PHYSICS & ASTRONOMY
Graduate Program
EXCELLENCE IN THE 21ST CENTURY
Physics and Astronomy at The University of Alabama

With world-class facilities, financial support, and young, energetic faculty, the graduate program at The University of Alabama is dedicated to helping you realize your potential.

The Department of Physics and Astronomy at The University of Alabama provides an exciting opportunity for students to work on cutting-edge research with internationally renowned scholars, and receive the intensive preparation required for today’s top positions in industry and academia.

Over the last 10 years, we have recruited over 20 new faculty members, each a world-class researcher in their own right. This rapid growth has resulted in a young, vibrant faculty focused on bringing world-class research and training to their graduate students.

State-of-the-art research laboratories are augmented by world-class user facilities across campus and dedicated clean room, analytical, and machine shop staff to assist and train researchers in the latest techniques and equipment.

We offer doctor of philosophy (PhD) and master of science (MS) degrees in physics, with the option of specialization in astronomy. Although we offer a course-only MS, our graduate program is mostly oriented toward current physics research.

Research toward a degree may be conducted in either experimental or theoretical areas. Fields of strength at UA include astronomy and astrophysics, condensed matter, elementary particles, high energy, and particle physics.

Our department is fully committed to the success of our graduate students. All students admitted to the graduate program are fully supported financially by either teaching assistantships, research assistantships, or fellowships.

For more information on applying, or if you would like to set up a visit, please contact the graduate admissions director at physgrad@ua.edu.
A core research strength at The University of Alabama

PHYSICS AND ASTRONOMY:

State-of-the-art user facilities and regular access to national research laboratories complement our faculty members’ world-class group laboratories.

Although there is significant collaboration across borders, research is nominally broken down into either experimental or theoretical groups. Experimental strengths include magnetic materials, high-energy physics, materials science, extragalactic astronomy, and particle astrophysics. Theoretical programs include condensed matter, elementary particles, atomic and molecular physics, extragalactic astronomy, astrophysics, and particle astrophysics.

Observational and theoretical astronomy research programs include galaxy interactions and morphology, active galaxies and quasars, galaxy and gas dynamics in clusters of galaxies, thermonuclear supernovae, and the cosmological distance scale. Faculty and students use national observatories, the Hubble Space Telescope, and various satellites to collect data.

Experimental and theoretical condensed matter includes cutting edge interdisciplinary research at the Center for Materials for Information Technology (MINT), and frequent trips to Argonne, Brookhaven, and Oak Ridge National Laboratories. Research at the MINT center focuses on nanometer scale science and technology, magnetic materials, and devices for information storage. This includes spin electronics, novel strategies for information storage, and the theoretical and experimental study of the electronic and magnetic properties of novel materials.

Particle astrophysics uses fundamental particles to explore some of the most extreme objects in the universe, and uses astronomical signals to push the boundaries of particle physics. Experimental activities center on the IceCube Neutrino Observatory at the South Pole, and theoretical activities focus on the phenomenological aspects of new physics beyond the Standard Model such as supersymmetry, extra dimensions and Grand Unified Theories.

Theoretical particle and nuclear physics research is being pursued by a group of 4 faculty members and currently 7 graduate students. The research projects being carried out by the faculty include both individual projects and joint projects within the group. The individual projects are in the areas of phenomenology, cosmology, holography (gauge/gravity correspondence), and matrix models of physical systems. The joint projects within the group involve topics such as application of holographic methods, topological solitons, the quark-gluon plasma, and the universe shortly after the big bang.”

Experimental nuclear and particle physics researchers at UA collaborate on international experiments that seek to answer some of the most fundamental questions in particle physics. We are involved in: searches for new physics beyond the Standard Model at the energy frontier with the CMS experiment at CERN’s Large Hadron Collider; direct Dark Matter detection with the LZ experiment; searches for magnetic monopoles with the MoEDAL experiment at CERN; and an attempt to understand the nature of the neutrino by searching for neutrinoless double beta decay with the EXO-200 and nEXO experiments. These activities involve collaboration with institutions and laboratories across the world, and include travel to the sites of our projects in Switzerland, South Dakota, and New Mexico. Facilities within the group include a state of the art radiation detection lab, cleanroom labs for preparing samples for trace (ppt) analysis, and a full set of tools and instruments for developing and characterizing devices for detector calibration.
FACULTY SPOTLIGHTS

Dr. Claudia Mewes’ research combines different theories and simulation tools to close the gap between materials design and device performance with the ultimate goal of finding new materials that work best in confined environments. In 2015, she won a CAREER award from the National Science Foundation for her research in spintronics, which aims to use the spin and charge of electrons to develop highly functional and energy-efficient devices. Dr. Mewes is a 2016 recipient of the President’s Faculty Research Award, co-founder of the UA Women in Physics Club, and founder of the UA Girls in Science program, which brings hands-on STEM activities to girls at local high-need middle schools.

