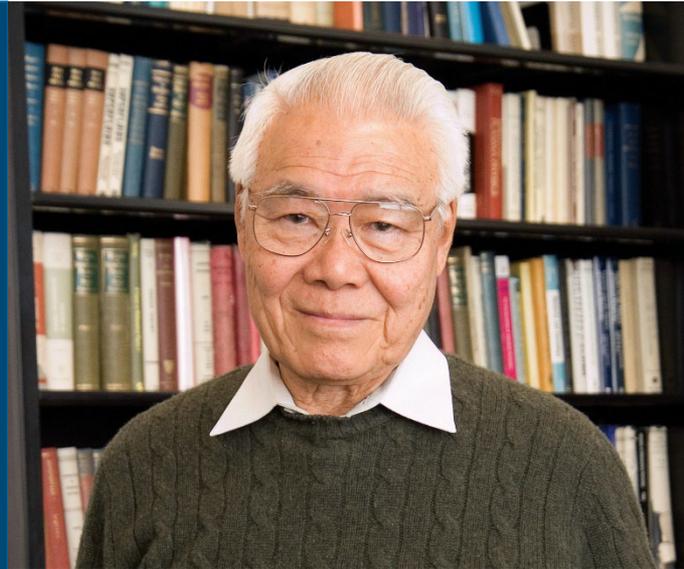


Graduate programs in Accelerator Science and Engineering



Katherine Harkay

Argonne National Laboratory

For the Lee Teng and Helen Edwards Interns

July 19, 2019

Design, research, and operation of accelerators requires broad range of skills

Students interested in the following fields may consider pursuing graduate education for a career in accelerators:

- Physics
Electricity and magnetism, linear and nonlinear mechanics, optics, and computational physics.
- Electrical Engineering
Digital and analog, low- and high-power radio frequency (rf) systems, high precision power supplies, advanced analog and digital diagnostics electronics.
- Computing and Controls Systems
Advanced controls systems to monitor, model, and control the hardware that influences the behavior of the particle beam.
- Mechanical Engineering
Finite element analysis, high heat load materials, cryogenic systems, magnet design, and structural design.
- Material Science
Superconducting magnets and rf cavities; surface properties in ultra-high vacuum systems.



U.S. Particle Accelerator School

Education in Beam Physics and Accelerator Technology



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Current Program

USPAS sponsored by Northern Illinois University and UT Battelle
 Jan 21 – Feb 1, 2019
 held in Knoxville, Tennessee

[View Details >>](#)

APPLY NOW

Next Program

USPAS sponsored by University of New Mexico
 June 17 - 28, 2019
 held in Albuquerque, New Mexico

[View Details >>](#)

(Applications coming soon)



Hot Topics

- Jonathan Ang of Columbia University receives RadiaSoft scholarship. [Read more here...](#)
- Applications are now being taken for the Panofsky Fellowship program at SLAC. [Read more here....](#)
- Call for Nominations for the 2019 USPAS Prize for Achievement in Accelerator Science and Technology. [Read details here....](#)

Accelerator Tutorials



LHC Superconducting Magnets

Watch this first video, in a sequence of three, explain the role of superconducting magnets in the Large Hadron Collider and also explain how they work and are constructed. Used with permission: CERN

[See more Accelerator Tutorials.](#)

Find us on

Opportunities

[Internships](#)

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[Job Openings](#)

[Other Educational Opportunities](#)

Educational Opportunities

Accelerator Schools

- CERN Accelerator School
 - CERN Accelerator School Proceedings
- SLAC Summer Institute
- Joint Universities Accelerator School
- European School of High Energy Physics
- CERN-Latin American School of High Energy Physics
- Jyvaskyla Summer School

Graduate Programs

University of California, Berkeley:

The **Nuclear Engineering Department** offers a graduate course in Accelerators and Ion Sources, and both the Nuclear Engineering and Physics departments offer undergraduate and graduate courses in Plasma Physics. Students have rich opportunities for practical experience with accelerators on many facilities, including the **High Flux Neutron Generator (HFNG)** in the NE Department, and the **88" Cyclotron**, **Advanced Light Source (ALS)** and the **BELLA Laser Acceleration** facility at **Lawrence Berkeley National Lab** adjacent to campus. Students also have opportunities to intern with the **Accelerator Technology and Applied Physics Division (ATAP)** at LBNL. The Berkeley campus is also just an hour's drive away from **SLAC National Accelerator Lab** and **Lawrence Livermore National Lab**, where many of our students receive theoretical and hands-on training with accelerators.

