

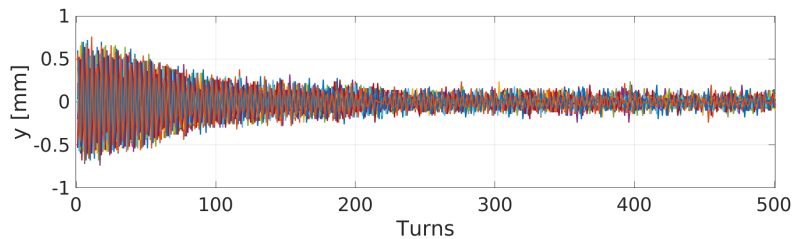
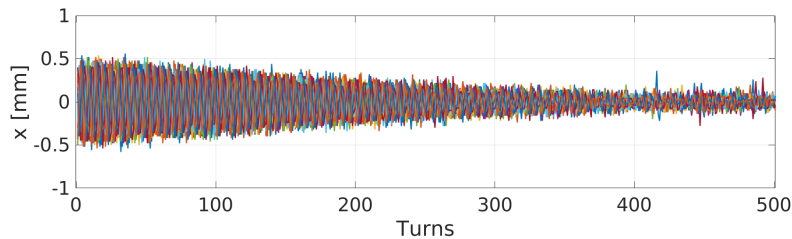
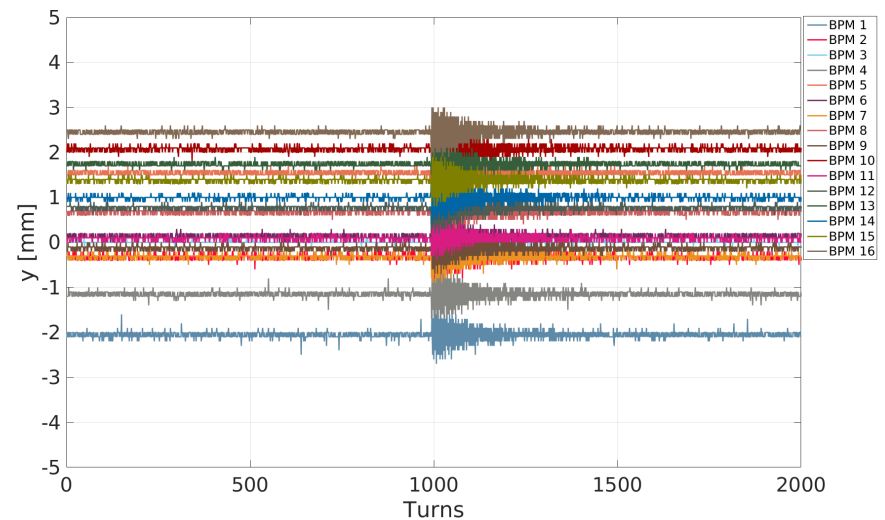
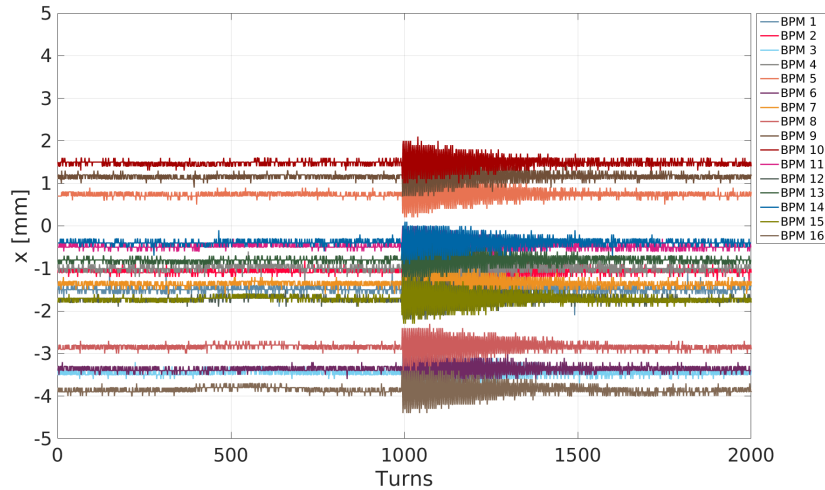


Measurements and experience with the new PSB BTMS

P. Zisopoulos*, F. Antoniou , A. Garcia-Tabares

Acknowledgements: PSB-OP Team

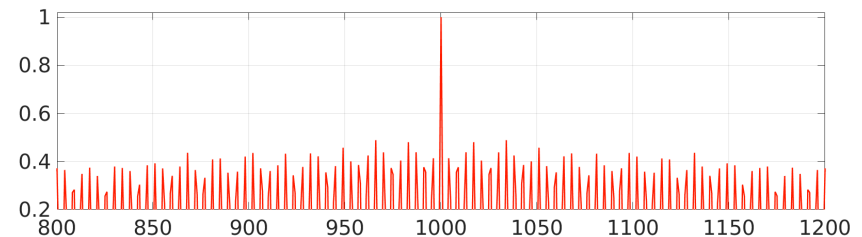
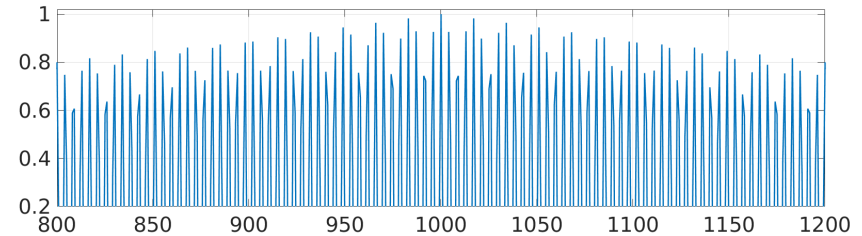
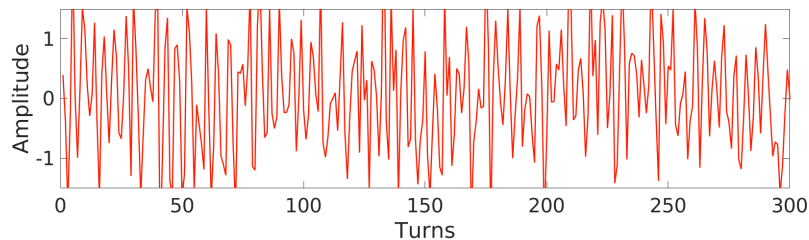
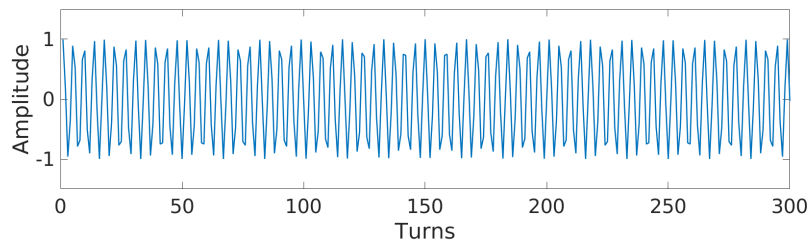
Recording the TbT data for Ring 1



- Taking full advantage of the new PSB TbT system means first to understand it
- Assuming ideal BPMs, the quality of any measurement depends on the interplay between SNR and physics (decoherence, intensity effects etc.)
- For these particular data, excitation amplitude is half a millimeter, resolution 100 μ m - Weak excitation but is it enough?

