



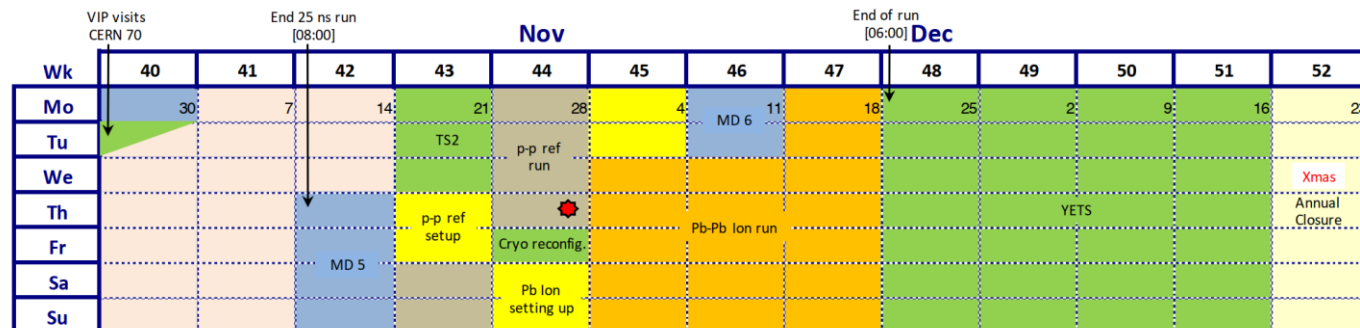
Intensity Ramp-Up for Pb Ion Run 2024

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253rd Machine Protection Panel Meeting, September 13th, 2024

Introduction

- **Pb ion run scheduled to start on Nov. 2nd, 2024, following the pp ref. run**
- **Reminder: 2023 ion intensity ramp-up**
 - Performed as planned but slowed down by several issues: Beam losses in the ramp, ALICE background issue, ...
→ Included intermediate intensity steps (~350b, 650b, 1100b) and additional fills
 - Reached 1240b but then operated with 960b/1080b (mainly to reduce risk of dumping on beam losses in the ramp and to avoid limits on injected intensity at the TDIS by using shorter trains)
- **Configuration for ion run 2024***
 - Similar configuration as in 2023:
 - Slip-stacked 50 ns beams, crystal collimation, similar optics (only major change: reversed IR1 polarity)
 - Coupled with mitigations for the issues observed last year:
 - More open collimation hierarchy, reduced crossing angle, squeeze below 1m at flat top (not in the ramp)



