CERN EFFORTS

Tasks of Interest

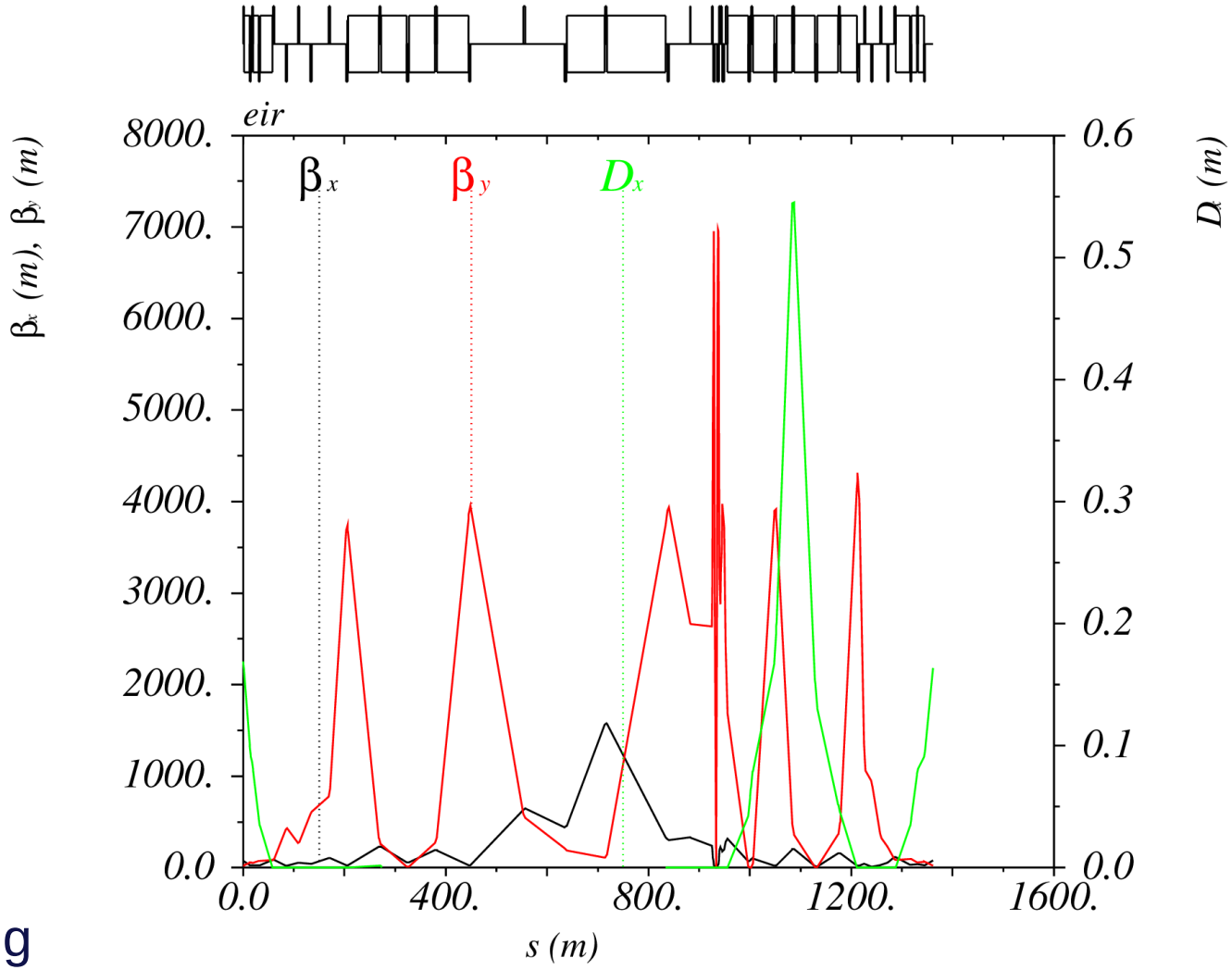
- Simulation tools – tilted solenoid, tapering, MADX-SAD comparison/translation
- Emittance estimates
  - Through analytical formulas
  - Studying how combinations of emittance sources add
  - Aim to identify areas/magnets that need tighter alignment than others
- Exploring measurement techniques for FCC-ee
  - Implement and test AC-Dipole
  - Single kick simulations
  - Test suitability for closed orbit distortion measurements
  - Perform tracking studies for all scenarios

Relaxed Optics Macro

Strategy:

1. Save initial twiss function
2. Compute 10% larger in both planes
3. Match optics for this
   - Using matching section quads
     - Preserves sextupole phase advance
   - Match to the arc
4. Plot twiss and save optics to file
5. Repeat step 2 until no more convergence

Example job file and macros found in:
/afs/cern.ch/work/l/lvanries/public/for_tuning_studies/relaxed_optics_example

