Elens commissioning

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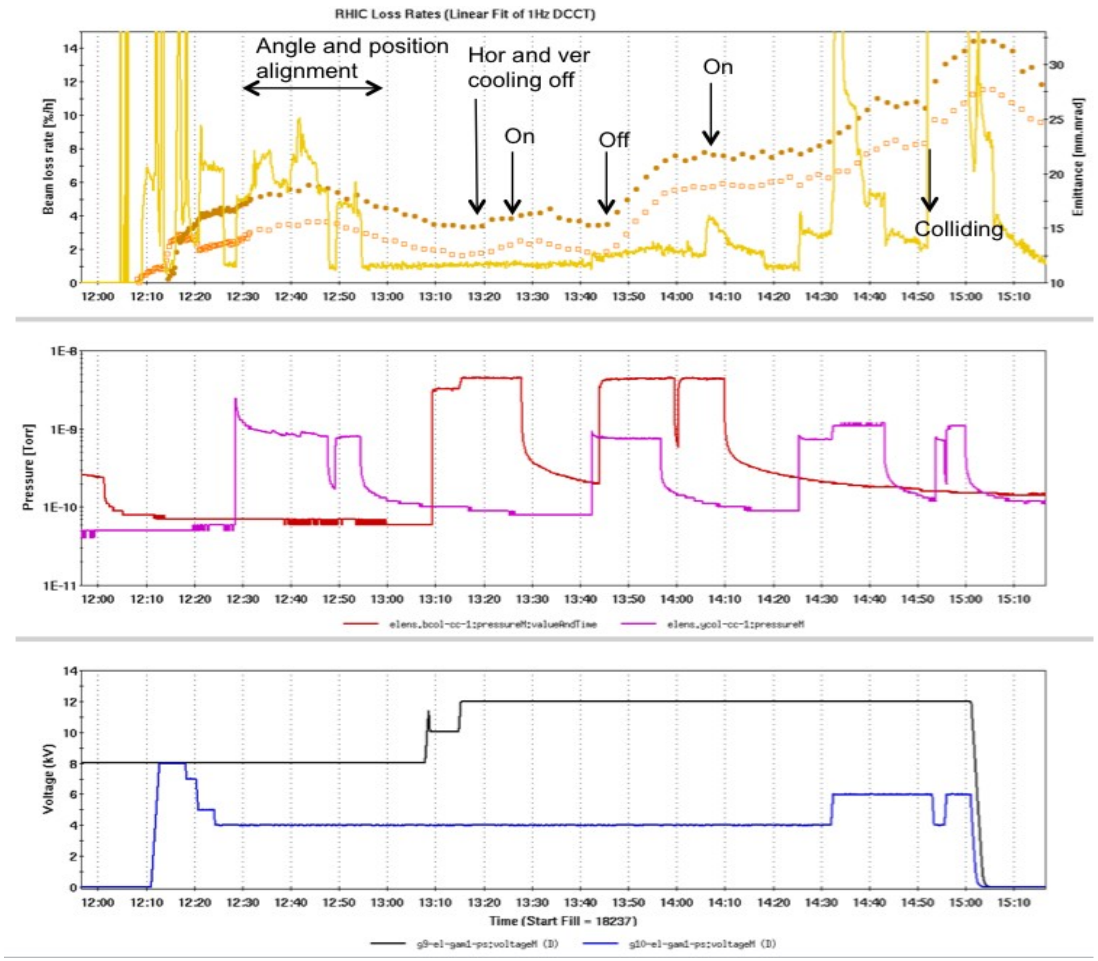
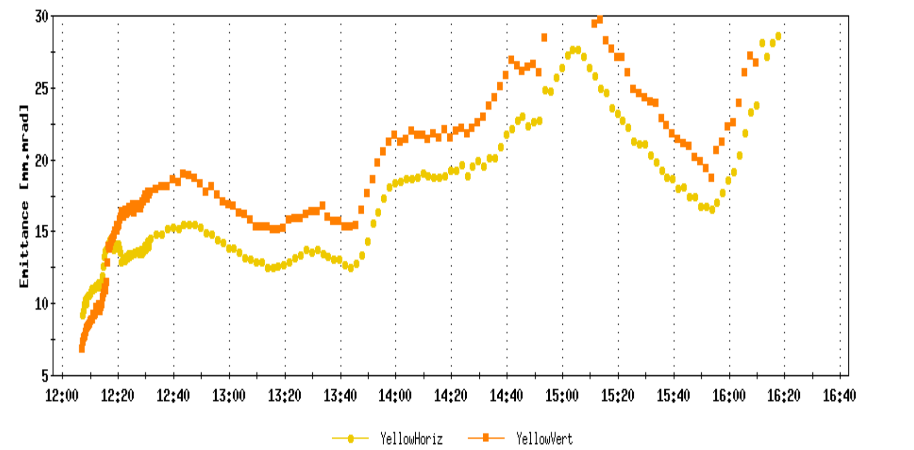
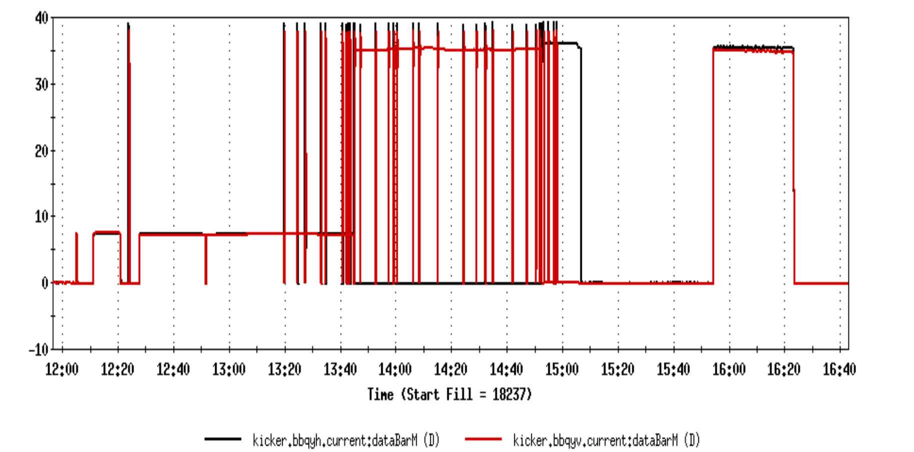
APEX – 24/04



