MD 3292: Summary of BTF studies MD Block 3&4

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OP crew on shift and injectors

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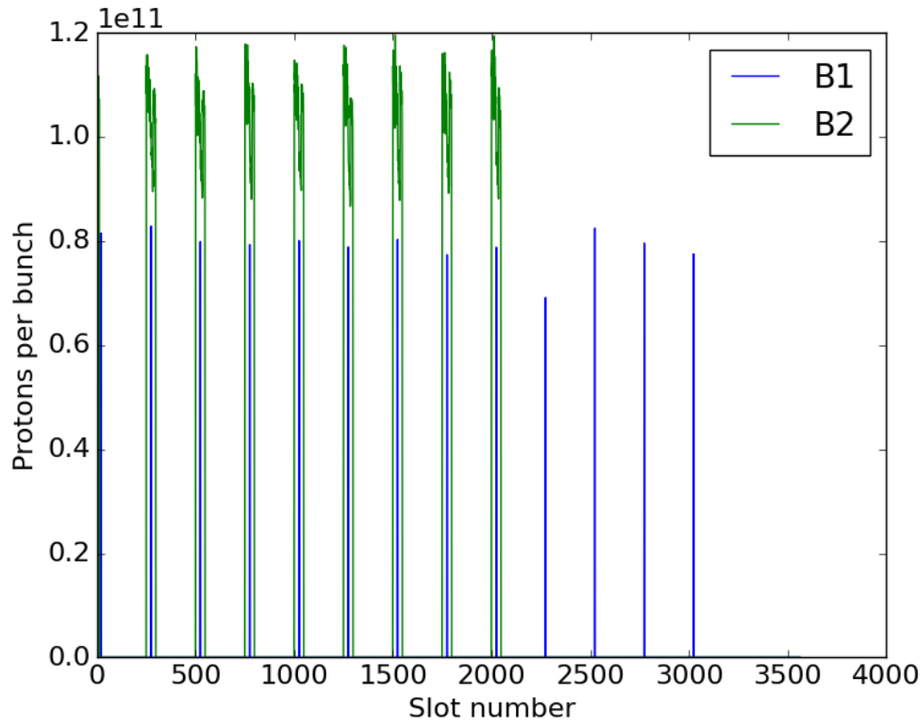
MD 3292 (Block 3)

- BTF gated system used with amplitude thresholds estimated from previous BTF MD (3290)

- 1 Fill: 13 INDIVS in B1 (gated BTF measurements) and 48 Nominal bunches in B2

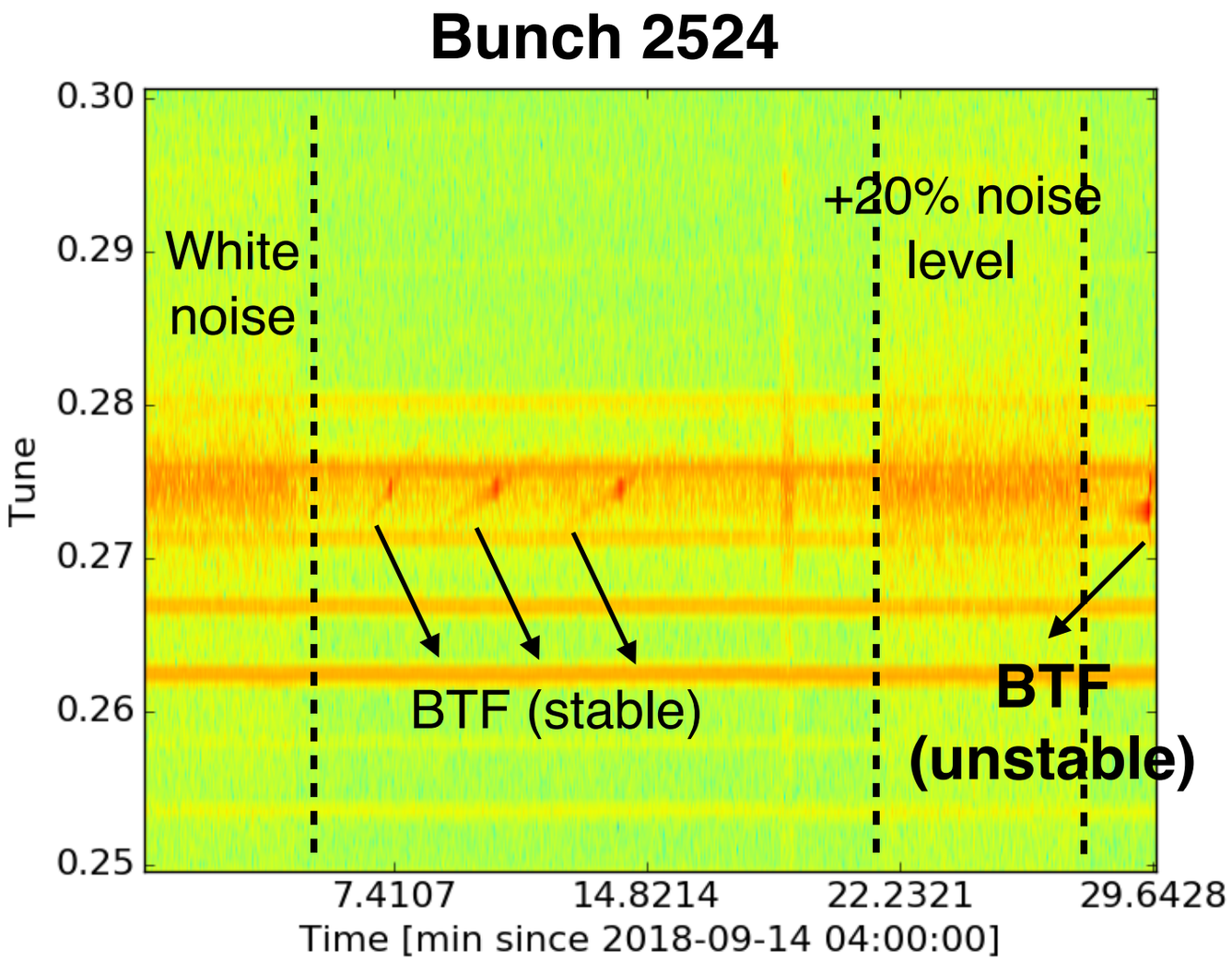


- **Several problems with the BTF application:**
  - No possibility to set-up excitation amplitude through the GUI **due to an update of the INSPECTOR** We changed the excitation by using FESA (**thanks G. Trad**)
  - No excitation in the vertical plane **due to bad phasing in this plane.**
  - **Solved for next MD (block 4) (thanks T. Levens)**

