ATF2

Final Focus System at ATF

Final goal:
ensure collision of ILC nm beams,
risk reduction of ILC

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for the
ATF2 collaboration
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LCWS

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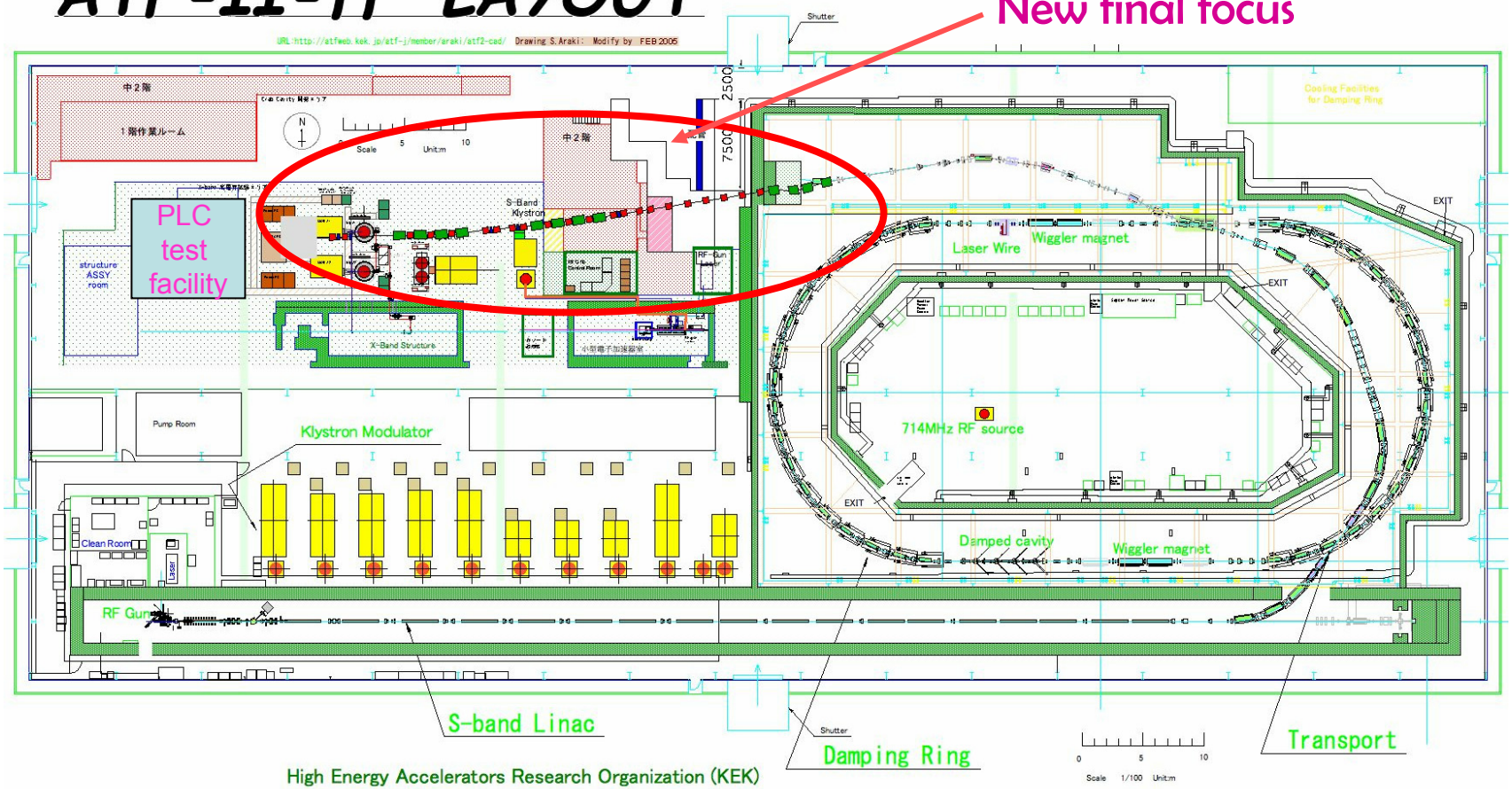
ATF2 collaboration is open, please join!

