

# PHYSICS (PHYS)

## Degrees Offered: Ph.D., M.S.

*These programs are offered in Durham.*

Physics is concerned with the properties of matter and the laws that describe its behavior. As a fundamental science, its discoveries and laws are basic to understanding in nearly all areas of science and technology. Advances in such diverse fields as medical instrumentation, solid state electronics, and space research have relied heavily on the application of basic physical laws and principles.

The mission of the Department of Physics is two-fold: to prepare students for a variety of career opportunities in business, industry, government and education/academia, and to conduct world-class research in various fields, including space and astrophysics, nuclear physics, high-energy physics, gravity, and solid state physics. The department has currently 28 teaching faculty, 11 research faculty, 105 undergraduate students and 60 graduate students. It houses state-of-the-art educational and laboratory facilities; the affiliated UNH Observatory is open to the public.

The Department of Physics offers the degrees of Master of Science and Doctor of Philosophy. Interested students are encouraged to contact the department for further information. More detailed information is also on the physics department web page at [www.physics.unh.edu](http://www.physics.unh.edu).

## Admission Requirements

Applicants to the master of science and doctor of philosophy programs are expected to have a bachelor's degree in science, with at least 24 credits in physics and closely allied fields. Applicants must submit current scores (within five years) from the general test of the Graduate Record Examination (GRE), and from the GRE physics subject test.

## Interdisciplinary Research

The department encourages research in areas related to physics or applied physics. If students desire to do research in a field related to physics, special provisions may be made. Contact the department chairperson or graduate adviser for details.

<https://physics.unh.edu/>

### Programs

- [Physics \(Ph.D.\)](#)
- [Physics \(M.S.\)](#)

### Courses

## Physics (PHYS)

**PHYS 805 - Experimental Physics**

**Credits:** 4

Experiments in nuclear, solid-state, and surface physics. Includes discussion of laboratory techniques, data analysis, and data presentation. Special projects assigned to individual students.

**Repeat Rule:** May be repeated up to 1 time.

**PHYS 806 - Introduction to Physics Research and Teaching**

**Credits:** 1

This course introduces new graduate students to both research and teaching. The teaching portion focuses on facilitating group work, problem solving, and deeper student thinking. The research portion focuses on research currently conducted at UNH, library resources, responsible conduct in research, how research differs from coursework, and how research results are presented in the research community. Cr/F.

**PHYS 810 - Astrophysics I**

**Credits:** 4

A comprehensive review of modern astrophysics. Topics covered include the celestial sphere, celestial mechanics, the tools of the modern astronomer (including different types of telescopes for studying the electromagnetic radiation from space), stellar spectra, stellar atmospheres, stellar interiors, the formation of stars, stellar evolution, and the stellar graveyard (white dwarfs, neutron stars, and black holes).

**Equivalent(s):** EOS 810

**PHYS 812 - Introduction to Space Plasma Physics**

**Credits:** 4

Introduction to the subject of space plasma physics including solar physics, heliospheric physics, magnetospheric physics, and ionospheric physics. The course provides an overview of the basic phenomena and processes (e.g. particle acceleration and transport, shock formation, magnetic structures and reconnection, wave propagation, wave-particle interactions, instabilities), theoretical techniques (e.g. single-particle orbits, kinetic and fluid descriptions), and experimental techniques. (Also offered as EOS 812.) (Alternate years only.)

**Equivalent(s):** EOS 812

**PHYS 818 - Introduction to Solid-State Physics**

**Credits:** 4

Crystal structure, diffraction, lattice vibrations, electronic and optical properties of metals and semiconductors; selected topics in modern condensed matter physics. Prereq: introduction to quantum mechanics I, electricity and magnetism I or equivalent. (Normally offered every other year.)

**PHYS 820 - Nuclear Physics**

**Credits:** 4

Nuclear phenomenology, reactions, models, radiation, interaction of radiation with matter; accelerators; properties and interactions of elementary particles; symmetries and symmetry breaking standard model. Prereq: introduction to quantum mechanics I and II; electricity and magnetism I and II; or permission of instructor.

**PHYS 864 - General Relativity and Cosmology**

**Credits:** 4

Review of special relativity, and the motivation for considering gravity in terms of curvature of space time. Introduction to Riemannian geometry, general relativity and Einstein's equations. Application of general relativity in the study of black holes, gravitational waves, cosmology, as well as recent results on inflation and quantum gravity. (Alternate years only.)

**PHYS 895 - Independent Study**

**Credits:** 1-8

Individual project under direction of a faculty adviser.

**PHYS 899 - Master's Thesis**

**Credits:** 1-6

May be repeated up to a maximum of 6 credits. Cr/F.