- Measurements acquired at flat top energy on B1 H white noise (injected for few seconds)

- **Due to some problem with the tune application we could not move to squeeze mode and we decide to continue studies with noise → No measurements with BB Long Range**

Preliminary results MD 3292 Block 3

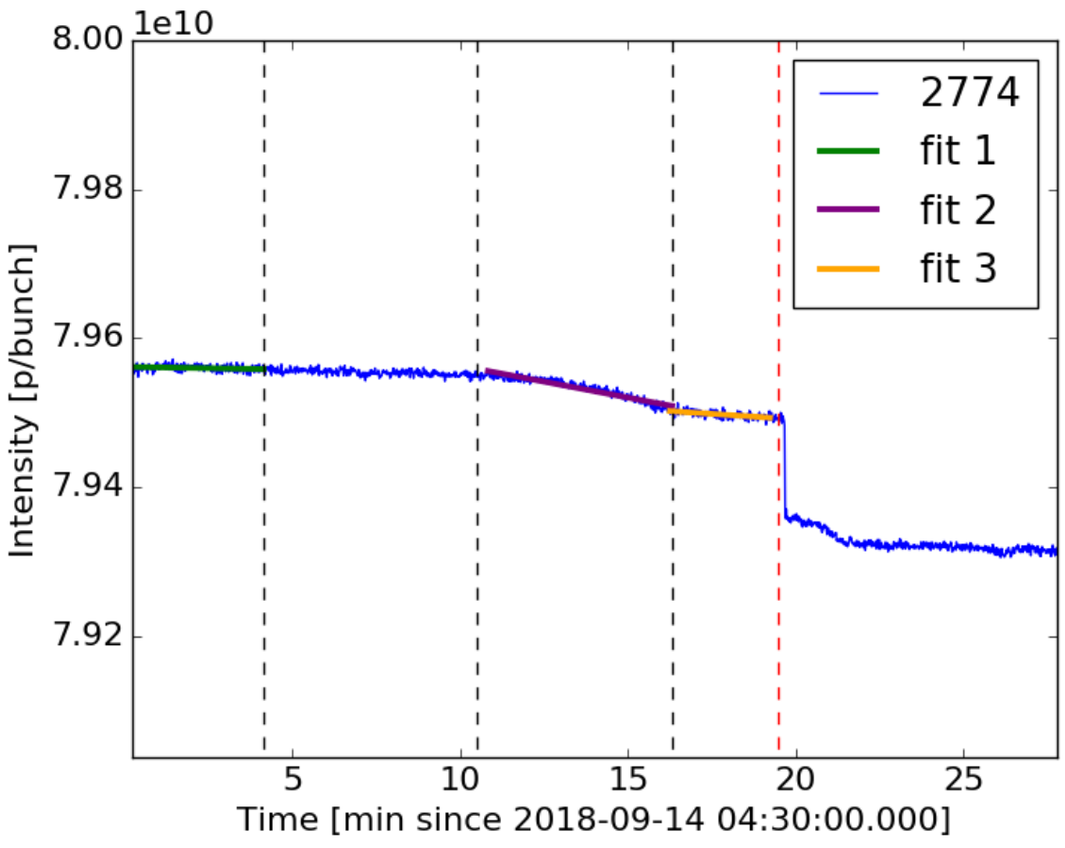


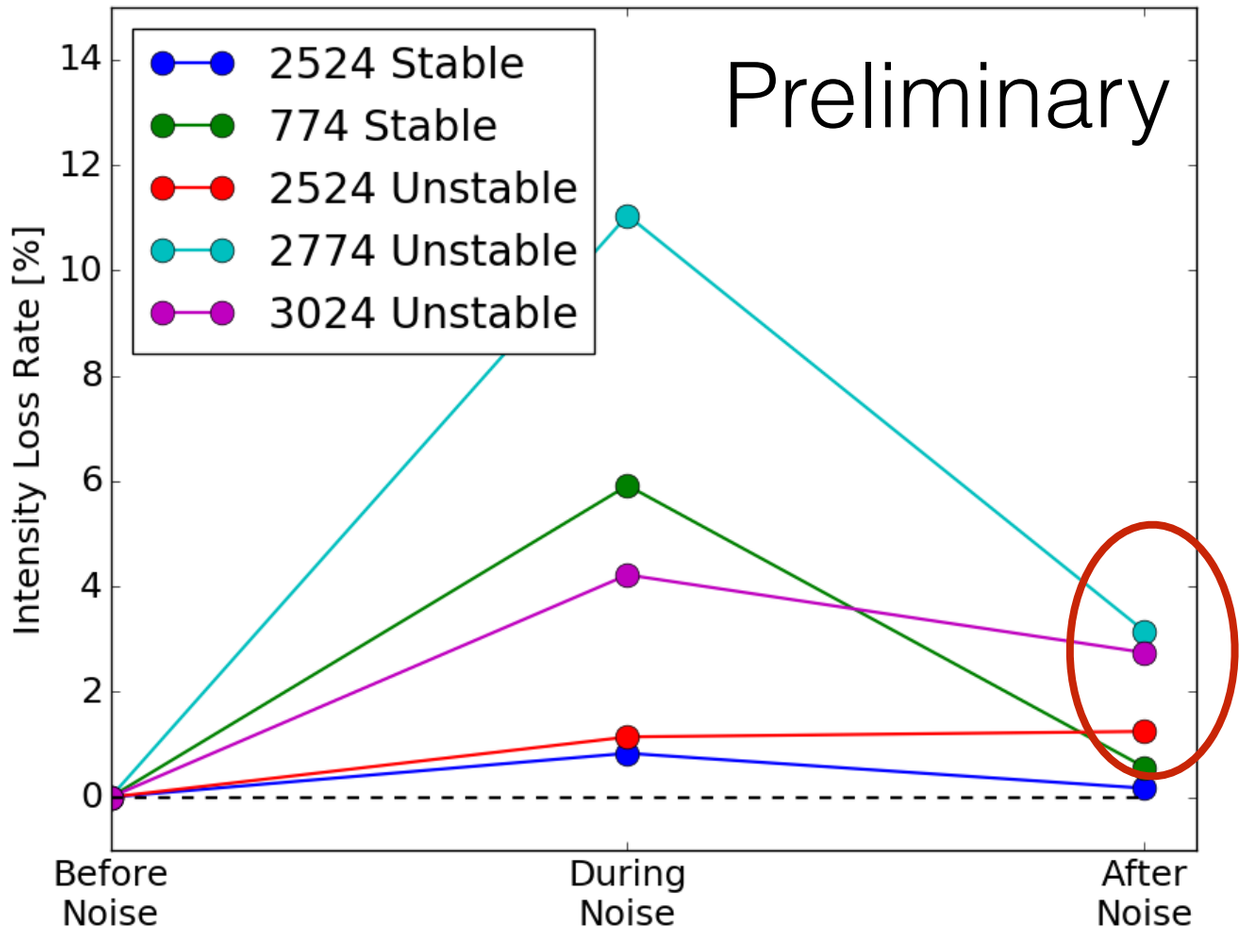
BTF measurements at flat top (gated) **NO Instability due to BTF excitation itself**