*For details see R. Bruce, LBOC#168, 25.6.2024

Intensity Ramp-up Proposal for Pb Ion Run 2024

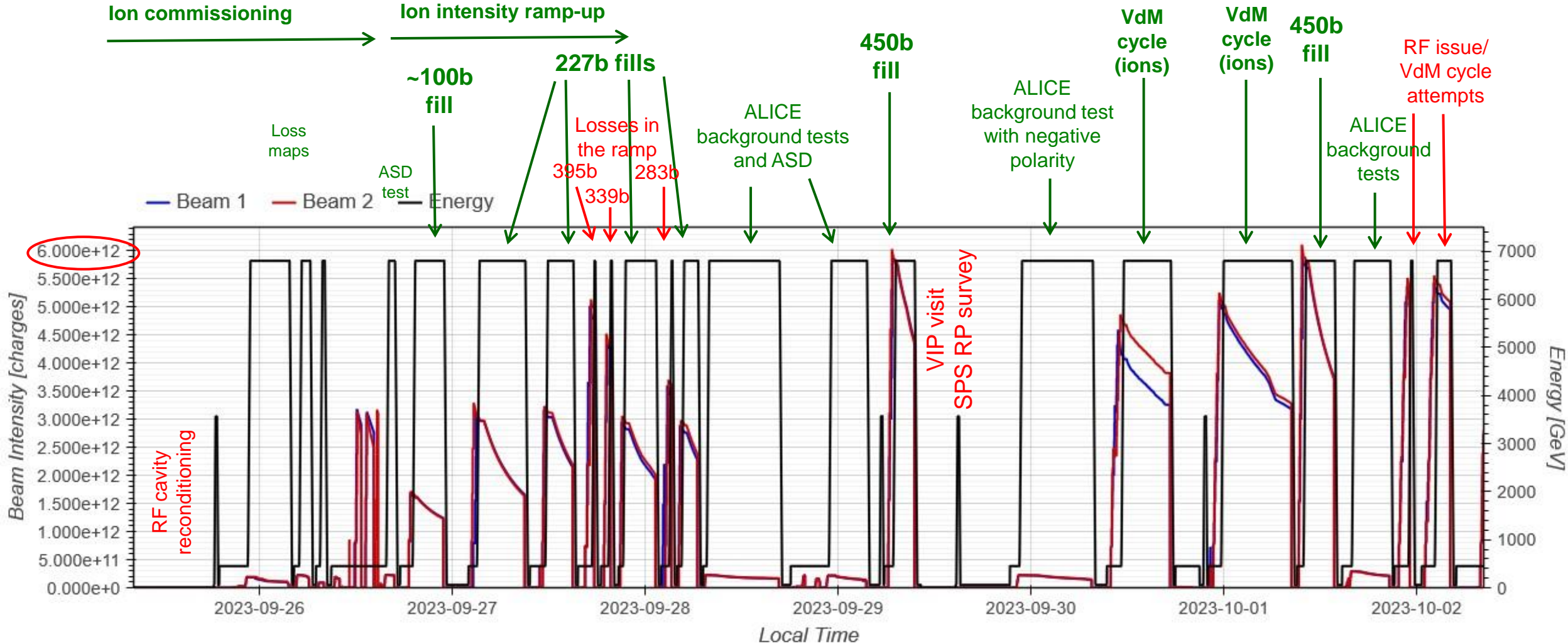
- **Keep the intensity ramp-up steps as agreed for 2023**
- **Intensity steps:**
 - Cycle setup with low intensity
 - 80b, one fill, >2h in Stable Beams
 - 250b, two fills, >5h Stable Beams in total
 - 450b, two fills, >5h Stable Beams in total
 - Combined checklist before going to the next intensity step
 - 850b, two fills, >5h Stable Beams in total
 - 1240b (full machine) corresponding to ~20 MJ of stored energy per beam
- **Crystal behaviour to be monitored carefully**
- **After Alice polarity reversal: 1x cycle with low intensity, 1x 450b fill (>2h in SB), then full machine**

Thank you very much for your attention!



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Ion Run: September 25th to October 2nd 2023

