MD 3308:
Instability growth rate vs chromaticity at injection

D.Amorim, S.Antipov, X.Buffat, **E.Carideo**, J.Dalla-Costa, T. Dascalu, J.-C. Dumont,
K. Fuchsberger, N.Mounet, A. Oeftiger, B. Salvant, D. Valuch

Goal: *Measure instability growth rate vs Chromaticity*

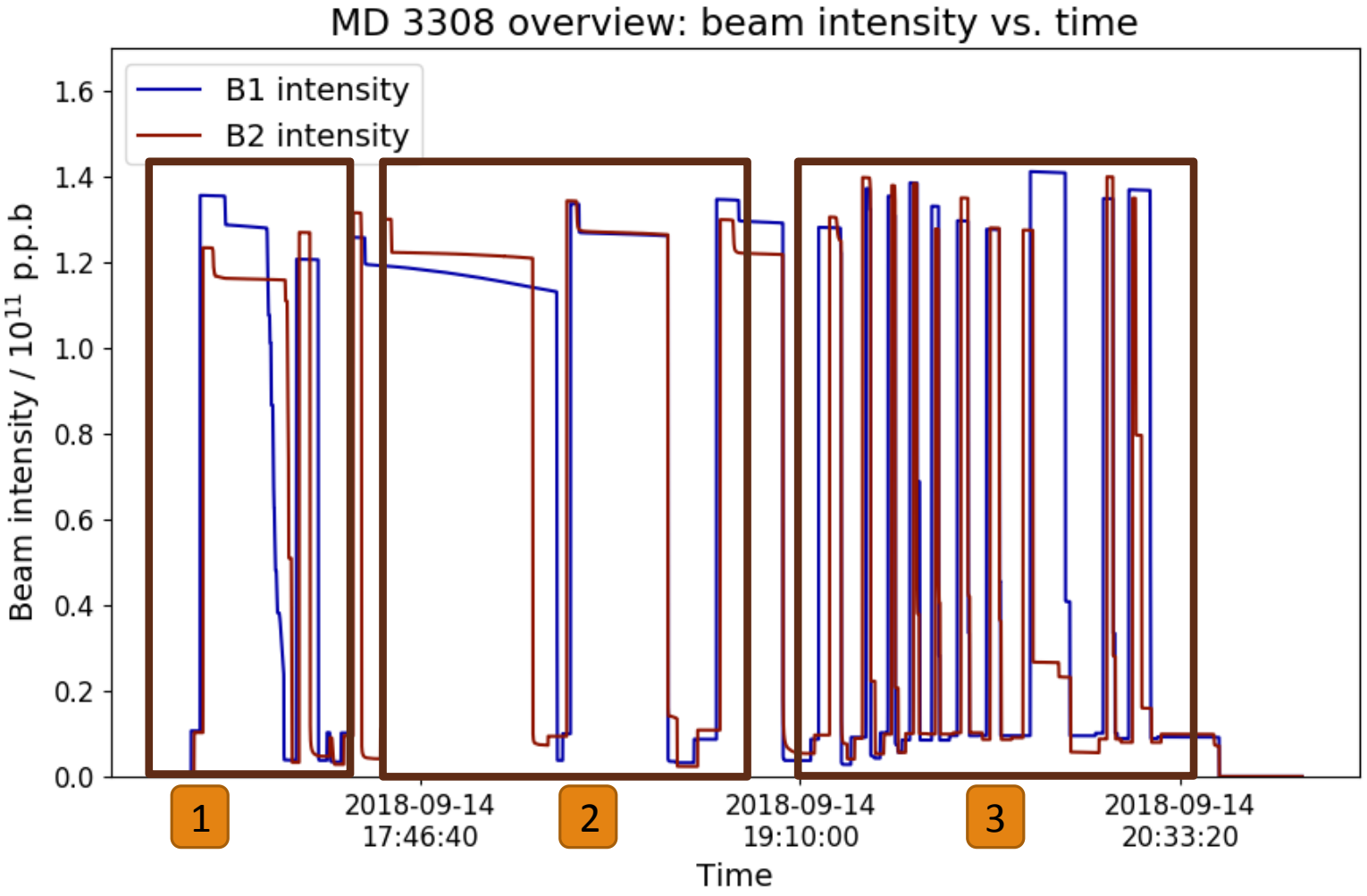
MD procedure:

- Setting the Octupole current to 0 A

- Inject nominal bunch
- Trim H-V chromaticities in a range of [-35, -5] by steps of 5
- Switch OFF the ADT to let the instability develop
- The Rise Time is measured from the instability signal, saved with the ObsBox

- Then switch back on the ADT, reinject and restart the process again ...

