
CERN

MD4830: Assessing Collimator Coating Robustness with Beam Scraping

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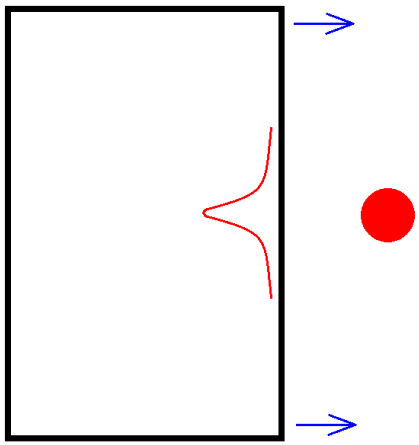
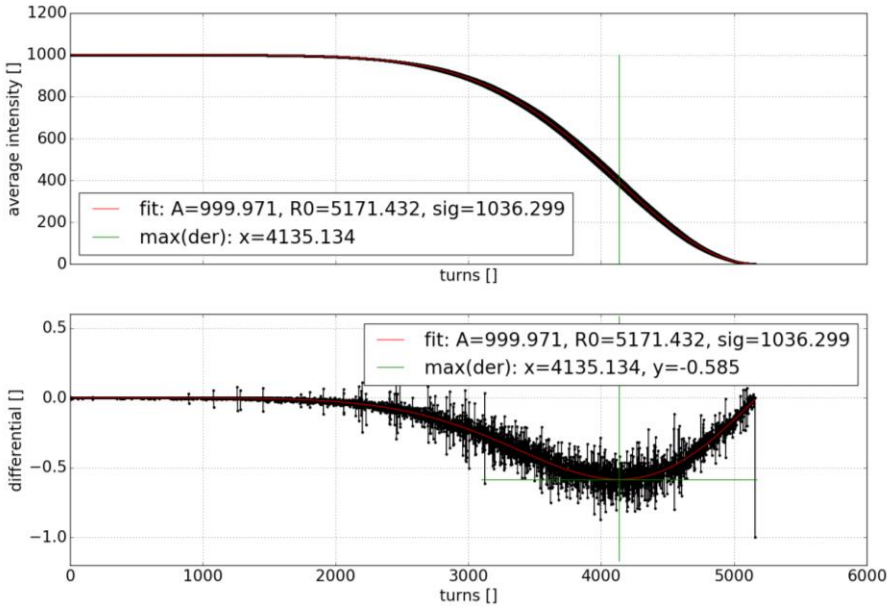
MD Merit

- In HiRadMat tests, Mo-coated MoGr jaw samples showed a resistance to beam impact better than that of Cu-coated samples - HL-LHC-like loads on the coating in a single-pass approach;
- Aim: to test endurance of the coating layers of the TCSPM.D4R7.B2 in a configuration closer to the operational one (multi-turn environment) than that of HiRadMad:
  - ~~Induce damage on coating layer;~~
  - Assess with measurements a safe value of energy/power deposition in Mo layer;
- Direct consequences of measurements on:
  - Alignment procedures of Mo-coated TCSPM collimators, in case BLM-based procedure is followed (e.g. because BPMs are not temporarily usable)
  - Assessment of loads on the Mo-layer in case of beam losses with minimum life times;

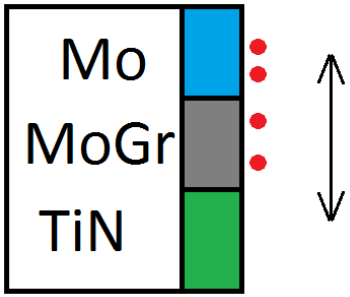


- Measurements performed scraping the ion beam (trains) at flat top with one jaw of the prototype TCSPM.D4R7.B2
  - Power deposition concentrate into the Mo-layer, thanks to scraping movement and use of ions (energy loss dominated by ionisation);
  - Scraping only a fraction of the beam allows to repeat the scraping action more than once with the same beam;
  - Configuration similar to alignment situation (apart from beam intensity!);

Energy Deposition Considerations



Instead of full beam scraping (picture on the left), perform a sizeable step to scrape the beam (enough to have a sizeable signal on BCT);



Perform a scraping step per transverse position of the 5th axis;

- Heating tests (lab) on Mo-coated MoGr samples (M. Taborelli et al.):
  - Block heated for 48h @400C: no signs of coating peeling;
  - Small sample @1000C: no signs of coating peeling either;
- Thermo-mechanical analysis on going (EN/MME), to verify how many ions need to be scraped to reach similar temperatures:
  - Scraping step size will be ~0.5σ, implying 20-100ms of scraping time;
  - Beam scraping in the vicinity of 1σ, where the number of scraped ions scraped is maximized for the same scraping step;
  - High thermal conductivity may imply large beam intensity scraped to get to desired temperatures;

Procedure

Main activities:

1. Inject ion beams and ramp energy to FT;
   - During injection, get normaised emittance with wire scan and BSRT;
2. Centre collimator with BPMs;
3. Scrape beam with TCP.D6R7.B2 down to 3-3.5σ (beam σ) – i.e. edge of Gaussian core;
4. Align TCPSM 5th axis to Mo layer and scrape the beam with one jaw:
   1. 1st spot: aim at 400C – 5th axis position: 9.87 mm;
   2. 2nd spot: aim at <400C (eg 200C) – 5th axis position: 7.87 mm;
5. Align TCPSM 5th axis to MoGr and scrape the beam with one jaw (same steps as for Mo layer):
   1. 1st spot: 5th axis position: 2 mm;
   2. 2nd spot: 5th axis position: 4 mm;

Still to finalise:

1. Detailed assessment of scraping steps extension and desired scraped intensity per step;
2. Total beam intensity to be injected;
3. Changes to BLM thresholds?
4. Actual procedure inspection to be finalized with EN/STI;

Requests:

- 6h MD time – should be enough for a second ramp, if needed;
- Measurements at FT (no Q-change/squeeze/collisions – i.e. β*=1m);
- Tests only B2 (TCSPM available only there);

Back-up Slides