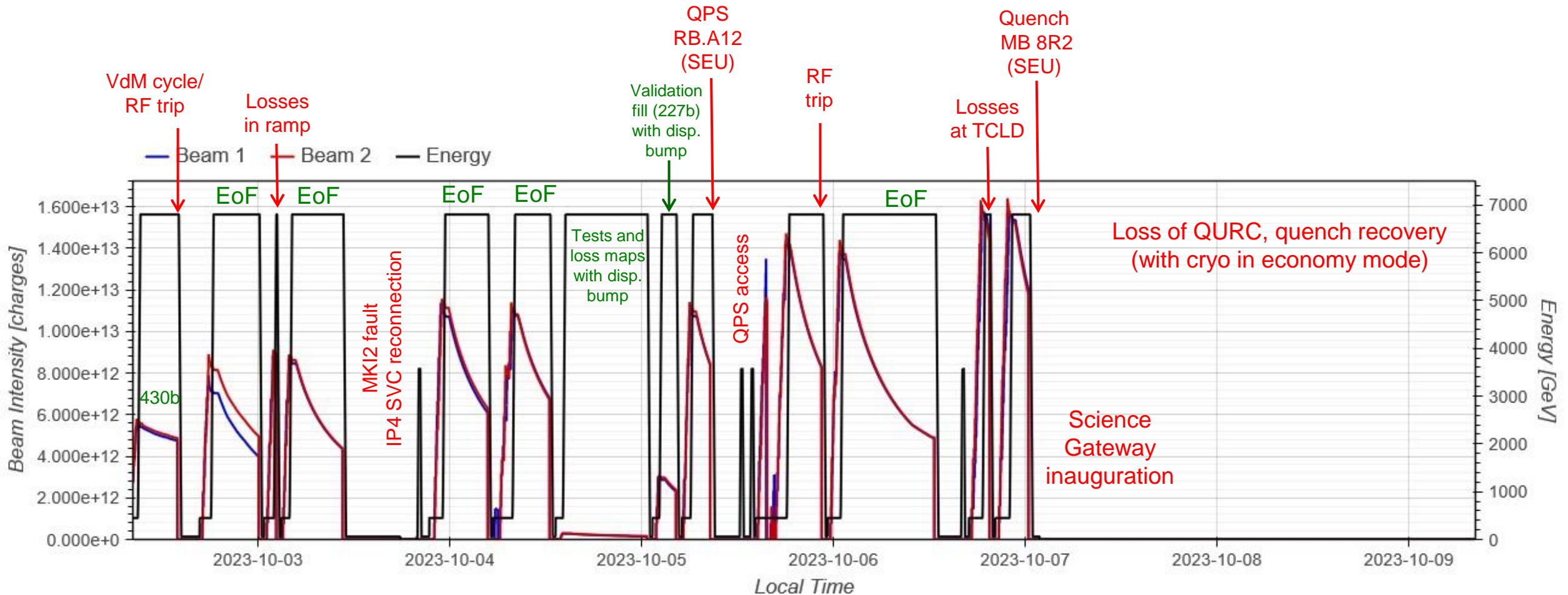


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Ion Run: October 2nd to October 9th 2023



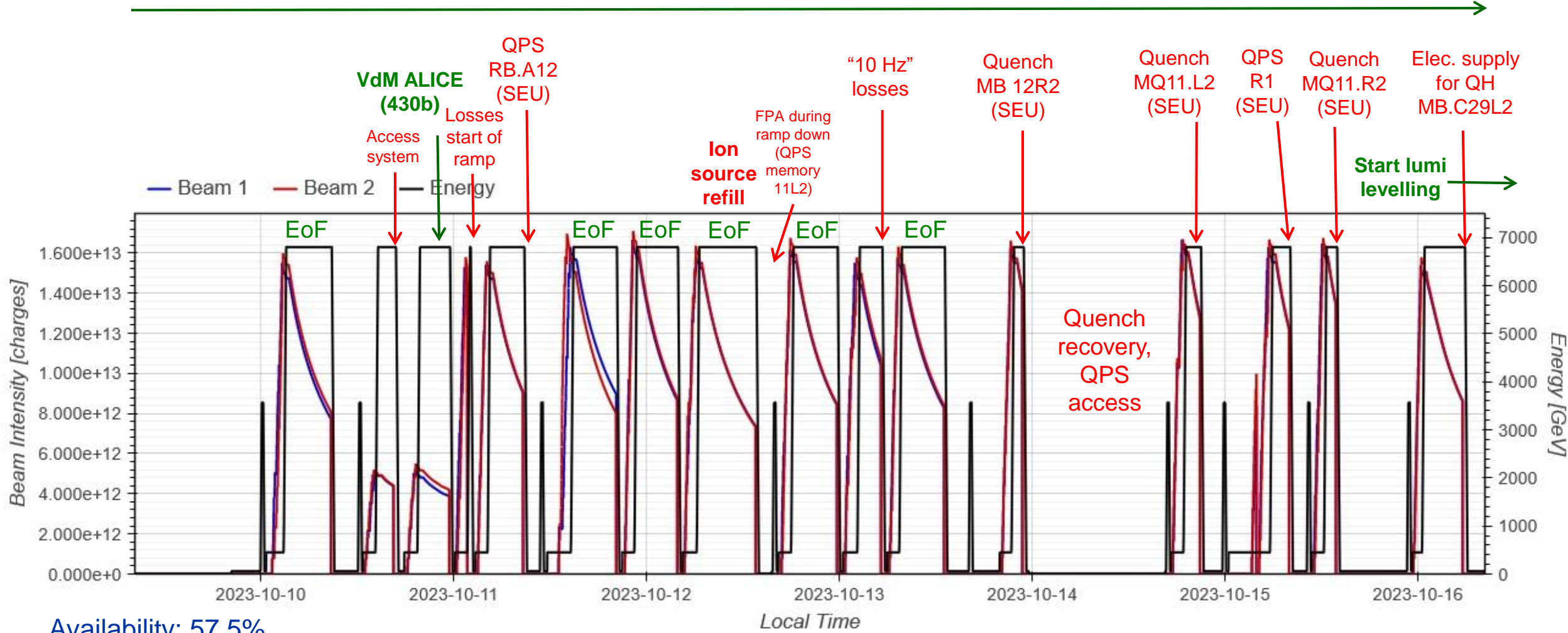
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Ion Run: October 9th to October 16th 2023