MD overview



1

16:00-16:50

Machine preparation

2

16:50-18:30

- First set of measurement
- Instabilities were triggered by setting an ~0 ADT gain in LSA
- Bunch was not systematically unstable: ADT was still providing some damping

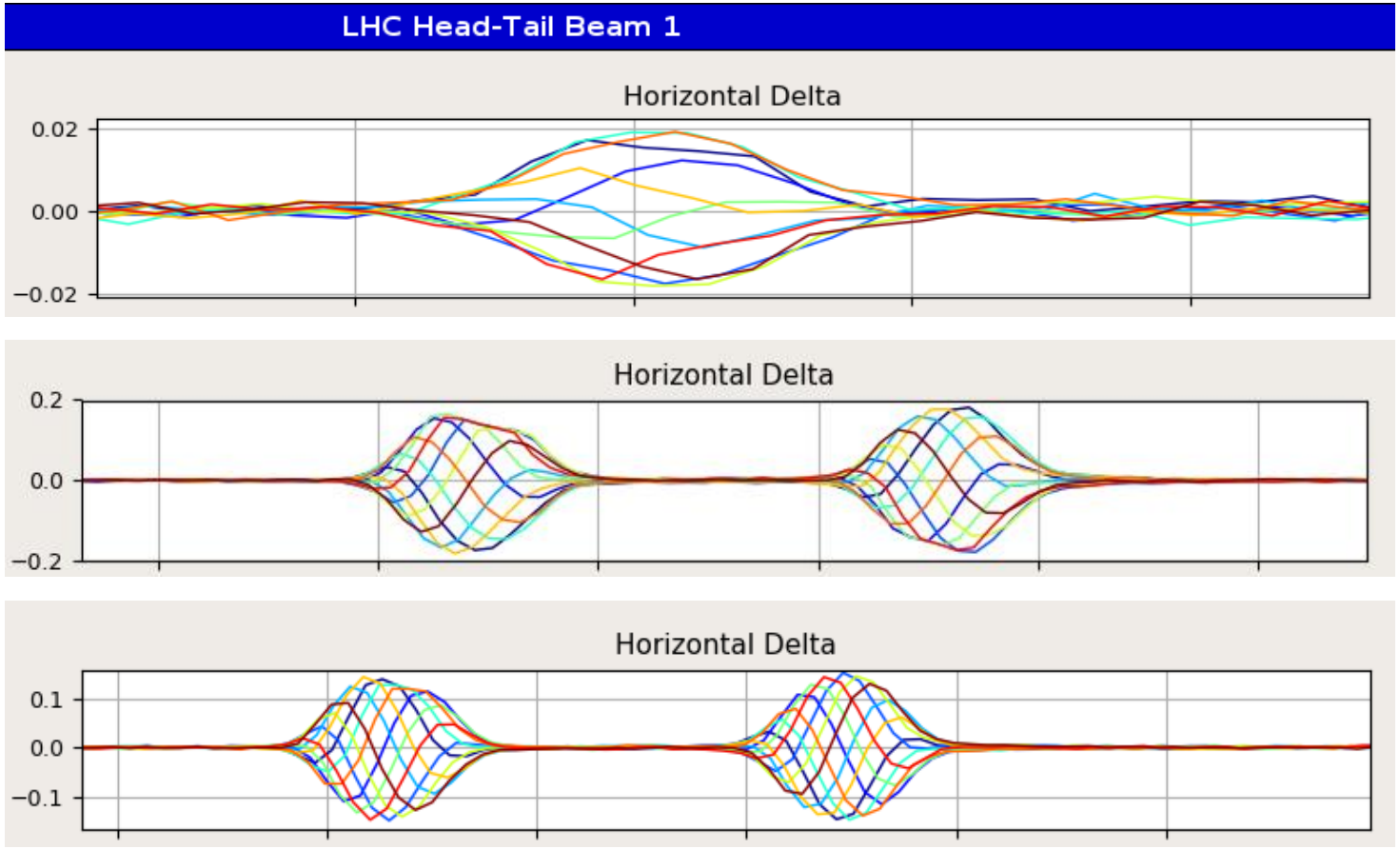
3

18:30-20:40

- Second set of measurement
- ADT modules were switched off to let the instability develop
- Systematic instabilities

