Optics measurements based on forced 3D beam excitation in PETRA III

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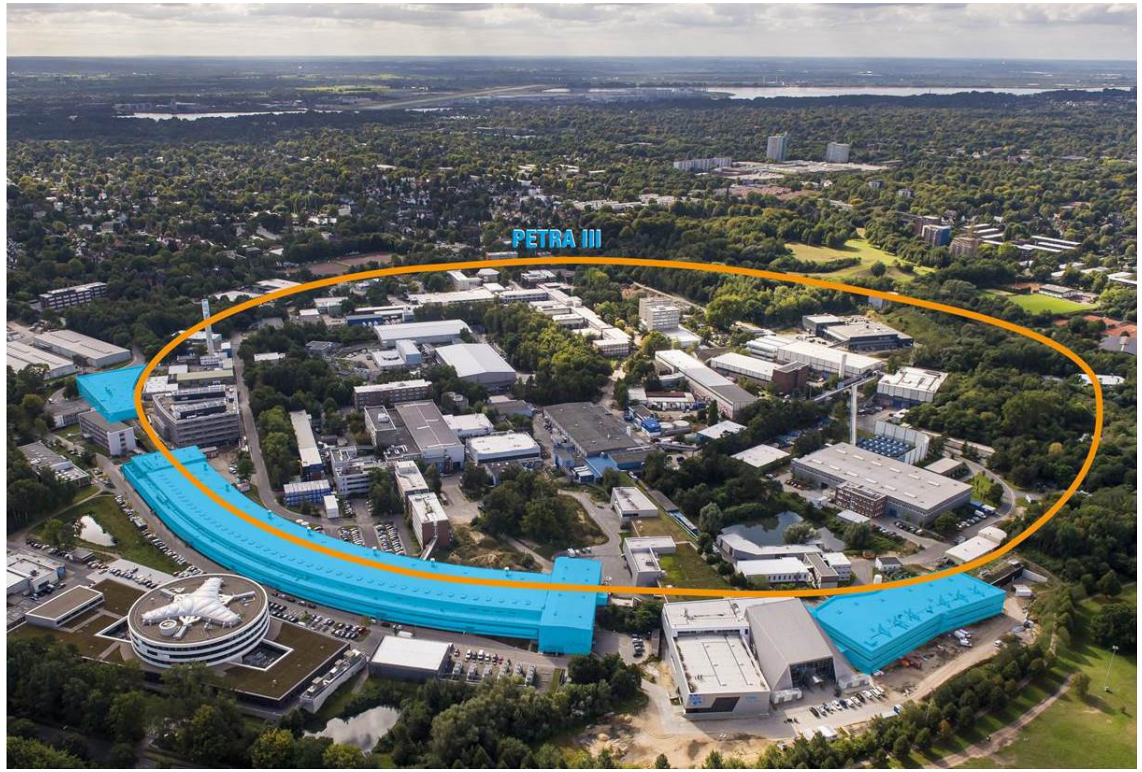
Overview

