BEAM PREPARATION IN INJECTORS AND BEAM CHARACTERISTICS

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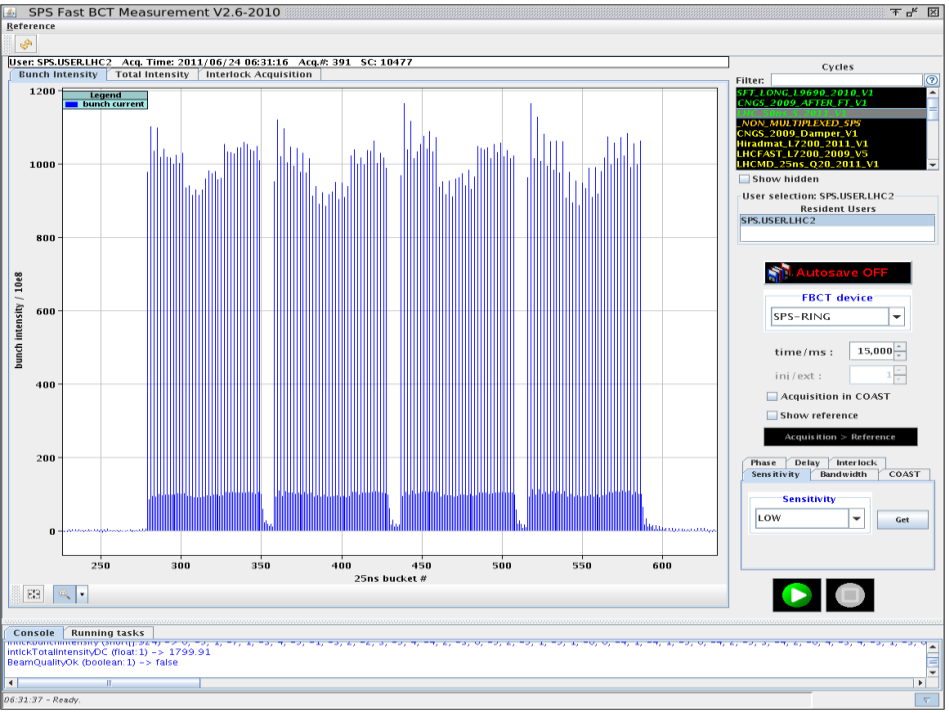
BE-OP-SPS

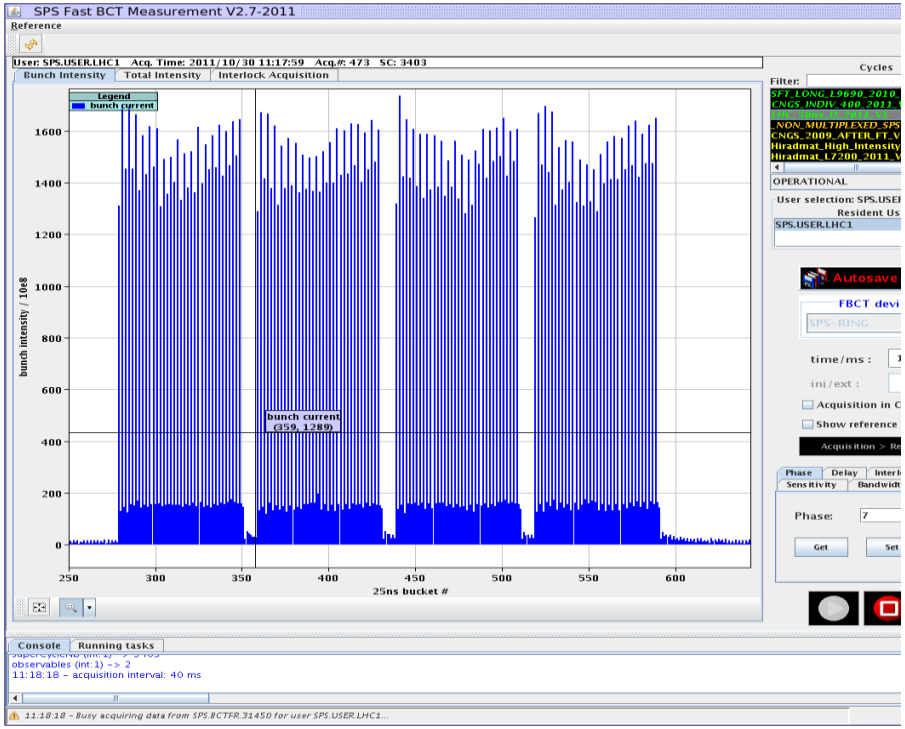
Content

- Drifting beam parameters
- Emittances and intensity
- Scraping strategy.
- Considerations on filling strategy and SC composition
- Conclusions

