Simulation Development and Analysis for TWOCRYST and the Collimation Team

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CERN Summer Student Programme

Who am I?

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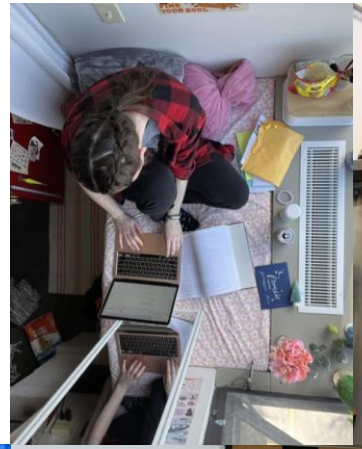
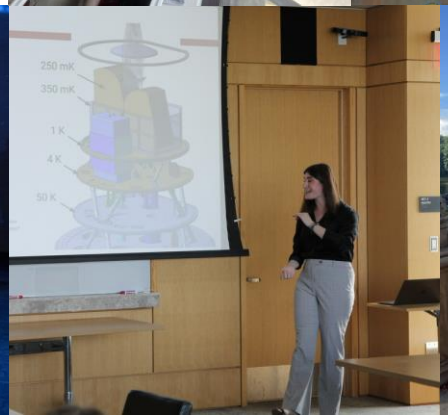







Who is my mentor and what team will I be working with?

- TWOCRYST is a part of the Collimation team in the Beams Department, Accelerator Beam Physics Group, and Nonlinear Dynamics and Collimation Section (BE-ABP-NDC)
- Collimators absorb all the particles that stray from the beam trajectory in an accelerator.
    - These stray particles may cause damage in sensitive areas of the accelerator (including causing the superconducting magnets to quench)
- Currently a collimation system exists to protect the elements of the accelerator, limit interference from debris from collisions, and limit noise
- **My mentor is Dr. Kay Dewhurst, a fellow here at CERN**

What is crystal collimation?

- The next upgrade to the LHC will be making it the High-Luminosity LHC (HL-LHC)
- While current collimator technology will work for HL proton collisions, it will not work for HL ion collisions
- The hope is that crystal collimators (bent silicon crystals) can replace the first few collimators in the hierarchy
    - This will allow the lead ions to be deflected at a greater angles (which means they will be less likely to scatter and effect the superconducting magnets downstream).

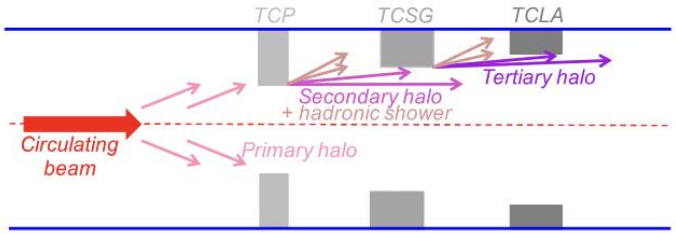


Fig. 1 Working principle of the present collimation system

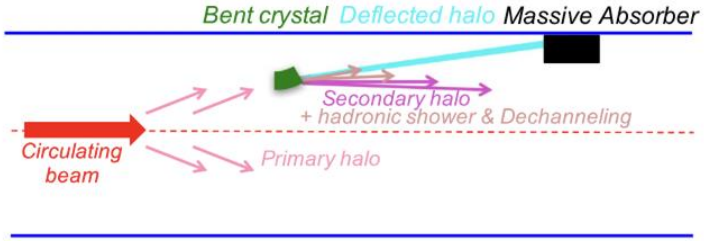


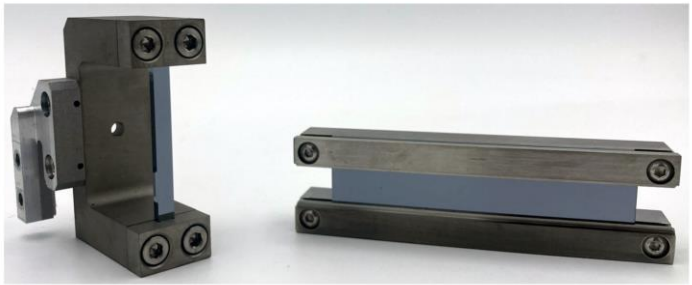
Fig. 3 Working principle of the crystal collimation system

