Present Status of Near Future Study

S.Kuroda(KEK)
On behalf of task groups

Non-Mover BBA

IP tuning

Pushed beta

bunch-bunch FB

Non-mover based BBA in Extraction Line

Measurement Method

1) We can estimate the quadrupole center with respect to BPM center to compare the orbit difference with the optics model by changing the quadrupole strength.

- We can perform the BBA with a short beam time, but the error of the optics model makes the ambiguity of the quadrupole center position.

2) We will measure the orbit difference by change the quadrupole strength for various beam orbits at the quadrupole with local bumps, and we can find the beam position with minimum orbit difference.

- We must prepare the program to make local bumps.
- We will spend the 2 or 3 shift to measure the quadrupole center.

Software preparation

1) "quadrupole–BPM response" program.
2) local bump at extraction line.

Beam Test schedule

We will measure the BBA for stripline BPMs after the optics modeling measurement.

T.Okugi

IP Tuning(1)

G.White at ip tuning meeting 220908

Tuning Simulation Steps

- Apply standard errors to FFS + EXT
- Use EXT and FFS feedback for orbit correction
- Perform EXT dispersion and coupling correction
- Perform quad and sext BBA in FFS.
- Final IP tuning only using FFS sextupole multiknobs using x,y and tilt moves and strength tweaks.

IP Tuning(2)
Errors

Coordinate system used here is right-handed. Roll = rotation in x-y plane, pitch= rotation in y-z p

The reference ground motion model for ATF based on measured GM spectra on the DR floor is in t
(also available as a standalone Matlab routine- to be provided here shortly).

Error Parameter	Error magnitude
x/y/z Post-Survey	200 um
Roll Post-Survey	300 urad
BPM - Magnet field center alignment (initial install) (x & y)	30 um
BPM - Magnet alignment (post-BBA, if BBA not simulated) (x & y)	10 um
Relative Magnetic field strength (dB/B) (systematic)	1e-4
Relative Magnetic field strength (dB/B) (random)	1e-4
Magnet mover step-size (x & y / roll)	300 nm / 600 nrad
Magnet mover LVDT-based trim tolerance (x & y / roll)	1 um / 2 urad
C/S - band BPM nominal resolution (x & y)	100 nm
Stripline BPM nominal resolution (x & y)	10 um
IP BPM nominal resolution (x & y)	2 nm
IP Carbon wirescanner vertical beam size resolution	2 um
IP BSM (Shintake Monitor) vertical beam size resolution	use attached data
EXT magnet power-supply resolution	11-bit
FFS magnet power-suppy resolution	20-bit
Pulse - pulse random magnetic component jitter	10 nm
Pulse - pulse relative energy jitter (dE/E)	1e-4
Pulse - pulse ring extraction jitter (x, x', y, y')	0.1 sigma
Corrector magnet pulse-pulse relative field jitter	1e-4

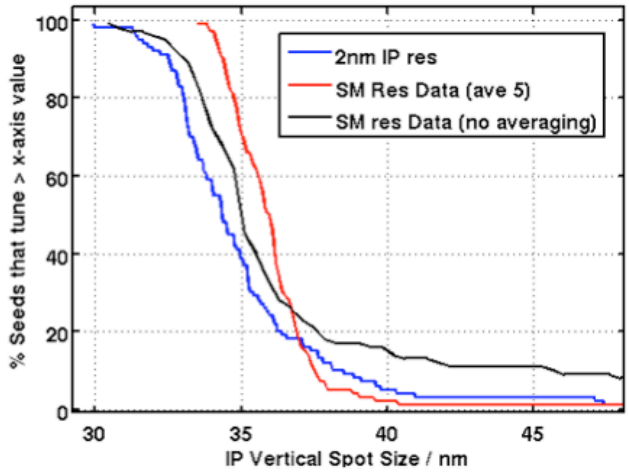
Done

- Error list on wiki
- Also GM- ATF fitted Model
- Also include measured multipoles for final doublet, sextupoles and FFS bends.

