DEPARTMENT OF PHYSICS AND ASTRONOMY

Chair: Joel W. Walker (jwalker@shsu.edu) (936) 294-4803

Website: Department of Physics and Astronomy (http://www.shsu.edu/academics/physics/)

Physics is the study of how nature behaves. It is concerned with the basic principles of the universe and is one of the foundations on which other physical sciences are based. The beauty of physics is exhibited by the simplicity of its fundamental theories and in the way a small number of basic concepts, equations, and assumptions can expand the student's understanding of the world.

Mission

The mission of the Department of Physics and Astronomy is to promulgate the ability to critically think about nature through teaching and to develop the inquisitiveness to seek additional knowledge by research. In conducting this mission, the Department of Physics and Astronomy will provide capable scientists that can make positive contributions to our society. In order to accomplish this mission, the Department of Physics and Astronomy will take the following steps:

- Improve success in learning and research among all students in the department.
- Develop additional methods to plan and assess the program in the department.
- Recruit and retain qualified, motivated students.
- Promote diversity in the faculty and students.
- Collaborate with other institutions and departments to enhance educational opportunities.
- Develop and implement additional educational services to off-campus audiences.
- Provide assistance to teachers in the schools preparing the future students for the institution.

Academic Programs

Physics students may pursue a Bachelor of Science degree in Physics or a dual degree consisting of a Bachelor of Science in Physics from Sam Houston State University and a Bachelor's degree in a chosen engineering field at a university with an accredited degree program. Students also may enroll in a two-year pre-engineering program. The Bachelor of Science degree in Physical Science with Secondary Certification is available to students seeking careers in secondary education.

Career Opportunities

Graduates with a Bachelor of Science degree either pursue further education at the graduate level or enter the workforce. Approximately one-half of the graduates pursue graduate study seeking either the Master of Science or Ph.D. degree. The remainder primarily enter the engineering profession but may also enter the fields of computer science and education.

Program Specific Requirements

Physics students will learn the simplicity of nature and the unifying aspects of the laws of physics. This is accomplished by recognizing physical problems, developing a hypothesis and predicting the consequences of it, performing experiments to test the predictions, and formulating the results into a theory. The skills of inquiry, observation, and experimentation are used in all scientific careers including engineering, business, teaching, and administration. The Physics and Astronomy Department has basic research laboratories in selected fields and provides opportunities for advanced students to be involved in research projects. The University operates computer laboratories containing desktop computers, and work stations at several locations on campus.

Curriculum

Required Courses For Major

The Bachelor of Science degree requires at least 38 hours in Physics as follows:

Code	Title	Hours
Course Requirements		
PHYS 1401	Physics Boot Camp	4
PHYS 1411	Introduction To Physics I	4
PHYS 1422	Introduction To Physics II	4
PHYS 3370 & PHYS 4110	Intro To Theoretical Physics and Adv Undergrad Laboratory I	4
PHYS 3391 & PHYS 3111	Modern Physics I and Modern Physics Laboratory I	4
PHYS 4366	Intro Quantum Mechanics	3

PHYS 4368	Electricity And Magnetism	3
PHYS 4370	Classical Mechanics	3
PHYS 4371	Thermodynamcs & Statistcl Mech	3
PHYS 4395	Undergraduate Research	3
Select 1 or more advanced electives:		3-12
PHYS 3395 & PHYS 3115	Electronics & Circuit Analysis and Electronic & Circuit Anlys Lab	
PHYS 4333 & PHYS 4113	Light And Optics and Light And Optics	
PHYS 4367	Intro To Solid State Physics	
PHYS 4396	Selected Topics In Physics	
ASTR 3303	Life in the Universe	
ASTR 3383	Cosmic Catastrophes	
Total Hours		**38-47**

All Physics majors meet the requirements for a minor in mathematics.

- Bachelor of Science, Major in Physics/Engineering Dual Degree (http://catalog.shsu.edu/archives/2021-2022/undergraduate/colleges-academic-departments/science-and-engineering-technology/physics-and-astronomy/bs-physics-engineering-dual-degree/)
- Bachelor of Science, Major in Physics (http://catalog.shsu.edu/archives/2021-2022/undergraduate/colleges-academic-departments/science-and-engineering-technology/physics-and-astronomy/bs-physics/)
- Minor in Physics (http://catalog.shsu.edu/archives/2021-2022/undergraduate/colleges-academic-departments/science-and-engineering-technology/physics-and-astronomy/minor-physics/)

Student Organizations

Society of Physics - The Society of Physics is a nationally recognized organization. The society sponsors field trips, campus visits by potential students, and attendance at professional meetings.