Drifting beam parameters (examples)



Booster ring 1 and 2 lower intensity



Bunch splitting

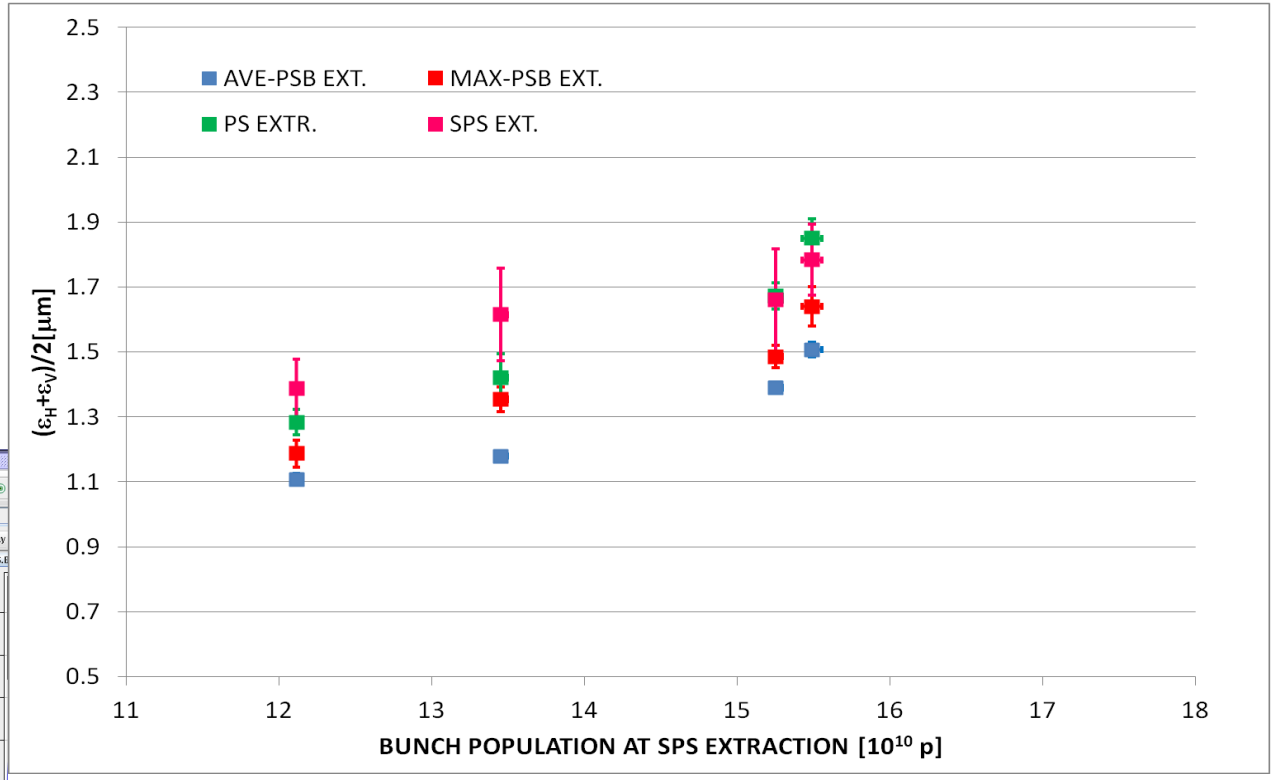
Drifting beam parameters

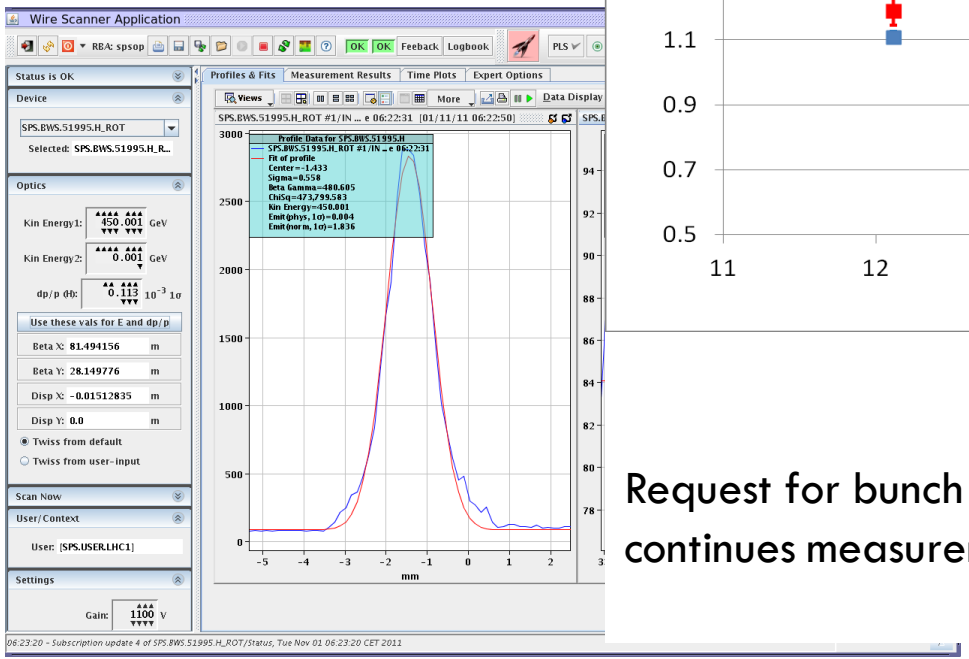
parameter	frequency	Remarks
PSB Ring intensity	Almost every fill	Relatively easy
PSB-PS Transfer	Checked and corrected when emittances too high	Easy when tools are working.
Splitting	Every fill	Needs skill
PS-SPS transfer (inj. oscillations)	Almost every fill	Easy and quick
Injection phase	Almost every fill	Easy and quick
