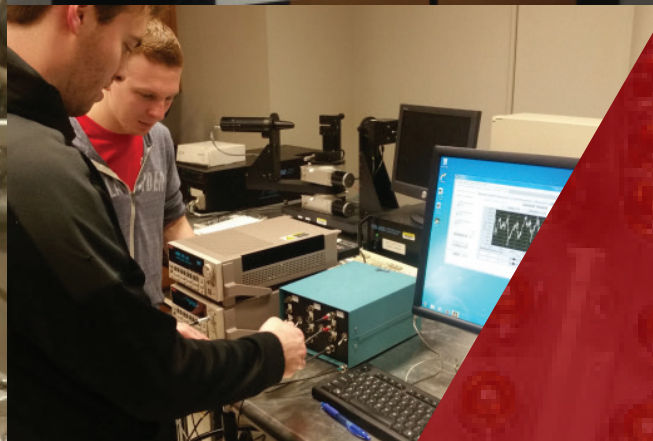
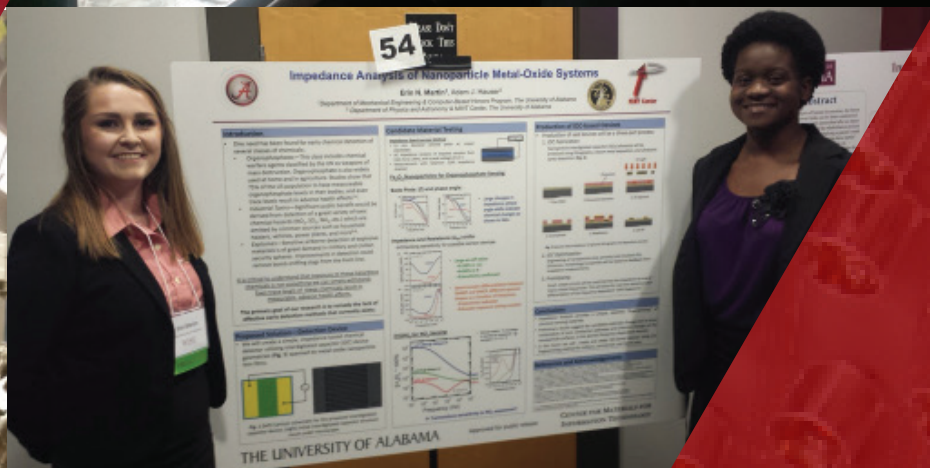


# PHYSICS & ASTRONOMY

Graduate Program



THE UNIVERSITY OF ALABAMA®

# EXCELLENCE IN THE 21<sup>ST</sup> CENTURY

## Physics and Astronomy at The University of Alabama

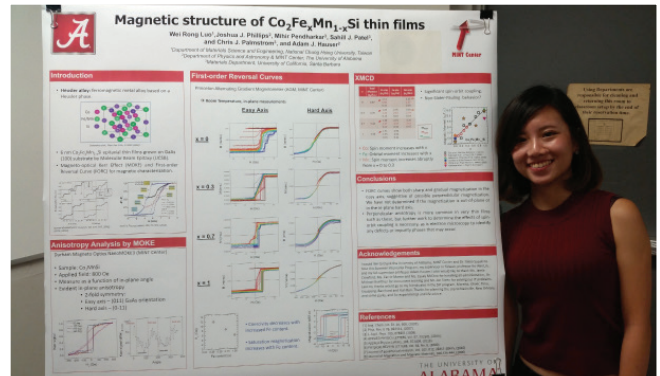
With world-class facilities, financial support, and young, energetic faculty, the graduate program at The University of Alabama is dedicated to helping you realize your potential.

The Department of Physics and Astronomy at The University of Alabama provides exciting opportunities 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. While we offer a course-only MS, our graduate program is primarily focused on 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](mailto:physgrad@ua.edu).





# PHYSICS AND ASTRONOMY:

## A core research strength at The University of Alabama



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

**A**lthough 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, 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 be-

yond 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.