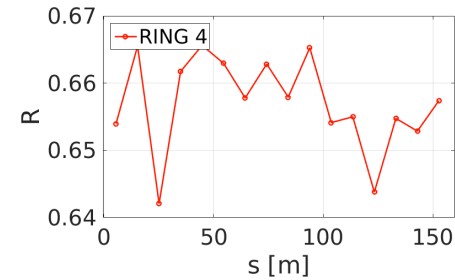
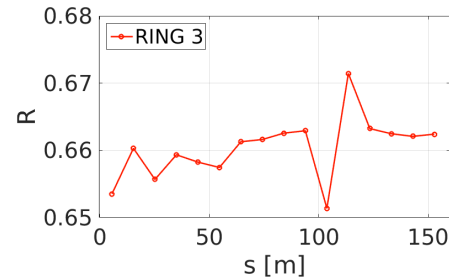
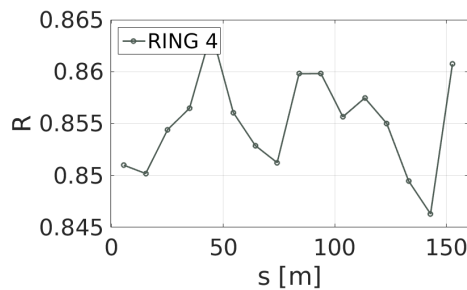
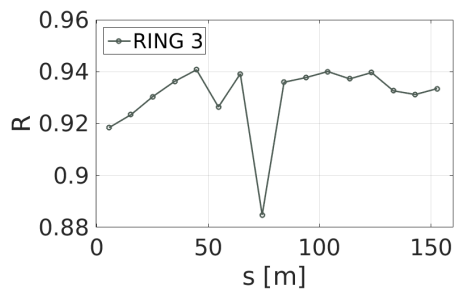
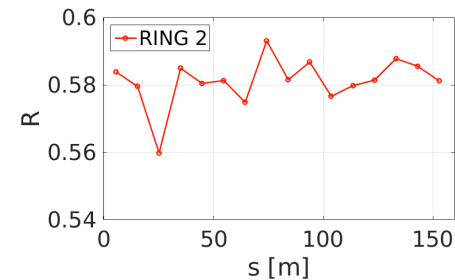
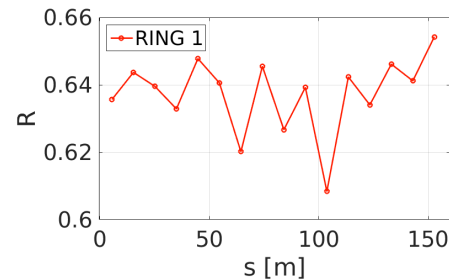
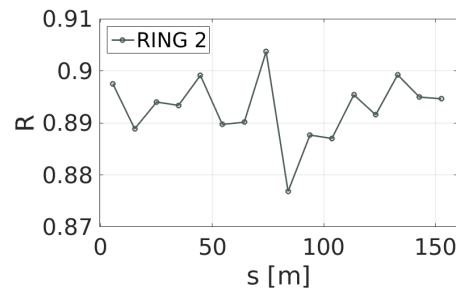
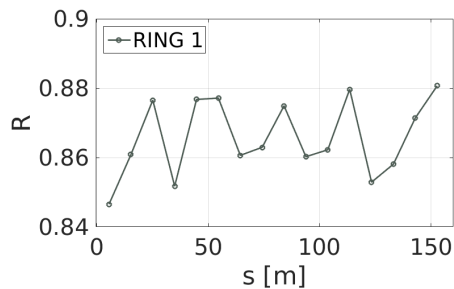
Noise level

- 1) Use autocorrelation techniques



- Assume a pure sinusoid and noise (AWGN) superimposed on it
- The autocorrelation of the noisy signal yields a spike. The ration of the amplitude of the spike and the next harmonic is analogous to the noise level.

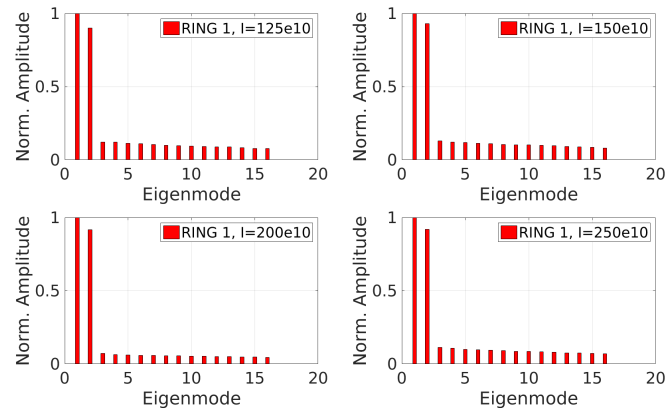
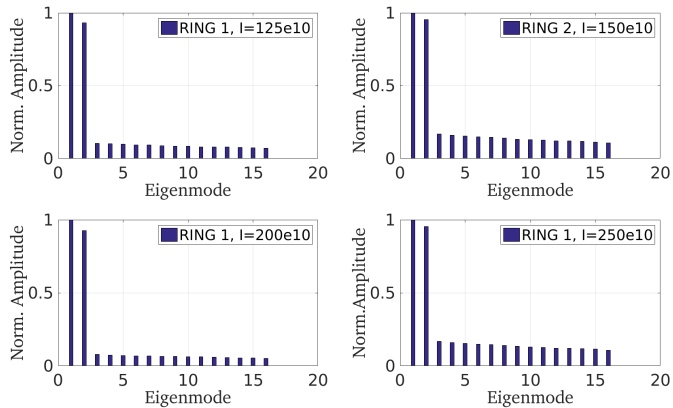
Noise level