Longitudinal blow-up in SPS	Every couple of days	Becomes tricky for high intensities (> $1.4\ 10^{11}$)

These checks and adjustments can be done by the OP-crew in 10 to 20 minutes.
However, if beam requirements go outside the operational parameter window (e.g. Intensity increase, change of longitudinal emittance etc.) some of these adjustments need expert intervention.

Emittance and Intensity

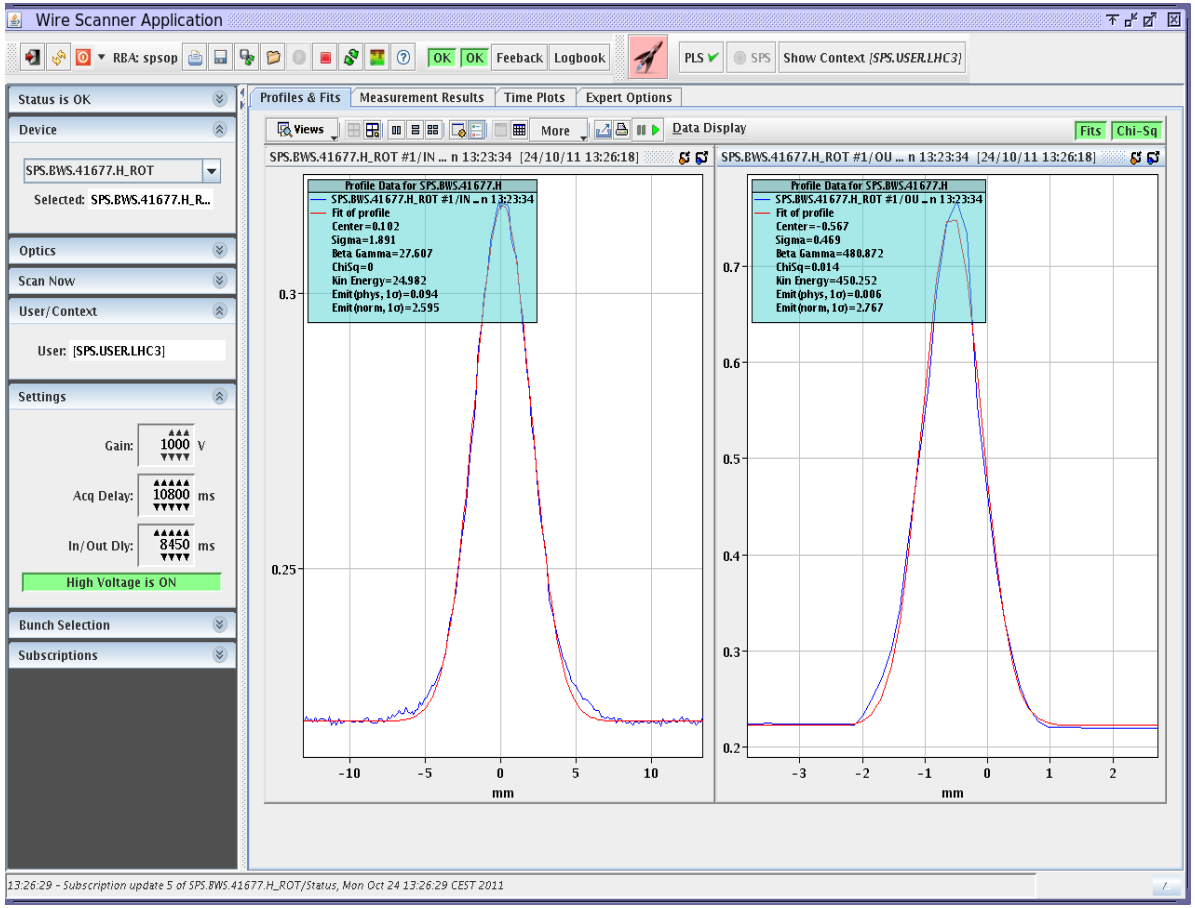
- Booster ring 1 and 2 poorer performance
- For higher intensities there is bigger scatter at 450 GeV in SPS.
- Presence of tails at 450GeV for high intensity.