ATF2 proposal timeline

- November 2004, 1st ILC workshop: discussion of ATF2 proposal, strong support, decided continue development of the project
- December 2004-January 2005
  - developments of proposal, optics design and comparison, video and phone meetings, ATF2 mini-workshop at KEK, joint PAC05 paper
  - Form the ATF2 proposal editorial board (G.Blair, T.Sanuki, A.Seryi)
  - International collaboration is being formed
- January 5, 2005 – workshop on ATF2 at SLAC (~50 participants)
- January – March: preparation of the proposal document
  - presently ~2/3 of material collected, editing is ongoing
- Finalize the design and proposal in June 05 (BDIR workshop in UK)
  - negotiate contributions from participating institutions
- Start hardware production in mid 2005, aim for the first beam in FF at the beginning of 2007

ATF-II-ff LAYOUT



ATF2 Goals & stages:

(A) Small beam size (with Shintake BSM at IP)

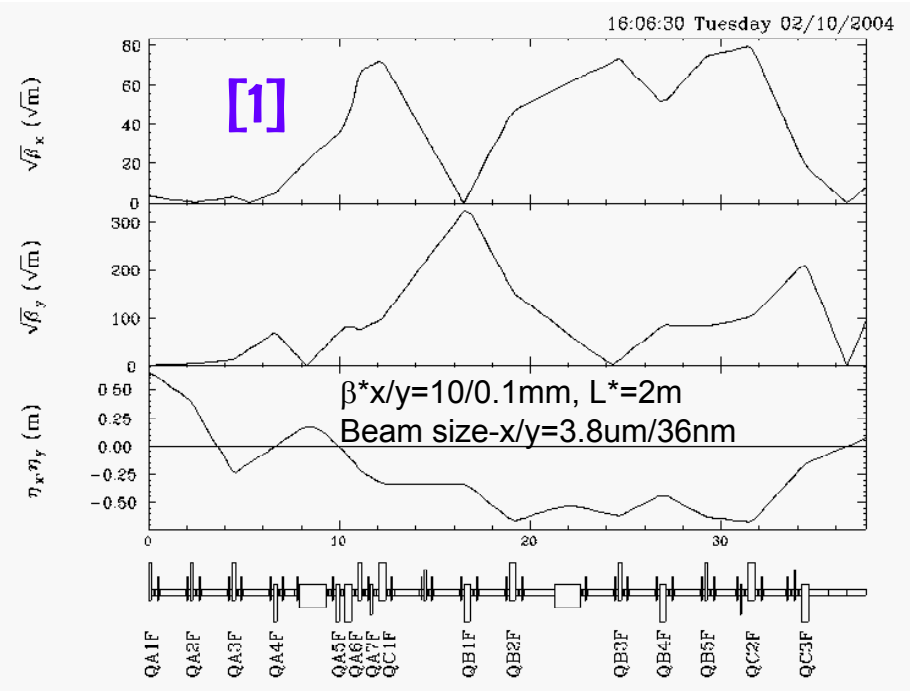
- (A1) Obtain σ_y ~ 35nm
- (A2) Maintain for long time

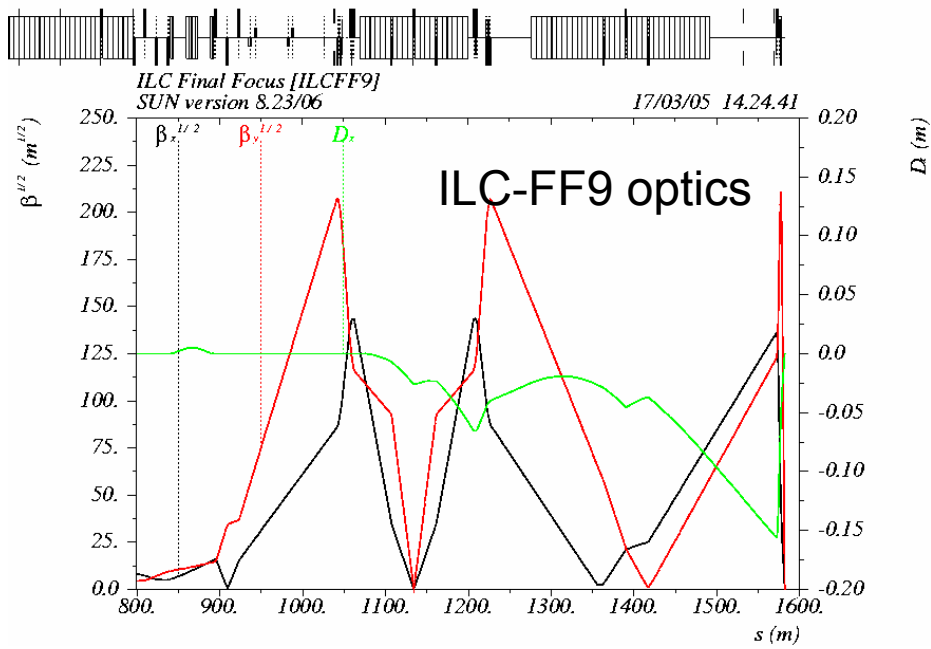
(B) Stabilization of beam center (with nano-BPM at IP)