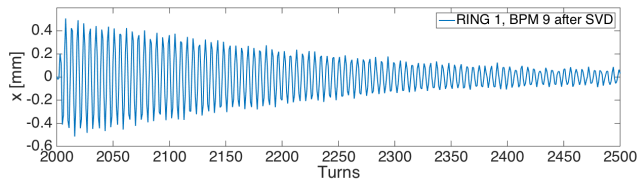
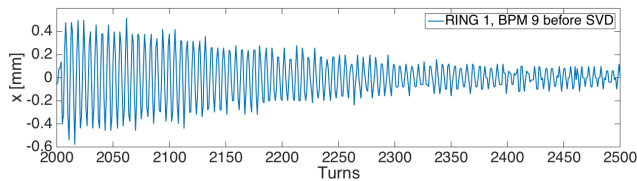
- This method is more suitable for relative measurements i.e. a particular BPM could be found with a large dip in R with respect to the other BPMs

Noise level

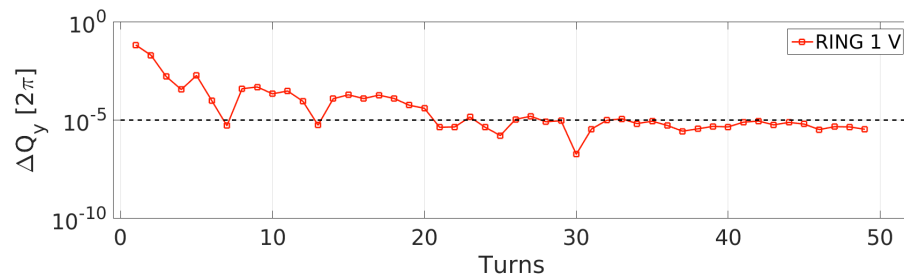
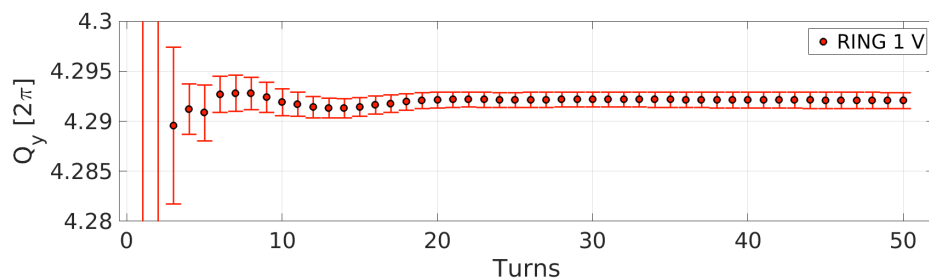
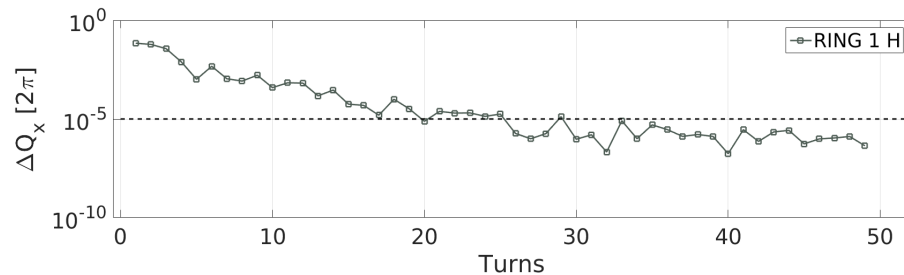
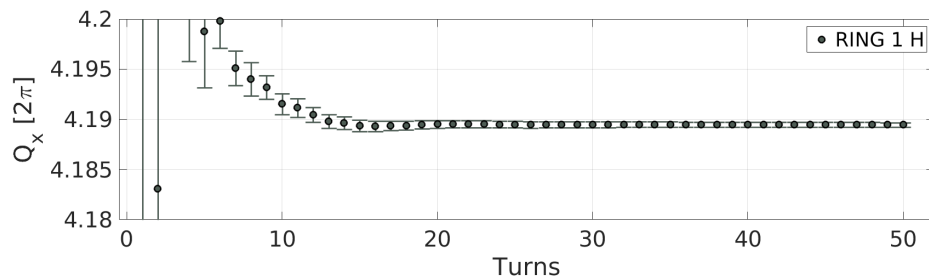
1) Use SVD Techniques



- SVD is powerful method to investigate and correct noise in TbT data.
- Around 10% in the SVD spectra for these particular data
- With increasing intensity it does not seem to improve dramatically