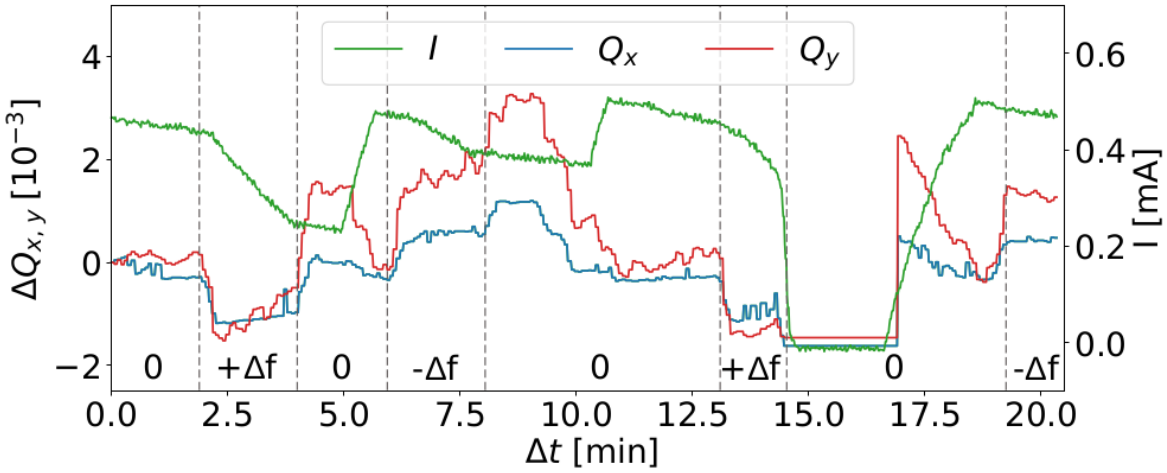


Tilted Solenoid Strategies

Method	Benefits	Drawbacks	Example files
Misalignment of Solenoid Implemented like alignment errors	• Very simple • No need to change lattice file	• Radiation in solenoid not correct • Not SAD layout	/afs/cern.ch/work/l/lvanries/public/for_tuning_studies/Misaligned_Solenoid
Sliced Solenoid interleaved with vertical bends angle = vertical dipole field	• Gives correct radiation	• Lattice has to be heavily modified • Not SAD layout	/afs/cern.ch/work/l/lvanries/public/for_tuning_studies/Interleaved_Solenoid
Tilt through change of coordinate system Rotations and translations at solenoid entrance/exit	• Exact replication of SAD layout • Exact agreement with SAD optics	• Completely new lattice file from new translator • Rotation causes strange dispersion	/afs/cern.ch/work/l/lvanries/public/for_tuning_studies/SAD_Style_Solenoid

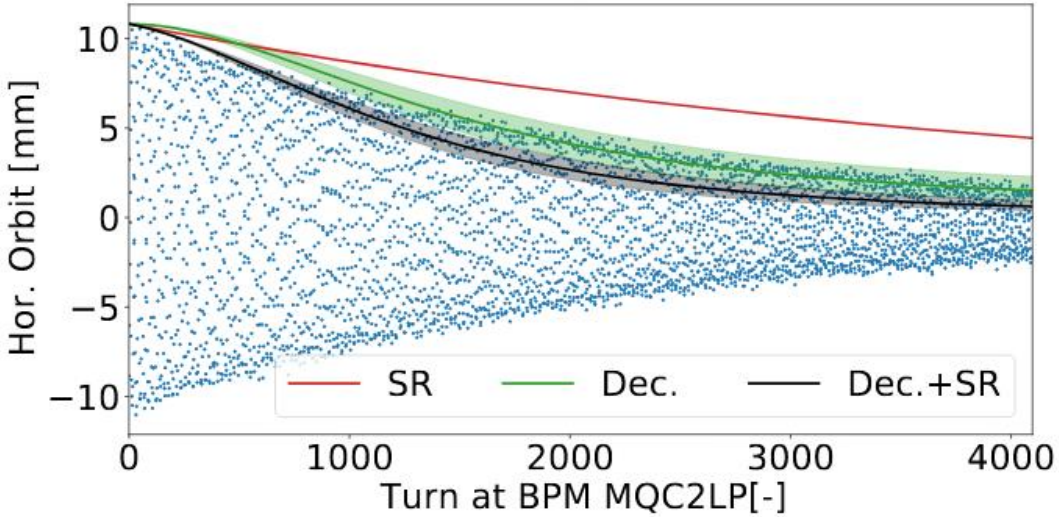
SuperKEKB and FCC-ee

- Very similar machines (crab-waist optics, -I transformation, …)
- SuperKEKB faces various commissioning challenges → International task force formed
  - Low beam life time, especially for very squeezed optics
  - Hard to establish stable conditions for machine studies
  - Larger chromaticity and amplitude detuning than model
- Studies at SuperKEKB will help
  - Finalizing FCC-ee design
  - Showing commissioning challenges
  - Finding optics measurements strategies



Optics measurement studies at SuperKEKB

- SuperKEKB uses Closed Orbit Distortion and Turn-by-Turn (TbT) measurements
  - Helps understanding and gaining hands-on experience for FCC-ee
- Establish good TbT measurements using an AC-dipole like excitation ongoing
  - Not yet optimized in SuperKEKB
- Measurement technique and theory of decoherence about to be finalized
  - Several uncertainties
  - Emittance during measurement unknown
  - BPM calibration and resolution
  - Decoherence and head-tail



Proposed studies at SuperKEKB and LHC

- **SuperKEKB:**
- TbT measurements with different number of bunches, filling pattern and bunch charge
- Powering octupole coils in final focus
  - See impact on decoherence and amplitude detuning
  - Understand contribution of impedance, e.g. head-tail effect
- Aim to drive beam with AC-dipole like element at higher amplitudes

- **LHC:**
- Aiming for closed orbit distortion measurement at large machine