News from the Tuning WG

J. Keintzel and R. Tomás

FCC-ee Design Meeting
CERN, Geneva, Switzerland
10 July 2024

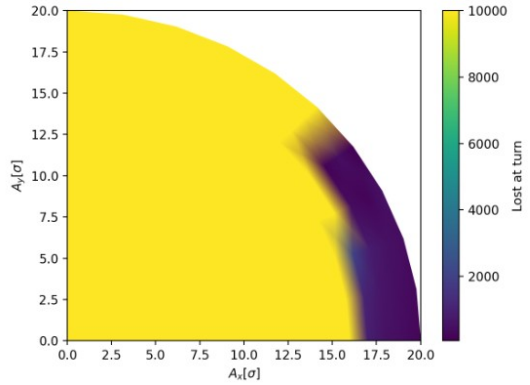
FCCIS – The Future Circular Collider Innovation Study. This INFRADEV Research and Innovation Action project receives funding from the European Union's H2020 Framework Programme under grant agreement no. 951754.

Lattices and Alignment

- GHC: K. Oide is working on new lattice with LCC arcs (updates today)
- LCC: P. Raimondi is working on new lattice with twin quadrupoles
- Combined function or nested: C. Garcia progressing on optics design
- P. Hunchak: Non-linear chromaticity more working point independent in LCC than in GHC

- J. Wenninger: From experience of LEP/LHC tunnel, tolerate 150 µm misalingments in arcs → ~1 major alignment per year → frequent optics tuning during the year
- K. Skoufaris: Correlated and uncorrelated ground motion with amplitude of 100 nm at 1 Hz leads to 17σ DA_{min}

Frequency Range - f_{gm} - [Hz]	Amplitude - A - [nm]	Wave length (Correlation) - λ - [km]	Oscillations / 2500 turns
100 - 400	1	0 (None)	75.6 - 302.4
10 - 100	5	0 (None)	7.56 - 75.6
1 - 10	20	0 (None)	0.756 - 7.56
0.01 - 1	100	0 (None)	0.00756 - 0.756
0.01 - 1	1000	10	0.00756 - 0.756

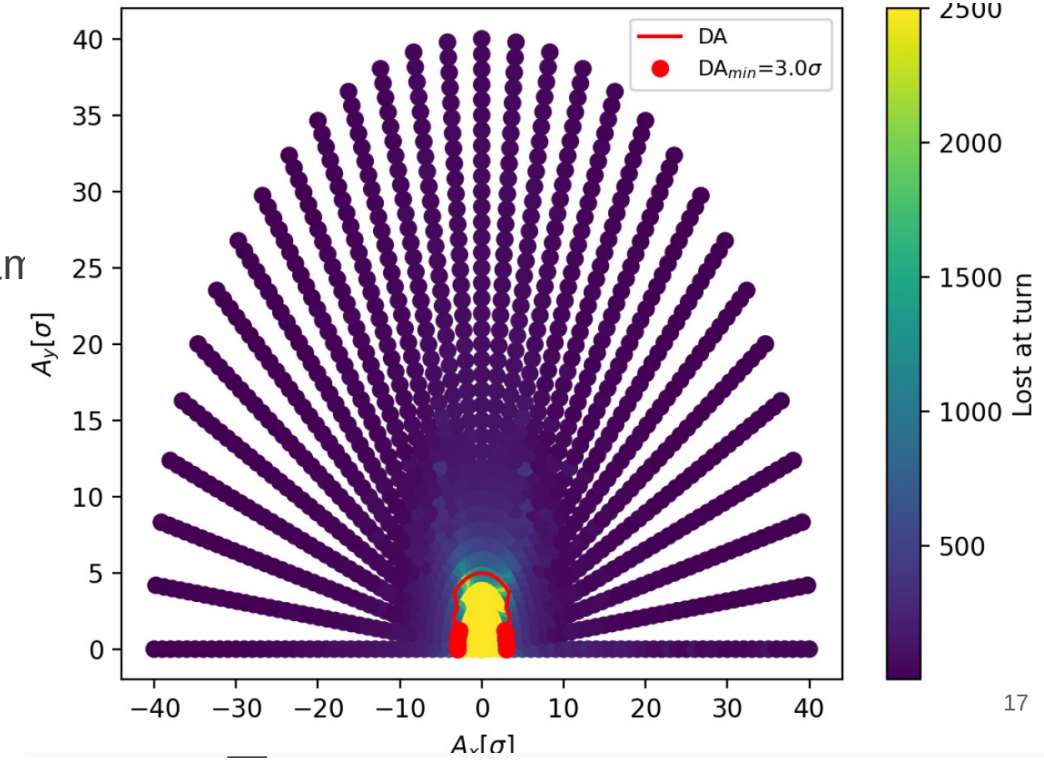


Commissioning and BBA

- L. v. Riesen-Haupt: Relaxed optics (factor 3/2 for H/V β*) matched while keeping tunes
- Crab-sextupoles lead to decrease of DA and more challenging tuning and should be switched off at start of tuning
- K. Skoufaris: Only 3σ DA when all sextupoles reduced by factor 2