At higher noise amplitude bunches are more sensitive to external excitations (BTF) and BTF could trigger instabilities →Impact on transverse beam stability

Beam Losses and instabilities

Fit in different intervals (before, after and during noise)



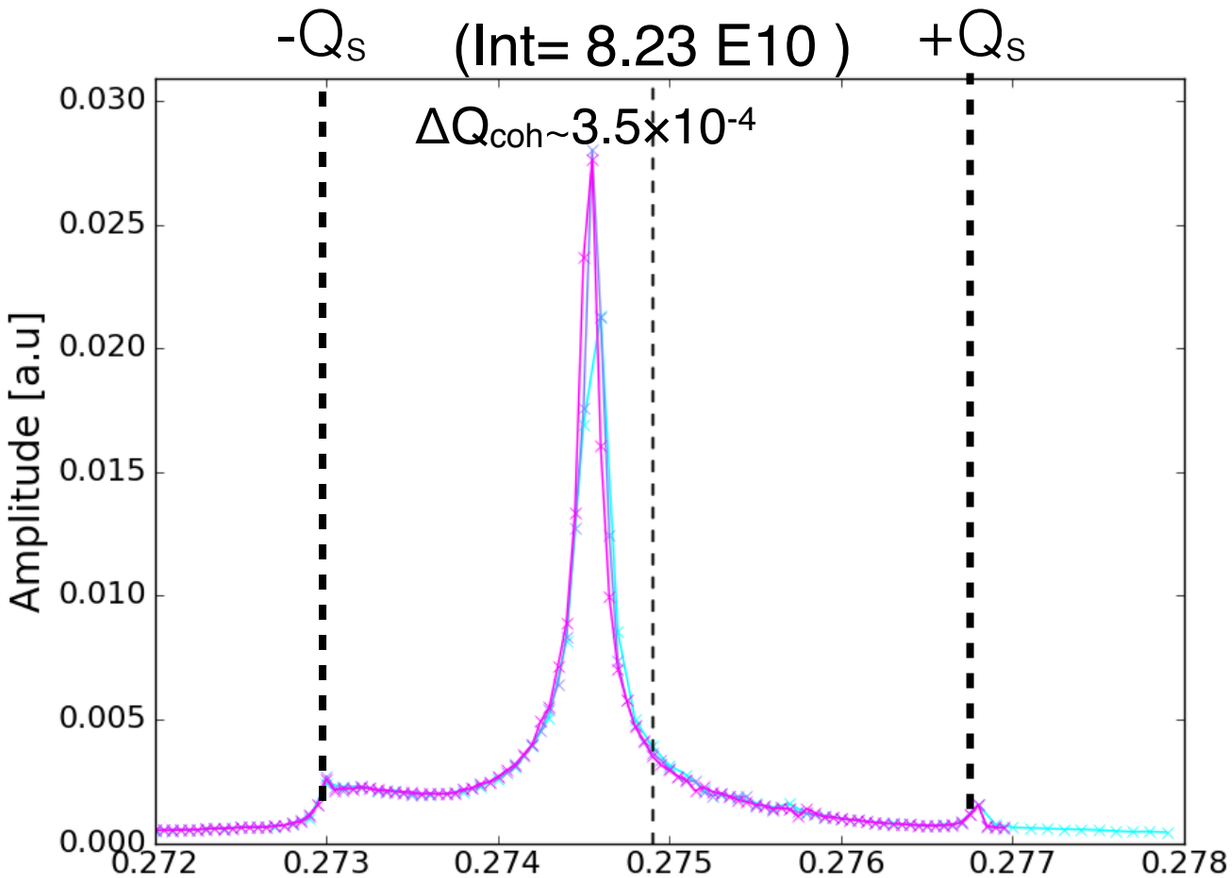


Drop of intensities observed while injecting noise
→ bunches that got unstable during BTF continue to loose intensity even when noise stopped

From beam profiles can we detect population in the tails? → Analysis ongoing

Impedance and BTF response at top energy

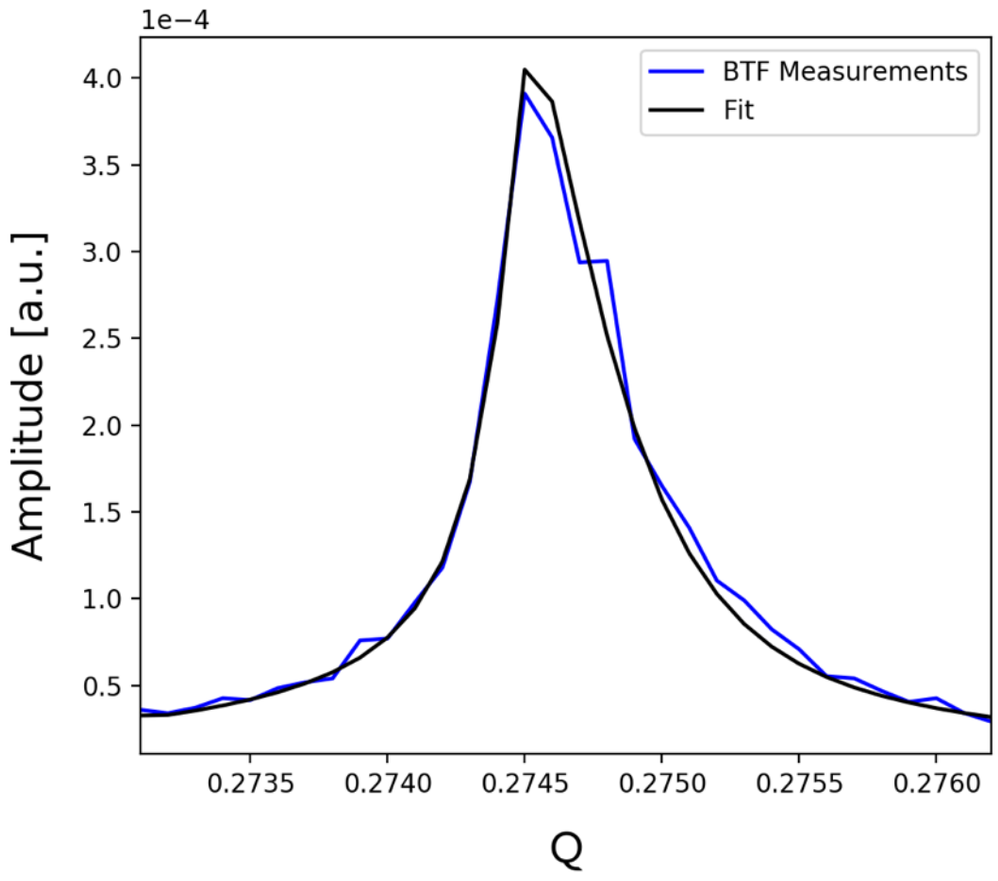
- Tune shift observed in BTF response (asymmetric sidebands w.r.t. tune peak)
- Difficult to reconstruct Stability Diagram by using analytical fitting function when in the presence of impedance response

