Polarized Source Development for the Chiral Belle Upgrade at SuperKEKB

Alexandre Beaubien, PhD candidate

University of Victoria

The Belle II collaboration

Partially funded from:

TRIUMF-KEK Exchange Program for Early Career Researchers





Chiral Belle Upgrade to SuperKEKB



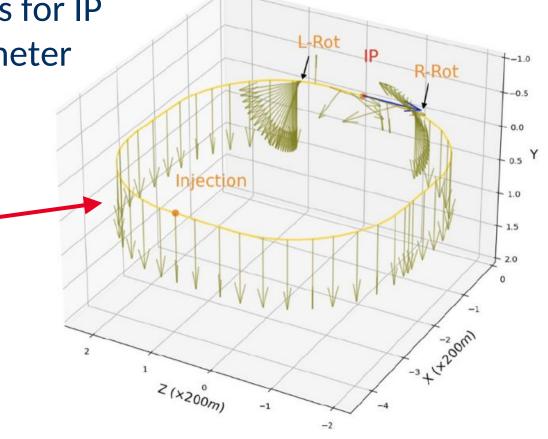
Polarized beams require upgrading SuperKEKB with:

1. Source for polarized electrons



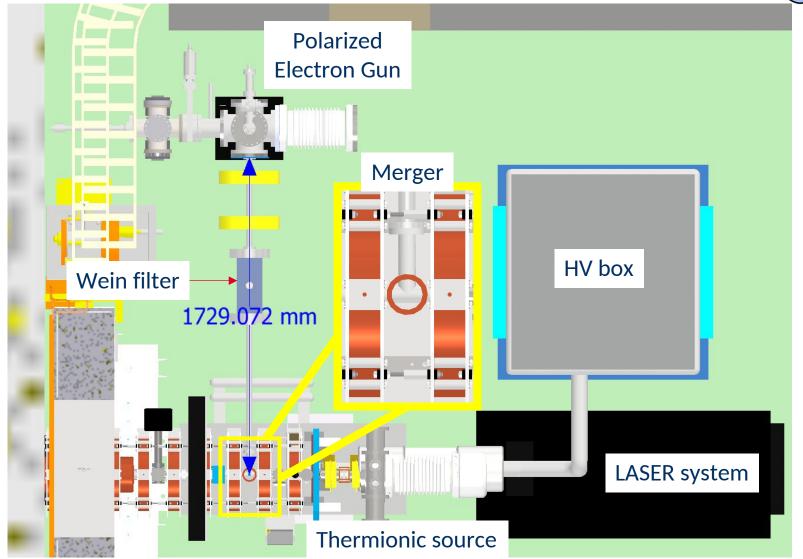
3. Compton polarimeter

Transverse polarization is the stable spin orientation in storage ring



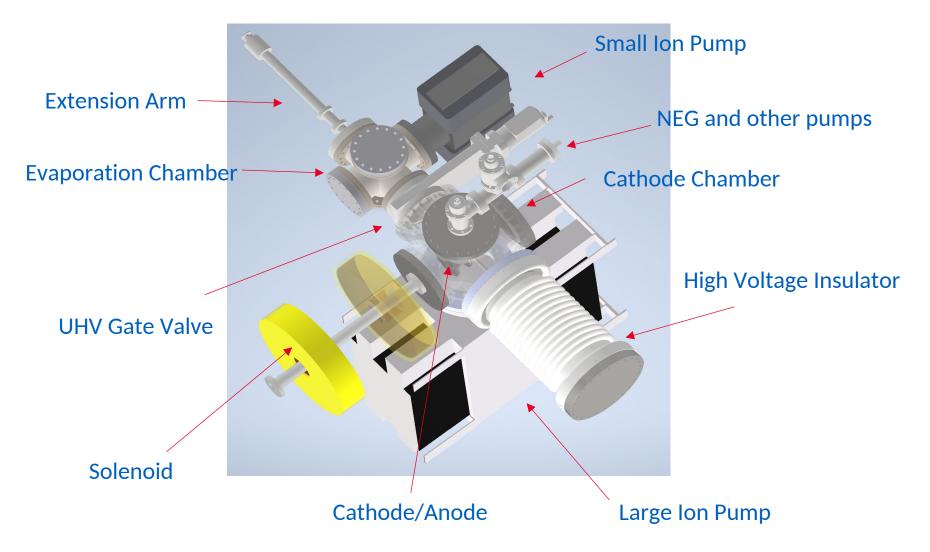