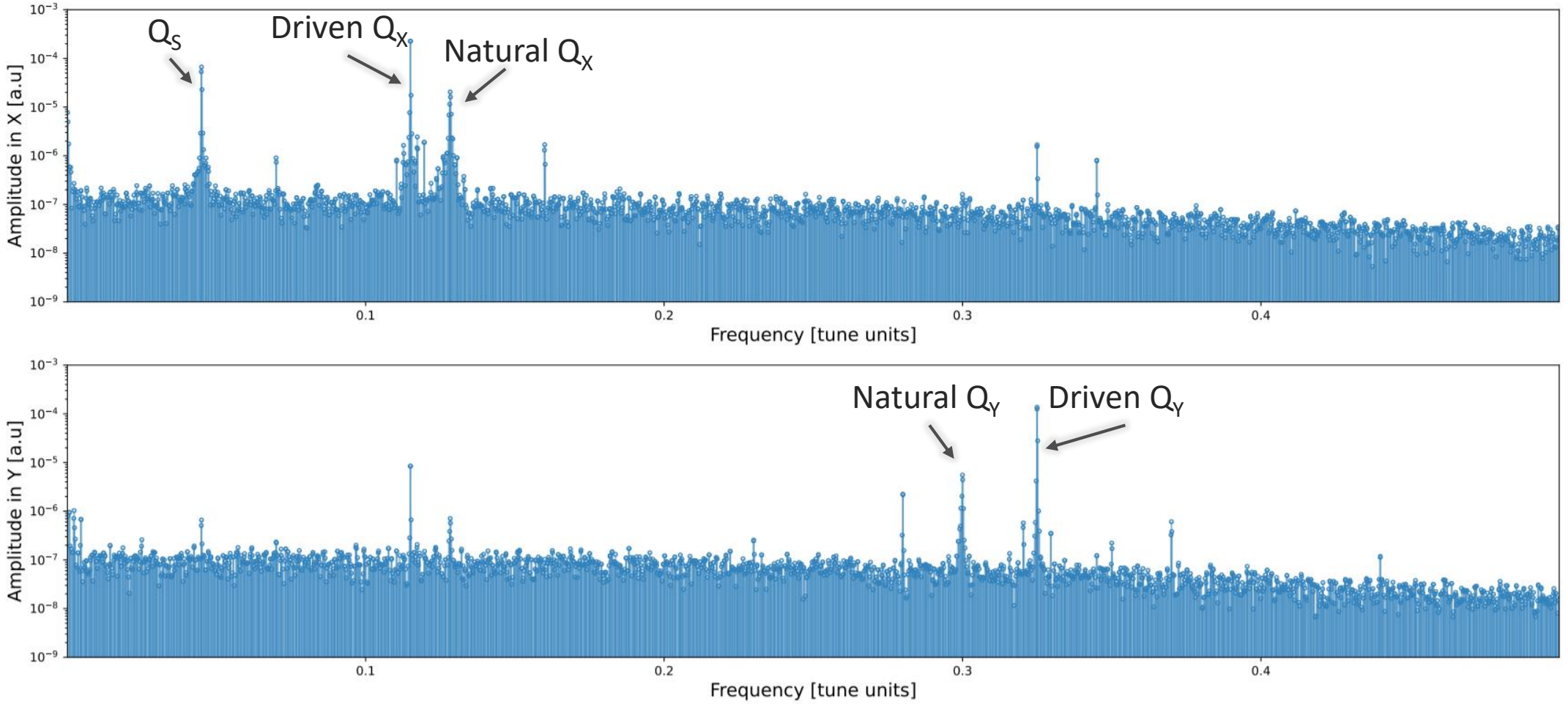
- Forced 3D beam excitation
- Libera BPM electronics
  - Avoiding MAF filters
- Sample measurement
- Measurement optimisation and beam-based model



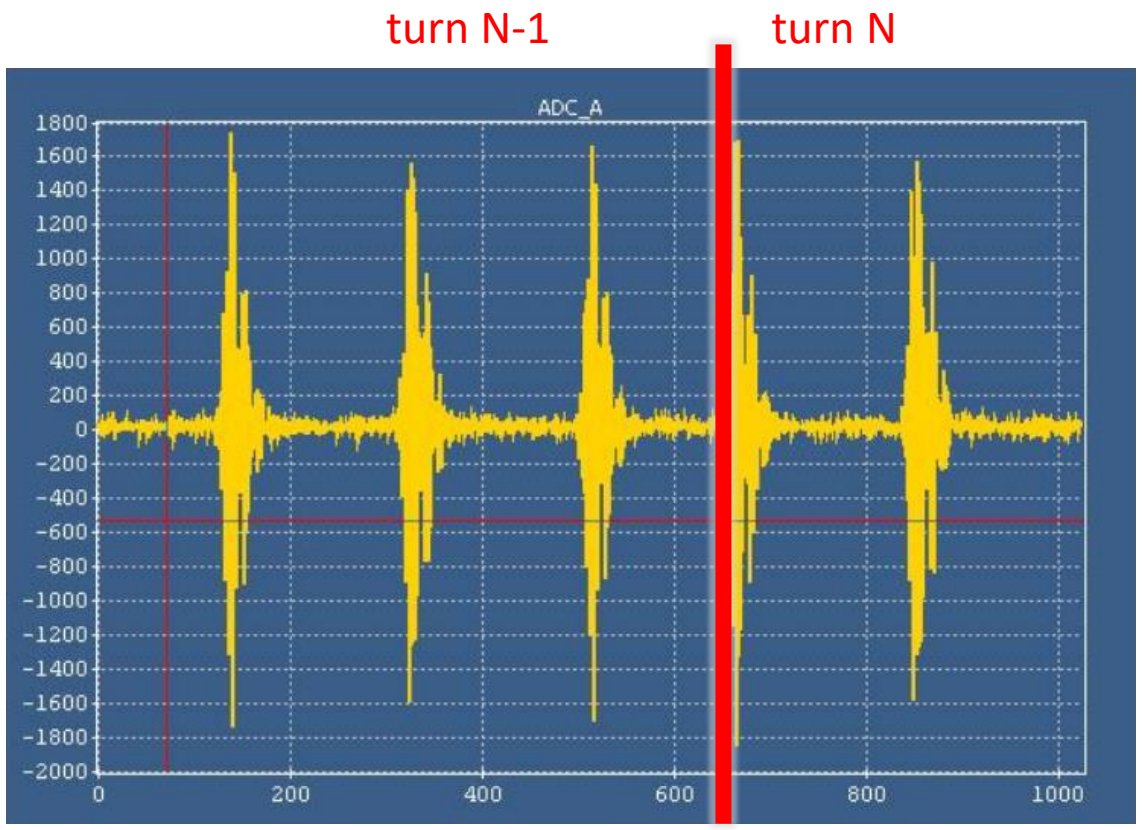
“AC-Dipoles” at PETRA III

- Transverse and longitudinal dampers equipped with generators
  - Can generate sine-wave up to 62.5 MHz
  - Betatron frequencies in 10s kHz range
    - Possible step-like excitation, i.e. all bunches see the same kick
- Low power in longitudinal direction
  - Excitation frequency has to be very close

