Physics and Astronomy

Chair
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Undergraduate majors: physics (BA, BS); applied physics (BS); astronomy (BA, BS)
Undergraduate minors: physics; astronomy

Graduate degrees: MS in physics; MS in astronomy; PhD in physics

Faculty: https://physics.uiowa.edu/people
Website: https://physics.uiowa.edu/

Courses

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Physics Courses

PHYS:1000 First-Year Seminar 1 s.h.
Small discussion class taught by a faculty member; topics chosen by instructor; may include outside activities (e.g., films, lectures, performances, readings, visits to research facilities). Requirements: first- or second-semester standing.

PHYS:1200 Physics of Everyday Experience 3 s.h.
Principles of physics; basic motion, behavior of fluids, waves, temperature and heat, gravity and planetary motion, electricity and magnetism, optics, nuclear energy, radioactivity, and medical imaging technology; examples from everyday experience; for non-science majors. GE: Natural Sciences without Lab.

PHYS:1400 Basic Physics 3-4 s.h.
Quantitative treatment of mechanics, electricity, heat, liquids, gases, and atomic, nuclear, and elementary particle physics. Requirements: must have completed high school trigonometry or achieved a minimum ALEKS score of 75%. GE: Natural Sciences with Lab; Natural Sciences without Lab.

PHYS:1409 Basic Physics Lab 1 s.h.
Laboratory for PHYS:1400. Corequisites: PHYS:1400 (if not taken as a prerequisite). GE: Natural Sciences Lab only.

PHYS:1410 Physics of Sound 3-4 s.h.
Acoustical foundations of music; production of sound by vibrating objects, properties of sound waves, vocal acoustics, hearing, room acoustics, principles of electroacoustics. GE: Natural Sciences with Lab; Natural Sciences without Lab.

PHYS:1511 College Physics I 4 s.h.
Algebra-based treatment of mechanics, waves, thermodynamics, and special relativity. Requirements: must have completed high school trigonometry or achieved a minimum ALEKS score of 75%. GE: Natural Sciences with Lab.

PHYS:1512 College Physics II 4 s.h.
Continuation of PHYS:1511; algebra-based treatment of electricity, magnetism, light, and modern physics. Prerequisites: PHYS:1611 or PHYS:1511. GE: Natural Sciences with Lab.

PHYS:1611 Introductory Physics I 4 s.h.

PHYS:1612 Introductory Physics II 4 s.h.
Continuation of PHYS:1611; calculus-based treatment of electricity, magnetism, and light. Prerequisites: PHYS:1611. Corequisites: MATH:1560 or MATH:1860. GE: Natural Sciences with Lab.

PHYS:1619 Introductory Physics II Lab 1 s.h.
Laboratory for PHYS:1612. Requirements: 3 s.h. in PHYS:1612. GE: Natural Sciences Lab only.

PHYS:1701 Physics I 4 s.h.
Introduction to physics; calculus-based treatment of Newtonian mechanics for point particles and rigid bodies; conservation laws. Offered fall semesters. Corequisites: MATH:1850. Requirements: physics or astronomy major. GE: Natural Sciences with Lab.

PHYS:1702 Physics II 4 s.h.
Continuation of PHYS:1701; introduction to fluid mechanics, electricity, magnetism (Maxwell's equations). Offered spring semesters. Prerequisites: PHYS:1701. Corequisites: MATH:1560 or MATH:1860. GE: Natural Sciences Lab only.

PHYS:1703 Physics III 4 s.h.
Continuation of PHYS:1702; introduction to physics; calculus-based treatment of electromagnetic waves and optics; mechanical and sound waves; thermal physics. Offered fall semesters. Prerequisites: PHYS:1702.

PHYS:2704 Physics IV 3-4 s.h.
Introduction to quantum mechanics and other topics in modern physics, including special relativity, atomic and solid state physics. Offered spring semesters. Prerequisites: (PHYS:1612 or PHYS:2703) and (MATH:1860 or MATH:1550). Requirements: for 3 s.h. option—nonmajor.

PHYS:2905 Programming for Physics 2 s.h.
Introduction to scientific programming for applications in physics.

PHYS:2990 Reading in Physics arr.
Selected topics in physics.

