Summary Optics Design, Optics Measurement and correction

Catia Milardi, Michael Boege

- M. Sjoestroem – Beam Based Calibration of BPM offsets

  - static BBA using quads (individual powered, shunts, extra PS) hysteresis effects important, tune control during measurement

  - K-Modulation harmonic variation of quadrupole fields (LEP, TRISTAN, ALBA (modulate corr)

- At MAXIV quads within sextupoles

  problem of reproduction of quad centers for different excitation of sextupole

  → solution calibration at zero current

  reproducibilty within a few micron some outliers

  thermal effects are affecting BBA constants

  Message: Do not forget iron saturation if you windings on higher order multipoles !

- I. Martin – Optics Measurement Using Fast Orbit Feedback Data

  - Streamlined LOCO procedure

  - Slow: standard procedure takes ~20 minutes

  - Fast: orbit data are extracted from 1kHz data stream (8Hz modulation is well suited depends on various factors: eddy currents, magnets, PS) takes ~1 minute

  good agreement for slow and fast measurement

- Python Interface for stable operation !

- NSLS-II algorithm cross check TBT, DC/AC RM measurement + LOCO

→ LOCO more precise (multi freq excitation as well)

→ TBT faster

slow orbit feedback running to keep orbit stable

- ALBA could do Off-Energy RM measurements

- ALBA nonlinear RM measurements modulating sextupoles

- ESRF ID compensation with AC RM measurement

Diamond-II storage ring tuning (H. Ghasem)

Diamond II Design GOALs

Design goals for Diamond-II storage ring:

1) Improve quality of photon beams delivered to users:

- Increase spectral brightness (electron beam emittance, beam energy)
- Increase transverse coherence (electron beam matched to photons)
- Reduced source size, line-width (emittance, energy spread)
- Optimise spectral range (beam energy, ID parameters)

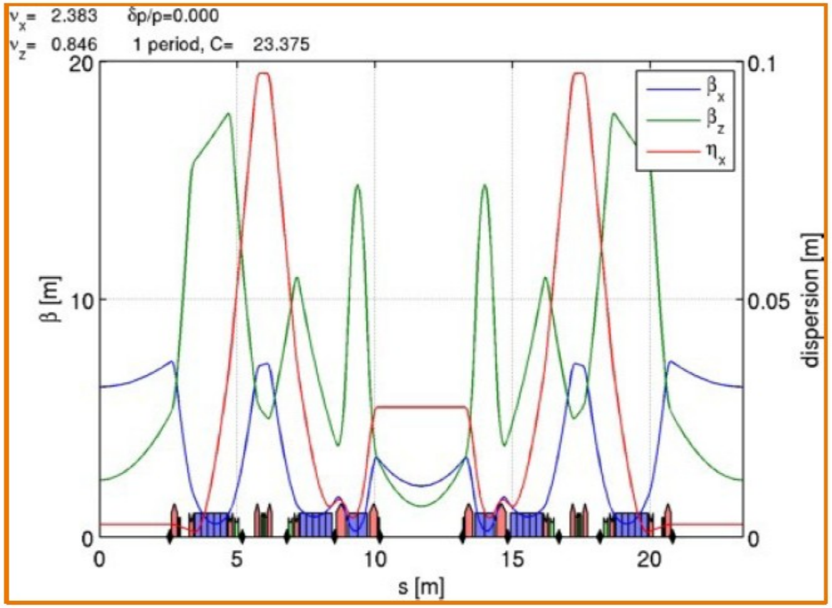
2) Increase number of straight sections:

- Convert bending magnet beamlines (ID / wiggler / bespoke 3-pole wiggler)
- Relocate existing IDs (I04.1 and I20-EDE)
- Space for new beamlines (up to six)
- Space for ancillary components (RF cavities, diagnostics equipment, ...)

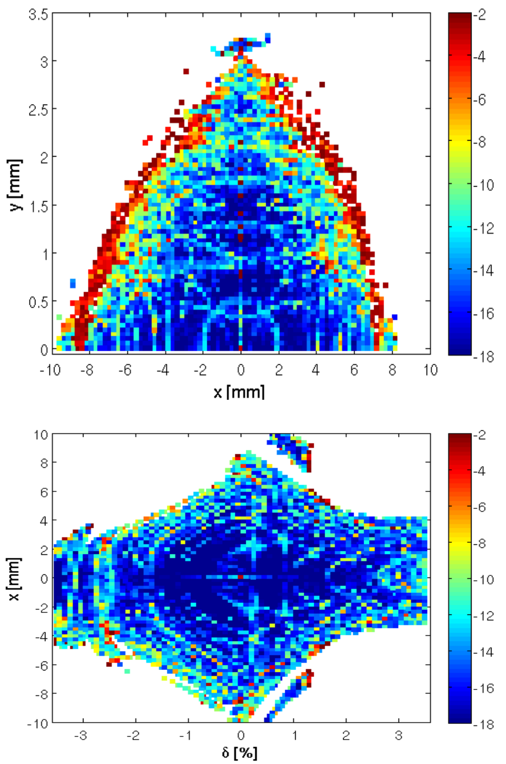
Diamond-II Lattice

- Use the ESRF cell (7BA with longitudinal gradient dipoles) – removing the mid dipole to make it a 6BA with a straight at the center.