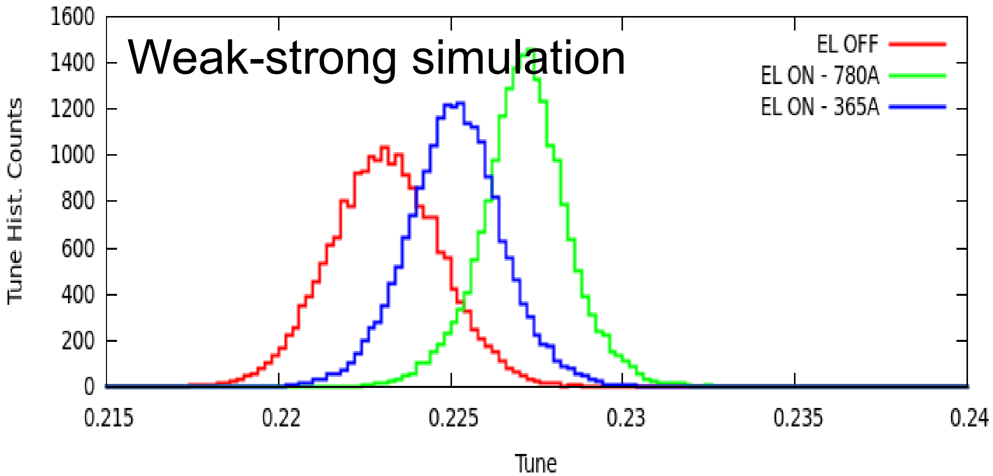


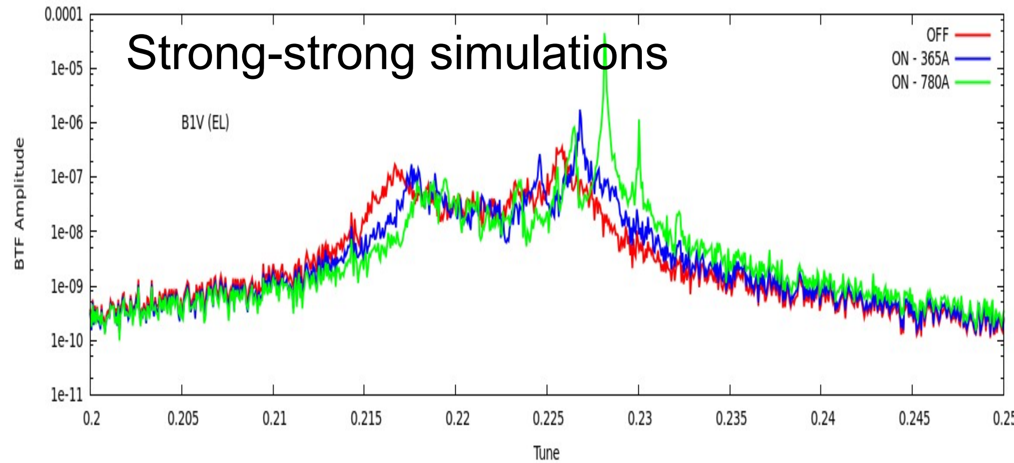


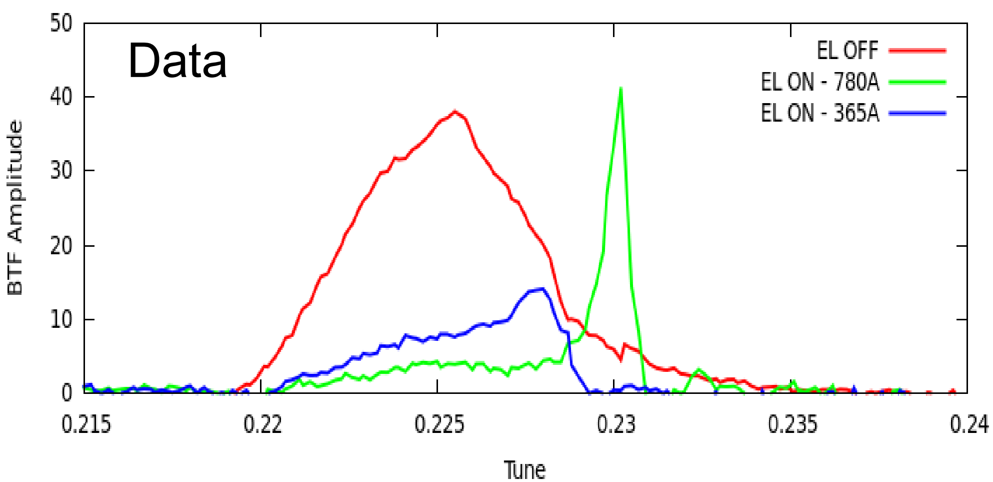
→ The goal was to measure the emittance blow-up as function of intensity

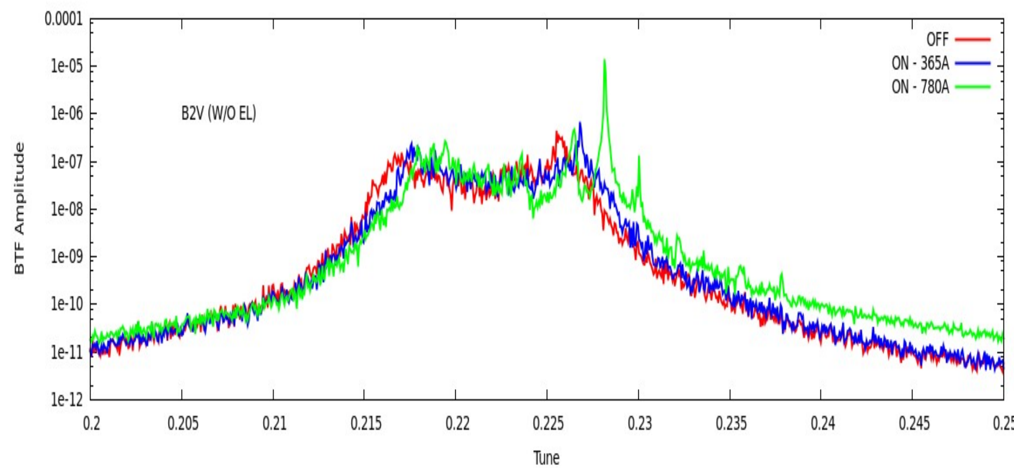
→ BBQ kickers were left running at high current due to a problem in BTF controls: not conclusive