Request for bunch by bunch measurement with WS and a continues measurement (ionisation beam profile)

Emittance 25 nsec beam

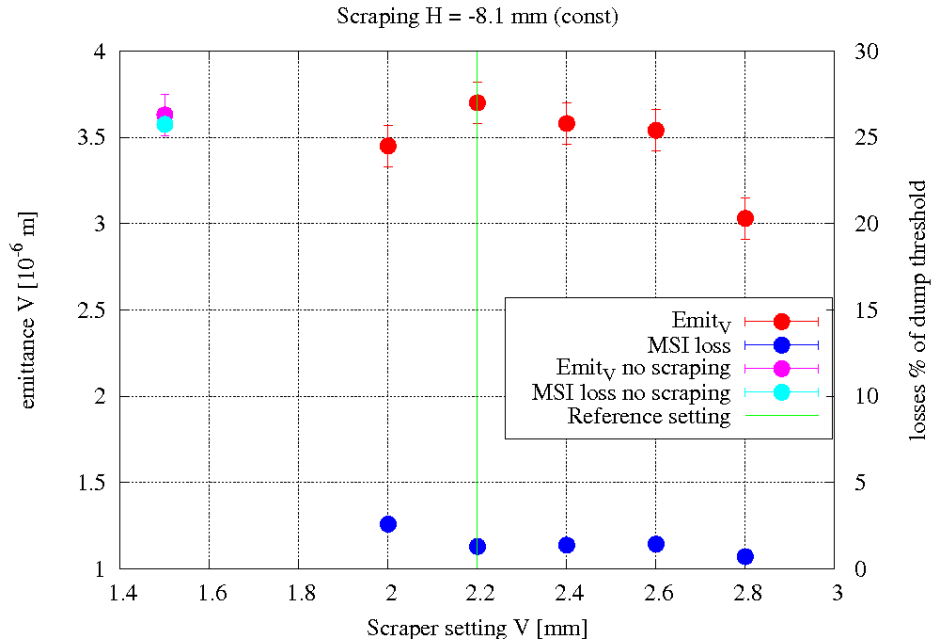


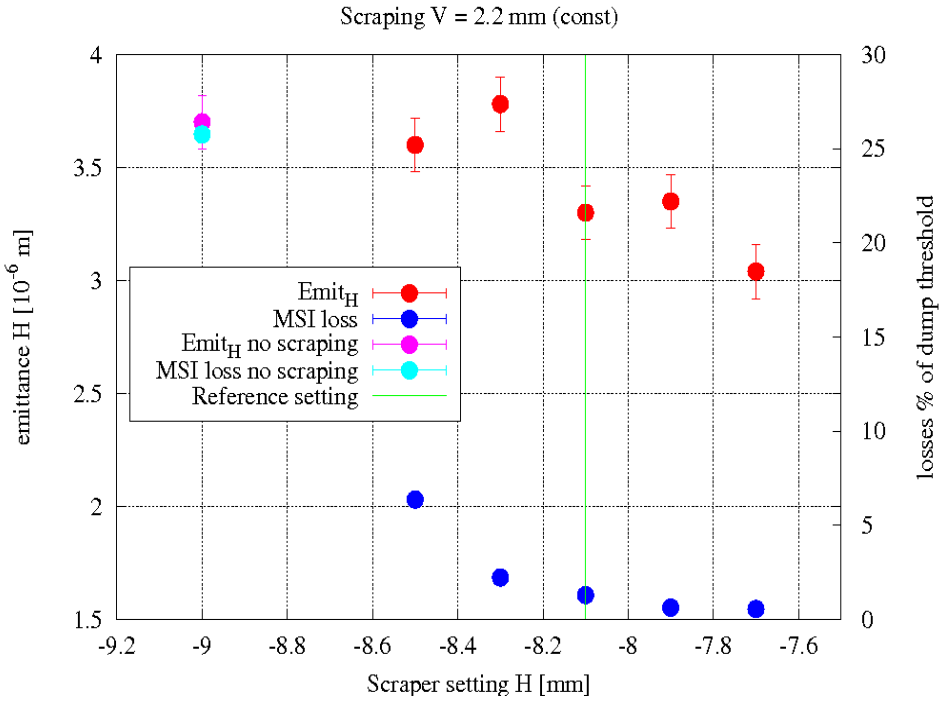
Intensity	**< 1.15e11**
εH	2.6-3.0 μm
εV	2.6-3.0 μm

