

# Spin-Polarized Electron Source Location Study

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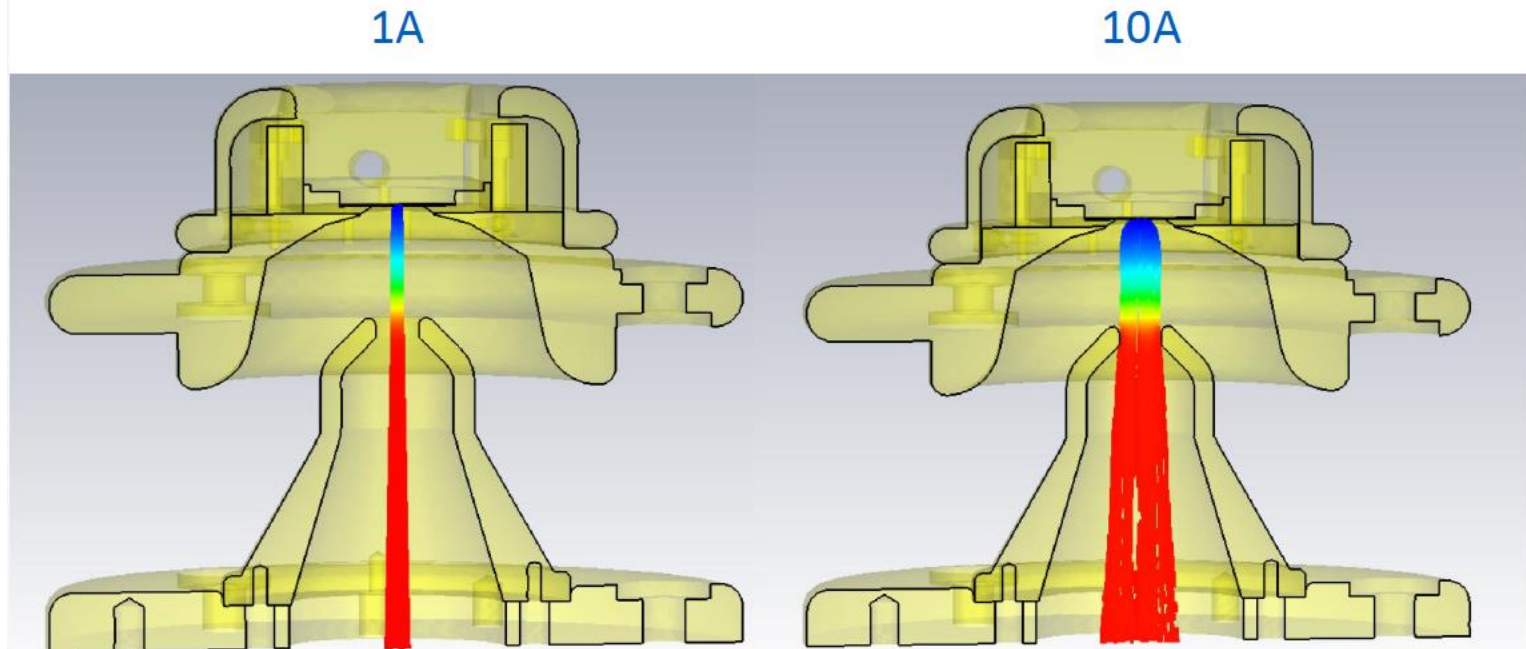
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# Motivation & Objectives

- Design and implement a polarized electron source for use in the Touschek Lifetime experiment.
- Determine suitable site(s) for installation of source and merge lines to insert polarized electrons into the SKB linac.
- Add a polarized source with minimal:
  - Changes to/effects on the beamline
  - Cost
  - Annoyance to the KEK accelerator team

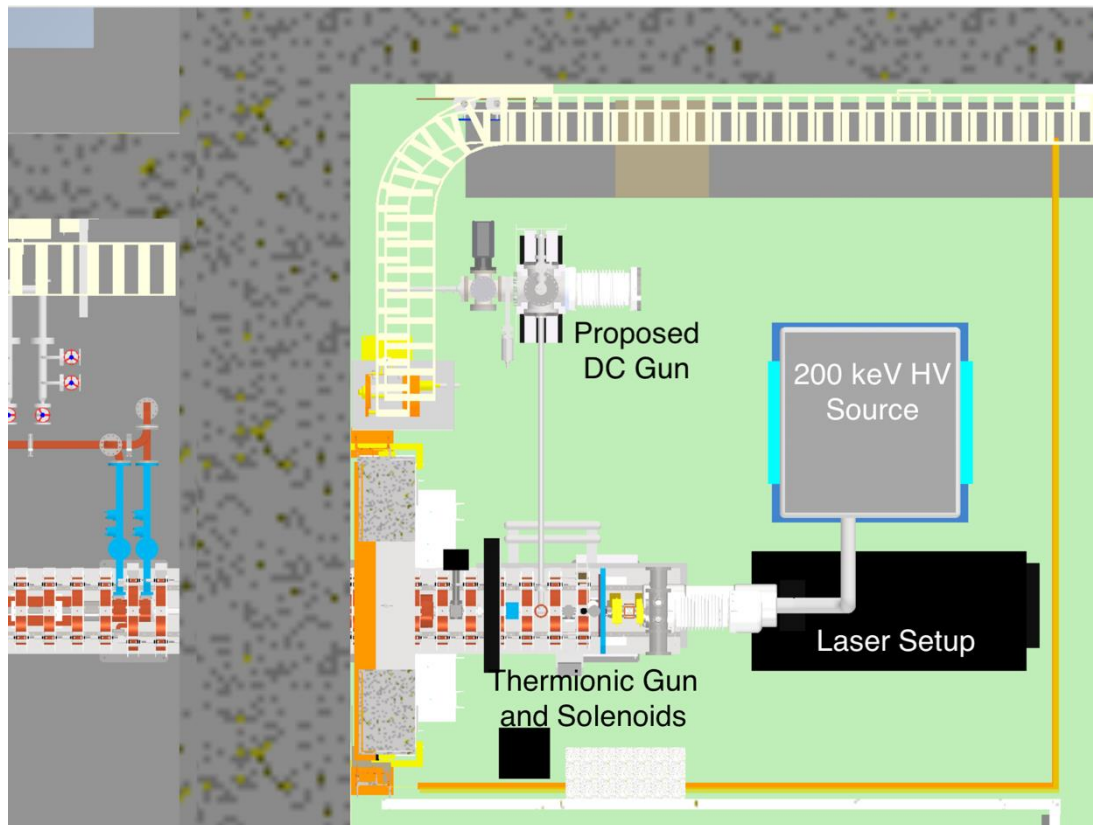
# Polarized Electron Source – DC Gun (Alex)