The **Department of Physics** has a **plasma and nonlinear dynamics group** with research topics covering advanced accelerator concepts, nonlinear dynamics, intense charged particle beams, nonneutral plasma physics and laser-plasma interactions. Students have opportunities to conduct research with the **ALPHA collaboration** at CERN, where antimatter traps are used to synthesize and probe the fundamental physics of antihydrogen, and to participate in research on laser-plasma interactions, ultra-fast processes in materials, and high-energy density physics with scientists at **Lawrence Livermore National Laboratory**, and **SLAC National Laboratory**.

University of California, Los Angeles:

The Department of Physics at UCLA does research into beam physics and accelerator technologies through the **Particle Beam Physics Lab**.

University of Chicago:

The Department of Physics at the University of Chicago does research in many areas including **Beam Physics**.

Colorado State University:

Students may study

- Charged Particle Beam and Laser Beam Engineering in the **Department of Electrical and Computer Engineering** (Beam Dynamics, Controls, RF Devices, Lasers, Optical Materials and Computing to name a few areas of interest),
- High-Energy Physics in the **Department of Physics**
- Radiation and Health Physics in the **Department of Environmental and Radiological Health Sciences**

There are also remote learning possibilities through CSU Online.

16 grad programs listed

Many programs linked to DOE labs with accelerators.

Several Universities also have their own accelerator research labs.

Cornell University:

Students who wish to undertake graduate study in **Accelerator Physics, Experimental Particle Physics, and Theoretical Particle Physics** may pursue a Ph.D. through Cornell's Department of Physics.

Cornell University has created the Graduate Education in Accelerator Research (GEAR) program to increase the number of graduate students pursuing doctoral degrees in accelerator physics. Doctoral students from all universities are invited to carry-out their thesis research at Cornell University. Students will spend up to two years at Cornell doing research under the supervision of an accelerator faculty member, working on a topic of interest to that faculty member. Your home faculty advisor will also have the opportunity to participate. Prior to starting research at Cornell, you are expected to take prerequisite courses at your home institution and attend the USPAS. This approach provides the opportunity to be supervised by faculty and to interact extensively with the accelerator or device targeted by your research in a way that is rarely available. Up to two GEAR students will work alongside Cornell's doctoral students in accelerator physics. Send letters of interest to lepp-search@cornell.edu

Florida Atlantic University:

The experimental portion of the **Graduate Program in Physics** at Florida Atlantic University concentrates on condensed matter physics and spectroscopy.

Illinois Institute of Technology:

The Center for Synchrotron Radiation Research and Instrumentation (CSSRI) at the Illinois Institute of Technology coordinates and facilitates activities among the CATs affiliated with IIT, and any other scientists at the University with an interest in synchrotron radiation research. Graduate programs in **Physics** and **Molecular Biophysics** as well as other science and engineering disciplines use synchrotron radiation as a research tool. **The Center for Accelerator and Particle Physics** at the Illinois Institute of Technology is committed to progress in Elementary Particle

Indiana University:

The **Department of Physics** at Indiana University/Bloomington offers a professional Master's Degree in Accelerator Physics and Technology in partnership with the USPAS. Detailed information can be found on the [USPAS website](#).

University of Maryland at College Park:

The **Institute for Research in Electronics and Applied Physics** (IREAP) is home to the **University of Maryland Electron Ring** (UMER) which is actively involved in training graduate students for careers in Accelerator Science and Engineering. UMER is a dedicated small-scale facility for beam physics research and student training. Research topics include experimental beam physics, nonlinear optics, the physics of rings and beam space-charge, computational modeling, and diagnostics. UMD **Radiation Facilities** also trains AS&E graduate students within IREAP and the Department of **Materials Science and Engineering** on topics including cyclotrons, cathodes, pulsed power, normal and superconducting RF, and radiological sciences. Facilities include a 250 kW training reactor, two high-power electron linacs, and a cyclotron.