Conceptual Design





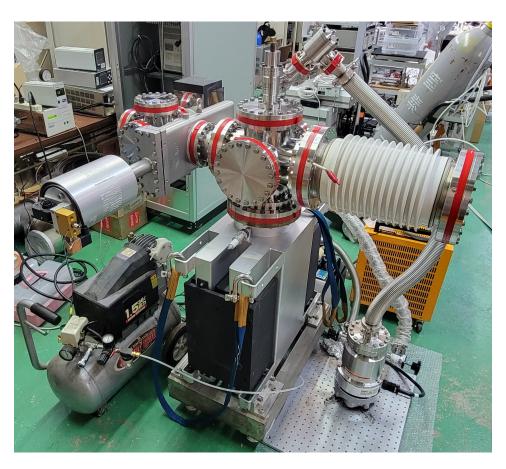
Polarized Electron Gun

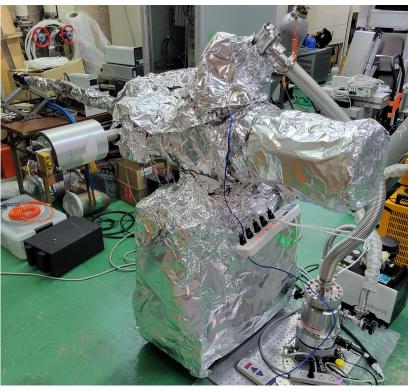




Building Vacuum Chamber & Baking

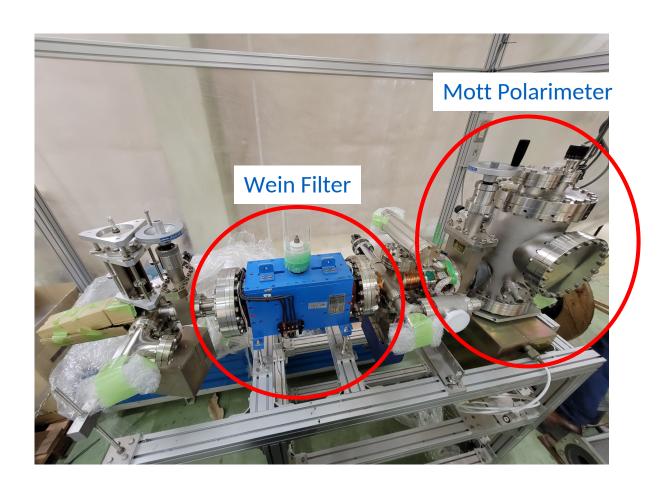






Wein Filter and Mott Polarimeter

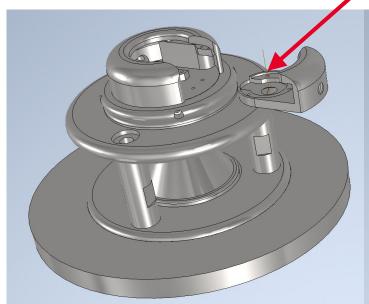


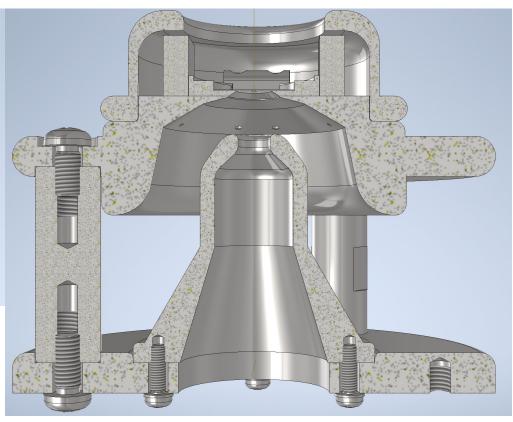


Cathode & Anode



Cathode goes here

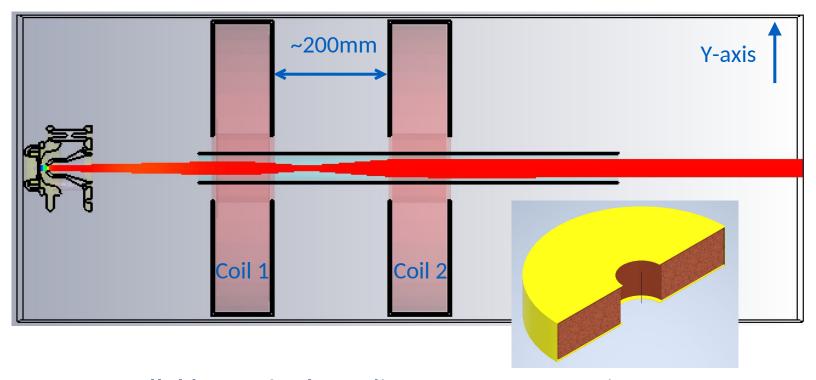




Adapted from a design by N. Yamamoto; Redesigned in part for low emittance at 200keV using Inventor

Focusing Magnet





Create parallel beam for long distance transportation