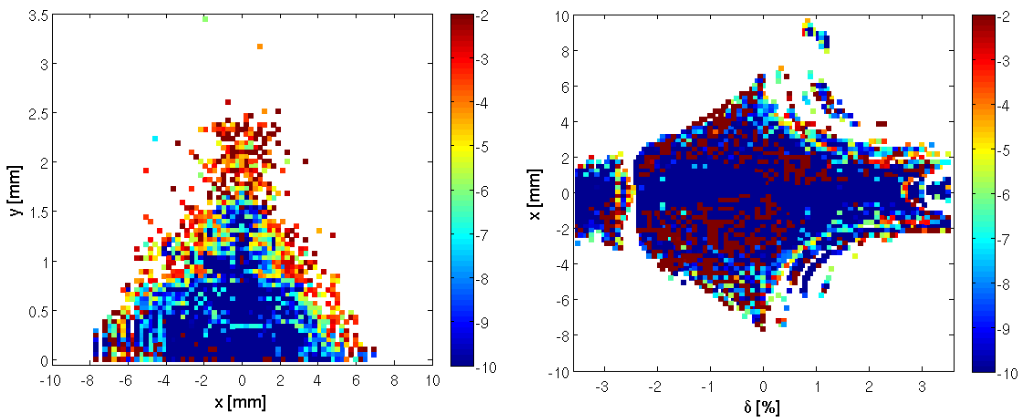
Modified-Hybrid 6 Bend Achromat (M-H6BA)



DA after chromaticity correction



DA with:
multipole errors + simplified errors using Gaussian distr.



M-H6BA – Commissioning simulation

Parameter	Value
Girder misal. /roll [µm /µrad]	150/150
Dipole misal. / roll within girder [µm /µrad]	50/100
Quad., Sext., Oct. misal. /roll within girder [µm /µrad]	25/100
BPM misal. /roll within girder [µm /µrad]	100/100
BPM misal. /roll within girder at BBA level [µm /µrad]	5/5
Dipole/Quad./Sext./Oct. fractional strength error	1E-3

- 252 HV correctors
  - 192 of HV CORs are as additional winding in the sextupoles.
  - 60 of HV CORs are as 80 mm separate magnets
- 252 BPMs
- 144 Skew quadrupole as additional windings inside the sextupoles
  - 96 @ dispersive places and 48 @ non dispersive places

- Commissioning simulation has been done and the results revealed that, the correction algorithm can correct the errors for 94% of the all machine ensembles.

Low and Negative Alpha Commissioning at KARA Storage Ring (A. Mochihashi)

Possibilities for Modified Alpha in KARA

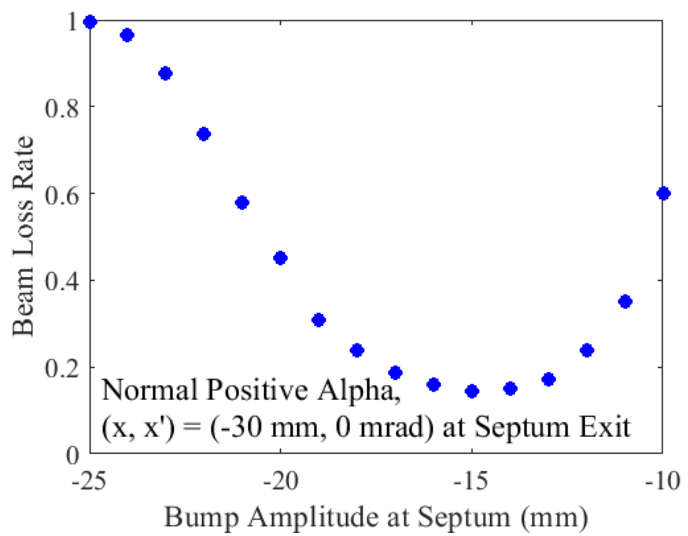
- Negative Alpha
  - Exepriments for Collective Phenomena
    - Head-tail instability in negative-α and negative-chromaticity
    - Potential-well distortion
    - Microbunching instability
    - THz CSR (in low negative α)
  - Single Particle Beam Dynamics
    - Expansion of dynamic aperture in negative chromaticity
    - Emittance modification
    - Negative alpha @ various beam energy with ramping-up
- Low Alpha
  - Single Particle Beam Dynamics
    - Top-up injection at low-α
    - Low-α @various beam energy with ramping-up

Etc...

