Introduction to ATF2 Beam Tuning

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1.Layout and optics

2.EXT tuniing

Dispersion and Coupling correction

3.FF tuning

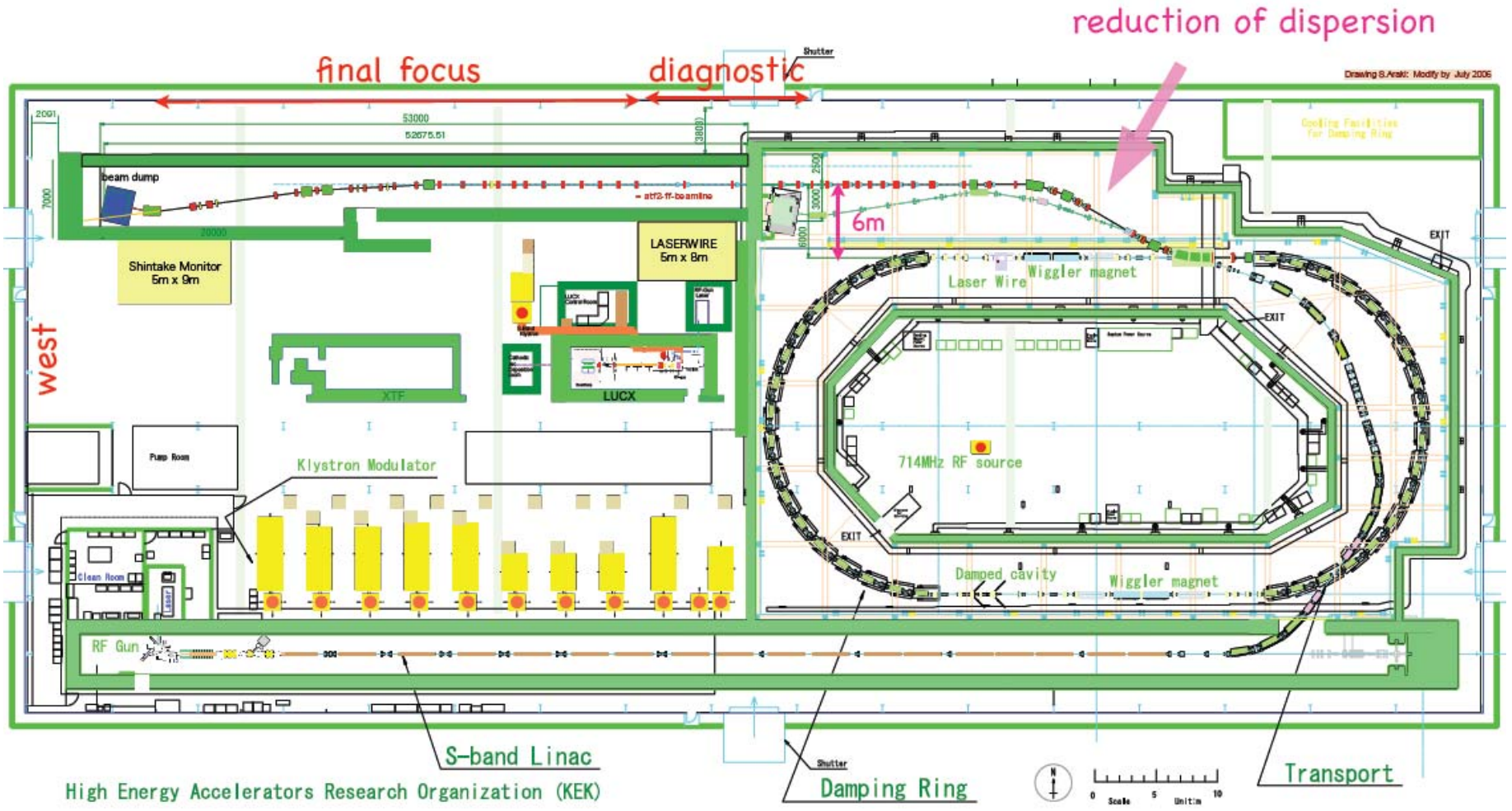
Beam size tuning

LET meeting@Daresbury Jan. 2007

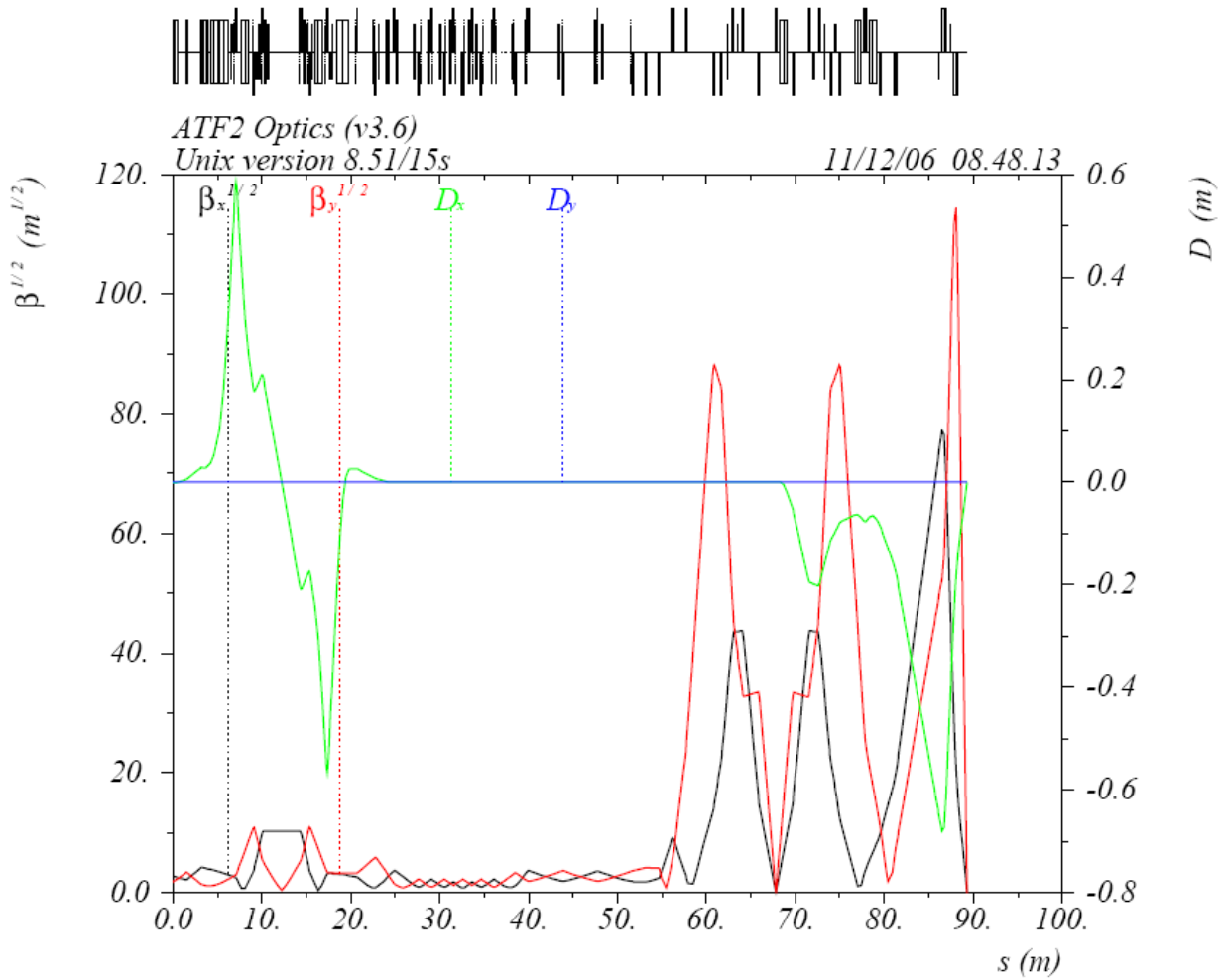
1. Layout and Optics

Optics v3.5, 1 July 2006

<----------FF---------><-----------EXT------------>



M.Woodley 3rd ATF2 project meeting Dec. 2006



βx*=4mm, βy*=100um