1240b

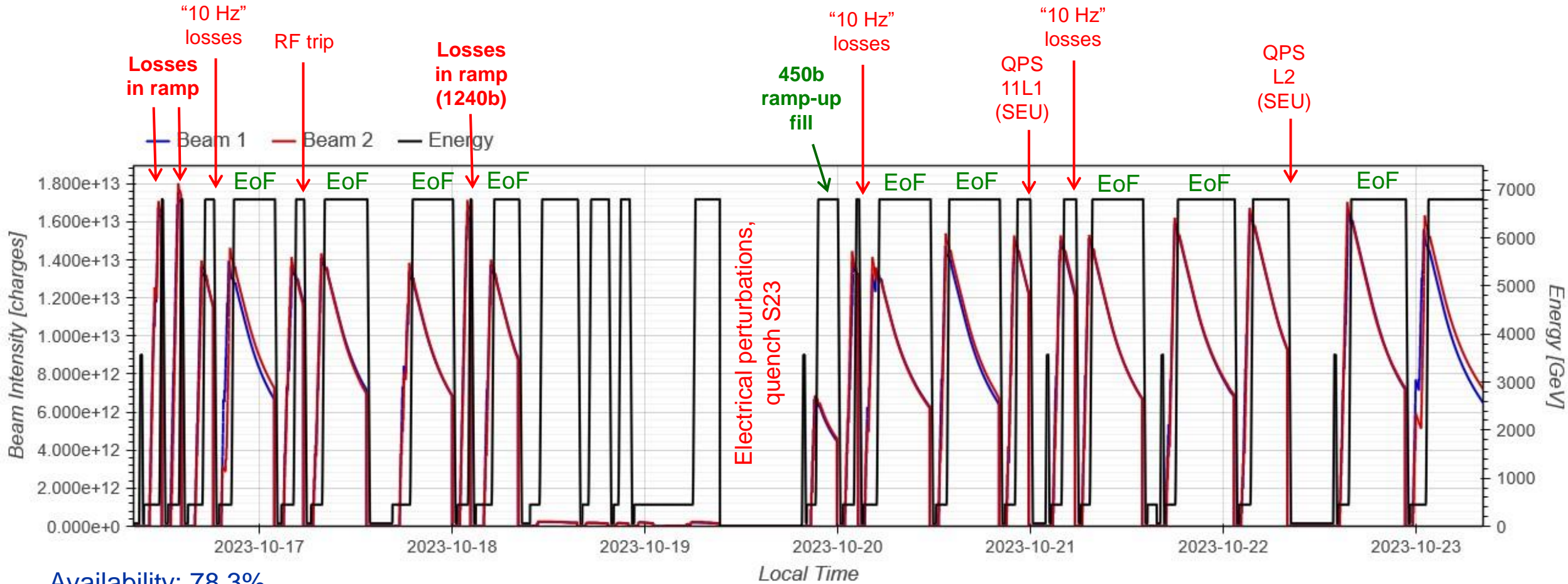
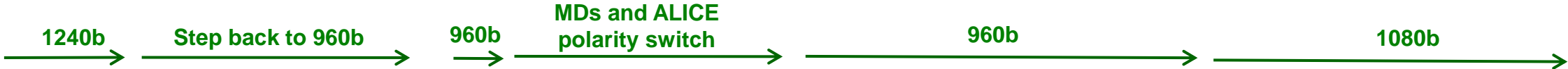


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Ion Run: October 16th to October 23rd 2023

