Fundamentals of Accelerators Course – Learning by Doing

The Course

PHY 542: Fundamentals of Accelerator Physics and Technology is the second in a two course series at Stony Brook University on accelerator science and technology. The purpose of this course is to introduce the fundamentals of beam physics via experimental investigation and beam dynamics simulations on scaled experiments employing electron beams. The course is 25% lecture, 30% simulation and 45% experimental.

The course is intended for graduate students and advanced undergraduate students who want to familiarize themselves with principles of accelerating charged particles and gain knowledge about contemporary particle accelerators and their applications.

Students work in the Linac Control Room environment performing data collection and measurements (under supervision of the linac operator) required to make the final report. Some measurements can be done automatically, if a student has experience in writing scripts in Python. The instructor and linac operator help to setup the python module and introduce Control System I/O function calls.

The Accelerator Test Facility (ATF) linac, e-beam transport environment and ATF Control Room are used in this course. Also, one of the lectures is usually performed by ATF users working on a current scheduled experiment. In this lecture the work status, goal and plans of this experiment are usually described to give students a sense of what kind of research is currently underway in the Advance Accelerator Concepts field.

The course will cover a wide array of the measurements and manipulations that are needed for beam dynamics studies. Upon completion, students are expected to understand the basic principles and relations of beam dynamics, many of which they will have experimentally verified. Furthermore, they will have gained experience in measurement techniques and analysis of experimental observations.

While emphasis will be given on experiments, the course will also offer exposure to the latest accelerator computer simulation techniques.

The Future

With the current success of Advanced Accelerator research, “table top” accelerators will be developed in the near future which will diminish the cost for the infrastructure and the environment of present accelerators used in research, medicine and industry together by achieving the same or better beam parameters.

Note: The U.S. Particle Accelerator School provides similar classes during two weeks of intensive studies twice per year.

The Instructors

Mikhail Fedurin: ATF Accelerator Physicist and ATF linac operator, has an extensive experimental background in storage rings and linear accelerators operation, and unique experience in design, fabrication and commissioning of insertion devices for accelerators.

Dmitry Kayran: C-AD Accelerator Physicist has extensive experience in the designing, commissioning, and operation of accelerators that provide high quality high current e-beams for free electron lasers and electron coolers.

How is this Course Beneficial to Students?

Many of the former students of this course are seen and met by prominent members of the accelerator physics community.