IP Tuning(3)

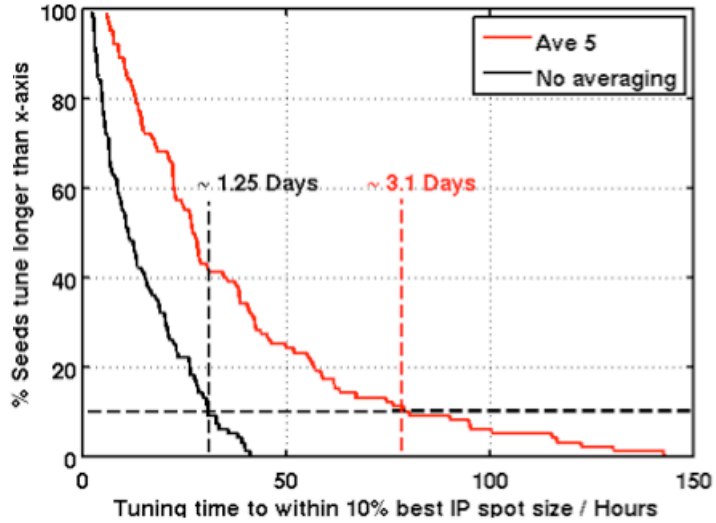
Result with New SX Knob

Results with IPBSM Resolution Data



- Tuning performance using IPBSM resolution data.

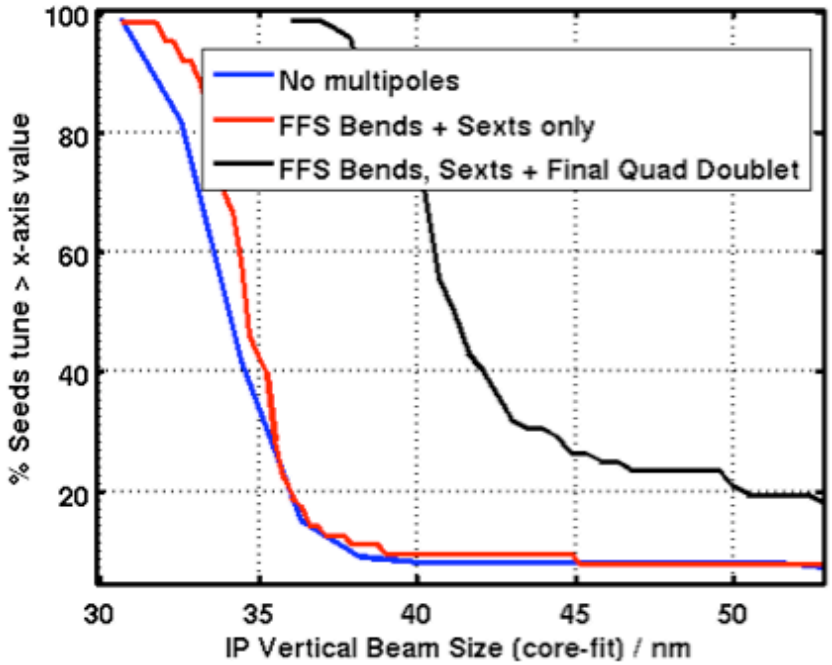
Tuning Time



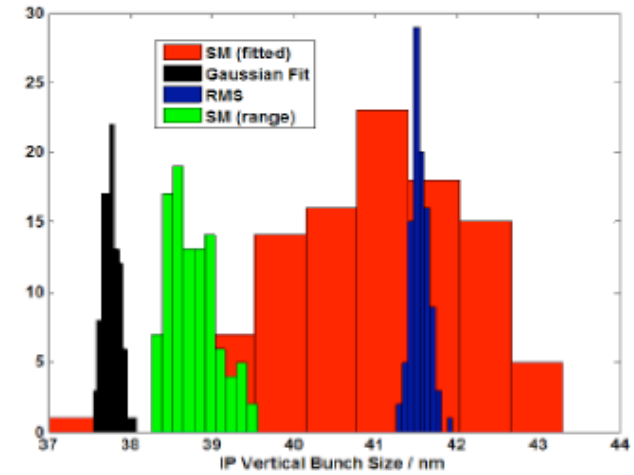
- Tuning time with and without averaging of IP spot size measurements with IPBSM

IP Tuning(4)