- − Coil 1: 1.05 A − Coil 2: 1.5 A − 2800 turns
- Minimize p_t in x-y plane for parallel beam

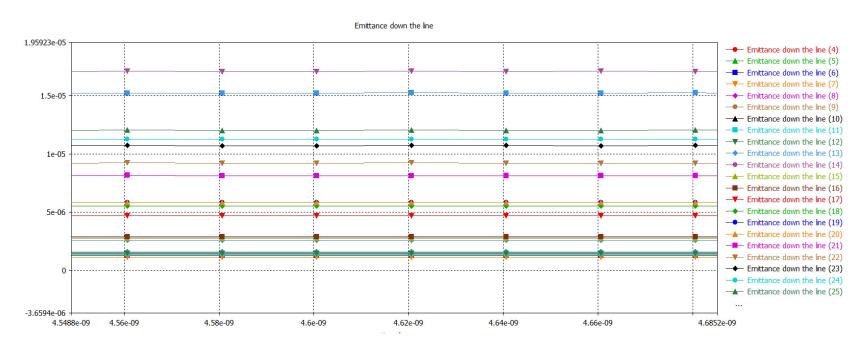
Emittance



Grid parameter sweep:

- coil 1: 0.75A 1.25A
- coil 2: 1.25A 1.75A

Emittance near after the **focusing magnets** (~60cm from cathode)



Emittance is consistently in O(1 mm*mrad) range i.e. 10^-6 No matter the currents and the distance to anode/cathode

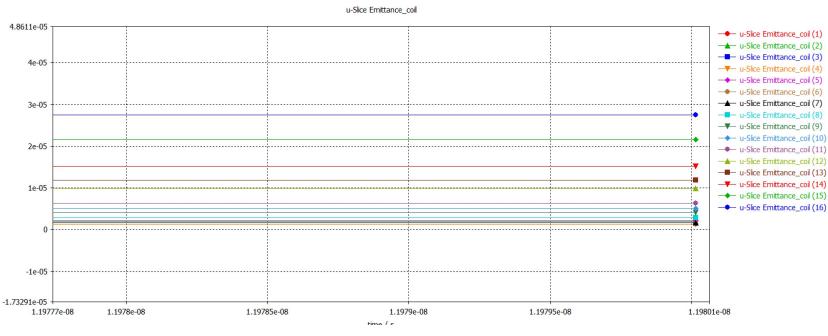
Emittance



Grid parameter sweep:

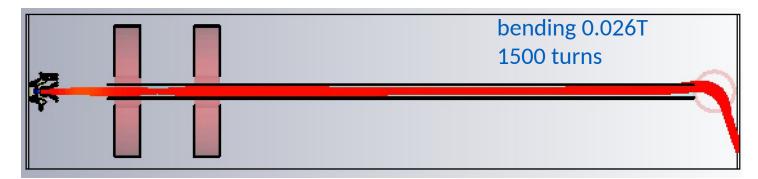
- coil 1: 0.75A 1.25A
- coil 2: 1.25A 1.75A