Dr. Jeremy Bailin studies the structure and history of galaxies like our Milky Way, especially focusing on their stellar and dark matter halos. His primary tool is large scale supercomputer simulations, while also incorporating observations taken with the Hubble Space Telescope and radio telescopes. His research on the structure and history of simulated galaxies has been funded by NASA via the Space Telescope Science Institute and the NSF, and includes the participation of a plethora of undergraduate and graduate student researchers. He received the 2015-2018 College of Arts and Sciences Distinguished Teaching with Technology Fellowship in recognition of his innovation in the classroom, and is interested in understanding what teaching methods truly promote student learning.
The Department of Physics and Astronomy offers the doctor of philosophy (PhD) and master of science (MS) degrees in physics, with the option of specialization in astronomy. Although we offer a course-only MS, our graduate program is mostly oriented toward current physics research. Experimental programs include magnetic materials, high-energy physics, materials science, observational extragalactic astronomy, and particle astrophysics. Theoretical programs include condensed matter, elementary particles, atomic and molecular physics, extragalactic astronomy, astrophysics, and particle astrophysics.

Physics graduate students begin by taking core physics courses in Classical Mechanics, Electromagnetism, Quantum Mechanics, and Statistical Physics. Astronomy students typically substitute a course in Radiative Processes for the second semester of Electromagnetism, and take Theoretical Astrophysics instead of Quantum Mechanics II. Students also take at least four elective courses in their chosen broad area of research.

Students receive instruction formally and informally through classwork and laboratory instruction from faculty, postdoctoral scholars, and research scientists. All students admitted to the graduate program are fully supported financially by either teaching assistantships, research assistantships, or fellowships.

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**EXAMPLE COURSE SEQUENCES**

### Astronomy

**FIRST YEAR**
- **FALL SEMESTER:** Classical Mechanics, Electromagnetic Theory I
- **SPRING SEMESTER:** Radiative Processes, Quantum Mechanics I, Statistical Physics

**SECOND YEAR**
- **FALL SEMESTER:** Theoretical Astrophysics, Stars and Stellar Evolution
- **SPRING SEMESTER:** Galaxy and Stellar Dynamics, Extragalactic Astrophysics

### Condensed Matter

**FIRST YEAR**
- **FALL SEMESTER:** Classical Mechanics, Electromagnetic Theory I
- **SPRING SEMESTER:** Electromagnetic Theory II, Quantum Mechanics I, Statistical Physics

**SECOND YEAR**
- **FALL SEMESTER:** Quantum Mechanics II, Magnetism and Magnetic Materials, Advanced Laboratory
- **SPRING SEMESTER:** Solid State Physics, Advanced Magnetic Phenomena, Research Techniques

### Nuclear & Particle Physics

**FIRST YEAR**
- **FALL SEMESTER:** Classical Mechanics, Electromagnetic Theory I
- **SPRING SEMESTER:** Electromagnetic Theory II, Quantum Mechanics I, Statistical Physics

**SECOND YEAR**
- **FALL SEMESTER:** Quantum Mechanics II, Nuclear and Particle Physics
- **SPRING SEMESTER:** Quantum Field Theory, High-Energy Physics, Relativity and Cosmology
2015-2016 Graduate Class Averages

Domestic/International: 44%/56%
GPA: 3.7 (3.4-3.9 range)
Physics GRE (raw): 723 (610-860*)
Physics GRE (%): 55% (31-80%*)
General GRE: 313 (300-329)

*Some students were admitted without a Physics GRE score.

HOW TO APPLY

Admission Requirements

The minimum requirements for admission include a combined verbal plus quantitative score of at least 300 on the general GRE (1,000 on the prior scoring system); this GRE score must be less than five years old at the time of enrollment.

For applicants whose first language is not English, we require a TOEFL score of at least 550 on the paper-based test (PBT) or 213 on the computer-based test (CBT) or 79 on the internet-based test (iBT) or an iELTS score of at least 6.5; these scores need to be less than two years old at the time of enrollment. If you have received a degree from a U.S. institution within three years of the time of enrollment, a TOEFL score is not necessary.
Boasting a low cost of living and a small-town feel, Tuscaloosa also offers big-city amenities, a vibrant nightlife, concert and art events, and scenic outdoor recreation.

In recent years, Tuscaloosa has been named the “Most Liveable City in America,” one of America’s “100 Best Communities for Young People,” one of the “50 Best College Towns,” and one of the “Best Places to Launch a Small Business.”
The University of Alabama is committed to providing an environment for employees, students and campus visitors that is free from harassment based on race, color, religion, ethnicity, national origin, sex (which includes sexual orientation, gender identity and gender expression), age, disability or veteran status.