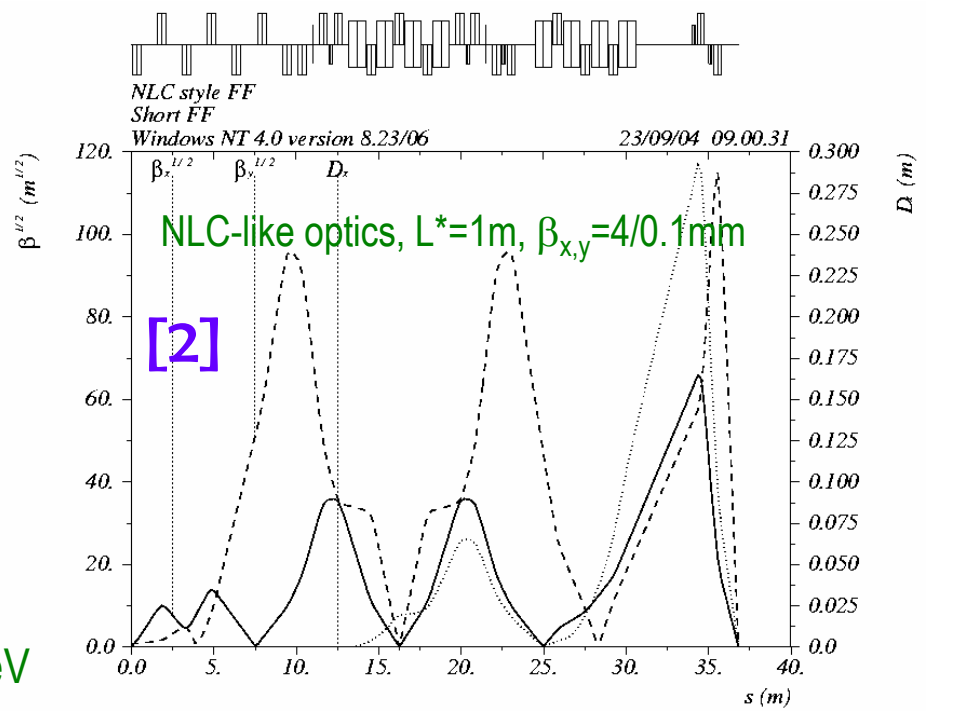
- (B1) Down to < 2nm by nano-BPM
- (B2) Bunch-to-bunch feedback of ILC-like train

FF optics for ATF2

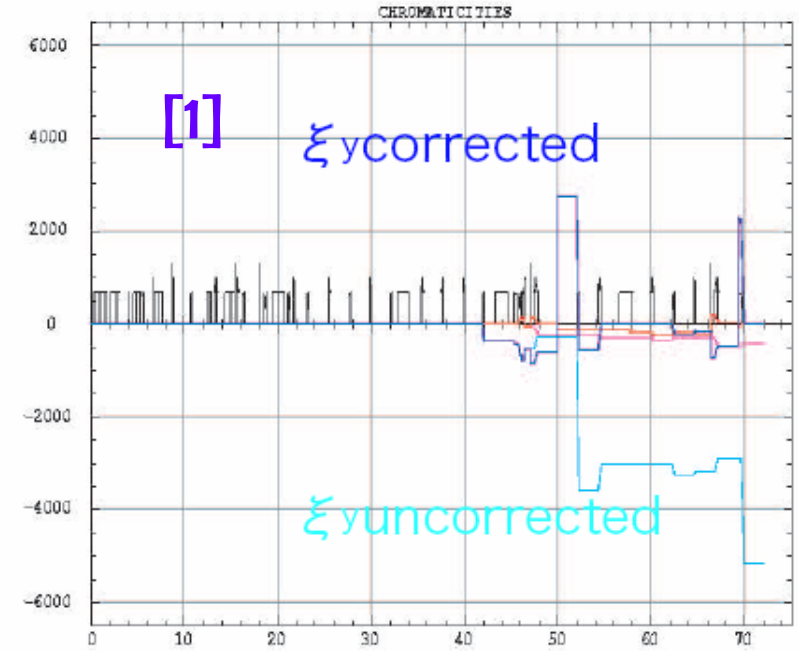
- Two versions of optics were considered
  - [1] by Kuroda-san
  - [2] scaled from NLC