Online observations

Head-Tail signal shows clear mode 0 for all chromaticities measured

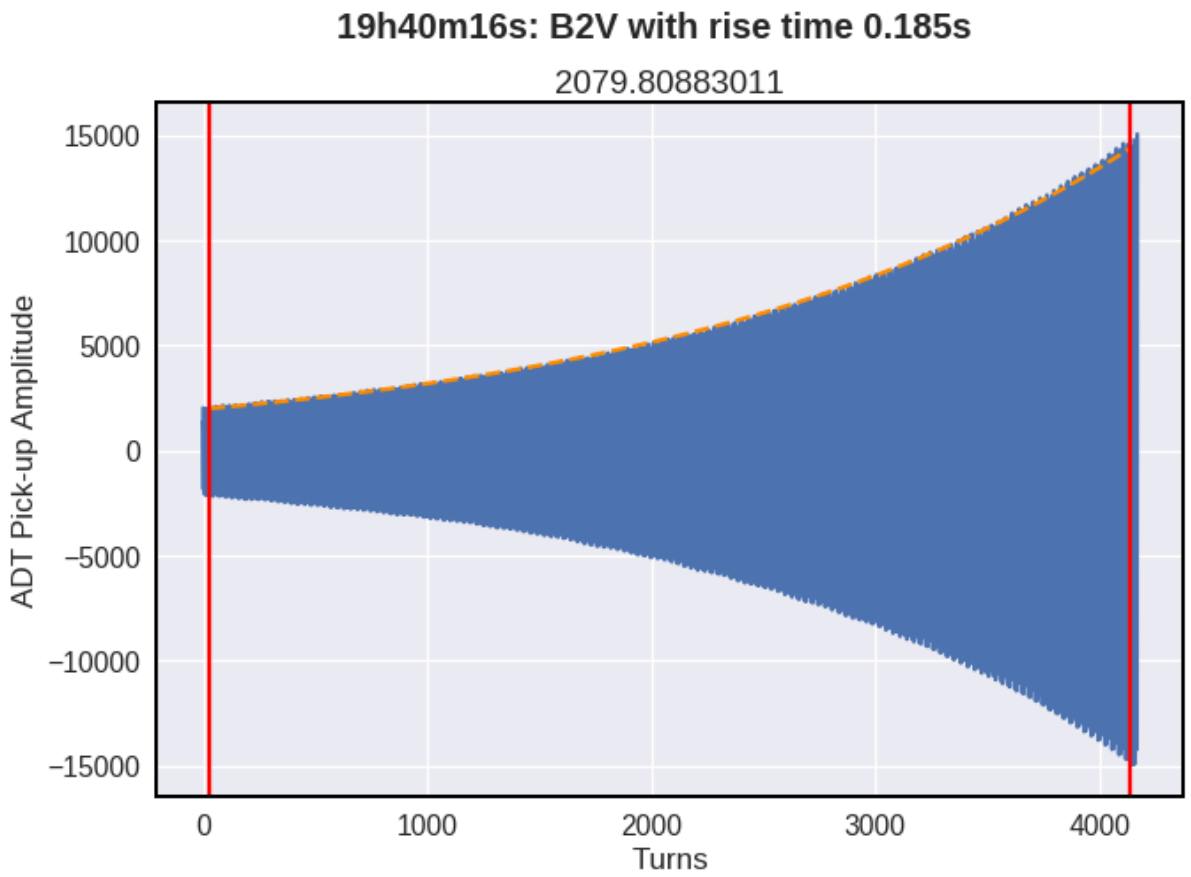


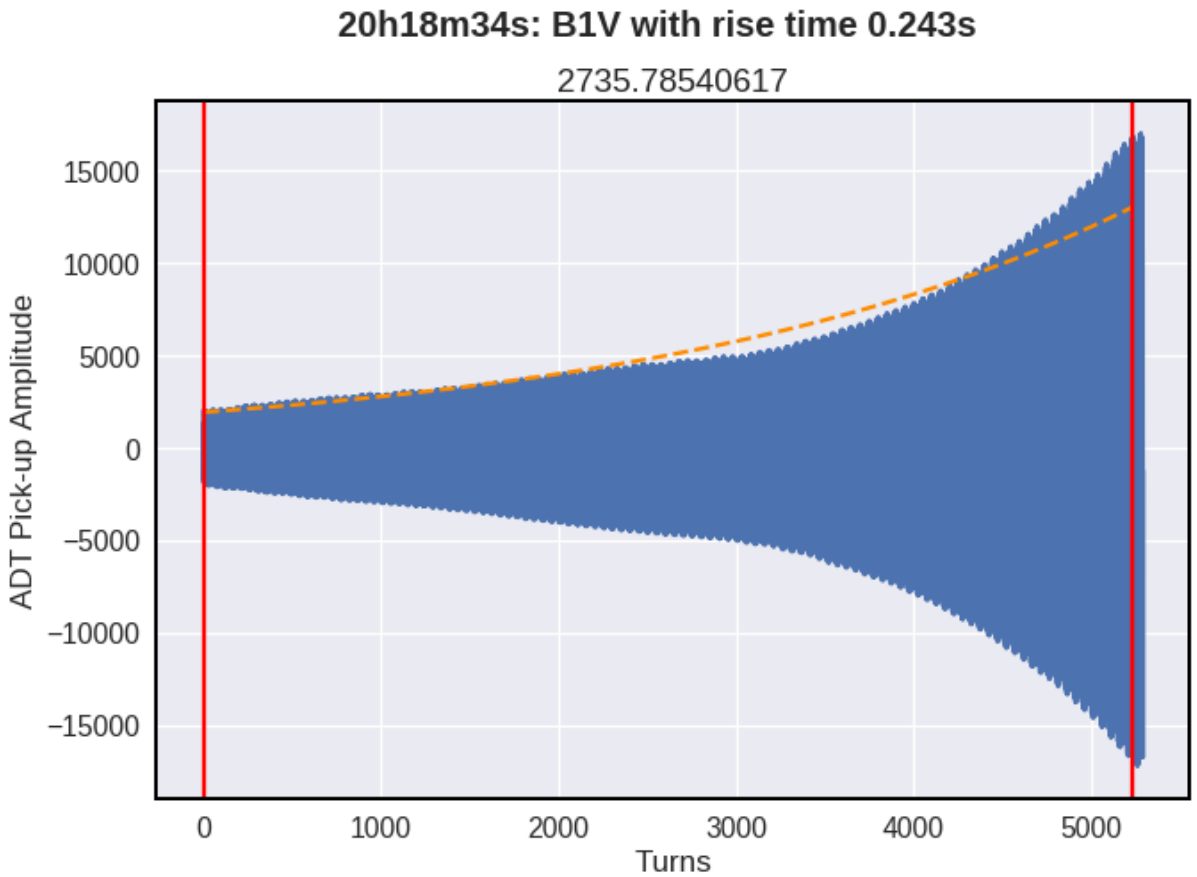
Q'= -10

Q'= -20

Q'= -30