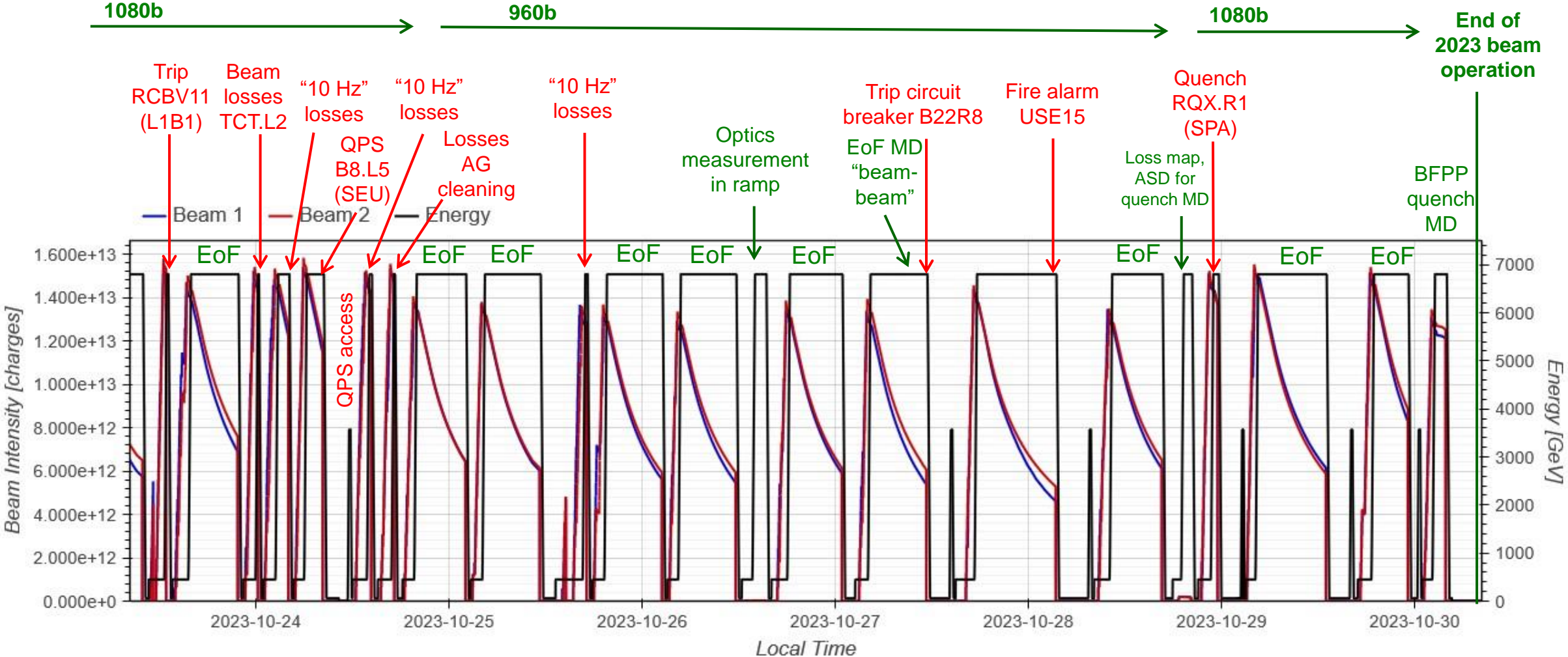


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Ion Run: October 23rd to October 30th 2023



Availability: 82.7%

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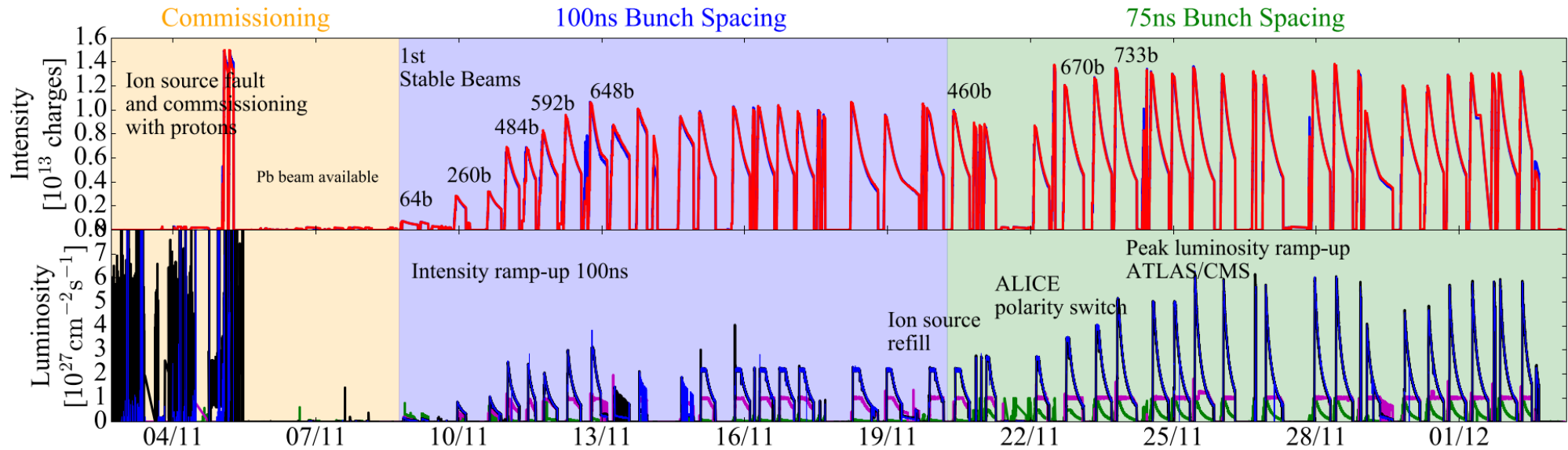