# MEET OUR FACULTY

\$8.1 Million Grants and Research Expenditures, 2017  
3 Young Investigator Awards, 2014-2017  
60% of faculty hired in the last 10 years

## ASTROPHYSICS

Jeremy Bailin, PhD, University of Arizona  
Dean Townsley, PhD, UC Santa Barbara

## CONDENSED MATTER EXPERIMENT

Paulo Araujo, PhD, Minas Gerais  
Adam Hauser, PhD, The Ohio State University  
Patrick LeClair, PhD, Eindhoven  
Gary J. Mankey, PhD, Penn State University  
Tim Mewes, PhD, Kaiserslautern  
Rainer Schad, PhD, Hanover

## CONDENSED MATTER THEORY

Claudia Mewes, PhD, Kaiserslautern  
Sanjoy K. Sarker, PhD, Cornell University  
Georg Schwiete, PhD, Bochum  
Wang-Kong Tse, PhD, Maryland University

## EXTRAGALACTIC ASTRONOMY

Ronald J. Buta, PhD, University of Texas  
Jimmy Irwin, PhD, University of Virginia  
William C. Keel, PhD, UC Santa Cruz  
Preethi Nair, PhD, Toronto  
Raymond E. White, PhD, University of Virginia

## PARTICLE ASTROPHYSICS EXPERIMENT

Marcos Santander, PhD, University of Wisconsin-Madison  
Dawn R. Williams, PhD, UC Los Angeles

## PARTICLE ASTROPHYSICS THEORY

Nobuchika Okada, PhD, Tokyo Metropolitan

## PARTICLE PHYSICS EXPERIMENT

Jerome K. Busenitz, PhD, University of Illinois  
Conor Henderson, PhD, MIT  
Igor Ostrovskiy, PhD, University of Alabama  
Andreas G. Piepke, PhD, Heidelberg  
Paolo Rumerio, PhD, Northwestern University  
Ion Stancu, PhD, Rice University

## PARTICLE PHYSICS THEORY

Benjamin C. Harms, PhD, Florida State University  
Matthias Kaminski, PhD, LMU Munich  
Nobuchika Okada, PhD, Tokyo Metropolitan  
Allen Stern, PhD, Syracuse University

## 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 & 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.



# COURSEWORK

The graduate program at UA provides a deep foundation in physics and mathematics, as well as specialized offerings on research-level special topics and advanced techniques.

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 formal and informal instruction 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.

## EXAMPLE COURSE SCHEDULES

### 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

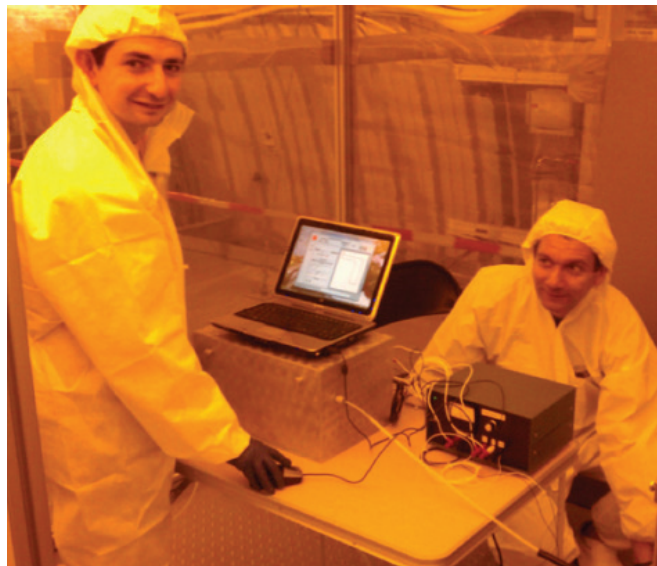


# DEPARTMENTAL STATISTICS

## 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); GRE scores 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.



## 2016-2017 Graduate Class Averages

Average undergrad GPA: 3.6 (3.0 - 3.9) — on 4.0 point scale.

*For international/transfer students:*

Average graduate MS GPA: 3.7 (3.4 - 3.9)

Grad MS percentage: > 70%

Average GRE general score: 319 (304 - 335)

Average GRE quant percentile: 85% (47% - 97%)

Average PGRE score: 830 (660 - 990)\*

Average PGRE percentile: 73% (42% - 94%)

\*Some students were admitted without a Physics GRE score.

Average TOEFL: 102 (89 - 116)



# GRADUATE FAQ



## 1. What factors are important in securing a graduate position at UA?

Graduate admission decisions are based on your entire application package. Some specific criteria include:

- Proficiency (A to B average) in undergraduate physics, especially upper level physics courses.
- GRE scores higher than 300, in particular a strong performance in the quantitative section.
- Previous research experience, conference presentations, and journal publications are looked upon very favorably.
- Reference letters by research advisors and upper level physics instructors are very important.
- A statement of purpose that shows familiarity with research areas and potential faculty advisers.
- While the Physics GRE is not required, note that a score above 70th percentile will waive the PhD qualifying exam requirement.