PETRA III: Forced 3D excitation



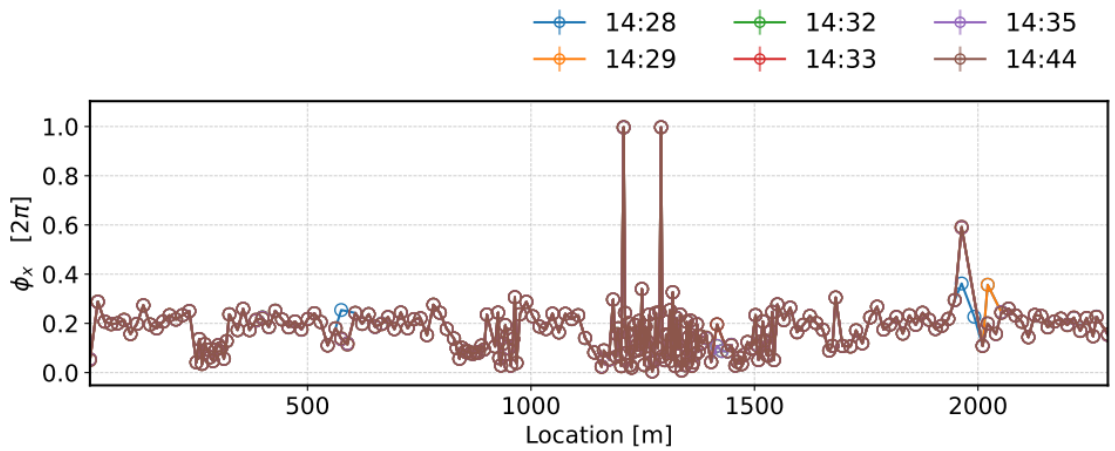
BPMs without MAF

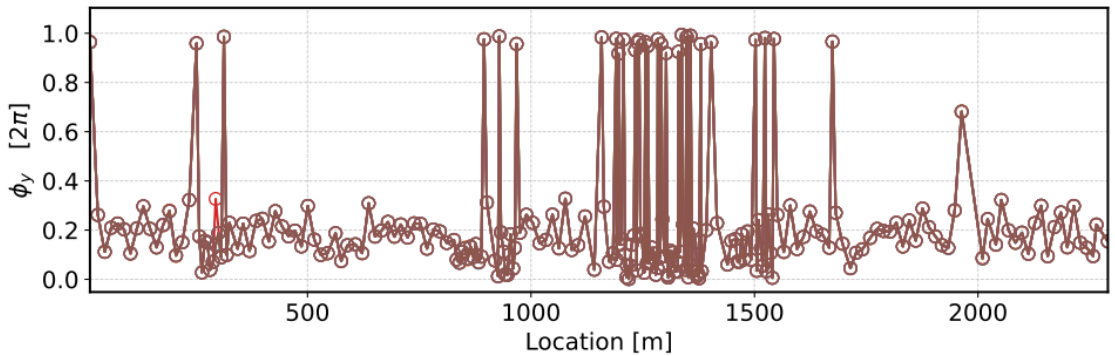


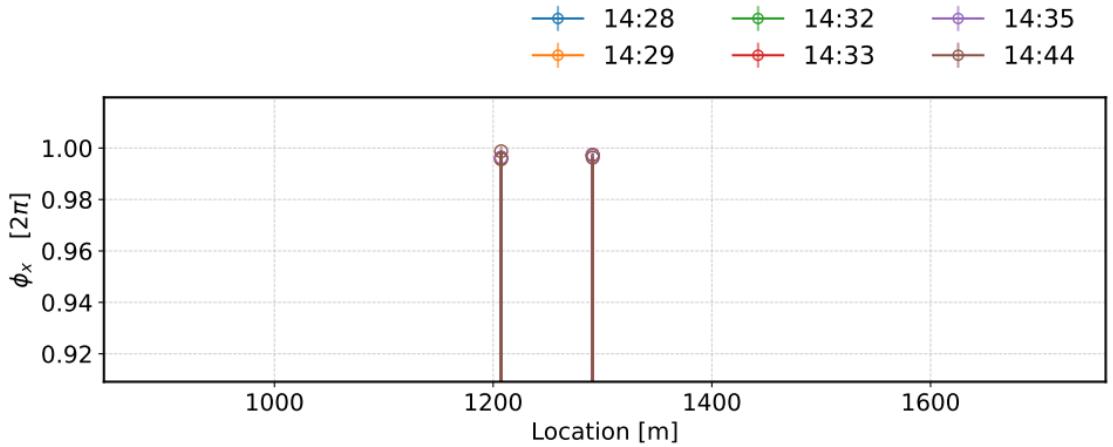
Bunch 1 around channel 650

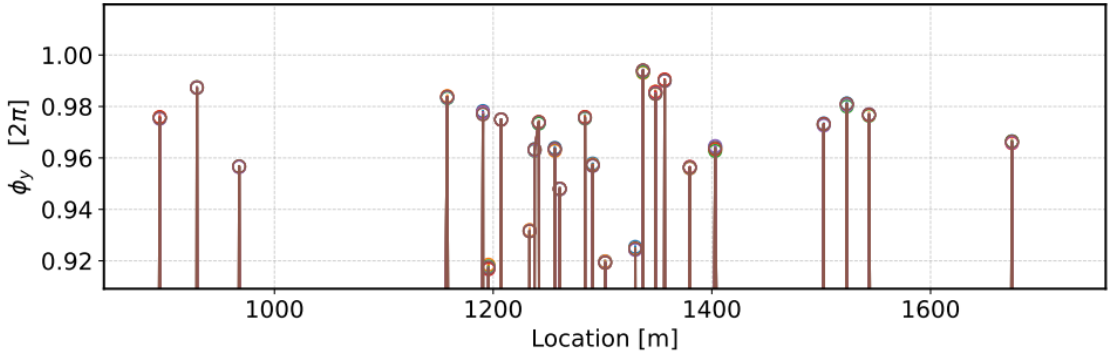
- ADCs on BPM electrodes see more than a revolution period
  - From bunch No. ~240 (turn N-1) to arrival of bunch ~400 (turn N)
- Timing may vary by ~100 channels (BPM to BPM)
- Leads to unphysical measurements with regular filling pattern
  - Negative phase advances

