Collimation MD Requests for MD3

A. Mereghetti, on behalf of the LHC Collimation Team
Overview

New request! MD4123: Proton collimation quench test;
- Important preparation effort;

LSWG, 17th May MD3343: Parallel Automatic Collimator Alignment;
- Requested by Gaby for MD1 and MD2, but targeting MD3;

New request! MD4165: BLM response at collimators;

LSWG, 17th May MD3283: Active Halo Control Using Colored Noise Excitation;
- only 1 beam required; on the other one, we would like to confirm past results on core;

LSWG, 17th May MD3328: Injection with Collimators at 3σ and Tight Cold Aperture;

New request! MD4166: Crystal collimation with partially-stripped Pb ion beams;
- Relevance depends on push on partially-stripped ion beams;

New request! MD4167: Operational aspects of crystals collimation with proton beams;
- Important preparation effort;
- Can be dropped if Pb ions are available already in MD3;

New request! MD4168: Crystal Collimation tests with Pb Ion Beams;

LSWG, 17th May MD3329: IR7 Collimator Hierarchy Limit and Impedance;

See slides by B. Salvachua
See slides by G. Azzopardi
MD4166 – Crystal Collimation of Partially-Stripped Pb-Ions

-- Introduction

• Potential deployment of crystals for partially-stripped ions:
  • Poor cleaning recorded with regular collimation system during MD3284;
    → Important to find an alternative!
  • Tests would represent first time of channelling partially-stripped ions;

-- Main goal of MD: check with beam feasibility of crystal collimation with partially-stripped ions:

  • Perform angular and linear scans, to verify feasibility of channelling with partially-stripped ions;
    • First feasibility test: not necessarily the four crystals if one is assessed entirely;
  • Perform loss maps, to compare results against performance of regular IR7 collimator settings;
  • Measurements would be performed at FT if results at injection are promising;

-- Requested: 6 hours, 1 beam, inj (and FT) optics, 30 pilots (max);
MD4167 – Operational Aspects of Crystal Collimation with Proton Beams

-- Introduction

• Studies on-going to have crystal collimation as baseline in HL-LHC with ions;
• Potential deployment of crystals already during 2018 ion run:
  • Ions available only for a limited amount of time, and close to their deployment in physics;
  • Time is needed in case of hardware / software changes;
  • Protons are a good chance to qualify hardware;
  • poor machine availability in past 2018 MD slots!!

-- Main goal of MD: Demonstrate with beam that channelling conditions can be achieved and maintained during an entire LHC cycle, i.e. from injection to physics:

1. Completing the set of measurements required for a proper characterisation of crystals:
   • Missing linear scan and LMs at FT for B2H + almost entire characterisation of V crystals at FT;
   • Procedure analogous to that of MD3327;
2. Play operational functions for crystals – NB: important preparation effort;
   • Procedures analogous to that of MD1879;
3. (if time permits): demonstrate cleaning with high intensity beams;

-- Requested: 10 hours, both beams, FT optics, 30 pilots;
NB: this MD can be dropped if Pb-82 beams are already available in MD3!
MD4168 – Crystal Collimation Tests with Pb Ion Beams

-- Introduction
- Studies on-going to have crystal collimation as baseline in HL-LHC with ions;
- Promising results (cleaning) in 2017 with Xe beams;

-- Main goal of MD: Re-assess performance of present hardware:
- Test new hardware installed during last YETS with Pb-82 ions;
- Feedback for HL-LHC baseline;
- Feasibility for 2018 ion run!

-- MD Procedure:
- Full assessment of crystal performance with ion beams:
  - Angular and linear scans, to determine operational parameters for channelling;
  - Loss maps, to compare results against performance of regular IR7 collimator settings;
- To be performed at injection and at FT!