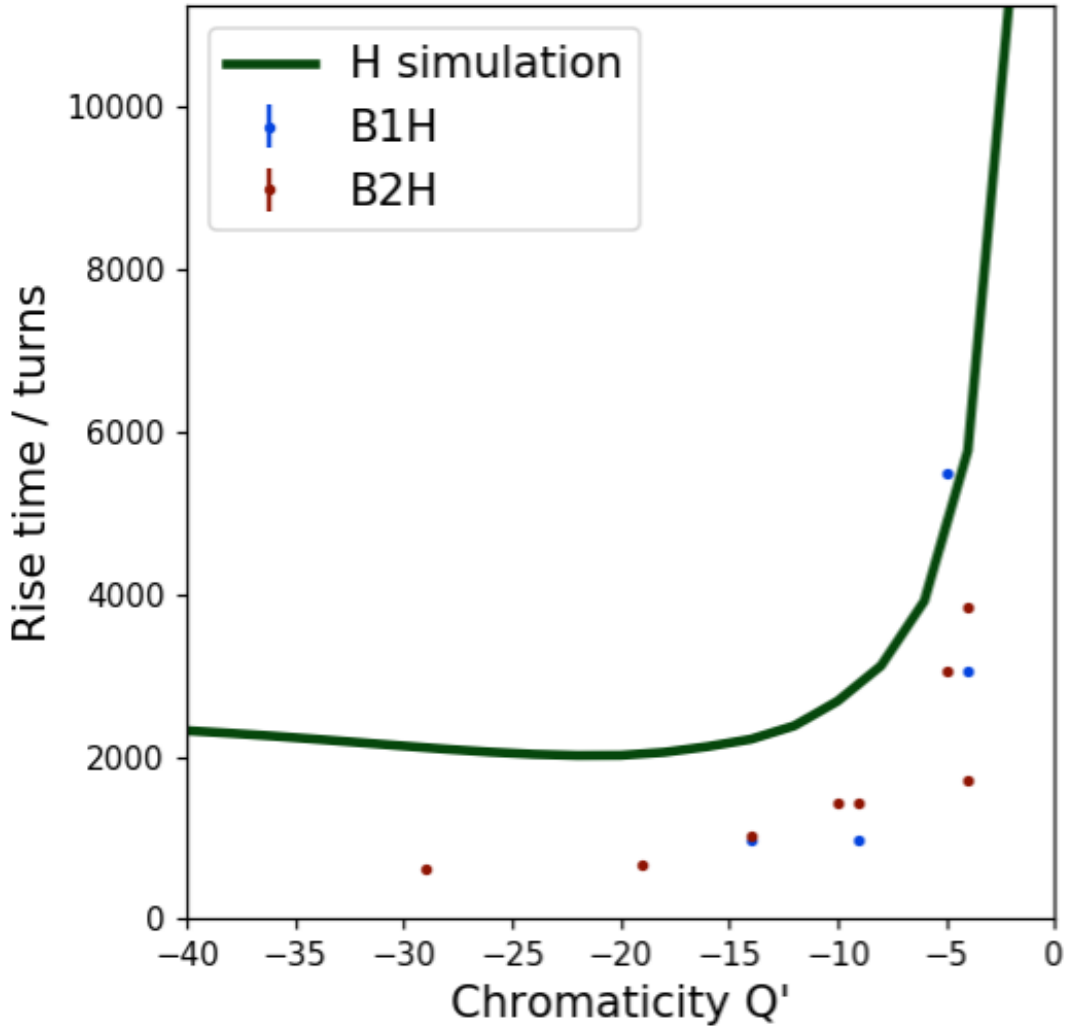
Rise times fitted from the instabilities caught by the ADT ObsBox