Michigan State University:

Michigan State University (MSU) is home to prominent accelerator facilities supporting nuclear physics at the **Facility for Rare Isotope Beams (FRIB)** and the **National Superconducting Cyclotron Laboratory (NSCL)**. MSU supports a number of graduate-level education programs in Accelerator Science and Engineering at the **Department of Physics and Astronomy** (including the **VUBeam** online degree program), the **Department of Electrical and Computer Engineering**, the **Department of Mechanical Engineering** (including the **MSU Cryogenic Initiative** for workforce training in the operation of large cryogenic plants for accelerator facilities), and the **Department of Computational Mathematics Science and Engineering (CMSE)**. Prospective students should apply to departments linked with their interests and can be supported under a variety of programs including a DOE-sponsored traineeship, the **Accelerator Science and Engineering Traineeship (ASET)**, which supports students with US citizenship or permanent resident status to study at MSU with augmented research traineeships in US national laboratories. Topics at MSU include: superconducting RF technology and RF engineering, ion source development, beam dynamics and optics, computer modeling and advanced computations, cryogenic systems, beam diagnostics and instrumentation, as accelerator controls and optimization.

Northern Illinois University:

The **Department of Physics** offers Master of Science and Doctor of Philosophy degrees with specialties in **Accelerator and Beam Physics**. The program has close ties to the major accelerator research facilities at nearby Fermi National Accelerator Laboratory (**FNAL**) and Argonne National Laboratory (**ANL**). Faculty members, as associates of the Northern Illinois Center for Accelerator and Detector Development (**NICADD**), collaborate with these two national laboratories and with colleagues around the world in high-priority accelerator projects and accelerator-driven experiments in a variety of disciplines.

Old Dominion University:

The **Old Dominion University Center for Accelerator Science (CAS)** in the Physics Department aims to meet the nation's need for scientists and engineers who will advance the next generation of accelerators and light-sources - tools that enable an ever-widening range of basic and applied research, numerous medical applications, as well as industrial and Homeland Security functions. The ODU CAS was created as a joint initiative with the Thomas Jefferson National Accelerator Facility (JLab). The majority of the ODU students in Accelerator Science conduct their research in collaboration with JLab scientists and perform their experimental work using the unique experimental facilities at JLab.

Stanford University:

Applied Physics, Physics and **Electrical Engineering** departments at Stanford University, in conjunction with **SLAC National Accelerator Laboratory**, carry out research in many areas of accelerator physics including synchrotron radiation, free-electron lasers, advanced acceleration methods, ultrafast electron diffraction and microscope.

Stony Brook University:

The **Department of Physics and Astronomy at Stony Brook University** offers research in many areas including Accelerator and Beam Physics. Other Stony Brook University departments are participating in Accelerator Science through the **Center for Accelerator Science and Education (CASE)**. The CASE is a joint venture of Stony Brook University and **Brookhaven National Laboratory (BNL)**. A lot of CASE's research is conducted at BNL's accelerator facilities: RHIC, ATF and NSLS II.

University of New Mexico:

Students may study Charged Particle Beam Physics and Engineering, and Laser Beam Engineering in the **Department of Electrical and Computer Engineering** (Beam Dynamics, Controls, Lasers, Microwaves, Pulsed Power, High Power RF Devices, Diagnostics, to name a few areas of interest).

The **New Mexico Center for Particle Physics** together with the Nuclear Physics, Astrophysics, Particle Physics and Cosmology/Inflation groups bring a diverse yet synergistic research focus to the **Department of Physics and Astronomy**.

University of Tennessee, Knoxville:

The Department of Physics and Astronomy offers a doctoral Program in Accelerator Physics. The department has close ties with **Oak Ridge National Laboratory (ORNL)**, and graduate students in the accelerator program perform research at ORNL's Spallation Neutron Source accelerator (<https://neutrons.ornl.gov/sns>). Research projects are focused on solving the most critical challenges for high intensity, high power accelerators. For more information please contact the UT Accelerator Physics staff (<http://www.phys.utk.edu/research/graduate.html>).



U.S. Particle Accelerator School

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Master's Degree

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See website for
Cost and
Application
procedure

IU/USPAS Master's Degree Overview

Indiana University Bloomington (IU) in the Department of Physics offers a Master's of Science degree in Beam Physics and Technology that can be obtained by taking USPAS courses. Students must be admitted to the IU program and then complete all requirements within five years of enrollment.