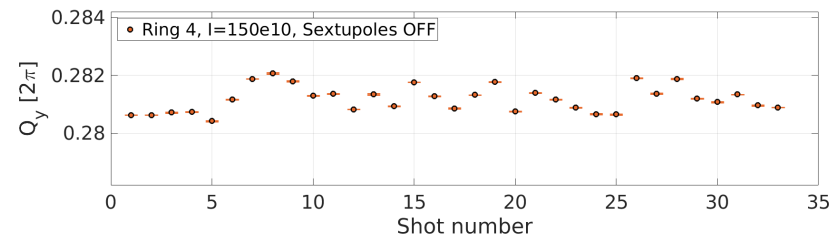
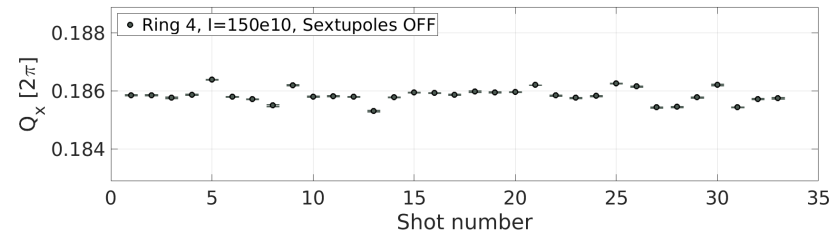
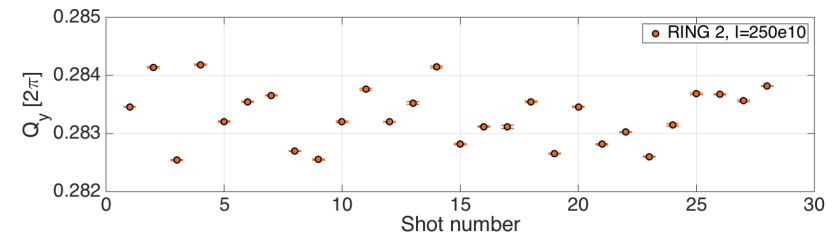
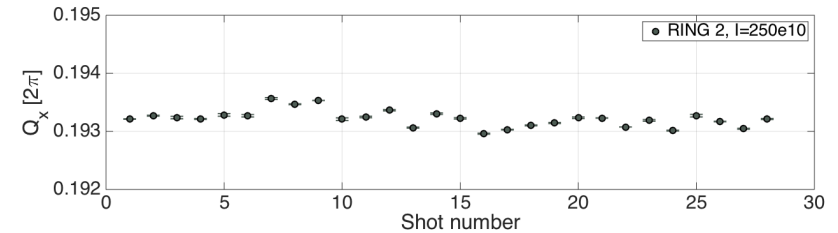
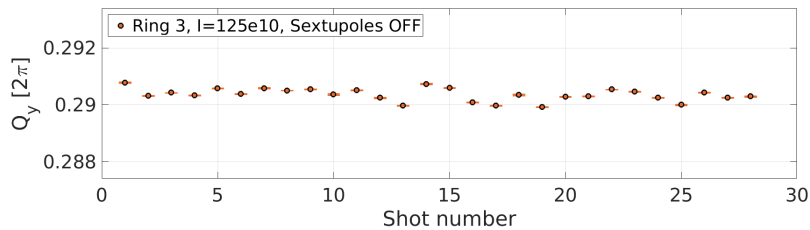
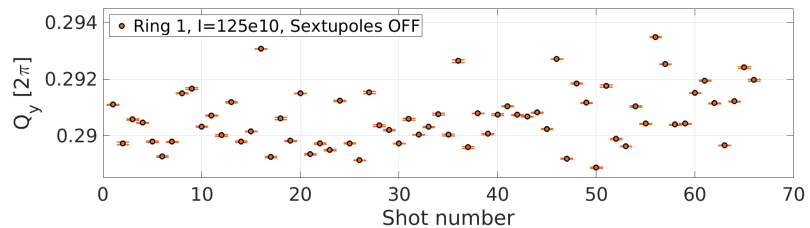
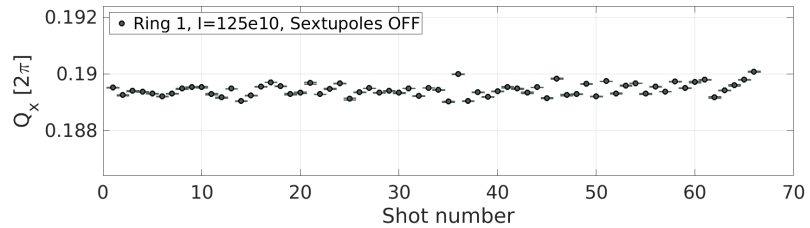


Measuring the tunes in about 20 turns

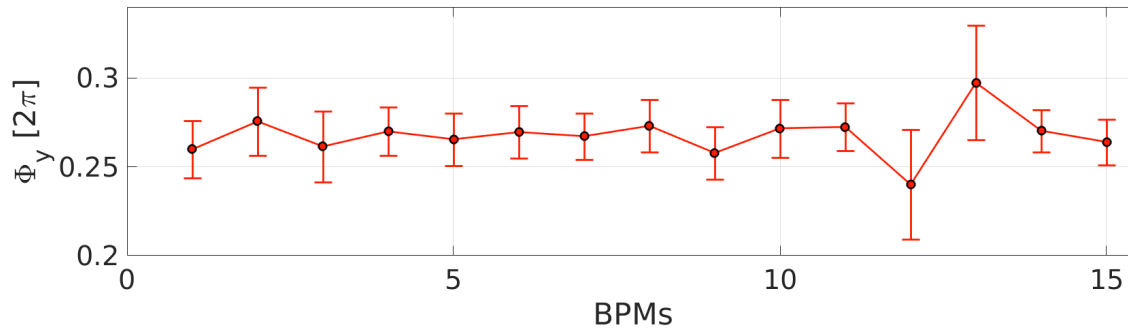
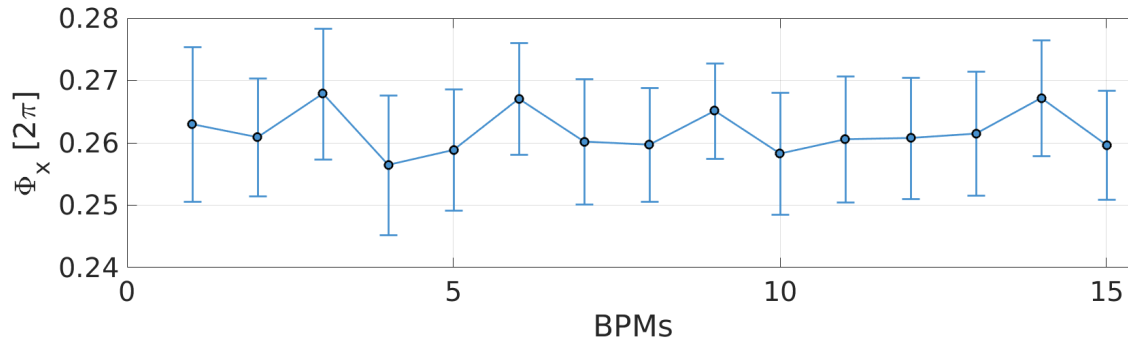


- The PSB BPMs are symmetric to the longitudinal position and (assuming no large phase-beating) symmetric to the optics.
- It is anticipated that mixing all the BPM data together would yield accurate tune measurements for a small number of turns (paramount importance for TbT analysis)
- At around 20 turns the convergence is at 10^{-5} . Applications : Sliding windows of small turns, fast frequency maps etc.

