The graduate program in Physics offers a comprehensive education in physics and opportunities to engage in experimental and theoretical research with internationally recognized groups using state-of-the-art techniques and instrumentation. We also offer a collegial, supportive atmosphere, with close interactions among students, faculty and staff that are unique to a “Tier-1” research university.

RESEARCH CONCENTRATIONS
Our program awards both a Ph.D. in Physics and a combined Physics Ph.D./Computational Science M.S. degree. The research in the Department is focused in four principal areas, which are currently among the most active in the basic and applied physical sciences. Both experimental and theoretical research is conducted in the Department in each of these areas.

BIOPHYSICS AND LIVING SYSTEMS investigates problems at the interface of physical and life sciences. Molecular biophysics addresses the contributions of molecular structure and dynamics to biological function. Spectroscopic investigations of catalysis in metallo-enzymes use steady-state and time-resolved techniques of electron paramagnetic resonance and transient optical absorption spectroscopies. Experimental approaches to elucidating cellular and biomolecular processes use high-sensitivity fluorescence methods, including fluorescence correlation spectroscopy. Single molecule fluorescence resonance energy transfer, single molecule particle tracking, as well as magnetic tweezers techniques are used to study nucleic acid structures and protein-DNA interactions. Theoretical statistical physics is used to understand how biological systems, from molecular circuits and single neurons to brains and populations, learn from their environment and respond to it. Numerical and analytic models are used to analyze biological populations to predict their future evolution.

PROFESSIONAL DEVELOPMENT
The Laney Graduate School offers a range of programs that encourages students to develop their professional skills, engage with broader professional communities, and prepare for their careers.

VISIT GS.EMORY.EDU TO LEARN MORE.
CONDENSED MATTER PHYSICS AND OPTICS group at Emory investigates nanoscale systems where surfaces, interfaces, and confinement effects result in new physical phenomena. Such phenomena are expected to be important for the development of future information technology, novel sensors, and artificial intelligence. Studies include nanoscale magnetic (spintronic) devices, nano-optical systems and devices, plasmonics, two dimensional materials, effects of topology on the electronic and magnetic properties of nano-structures, strongly correlated electronic materials, and complex magnetic and electronic systems. Our research in optics and light matter interactions at the nanoscale (nano-photronics) focuses on the influence of dimensionality, structure, composition, and nonlinearities in electromagnetic phenomena. Our investigations of the roles of geometry and topology in reduced dimensions, e.g., in atomically thin 2D materials, are aimed to achieve the ability to control and manipulate charge carriers and their degrees of freedom such as charge, spin, and pseudo-spin, especially in the context of quantum optics and strong light-matter interactions.

SOFT MATTER PHYSICS research addresses the properties of materials that display both fluid and solid behavior (“complex fluids”). It examines the connection between microscopic and macroscopic properties. Microscopy techniques are used to study phase transitions in colloidal systems. Light scattering, rheology, thermal imaging and microfluidics are used to investigate fluid dynamics and multi-phase flow. Experiments on polymers concern the glass transition, structural relaxation, miscibility, and nanoscale interactions in polymers that affect dynamics at and near interfaces. Equilibrium properties of glasses are studied from molecular to microscopic to macroscopic scales, with jamming and granular studies even used to mimic natural phenomena at geophysical scales.

STATISTICAL AND COMPUTATIONAL PHYSICS addresses equilibrium and non-equilibrium properties of condensed matter. Theoretical and computational work investigates the emergence of complex collective behavior, pattern formation under far from equilibrium conditions, the glass transition, fracture propagation, dynamical synchronization in complex networks, self-organized criticality, optimization, non-equilibrium growth phenomena, fractals, and kinetic roughening of surfaces and interfaces. Theoretical and computational methods are also being applied to problems in biological physics, including vascularization, dynamics of molecular motors, morphogenesis, and intracellular active transport and jamming.

Visit our website for links to more information about all of our research groups, at http://physics.emory.edu/graduate.

Physics researchers benefit from close interdisciplinary interactions and collaborative opportunities with other graduate programs and research centers at Emory University. Among the closely collaborating units are the Department of Mathematics and Computer Science, which is also located in the Math and Science Center Building, and the Department of Chemistry and the Emerson Center for Scientific Computation located across the street. Researchers at Emory’s renowned School of Medicine are a short walk away.

CURRICULUM

RESEARCH ROTATIONS: PROCESS OF IDENTIFYING A PH.D. ADVISOR

Students entering our program get to spend the first month talking with various faculty members about their research and identify two potential Ph.D. Advisors. They then get to try out those two potential advisors by doing research rotations with each one during the fall and spring semesters of the first year.

During this process students will join the prospective group and get “hands on” experience on a research project to evaluate their interest in the research area and determine if this would be a good match for their dissertation. Students interact closely with the potential Advisor and their group members.

Each rotation culminates with a summary report that undergoes feedback and revision with the Advisor to gain scientific writing experience. Having identified their Ph.D. Advisor, students begin their dissertation research in earnest during their first summer. A research report and literature summary is prepared by the student at the end of the first summer to prepare them for their Qualifier Proposal. Students also give a presentation of their research progress to the faculty and students.

COURSEWORK

Students usually complete most of their course requirements in the fall and spring semester of their first year, leaving only a couple of elective courses related to their Ph.D. research for later years. All students must pass, by obtaining a grade of a B- or better, the four core courses (Statistical Physics, Quantum Mechanics, Electrodynamics, and Classical Mechanics). This replaces our need of a traditional qualifier exam on core physics principles typically found in most physics graduate programs, allowing our Qualifier Proposal to be entirely research based. Students who enter our program with an MS degree may test out of the core courses and immediately enter advanced standing. Beyond the four core courses, students need only take four electives, one of which may be advanced lab if they do not have an equivalent senior experimental course from their B.S degree.