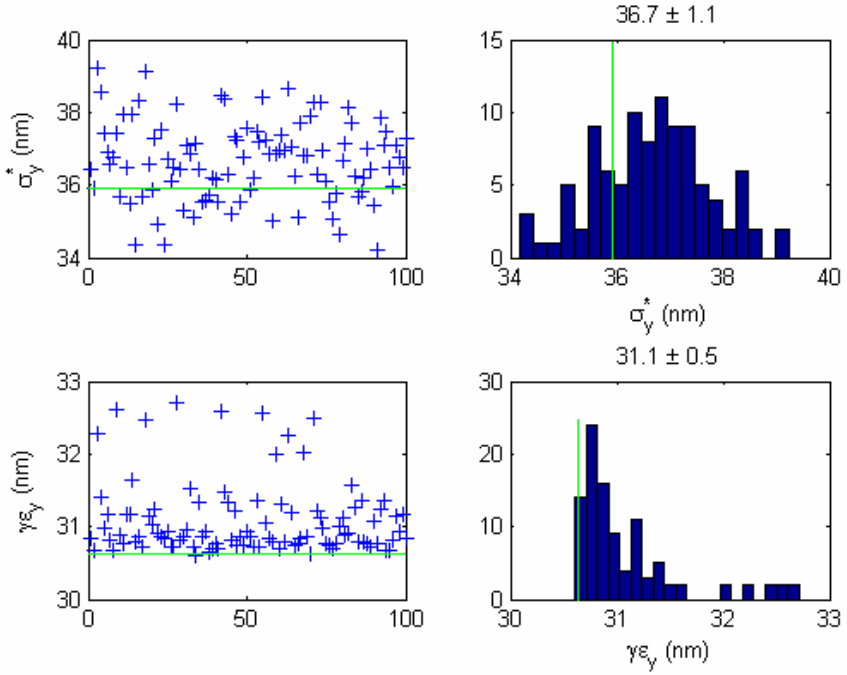
tracking

σy*≈35nm for εx=2e-9, γεy=3e-8, dp/p=8e-4

2. EXT tuning

- Vertical dispersion correction
- x-y coupling correction

At the 3rd ATF2 project meeting, these corrections were discussed
(M.Woodley, T.Okugi, R.Tomas)



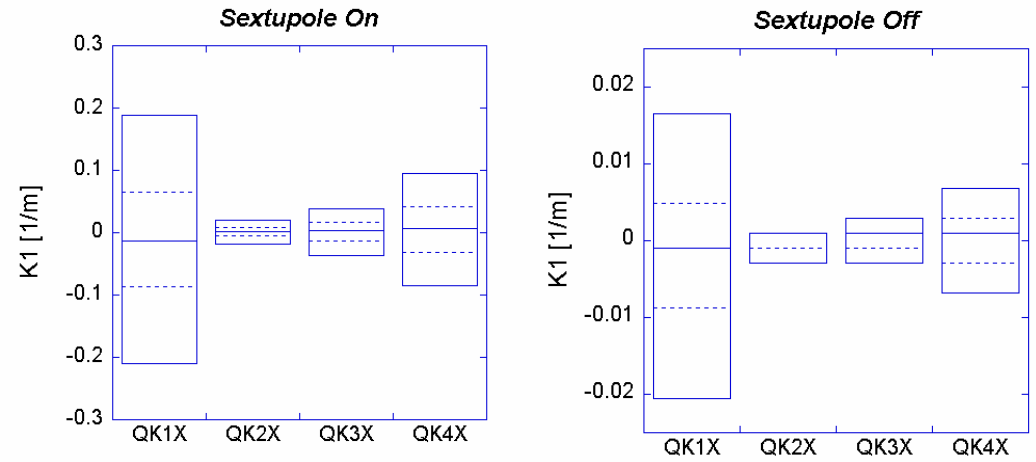
Several methods of ηy correction (skew Q, orbit bump) were studied.
Beam size is recovered to be less than 40nm after correction with roll error of 0.3mrad.

M.Woodley

Required field strength of skew Q, however, strongly depends on the correction method

Orbit bump method for vertical dispersion correction required stronger magnetic field of skew Q for coupling correction.

In dispersive section of EXT line, there are B with SX component, and SX magnets for tuning chromaticity and 2nd order dispersion. They produce strong x-y coupling when there is orbit bump.



When SX component are all off, the required field are reduced by ≈1/10.