## 2. What is the due date for applications?

In order to be considered for university fellowships all application materials should be received by December 15. To receive full consideration for departmental support via graduate teaching or research assistantships, all application materials should be received by February 15.

## 3. How are graduate students supported financially?

Financial support is available for PhD students in good academic standing either through teaching assistantships, research assistantships, or fellowships. Tuition and fees are waived. Graduate students who are supported by an assistantship or a fellowship also receive free health insurance. Students are also strongly encouraged to apply for external graduate fellowships. Further details on financial support can be found at the webpage:

<https://physics.ua.edu/graduate-program/teaching-and-research-assistantships/>

## 4. What are my prospects after graduation?

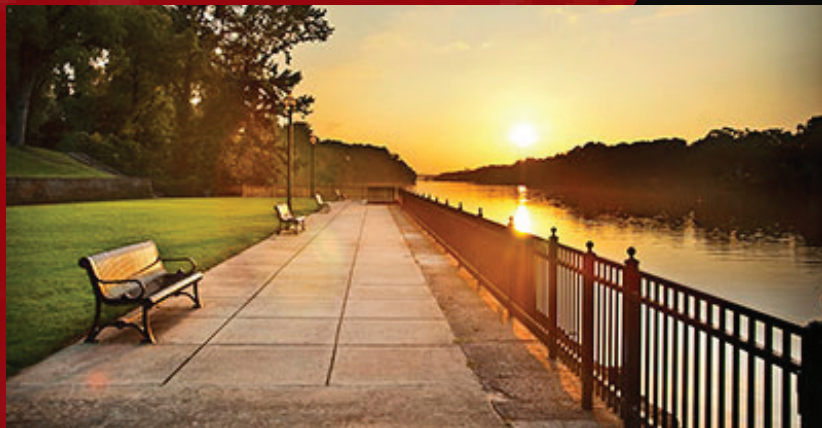
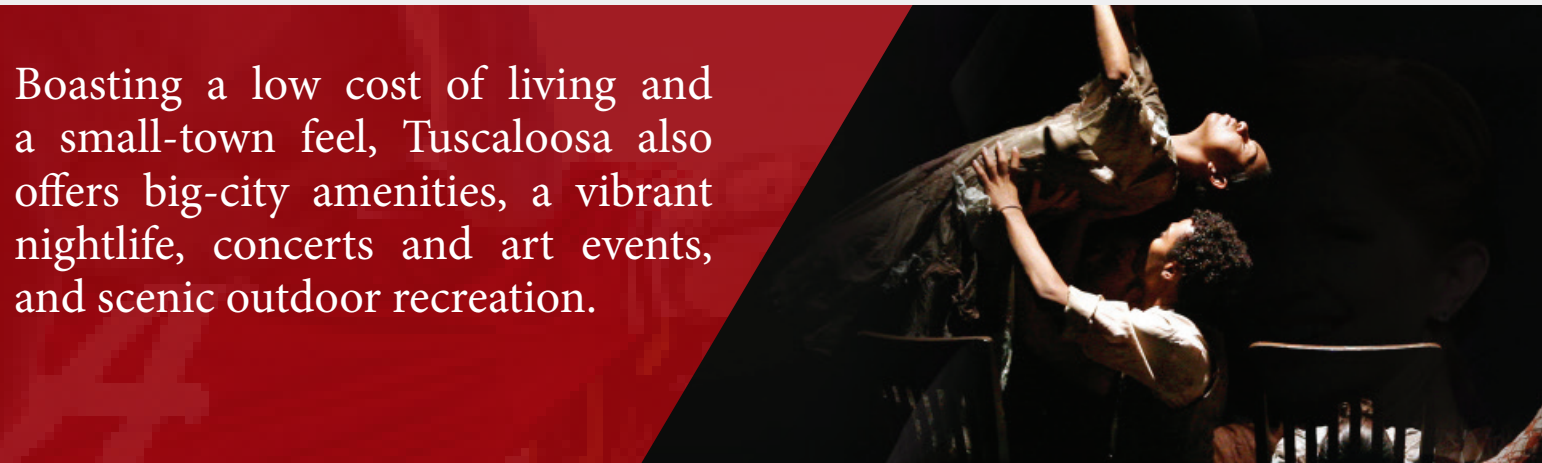
Students who graduate with an MS or PhD in Physics/Astronomy from UA have moved into multiple career paths, including academia, national labs, industry, teaching, as well as non STEM fields. Please visit our Alumni page for information on career paths taken by our recent graduates: <https://physics.ua.edu/physics-astronomy-alumni/>

More information available here: <https://physics.ua.edu/graduate-program/graduate-admissions/>



# TUSCALOOSA: A HIDDEN GEM

Boasting a low cost of living and a small-town feel, Tuscaloosa also offers big-city amenities, a vibrant nightlife, concerts 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.”