Optics stability along the cycle



Phase measurements for Ring 1

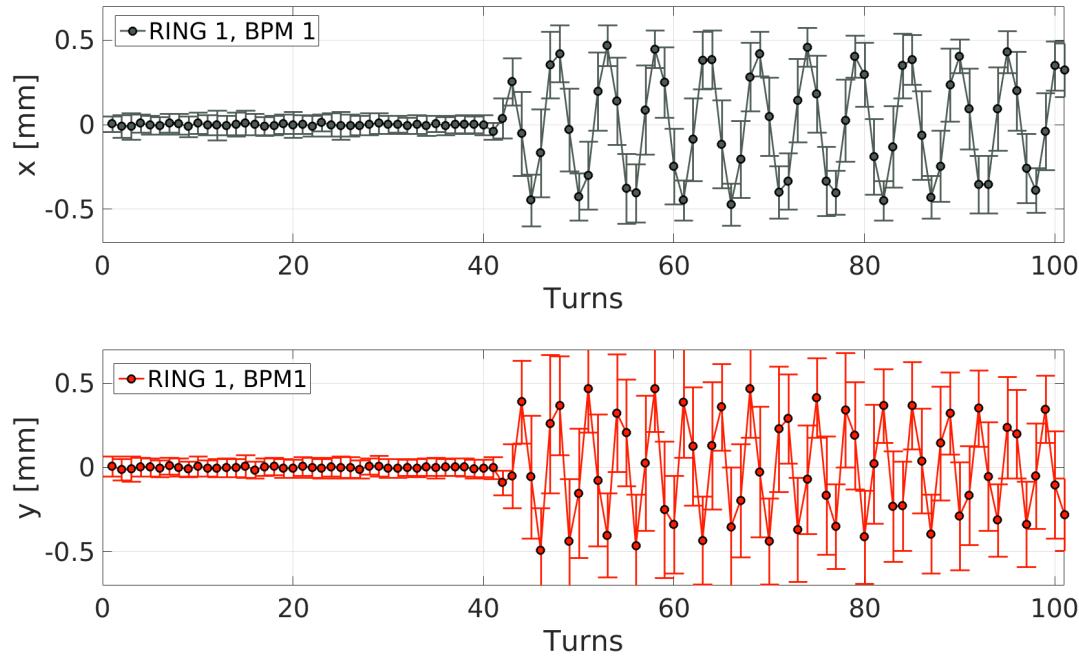


- Very poor reproducibility of the phase advance
- This information will be used for beta-beating measurements but not for adjacent BPMs (at least with these optics)

Phase measurements for Ring 1

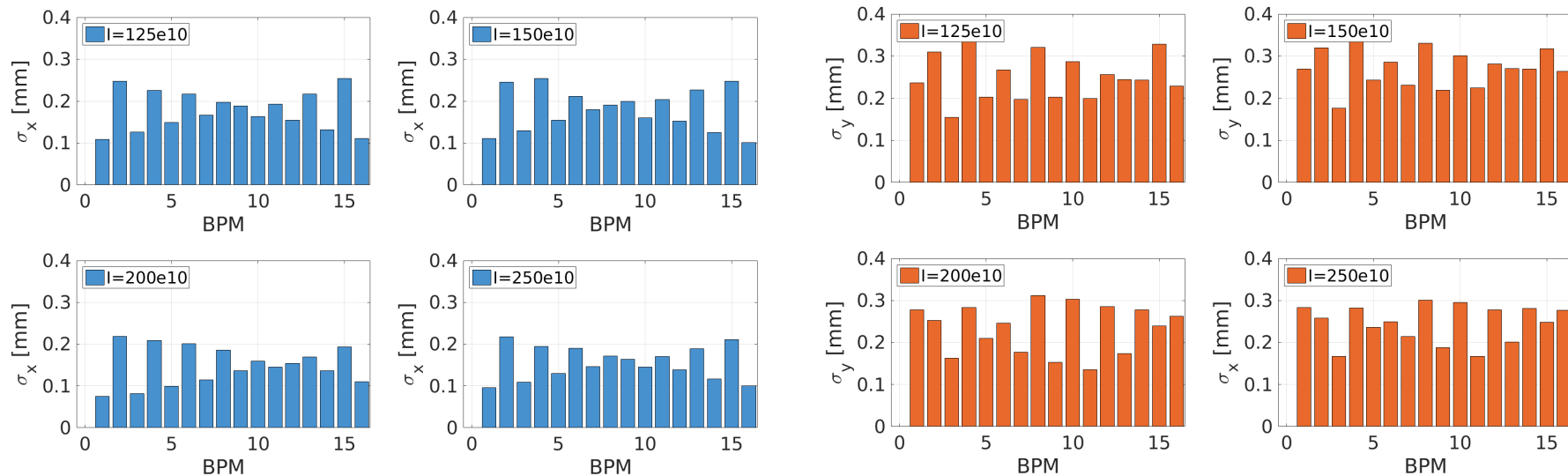
- Possible scenarios for poor reproducibility of the phase include:
 - Shot-to-shot orbit jittering in the BPMs
 - Shot-to-shot variation of the kicker amplitude
 - Asynchronous BPMs i.e. Turn N for BPM M is Turn N-x for BPM M+m, (x is the lag)

A hint towards asynchronous BPMs?



- Large errorbars in the shot-by-shot reproducibility of the TbT trajectory!
- This could mean that the orbit is changing shot-by-shot and in combination to the poor reproducibility of the phase, some BPMs might be not synchronized with the instance of the kick.
- Or the instance of the kick changes for every data-set.
- This was also reproducible for the TbT data of the other BPMs and rings

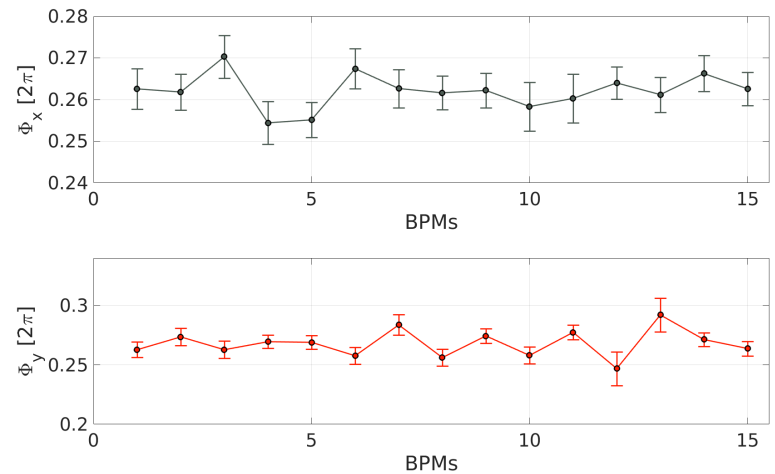
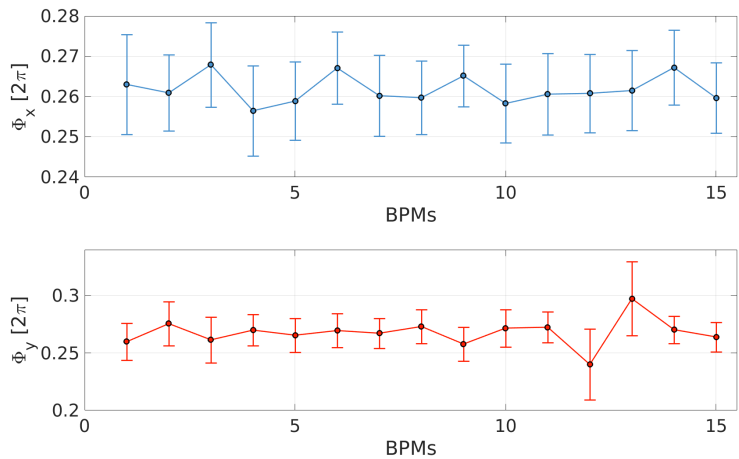
Statistical jittering of the Kick Turn