Many of our elective courses offered provide introduction to the varied areas of research: solid-state, nanophotonics, soft matter, polymers, continuum mechanics, biomacromolecules, molecular and single molecule biophysics, theoretical tools in physical biology, advanced statistical physics, etc. For more detailed information about course requirements for the physics Ph.D. program, as well as the Physics PhD/Computational Sciences MS degree, please visit: http://www.physics.emory.edu/home/academic/graduate/guide.html.

TEACHING

Participation in Emory’s Teaching Assistant Training and Teaching Opportunity (TATTO) Program for three semesters introduces students to current pedagogical techniques and practices. Students gain first-hand experience by being instructors for one of our undergraduate laboratory courses, and by working closely with a faculty member as a co-teacher for one semester in a Physics lecture course. Other teaching opportunities are available on a competitive basis (PRSIM and ORDER).
**PH.D. QUALIFICATION PROCESS**

The Qualifier Proposal assesses the student’s ability to carry out dissertation level research evaluating their ability to independently read the research literature and develop their own ideas into a well throughout research proposal. This process evaluates and trains students in the practical and creative aspects of scientific research with heavy emphasis on the ability to formulate, articulate, and justify scientific ideas. Our program does not have a traditional qualifier exam testing the ability to do standard physics problems. Instead, the Physics Qualifier Proposal at Emory involves the preparation of a research proposal that is conceived, literature-researched, and presented by the student in the spirit of a small grant proposal. Formally the function of the qualifier process is to determine the student’s ability to progress further towards the Ph.D.

**DISSERTATION**

Once students have successfully completed the qualifier process, they should form their Ph.D. Dissertation Committee. This consists of five faculty members (the Ph.D. Advisor, three faculty members within the Physics Graduate program one of which is in a different research area, and a faculty member external to the Physics Graduate program that is familiar with the research area). Students meet with their Dissertation Committee once a year to provide an update on their research and discuss progress towards their Ph.D. degree, evaluating whether the body of research appropriately warrants a Ph.D. in Physics. With approval from the Dissertation Committee, the Ph.D. culminates in an oral defense of their research. Finally the Ph.D. Degree is awarded with the submission of a successfully defended dissertation thesis to the Laney Graduate School.

All graduate students receive comprehensive funding, including competitive stipends ($25,000 for 12 months) plus full tuition coverage, Emory’s student health insurance, and conference travel support. These awards are renewed each year, contingent upon satisfactory academic performance. Eligible applicants are nominated for the George W. Woodruff Fellowship or the Emory Graduate Diversity Fellowship, two school-wide fellowships renewed each year, contingent upon satisfactory academic performance. Awards are competitive stipends ($25,000 for 12 months) plus full tuition coverage, Emory’s student health insurance, and conference travel support. These awards are renewed each year, contingent upon satisfactory academic performance. Eligible applicants are nominated for the George W. Woodruff Fellowship or the Emory Graduate Diversity Fellowship, two school-wide fellowships.

Exceptionally qualified physics graduate students with research interests related to population dynamics and human health may be considered for admission with a fellowship under the interdisciplinary Molecules to Mankind (M2M) program at Emory, supported by a Burroughs Wellcome Fund.

**FACULTY**

The Department of Physics faculty is composed of 16 members at the three professorial ranks and 3 lecturers.

**THE BIOPHYSICS GROUP** includes Professors Berland, Finzi, Kim, and Warncke (experiment), and Berman, Nemenman and Weissman (theory).

**CONDENSED MATTER PHYSICS AND OPTICS GROUP** includes Professors Harutyunyan and Urazdin (experiment), and Srivastava (experiment and theory).

**SOFT MATTER GROUP** includes Professors Burton, Roth, and Weeks (experiment). Statistical and Computational Physics Group includes Professors Boettcher, Family, and Hentschel (theory).

Our website has a complete list of faculty members, with links to their individual pages containing information about teaching, research and more. Visit: http://physics.emory.edu/home/people/faculty/index.html

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**LANEY GRADUATE SCHOOL DEGREE PROGRAMS**

- Anthropology
- Art History
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- Bioethics
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- Cancer Biology
- Genetics and Molecular Biology
- Immunology and Molecular Pathogenesis
- Microbiology and Molecular Genetics
- Molecular and Systems Pharmacology
- Neuroscience
- Population Biology, Ecology, and Evolution
- Biomedical Engineering
- Biostatistics
- Business
- Chemistry
- Clinical Psychology
- Cognition and Development (Psychology)
- Comparative Literature
- Computer Science and Informatics
- Development Practice
- Economics
- English
- Environmental Health Sciences
- Environmental Sciences Epidemiology
- Film and Media Studies
- French
- History
- Health Services Research and Health Policy
- Islamic Civilizations Studies
- Mathematics
- MD/PhD
- Music
- Neuroscience and Animal Behavior (Psychology)
- Nursing
- Nutrition and Health Sciences
- Philosophy
- Physics
- Political Science
- Religion
- Sociology
- Women’s, Gender, and Sexuality Studies

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**Requests for Additional Information:**

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**EMORY DIVERSIFYING GRADUATE EDUCATION**
Emory’s Physics Department focuses on several emerging research areas:

- Nanoscience and optics
- Biophysics and living systems
- Soft matter physics
- Nonlinear and statistical physics

Program benefits for PhD candidates:

- Lab rotations prior to joining a group
- State-of-the-art research facilities
- Travel awards for scientific conferences
- Small classroom environment
- Direct interaction with faculty advisors
- Tuition and living expenses included

Physics at Emory

- Beautiful campus setting in a quiet residential neighborhood
- Access to Atlanta’s unique restaurants, shopping, and nightlife
- Collaboration with leading international scientists

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