

# PHYSICS AND ASTRONOMY

Department Website (<http://www.physics.sc.edu/>)

Ralf Gothe, *Chair*

The undergraduate program in physics is designed to provide a fundamental understanding of both experimental and theoretical physics. All of the majors provide a strong basis for graduate study in physics. The applied major is designed for students seeking employment by industrial or governmental laboratories upon completing their B.S. By a suitable choice of electives students will also be prepared for graduate study in the other sciences, mathematics, medicine, or engineering or to enter the University's special teacher education program that leads to a master's degree and teacher certification.

## Programs

- Astronomy Minor (<https://academicbulletins.sc.edu/undergraduate/arts-sciences/physics-astronomy/astronomy-minor/>)
- Physics Minor (<https://academicbulletins.sc.edu/undergraduate/arts-sciences/physics-astronomy/physics-minor/>)
- Physics, B.S. (<https://academicbulletins.sc.edu/undergraduate/arts-sciences/physics-astronomy/physics-bs/>)

## Courses

### ASTR 101 - Introduction to Astronomy (4 Credits)

An introduction to the solar system and universe accomplished with interactive lectures, demonstrations, and laboratory experience. Designed primarily for the non-science major.

**Carolina Core:** SCI

### ASTR 201 - Introduction to Astronomy II: The Dark Universe (3 Credits)

Astronomical topics including stellar death, black holes, dark matter, dark energy and cosmology. Astronomical techniques and application of the scientific method in astronomy.

**Prerequisites:** ASTR 101 or SCHC 115.

**Carolina Core:** SCI

### ASTR 320 - Introduction to Radio Astronomy (3 Credits)

Nature of the sun, planets; galactic and extragalactic sources at radio wavelengths; quasars; techniques, detectors, and telescopes.

**Prerequisites:** ASTR 211, MATH 115 or equivalent, and PHYS 202, PHYS 212.

### ASTR 340 - Introduction to Relativistic Astrophysics (3 Credits)

Final states of stellar evolution; white dwarfs, neutron stars, black holes. Cosmology.

**Prerequisites:** ASTR 211, MATH 115 or equivalent, and PHYS 202, PHYS 212.

**Cross-listed course:** PHYS 340

### ASTR 499 - Undergraduate Research (3 Credits)

Introduction to and application of the methods of research. A written report on work accomplished is required at the end of each semester.

**Graduation with Leadership Distinction:** GLD: Research

### ASTR 533 - Advanced Observational Astronomy (1-3 Credits)

Development of a combination of observational techniques and facility at reduction of data. A maximum of eight hours per week of observation, data reduction, and consultation. Offered each semester by arrangement with the department.

### ASTR 534 - Advanced Observational Astronomy (1-3 Credits)

A continuation of ASTR 533. Up to eight hours per week of observation, data reduction, and consultation.

### ASTR 599 - Topics in Astronomy (1-3 Credits)

Readings and research on selected topics in astronomy. Course content varies and will be announced in the schedule of classes by title.

### PHYS 101 - The Physics of How Things Work I (3 Credits)

A practical introduction to physics and science in everyday life-from concrete examples to basic physical principles.

**Carolina Core:** SCI

### PHYS 101L - The Physics of How Things Work I Lab (1 Credit)

Experiments, exercises, and demonstrations to accompany PHYS 101.

**Prerequisite or Corequisite:** PHYS 101.

**Carolina Core:** SCI

### PHYS 102 - The Physics of How Things Work II (3 Credits)

A continuation of PHYS 101 with emphasis on electricity, magnetism, optics, and atomic physics.

**Prerequisites:** PHYS 101.

### PHYS 102L - The Physics of How Things Work II Lab (1 Credit)

Experiments, exercises, and demonstrations to accompany PHYS 102.

**Prerequisite or Corequisite:** PHYS 102.

### PHYS 151 - Physics in the Arts (3 Credits)

The physics of sound, color, illumination; musical instruments and photographic processes. Credit may not be received for both PHYS 151 and PHYS 153 or both PHYS 151 and PHYS 155.