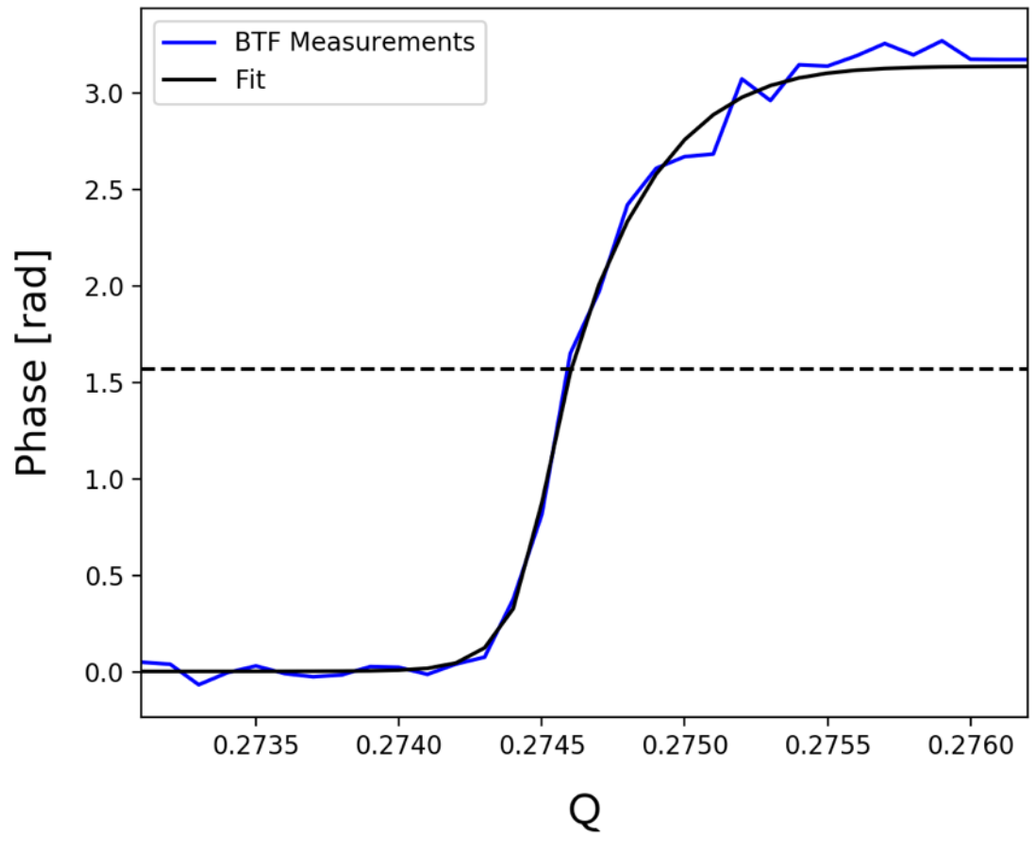


COMBI Comparison (PySSD and Impedance)

```
Tune shift: 0.27448399821526354
Tune spread: 1.0223026086236071
Amplitude: 4.788423208582099e-08
```