-- Requested: 12 hours, both beams, injection and FT optics, 30 pilots;
NB: higher in priority than MD4167 if Pb-82 beams are already available in MD3 + could be combined with commissioning shift with Pb ion beams
Spare Slides
-- Main goal of MD:

- Verify with beam the stability of the beam-based alignment (as done in past years, e.g. MD314, MD1447, MD2191);
- Characterise the collimator configuration presently operational and pushed ones in terms of hierarchy limit, cleaning performance and impact on impedance;

-- MD Procedure: 2 ramps:

1. Cleaning-related measurements:
   - 1 nominal bunch, several pilots;
   - betatron LMs at FT (no Q-change/squeeze/collisions): standard coll. settings and pushed configurations;

2. Impedance-related measurements:
   - 1 nominal(-ish) bunch, 1 HL-LHC like bunch;
   - Tune-shift measurements;
   - Octupole current Instability threshold measurements;

-- Requested: 8 hours, 2 ramps, both beams;
Active halo control aims at increasing tail diffusion speed via beam excitation with the ADT on selected betatron frequencies:

- Main application: to clean tails with an active system, avoiding spurious beam dumps induced by tail scraping following orbit jitter;
- There is beneficial potential for Run III LHC and HL-LHC;

Main goals of MD:
- Re-assess success of past results with fixed-frequency excitation (MD312, MD1388, MD2485);
- Verify with beam the effectiveness of coloured noise on tail diffusion speed (skipped in the past due to problems with waveform generator);

MD Procedure (identical to past years):
- Measurements carried out at injection energy only – inject, measure, dump;
- Inject several INDIVs:
  - Blow-up most of them, to enhance tail population;
  - Keep one as witness (effects on core);
- Excite the beam (fixed frequency / coloured noise);
  - Evaluate tail population and beam profile via TCP scraping;

Requested: 8h, injection energy/optics, only one beam (parallel studies possible);
MD3328 – Injection with Collimators at 3σ and Tight Cold Aperture

R. Bruce, J. Molson, S. Redaelli

-- Main goal of MD:
• Assess the possibility to inject with very tight cold aperture at injection → relevant for future accelerators, e.g. FCC;
• Emulate with the LHC an injection in FCC or in HE-LHC with tight aperture as far as collimation cleaning is concerned;

-- MD Procedure:
• Approach: inject – assess losses – dump:
  • Scan various TCP openings, down to 3σ;
  • Scan various orbit bumps in the arc, to artificially reduce aperture;

-- Requested: 10 hours, trains of bunches up to e.g. 48b, both beams;

<table>
<thead>
<tr>
<th></th>
<th>TCPs – ε=3.5μm</th>
<th>Aperture – ε=3.5μm</th>
<th>Aperture – ε=2.5μm</th>
<th>Aperture – ε=2μm</th>
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<tbody>
<tr>
<td>Present LHC</td>
<td>5.7 σ</td>
<td>12 σ</td>
<td>14.2 σ</td>
<td>15.9 σ</td>
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<tr>
<td>FCC (expected)</td>
<td>3 σ</td>
<td>8.5 σ</td>
<td>10 σ</td>
<td>11.2 σ</td>
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MD3327 – Crystal Collimation Tests with Proton Beams

M. d’Andrea, D. Mirarchi, S. Redaelli, R. Rossi, W. Scandale

-- Introduction
Crystal collimation is studied as alternative scheme for ion collimation at the HL-LHC;

-- Main goal of MD
• Crucial to have early on feedback on the hardware: tests with proton beams fundamental for system setup in preparation of ion run 2018 – more in details:
  • Check new hardware installed in YETS2017 for operation (B2H) – Priority
  • Check stability of hardware/settings (goniometers, control system, crystals, etc...) for other TCPCs

-- MD Procedure (not different from past tests):
• Crystal set as primary → angular scans to find channelling orientation;
• Linear scans with absorber to characterize channelled beam;
• Cleaning measurements with loss maps;
• Tests both at injection ad at top energy;

-- Requested:
• 10 hours, 30 bunches (all pilots), both beams