Scholarships

The Physics Department awards scholarships on a competitive basis. Students with a GPA of 3.0 or higher should inquire about the Burroughs Scholarship (awards average $3,000 to $4,000 per semester) to the department chair (936) 294-1601. Other general scholarships are available from the University. Information on University scholarships may be obtained at the Office of Academic Scholarships (http://www.shsu.edu/dept/financial-aid/scholarships/) or by telephone (936) 294-1672. Prospective students should contact the Chair of the Physics Department, Box 2267, Huntsville, Texas 77341 or the website.

Astronomy

ASTR 3303. Life in the Universe. 3 Hours.
Students explore the evolution of life on Earth from an astronomical perspective and investigate the likelihood that this could happen elsewhere in the universe. This course also explores the possibility of communicating with intelligent species elsewhere in our galaxy and how humanity could best go about doing so. This course is typically taught every other year.
Prerequisite: PHYS 1403 or PHYS 1404.

ASTR 3383. Cosmic Catastrophes. 3 Hours.
Students build on knowledge of basic astronomical concepts discussed in previous coursework. Topics may include supernovae, neutron stars, black holes, gamma-ray bursts, worm holes, extra dimensions, and determination of the origin, state, and fate of the universe. This course is typically taught every other year.
Prerequisite: PHYS 1403 with a C or better.

Physics

PHYS 1101. General Physics Laboratory I. 1 Hour. [TCCN: PHYS 1101]
Credit 1
Prerequisite: MATH 1410 or MATH 1316 or MATH 1420 .

PHYS 1102. General Physics Laboratory II. 1 Hour. [TCCN: PHYS 1102]
Credit 1 .

PHYS 1105. Class Phy & Thermodynamics Lab. 1 Hour. [TCCN: PHYS 1105]
Credit 1 .

PHYS 1301. General Phy-Mechanics & Heat. 3 Hours. [TCCN: PHYS 1301]
A modern treatment is made of the laws and principles of motion. This course is intended for science majors whose degree plan does not require a calculus-based treatment. The PHYS 1101 experimental laboratory course should be taken concurrently.
Prerequisite: MATH 1410 or MATH 1316 or MATH 1420.

PHYS 1302. Gen Phy-Snd,Lght, Elec, & Mag. 3 Hours. [TCCN: PHYS 1302]
The course is a continuation of PHYS 1301, covering the subjects of electricity and magnetism. The course is intended for science majors whose degree plan does not require a calculus-based treatment. The PHYS 1102 experimental laboratory course should be taken concurrently.
Prerequisite: PHYS 1301 and MATH 1316 or MATH 1410 or MATH 1420.

PHYS 1305. Classical Physics & Thermdynmc. 3 Hours. [TCCN: PHYS 1305]
Students study the fundamentals of motion, forces and heat at a conceptual level. The course is intended for students who are not science majors, including those on primary and middle school education tracks.

PHYS 1401. Physics Boot Camp. 4 Hours.
Students engage in a review of the essential survival-level skills of problem analysis required for the first two years of the pre-engineering and physics curricula. The course provides familiarity with the core problem-solving tools required for the first two years of work in these majors. All students considering a physics major should enroll in the Bootcamp during their first semester on campus. A weekly problem recitation session is integrated.

PHYS 1403. Stars & Galaxies. 4 Hours. [TCCN: PHYS 1403]
Students study the universe beyond the solar system. Topics may include the nature of stars, stellar evolution, galaxies, quasars, cosmology, the universe as a whole, and theories about the origin and fate of the universe. Along the way, students are introduced to tools astronomers use to determine such properties as temperatures, compositions, motions, masses, and evolution of astronomical objects. Note: PHYS 1403 and PHYS 1404 may be taken in either order.

PHYS 1404. Solar System Astronomy. 4 Hours. [TCCN: PHYS 1404]
Students study the solar system as well as other planetary systems. Topics may include the nature of science, apparent motions in the sky, the historical development of the laws governing the solar system, the structure and membership of solar system objects, the formation of the solar system, and extrasolar planets and our understanding of other solar systems. Note: PHYS 1403 and PHYS 1404 may be taken in either order.

PHYS 1411. Introduction To Physics I. 4 Hours. [TCCN: PHYS 2425]
Students are introduced to the topics of classical mechanics, including linear motion, forces, rotation, and conservation laws. Considerable attention is given to the solution of problems with the emphasis placed on fundamental concepts. Students must register concurrently for the integrated weekly laboratory problem-solving session.
Prerequisite: MATH 1420.

PHYS 1422. Introduction To Physics II. 4 Hours. [TCCN: PHYS 2426]
Students are introduced to the topics of electricity and magnetism, including Maxwell?s equations, the Lorentz force, and basic electrical circuits. Considerable attention is given to the solution of problems with the emphasis placed on fundamental concepts. Students must register for the integrated weekly laboratory problem-solving session.
Prerequisite: PHYS 1411 and MATH 1430.

