PHYSICS (PHD)

Graduate School

Program Website (https://physics.cornell.edu/graduate/)

CIP: 40.0801 | **HEGIS:** 1902.00 | **NYSED:** 13444

Graduate Field

Physics (https://catalog.cornell.edu/graduate-school/physics/)

Program Description

The graduate physics program is designed to give students an adequate background in the concepts and techniques of theoretical and experimental physics in preparation for careers at the most advanced level in research or teaching.

Research and Study Opportunities

Theoretical physics - Condensed Matter: Subjects for study include mesoscopic systems and random matrix theory; collective properties of Bose and Fermi condensates; density functional theory (electronic and liquid) with applications to surface growth and interfaces, defects in solids, matter under extreme conditions, and nanophysics; statistical mechanics and critical phenomena applied to crackling noise, dynamical systems, biological systems, and quasicrystals; inverse problems in protein crystallography; strongly interacting electron physics of magnetism, superconductors, and disordered systems.

Theoretical physics - Particle and Astrophysics: Physics of extra dimensions and supersymmetry, mechanisms for electroweak symmetry breaking, collider phenomenology; lattice gauge theories; particle astrophysics and cosmology; string theory and its application to cosmology, brane world; field theories; astrophysics; black holes; and general relativity.

Experimental particle physics: Our research uses the Large Hadron Collider (LHC) at CERN, which is the first collider to explore the TeV energy scale, where the Standard Model of particle physics must break down unless new phenomena appear. Cornell is a member of CMS, one of two detector collaborations for elementary particle physics at the LHC. Research topics include mechanisms for electroweak symmetry breaking, including the Higgs mechanism and alternatives, scenarios for physics beyond the Standard Model such as supersymmetry, extra dimensions and new strong interactions, top quark physics, and dark matter. Cornellians are designing online software for the pixel detector, developing strategies for identifying electrons in the electromagnetic calorimeter, writing analysis software capable of handling petabytes of data distributed world-wide, and ensuring that the trigger will successfully pluck new physics out of the huge background of conventional processes. In the next few years, they will also start developing hardware upgrades of the pixels and the trigger.

Accelerator Physics: The electron-positron collider CESR at Cornell University is used as a test-bed for accelerator physics and for X-ray science. Having this large accelerator on campus provides a unique opportunity for students interested in many aspects of accelerator physics. Currently, CESR is testing design concepts for the Linear Collider, which will be the world's largest high-energy physics accelerator. Accelerator research also includes an active program to develop the superconducting radio-frequency cavities needed for the next generation of electron-positron colliders and for future X-ray facilities. The group is also developing a new X-ray facility, the Energy Recovery Linac, for the Cornell campus that offers students the unique opportunity to join a large-scale science project in an early state where many phenomena are still unknown, many parameters need to be computed, and many important decisions are being made.

Experimental condensed matter physics: Subjects of study include nanostructures and quantum transport; superfluid, solid, and supersolid helium; atomic-resolution STM and tunneling spectroscopy; photoemission spectroscopy; high-temperature superconductivity; nanomagnetics; new forms of scanning-probe microscopy; nanomechanical systems and limits of quantum m&

Concentrations

- Experimental physics
- Physics
- Theoretical physics

Program Information

- Instruction Mode: In Person
- Location: Ithaca, NY
- Minimum Credits for Degree: 72

Program Requirements

- Minimum Semesters for Degree: 6

Graduate School Milestones

- Responsible Conduct of Research Training: Required
- Open Researcher and Contributor ID (ORCID): Required
- Student Progress Reviews (SPR) begin: Second Year
- Examination for admission to candidacy (A Exam): Spring of third year
- Defense of Dissertation (B Exam): Spring of seventh year

Field Specific Milestones

- Qualifying examination (Q Exam): Spring of first year

Course Requirements

- Course requirements are determined by the student's Special Committee.
- Enrollment in a GRAD research course or the equivalent field specific research course is expected of all students.

University Graduation Requirements Requirements for All Students

In order to receive a Cornell degree, a student must satisfy academic and non-academic requirements.

Academic Requirements

A student's college determines degree requirements such as residency, number of credits, distribution of credits, and grade averages. It is the student's responsibility to be aware of the specific major, degree, distribution, college, and graduation requirements for completing their chosen program of study. See the individual requirements listed by each college or school or contact the college registrar's office (https://

registrar.cornell.edu/service-resources/college-registrar-directory/) for more information.

Non-academic Requirements

Conduct Matters. Students must satisfy any outstanding sanctions, penalties or remedies imposed or agreed to under the Student Code of Conduct (Code) or Policy 6.4. Where a formal complaint under the Code or Policy 6.4 is pending, the University will withhold awarding a degree otherwise earned until the adjudication process set forth in those procedures is complete, including the satisfaction of any sanctions, penalties or remedies imposed.

Financial Obligations. Outstanding financial obligations will not impact the awarding of a degree otherwise earned or a student's ability to access their official transcript. However, the University may withhold issuing a diploma until any outstanding financial obligations owing to the University are satisfied.

Learning Outcomes

As part of your education, we want to ensure that first and foremost, you know how to "think like a physicist". This implies that you can synthesize knowledge from different areas, make educated guesses and take your hard-earned course-based knowledge to the next level, where you will apply it and knowledge that you acquire independently or with your mentors and peers to solve problems of interest. That is why we prefer a broad education and course base, and our education will prepare you for a career not just in the specific area that is your dissertation topic but our Ph. D. should prepare you for a career as a professional scientist, with all the flexibility that that implies.

Physicists must also learn how to communicate using written, spoken and presentation skills. You will acquire these skills as part of our course work. For example, Physics 6510, our Advanced Laboratory course has formal materials on how to carry out "Back of the envelope calculations" and a requirement to write lab reports in standard journal (Physical Review Letters) format as well as make a presentation to faculty and peers in a timed format. These formative skills are essential for the practicing Physicist.

Additionally, it is essential that Physicists are aware of ethical issues pertaining to the conduct and dissemination of research, in collaborative research endeavors as well as instances that may arise concerned with the teaching arena. Opportunities to participate in training concerned with ethical issues will be provided and must be completed by all students in their first year. The successful completion of the Responsible Conduct of Research unit online is required of all students.

Proficiencies

A candidate for a Ph.D. in Physics is expected to demonstrate mastery of knowledge in the field of Physics, and to synthesize and create knowledge by making an original and substantial contribution to the Field of Physics in a timely fashion.

Proficiencies that are required to be demonstrated by the candidate

Make an original and substantial contribution to the discipline by becoming proficient in the following areas:

- Show your ability to think independent and creatively
- Identify new research opportunities in the field
- The ability to acquire and communicate advanced research skills
- Bring together existing knowledge, identify, and seek out resources, information; apply these to evaluate and apply your own research findings as well as those of others. Apply research findings as appropriate.
- Master and/or innovate research methodologies, and techniques
- Master communication skills for oral and written information exchange
- A commitment to advancing scholarship
- Maintain familiarity with advances in the field
- Engage and communicate findings via professional publications, participation in professional societies, research seminars and other modes of communication
- Support learning—through teaching, collaborative inquiry, mentoring, or demonstration
- Demonstrate professional skills
- Advance ethical standards in the field
- Listen, give, and receive feedback effectively.