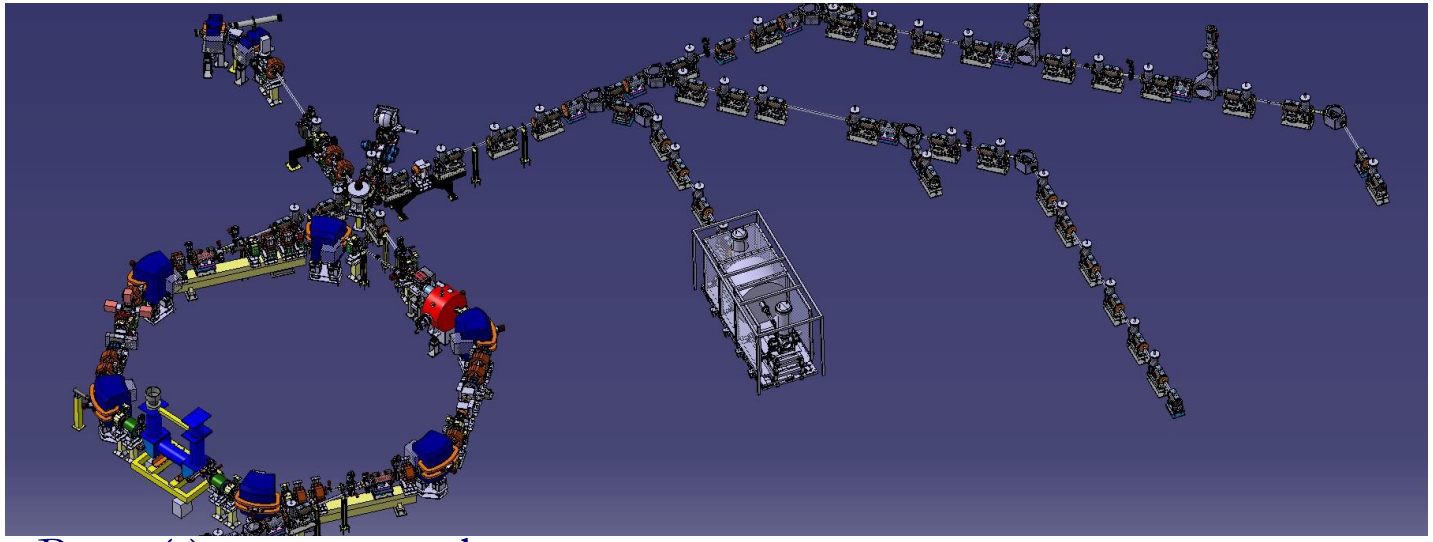
Progress with Pbars and H- beams

D. Gamba, on behalf of AD/ELENA team

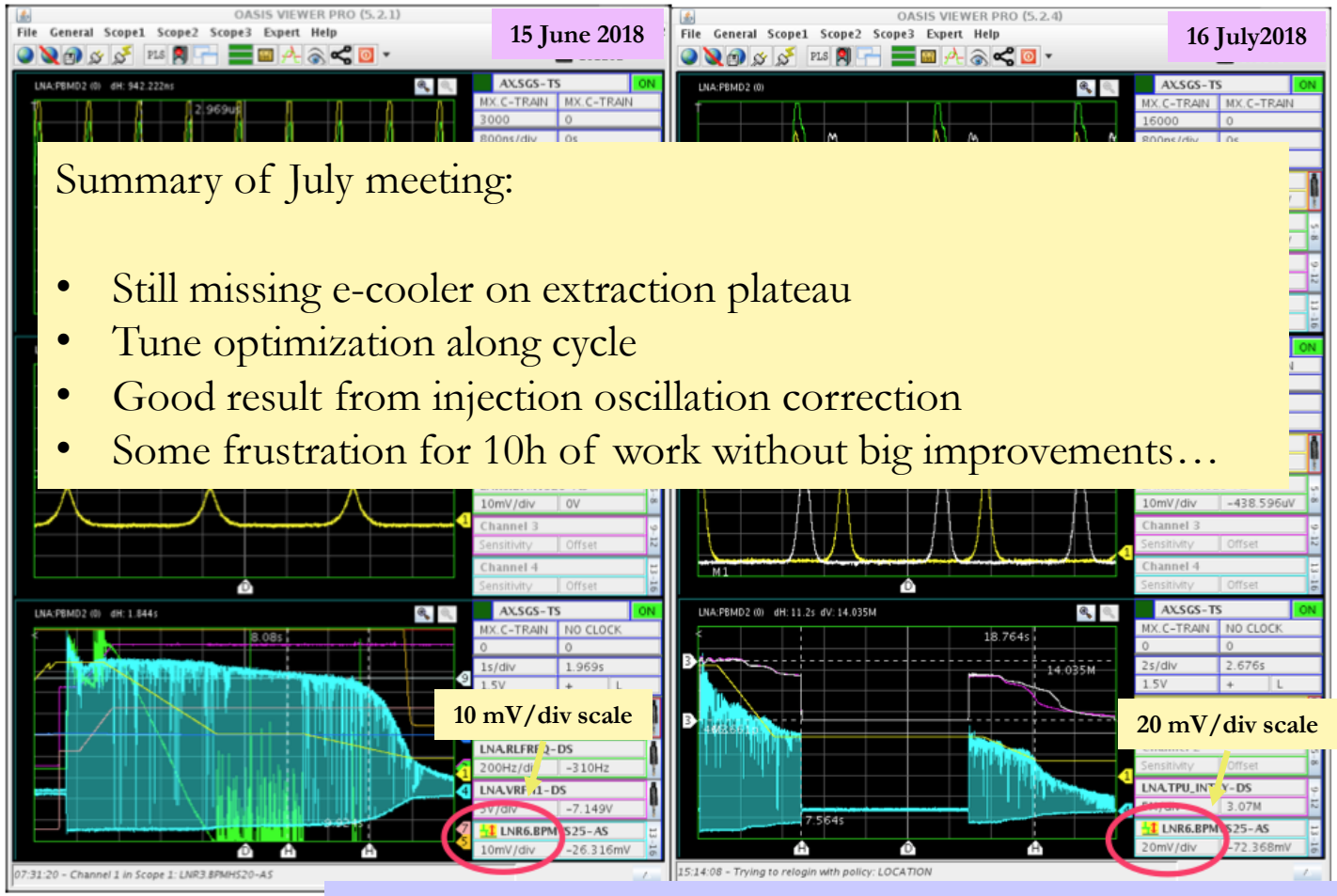
ELENA Commissioning Meeting 13th Sep 2018