BTF data





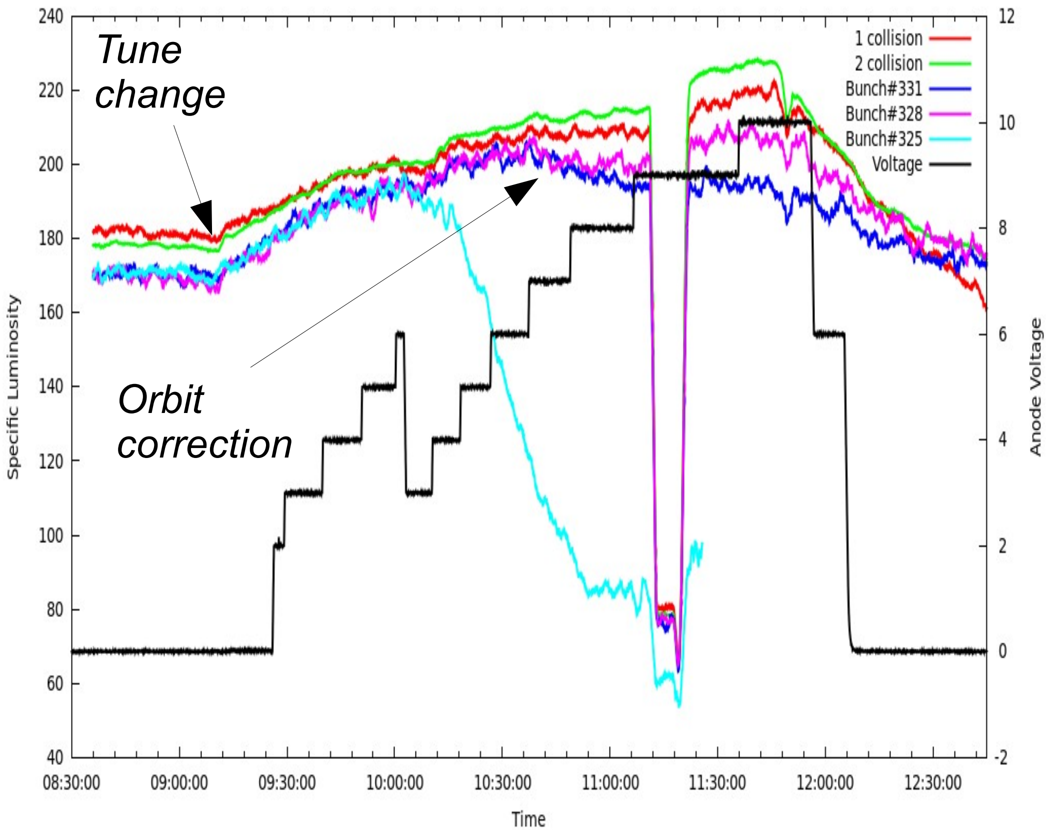


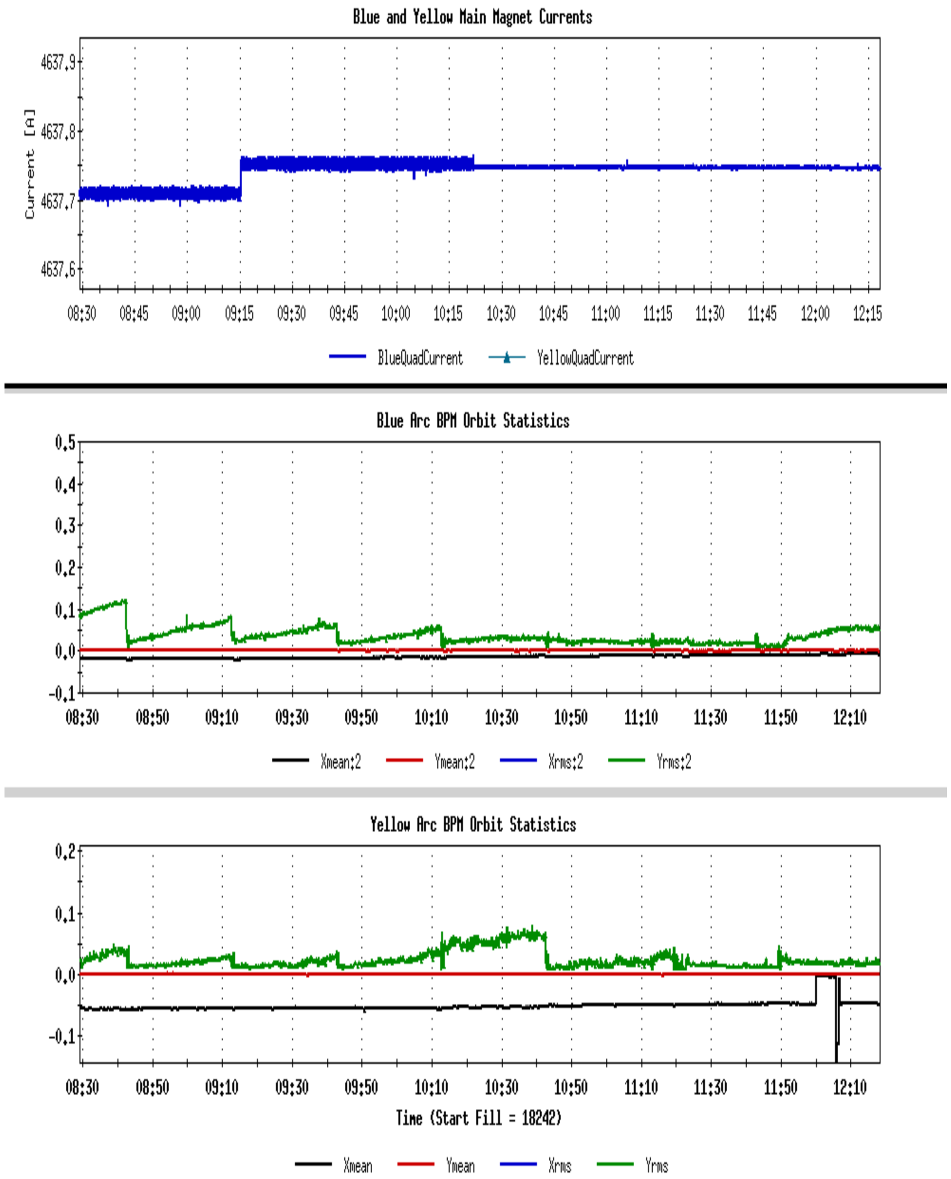


→ BTF data show a small reduction of tune spread and appearance of coherent mode

→ Well reproduced in simulations: confirms the hypothesis of coherent mode

Short pulse (2.5 bunches)