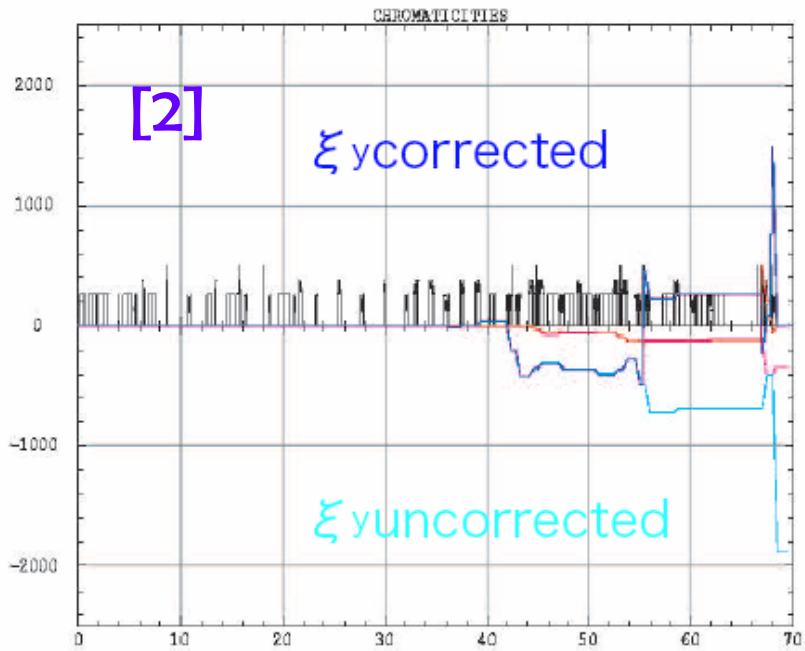


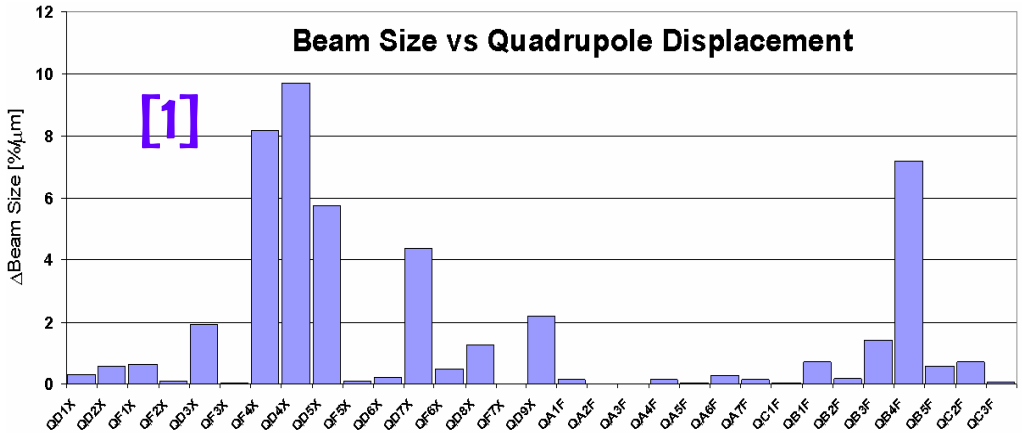


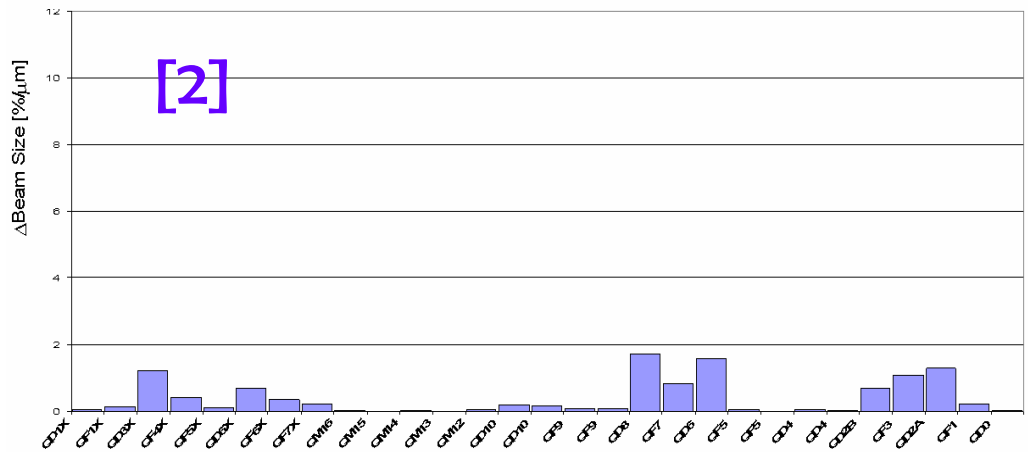


Beam: $\gamma\varepsilon_x$=3e-6 m , $\gamma\varepsilon_y$=3e-8 m, E=1.54 (1.28) GeV





