Integrating Chicane in G4BeamLine

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More on G4Beamline Lattice

- Effect of coil geometry on G4Beamline lattice
- Placement of proton absorber – straight lattice
- Placement of proton absorber – chicane
- Optimisation
- Proton power deposition with chicane/absorber system
Effect of coil geometry on G4BL

- Now have a full coil geometry implemented in G4BL
  - Removed constant 1.5 T field
  - Replaced with two sections of coils inspired by FS2A lattice
    - Small coil 430 mm inner radius for Drift
    - Large coil 650 mm inner radius for Buncher/Rotator (to accommodate RF)
  - Three bits of “matching”
    1. Matching from capture solenoid into 1.5 T region
    2. Matching from small coils to large coils
    3. Matching from large coils to cooling lattice
  - Necessary precursor to implementing chicane
Matching - Capture -> 1.5 T
Matching – 1.5 T -> Cooling

- G4Beamline baseline
- No chicane, no absorber

Graphs showing variations in magnetic field strength and beta values over a range of coordinates.
Performance
Performance

![Graph showing transmission over distance with two lines representing G4Beamline baseline and No chicane, no absorber.](image)
Optimisation of combined proton absorber, chicane system

- When proton absorber and chicane included, optimise over 4 parameters
  - Proton absorber thickness
  - Drift length
  - Absorber position
  - Chicane angle
- Start with just proton absorber
- Then just chicane
- Then full system
- (Optimisation not finished)
Add proton absorber
Try to fix longitudinal phase space
Optimise on position of absorber
Optimise on length of drift
Proton absorber, No Chicane

- Compare with power remaining in proton beam
Proton absorber, No Chicane

<table>
<thead>
<tr>
<th>Proton absorber thickness [mm]</th>
<th>Maximum rate (mu+/proton)</th>
<th>Proton beam power [%]</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>0.1171</td>
<td>100</td>
</tr>
<tr>
<td>50</td>
<td>0.103</td>
<td>90.9</td>
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<td>100</td>
<td>0.08714</td>
<td>82.4</td>
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<td>200</td>
<td>0.08374</td>
<td>70.9</td>
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<tr>
<td>300</td>
<td>0.06805</td>
<td>60.6</td>
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</tbody>
</table>

- Ultimate figure(s) of merit is mu+/proton compared to proton beam power leaking into downstream accelerator
Chicane, no proton absorber

Absorber thickness 1e-09 mm

Drift length [m]

$\Delta \theta$ [°]

$\text{Mu+/proton}$

0

0.02

0.04

0.06

0.08

0.1
Chicane, no proton absorber

<table>
<thead>
<tr>
<th>Chicane dθ [°]</th>
<th>Maximum rate (mu+/proton)</th>
<th>Proton beam power [%]</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>0.1171</td>
<td>?</td>
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<tr>
<td>1.0</td>
<td>0.1091</td>
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<td>1.5</td>
<td>0.0975</td>
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<tr>
<td>1.75</td>
<td>0.1006</td>
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</table>
100 mm proton absorber + chicane
200 mm proton absorber + chicane
Chicane, no proton absorber

Clean up of input deck
- Optimisation ongoing
- Final step:
  - Plot $d\theta$ vs absorber thickness vs muon rate
  - Plot $d\theta$ vs absorber thickness vs proton power
  - Choose parameters, rebaseline
- Looks like we will get a hit on muon rate