PHYS 2426. Heat, Waves & Modern Physics. 4 Hours.
An introduction to topics in heat and wave motion including sound and light. The quantitative description of phenomena is emphasized. The laboratory continues as an integral part of the course.
Prerequisite: PHYS 1411 and MATH 1420.

PHYS 3111. Modern Physics Laboratory I. 1 Hour.
Laboratory taken in conjunction with PHYS 3391. Students reproduce key experimental outcomes underlying 20th century physics.
Prerequisite: PHYS 1422 .

PHYS 3115. Electronic & Circuit Anlys Lab. 1 Hour.
Laboratory taken in conjunction with PHYS 3395. Students construct and analyze advanced circuits including both classical and digital components.
Prerequisite: PHYS 1422 .

PHYS 3117. Astronomy Laboratory. 1 Hour.
1 Credit.

PHYS 3360. Statics And Dynamics. 3 Hours.
Students study equilibrium, using concepts of force and torque. Vectors, calculus and differential equations are used.
Prerequisite: PHYS 1411 and MATH 2440.

PHYS 3370. Intro To Theoretical Physics. 3 Hours.
Students are introduced to essential quantitative analysis tools of theoretical physics. The course focuses on physics applications of series (Taylor, Fourier, Laurent), vector differential equations, and complex analysis. Students register concurrently for the PHYS 4110 laboratory, which introduces technologies such as Python (programming), Mathematica (computer algebra), Linux (operating system) and LaTeX (typesetting) commonly used in research applications.
Prerequisite: PHYS 1422 and MATH 2440.

PHYS 3391. Modern Physics I. 3 Hours.
Students explore the historical breakdown of classical physics that occurred at the beginning of the 20th century, presaging the introduction of Relativity Theory and Quantum Mechanics. Significant treatment of probability and statistics is integral to the understanding of these topics. The PHYS 3111 laboratory must be taken concurrently. PHYS 3111 must be taken concurrently.
Prerequisite: MATH 2440 and PHYS 1422.

PHYS 3395. Electronics & Circuit Analysis. 3 Hours.
Students study advanced circuit analysis, including analog and digital integrated circuits, selected discrete components, and applications to various digital and analog systems. The PHYS 3115 laboratory must be taken concurrently.
Prerequisite: PHYS 1422 .

PHYS 3397. Astronomy. 3 Hours.
Students study the solar system, sun, stars, and stellar systems, their motions, structure, energy sources and evolution, star clusters, interstellar matter, galaxies, and cosmology. The PHYS 3117 laboratory must be taken concurrently.
Prerequisite: PHYS 3117 must be taken concurrently.

PHYS 3398. Astronomy-Honors. 3 Hours.

PHYS 4110. Adv Undergrad Laboratory I. 1 Hour.
This laboratory course provides additional, in-depth hands-on experience designed to complement course work.

PHYS 4113. Light And Optics. 1 Hour.
Laboratory taken in conjunction with PHYS 4333. Students reproduce key experimental outcomes with lensing, reflection, interference and diffraction. Credit 1.

PHYS 4331. Physics For Forensic Sciences. 3 Hours.
Forensic science makes use of a number of physical techniques. Students are provided with an understanding of the physics used in forensic science that enhances the standard introductory physics course. Topics covered may include interior and exterior ballistics, optics, stress and strain, elementary fluid mechanics.

PHYS 4333. Light And Optics. 3 Hours.
The wave theory of light is emphasized. Phenomena such as interference, diffraction and polarization are treated with quantitative detail. The PHYS 4113 laboratory must be taken concurrently.
Prerequisite: PHYS 1422 .

PHYS 4366. Intro Quantum Mechanics. 3 Hours.
The subject of quantum mechanics describes the wave nature of matter, which is relevant at atomic scales. Topics may include the harmonic oscillator, potentials, symmetries, rotation and spin, the hydrogen atom, and atomic spectra.
Prerequisite: PHYS 3391 and MATH 3376 with a grade of C or better.

PHYS 4367. Intro To Solid State Physics. 3 Hours.
Students are introduced to the concepts of crystal structure, crystal diffraction, reciprocal lattices, crystal binding, phonons, the free electron Fermi gas, semi-conductors, energy bands, Fermi surfaces, point defects, and optical properties of crystals.
Prerequisite: PHYS 3391.

PHYS 4368. Electricity And Magnetism. 3 Hours.
Student engage in a more advanced treatment of the classical theory of Electricity and Magnetism which extends the material covered in PHYS 1422. Maxwell?s equations are studied in integral and differential form. Topics may include electro- and magneto-statics and dynamics, potentials, fields, waves, and applications to materials.
Prerequisite: MATH 3376 and PHYS 1422.