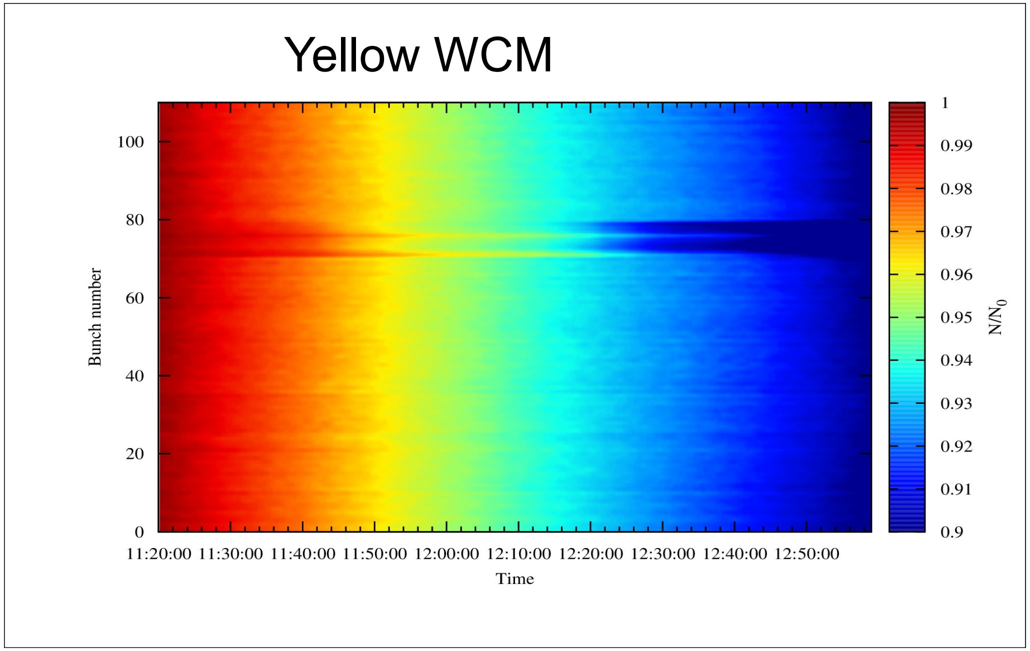


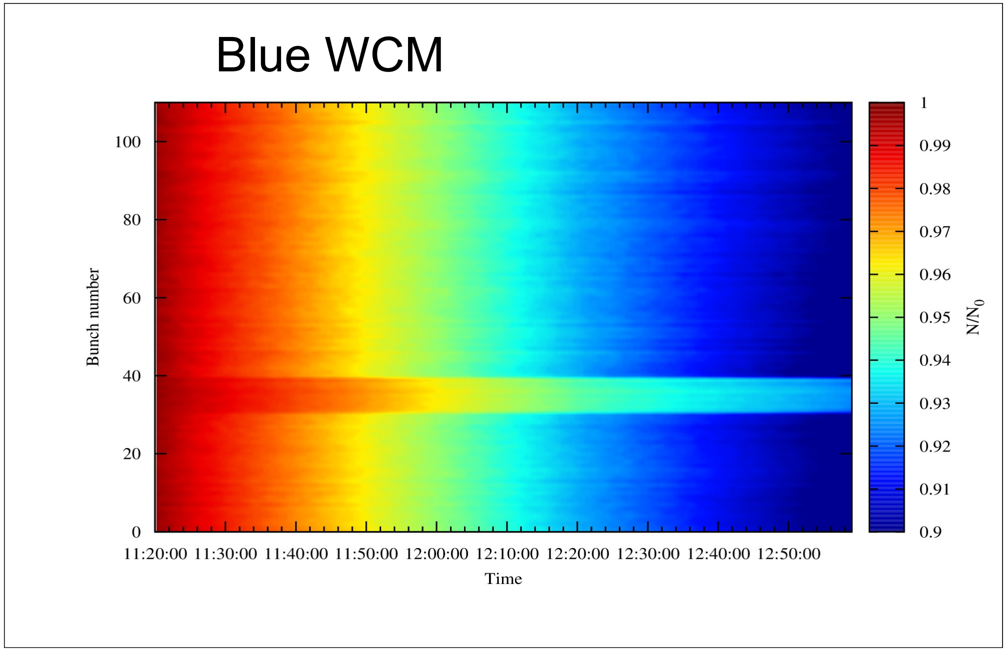


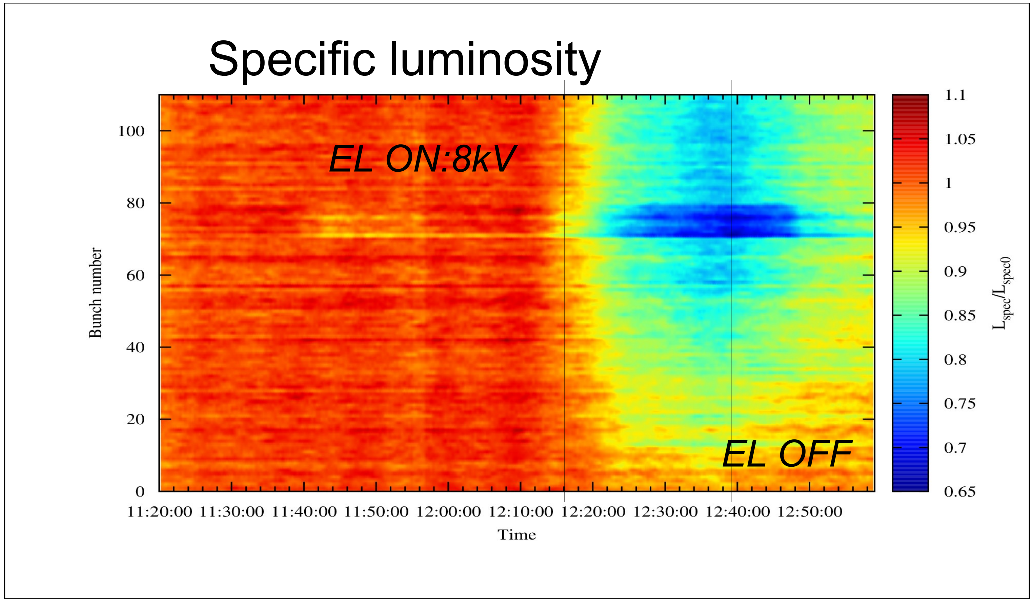
→ Small emittance blow-up observed at V>7kV

→ Also corresponds to an orbit correction: offset could be the cause

Long pulse (full beam)