PHYS:3710 Intermediate Mechanics 3 s.h.
Introduction to Newtonian mechanics; noninertial reference systems; central forces, celestial mechanics; rigid body motion; Lagrangian and Hamiltonian equations of motion; small oscillations. Prerequisites: PHYS:1511 or PHYS:1511 or PHYS:1701) and (MATH:1860 or MATH:1560).

Website: https://physics.uiowa.edu/
PHYS:3730 Statistical Physics 3 s.h.
Integrated introduction to subjects of thermodynamics, statistical mechanics, classical and quantum statistics of interacting particles; kinetic theory; emphasis on applications. Prerequisites: PHYS:2704.

PHYS:3741 Introduction to Quantum Mechanics I 3 s.h.
Superposition principle, Stern-Gerlach experiment, linear operators, measurement theory, time evolution, angular momentum, wave mechanics in one dimension, one-dimensional harmonic oscillator, two-body problems with central forces, and the hydrogen atom. Prerequisites: MATH:2850 and PHYS:2704 and MATH:2700.

PHYS:3742 Introduction to Quantum Mechanics II 3 s.h.
Continuation of PHYS:3741; Perturbation theory, variational methods, WKB approximation, scattering, Helium atom, periodic table, atomic spectroscopy, transition rates, and other selected applications. Prerequisites: PHYS:3741.

PHYS:3756 Intermediate Laboratory 3 s.h.
Introduction to instruments and techniques of experimental physics and basic skills needed for carrying out experimental physics research; hands-on use of a variety of instruments and equipment. Prerequisites: PHYS:2704. Corequisites: PHYS:3811.

PHYS:3811 Electricity and Magnetism I 3 s.h.
Introduction to electricity and magnetism; topics include electrostatics, magnetostatics, potential theory, and electric and magnetic fields in matter. Prerequisites: (MATH:3550 or MATH:2850) and (PHYS:1612 or PHYS:1702 or PHYS:1512).

PHYS:3812 Electricity and Magnetism II 3 s.h.
Continuation of PHYS:3811; introduction to electricity and magnetism; topics include Maxwell's equations, electromodynamics, electromagnetic waves, radiation, and special relativity. Prerequisites: PHYS:3811.

PHYS:3850 Electronics 4 s.h.
Design and construction of small circuits; use of measurement instruments—oscilloscope, multimeter, function generator; circuits, including transistors, operational amplifiers, digital, analog-to-digital conversion. Prerequisites: PHYS:1512 or PHYS:1612 or PHYS:1702. Requirements: physics or astronomy major.

PHYS:4720 Introductory Optics 3 s.h.
Wave motion and superposition, electromagnetic theory, photons, propagation of light, geometrical and physical optics, interference, diffraction, polarization, and Fourier optics; optical components, devices, and systems. Prerequisites: (PHYS:1512 or PHYS:2703 or PHYS:1612) and (MATH:1560 or MATH:1860). Same as ECE:4720.

PHYS:4726 Electro Optics 3 s.h.
Wave equation solutions; optical birefringence; finite beam propagation in free space, dielectric waveguides and fibers; optical resonators; nonlinear phenomena; electro-optic, acousto-optic modulation; optical detection, noise; application to communication systems. Requirements: for ECE:5790—ECE:3700; for PHYS:4726—PHYS:3812. Same as ECE:5790.

PHYS:4728 Introductory Solid State Physics 3 s.h.
Phenomena associated with solid state; classification of solids and crystal structures, electronic and vibrational properties in solids; thermal, optical, magnetic, dielectric properties of solids. Prerequisites: PHYS:3741. Same as ECE:4728.
**Astronomy Courses**

**ASTR:1000 First-Year Seminar**  
Small discussion class taught by a faculty member; topics chosen by instructor; may include outside activities (e.g., films, lectures, performances, readings, visits to research facilities).

**ASTR:1060 Big Ideas: Origins of the Universe, Earth, and Life**  
Origin of the universe, the biochemistry of life, and the origin of life on Earth; for non-science majors. Recommendations: first-year or sophomore standing. GE: Natural Sciences without Lab. Same as BIOL:1060, EES:1060.