Bunch int=0.05E11

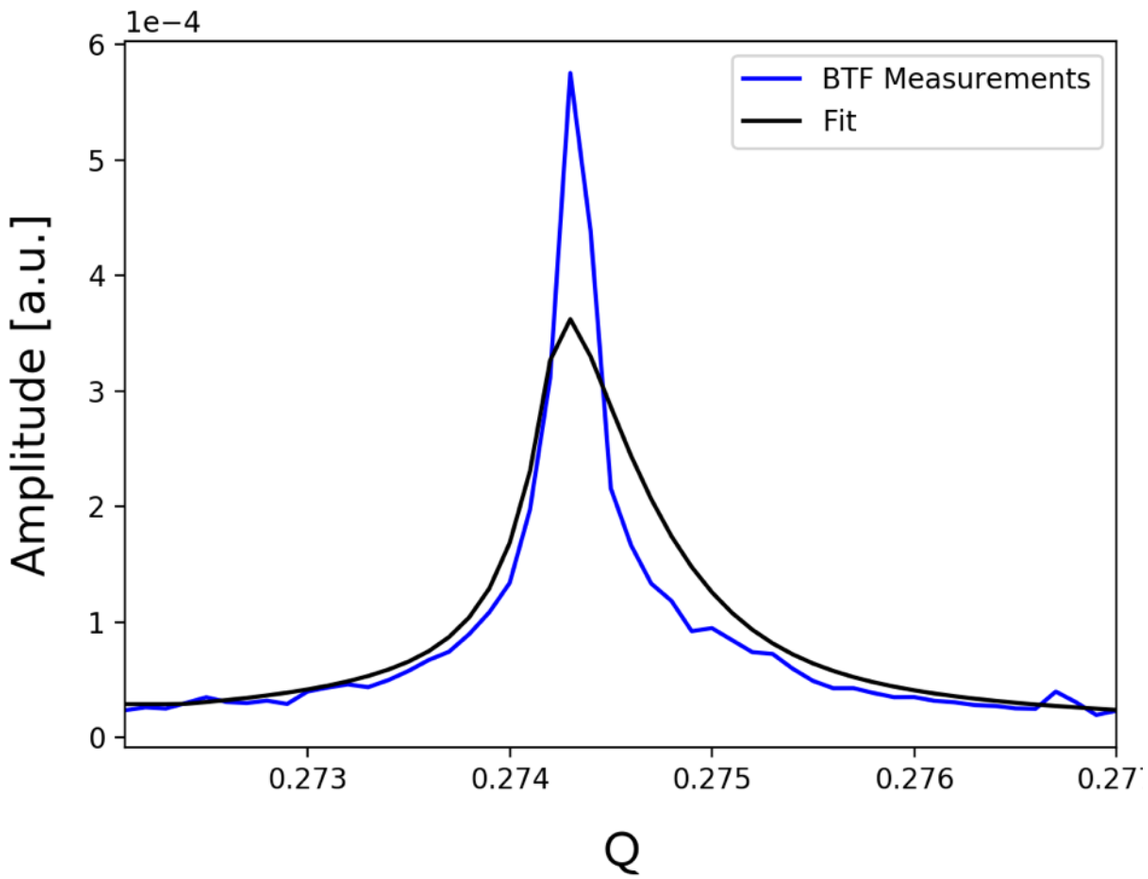


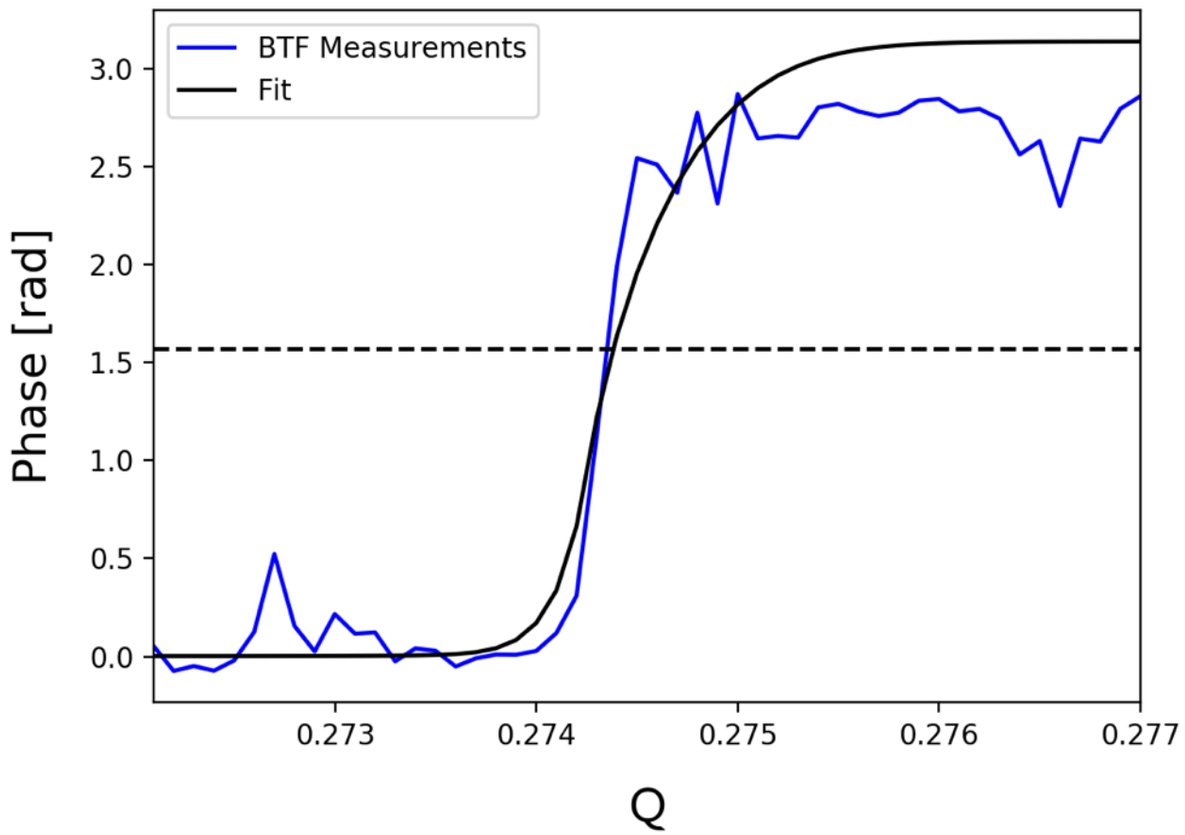


COMBI Comparison (PySSD and Impedance)

```
Tune shift: 0.2742137642768119
Tune spread: 1.4405459258983169
Amplitude: 5.925715328032227e-08
```