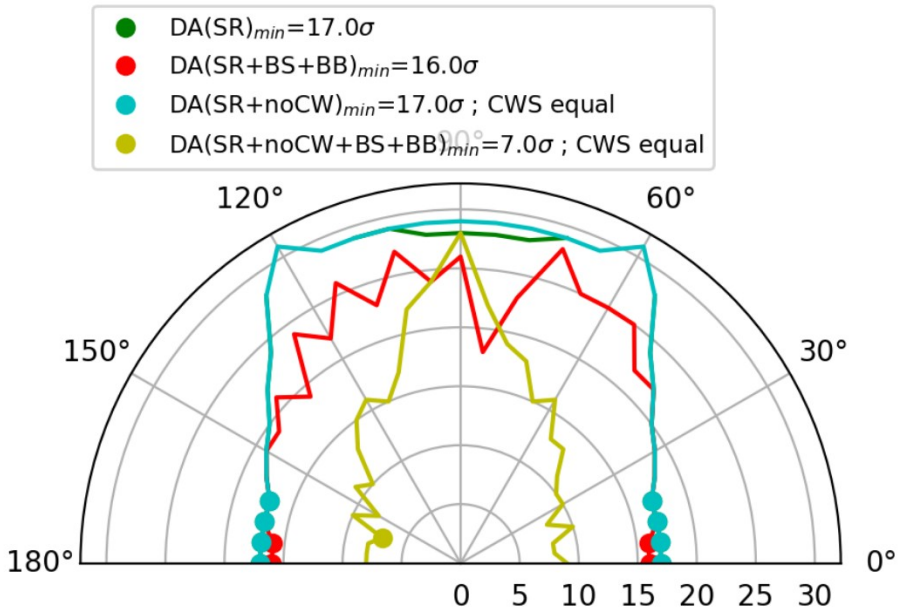
- X. Huang: About 10 µm arc quadrupole BBA accuracy with 1 µm BPM resolution, ~ 20 µm for sextupoles (larger error for low modulation)
- C. Goffing: Explore BBA techniques at SKEKB, best yield error of ~ 50 µm

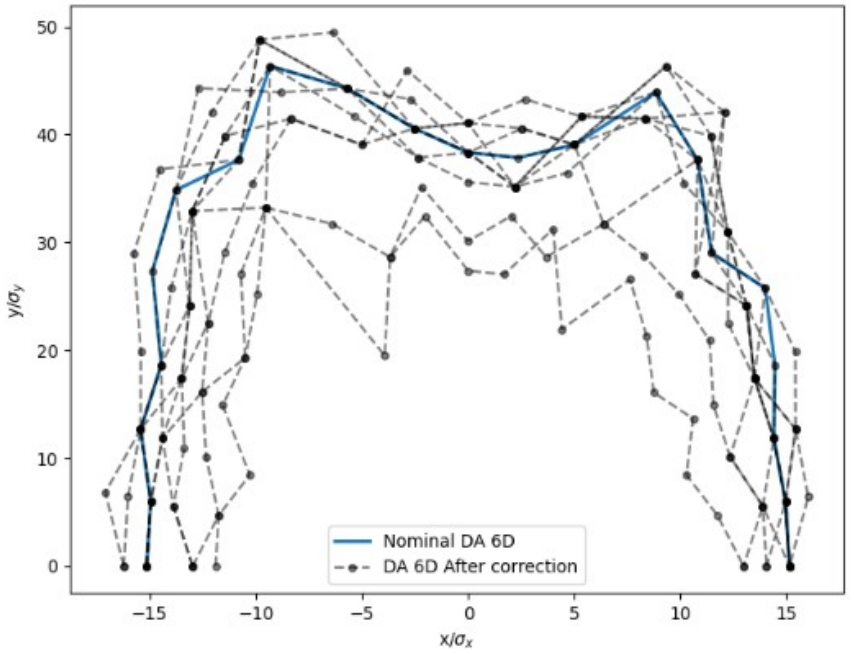
- To Do: Define updated commissioning strategy
  - Start from relaxed optics with sextupole strengths for sufficient DA
  - Simulate beam threading
  - BBA, tuning, and IP tuning
  - Define squeezing scheme



Tuning and DA I

- S. Liuzzo/E. Musa/S. Sai: Phase advance corrections crucial to improve tuning performance
- E. Musa: Large DA with 100 µm arc misalignment, SR, crab-waist and phase advance correction applied
- K. Skoufaris: phase advance tolerance between sextupoles of < $10^{-3}/10^{-4}$ in arcs/IRs → tight BPM tolerances
- K. Skoufaris: With beam-beam without CW DA reduced to 7σ