Nice gaussian beams

Scraping

Scraping studies showed the importance of the scraping position. The scraper has to cast a shadow on the transfer line collimators. In this way even large emittances can be transferred.

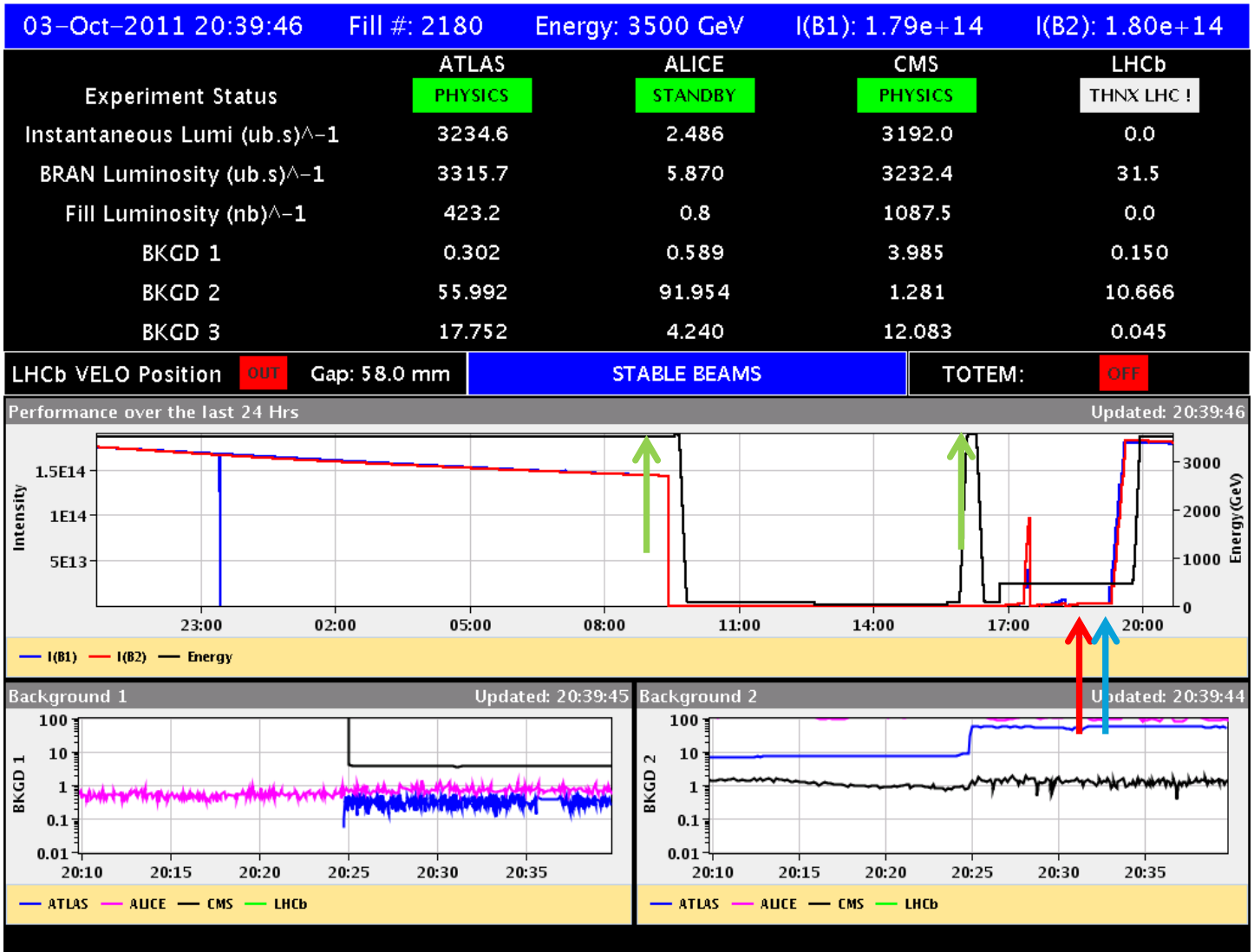




Courtesy to Lene Drosdal

Scraping, Emittances and Intensities.

