists. Does not apply toward a major or minor in physics, astronomy or astrophysics.

**PHY 3320 Intermediate Classical Mechanics (3)**

Pre-requisite(s): PHY 2360 and MTH 3325; or consent of instructor

Topics normally include vectors, linear transformations, Newtonian mechanics for a single particle, linear and nonlinear oscillations, Euler's equation, Lagrangian and Hamiltonian dynamics, central forces, and orbital motion.

**PHY 3330 Intermediate Electricity and Magnetism (3)**

Pre-requisite(s): PHY 2360; and MTH 3326 or concurrent enrollment; or consent of instructor

Topics normally include electrostatics, Laplace's equation, method of images, multipole expansion, magnetostatics, and Maxwell's electromagnetic field equations.

**PHY 3350 Topics in Astronomy (3)**

Pre-requisite(s): PHY 2455 and PHY 2360

Topics in contemporary research in astronomy and astrophysics.

**PHY 3372 Introductory Quantum Mechanics I (3)**

Pre-requisite(s): PHY 2350, 2360 and MTH 2311; and MTH 3326 or concurrent enrollment; or consent of instructor

Postulates of quantum mechanics, operators in Hilbert space, superposition principle and compatible observables, time development, conservation theorems, one-dimensional bound and unbound state problems, WKB approximation, and theory of conduction in solids.

**PHY 3373 Introductory Quantum Mechanics II (3)**

Pre-requisite(s): PHY 3372 and MTH 3326

Problems in three dimensions, perturbation theory, unitary transformations, quantum statistics, atomic spectroscopy, and introductory solid state, nuclear, and elementary particle physics.

**PHY 3455 Observational Astronomy (4)**

Pre-requisite(s): PHY 2455

Fundamentals of practical sky observing including visual, photographic, and photometric techniques using local telescopes and CCD cameras. Introduction to methods for finding and identifying celestial objects, making observations, and operating an observatory, telescopes, and related equipment.

**PHY 3V95 Undergraduate Research in Physics (1-3)**

Pre-requisite(s): Consent of instructor

Research conducted under the supervision of a faculty member in the department. May be repeated up to a maximum of six semester hours.

**PHY 3V9R Research (3)**

Pre-requisite(s): Consent of the instructor  
Undergraduate research undertaken with the supervision of a faculty member. May be taken for a maximum of 6 hours.

**PHY 4001 Exit Exam (0)**

Pre-requisite(s): Senior standing  
An exit examination, designated by the department, is required of all physics majors. This examination will be chosen by the department from the GRE Subject Test or another similar examination.

**PHY 4150 Instructional Observing (1)**

Pre-requisite(s): PHY 3455  
Teaching astronomy techniques and assisting on observing nights for the PHY 3455 class and campus outreach events.

**PHY 4190 Dissemination of Research Results in Physics (1)**

Pre-requisite(s): Departmental approval required  
Culmination of an undergraduate research project including presentation of research results.

**PHY 4322 Advanced Topics in Classical Physics (3)**

Pre-requisite(s): PHY 3320, 3330, and MTH 3326  
Continuation of PHY 3320 and 3330. Topics normally include: dynamics of systems of particles: rigid-body motion; coupled oscillations; the wave equation in one dimension; gauge transformations; electromagnetic waves in conductors and nonconductors; dispersion; multiple radiation; Linaard-Wiechert potentials; relativistic electrodynamics.

**PHY 4340 Statistical and Thermal Physics (3)**

Pre-requisite(s): PHY 3372 and MTH 3326  
Topics normally include: basic probability concepts; macroscopic thermodynamics; statistical thermodynamics; kinetic theory; quantum statistics.

**PHY 4350 Introduction to Stellar Structure and Evolution (3)**

Pre-requisite(s): PHY 2455; and MTH 3326 or concurrent enrollment  
A quantitative study of the physics of stars and stellar systems. Topics include observed properties of stars and the physics underlying those properties, radiation and stellar spectra, the interior structure of stars, the life cycles of stars, white dwarfs, neutron stars, and black holes.

**PHY 4351 Introduction to Modern Cosmology (3)**

Pre-requisite(s): PHY 4350 and MTH 3326  
An introduction to modern cosmology, including observational cosmology, Newtonian gravity, relativistic cosmological models, thermal history of the universe, dark matter and dark energy, inflationary models, the origin of the light elements, structures in the universe, and the cosmic microwave background radiation. The principles of Einstein's general theory of relativity and observations in experiments will also be covered.

**PHY 4360 Computer Models in Physics (3)**

Pre-requisite(s): PHY 3320, 3372, and CSI 3324  
Application of contemporary computer methods to the solution of physics and engineering problems. Theory and applications of finite difference equations. Deterministic, discrete, and continuous models. Computer graphics. Waves in classical and quantum physics. Monte Carlo calculations, electric circuits, partial differential equations in physics and engineering.

**PHY 4372 Introductory Solid State Physics (3)**

Pre-requisite(s): PHY 3373  
Topics normally include: crystal structure; reciprocal space; elastic and thermal properties; electronic structure; the Fermi surface; elementary semiconductor physics; dielectric and magnetic properties of solids.

**PHY 4373 Introductory Nuclear and Particle Physics (3)**

Pre-requisite(s): PHY 3373  
Topics normally include: nuclear structure and models; angular momentum and isospin; conservation laws and discrete symmetries; electromagnetic and weak interactions; quark model; nuclear and particle astrophysics.

**PHY 4374 Introduction to Relativistic Quantum Mechanics (3)**

Pre-requisite(s): PHY 3373  
Dirac's equation, its covariance properties, its solutions; Foldy-Wouthuysen transformation and exact results; propagator theory; applications in various areas of physics.

**PHY 4V80 Special Topics in Physics (1-3)**

Pre-requisite(s): Upper-level standing and consent of instructor  
Advanced topics in physics, astronomy, or astrophysics. May be repeated once for credit with a different topic up to a total of six semester hours.

**PHY 4V9R Research (3)**

Pre-requisite(s): Consent of the instructor  
Undergraduate research undertaken with the supervision of a faculty member. May be taken for a maximum of 6 hours.