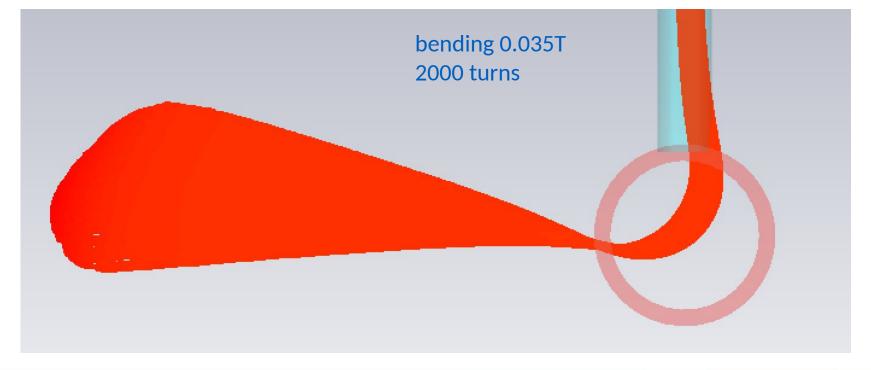
Emittance near the merging dipole (~1.6m from cathode)



Bending Magnets (Helmholtz Coils)







Summary



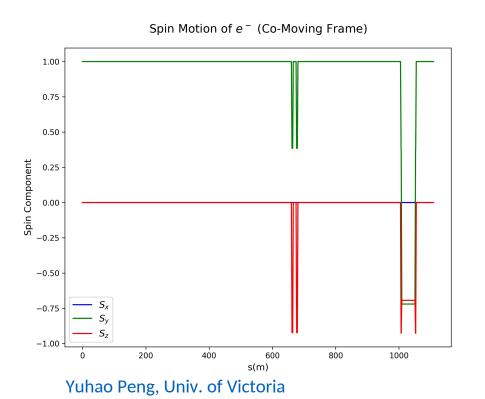
- Design of polarized electron gun finished
- Beam tracking simulation finished
- Construction and testing In progress
- Design and simulation of merger In progress

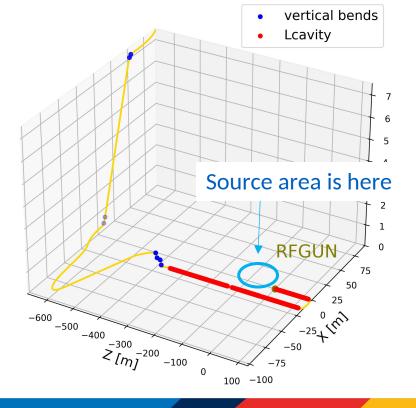
Backup

Beam Transportation Simulation



Simulations show that transversally polarized electrons injected into the Linac maintain polarization as it enters the ''' | FREE LinaC





Proposed Touschek Lifetime Measurement: A First Step

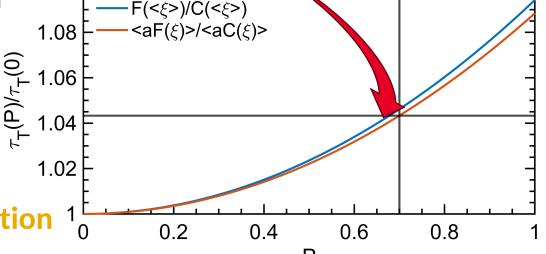
With beam polarization of 70%,

Touschek lifetime is expect to increase by 4%.

Demonstrate the feasibility of the project

Confirm simulations of polarized beam transportation

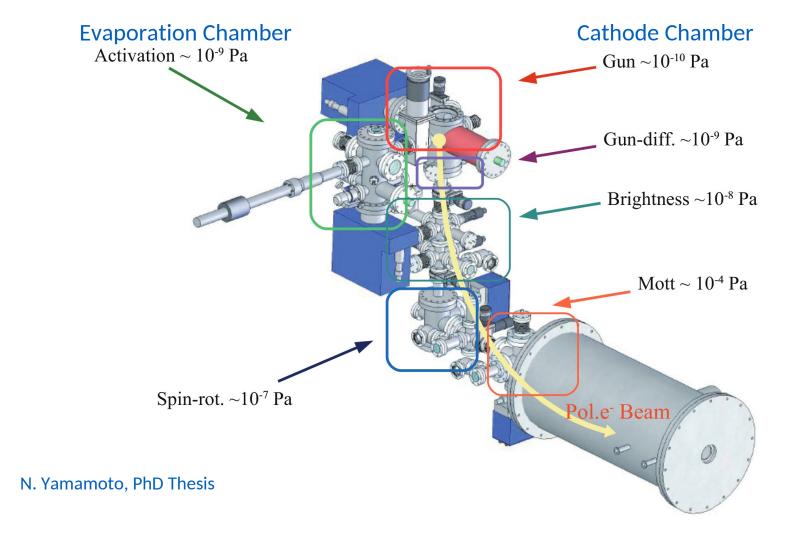
1 to 2 weeks experiment



Provide valuable experience and new independent data on SuperKEKB to precisely measure the beam energy, to improve our modelling of the accelerator, possibly help with getting to higher luminosity