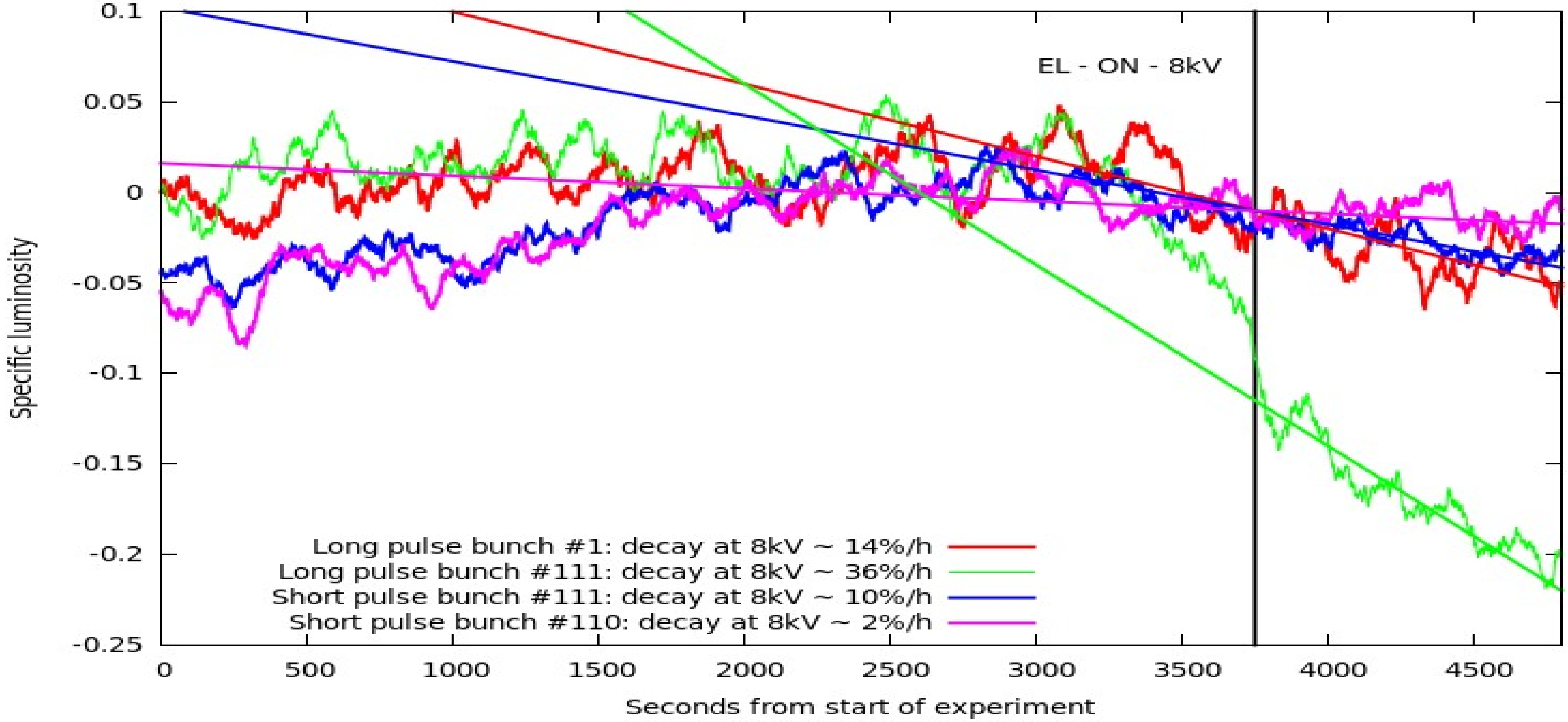


→ Besides bunches colliding once no clear degradation of lifetime (decay ~7%/h)

→ Clear emittance blow-up in all bunches

→ The trailing bunches suffer more: ion cloud build-up along the bunch train?