- Beam(s) status at a glance
  - Bunch rotation implementation
- Inj. line studies/steering
- Gbar transfer line studies and first SEM results
- Other studies

PBAR Status mid July

Where we are with pbar July

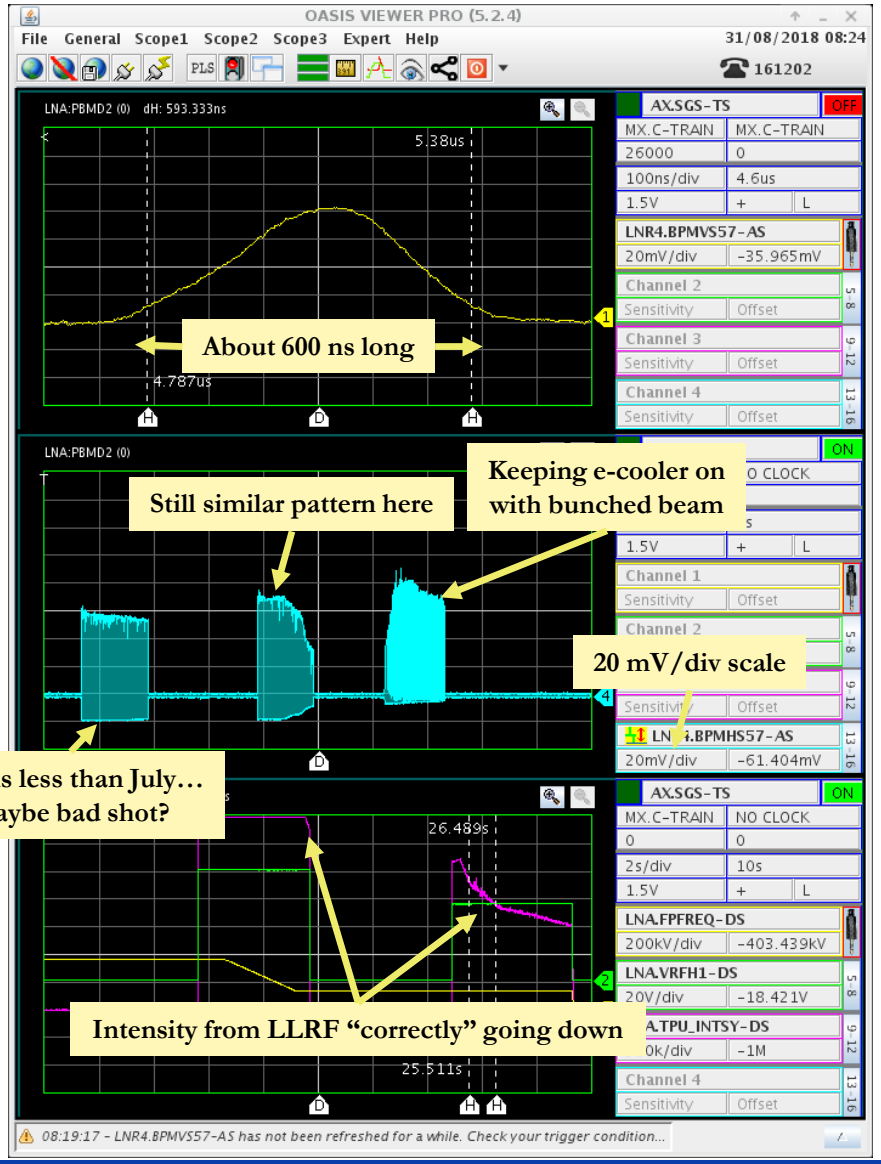


Summary of July meeting:

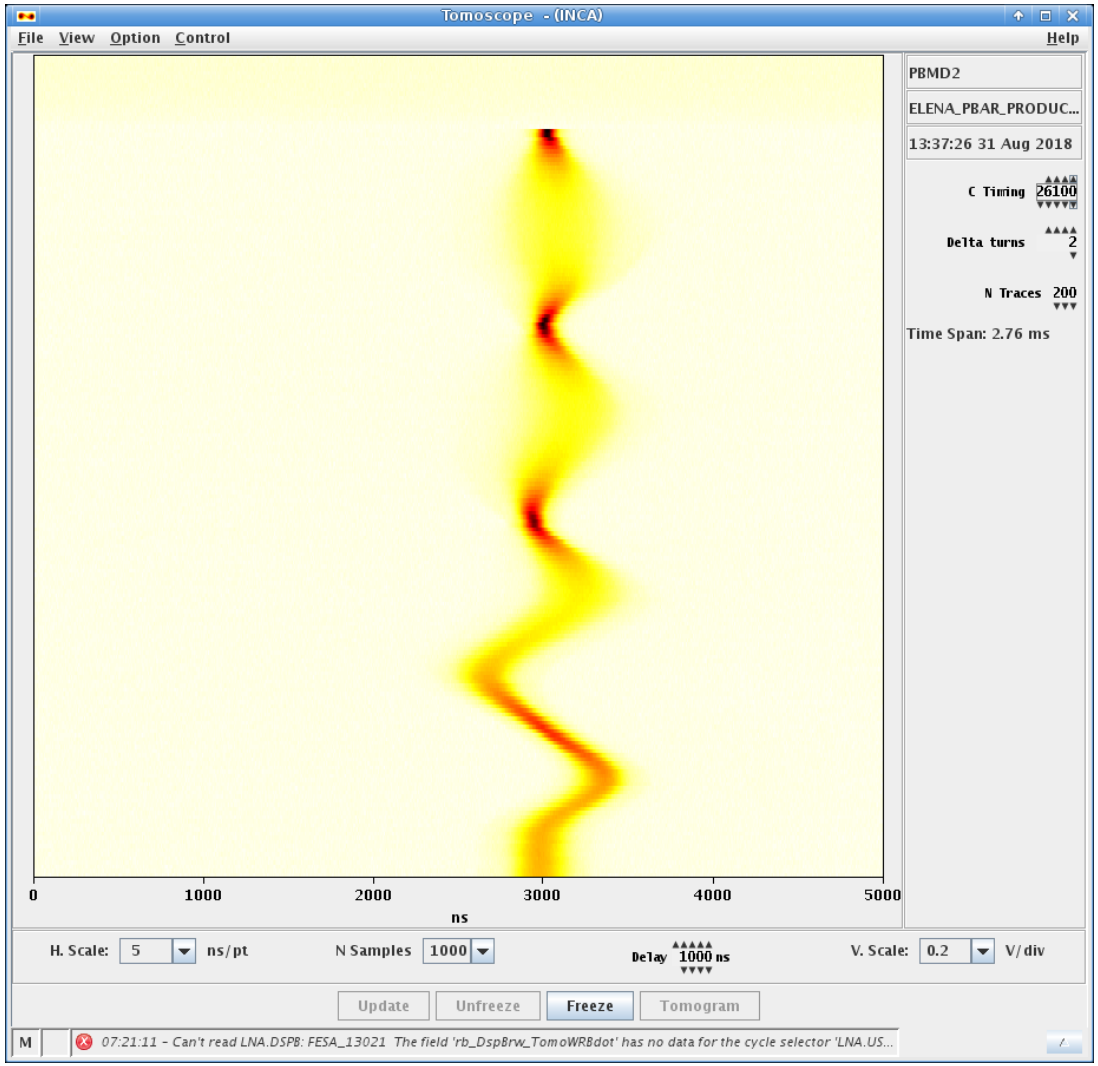
- Still missing e-cooler on extraction plateau
- Tune optimization along cycle
- Good result from injection oscillation correction
- Some frustration for 10h of work without big improvements…