Bunch int=1.0E11

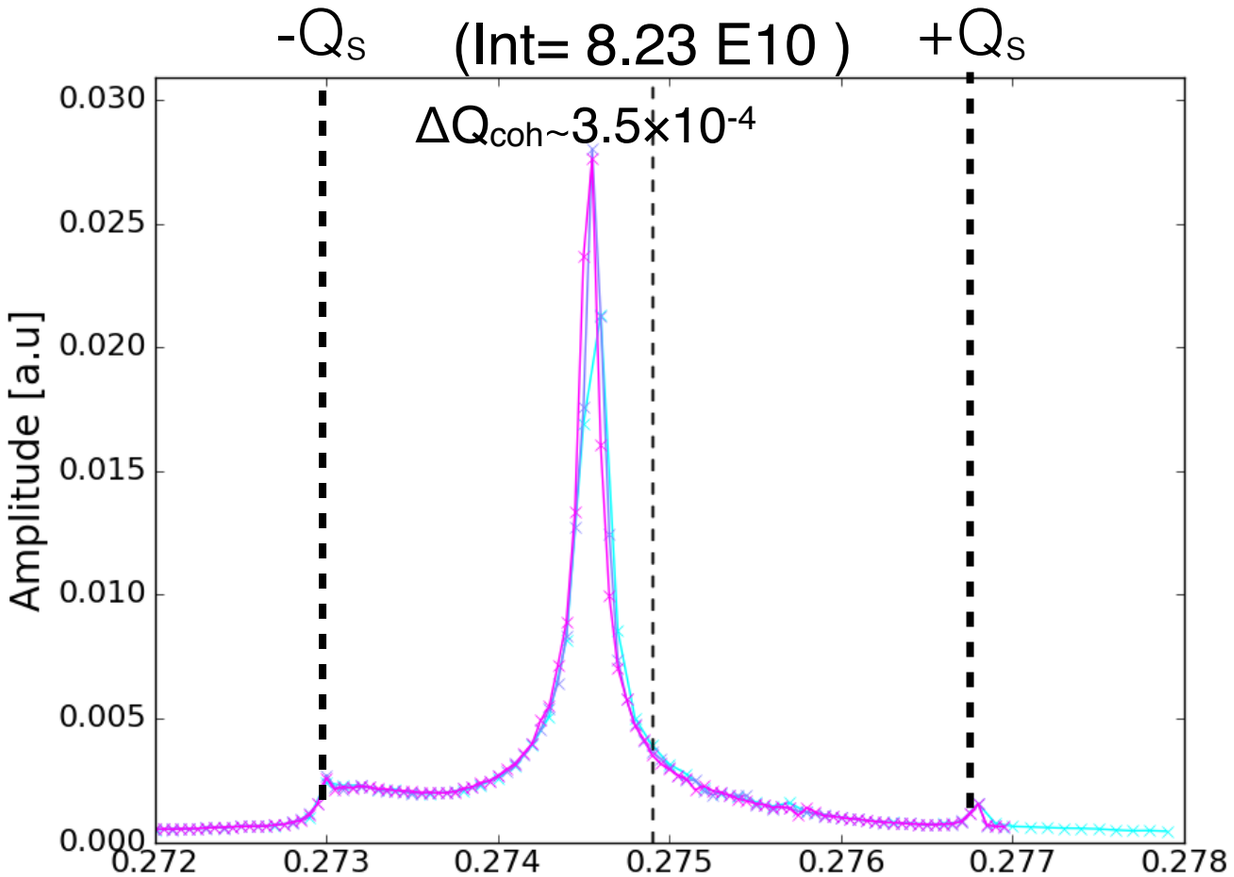




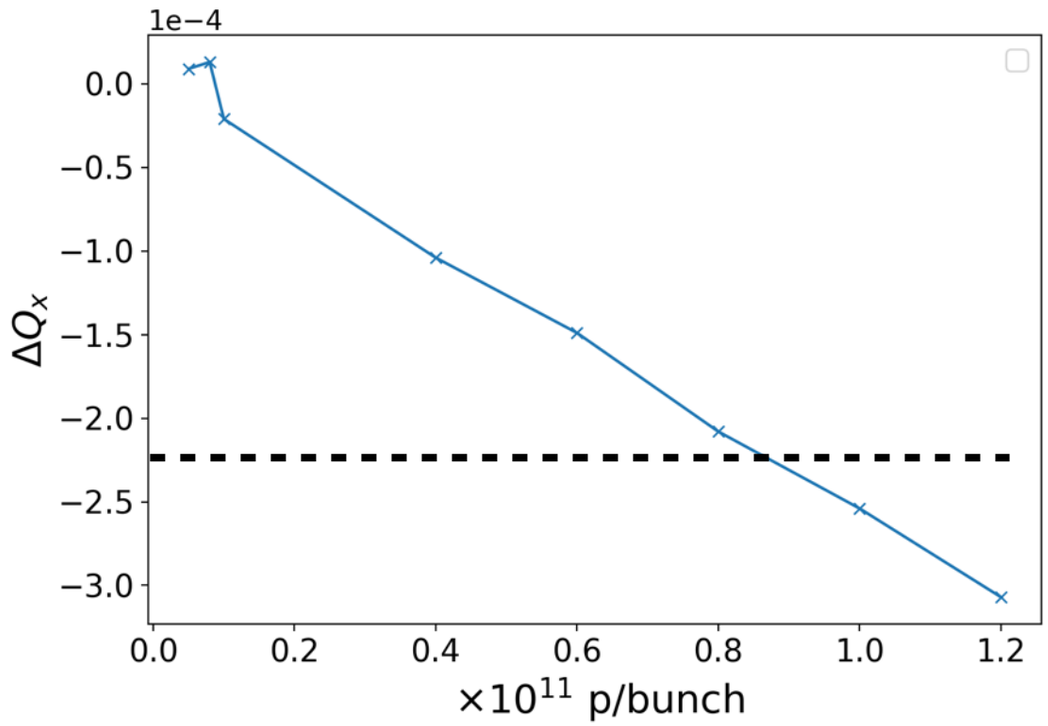
- Impedance contribution in simulated BTF response
- Fitting function method does not applied in the presence of strong impedance

Impedance and BTF response at top energy

- Tune shift observed in BTF response (asymmetric sidebands w.r.t. tune peak)
- Difficult to reconstruct Stability Diagram by using analytical fitting function when in the presence of impedance response



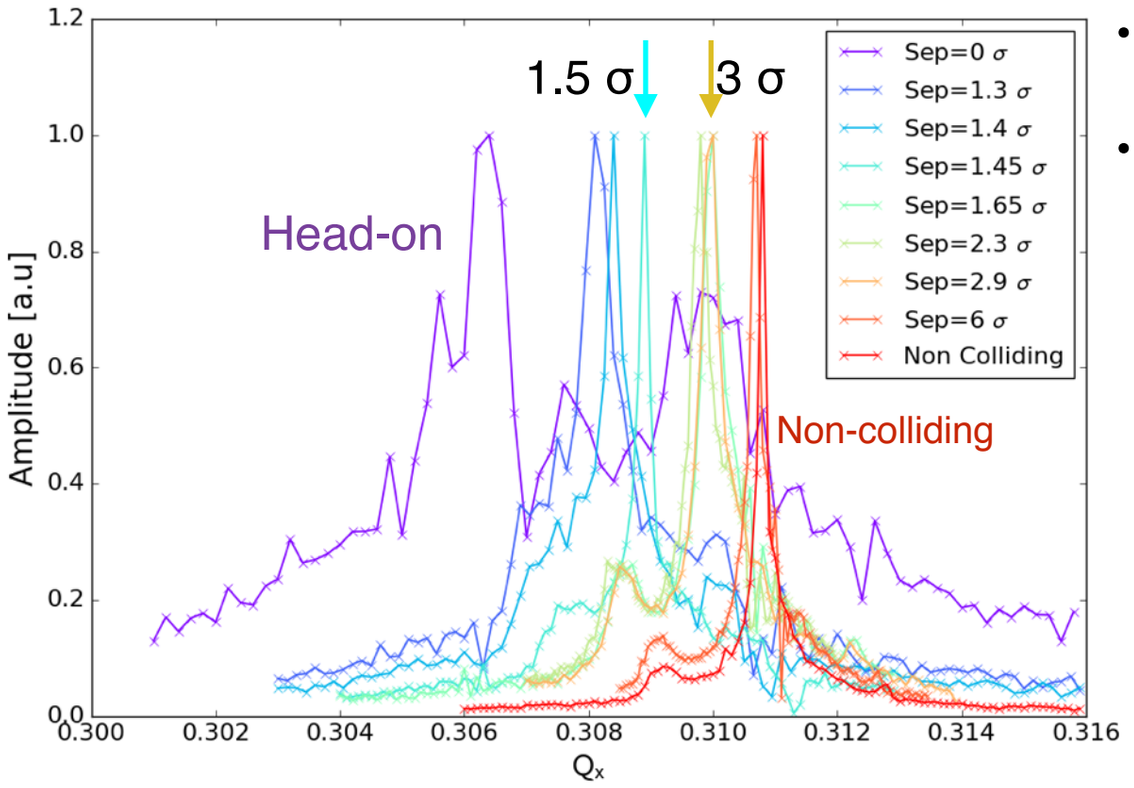
- Tune shifts compatible with measurements by D. Amorim et al. (4x10^{-4}) https://indico.cern.ch/event/743627/
- In agreement with COMBI simulations