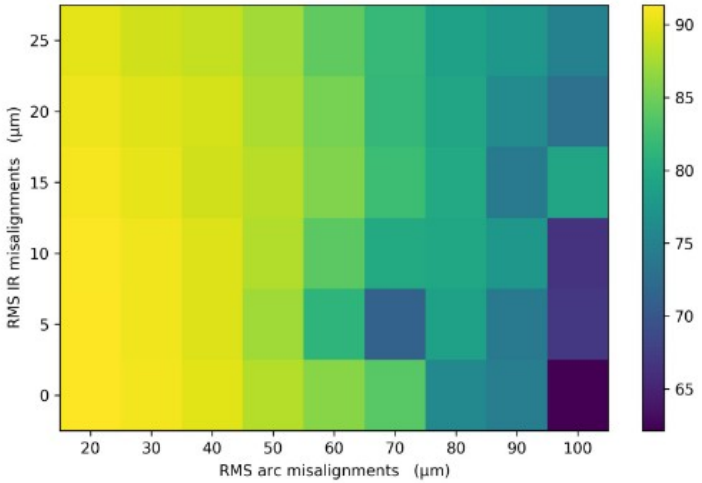


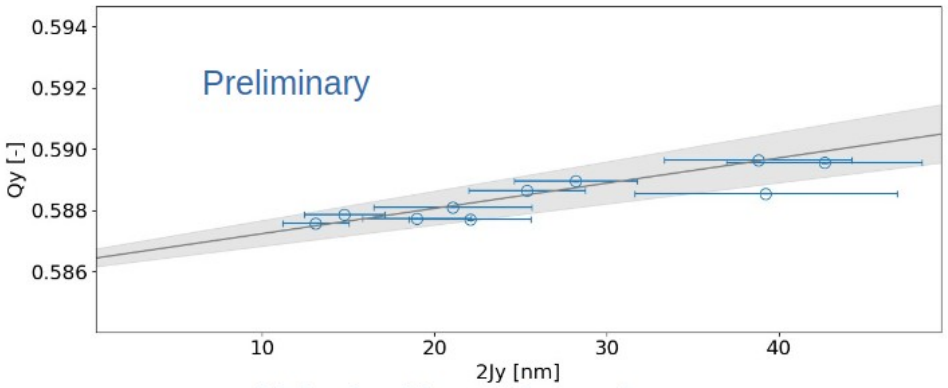


Tuning and DA II

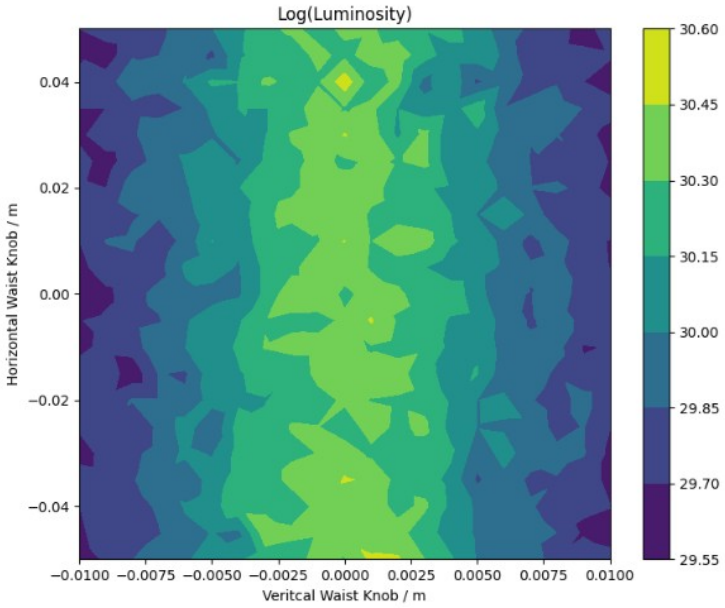
- Y. Wu: ~60 % polarization with 100/20 μm misalignment in arcs/IRs; large spin tune shifts of ~10^{-4} to be understood
- A. Hussain: tolerances defined mostly at Z, corrections and beam-beam to be added to relax tolerances
- J. Keintzel/M. Le Garrec: Optics measurements at SKEKB show significant discrepancies for non-linear optics even for large β* , tbc ; (Working theory for SBL: dust/discharge effect)
- L. v. Riesen-Haupt: IP waist knobs used for luminosity improvement

- To Do: Add tuning knobs (S. Sai, L. v. Riesen-Haupt) to tuning studies





40 % CW, V kick, dQy/d2Jy = (82±13) x 10^3 m^{-1} ?



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Thank you!

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