T.Okugi

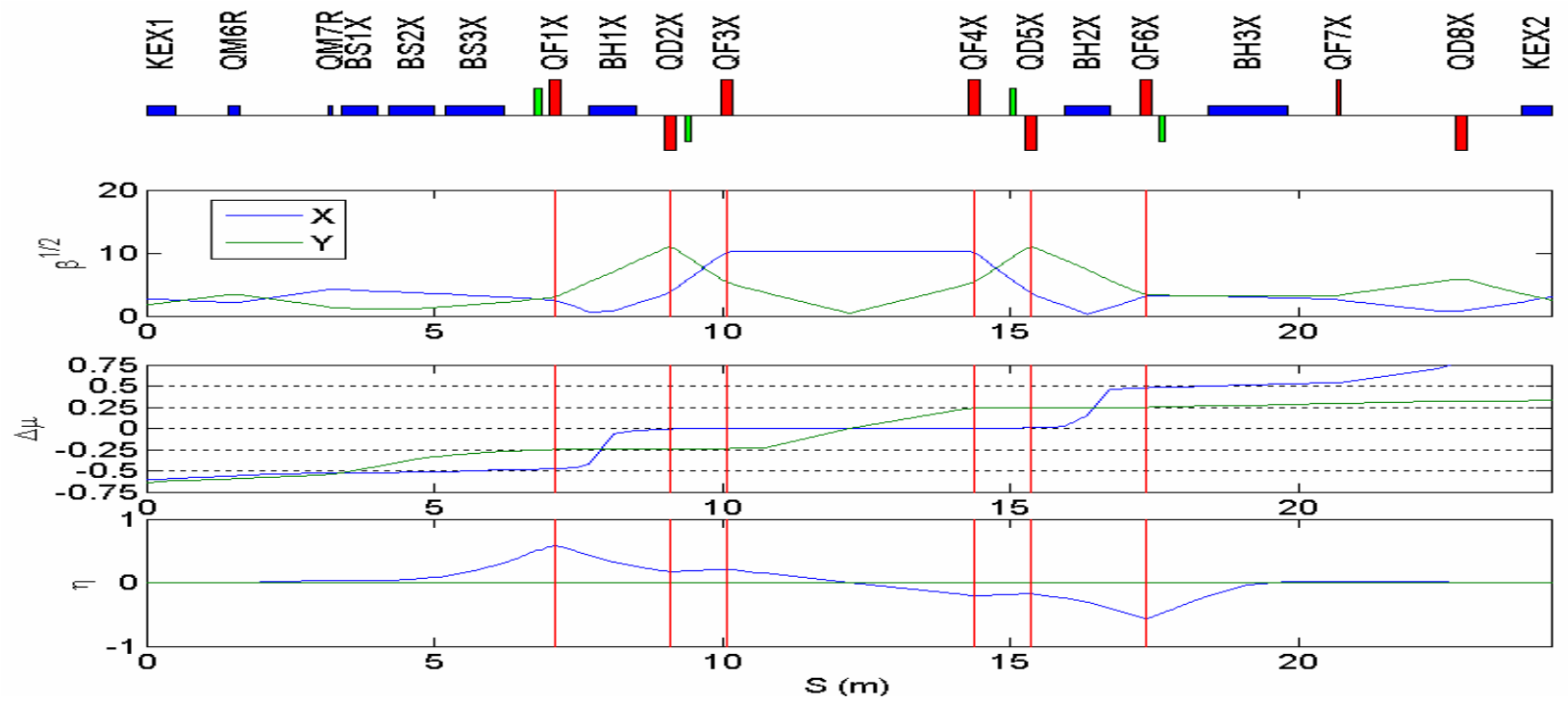
SX field in EXT is so strong that vertical orbit offset there produces strong x-y coupling.

These SX are for chromaticity and 2nd order dispersion. But they have almost no effect to the beam size at IP.

<u>What to do</u>

Need to find better SX setting

And also accurate measurement of SX component of B



3. FF tuning

- Beta matching
- BBA
- Beam size tuning

Beam size tuning → alignment tolerance
Linear knob tuning gave the tolerance for Q;
(dK1/K1, dx, dy, roll)=(3e-4, 24μm, 12μm, 60μrad)
(2nd ATF2 project meeting)
Beam rotation matrix correction by J.Jones for ILC BDS
(ATF2-IN2P3-KEK Kick-off mrrting,Annecy,9-11 Oct.2006)
→ application to ATF2
BBA+traditional tuning by G.White
(3rd ATF2 project meeting)