**ASTR:1070 Stars, Galaxies, and the Universe**  
Survey topics including the Sun; life cycles of stars including black holes and pulsars; diversity of galaxies including the Milky Way and distant quasars; cosmology—the history, structure, and fate of the universe; current results from recent astronomical observations; for non-science majors. Recommendations: closed to physics and astronomy majors. GE: Natural Sciences with Lab; Natural Sciences without Lab.

**ASTR:1079 Introduction to Astrophysics**  
Survey of topics in astronomy and astrophysics; topics include the Solar System and exoplanets, nearby stars in the Galaxy, distant galaxies and unseen black holes; focus on citizen science projects that allow students to examine real data; for non-science majors. GE: Natural Sciences without Lab.

**ASTR:1771 Fundamental Astronomy I: The Solar System and Exoplanets**  
Quantitative introduction to physical principles needed to understand astronomical phenomena (e.g., laws of motion, gravitation, radiation), astronomical instrumentation, properties structure, and evolution of solar system bodies, exoplanets, and the search for life. Requirements: four years of high school math. GE: Natural Sciences with Lab.

**ASTR:1772 Fundamental Astronomy II: Evolution of Stars, Galaxies, and the Universe**  
Continuation of ASTR:1771; quantitative introduction to stellar, Galactic, and extragalactic astronomy; topics include the Sun, stellar evolution, stellar corpses such as neutron stars and black holes, the Milky Way galaxy, the interstellar medium, galaxies, cosmology, and fate of the universe. Prerequisites: ASTR:1771. Requirements: four years of high school math. GE: Natural Sciences with Lab.

**ASTR:2991 Reading in Astronomy**  
Selected topics in astronomy.

**ASTR:3771 Introduction to Astrophysics I**  
Topics include celestial mechanics, radiative transfer, stellar structure and evolution, and star formation; first in a two-semester sequence. Prerequisites: PHYS:2704 and ASTR:1772 and ASTR:1771 and (MATH:2850 or MATH:3550) and (MATH:2700 or MATH:2550). Recommendations: computer programming experience.

**ASTR:3772 Introduction to Astrophysics II**  
Continuation of ASTR:3771; topics include post-main-sequence stellar evolution, stellar remnants, close binary stars, the Milky Way and other galaxies, active galactic nuclei, galaxy evolution, and cosmology; second in a two-semester sequence. Prerequisites: ASTR:3771.

**ASTR:4850 Observational Techniques in Astronomy**  
Introduction to instruments of optical (and sometimes multi-wavelength) astronomy and basic skills needed for carrying out observational astronomical research; hands-on use of observing equipment; nighttime observing sessions. Prerequisites: PHYS:2704 and ASTR:1772 and ASTR:1771.

**ASTR:4996 Reading in Astronomy**  
Selected topics in astronomy.

**ASTR:6782 Extragalactic Astronomy**  
Normal and active galaxies, large scale structure, the early Universe, cosmology.

**ASTR:6785 The Interstellar Medium**  
The interstellar medium; optical properties of small interstellar grains, radiative processes in interstellar gas, structure of HI regions, interstellar shock waves, supernova remnants, modification of interstellar medium by luminous stars, molecular clouds.

**ASTR:6790 Stellar Astrophysics**  
Stellar interiors, nuclear astrophysics; advanced topics.

**ASTR:6870 Radiative Processes in Astrophysics**  
Physics of stars including interiors, spectra, nuclear processes, plasma hydrodynamics, and the extreme physics of condensed final states.

**ASTR:6880 High Energy Astrophysics**  
Detection of X-rays and gamma-rays, black holes and neutron stars, accretion onto compact objects, pulsars, supernova remnants, cosmic rays, and gamma-ray bursts.

**ASTR:7775 Special Topics in Astrophysics**  
Advanced lectures.
**ASTR:7830 Space and Astrophysical Plasma**

**Physics**

3 s.h.

Dynamics and evolution of space and astrophysical plasmas; heliosphere, planetary magnetospheres, accretion disks; plasma waves, shock waves, turbulence.

**ASTR:7970 Seminar: Astrophysics and Space**

**Physics**

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Current research.

**ASTR:7991 Research: Astronomy**

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Original research in observational, theoretical astronomy.