Pre-filling and Filling Strategy



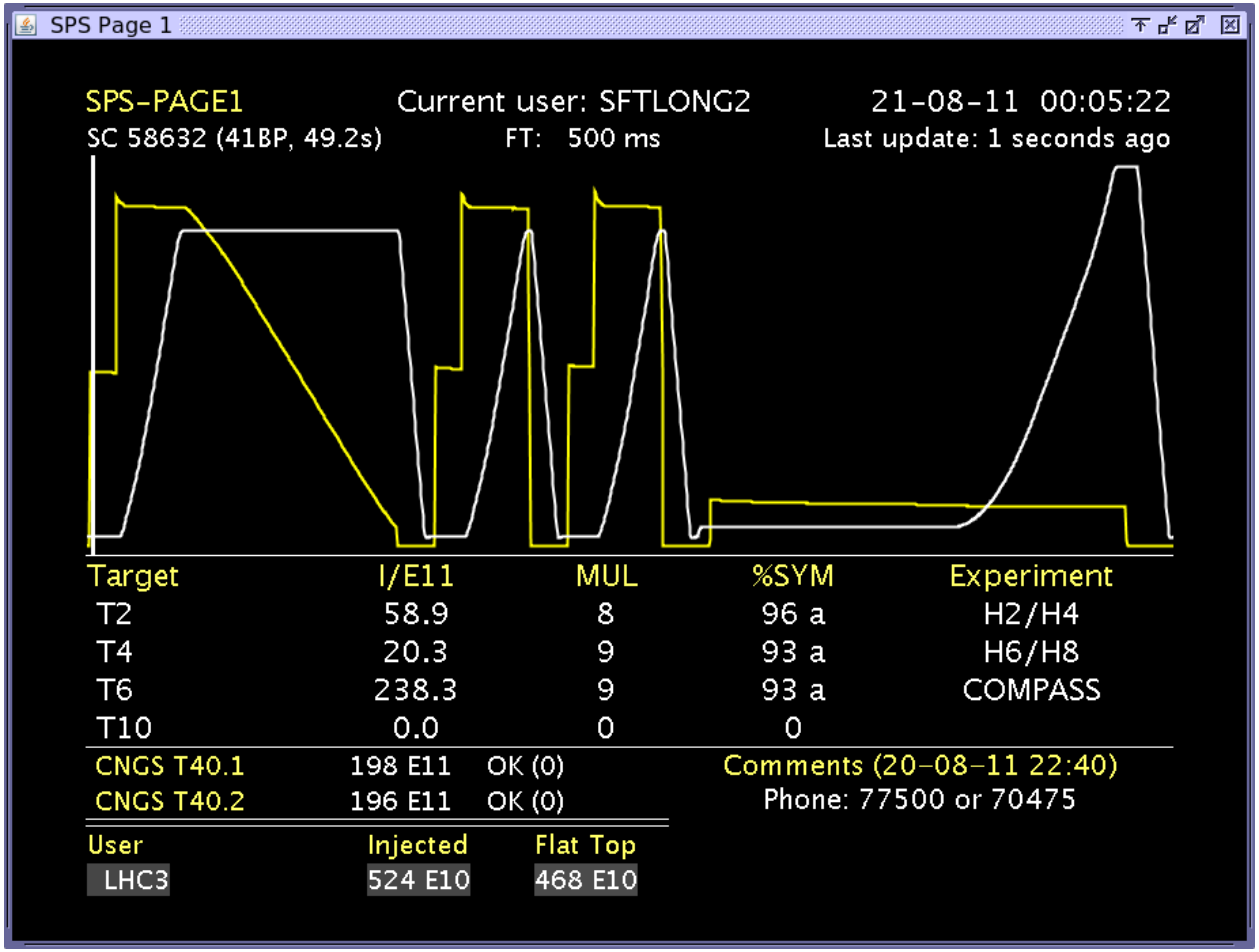
LHC filling cycle check (no adjustments)