Include Measured Magnet Multipole Components



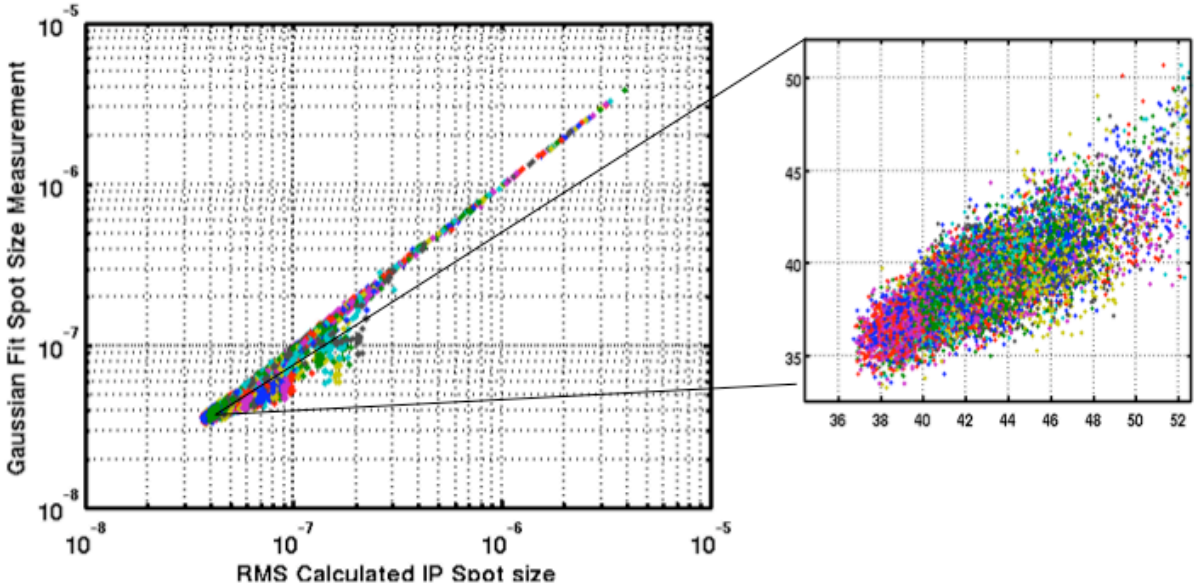
- Measured multipoles of final doublet have major impact on beam size (mainly due to sextupole component).
- Need to re-match optics for these conditions before tuning.



IP Tuning(5)

Measurement dependence of beam size

Measurement Comparison



- 100 seeds, core vs. rms beam size for all tuning steps
- Near target region- seems possible to predict core size ~ +/- 2nm, similar to measurement resolution.

Analysis will continue.
The task group has meeting every 2 weeks.

Pushed Beta(1)

R.Thomas

Tuning algorithm

- Simplex varying all x/y/tilt displacements and strengths of FFS magnets to minimize rms σ_y and σ_x
- Includes: initial misalignments, ground motion, 10^{-4} random errors in all magnet strengths and Shintake error of 2nm.
- Does not include: Jitter from DR, mover speed, mover ranges, Shintake realistic response, multipolar errors...

Numbers are not yet identical to those used by Glen

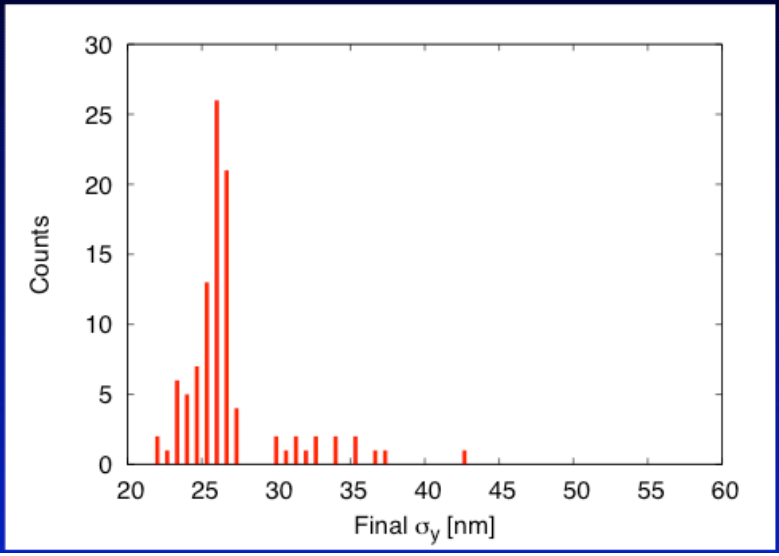
Summary table

case	Max. tuning time	Ratio of success
β_y=0.1mm	5.5 days	100%
β_y=0.05mm	8 days	90%
β_y=0.025mm	10 days	80%