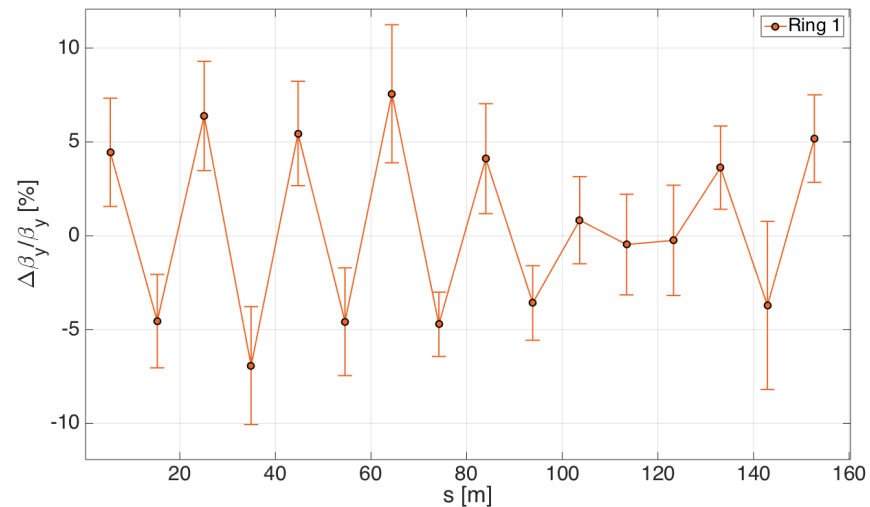
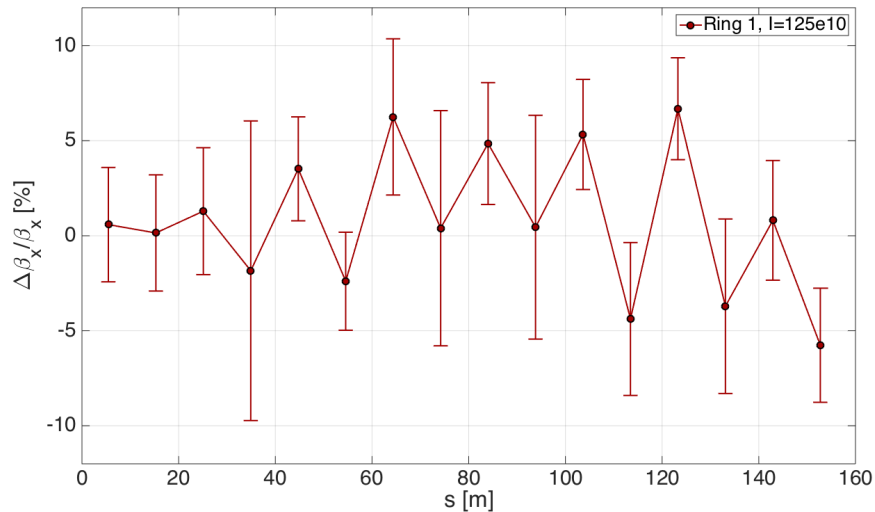
- Position Uncertainty is modulated inside the ring
- Maybe some BPMs have synchronicity issues? To be checked

Massaging the data

- Performing SVD cleaning technique and Statistical Data Cleaning might help in situations like this

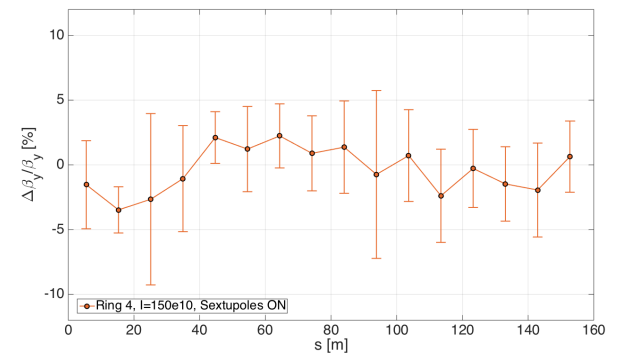
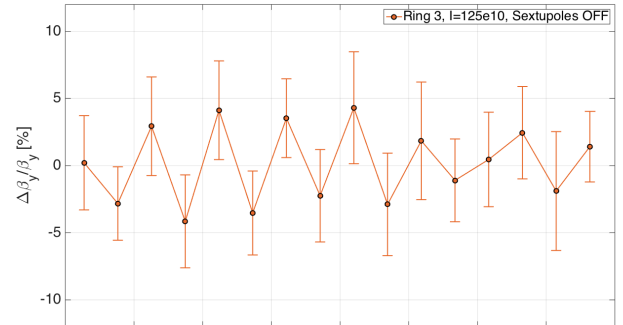
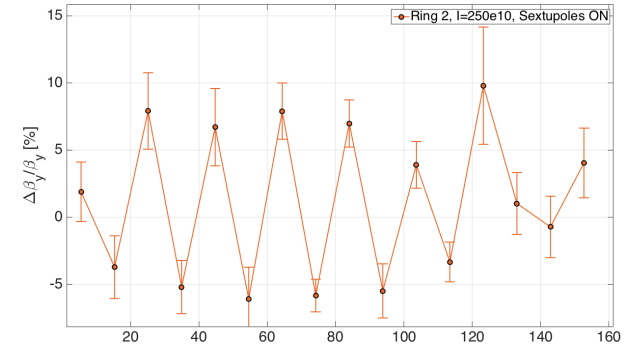
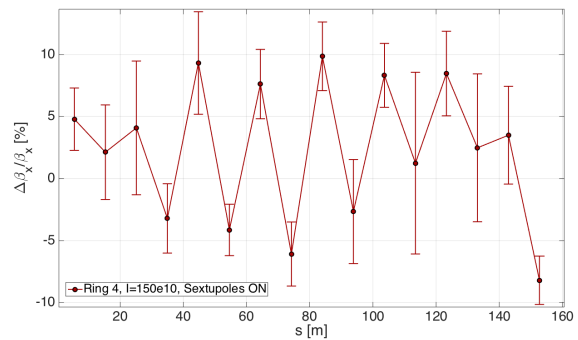
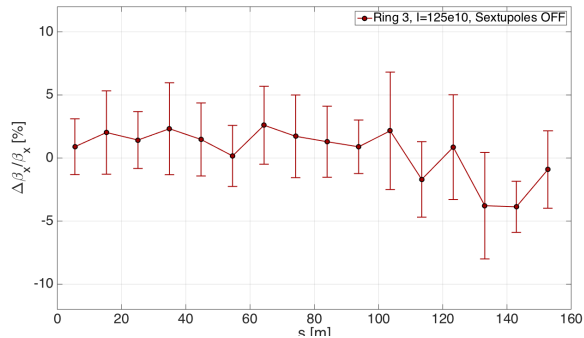
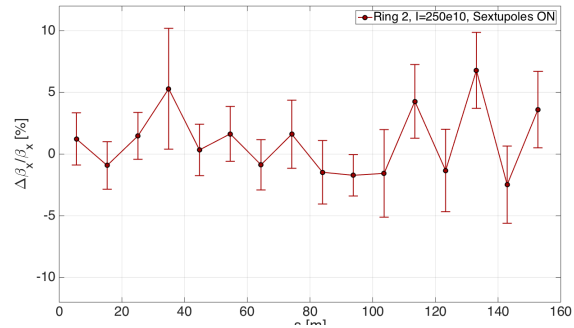