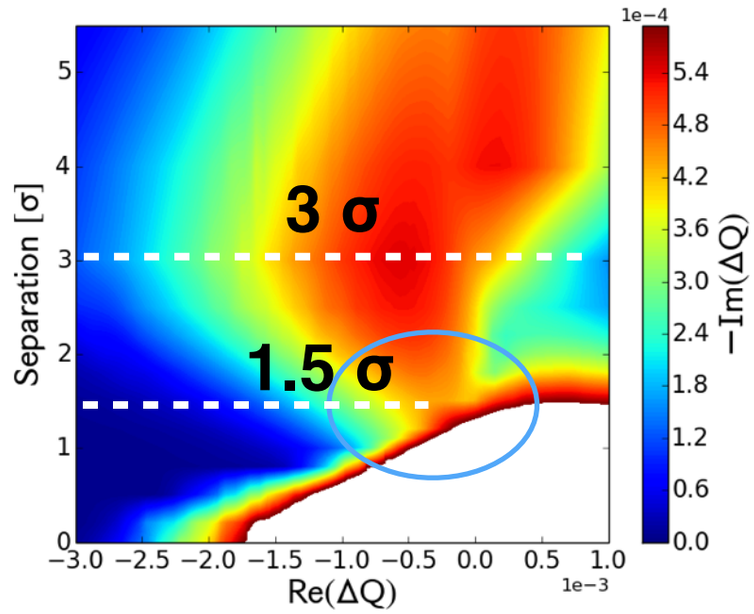
MD 3292 (Block 4)

- 3 lower intensity INDIVS in Beam 1 and 2 trains of 48 nominal bunches on B2.
- Due to a mismatch of the sextupoles in sector 34 (somehow hidden leftover from a previous MD) we could not ramp the energy to reach flat top (a dump was required to solve the problem).
- Unfortunately we could not re-inject trains in B2 due to a cavity problem in the PS. Waiting for recovery, we decided to acquire BTF measurements at injection energy with lower intensity INDIVS on both Beams as a function of the octupoles (8 A, 13 A) and chromaticity (Q'~3, Q'~1)
- Since trains could not be recovered in time, we decided to proceed injecting 3 lower INDIVS in both beams for head-on studies, but not long-range as foreseen.
- At flat top, we reduced the impedance by opening the secondary and primary collimators (TCSPM and IR7 TCSGs at 15sig, IR7 TCP settings at 6sig)
- At the end of the squeeze we collided the beams. BTF measurements were acquired with different beam offset separations (0,1,1.2,1.4,1.6,6 σ)

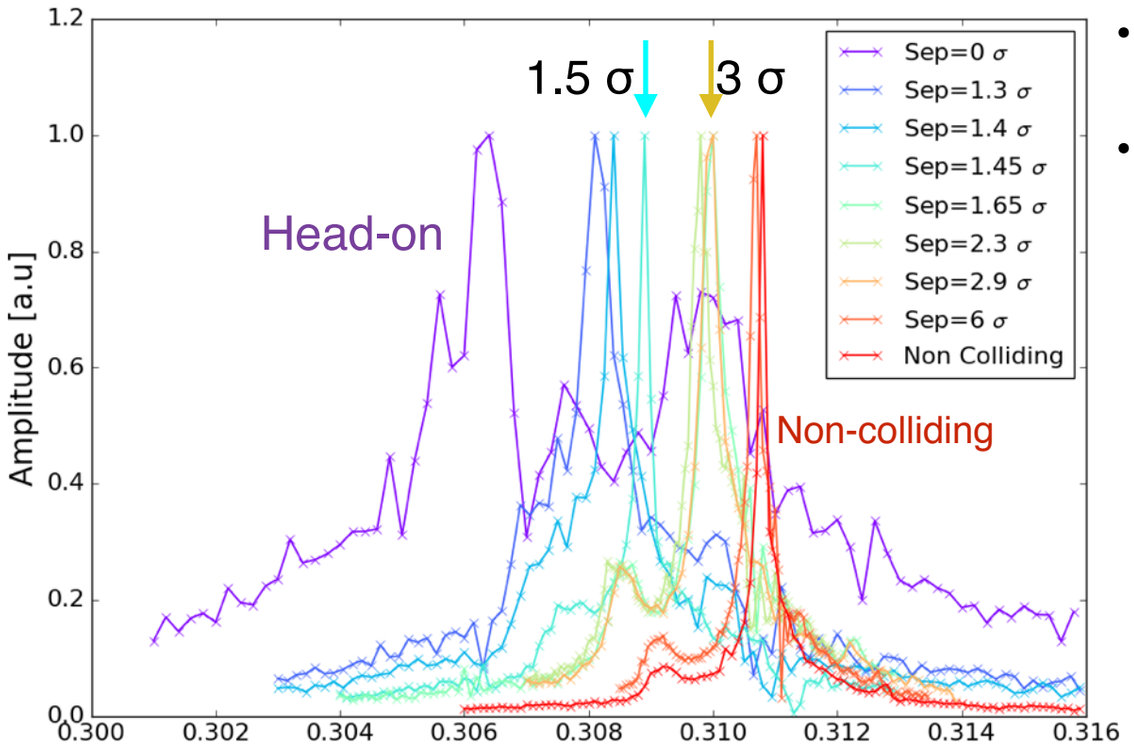
BTF Measurements in the presence of Head-on beam-beam



- Biggest tune spread observed with full Head-on collision (as expected)
- Smallest tune spred observed at ~1.5 σ Minimum of stability (as expected)