Checklist for going to 850 bunches

Bunch pattern / intensity	50ns_119b_58_51_58_56bpi_9inj_3INDIV_4NC, 50ns_227b_170_170_161_56bpi_7inj_3INDIV_, 50ns_339b_338_114_107_56bpi_9inj_3INDIV_, 50ns_451b_394_394_161_56bpi_11inj_3INDIV, Multi 22b 10 12 6 3bpi 10inj PbPb 1us, 100ns 432b 374 250 181 28bpi 27inj VdMPb
Start date	26-SEP-2023 22.53.11.720364
End data	01-OCT-2023 13.42.39.757614
Fill numbers	9192-9197, 9199-9201, 9204, 9206, 9208, 9209, 9212, 9213
Comment	Combined checklist for the 80b, 250b, and 450b fills of the Pb ion intensity ramp-up
Next intensity	850b
Intensity ramp-up: In case of non-conform points in the following check lists, the intensity increase is put on hold pending a satisfactory understanding / resolution of the issue	
Comments / Issues	
RF	An HOM coupler quench in 3B2 (without beam) prevented from switching on the cavity. After cooling for ~15mins it was possible to switch back on. No problems since.
OFB	Gain increased almost factor 2 in region 5.5 - 6.5 TeV, but not sufficient to avoid orbit excursions of ~20 - 60 microns peak at the last 3 optics matched points in the ramp. The excursions affect mainly the H plane (factor 3-4 better in V), they also occur on the pp cycle ramps, always at optics matched points in the upper part of the ramp.
TCT orbit	For ions the tolerances at the TCT were increased to 4 sigma
BLMs	Newly introduced PM buffer's memory check disabled after having regularly false positives. Will be reinstated after further improvements can be applied over EYETS 2023/24. No unknown fast losses. But we are currently limited by a lifetime drop during the ramp. The BLMs that are concerned are TCLA, Q6 in IR7 and TCTPH.4L1.B1 and TCTPV.4L2.B1. For the last fill losses were up to 30 % during the ramp, this situation is better than in the previous fills. i.e. for the fill 9206 the losses were about 70 % for BLMQI.06R7.B1E_10_MQTL RS07 with MF = 0.6 during the RAMP. The reason is only due to increase of BLM thresholds. <i>The lifetime seems to scale with the bunches but the losses seem to depend on the loss pattern (channeling vs amorphous).</i> Change of BLM thresholds: Main changes to adapt IR7 collimation to the new collimation schema with crystals, this includes MQTL_cell_6. Small adjustments on IR7 DS magnets and IR3 (more details in the BI tab).
Heating	Heating of Crystal Goniometers (TCPC): One probe of TCPCH.A4L7.B1 is increasing by 10C to max 40.4C during the fills, while the other probes are increasing by ~3C during the fills (including the second probe of that crystal). The sharp increase is strongly correlated to bunch length at the start of the ramp, and decays slowly with intensity. Most TDIS probes do not seem to be logged anymore since a few days
Collimation	High losses during ramp. Background issue for ALICE (parallel scatters from TCT in beam 2) not yet understood Up to 1 sigma orbit errors towards end of ramp in some TCTs during ramp, which was corrected at FT. This was due to a not corrected matched point in the ramp, which has been fixed since fill 9204. The orbit is now much better in the ramp. No issues seen.

Reminder Ion Ramp-up 2018

- Intensity steps of 64b – 260b – 480b (combined [checklist](#)) – 648b
- Two fills with, in total, >8h in stable beams for each intensity step
- Finally, intensity increased to 733b after ~10 days of operation with 648b



J. Jowett et al., WEYYPLM2, IPAC'19