### PHYS 151L - Physics in the Arts Laboratory (1 Credit)

Laboratory work on wave motion, including acoustic, optical, photographic, and electronic measurements. Credit may not be received for both PHYS 151L and PHYS 153L or both PHYS 151L and PHYS 155L.

**Prerequisite or Corequisite:** PHYS 151.

### PHYS 153 - Physics in the Visual Arts (3 Credits)

Principals of optics: video, and photography, eye and vision, color, polarization, lasers, and holography. Credit may not be received for both PHYS 153 and PHYS 151.

### PHYS 153L - Physics in the Visual Arts Laboratory (1 Credit)

Laboratory work in geometrical and wave optics. Credit may not be received for both PHYS 153L and PHYS 151L.

**Prerequisite or Corequisite:** PHYS 153.

### PHYS 155 - Musical Acoustics (3 Credits)

The principles of musical and architectural acoustics, waves and vibrations, digital techniques for generating and recording sound, perception and measure of sound (psychoacoustics). Credit may not be received for both PHYS 155 and PHYS 151.

### PHYS 155L - Acoustics Laboratory (1 Credit)

Laboratory work in musical and architectural acoustics. Credit may not be received for both PHYS 155L and PHYS 151L.

**Prerequisite or Corequisite:** PHYS 155.

### PHYS 180 - Physics Concepts, Calculations, and Context (1 Credit)

Problem solving techniques and mathematical language using key concepts in introductory physics.

**Corequisite:** PHYS 201 or PHYS 202.

**PHYS 199 - Measurement and Analysis in Physics (2 Credits)**

Measurements in classical and modern physics are performed, and the analyzed results are compared with basic principles. Four hours of mixed lecture and laboratory per week.

**Prerequisites:** C or better in MATH 115 or equivalent or higher.

**PHYS 201 - General Physics I (3 Credits)**

First part of an introductory course sequence. Topics include mechanics, and selections from wave motion, sound, fluids, and heat. No previous background in physics is assumed.

**Prerequisites:** C or better in MATH 111, MATH 111I, MATH 112, MATH 115, MATH 116, MATH 122, MATH 141, or by placement score into MATH 122, MATH 141, or higher.

**Carolina Core:** SCI

**PHYS 201L - General Physics Laboratory I (1 Credit)**

Prerequisite or

**Corequisite:** PHYS 201.

**Carolina Core:** SCI

**PHYS 202 - General Physics II (3 Credits)**

Continuation of PHYS 201; includes electromagnetism, relativity, quantum physics, atomic and nuclear physics.

**Prerequisites:** C or better in PHYS 201.

**Carolina Core:** SCI

**PHYS 202L - General Physics Laboratory II (1 Credit)**

Prerequisite or

**Corequisite:** PHYS 202.

**Carolina Core:** SCI

**PHYS 211 - Essentials of Physics I (3 Credits)**

Classical mechanics and wave motion. Calculus-level course for students of science and engineering.

**Prerequisites:** C or better in MATH 141.

**Corequisite:** PHYS 211L.

**Carolina Core:** SCI

**PHYS 211L - Essentials of Physics I Lab (1 Credit)**

Prerequisite or

**Corequisite:** PHYS 206 or PHYS 211.

**Carolina Core:** SCI

**PHYS 212 - Essentials of Physics II (3 Credits)**

Classical electromagnetism and optics.

**Prerequisites:** C or better in PHYS 211 and MATH 142.

**Corequisite:** PHYS 212L.

**Carolina Core:** SCI

**PHYS 212L - Essentials of Physics II Lab (1 Credit)**

Prerequisite or

**Corequisite:** PHYS 207 or PHYS 212.

**Carolina Core:** SCI

**PHYS 291 - Einstein's Relativity: Understanding by Example (3 Credits)**

Special theory of relativity. Algebra-based course for students of all majors.