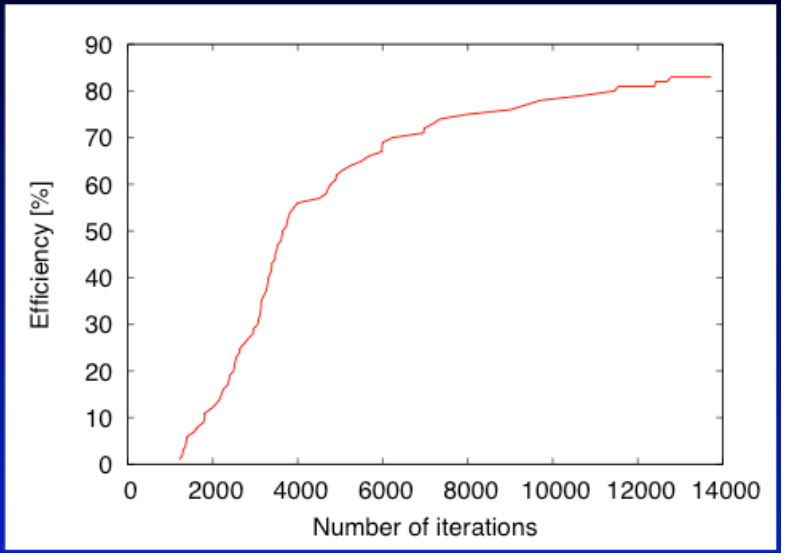
Very preliminary results but clear conclussion:
tuning difficulty increases for smaller β_y
$\rightarrow$ Another ATF2 challenge!

Pushed Beta(2)

Final spot size for β_y=0.025mm

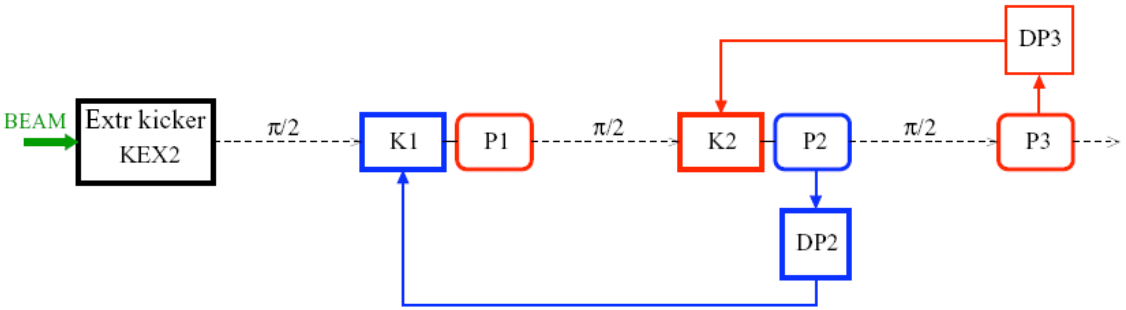


Success versus time, β_y=0.025mm



Bunch-Bunch FB(1)