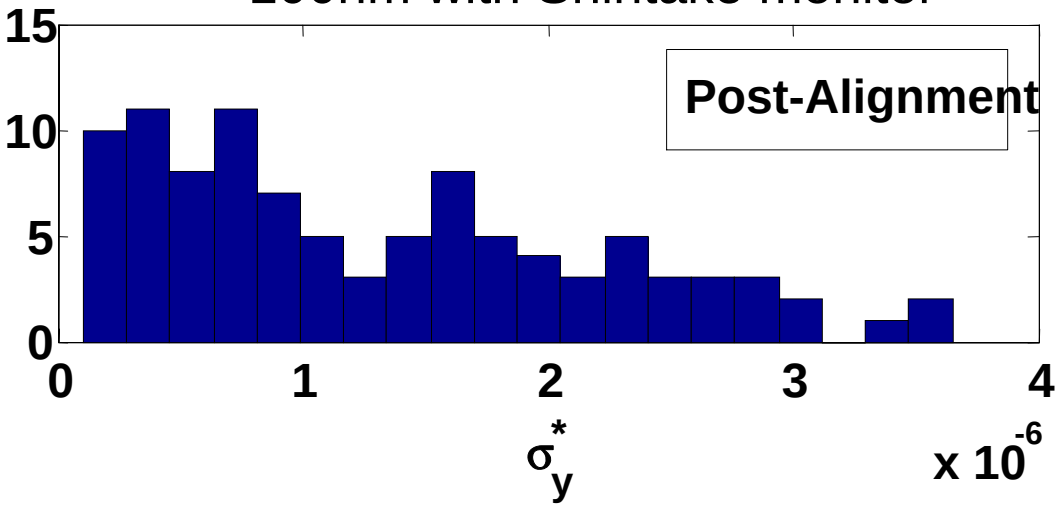
Initial errors from ILC assumption

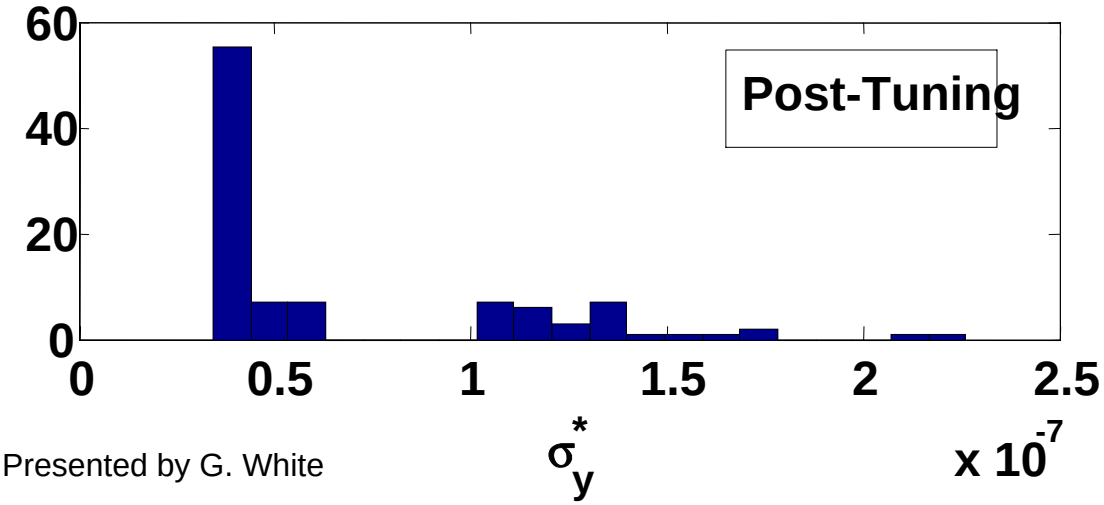
e.g. dx/dy=200um, roll=0.3mrad, dK=1e-4,…

Tuning

σy > 100nm with IP-BPM

< 100nm with Shintake monitor





- More work needed getting all seeds to converge.
  - Evaluate order of knob application.
  - More averaging per scan.
- Convergence typically in <20 iterations:
  - Assuming 1 min per IP spot-size measurement (90 bunches @ 1.5Hz), 10 scan points per knob iteration and 1 cycle through Sext tilt/dB scans:
  - If completely automated, tuning would take ~ 4.5 Hours.
- Need to add Ground Motion, component jitter, incoming beam orbit + energy jitter, BPM scale and magnet strength drifts…

Presented by G. White