From L. Ponce - ELENA Commissioning Meeting - 19 July 2018

Present PBARs to GBAR



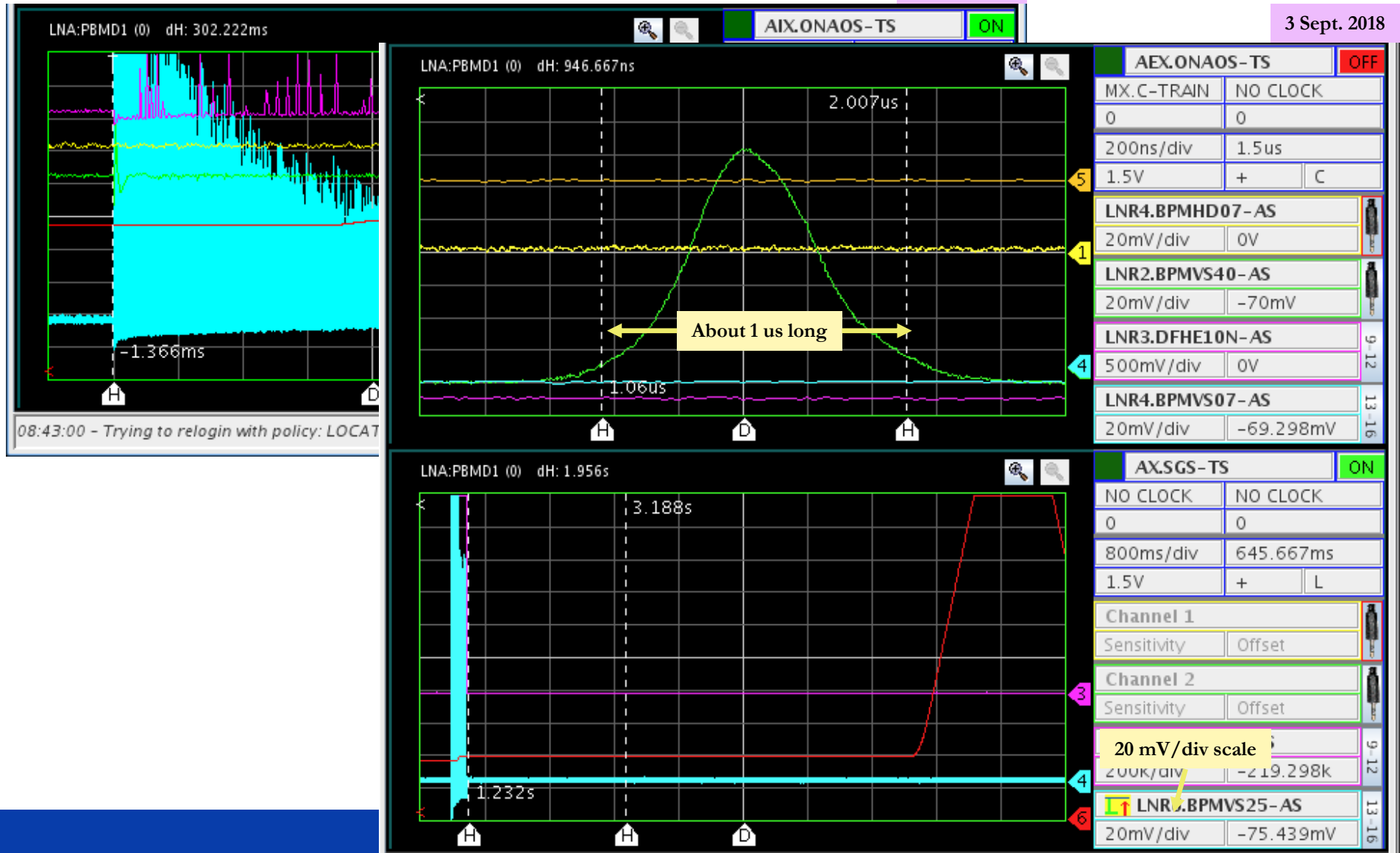
Possible bunch rotation



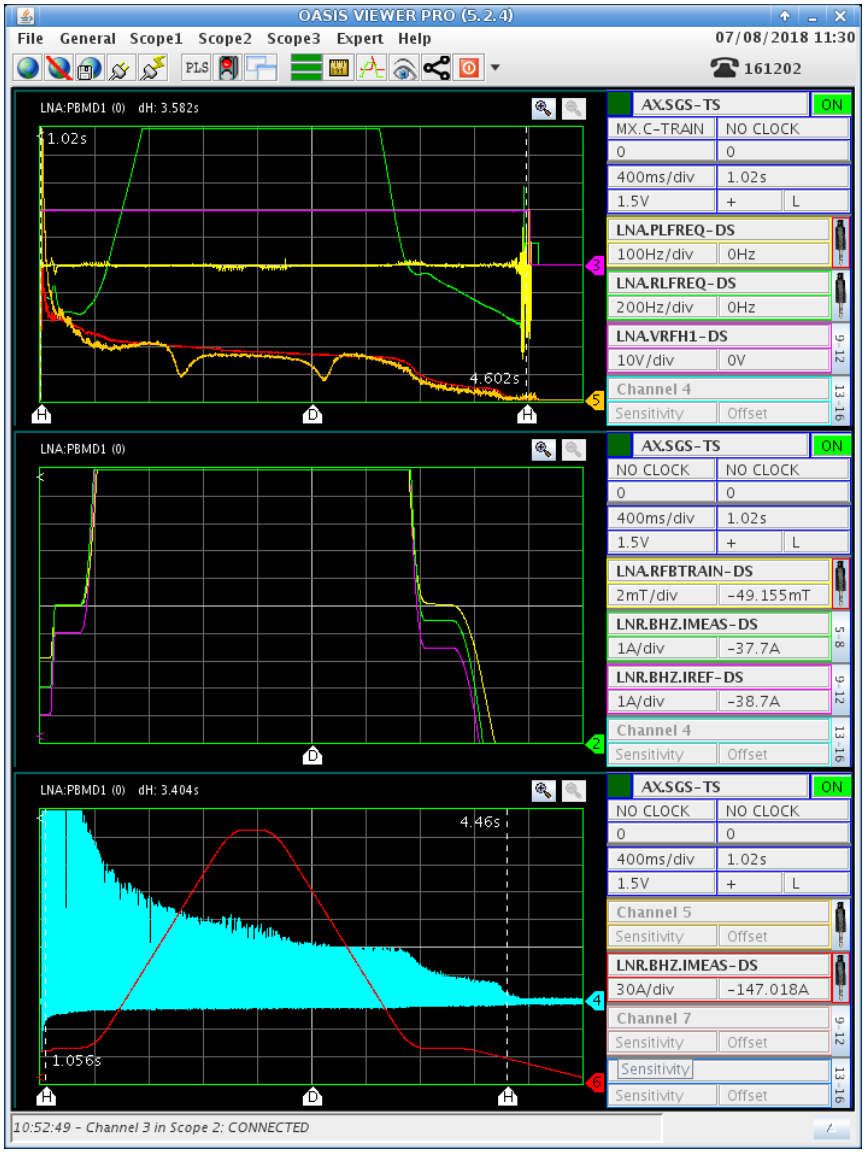
H- Status

24 July 2018

3 Sept. 2018



H- Status: a “full cycle”



- “Real” accelerating cycle:
  - From 85 keV to 100 keV
  - From 100 keV to 100 MeV/c
  - Back to 100 keV.
- Possible to have beam even for energies lower than 85 keV on the other side of the acceleration…
- Big radial loop contribution -> (more than 4 kHz! (see logbook)

- **Cycle that could be suitable for B-train/hysteresis studies.**

Injection line steering

- Study in collaboration with ABT (Yann Dutheil)

Resulting observations:

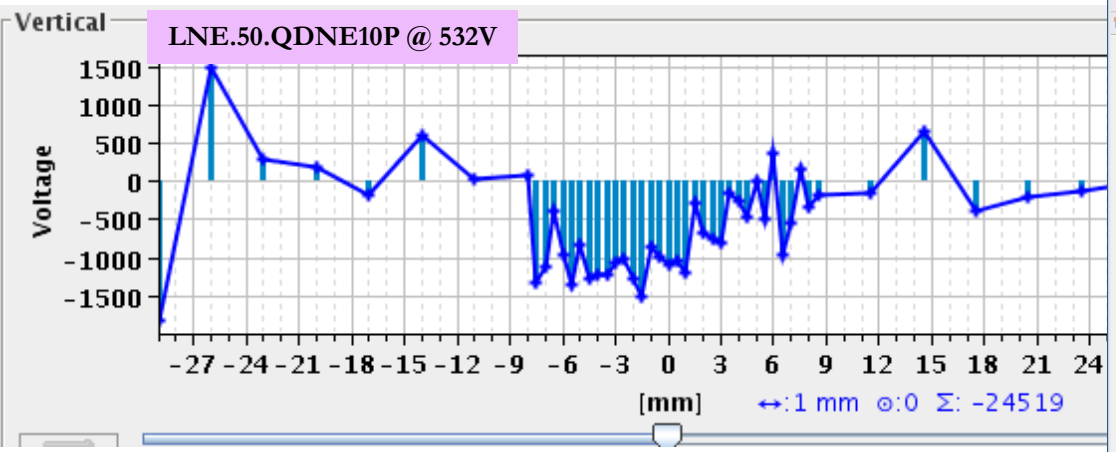
- DHZ7042 is an extremely strong corrector for the ELENA injection line.
  - we reduced its strength by acting on BHZ7010 upstream
  - It has big huge impact on alignment downstream