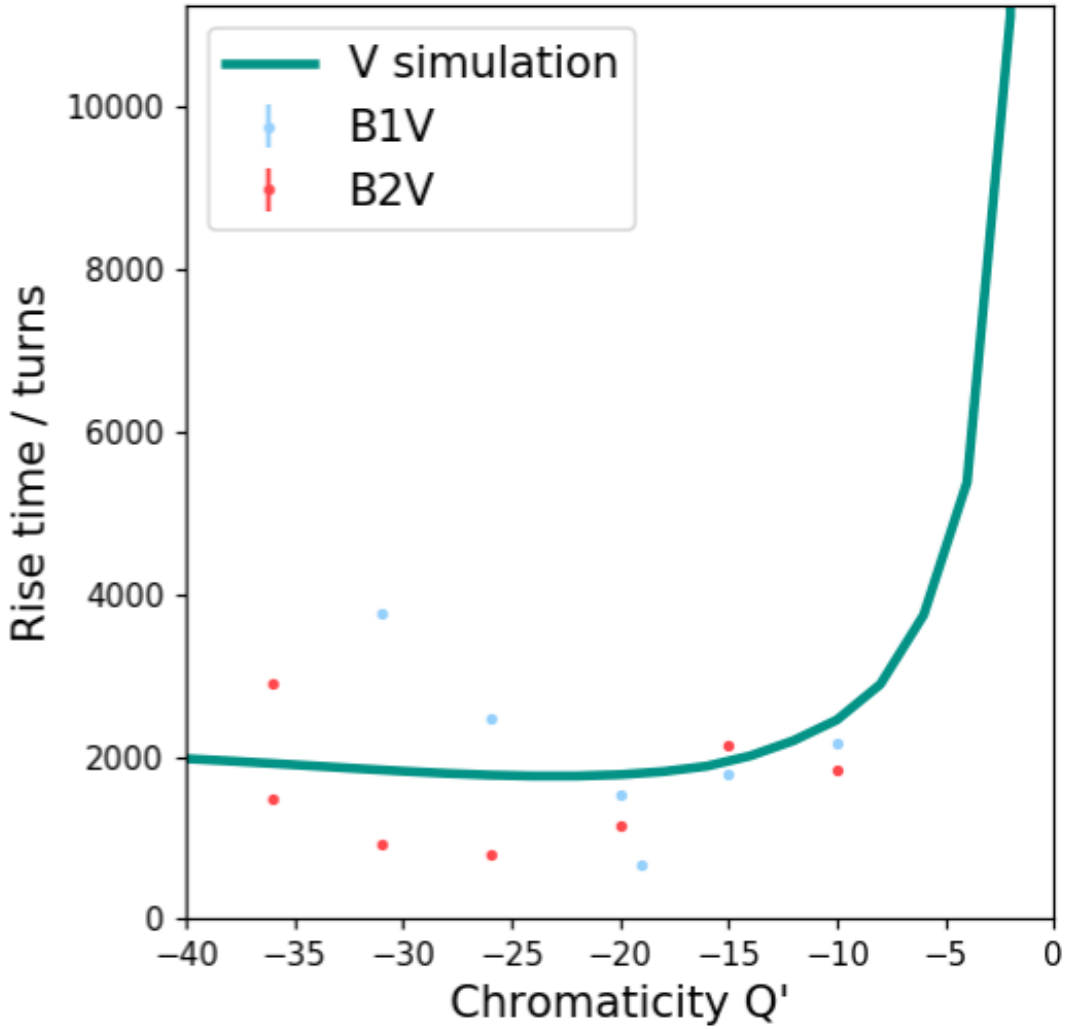




Results of the analysis

Predictions for LHC impedance model at injection 2017
Single bunch, Bunch intensity: 1e11 ppb
Bunch length: 1.2 ns, No damper
Measured rise times are scaled to bunch intensity