Short pulse vs long pulse



→ First bunch with long pulse comparable with short pulse: slow decay, could be due to offset

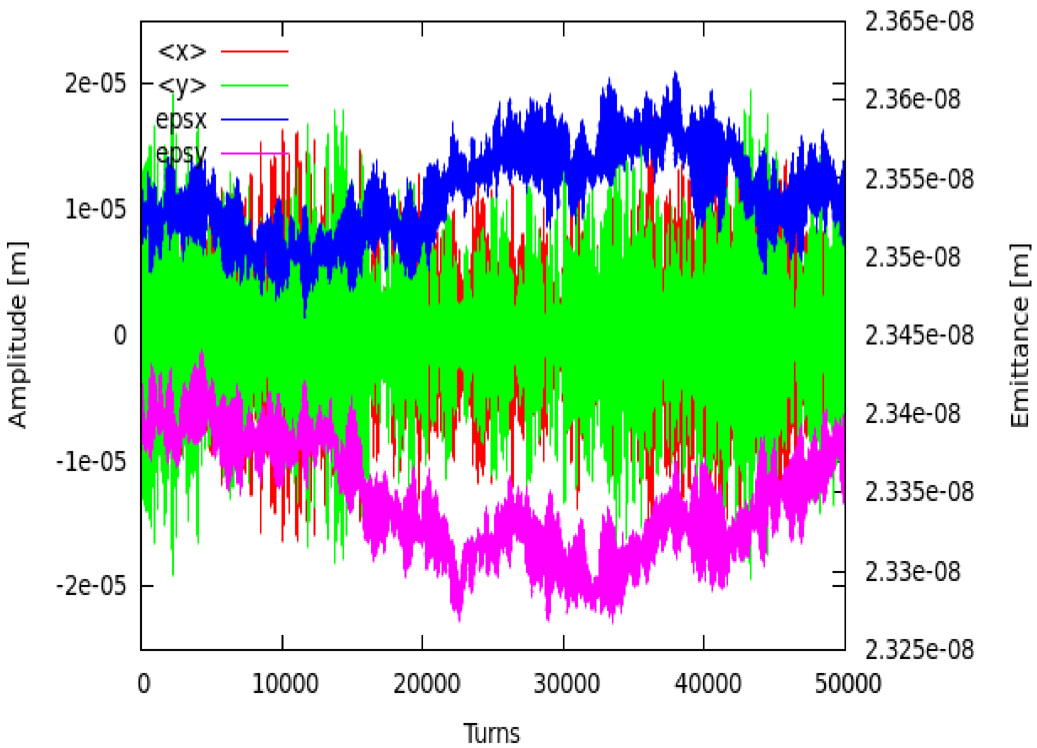
→ Last bunch with long pulse much faster decay: ion cloud build-up?

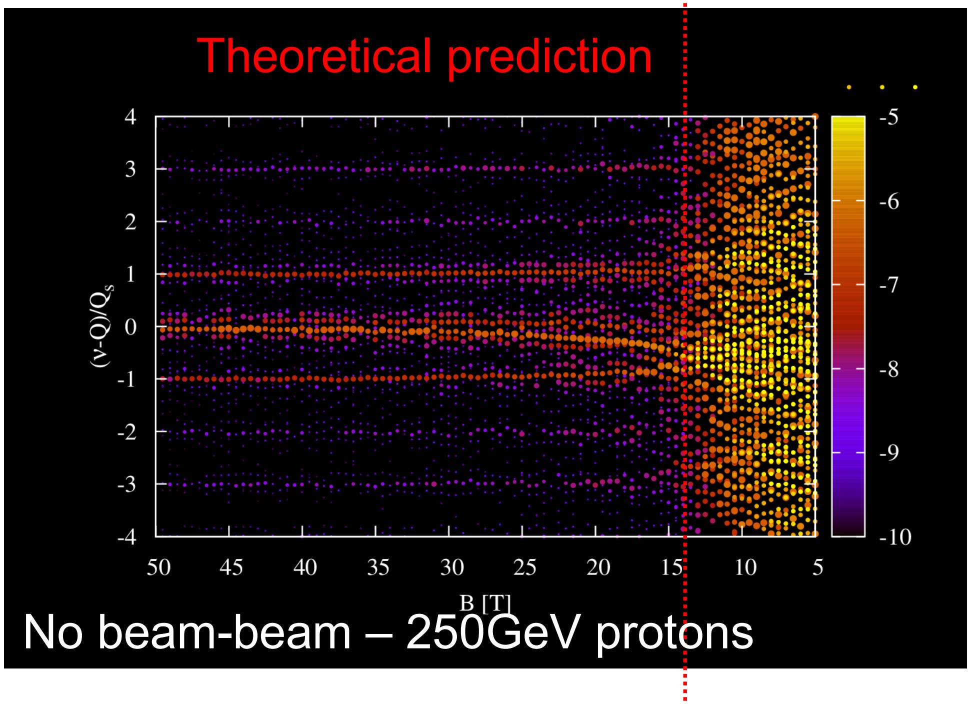
→ Strong blow-up when changing the voltage: could affect steady decay (size mismatch)

Electron lens driven TMCI

→ Using current parameters at the beginning of physics store no instability observed (1IP colliding)

→ Signs of coupling: could affects emittances should we verify dependency of emittance growth on solenoid field?