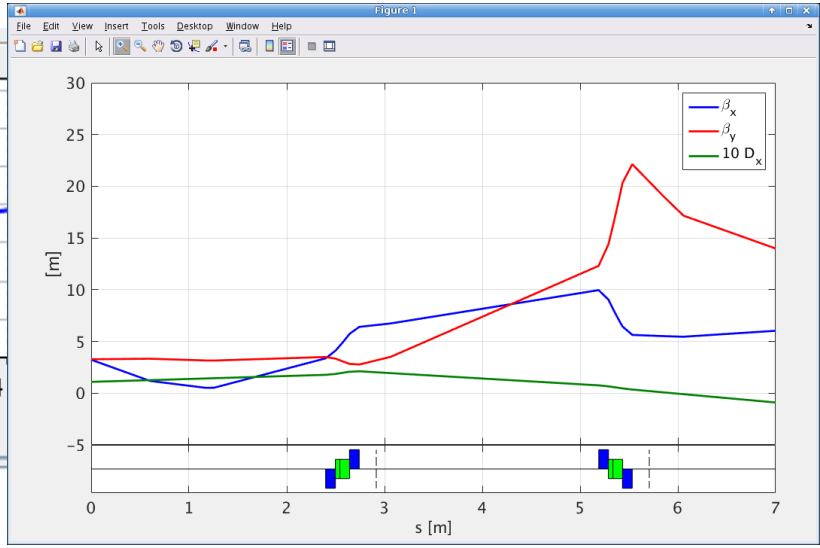
- With the steering we found (not optimal) we have less than 1 mm/A steering on BTV118 for each quadrupole of the LNI line (starting from LNI.QFN07)

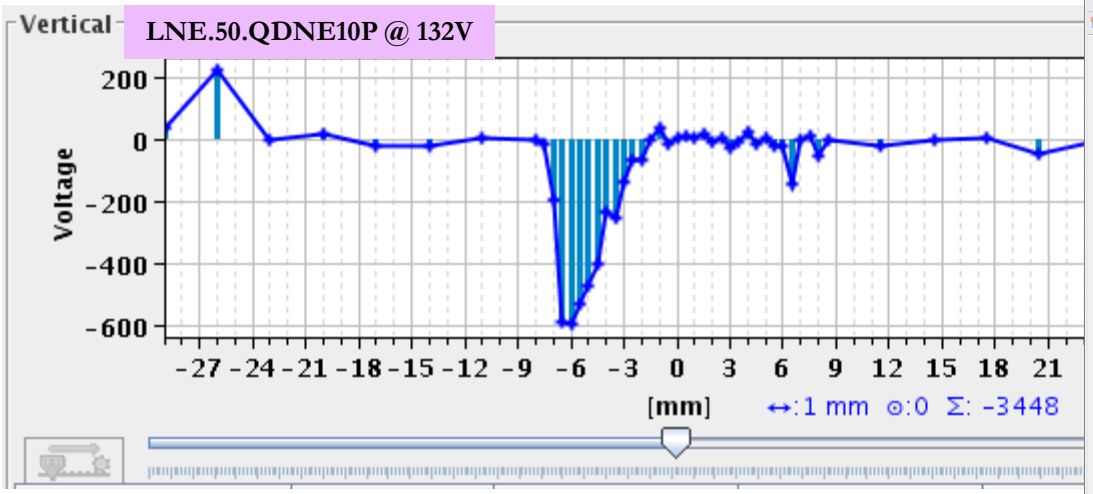
- Double spot visible on LNI.BTV15 is confirmed to be a reflection

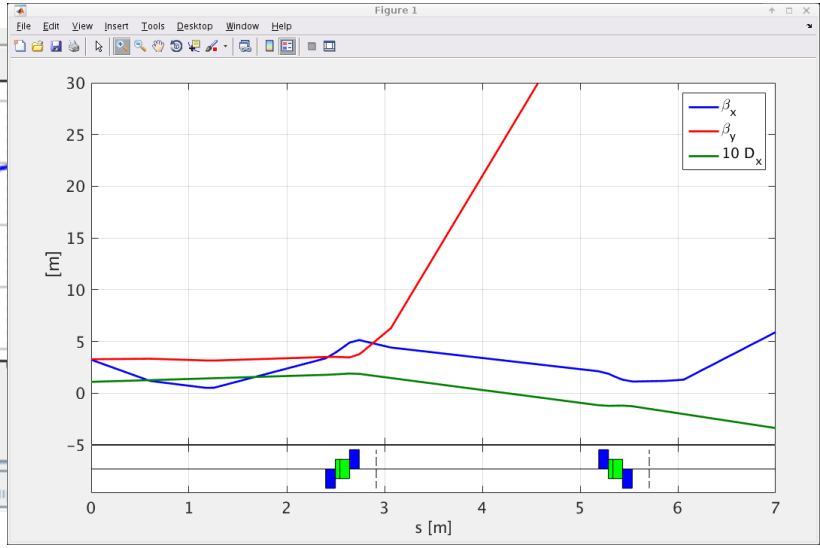
- For details, see logbook and logbook and wikis