Considering top-up operation, it is not straightforward to achieve enough (tolerable) injection efficiency (injection rate) in low and negative momentum compaction mode.

- Analysis of Beam Loss Position & Beam Loss Rate for
  - Normal Positive Alpha Mode

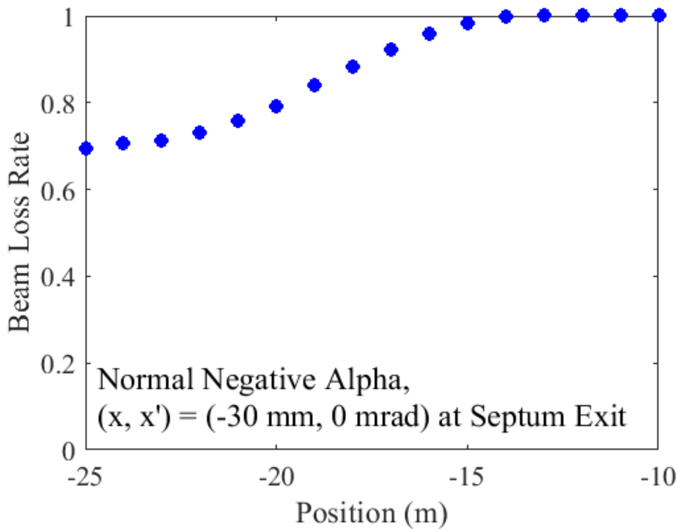
Maximuim injection rate of 85% could be expected in this simulation at (normal, positive) alpha lattice.



- Possible Beam Loss Position …
  - Injection Septum

Normal Negative Alpha Mode

Maximuim injection rate of 30% could be expected in this simulation at (normal, negative) alpha lattice.

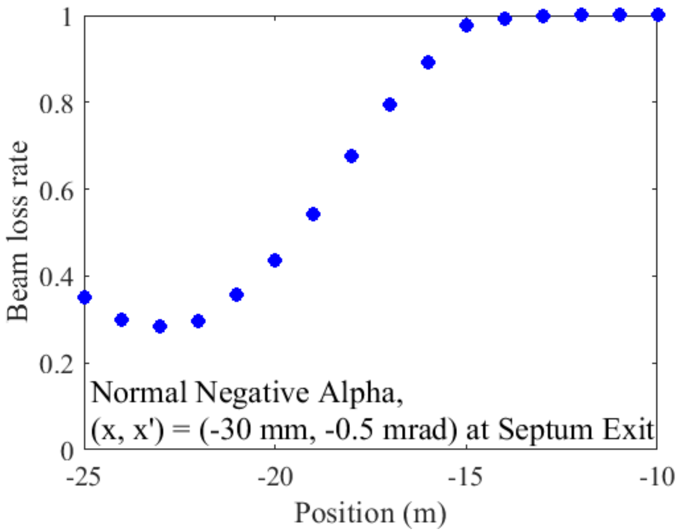


- Possible Beam Loss Position
  - Injection Septum

How to increase the injection rate?
…**Try to adjust exit angle at septum**

Normal Negative Alpha Mode with Septum Adjust

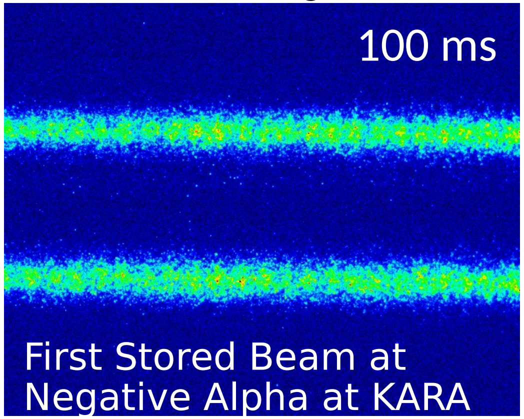
Maximuim injection rate of 70% could be expected in this simulation at (normal, negative) alpha with septum adjustment.



- Possible Beam Loss Position
  - Injection Septum
  - SC-ID (CLIC)

Beam Commissioning at KARA in Negative Alpha

- Strategy
  - Basis: „We can not cross the transition instability by keeping the beam.“
  - We have settled normal positive alpha as a starting point.
  - By changing the quads, we have gradually change the lattice to low positive alpha by keeping the beam injection.
  - After we have arrived at low positive alpha, we tried to go across a=0 by changing both the quads and the RF phase (180deg).
  - When we couldn‘t have stored beam, we went back again to the low positive alpha and tried again.
  - We have also adjusted 3-kickers, septum and beam transport line between the booster and storage ring.
  - We have tried to change BM in the storage ring.



- 2019/09/06 beam time
  - RF phase: 180deg changed
  - Kickers & septum changed
  - Sextupoles: positive chromaticity
- Stored current ~several 10 mA
- Charactarization of the beam parameters has not yet been done.