PHYS 4370. Classical Mechanics. 3 Hours.
Students engage in a more advanced treatment of the classical theory of Mechanics which extends the material covered in PHYS 1411. Newton?s second law is treated as a differential equation to study kinematics, oscillations, and conservation laws. Lagrangian dynamics are introduced, along with generalized coordinates. Additional topics may include orbital motion, rigid bodies, coupled systems, and effective potentials.
Prerequisite: MATH 3376.

PHYS 4371. Thermodynamcs & Statistcl Mech. 3 Hours.
Students study the statistical basis of the behavior of materials at finite temperatures and densities, deriving basic concepts of classical thermodynamics, including the first and second laws, properties of gases, entropy, and thermodynamic functions from their origins in statistical mechanics.
Prerequisite: PHYS 3391 and MATH 3376.

PHYS 4395. Undergraduate Research. 3 Hours.
Students conduct original research under the direct supervision of a faculty member. Projects may be supervised by non-physics faculty with departmental approval. Each student is expected to demonstrate initiative in planning, performing, and reporting work done on the selected topic. The course may be repeated for up to a total of 6 credit hours with departmental approval. The course may be repeated for an additional three semester hours credit with consent of Department Chair. This course should be taken in addition to hours required for physics major or minor and may be taken for Academic Distinction Credit. See Academic Distinction Program in this catalog.
Prerequisite: Consent of Department Chair.

PHYS 4396. Selected Topics In Physics. 3 Hours.
Students study various advanced topics of contemporary interest in physics. The course is offered upon demand, and content is dependent upon faculty availability and student interest. May be repeated for additional credit with distinct course content. May be repeated for additional credit.
Prerequisite: Consent of the instructor.

PHYS 4398. Senior Thesis. 3 Hours.
This is a directed elective for senior students majoring in physics seeking additional experience in a sophisticated research project. This research is conducted under the supervision of a member of the physics faculty and the results is presented in an organized written form of suitable length with appropriate attention to scholarly norms, including citation of prior works.

Director/Chair: **Joel W Walker**

Dalgis Barras, PHD (dmd073@shsu.edu), *Lecturer of Physics*, *Department of Physics & Astronomy*, PHD, LSU & A&M College; BS, Florida Int'L Univ

James Blackman Dent, PHD (jxd087@shsu.edu), *Associate Professor of Physics*, *Department of Physics & Astronomy*, PHD, Texas A&M University; BS, Univ of Missouri-Rolla

Hui Fang, PHD (hfang@shsu.edu), *Professor of Physics*, *Department of Physics & Astronomy*, PHD, Univ of Houston-Main; ME, Univ of Houston-Main; MS, Zhejiang University; BS, Zhejiang University

Barry Friedman, PHD (phy_baf@shsu.edu), *Professor of Physics*, *Department of Physics & Astronomy*, PHD, Univ of Illinois-Urbana; MS, Univ of Illinois-Urbana; BA, Rice University

Carol Renee James, PHD (phy_crj@shsu.edu), *Professor of Physics*, *Department of Physics & Astronomy*, PHD, Univ of Texas At Austin; MA, Univ of Texas At Austin; BA, Rice University

Gan Liang, PHD (phy_gnl@shsu.edu), *Professor of Physics*, *Department of Physics & Astronomy*, PHD, Rutgers University; BS, Beijing University

Charles R. Meitzler, PHD (phy_crm@shsu.edu), *Associate Professor of Physics*, *Department of Physics & Astronomy*, PHD, Rutgers University; BS, Penn State Un-Univ Park

Scott T Miller, PHD (stm009@shsu.edu), *Professor of Physics*, *Department of Physics & Astronomy*, PHD, Univ of Maryland-College Park; MS, Univ of Maryland-College Park; BA, Rutgers University; BS, Rutgers University

Holly A Sheets, PHD (has040@shsu.edu), *Lecturer of Physics and Astronomy*, *Department of Physics & Astronomy*, PHD, Univ of Maryland-College Park; MS, Dartmouth College; BS, Gettysburg College

William Madsen Shepherd, PHD (shepherd@shsu.edu), *Assistant Professor of Physics*, *Department of Physics & Astronomy*, PHD, Univ of Calif-Irvine; MS, Northwestern University; MS, Northwestern University; BA, Northwestern University; BA, Northwestern University; BA, Northwestern University

Joel W Walker, PHD (jwalker@shsu.edu), *Professor and Chair of Physics*, *Department of Physics & Astronomy*, PHD, Texas A&M University; PHD, Texas A&M University; BS, Harding University; BS, Harding University

Nelka Chithrani Wijesinghe, PHD (ncw020@shsu.edu), *Lecturer of Physics*, *Department of Physics & Astronomy*, PHD, Univ of Houston-Main; MS, Univ of Houston-Main; BSC, Univ of Peradeniya