Inject 12b

Adjustments of beam parameters

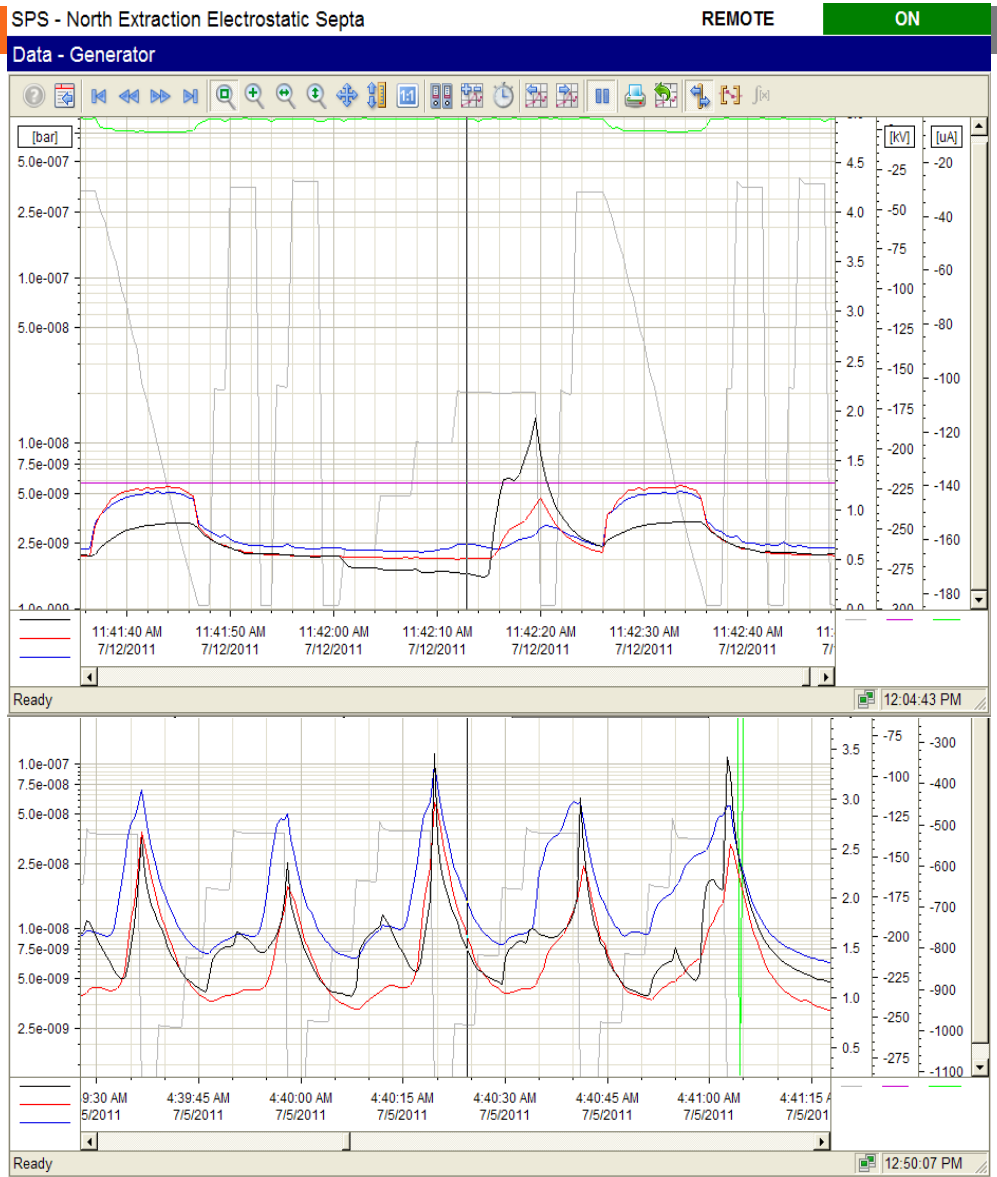
Start filling

Filling SC in 2011



- Minimal changes to SC length in order to have space for the numerous PS users and avoid permanent reshuffling.
- FT always present. Most NA experiments have short scheduled periods and suffer more from interruptions.
- Long flat top of FT cycle gives space in for PS users.