# FINANCIAL SUPPORT

The University of Alabama offers highly competitive fellowship, assistantship, and scholarship support to our 4500+ graduate and professional students.

Unless otherwise noted, contact Andrew Goodliffe at [amg@ua.edu](mailto:amg@ua.edu) for more information.



## GRADUATE TEACHING ASSISTANTSHIPS (GTA)

Graduate Teaching Assistants (GTA) typically lead laboratory class sections, grade coursework, provide tutoring, and lead lectures. GTAs are covered by the department for full tuition and benefits in year 1 without teaching duties. A stipend will also be offered at the standard yearly physics rate of approximately \$2,083/mo.

## GRADUATE COUNCIL FELLOWSHIPS

For exceptional students, the graduate council fellowship covers full tuition and benefits in year 1 without teaching duties. A stipend will also be offered at the standard yearly physics rate of approximately \$2,083/mo.

## DAVID A. FRANKO FELLOWSHIP

A special elite subsection of the Graduate Council Fellowship, the Franko fellowship gives a stipend of \$25,000/year for up to five years plus a full tuition scholarship, with an added supplement of \$8000 (for a total of \$33,000/year) in years 1 and 2.

## MCNAIR GRADUATE SCHOLARSHIP

A full tuition scholarship for underrepresented minority or first-time college applicants. Those who have completed a Ronald E. McNair Post-Baccalaureate Achievement Program at any US university may qualify for a full tuition scholarship for the duration of their program.

## NATIONAL ALUMNI ASSOCIATION FELLOWSHIP

Applicants must be residents of the State of Alabama. Nominations are made through the prospective/current program. For more information, contact Kathleen Nodine at [knodine@ua.edu](mailto:knodine@ua.edu).

## RESIDENTIAL/TUTWILER/MERIT SCHOLARS

Presidential Scholars, Tutwiler Scholars, or National Merit/National Achievement Finalists who graduate early and have not used all of their scholarship benefit during their undergraduate program may apply any remaining tuition benefit to a graduate program at The University of Alabama.