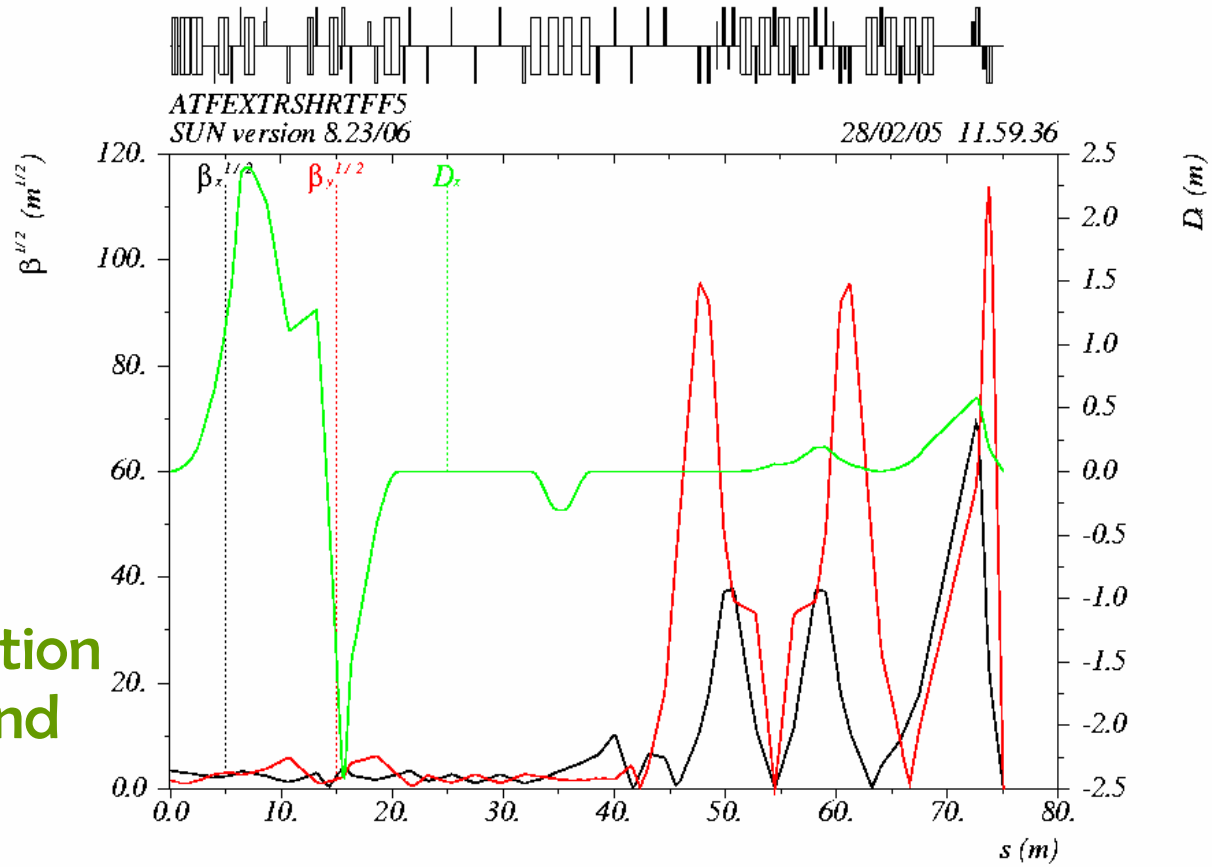




- Chromaticity is corrected upstream and final sextupoles cancel the geometric aberrations in [1] and corrected locally in [2]
- Tolerances are several times easier in [2]