EXT Bunch-Bunch FB

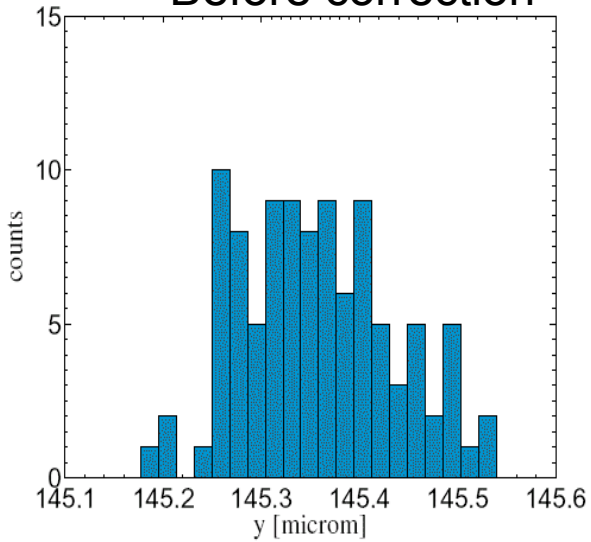


J.R,Lopez

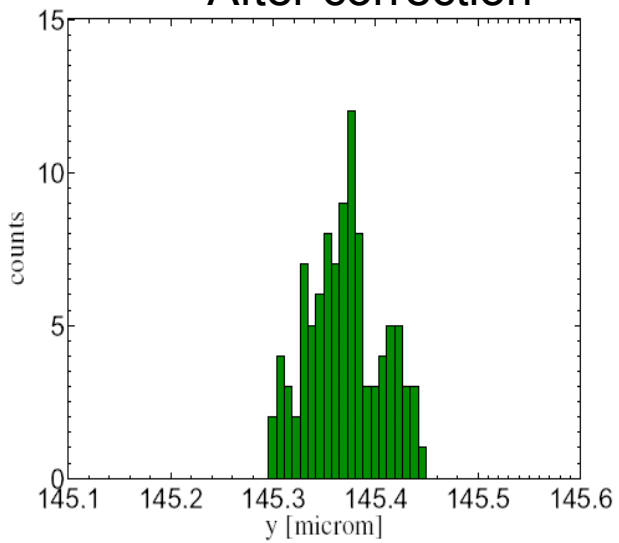
The EXT fast intra-train FB help to improve the shot-to-shot deviation at the EXT
line. However, downstream … big impact from the misalignment of the quadrupoles and sextupoles in the FFS. The main impact coming from the
final doblet alignment errors

Jitter at IP

Before correction

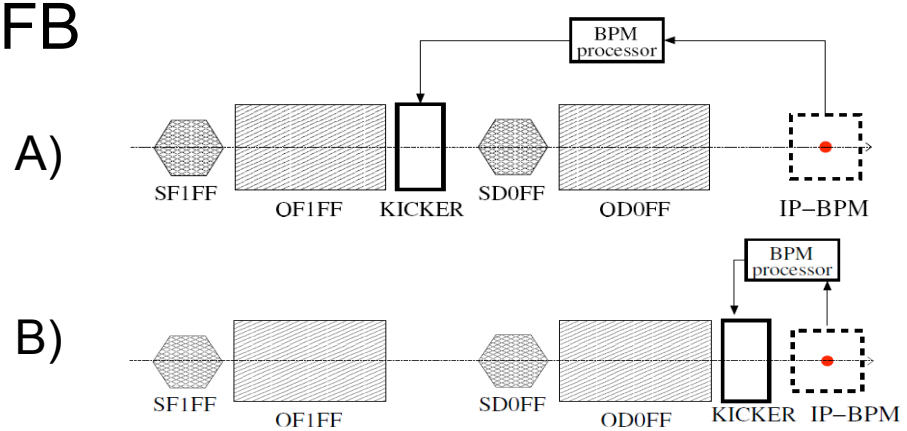


After correction



Bunch-Bunch FB(2)

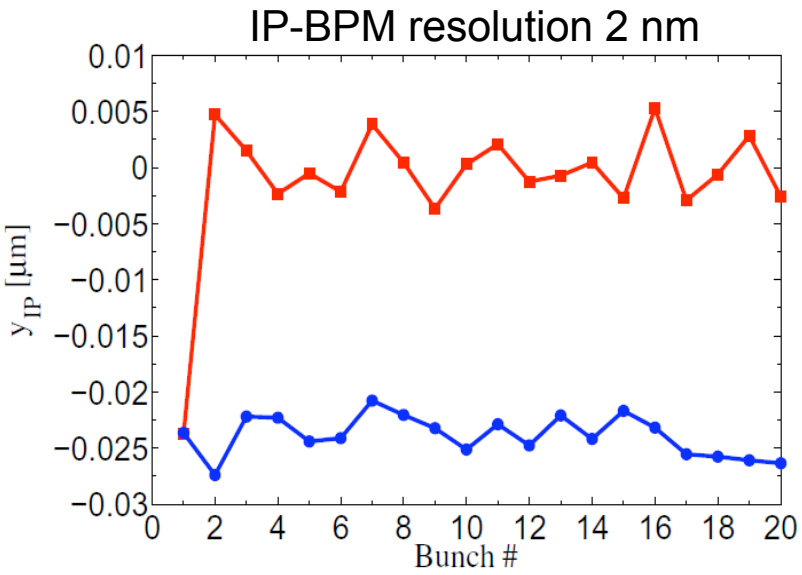
IP Bunch-Bunch FB



For GM

— with FB

— no FB



For FD position jitter

Zoom: