Physics

"I believe that the purpose of college is to give students the experiences they need to succeed in the real world. Cornell College's academic calendar is ideally suited to this task because it allows students to engage in more real-life experiences than they could under the semester system."
Derin Sherman, Professor of Physics

Cornell physics majors are introduced to the foundational theories of physics—classical mechanics, electricity and magnetism, quantum mechanics, and statistical mechanics—and to the ways physicists "do" physics, as they engage in hands-on activities in our lab courses. The department also offers a B.A. in engineering sciences and a B.S.E. in engineering, as well as courses and research experiences in astronomy and astrophysics.

The physics major prepares students for graduate work in physics or related fields such as astronomy and engineering. But within the liberal arts environment at Cornell, students also find connections between physics and other fields, such as music or theatre. Many students discover that their analytical and problem-solving skills are highly valued in a variety of occupations, including software development, financial markets, business, and technical fields.

Cornell physics faculty have varied backgrounds and interests in biophysics, medical imaging, condensed matter physics, and astrophysics, and they all share a dedication to teaching and innovation in the classroom. Professors get to know each of the students in the department, and they tailor experiences to meet individual interests and goals.

BENEFITS OF ONE COURSE AT A TIME

Cornell College's academic calendar allows students to engage in more real-life experiences than they could under the semester system. It also encourages faculty to use active-learning techniques beyond traditional lectures.

In Cornell physics classes, students frequently work in small groups on hands-on activities or problem solving, while the professor is present to provide guidance and feedback. The curriculum also devotes one entire block to the introductory labs after students have been through two blocks of physics. This is a good review, allows students to concentrate on lab technique and presentation skills, and uses labs that involve several areas of physics.

During the advanced physics lab capstone course, students spend an entire block researching a physics topic of their own interest. Working with a small team, students plan, design, construct, and carry out their own experiments, much like in an actual research lab. Students who go on to work in research labs, either in graduate school or industry, find the advanced lab to be a good preparation.

Other benefits of One Course include:

- Students cannot postpone studying for most of the semester and then cram before a few exams, because assignments are often due the next day rather than the next week or month. Students must keep pace, which helps deepen their understanding of the material.
- Students can use the classroom to work with other students on homework beyond normal class hours.
- It's easier to take calculus before physics.
- All classes end by 3 p.m. Athletics practice and music rehearsals are

cont. >

Faculty Bios & Courses

KARA BEAUCHAMP
Professor of Physics and Engineering
Teaches courses in physics, including Astronomy, Introductory Mechanics, Modern Physics, and Astrophysics. She collaborates with students on astrophysics research projects, and she has also studied high-temperature superconductors, magnetic materials, dye-sensitized solar cells, and local wind energy project feasibility. Ph.D. in Physics, University of Minnesota; B.A., Carleton College.

BRIAN D. JOHNS
Assistant Professor of Engineering
Teaches courses covering a range of engineering topics, including design principles, mechanics, thermodynamics, and materials. He also teaches upper-level electives and the engineering capstone course. He is a member of the Institute of Industrial Engineers (IIE) and the American Society of Mechanical Engineers (ASME). Ph.D. in Industrial Engineering and M.S. in Mechanical Engineering, University of Iowa.

NILOOFAR KAMRAN
Assistant Professor of Engineering
Teaches introductory physics and engineering courses, as well as upper-level courses in engineering. Her research focuses on controlling complex systems, with applications in control of satellites and of fluid flow of fuel in a rocket thruster. Ph.D. in Engineering Physics, Embry-Riddle Aeronautical University; M.S. in Aerospace Engineering, Shahid Beheshti University, Iran; B.S. in Mechanical Engineering, Guilan University, Iran

DERIN SHERMAN
Professor of Physics and Engineering
Teaches courses in physics and engineering, including Engineering Circuits, Lagrangian Mechanics, upper-level Electricity and Magnetism and the physics capstone Advanced Experimental Physics. He also teaches the nonmajors courses Science through Film and Fiction and Electronics for Everyone. Ph.D. and S.B. in Physics, Massachusetts Institute of Technology.

scheduled after 3 p.m., so these activities don't conflict with classes.