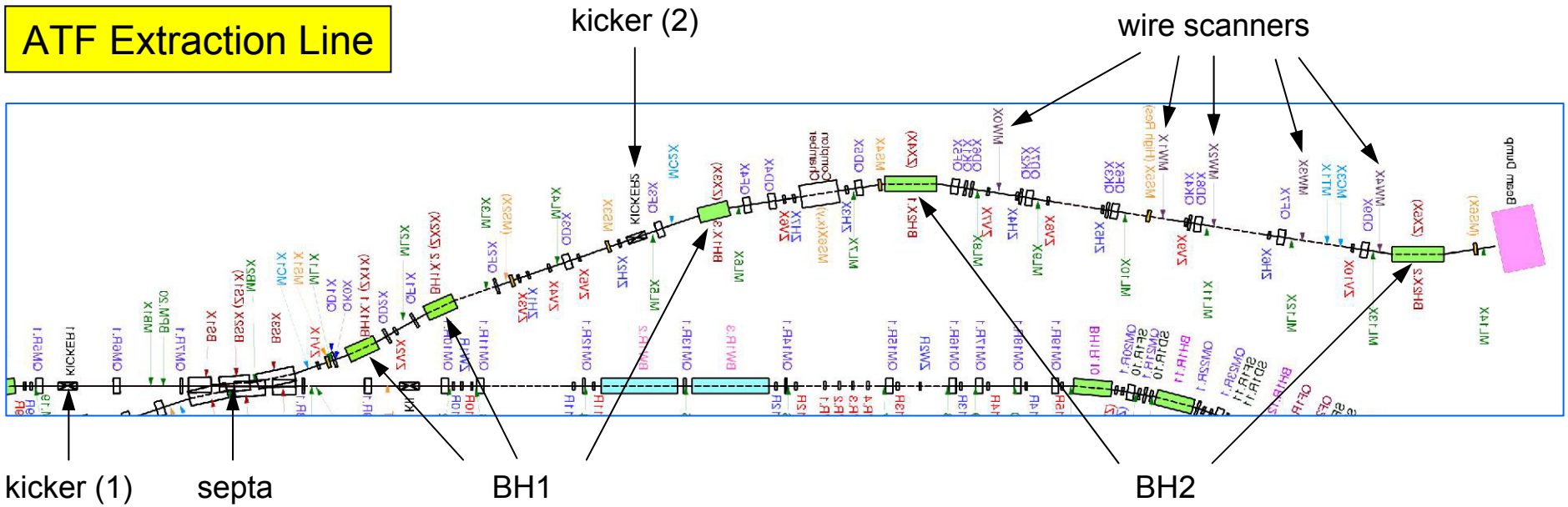
ATF2 optics

- The NLC-like optics has larger number of magnets (cost) but has better tolerances, bandwidth almost up to 1%, due to local chromaticity compensation it works well at 1TeV, and therefore was adopted for ATF2



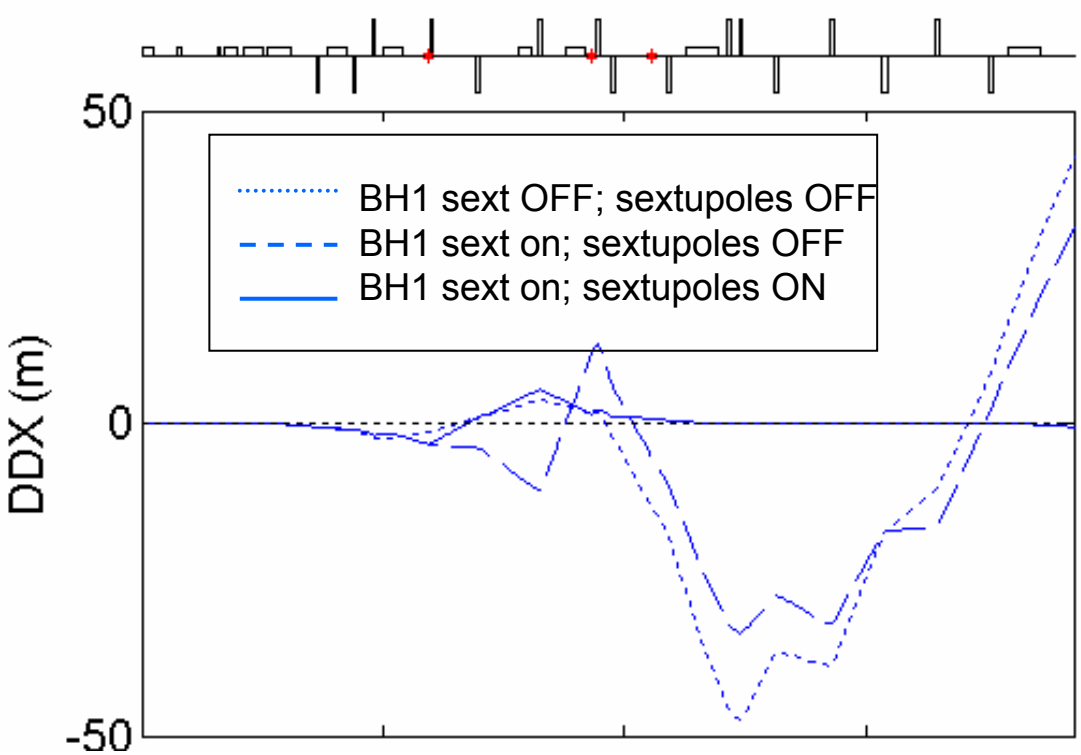
- The optics optimization continues
  - a chicane added to separate photons from laser wires in the diagnostics region
  - bunch compression by /2 is considered (make compatible, build much later?)
  - improving the diagnostics section (more cell) is considered
  - reduction of the number of magnets (cost) versus performance will be studied
  - improvement of existing extraction line are studied (correct. 2nd order disp.)