- 200 keV DC gun under CST Studio optimization
- Target: high bunch charge, low emittance
- Simulations at 1 A & 10 A currents show viable performance
- Integration constraints: compact footprint, radiation-controlled area
- See Alex's talk for details/more recent work



# DC Gun Location

- Modifications limited to SuperKEKB source room
- New 200 keV DC gun adjacent to existing thermionic gun
- Space validated with source team; avoid HV arcs

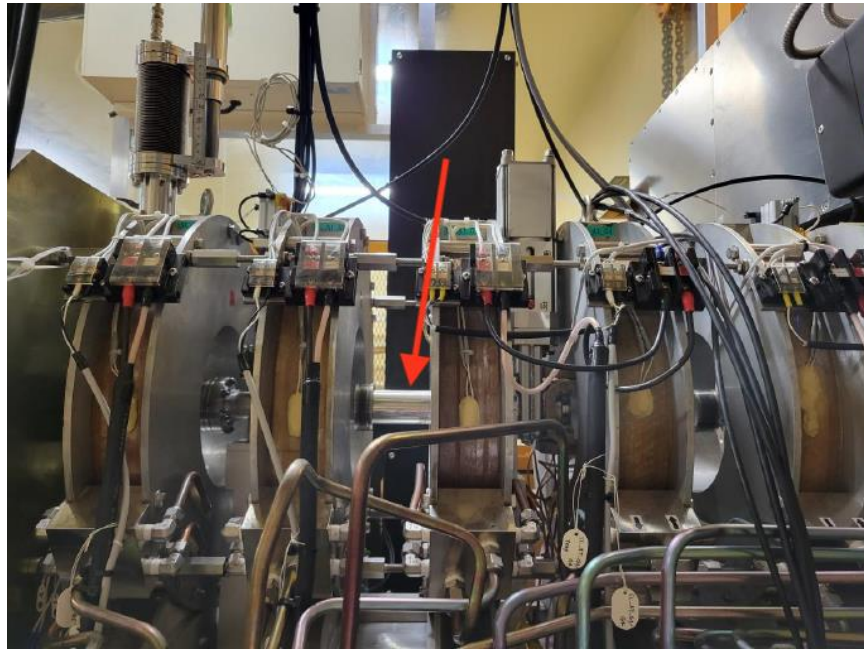


# Cathode & Spin Manipulation

- p-doped GaAs strained-compensated superlattice cathode for high polarization & QE – likely provided by X. Jin (iCasa)
  - Most likely activate with a CsO surface -- lifetime likely sufficient for our planned study
- Mott polarimeter bench tests planned
  - Also investigating possibility of installing a polarimeter in the beamline pre-merge for *in situ* measurements
- Wien filter (~ 30 cm) to rotate spin to vertical; existing unit to be tested

# Beam Merge Line

- Preferred merge in region of first four solenoids (after diagnostic apparatus)
- 90° bend, 10 cm radius  $\rightarrow$   $\sim$  165 G air-core solenoid magnet
  - Magnetic field from downstream solenoids is  $\sim$ 25 G at proposed merge site, likely not an issue
- Leverages existing RF buncher
- Two pairs of solenoids likely need to be converted to pulsed solenoids



# Solenoid Replacement & Alternatives

- Alternate options:
  1. Merge at thermionic gun lens
    - requires design/fabrication of new lens
  2. Place DC gun near HER RF gun
    - needs new dedicated RF buncher
    - still likely need pulsed solenoids

# Draft Proposal Writeup

- Material on these slides available as a draft proposal on Overleaf (<https://www.overleaf.com/read/ndkzkpcttvyn#cfb2a5>) and included in the Touschek Experiment proposal (<https://www.overleaf.com/project/665c3ea7e00a59b128d96ff1>)

## Polarized Source and Merger Line for SuperKEKB

June 16, 2025

### 1 Introduction

The Chiral Belle project aims to extend the lifetime of both the SuperKEKB accelerator facility and the Belle II experiment by injecting spin-polarized electrons in the high-energy ring. This modification would include the addition of a polarized electron source, spin rotator magnets before and after the interaction point (IP), and a Compton polarimetry system. The design, development and deployment of all the above components is a long-term effort that is planned to be completed in a future SuperKEKB long shutdown and is described elsewhere. As a first step and proof-of-principle, we have proposed the Touschek Lifetime Experiment, a smaller-scale project involving only the polarized electron source for installation and testing on a shorter timescale. This project would serve to demonstrate the feasibility of the project, confirm simulations of polarized beam



# Summary & Next Steps

- Installation path appears feasible with minor infrastructure changes
- Key components: DC gun, Wien filter, merge magnet, pulsed solenoids
- Component testing & integration studies and simulations underway