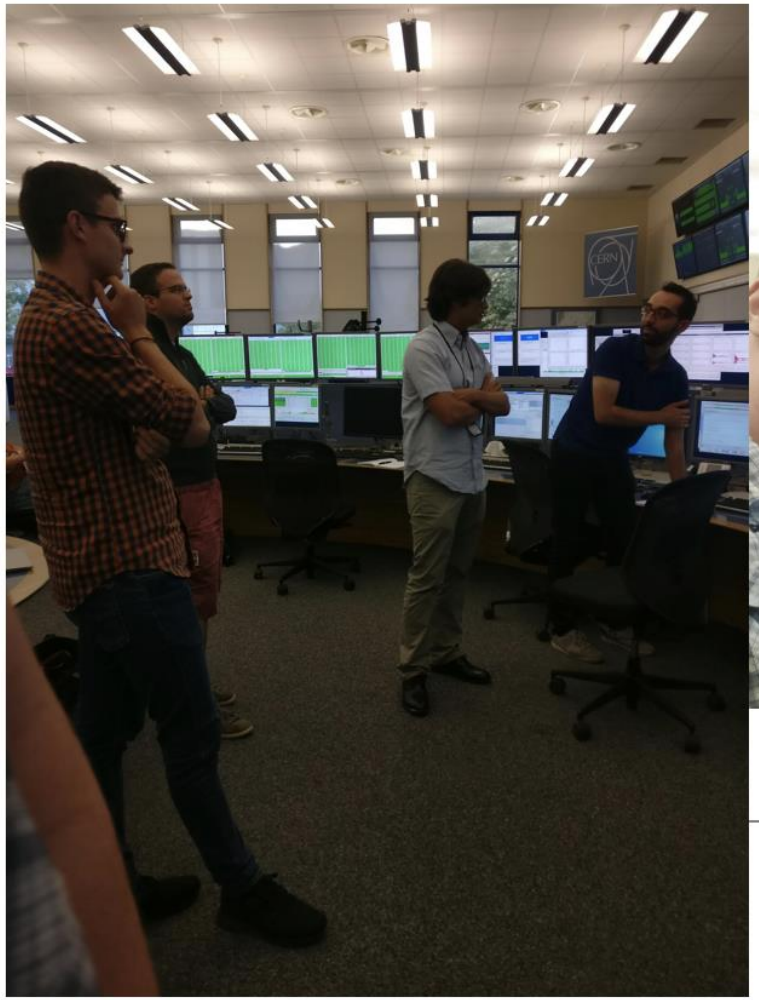
Conclusion

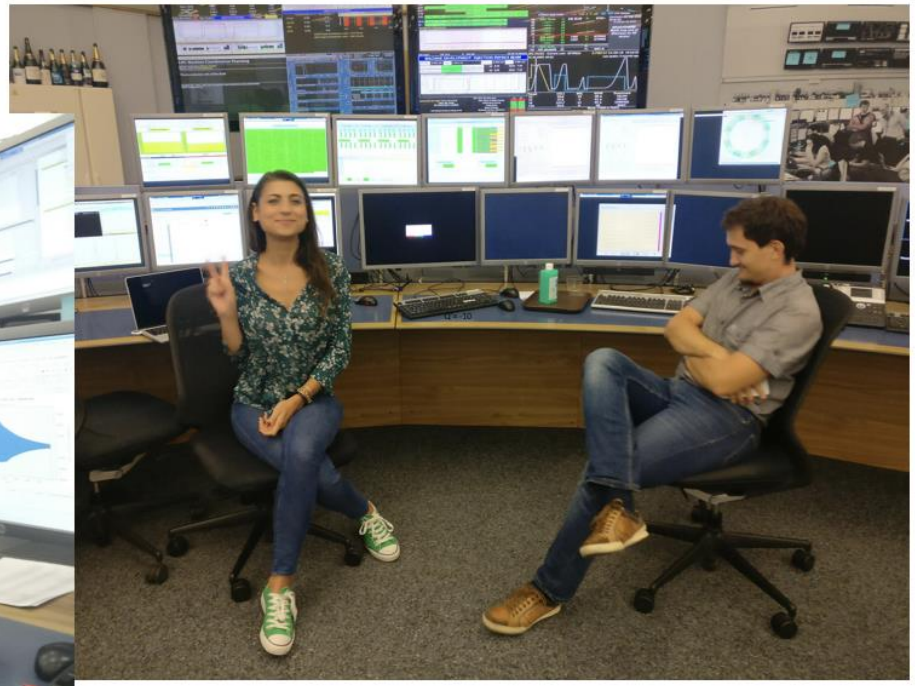
- First time the growth rate vs chromaticities was systematic measured in the LHC
  - Fast_measurements: many points taken in the four hours of the MD
  - Both beams and planes measured
  - Clear instability data

- First analysis comparing measurements with predictions from impedance model:
  - For H plane there is a factor 2 between measurement and simulation
  - For V plane we have outliers at very negative Q'

Next steps

- Improve the rise time analysis by carefully looking at each measurements: fit conditioning, cross-checking beam parameters, emittance effect
- Extract the mode 0 tune from the instability data to study variation vs chromaticity
- Possible improvements to the procedure:
  - Measure the rise time multiple times for each chromaticity to have more statistics
  - Perform a finer scan of the Q' close to zero
  - Measure the chromaticity more often (during the MD, Q' was measured every ~ two Q' trim)





Thank to all for the participation
and
Thank you for your attention !!

Back-up slide: Results