**Repeat Rule:** May be repeated for a maximum of 6 credits.

**PHYS 931 - Mathematical Physics****Credits:** 3

Complex variables, differential equations, asymptotic methods, integral transforms, special functions, linear vector spaces and matrices, Green's functions, and additional topics selected from integral equations, variational methods, numerical methods, tensor analysis, and group theory. (Also offered as MATH 931.)

**Equivalent(s):** MATH 931**PHYS 935 - Statistical Physics****Credits:** 3

Review of thermodynamics and kinetic theory, followed by an introduction to classical and quantum statistical mechanics. Microcanonical, canonical, and grand canonical ensembles; ideal Fermi and Bose gases and applications of statistical mechanics to selected physical problems. Prereq: PHYS 931; 939; 943.

**PHYS 939 - Classical Mechanics****Credits:** 3

Newtonian, Lagrangian, and Hamiltonian formulation of the classical mechanics of particles and rigid bodies. Topics that serve as background for the study of modern physical theories are emphasized.

**PHYS 941 - Electromagnetic Theory I****Credits:** 3

The formulation and detailed application of electromagnetic theory to physical problems. The material covered is at the level of the text by J.D. Jackson, "Classical Electrodynamics".

**PHYS 942 - Electromagnetic Theory II****Credits:** 3

The formulation and detailed application of electromagnetic theory to physical problems. The material covered is at the level of the text by J.D. Jackson, "Classical Electrodynamics".

**PHYS 943 - Quantum Mechanics I****Credits:** 3

Introduces non-relativistic quantum theory, covering wave mechanics, Dirac notation, angular momentum, the use of perturbation theory to calculate atomic energy levels, the interaction of atoms with radiation, and various approaches to calculating the differential scattering cross-section.

**PHYS 944 - Quantum Mechanics II****Credits:** 3

See description for PHYS 943.

**PHYS 951 - Plasma Physics****Credits:** 3

Kinetic theory of plasmas; plasma waves, instabilities, turbulence, diffusion, adiabatic motion of charged particles, nonlinear plasma phenomena. Prereq: PHYS 935; PHYS 941; PHYS 941. (Normally offered every other year.)

**PHYS 953 - Magnetohydrodynamics of the Heliosphere****Credits:** 3

Introduction to solar physics, with emphasis on gas dynamics and magnetic fields. Interior structure, the theory of convection, wave motions in the presence of magnetism and gravity, coronal heating theories, steady and nonsteady flows, dynamo theory, and the theory of solar flares and other transient phenomena. Salient observational data are reviewed. (Normally offered every other year.)

**PHYS 954 - Heliospheric Physics****Credits:** 3

The solar wind and its effects on cosmic rays. The basic equations of the solar wind: mass, momentum, angular momentum, and energy balance. Transport processes. Waves, shocks, and instabilities in the solar wind. The basic equations of energetic particle transport. Solar modulation of solar and galactic cosmic rays. Interaction of energetic particles with shock waves. Salient data are reviewed. (Normally offered every other year.) Also offered as EOS 954.

**Equivalent(s):** EOS 954**PHYS 961 - Advanced Quantum Mechanics I****Credits:** 3

Relativistic wave equations, propagator theory and Feynman diagrams, quantum theory of radiation, second quantization, introduction to quantum field theory and related topics. Prereq: PHYS 939; PHYS 944. (Normally offered every other year.)

**PHYS 962 - Advanced Quantum Mechanics II****Credits:** 3

Relativistic wave equations, propagator theory and Feynman diagrams, quantum theory of Radiation, second quantization, introduction to quantum field theory and related topics.

**PHYS 965 - Advanced Solid-State Physics****Credits:** 3

Theory of crystalline metals, semiconductors, and insulators. Selected topics from the following: surfaces, films, quantum dots, clusters, solid-state devices. Prereq: PHYS 935; PHYS 941; PHYS 943. (Normally offered every other year.)

**PHYS 987 - Magnetospheres****Credits:** 3

Introduces plasma physics of the interaction of solar and stellar winds with planets having internal magnetic fields, most predominately, the Earth. Both MHD and kinetic descriptions of internal and boundary processes of magnetospheres as well as treatment of the interaction with collisional ionospheres. Flow of mass, momentum, and energy, through such systems. Prereq: PHYS 951; PHYS 952;/or permission. (Also offered as EOS 987.) (Normally offered every other year.)

**Equivalent(s):** EOS 987**PHYS 995 - Special Topics****Credits:** 1-3

Any special fields of study not covered by the above courses may be included. Topic choices in previous years: astrophysics; elementary particles; lasers/masers; many-body theory; general relativity and cosmology; group theory; atomic physics; quantum theory of light; nonlinear equations, and chaos. May be taken more than once. (Not offered every year.)

**PHYS 999 - Doctoral Research****Credits:** 0

Cr/F.

**Faculty**

See <http://physics.unh.edu/people/faculty> for faculty.