Conceptual Design of the Gun

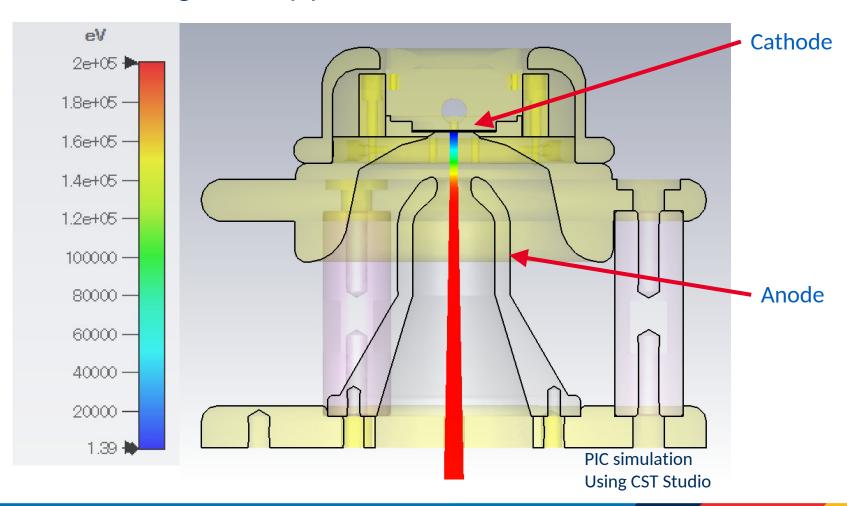




Beam trajectory

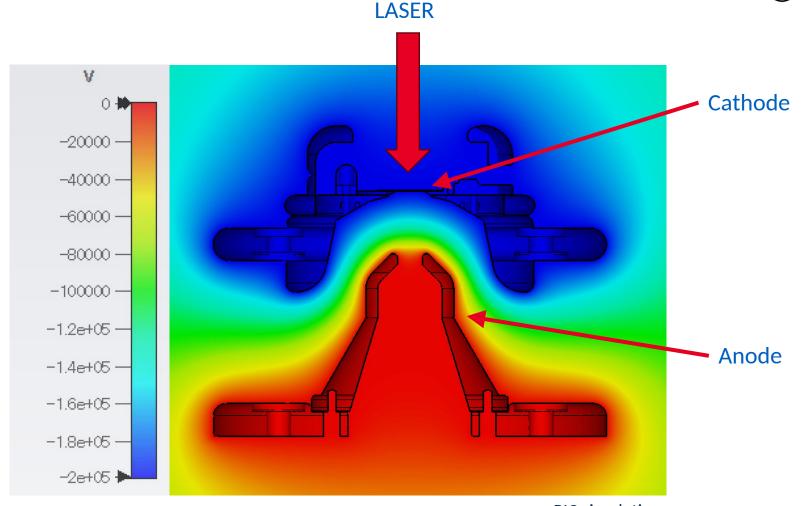


Anode geometry provides lowest beam emittance



Acceleration Potential





PIC simulation Using CST Studio

RF Gun Area





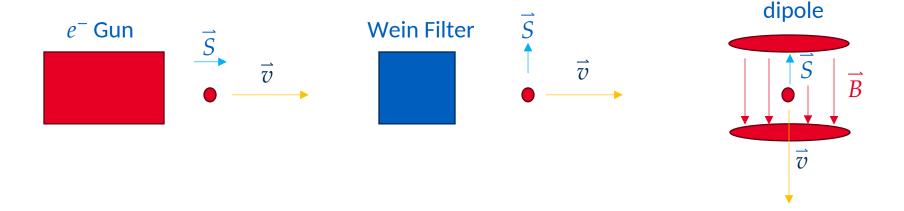


Spin Polarization Considerations