Beta-beating



- Poor reproducibility of the beta-beating due to the errors in the phases
- In this method, no assumptions are made for BPM misalignments, magnet errors in the lattice etc.
- The beta-beating is computed with a statistical interpretation of the beating information from all the BPMs
- Still on average, beta-beating for Ring 1 appears to be at around 5%

Beta-beating for the rest of the rings



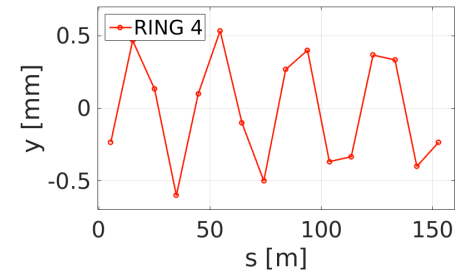
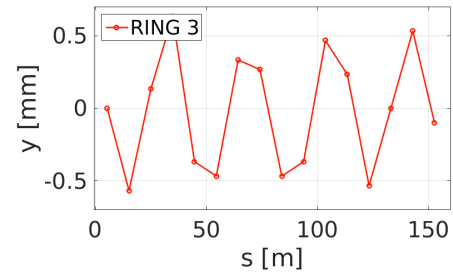
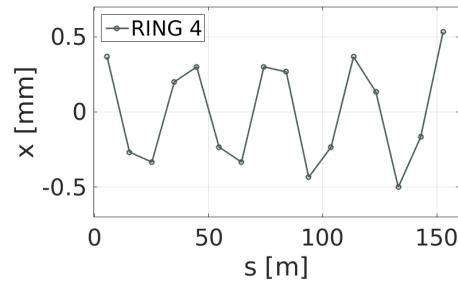
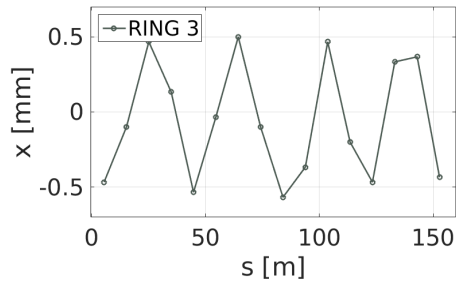
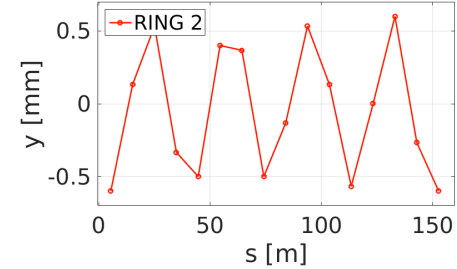
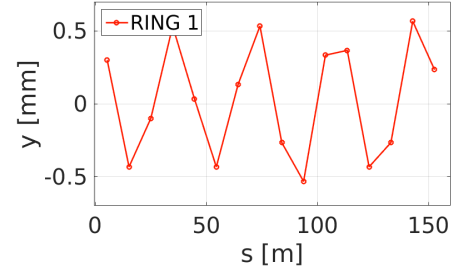
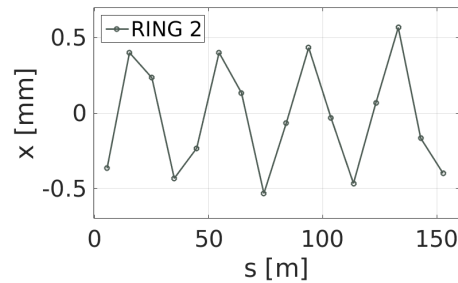
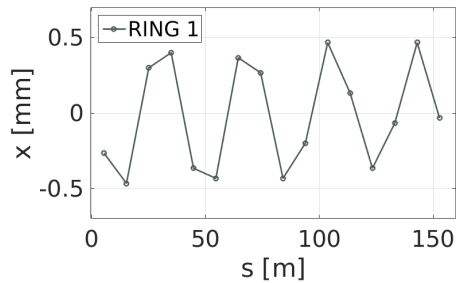
Conclusions

- Some general data analysis methods and measurements were presented that can be useful towards the full exploitation of the new PSB BTMS
- Very accurate tune measurements are possible for the current excitation.
- The reproducibility of the phase was found out to be poor. A larger excitation might also help towards this direction.
- First measurements of beta-beating around 5%-10% but the errorbars are very large !
- Very important for the linear studies: Investigate the phase error!