Course Requirements

30 semester hours of credit with a grade point average of B or above, including:

- IU/USPAS Courses
- Graduate-level "Classical Mechanics" and "Electromagnetism" courses transferred to IU from previous university or by taking the 2-week (3 credits) USPAS course "Classical Mechanics and Electromagnetism in Accelerators"
- Master's Thesis (3 - 9 credits)
- Oral defense of thesis

Admission Requirements

- Transcripts from universities you attended as an undergraduate or graduate student
- Completed electronic admission application
- Three letters of recommendation
- Graduate Record Examination (strongly recommended)
- Application Fee: \$55.00 US (payable to IU by credit card only)
- U.S. resident

Advantages

- Contemporary program reflecting the most recent knowledge in accelerator science and technology
- Study under USPAS instructors who are recognized experts in their fields
- Master's thesis topic and supervision setup consistent with student interests and location
- Can be completed concurrent with employment and other studies
- Attend USPAS courses at twice yearly sessions while you directly accumulate Indiana University credits
- Can be completed without physically attending Indiana University outside of thesis defense.

- Unique program at Fermilab; you can potentially get your PhD from any university.
- Fermilab provides research facilities, mentors, and stipend.
- A professor at the university serves as the PhD advisor.
- University awards PhD.
- ~10 students/year.
- Extremely successful; many past participants are prominent leaders today in the field.



Accelerator Physics Center

Joint University - Fermilab Doctoral Program in Accelerator Physics and Technology

Accelerator Physics and Technology is an exciting and challenging field with a growing number of diverse career options ranging from basic research in elementary particles to medical technology. The design, construction and operation of accelerator systems use techniques from physics, electrical and mechanical engineering and computer science.

The Joint University- Fermilab Doctoral Program was established in 1985 as a way to encourage students to pursue a career in accelerator physics and technology by providing research opportunities using facilities and expertise available at Fermilab. The Ph.D. Program works in a joint agreement with universities. Fermilab reimburses the university for the student's salary, provides the research project and supervisors while the student maintains a relationship with their home institution's advisers who oversee the students progress toward the PhD degree from their university.



Please click here for information about how to apply. There is significant flexibility in the start dates for individual students.

- Current Participants
- Past Participants



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Funding: Department of Energy Announces \$5 Million for Graduate Training in Particle Accelerator Science and Technology

APRIL 12, 2019

[Home](#) > Funding: Department of Energy Announces \$5 Million for Graduate Training in Particle Accelerator Science and Technology

WASHINGTON, D.C.—Today, the **U.S. Department of Energy (DOE)** announced a plan to provide \$5 million to one or more institutions of higher education to support graduate student training programs in the science and technology of particle accelerators. The support is intended to help build the highly technical workforce needed to sustain U.S. capabilities in this area.

"Particle accelerators have become increasingly critical tools not just for science, but also for industry and medicine," said James Siegrist, DOE Associate Director of Science for High Energy Physics. "DOE has led the world in the development of this technology, and this training initiative will help us continue to nurture the talent needed to sustain U.S. leadership in these crucial capabilities."

Traineeships are expected to focus on the broad physics and engineering of accelerators, including such advanced topics as superconductivity and cryogenics.

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More general DOE funding for graduate students, to support research at a DOE laboratory.

The DOE Science News Source is a Newswise initiative to promote research news from the Office of Science of the DOE to the public and news media.

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DOE's Science Graduate Student Research Program Selects 70 Students to Pursue Research at DOE Laboratories

WASHINGTON, D.C. – The Department of Energy's (DOE's) Office of Science has selected 70 graduate students from across the nation for its 2018 Solicitation 2 cycle for Office of Science Graduate Student Research (SCGSR) Program.

The SCGSR program provides supplemental funds for graduate awardees to conduct part of their thesis research at a host DOE laboratory in collaboration with a DOE laboratory scientist within a defined award period. The award period for the proposed research project at DOE laboratories may range from 3 to 12 consecutive months.

"These graduate student awards prepare young scientists for STEM careers critically important to the DOE mission," said U.S. Secretary of Energy Rick Perry. "We are proud of the accomplishments these outstanding awardees have already made, and look forward to following their achievements in years to come. They represent the future leadership and innovation that will allow American science and engineering to excel in the 21st century."

Graduate students currently pursuing Ph.D. degrees in areas of physics, chemistry, material

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MEDIA CONTACT

Allison Eckhardt
Media Relations & Outreach Manager
Allison.eckhardt@science.doe.gov
(<mailto:Allison.eckhardt@science.doe.gov>)
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