## JOINT FACULTY DEVELOPMENT FELLOWSHIP

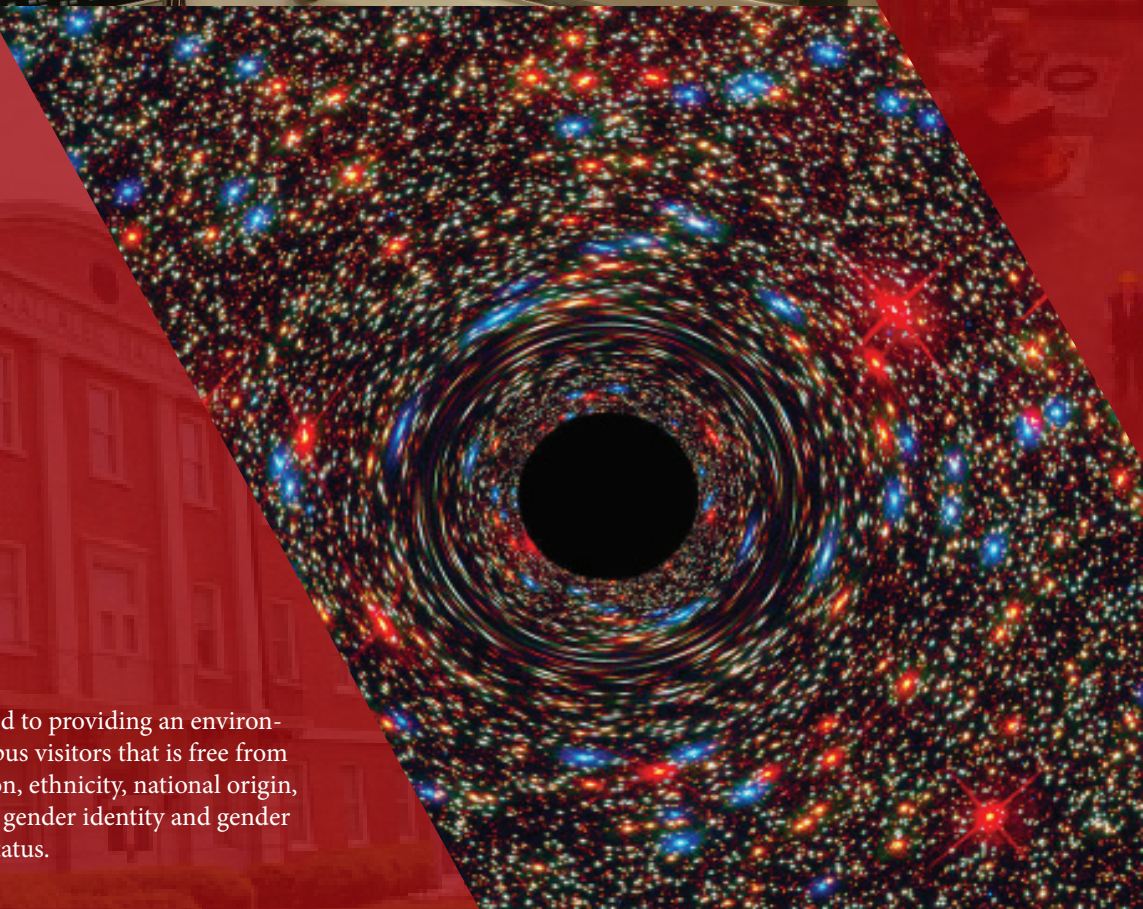
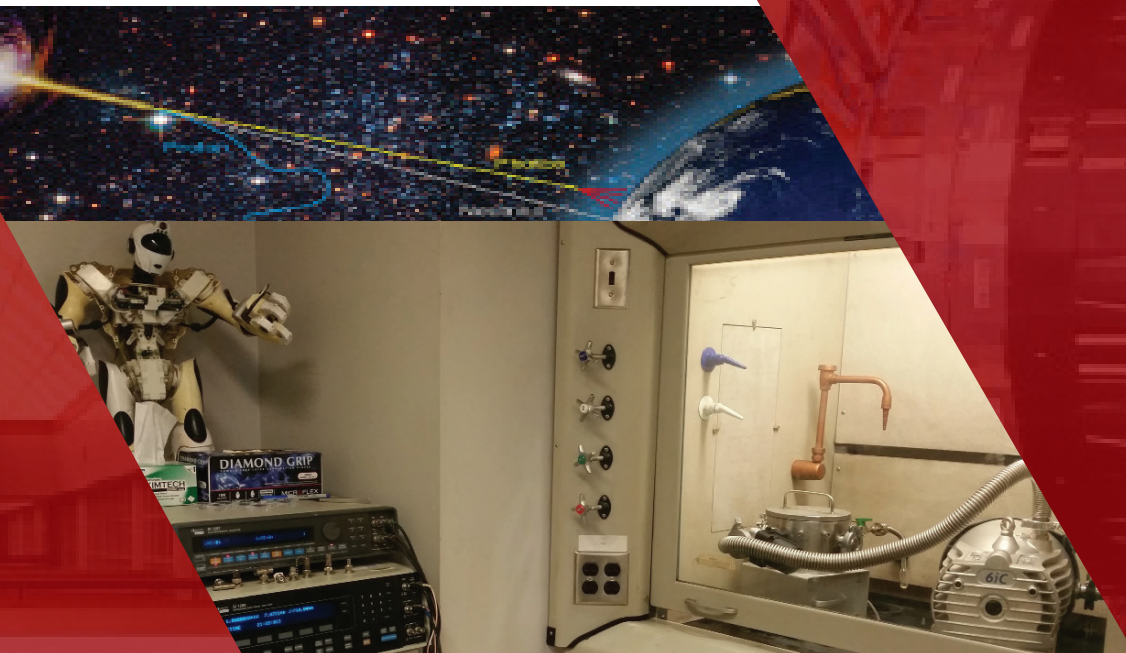
Alabama A&M University, Alabama State University, Oakwood College, and Stillman College faculty who do not have a terminal degree in their field of instruction can be nominated for this fellowship by their home institution.





## CONTACT US

Department of Physics and Astronomy  
physgrad@ua.edu | physics.ua.edu | (205) 348-5050



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.