RESEARCH AND PROJECTS

CAPSTONE PROJECTS

The following are examples of projects that recent physics majors designed and completed during their advanced lab capstone course:

- Designed and built a muon detector to show relativistic time dilation.
- Measured the size of an atom using wave properties of the electron.
- Measured the temperature of the sun using radio wave observations.
- Created graphene and used it to make a supercapacitor.
- Constructed a quantum teleportation device based on classical linear optics.
- Created a user interface control system using Doppler Shifted Ultrasound to recognize hand gestures.
- Created a quantum logic gate using C-13 chloroform and an NMR machine.
- Built an exoskeleton arm controlled by an EMG signal.
- Made a high resolution scanning tunneling microscope.
- Used holographic interferometry to study vibrational patterns of musical instruments.
- Studied solar cells based on quantum dots.
- Built a detector to study cosmic ray muons.
- Studied extrasolar planets by observing planet transits.
- Built and studied a system to wirelessly transfer electric power using magnetic resonance.
- Built a ruby laser for the purpose of making pulsed laser holograms
- Built a device for studying sonoluminescence, which uses ultrasound to produce light.

ON-CAMPUS RESEARCH

Physics and engineering sciences majors and faculty regularly engage in collaborative summer research projects. These projects allow students to develop important research skills while working both independently and alongside faculty mentors, and they often provide a stepping stone to research opportunities at larger institutions. Current research projects include:

- Exploring properties of star forming regions.
- Developing videos showing how to construct useful equipment for both doing physics demonstrations and exploring a range of physical phenomena.
- Creating a virtual-reality (VR) surgical simulator for orthopedic surgeons to alleviate the costs, risks, and errors associated with training surgical residents in real operating rooms.

OFF-CAMPUS RESEARCH

Majors in the department have had great success in their acceptance to major summer research programs (REUs) at universities across the U.S. and even abroad, including the Albert Einstein Institute in Hannover, Germany and the CERN particle accelerator lab in Switzerland. Cornell's physics department faculty get to know their students and their lab skills well, and they're able to write strong, detailed letters of recommendation. Recent REUs were completed at:

- University of Illinois
- Indiana University
- Los Alamos National Lab
- University of Florida
- Space Telescope Science Institute
- University of Oklahoma
- Kansas State University

AFTER CORNELL

ALUMNI CAREERS

National Association of Colleges and Employers (NACE) reports that demand for physicists is projected to grow 7 percent between 2014 to 2024, with a median salary of $64,500. Physicists are in demand as teachers, researchers, computer programmers, data analysts, and project administrators.

Science teacher, Walter Payton College Prep High School, Chicago (Class of 2016)

Civil designer, Shive-Hattery, Cedar Rapids, Iowa (Class of 2016)

Institutional research analyst, Suffolk University, Boston, MA (Class of 2014)

Research technologist, Northwestern University, Evanston, Illinois (Class of 2014)

Seaman (E-3), U.S. Navy, Fontana, California (Class of 2014)

Project administrator, BI Worldwide, Saint Cloud, Minnesota (Class of 2014)

Postdoctoral research associate, Los Alamos National Lab, New Mexico (Class of 2013)

Project engineer, Furlong Industrial Systems, Milwaukee, Wisconsin (Class of 2013)

Senior software engineer, Cazena, Minneapolis, Minnesota (Class of 2013)

Device and integration development engineer, Intel Corp, Hillsboro, Oregon (Class of 2012)

Electrical engineer, Textron Aviation, Wichita, Kansas (Class of 2012)

Software engineer, MetricStory, Seattle, Washington (Class of 2012)

GRADUATE SCHOOLS ATTENDED

M.A., San Francisco Teacher Residency, University of San Francisco (Class of 2017)

MEd, science education, University of Illinois, Chicago (Class of 2016)

Ph.D., electrical engineering, University of Minnesota (Class of 2016)

Ph.D., physics, University of California, Davis (Class of 2015)

M.S., sustainable engineering, Rochester Institute of Technology (Class of 2013)

Ph.D., chemistry, University of Oregon (Class of 2013)