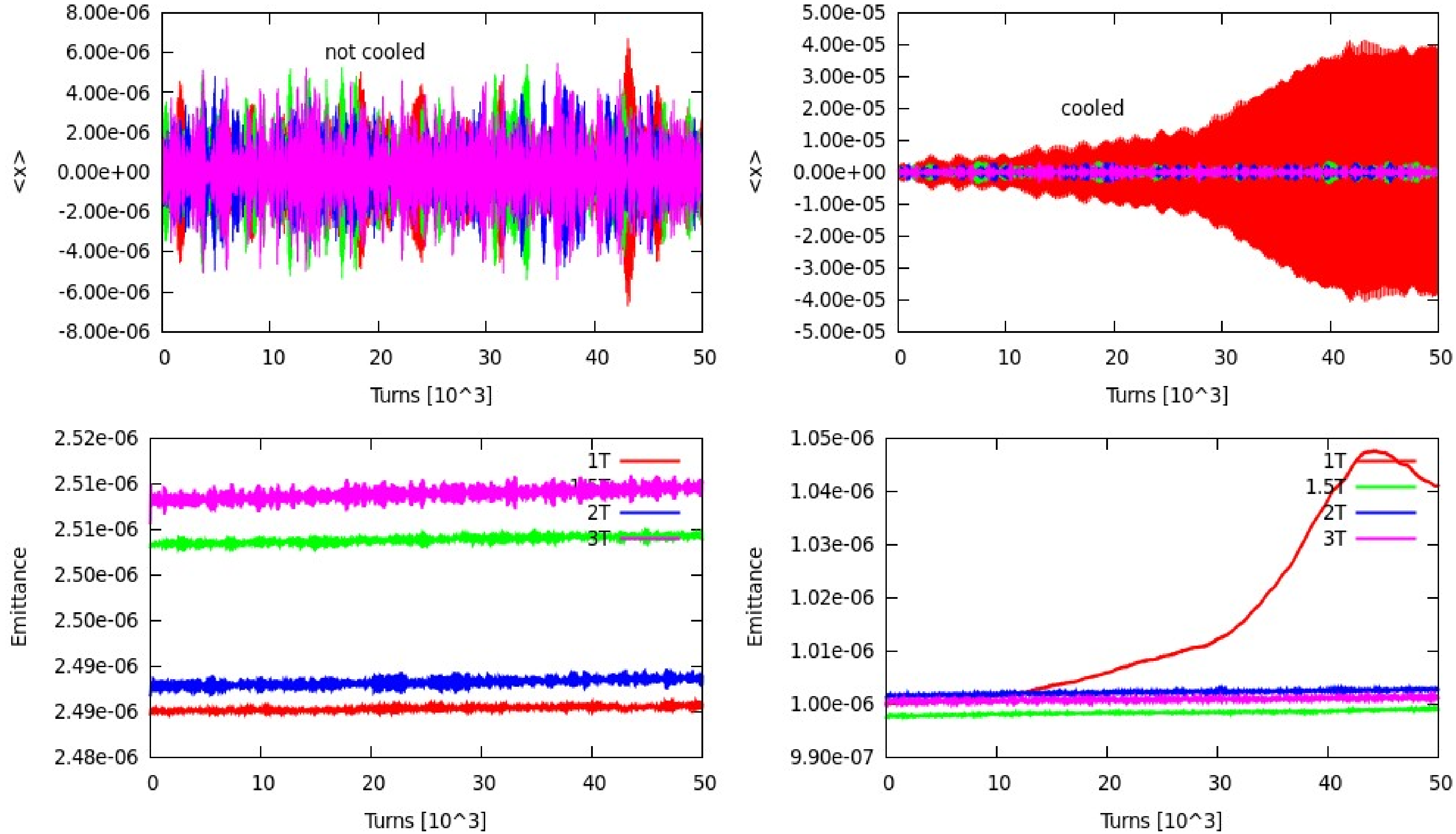


→ TMCI threshold from linear model with matched uniform beams:

$$B_{th} = \frac{1.3\, e N_p \xi_{el}}{r^2 \sqrt{\Delta Q\, Q_s}}$$

→ Depends also on tune spread (Landau damping), Q', coherent beam-beam effects

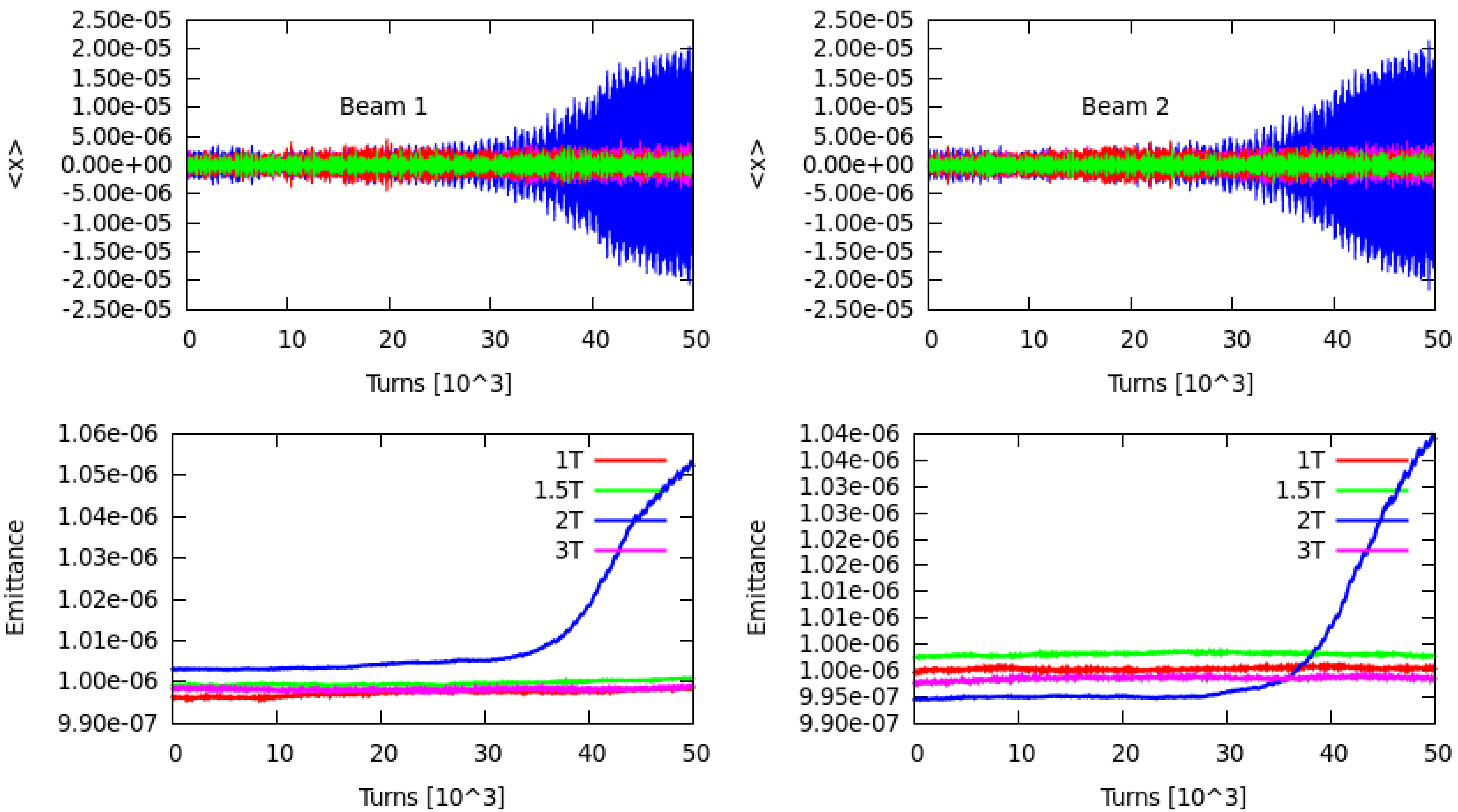
Instabilities – low Q_s



→ Ions: Q_s = 0.4e-3 (28MHz), σ_s = 0.6m, N_i = 1.6/1.0e9 p/bunch, $\sigma_{x,y}$ = 0.48/0.3mm, $\Delta Q_{x,y}$ = 5e-3, Q'=0.0, no beam-beam

