

Application for Research Stay at SuperKEKB

Name: Vaibhavi Gawas

Position: PhD Student

Institute: CERN

Supervisor at your institute: Frank Zimmermann

Overview of Research

In high-luminosity e^+e^- colliders, small imperfections in the interaction-point (IP) optics such as vertical dispersion, residual coupling, or a mismatch of the vertical waist can degrade luminosity, enlarge the beam spot, and enhance beamstrahlung. To mitigate these effects IP tuning knobs are used to vary these parameters in a controlled way and restore optimal performance. My research focuses on characterizing the main knobs (vertical dispersion, waist shift, and coupling), studying their influence on luminosity and observables, and developing strategies for their efficient use at FCC-ee. The aim is to develop methods to identify and correct IP aberrations using a minimal, orthogonal set of knobs.

Research Plan

During our stay at SuperKEKB, we would like to request the possibility of performing or participating in scans of the three main IP knobs: vertical dispersion, coupling knobs, and vertical waist shift. The plan is as follows:

1. Carry out small knob variations parasitically during luminosity production, within safe operational ranges.
2. Record luminosity, beam-spot sizes, and beamstrahlung (if possible).
3. Analyze correlations between luminosity and observables, and compare the results with predictions from Xsuite-based SuperKEKB lattice simulations.
4. Use these studies to better understand knob orthogonality, sensitivity, and safe tuning ranges, and to model luminosity degradation mechanisms (e.g., flip-flop from coupling, hourglass effect from waist shift, σ_δ feed-down from dispersion).

Obtaining and analyzing measurements from a real collider is essential for my PhD thesis, as it provides the experimental validation for simulation-based studies. We believe such studies can be performed without interrupting regular operations, as they could be combined with regular luminosity optimization during regular physics operation. And would provide valuable input both for SuperKEKB optimization and for preparing IP tuning strategies at FCC-ee.

Date: Nov-Dec 2025

Name of Fund: EAJADE

Remarks

This application form is sent to the international collaboration board for the SuperKEKB project. The proposed research will be discussed there, and the acceptance will be decided.