Dealing with ZS sparks



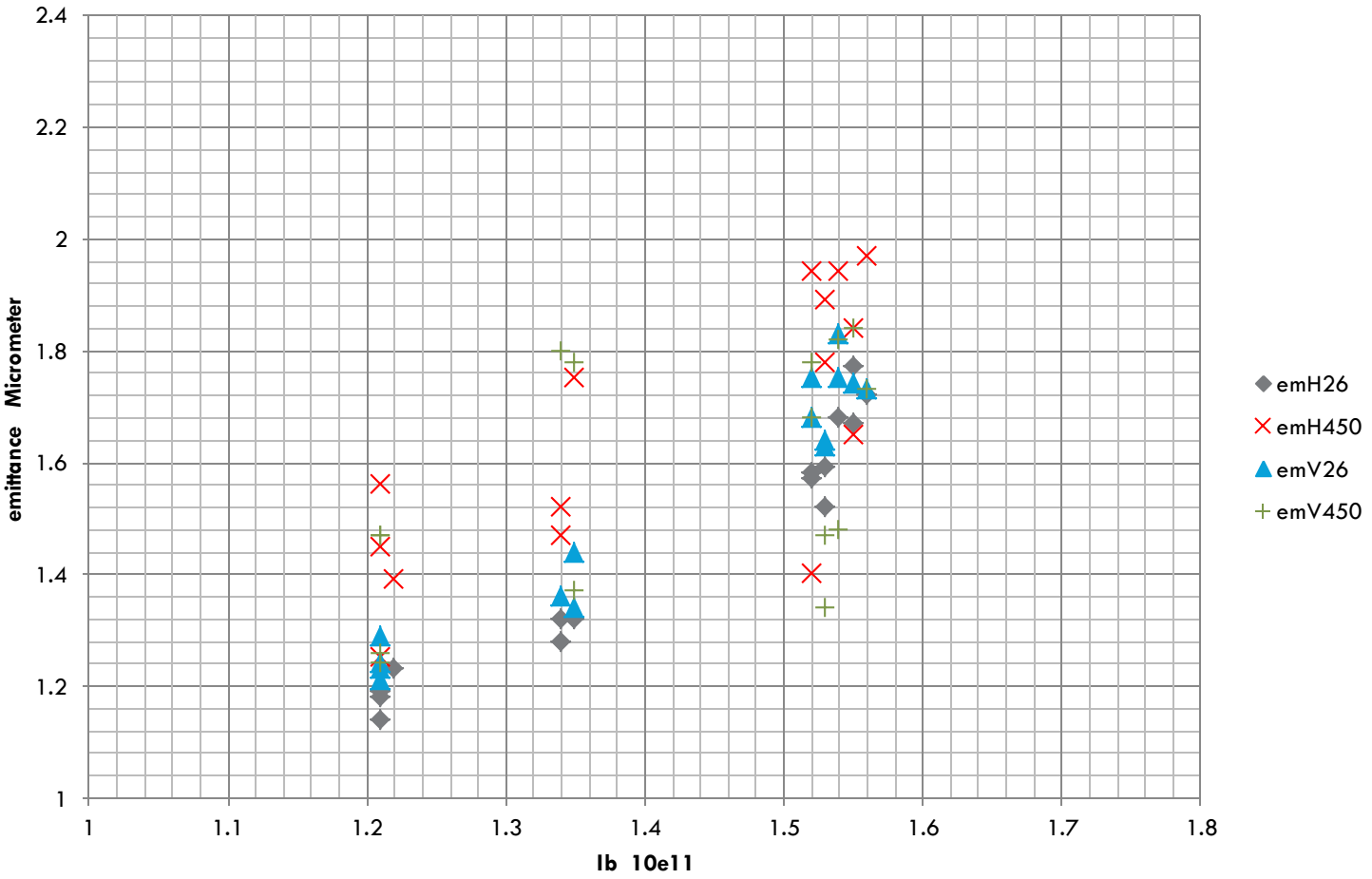
- Pressure rise during injection and acceleration under control by scrubbing.
- Pressure rise at beam dump always present even at the end of the run.
- Consequent filling cycles with high intensity not possible (ZS needs recovery time).
- New spark interlock during LHC cycle : beam dump on spark.
- For bunch intensities > 1.45 10^{11} frequent sparks and ZS needs to put at 110kV, which implies no slow extraction.

Considerations for 2012

- The switching between 12b and 36b by using the concept of spare cycle. PS has to keep the extraction and TT2 steering equal for both cycles.
- If ZS sparking problem persists with high intensities, we can take FT cycle out of the filling super cycle.
- In this case, and if necessary, we could shorten the super cycle for filling, e.g. keeping only one or two CNGS's. This would have a negative effect on PS users.
- During the actual filling, timing sequences should be frozen, no changing and no loading.

Conclusions

- During 2011run, the injectors increased the beam brightness in several steps. Injector operators gained a lot of experience for preparation, adjustment, and optimisation of the filling process.
- Several Beam parameters drift and need to be checked and adjusted just before the filling.
- Changing the parameters outside a pre-defined operational window (such as intensity) needs a pre-warning, since expert intervention is certainly needed.
- Just increase the scraping when there are losses at LHC injection is rarely the best solution.
- Since in 2012 we will most certainly run with high intensities (ZS sparks)we might have to review the filling cycle sequence.


2.4
2.2
2
1.8
1.6
1.4
1.2
1
emittance Micrometer
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
Ib 10e11
emH26
emH450
emV26
emV450