

Intensity increase criteria - general

□ Max. increase factor:

- Up to 0.25 MJ : typical factor ~2, max 4
- Up to 1-2MJ : max. factor ~2
- Above 1-2 MJ: no more than ~2 MJ a step

□ Green light for intensity increase:

- Minimum time ~10 days – time to look at the data (and generate problems).
- At least 10 fills / dumps – no anomaly in the PM (all 10 dumps analyzed).
 - **Exception:** we should spend a longer period (at least 3-4 weeks) with intensities in the 1-2 MJ range. Could be done in 2 different configurations (43, trains..).
- Beam cleaning adequate and no quenches, losses under control.
 - Highest observed losses scaled by intensity increase should be \ll BLM thresholds (\ll to be defined, factor 2?). **Essential also for efficiency !**
 - **BLM saturation in warm regions.**
- Abort gap population under control.
 - No Q4 quenches, BLM patterns reasonable.
- Formal “review” to approve each step (document that conditions are met).

Intensity increase – special criteria

In addition to the general criteria.

□ Stability criteria [to be in place to go > 0.25 MJ (proposal)]:

- Optics must be reproducible.
 - How to check:
 - Beam cleaning, collimator alignment & loss patterns
 - End-of-fill Qkicker measurements – not enough accuracy?
 - Insert special low intensity diagnostics fills – see also collimation (later).
 - Orbit must be stabilized to ~0.5 sigma - injection, ramp, squeeze, stable b.

□ Beam intensity criteria:

- Significant changes in bunch charge and bunch spacing should be associated to SMALL intensity factors (2 absolute max), respectively equivalent intensity.
 - Beam-beam and instabilities could drive fast(er) losses, lower lifetimes and larger loss rates for higher charges.
- Individual bunches to trains: significantly higher densities (e.g asynchronous dumps) – review situation (mostly kicker failure prot.).

Intensity increase - general

□ Tests / verifications after intensity increase:

- Diagnostics operational (BLMs, BPMs, BCTs, BSRT/A).
 - Sounds trivial but...
 - Watch the step from individual bunches to trains.
 - BPM sensitivity switch above $\sim 5E10$.
- Beam cleaning adequate (understand all issues, e.g. IR6 x20 factor, ...)
- Test beam dump at injection

□ Special MPS tests:

- Injection protection fully deployed and tested for $5E11$ - $1E12$ injected intensity.
- As specified in procedures
 - To be collected and grouped according to the steps that we will foresee.

Collimation: Required Beam Time

Test	Frequency	Time required
Measure cleaning efficiency for x, y, momentum losses at injection energy	every 3 days	4 h
Measure halo population & cleaning efficiency for x losses at top energy	every 3 days	1 h end of fill or special fill
Measure halo population & cleaning efficiency for y losses at top energy	every 3 days	1 h end of fill or special fill
Measure halo population & cleaning efficiency for momentum losses at top energy	every 3 days	1 h end of fill or special fill
Setup collimation at injection	tbd	12 h
Setup collimation at top energy	tbd	24 h
High power load tests	every intensity step	1 fill

+ optics measurements

Beam tests

- Fast increase of intensity implies limited learning (from errors and ‘natural’ failures) at low intensity. We may want to trigger more failures than anticipated (procedures).
 - Collimation tests (prev. slide from Ralph) may provide precious input.
- Proposal: use ‘end-of-fill’ (EoF) with limited risk beams (100 kJ?? Depends a lot on how much confidence we in the MPS at the time).
 - Perform as many MPS beam tests at EoF. Evaluate risk to define when it can be done (max. intensity).
 - Make more test than specified to debug as much as possible.
 - Force faults to gain experience – check risk.

Commitment

- We can dictate strict rules, but we must also provide the resources to do our job and follow the rules:
 - Continuous MP performance analysis.
 - Review + documentation for intensity increase.
 - ...

>> Cannot stop because an essential person is away.

Organization...