BTF Measurements in the presence of Head-on beam-beam



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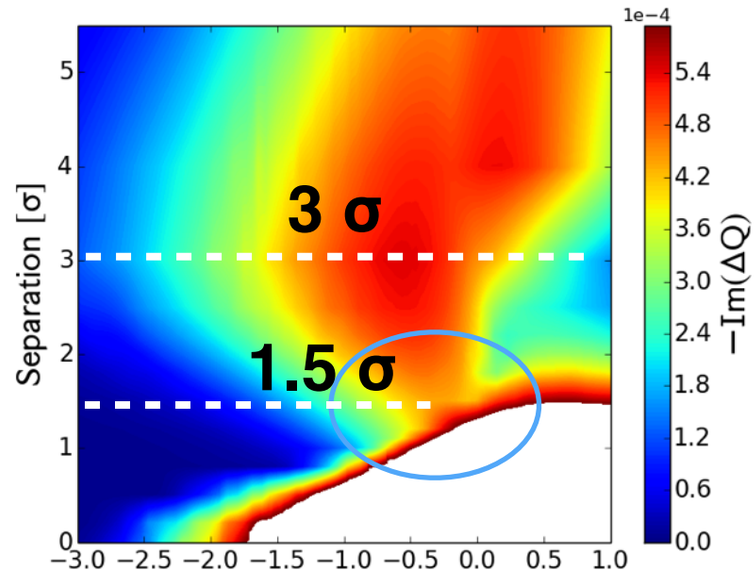
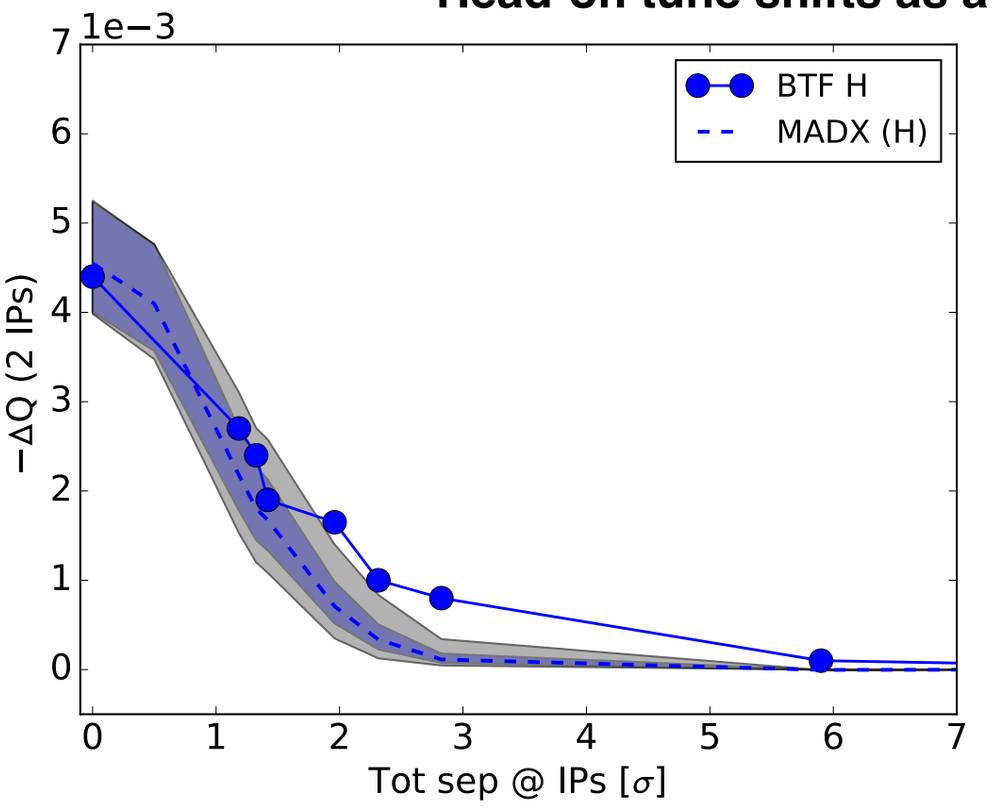
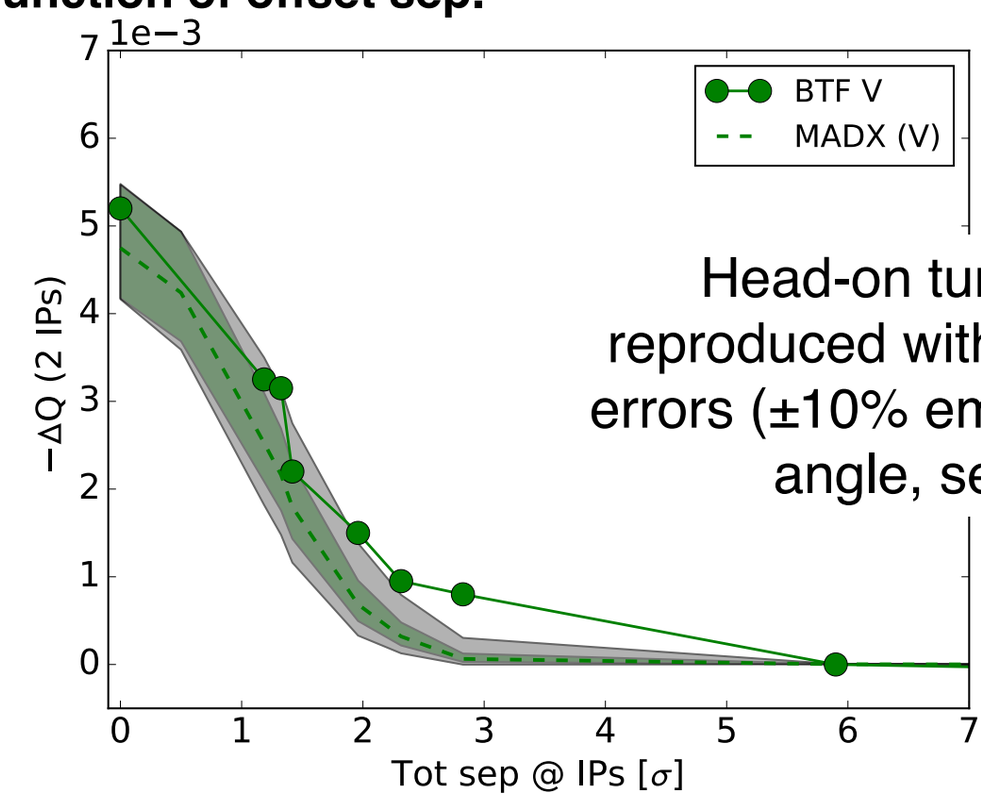


Head-on tune shifts as a function of offset sep.





Head-on tune shifts well reproduced with MADx in within errors (±10% emittance, crossing angle, separation)

Summary

- No instabilities triggered during the MD at flat top due to BTF excitation (settings and gated system successful) → **measurements at flat top are possible**
- **However some difficulties:**
    - **Impedance contribution has to be reduced (lower intensity bunches and retracted collimators)**
    - **Difficult to reconstruct stability diagrams in the presence of synchrotron sidebands due to chromaticity at flat top**

Measurements in the presence of noise:

- In the presence of low amplitude noise no instability observed with BTF (in the MD time window)
- Confirmed that noise could be source of instabilities (bunches sensitive to BTF excitation)
- Analysis of the beam profiles in the presence of noise ongoing, together with COMBI simulations with noise

Measurements in the presence of head-on interactions:

- Measurements acquired as a function of the separations at the IP → A minimum of stability at 1.5 σ (as expected) has been measured
- Tune shifts reproduced with MADX

Simulations of the coherent response of the BTF in COMBI are ongoing