**Prerequisites:** B or better in MATH 115 or equivalent.

**PHYS 306 - Principles of Physics III (3 Credits)**

Wave motion, optics, and thermodynamics. Calculus-level treatment; a continuation of PHYS 207 and PHYS 212.

**Prerequisites:** C or better in PHYS 207 or PHYS 212 and MATH 142.

**Corequisite:** MATH 241.

**PHYS 307 - Introduction to Modern Physics (3 Credits)**

Experimental foundations and general concepts of quantum theory and special relativity; with selected applications from atomic, condensed matter, and nuclear physics.

**Prerequisites:** C or better in PHYS 212 and MATH 241.

**PHYS 308 - Classic Experiments in Physics I (2 Credits)**

A laboratory course in the performance and analysis of experiments which have contributed to an understanding of basic concepts. One lecture/recitation and one three-hour laboratory period each week.

**Prerequisites:** PHYS 202, PHYS 207, or PHYS 212.

**PHYS 309 - Classic Experiments in Physics II (2 Credits)**

Further experiments which have contributed to an understanding of basic concepts. One lecture/recitation and one three-hour laboratory period each week.

**Prerequisites:** PHYS 308.

**PHYS 310 - Intermediate Experimental Physics (4 Credits)**

Descriptive statistics, scientific ethics, and design, construction, and reporting the results of experiments.

**Prerequisites:** C or better in PHYS 212.

**PHYS 311 - Introduction to Applied Numerical Methods (3 Credits)**

Introduction and application of linear algebra and numerical methods to the solution of physical and engineering problems. Techniques include iterative solution techniques, methods of solving systems of equations, and numerical integration and differentiation.

**Prerequisites:** MATH 141.

**Corequisite:** MATH 142.

**Cross-listed course:** EMCH 201, ENCP 201

**PHYS 340 - Introduction to Relativistic Astrophysics (3 Credits)**

Final states of stellar evolution; white dwarfs, neutron stars, black holes. Cosmology.

**Prerequisites:** ASTR 211, MATH 115 or equivalent, and PHYS 202, PHYS 207, or PHYS 212.

**Cross-listed course:** ASTR 340

**PHYS 399 - Independent Study (3-6 Credits)**

Contract approved by instructor, advisor, and department chair is required for undergraduate students.

**Graduation with Leadership Distinction:** GLD: Research

**PHYS 498 - Senior Thesis (3 Credits)**

An individual investigation in the library or laboratory or both under supervision of the major professor. The preparation of a scientific report is an integral part of the work.

**Graduation with Leadership Distinction:** GLD: Research

**PHYS 499 - Undergraduate Research (3 Credits)**

Introduction to and application of the methods of research. A written report on work accomplished is required at the end of each semester.

**Prerequisites:** PHYS 308 and PHYS 309.

**Graduation with Leadership Distinction:** GLD: Research

**PHYS 501 - Quantum Physics I (3 Credits)**

A self-contained treatment of quantum theory and its applications, beginning with the Schrodinger equation.

**Prerequisites:** C or better in PHYS 307 and MATH 242.

**PHYS 502 - Quantum Physics II (3 Credits)**

Advanced topics in quantum physics, plus topics in special relativity, high-energy physics, and cosmology.

**Prerequisites:** C or better in PHYS 501.

**PHYS 503 - Mechanics (4 Credits)**

Classical mechanics of particles, systems, and rigid bodies; discussion and application of Lagrange's equations, introduction to Hamiltonian formulation of mechanics.

**Prerequisites:** PHYS 206 or PHYS 211, MATH 242 or MATH 520.

**PHYS 504 - Electromagnetic Theory (4 Credits)**

Field theory of electric and magnetic phenomena; Maxwell's equations applied to problems in electromagnetism and radiation.

**Prerequisites:** C or better in PHYS 503.

**PHYS 506 - Thermal Physics and Statistical Mechanics (3 Credits)**

Principles of equilibrium thermodynamics, kinetic theory, and introductory statistical mechanics.