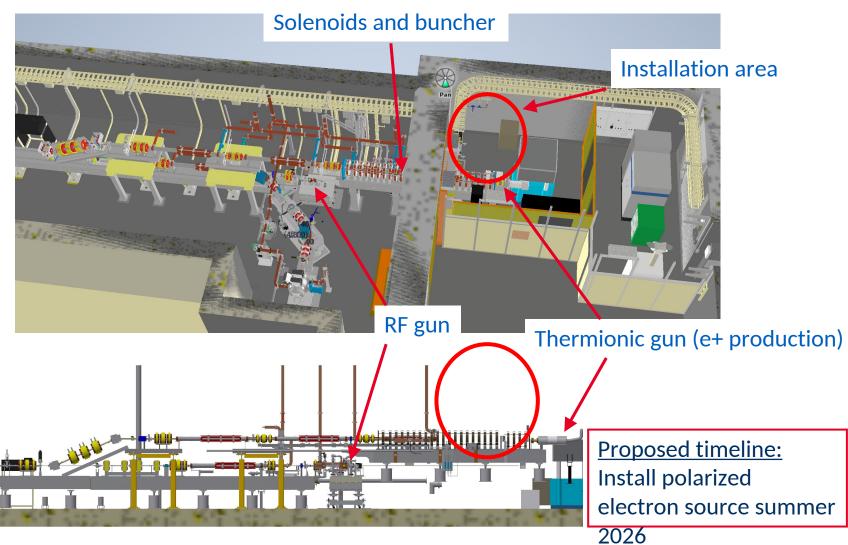
GaAs creates longitudinally polarized electrons.

Use Wein filter to obtain transversally polarized electrons.



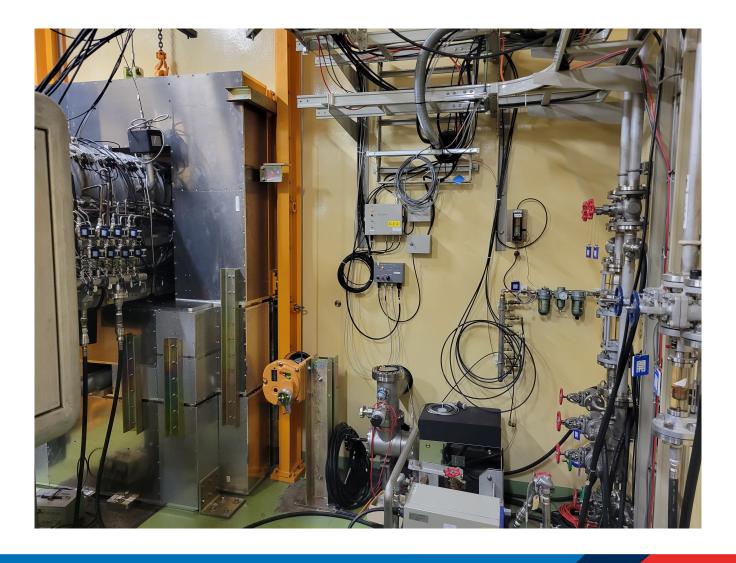
Source Room Available Area





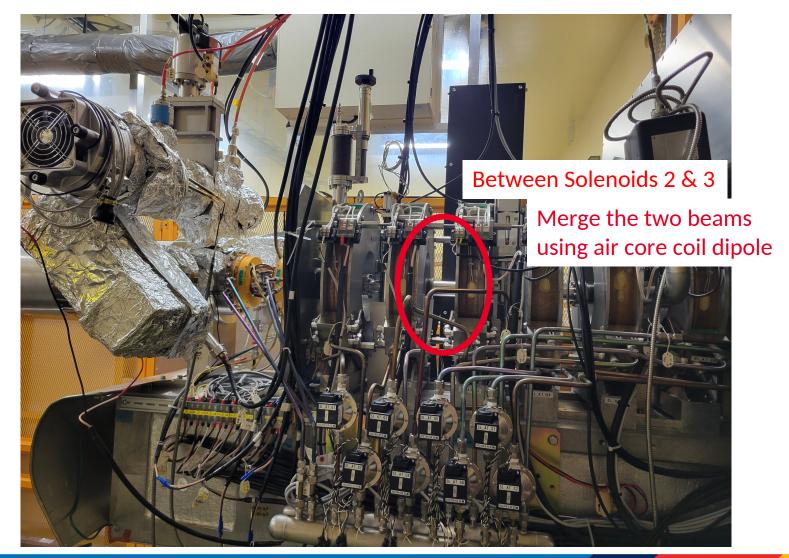
Source Room





Merge Location





Junction Photo