→ Electrons: I = 1A, $\sigma_e = 0.4*\sqrt{(3/Bsol)}$mm

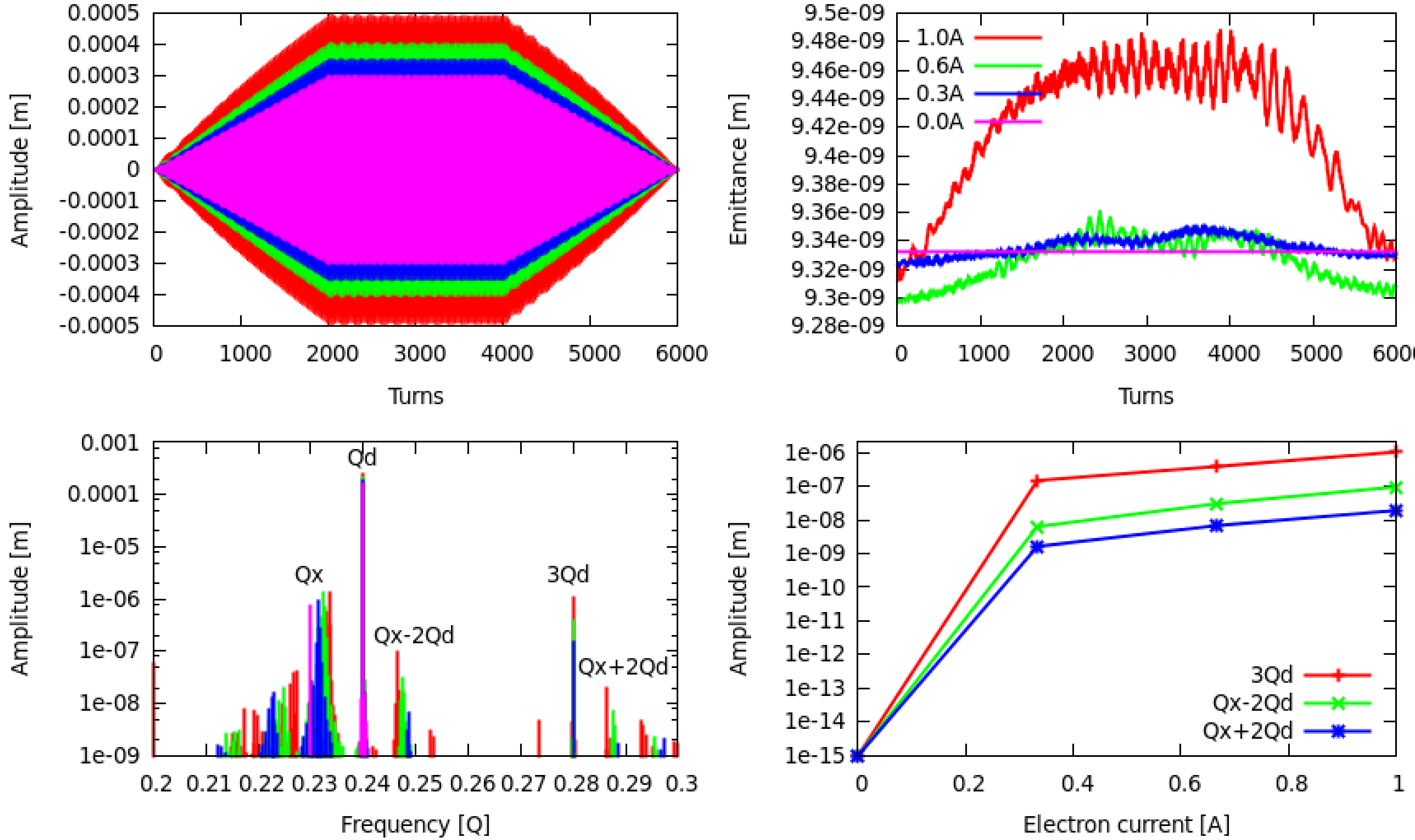
With beam-beam



→ Ions: Q_s = 0.4e-3 (28MHz), σ_s = 0.6m, N_i = 1.0e9 p/bunch, $\sigma_{x,y}$ = 0.3mm, $\Delta Q_{x,y}$ = 5e-3, Q'=0.0

→ Electrons: I = 1A, $\sigma_e = 0.4*\sqrt{(3/Bsol)}$mm

AC dipole and electron lens



→ Excite at constant 1σ amplitude (from linear theory without beam-beam)

→ Resonance driving terms can then be computed from spectral lines

Summary

- APEX 24/04:
  - Due to problem with BBQ kickers emittance data not conclusive
  - First evidence of tune footprint compression from BTF data: could be well reproduced in simulations

- End of store studies:
  - Short pulse: slow emittance blow-up, could be related to misalignment: we have to pay more attention to this in the future
  - Long pulse: dependency on position in the train, trailing bunches see strong emittance blow-up: ion cloud build-up? We can try clearing electrodes in blue lens, “holes” in the pulse or better vacuum could also help
  - Emittance studies are very difficult, the slightest change in the machine can affect the results!

- More time required to study emittance effects: two different regimes (short and long pulse) with most likely different sources. We have ideas on how to fix them but this needs to be tested

- Other topics:
  - instability studies: scan electron current at low solenoid field with and w/o beam-beam
  - AC dipole and electron lens: excite ion beam with different amplitudes and electron current