**Prerequisites:** C or better in PHYS 306.

**PHYS 509 - Solid State Electronics (4 Credits)**

Topics include: basic electrical circuits; electronic processes in solids; operation and application of individual solid state devices and integrated circuits. Three lecture and three laboratory hours per week.

**Prerequisites:** PHYS 207 or PHYS 212.

**PHYS 510 - Digital Electronics (3 Credits)**

Basic operation of digital integrated circuits including microprocessors. Laboratory application of microcomputers to physical measurements.

**Prerequisites:** C or better in PHYS 509.

**PHYS 511 - Nuclear Physics (4 Credits)**

An elementary treatment of nuclear structure, radioactivity, and nuclear reactions. Three lecture and three laboratory hours per week.

**Prerequisites:** C or better in PHYS 501.

**PHYS 512 - Solid State Physics (4 Credits)**

Crystal structure; lattice dynamics; thermal, dielectric, and magnetic properties of solids. Free electron model of metals. Band structure of solids, semi-conductor physics. Three lecture and three laboratory hours per week.

**Prerequisites:** PHYS 502.

**PHYS 514 - Optics, Theory, and Applications (4 Credits)**

Geometrical and physical optics; wave nature of light, lenses and optical instruments, interferometers, gratings, thin films, polarization, coherence, spatial filters, and holography. Three lecture and three laboratory hours per week.

**Prerequisites:** PHYS 306.

**PHYS 515 - Mathematical Physics I (3 Credits)**

Analytical function theory including complex analysis, theory of residues, and saddlepoint method; Hilbert space, Fourier series; elements of distribution theory; vector and tensor analysis with tensor notation.

**Prerequisites:** MATH 242.

**PHYS 516 - Mathematical Physics II (3 Credits)**

Group theory, linear second-order differential equations and the properties of the transcendental functions; orthogonal expansions; integral equations; Fourier transformations.

**Prerequisites:** PHYS 515.

**PHYS 517 - Computational Physics (3 Credits)**

Application of numerical methods to a wide variety of problems in modern physics including classical mechanics and chaos theory, Monte Carlo simulation of random processes, quantum mechanics and electrostatics.

**Prerequisites:** C or better in PHYS 212 and MATH 142.

**PHYS 521 - Biophysics (4 Credits)**

Principles of physics applied to living systems: diffusion, friction, low Reynolds-number world, entropy, free energy, entropic/chemical forces, self-assembly, molecular machines, membranes.

**Prerequisites:** MATH 142, PHYS 212, CHEM 112, BIOL 102.

**PHYS 531 - Advanced Physics Laboratory I (1-3 Credits)**

A laboratory program designed to develop a combination of experimental technique and application of the principles acquired in formal course work. A maximum of eight hours per week of laboratory and consultation.

**PHYS 532 - Advanced Physics Laboratory II (1-3 Credits)**

A continuation of PHYS 531. Up to eight hours per week of laboratory and consultation.

**PHYS 541 - Advanced Experimental Physics I (4 Credits)**

Continuation of PHYS 310. Optical apparatus (telescope, microscope, interferometer) and advanced project planning including equipment design and budgeting.

**Prerequisites:** C or better in PHYS 310.

**PHYS 542 - Advanced Experimental Physics II (4 Credits)**

Continuation of PHYS 541. Study of topics from advanced optics, astronomy, biophysics, digital electronics, nuclear/particle physics, or solid state physics, plus conduction of a physics experiment, including a written paper and an oral presentation.

**Prerequisites:** C or better in PHYS 541.

**PHYS 546 - Introduction to Astrophysics (3 Credits)**

This is an astrophysics course for physics students. The course will cover the basics of observational techniques, structure and evolution of stars, interstellar medium and star formation, structure and properties of the Milky Way and nearby galaxies, and generation and transfer of radiation in astrophysical environments.

**Prerequisites:** C+ or better in PHYS 307.

**PHYS 599 - Topics in Physics (1-3 Credits)**

Readings and research on selected topics in physics. Course content varies and will be announced in the schedule of classes by title.