No MAF: negative phase advances

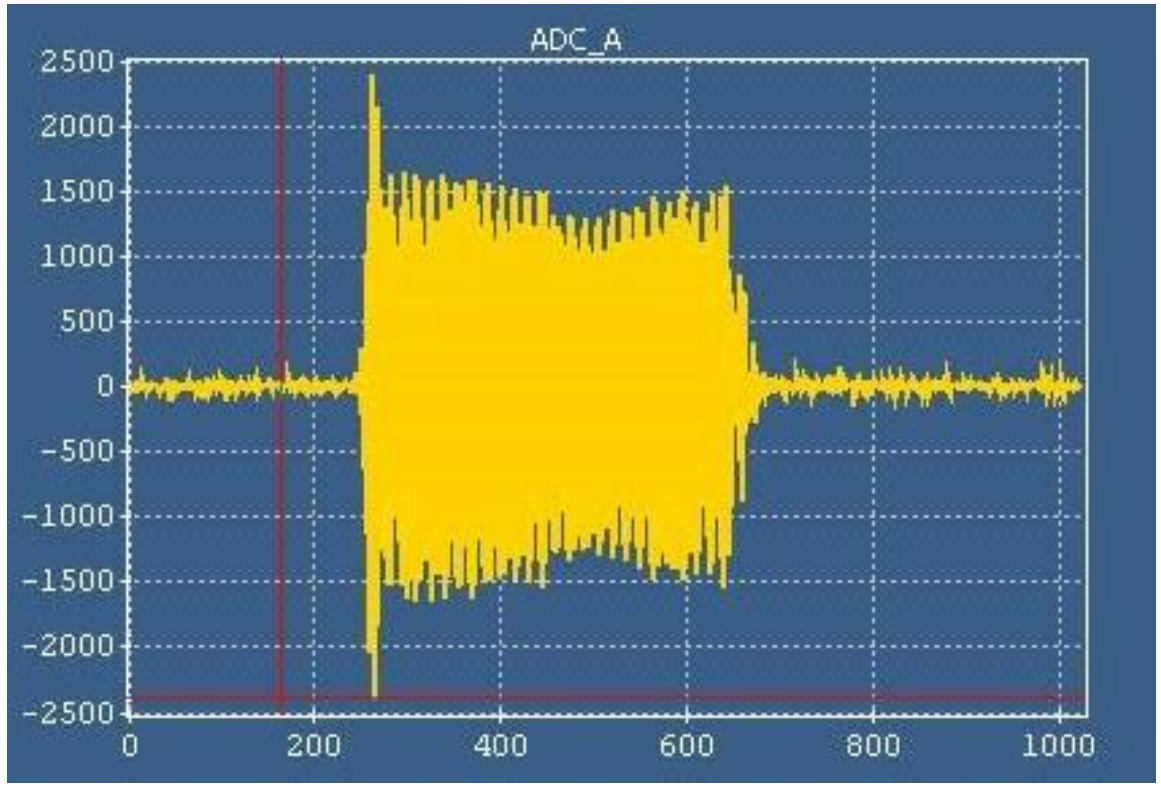








BPMs without MAF



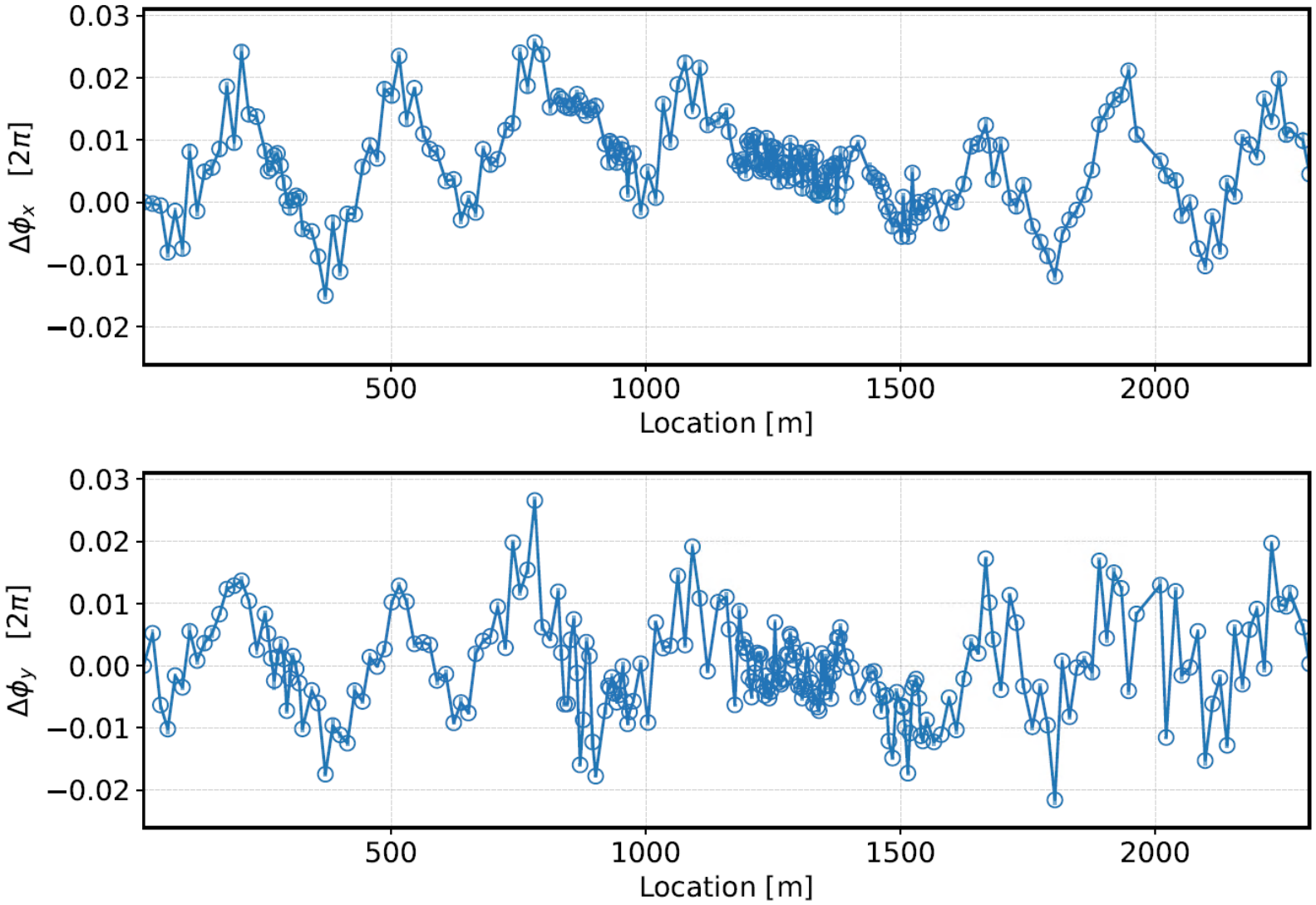
- Adapted filling scheme
  - Need to fit all bunches including the “ringing” into a single turn
  - Roughly second half of the ring