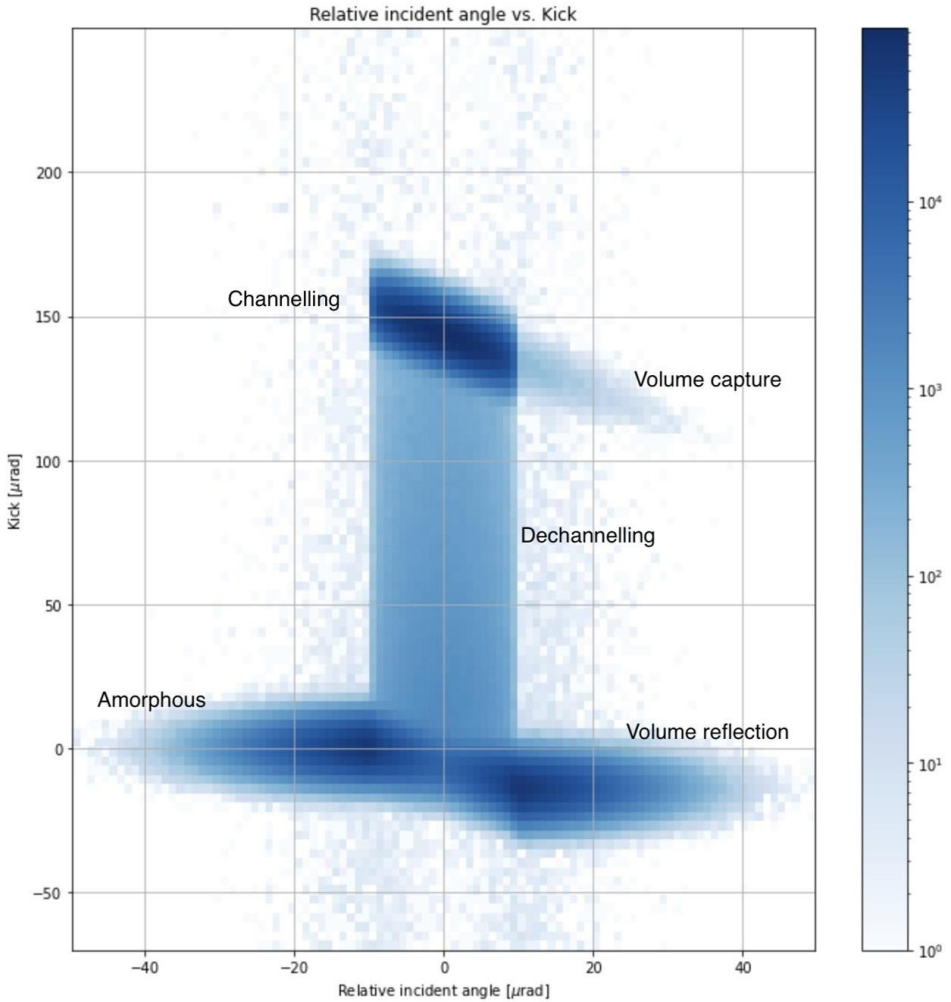
What experiment will I be working on this summer?

- TWOCRYST is a “proof of concept” that hopes to show the feasibility of double-channeling experiments in the LHC
    - This could be used to measure physical properties of positively charged baryons (λ_c)
- The crystals deflect particles by channeling them along crystal planes (specifically bent strip silicon crystal sheets)
- The bending of the long crystal corresponds to that of a 330 T magnet for a 1 TeV beam– 40 times more than the maximum magnetic strength of the LHC dipoles!

The bent crystal is used to deflect a small fraction of the circulating beam onto a fixed target

The long crystal is used to deflect the products which can help us measure the spin




Relative incident angle vs. Kick
Channelling
Volume capture
Dechannelling
Amorphous
Volume reflection
Kick [μrad]
Relative incident angle [μrad]
200
150
100
50
0
−50
−40
−20
0
20
40
10^4
10^3
10^2
10^1
10^0

What is my specific project and what do I hope to accomplish?

- ❏ Learn about the physics of channelling particles in crystals, and how crystal collimation connects to the work done in TWOCRYST
- ❏ Set up a SixTrack simulation (used to simulate protons in the LHC) for the TWOCRYST experiment, and then run and analyze the results
- ❏ Summarize the work of team members to update the section webpages
- ❏ Assist in various Machine Developments for the collimation team throughout the summer

Places I’ve been!