First signal on GBAR SEM



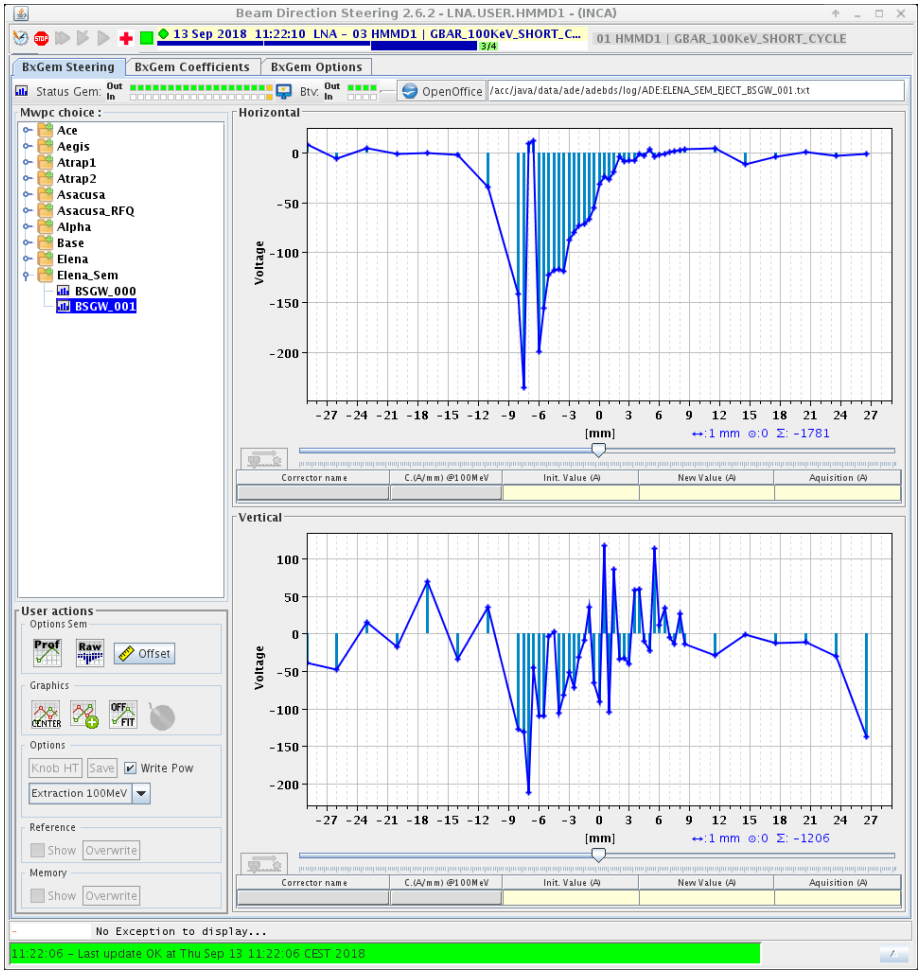


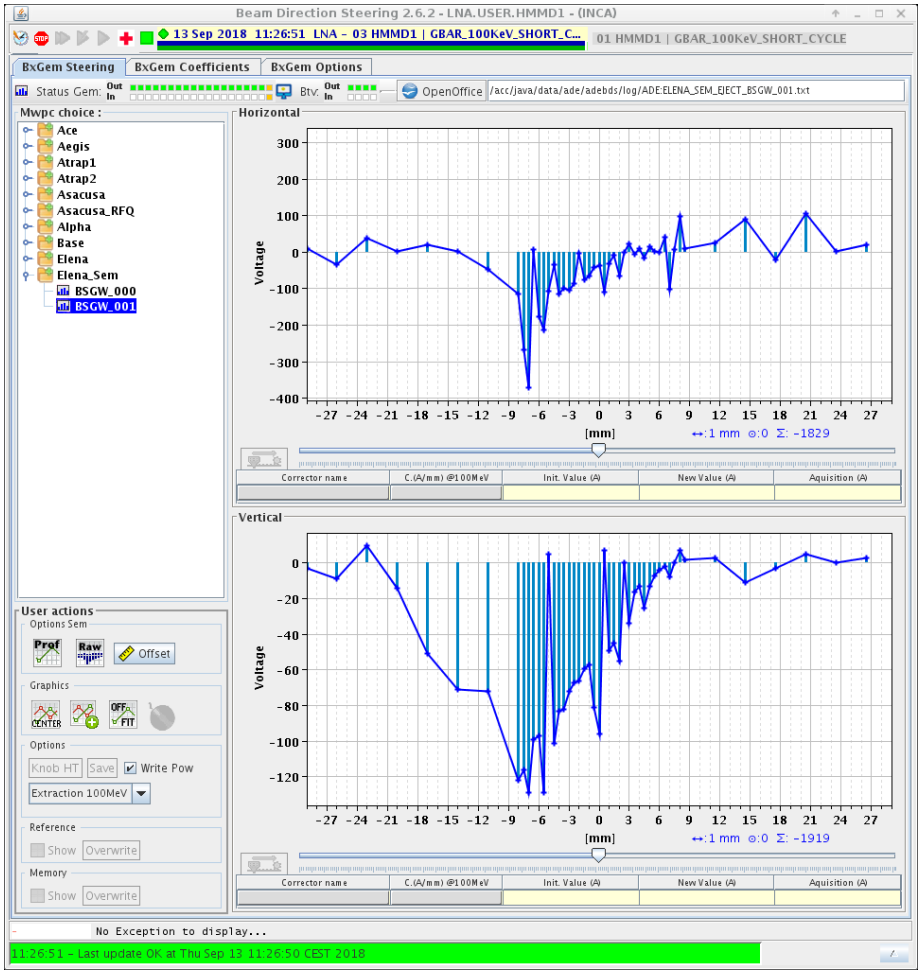




First signal on GBAR SEM

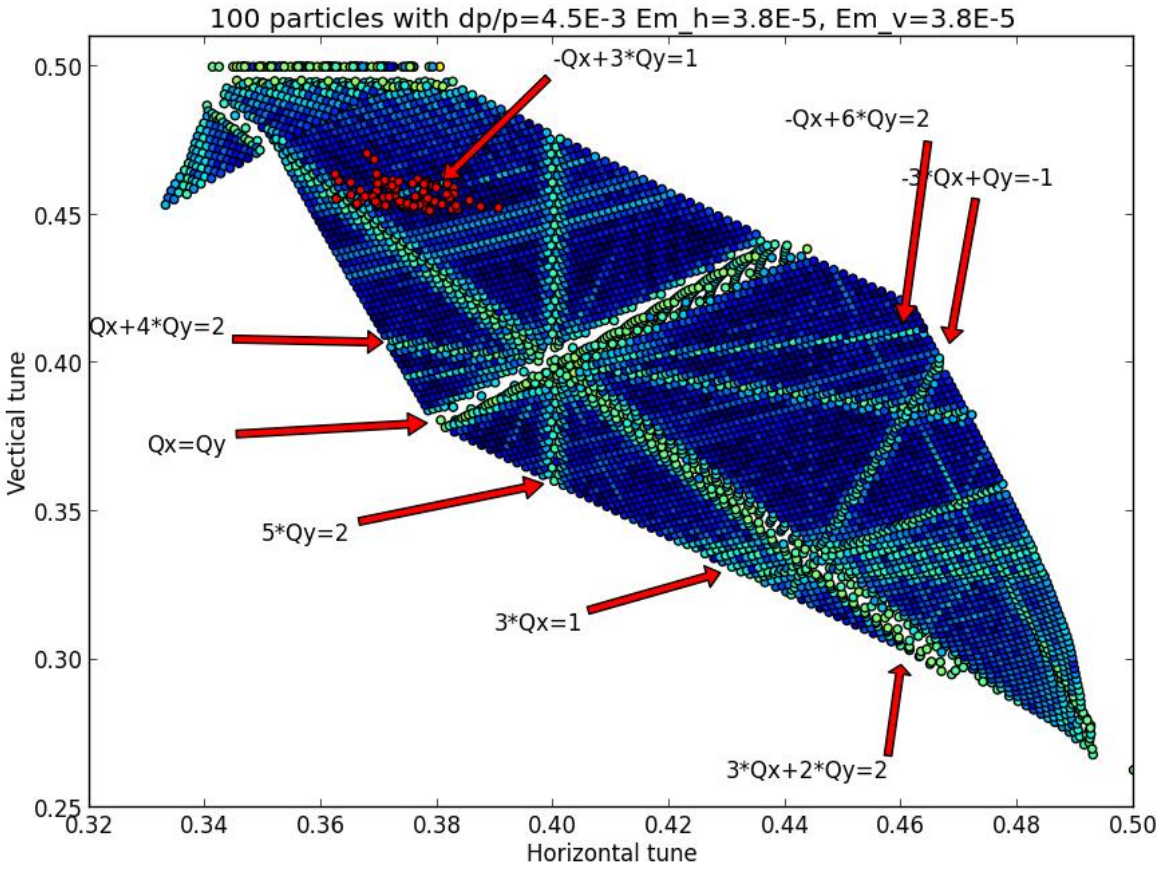
- Today, after further debugging of electric connection and adjusting gain in