➢ MAF filters are not needed

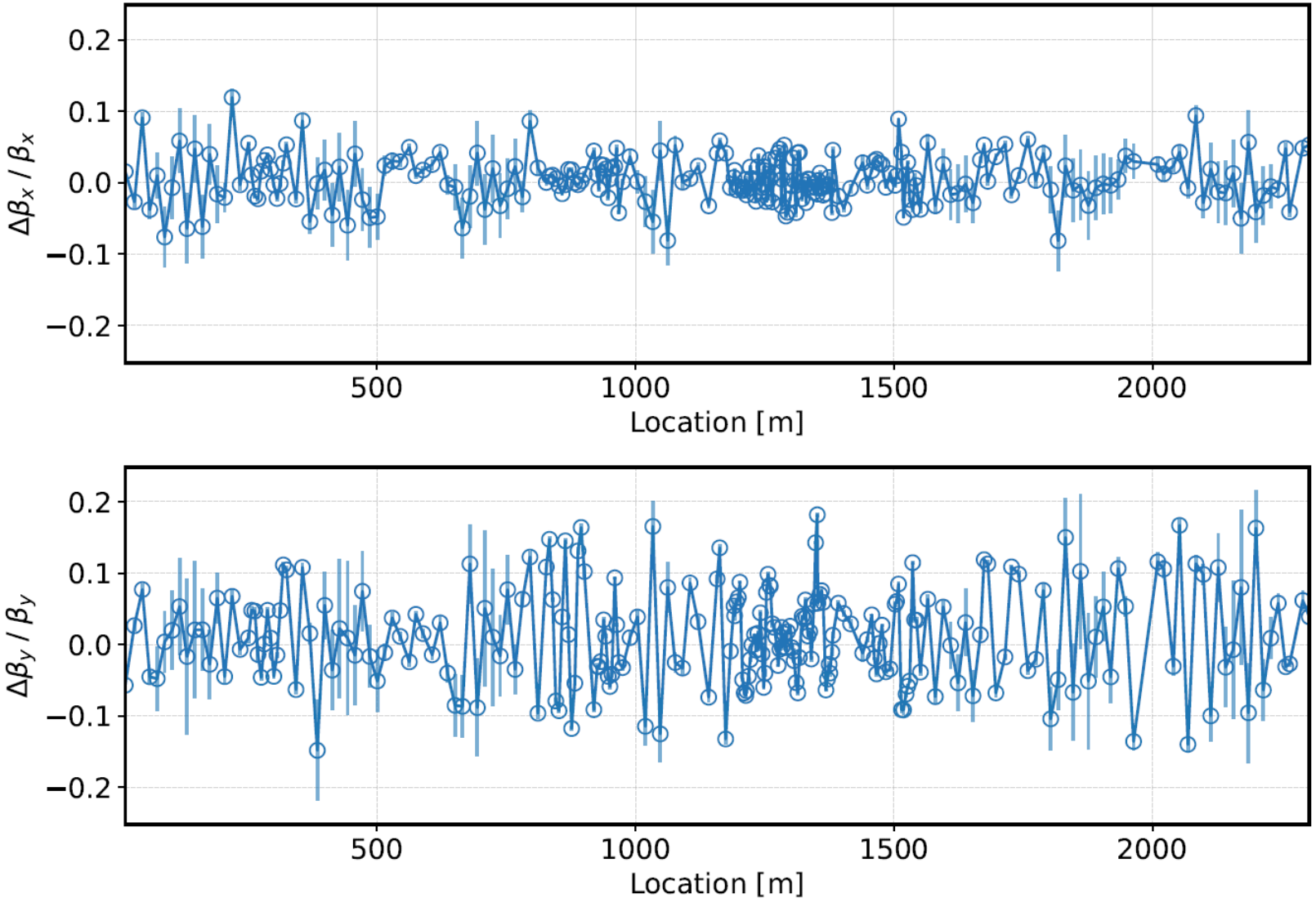
Measurement on March 16

- Beam current about 8 mA
  - Bunch current 0.25 mA
- Single 3D excitation
  - 25000 turns
  - Analysed in three chunks
- Average BPM resolution of 10 um
- Automated: takes couple of minutes (dump to dump)
- Easy to optimise further

Total phase advance beating



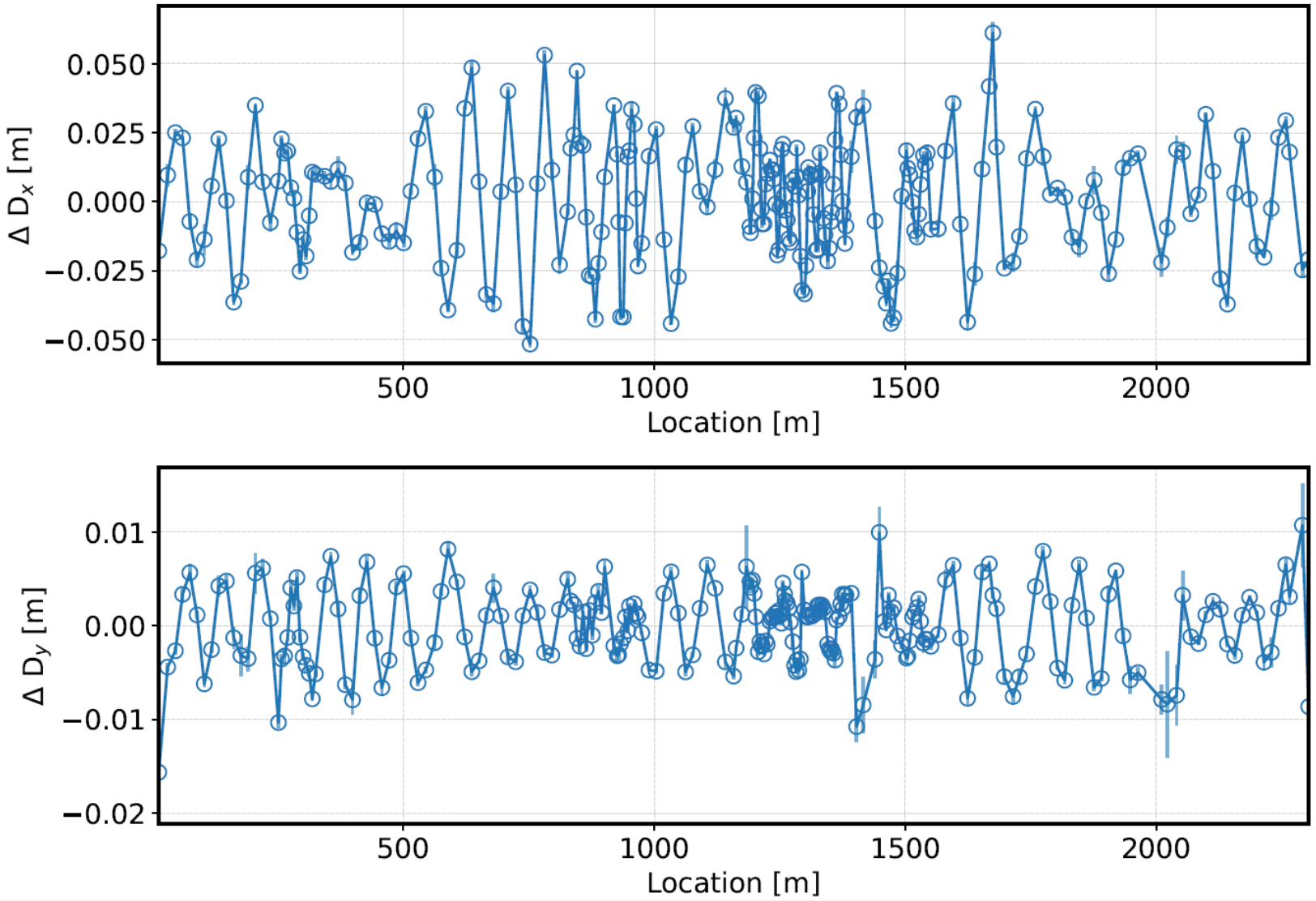
Beta beating (N-BPM method)



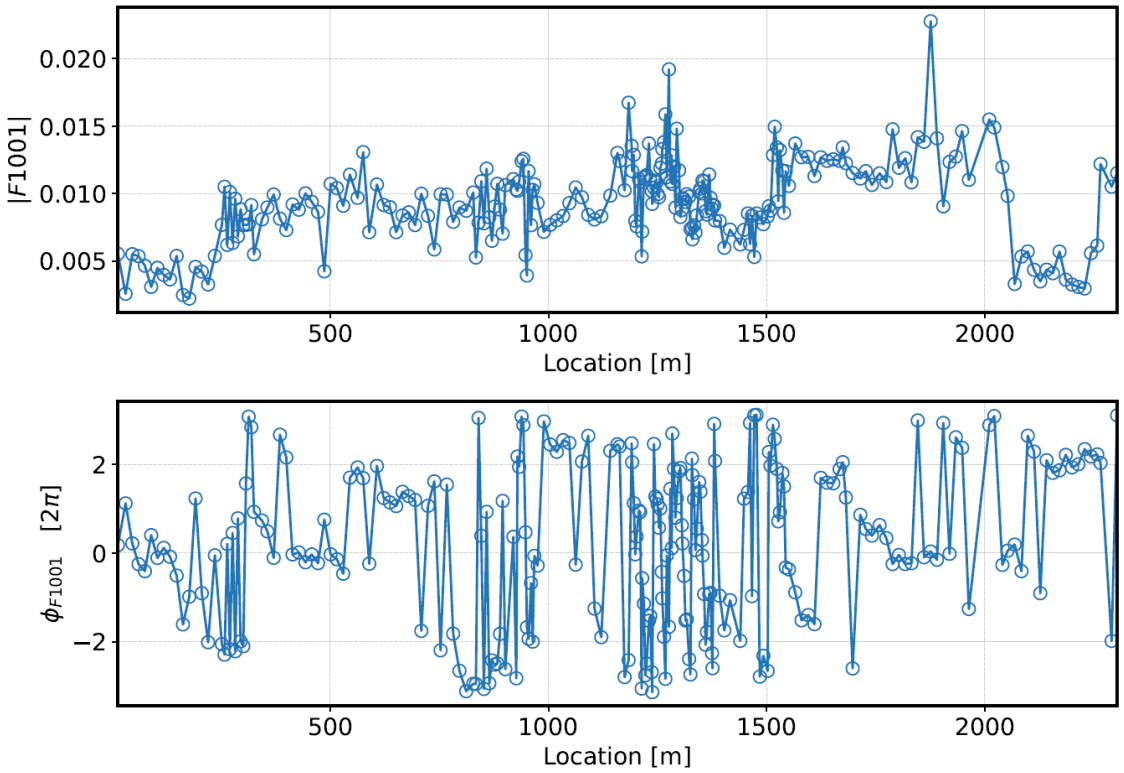
Analytical N-BPM method:

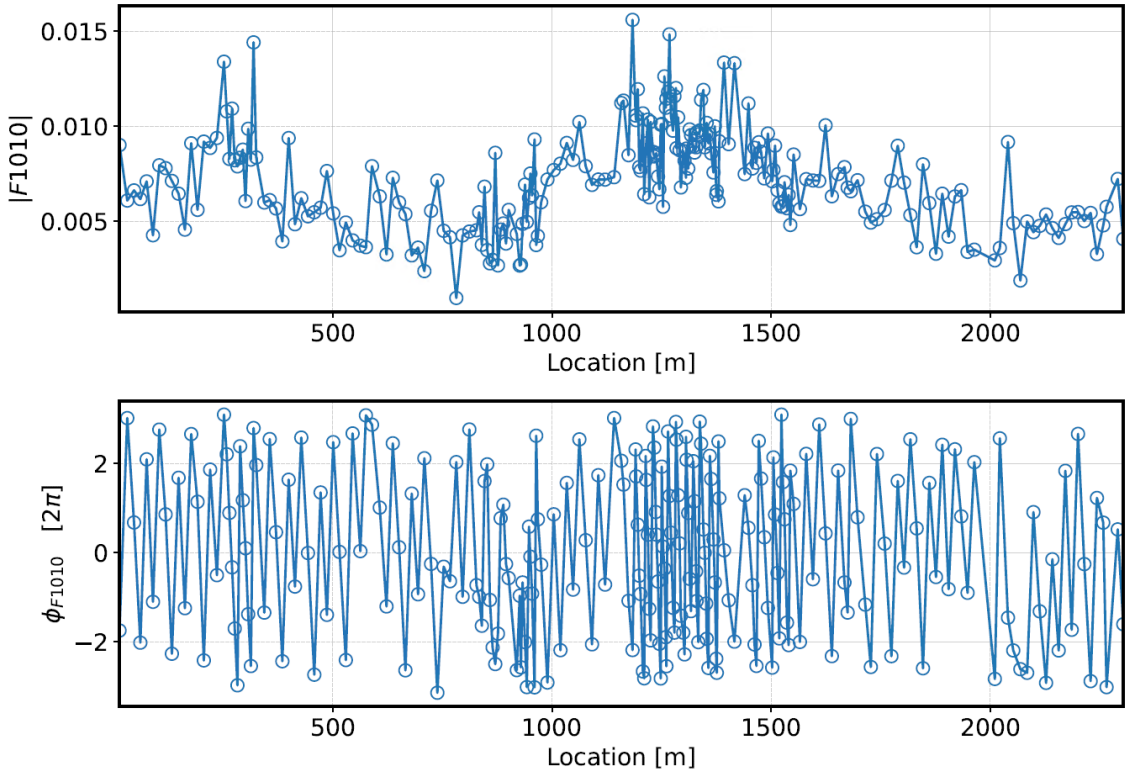
- Large error bars come from the estimate of transverse misalignment of sextupoles
- Orbit bumps now taken as uncertainty
- Once included in the model, the errors will go down

Dispersion beating



Coupling RDTs





F_{1001}- difference resonance

F_{1010} – sum resonance

Conclusions and plans

- Successfully forced 3D beam excitation in PETRA III
- Acquiring turn-by-turn BPM without MAF filters
- Plan to optimise the measurement parameters
  - Utilise beam-based model for the analysis