

NIU PHYSICS 659: Special Problems in Physics, Winter 2016
Instructor: *Swapan Chattopadhyay*
Course Syllabus

This is an independent study course involving personalized study, research, problem searching and problem solving in the field of Physics of Beams and Accelerator Science.

The enrolled student will perform literature search via the web, available libraries, and references provided by the instructor and identify relevant publications and current up-to-date status of the fields/topics mentioned below, search for potential areas for further exploratory research and list and quantify a limited set of graduate dissertation areas/topics that are mature for getting engaged in.

The areas/topics suggested for study/research in this semester are:

1. Theoretical, computational and experimental aspects of nonlinear dynamics of high intensity space-charge dominated proton beams as relevant for future proton accelerators for exploring neutrino physics and possibilities of scaled experiments at the Integrated Optics Test Accelerator (IOTA), under construction at Fermilab. The topics could address theoretical modelling or computer simulation or experimental measurements of nonlinear dynamics, dynamical diffusion, beam halo formation and resonance dynamics in general.
2. Explore and investigate possible research into the design and development of the 100 TeV-class proton collider as envisioned in the Future Circular Collider (FCC) design study at CERN and identify beam dynamics issues relevant for further research e.g. coherent beam instabilities; beam injection dynamics; beam-environment interaction via electromagnetic impedance, beam luminosity, beam lifetime and ring lattice.
3. Explore and investigate possible research into the proton-driven plasma wakefield experiment, AWAKE, under development at CERN. The possible research areas could be around beam-plasma high fidelity simulations, beam injection dynamics, beam and plasma diagnostics and scaling from present experiments to a proper collider.

The student is required to meet with the instructor at least once a week and make a day-trip to Fermilab at least once a week in order for the explorative research and study to be successful.

Possible resources:

- A. CERN website for AWAKE experiment;
- B. CERN website for FCC;
- C. Fermilab website for IOTA and FAST;
- D. Individual references provided by the instructor.