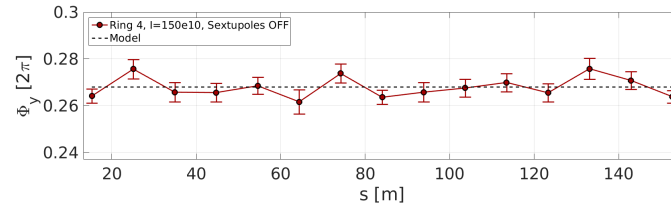
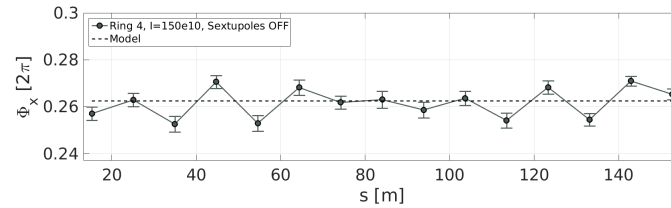
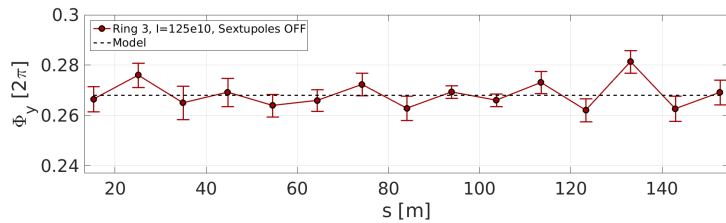
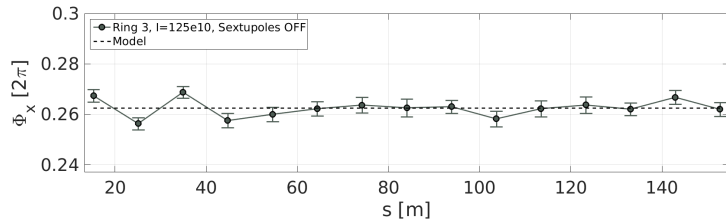
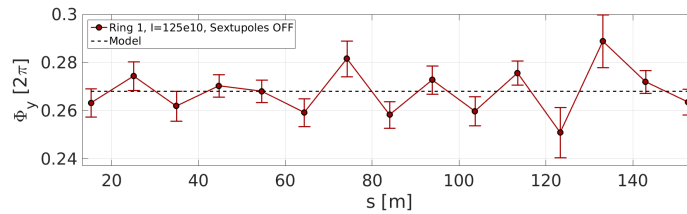
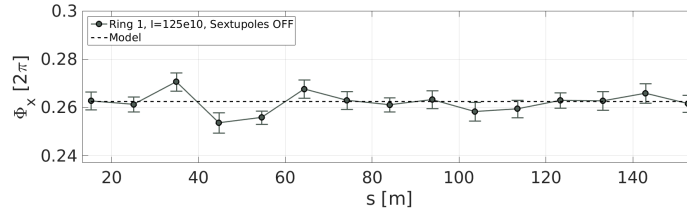
Thank you for your attention !

Spare Slides

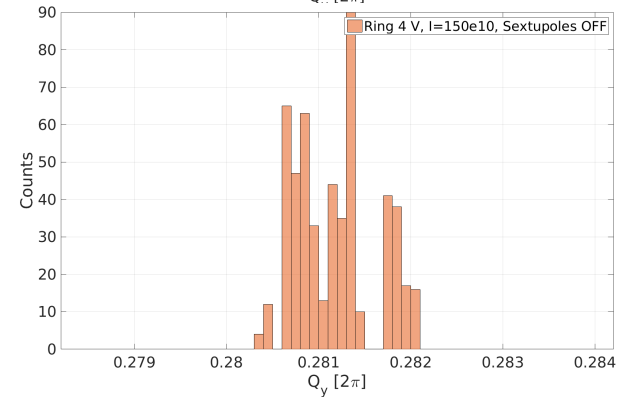
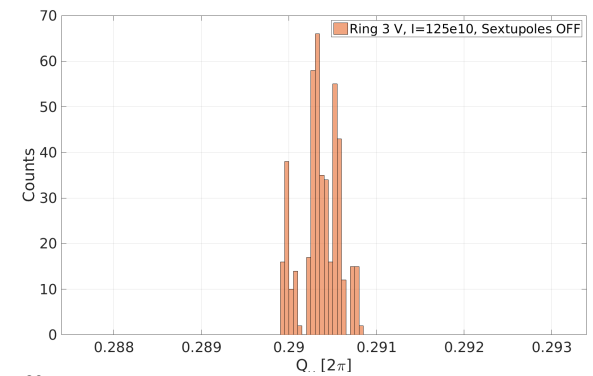
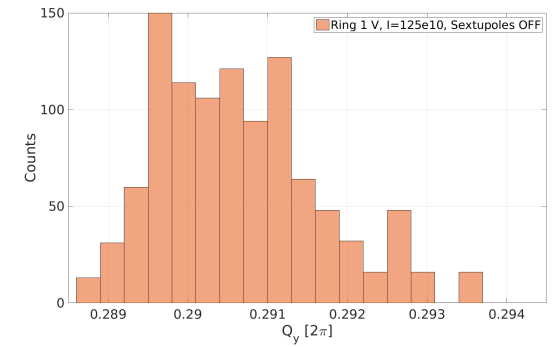
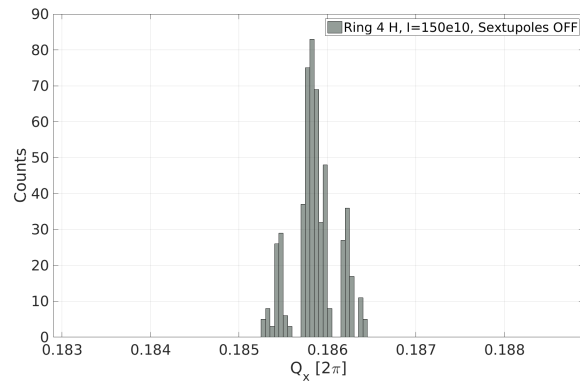
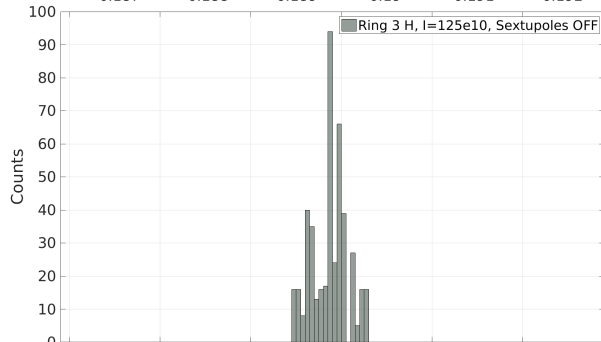
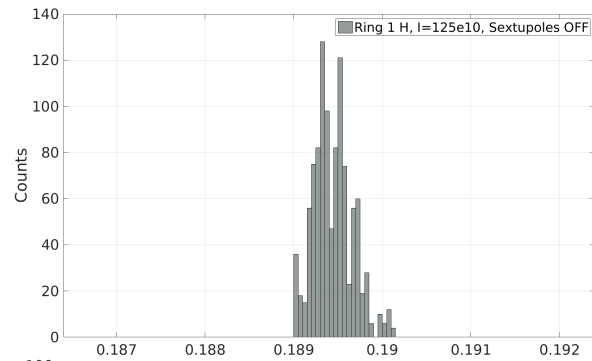
Check 1) First turn orbit



Phase Advance



Tunes



Tunes

