Practical Lattice Design

S. Alex Bogacz, Jefferson Lab and Dario Pellegrini, CERN

Purpose and Audience

This course is aimed at providing hands-on experience in designing lattices and tailoring beam optics to modern accelerator applications, ranging from simple transfer lines to rings for a variety of collider and light source applications. The course will first survey fundamental concepts of beam optics, and then will explore the state-of-the-art areas of modern accelerator design. Typically, a topic first will be discussed abstractly and then applied to a specific beamline. The course is directed to graduate students pursuing accelerator physics as a career, who want to master the art of lattice design.

Prerequisites

Courses in classical mechanics, electrodynamics, and physical or engineering mathematics, all at entrance graduate level; and the USPAS course 'Fundamentals of Accelerator Physics & Technology', or equivalent.

It is the responsibility of the student to ensure that he or she meets the course prerequisites or has equivalent experience.

Objectives

On completion of this course, the students are expected to harness the principles of particle beam optics and should be able to design a dedicated beamline, tailored for a given accelerator application.

Instruction Method

The course includes a set of introductory lectures followed by practical exercise sessions using interactive lattice design tool, OptiM, http://home.fnal.gov/~ostiguy/OptiM/. After a two-hour tutorial, students should be able to use OptiM for designing simple lattices. Homework projects will be assigned daily, and the results will be graded and discussed in the following sessions.

This course will rely heavily on "OptiM: A Program for Accelerator Optics" available free here http://home.fnal.gov/~ostiguy/OptiM/ The software used for the course runs on Windows platform. If you are unable to bring a Windows laptop to the School, please let us know and we will arrange to have a loaner for you.

Course Content

The course will start with a rudimentary FODO lattice description (mostly analytic formulation in a thin lens approximation), then it will discuss basic lattice building blocks, such as: dispersion suppressors, dispersion flips, and finally specialized periodic cells for momentum compaction management and emittance mitigation. The course focuses on hands-on experience in designing both rings and transfer lines for variety of collider, booster, and light source applications; e.g. isochronous, Multiple Bend Achromat, Theoretical Minimum Emittance rings etc.

Reading Requirements
Students will receive instructor-provided handouts. Pre-course reading suggestions include course materials from previous USPAS "Accelerator Fundamentals" (course materials can be found here http://uspas.fnal.gov/materials/materials-table.shtml

Credit Requirements
Students will be evaluated on homework assignments (70%) and a final project (30%).