1 fm⁻¹

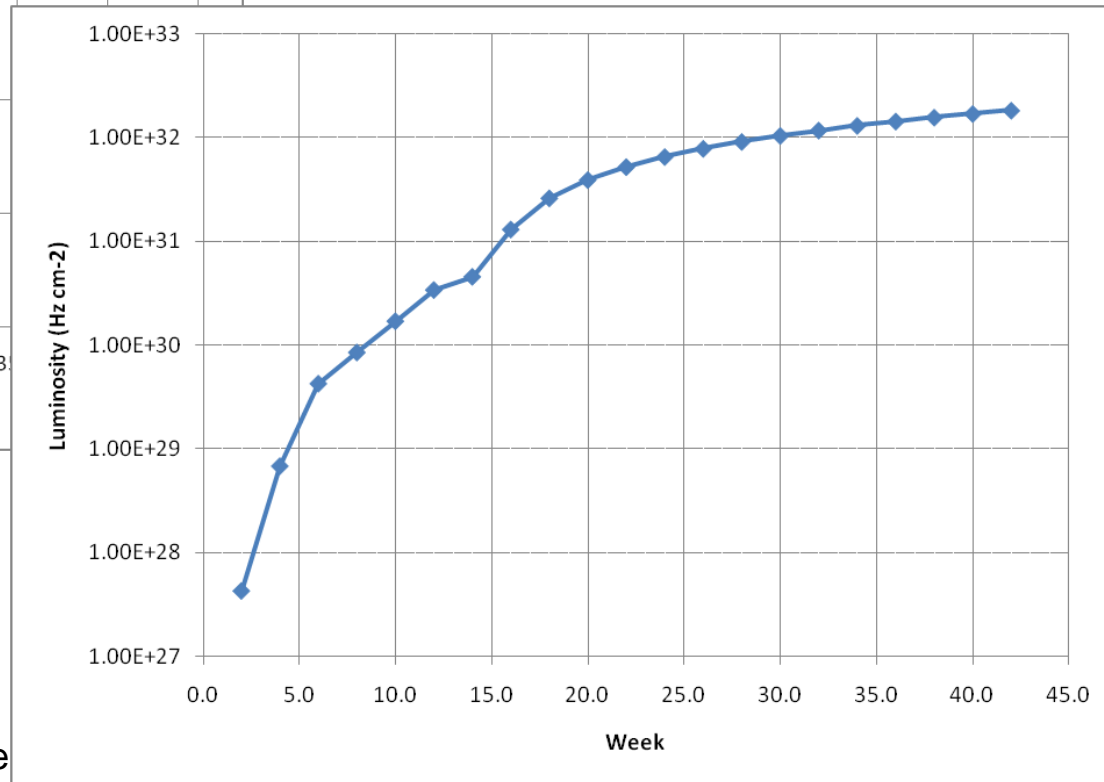
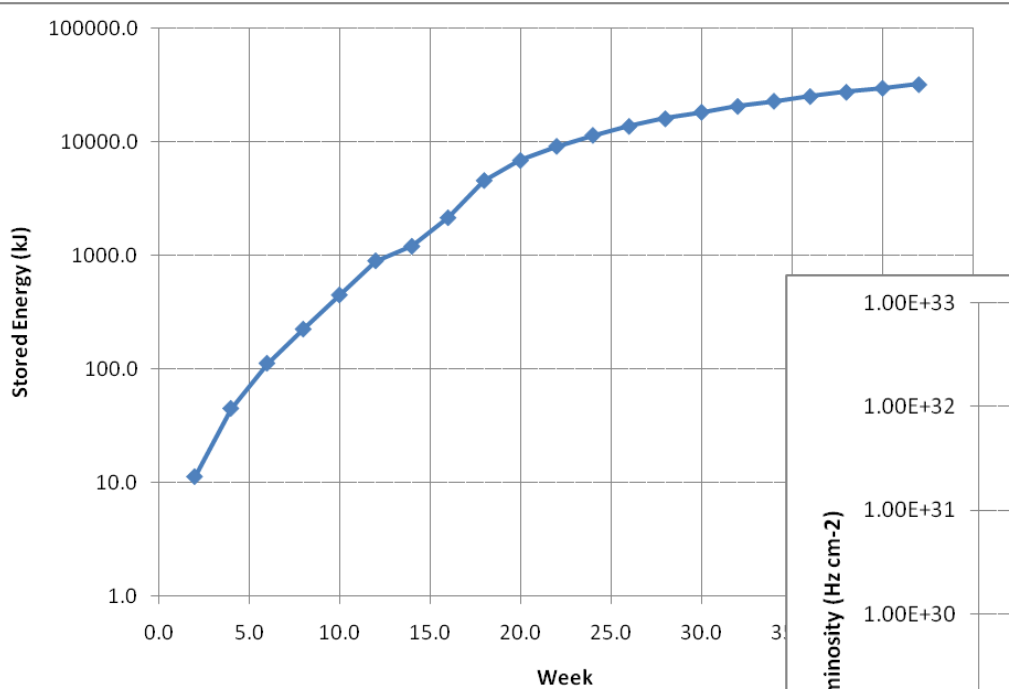
- Since Chamonix the 1 fm⁻¹ target for end 2011 is circulating...
- Performance models (Massi, Ralph, Roger,,,) show that to reach such an integrated Lumi, we must run flat out at $L=2E32$ cm⁻²s⁻¹ in 2011.
 - Corollary: we must reach $2E32$ cm⁻²s⁻¹ by the end of 2010.
 - Beam requirements: $I_b = 8E10$ p, $N_b \sim 700$ bunches, ~ 35 MJ.

YAM

- Simple model (see last week).
- Assumptions:
 - 2 weeks between energy steps = 10 days + margin for MD, access, ...
 - Follow rules for intensity increase (slide 1).
 - Move to $8E10$ p/bunch 'asap': in this case when starting with trains.
 - To respect ~ 2 MJ/step, max 48 bunches of $8E10$ per step (2.1 MJ).
 - May not be possible to respect 4 fold filling symmetry since this implies trains of 12 bunches or unequal length trains (not nice for beam-beam). Unless long-range is less of an issue...
- Running time 2010:
 - Max 7 months = ~ 32 weeks between April and end October.

Progression

□ After 32 weeks: $\sim 1E32 \text{ cm}^{-2}\text{s}^{-1}$, 12 MJ.



2/8/2022

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