electronics we have both profiles and on the "correct" plane.





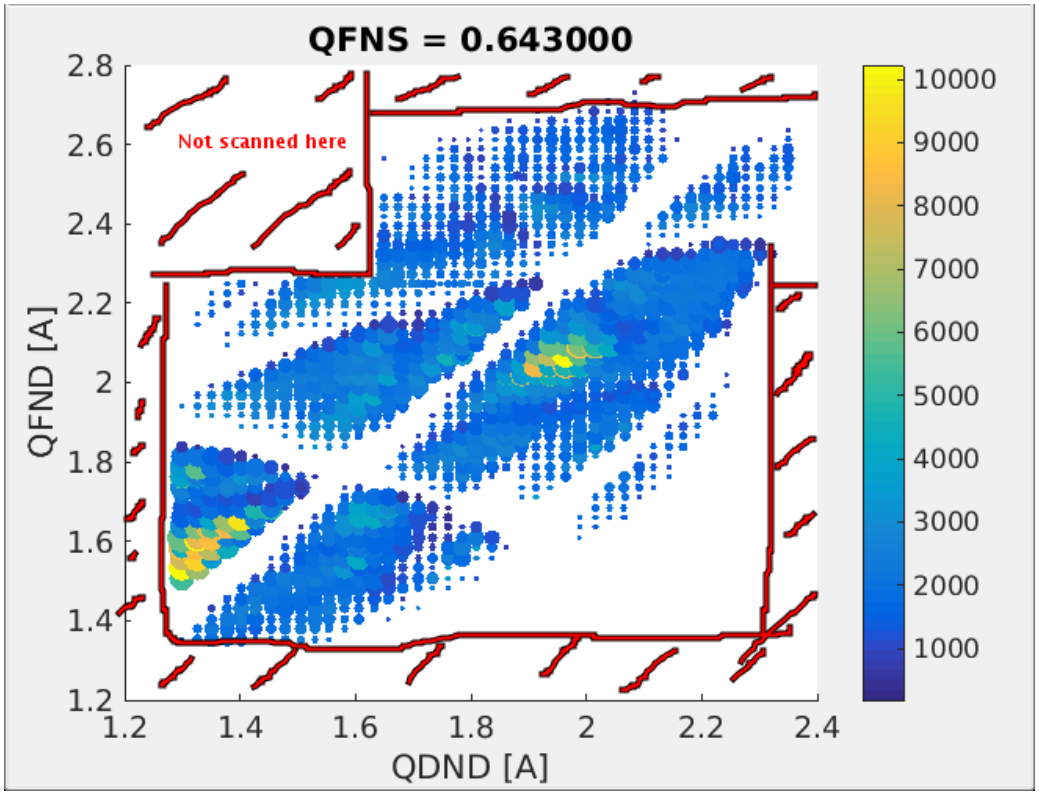
Studies ongoing: tune scan

- Lajos' machine model predicts strong resonances/small portion of tune diagram "available" for beam.
- For details, see logbook