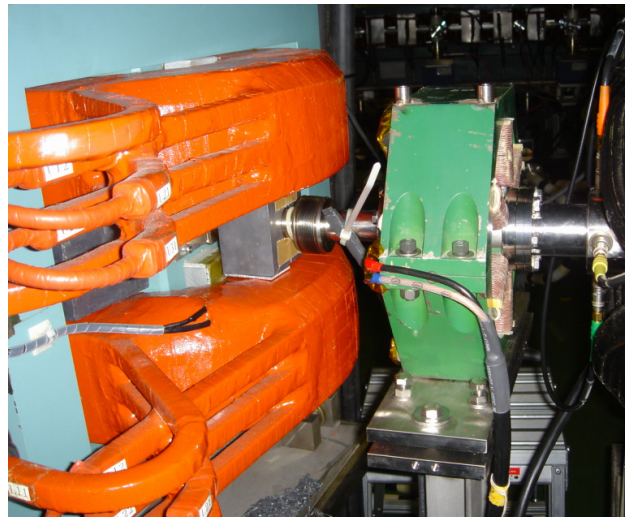
Ongoing work for extraction line improvements

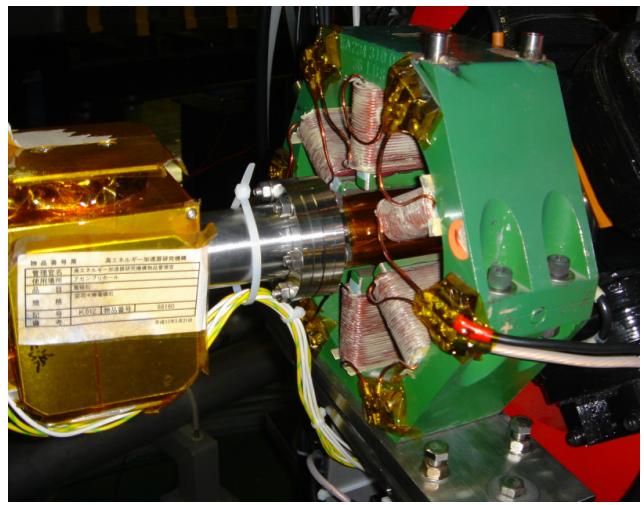


- The emittance measured in the extraction line is 4.8E-8m, which is three times larger than in the ring
- For the ATF2, we require emittance 3E-8m, which has a factor of two safety margin with respect to DR emittance
- Work is ongoing to decrease beam jitter in the extraction line, improve its optical properties

