Preliminary results of leakage from TSCG for ion crystal collimation

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Outline

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• Introduction to simulations

• Results

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Motivation

- **Ion collimation cleaning** reduced by two order of magnitude wrt to protons.
  - crystal collimation possible solution to improve the cleaning in view of increased ion beam intensity runs.

  - **Crystal cleaning improvement observed:**
    - Pb MD2016 but not as high as expected in DS1 and DS2 and slightly worst in arc-78 Q12-13
    - Xe MD2017 a factor higher than 10 using tight TCSGs and TCLAs settings

  - **Simulations are foreseen to understand the possible leakage from the TCSG and the observed improvement by tightening the collimator settings.**
Introduction to simulations

- First simulations performed: SixTrack-Fluka coupling
- 6.5xZ TeV Pb ions beam and 2016 MD collimator settings

- Flat top optics
- Initial distribution
  - Initial distribution from proton beam crystal channeled simulations
  - Assume that the crystal works for ions as for protons
• This first approximation does not take into account possible ion interactions with the crystal
• $x'$ and $y'$ of dechanelling particles $> 0$
Introduction to simulations

2016 MD collimator settings configurations

- Highest improvement observed in the horizontal plane about a factor 2 but slightly worst in arc-78 Q12-13.
- Different configurations were tested but no significant impact observed.
Results: B1H Pb standard collimation

Reference Pb case: standard collimation

DS1 $\sim 8 \times 10^{-4} \text{ m}^{-1}$
Peak $\sim 5 \times 10^{-3} \text{ m}^{-1}$
**Results: B1H TCSG B4L7**

**Horizontal case**

![Fragments histogram](image)

- Only light fragments out of the TCSG
- A factor 100 reduction of mean inefficiency and only a few peaks in the DS
Results: B1V TCSG D4L7

Vertical case

Only light fragments out of the TCSG

A factor 100 reduction of mean inefficiency and only a few peaks in the DS
Summary

• Two dedicated MDs with Pb ions in 2016 and with Xe ions in 2017 were performed to study ion crystal collimation efficiency. Results show lower cleaning efficiency than expected and an improvement by tightening the TCSGs and the TCLAs collimator settings.

• First simulations have been performed to try to understand the experimental observation considering the Pb 2016 MD settings.
  
  • Two orders of magnitude improvement with respect to the standard collimation is observed in simulations.
    
    ✓ If crystal works as for protons we would expect a minimum leakage from the 1 m C TCSG collimator used as absorber.
  
  • Ion channeling simulation may be needed for a better understanding of the experimental observations.
### Experimental results summary

**R. Rossi**

<table>
<thead>
<tr>
<th>Crystal</th>
<th>Injection $p$</th>
<th>Flat Top $p$</th>
<th>Injection Pb</th>
<th>Flat Top Pb</th>
<th>Injection Xe</th>
<th>Flat Top Xe</th>
<th>Bending Angle [μrad]</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1-H</td>
<td>17.5 ± 2.9</td>
<td>26.9 ± 5.5</td>
<td>6.1 ± 0.5</td>
<td>8.3 ± 1.2</td>
<td>8.4 ± 0.6</td>
<td>6.4 ± 1.1</td>
<td>63.2 ± 1.7</td>
</tr>
<tr>
<td>B1-V</td>
<td>17.8 ± 3.6</td>
<td>17.7 ± 3.9</td>
<td>5.6 ± 0.8</td>
<td>6.2 ± 2.3</td>
<td>5.8 ± 0.7</td>
<td>3.9 ± 0.5</td>
<td>39.8 ± 2.3</td>
</tr>
<tr>
<td>B2-H</td>
<td>10.6 ± 2.5</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>52.1 ± 1.6</td>
</tr>
<tr>
<td>B2-V</td>
<td>19.6 ± 0.5</td>
<td>20.1 ± 0.3</td>
<td>–</td>
<td>–</td>
<td>8.8 ± 1.0</td>
<td>8.2 ± 0.8</td>
<td>56.5 ± 1.5</td>
</tr>
</tbody>
</table>
Results: B1V TCSG D4L7 different settings

Settings from MD note “Crystal collimation cleaning measurements with ions” 2016
Only the impact of closing more TCSG.D4L7 has been studied -> no effect observed