Studies ongoing: tune scan

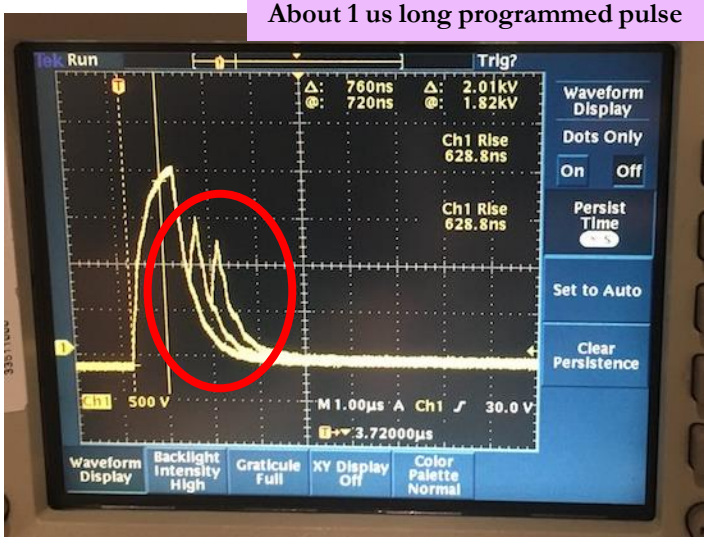
- Profiting of "fast" and "cheap" H- cycles to explore tune diagram with beam
- Here an example of measured lifetime as a function of different quadrupole settings at 85 keV
  - Lifetime computed on LLRF-TPU-generated intensity, which might be inaccurate for high intensities (yellow points are dominated by this)
  - **Still to be better analyzed and compared with machine model**



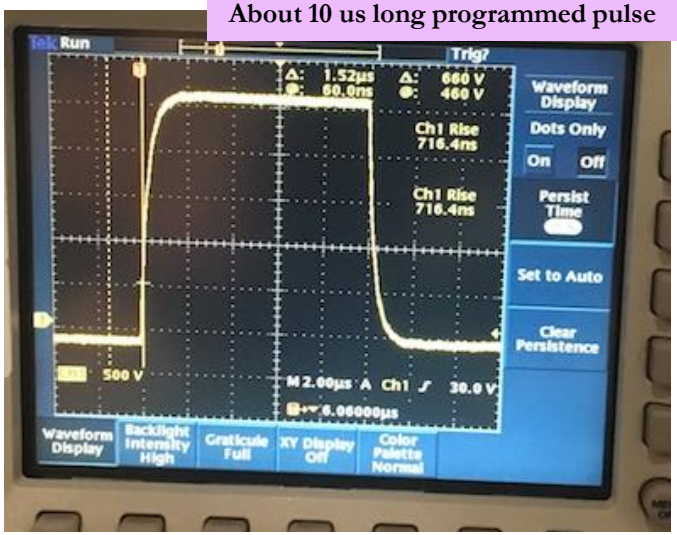
Studies ongoing: source

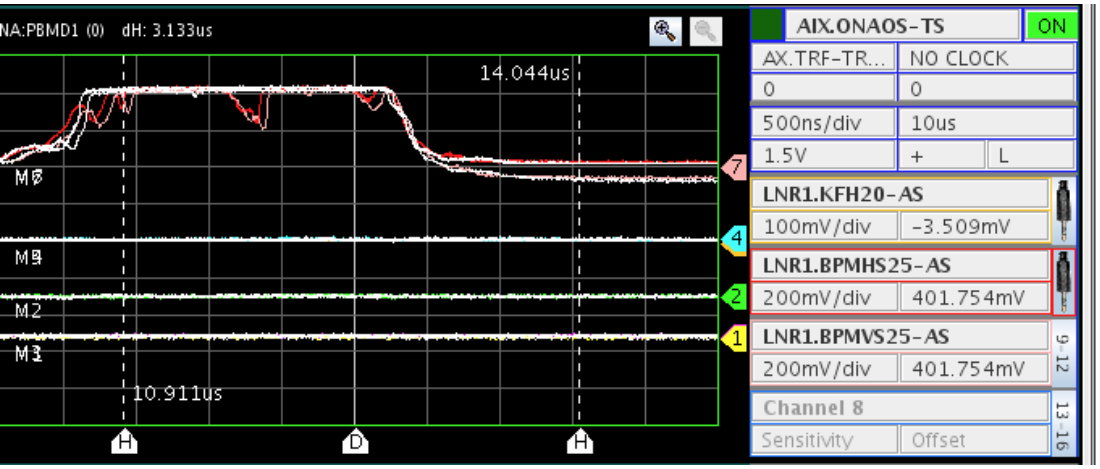
- Investigating stability of H- source puller voltage

About 1 us long programmed pulse



About 10 us long programmed pulse





Might be possible to see it on the beam by:

- Increasing septa and disabling inj kicker
- Seeing the signal on first BPM of injected beam. Here a first test in Aug:
  - Saturation of BPM electronic
  - Shot to shot oscillation in the pulse coming from source

Moreover

Developments

- **Extraction synchro** implemented and commissioned by RF team
- Estimate of **intensity based on TPU and LPU signals** by RF team
  - We observed some strange feature on TPU intensity signal, which might be due to saturation. Investigation still ongoing
- New **intensity and bunch length measurement** with 2 harmonics deployed see logbook
- **New voltage control** for cavity, allowing to go down to 120 kHz with RF.
  - i.e. allowing h1 injection with 85keV beam from source

Issues

- Struggling with **beam arrival time jitter** at GBAR due to some issue in LLRF reference frequencies generation. It seems solved for the time being.
- Needed to program **factor 2 higher voltage** to keep **H-** beam (see logbook). Why?!

Studies

- Some attempt to **measure chromaticity** (see logbook and logbook).
  - Lajos obtained values of about -2 in both planes
- Trying to study **alignment of electron beam and pbar beam** in cooler (see logbook)
- Trying to start **e-cooler on H- beam** (see logbook)

Beam size along cycle

at mid plateau:

* the beam is maybe a factor 2 bigger in Vertical, but no big difference in Horizontal.
* the debunching makes smaller beams in both planes.

no RF means longer bunches and smaller energy spread I guess. Maybe some link with dispersion? But why in vertical?

* the cooling is very effective in horizontal, reducing the beam sizes of about factor 3. It does something in vertical.
* the re-bunching makes beams again bigger.

at extraction plateau:

* the cooling reduces the beam size of a factor 2 in Vertical, is doing a little beam size reduction in Horizontal.