2nd order dispersion correction in extraction line

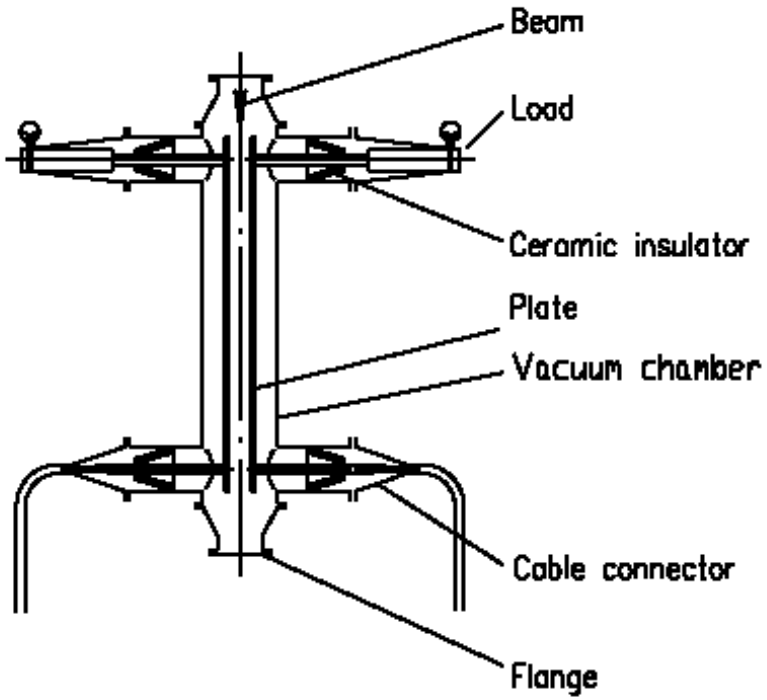


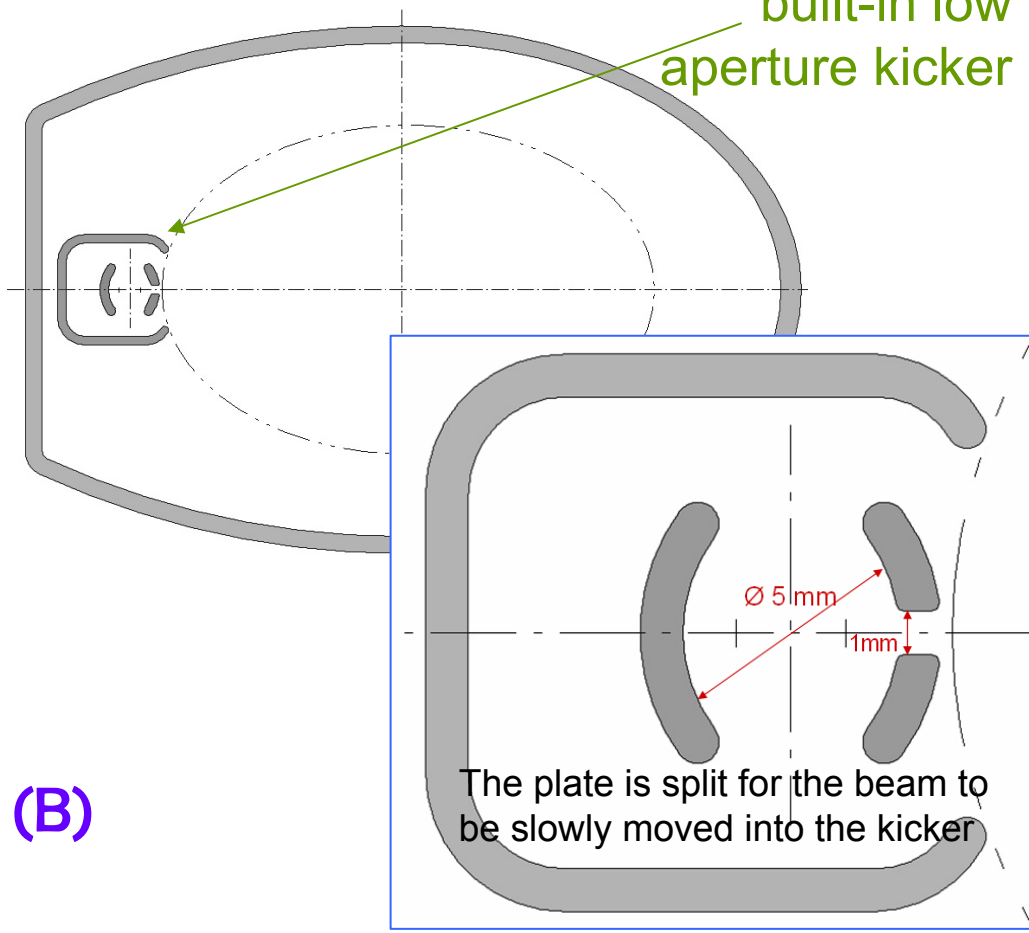




- Three sextupoles shipped to KEK and installed at ATF in the beginning of March

ILC-like train (~20b * 300ns) from ATF DR



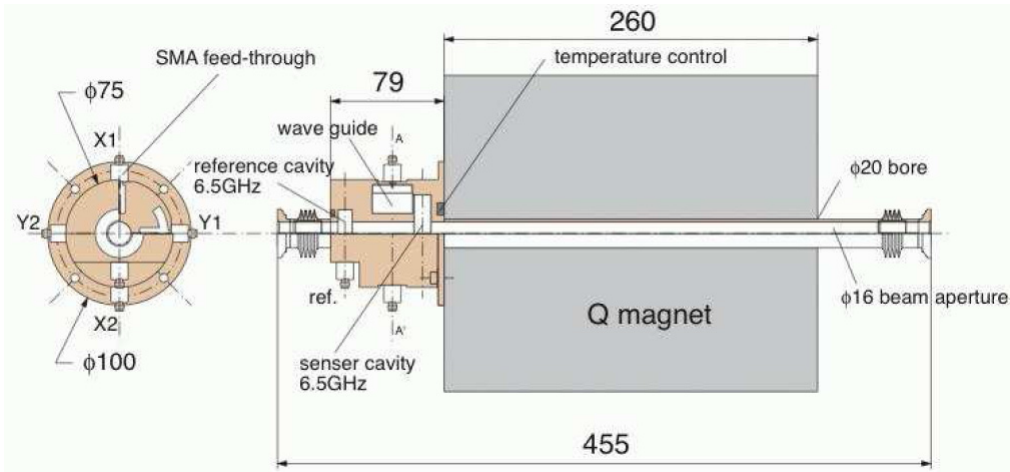


Essential for the goal (B)

- Two approaches of counter-fed stripline kicker:
  - TDR/BINP kicker (two sets in ATF DR: at ZH39R and QM6R.1)
  - low aperture (5mm) kicker with local orbit correction before ejection (require modification of existing septum to reduce thickness of its 22mm knife)

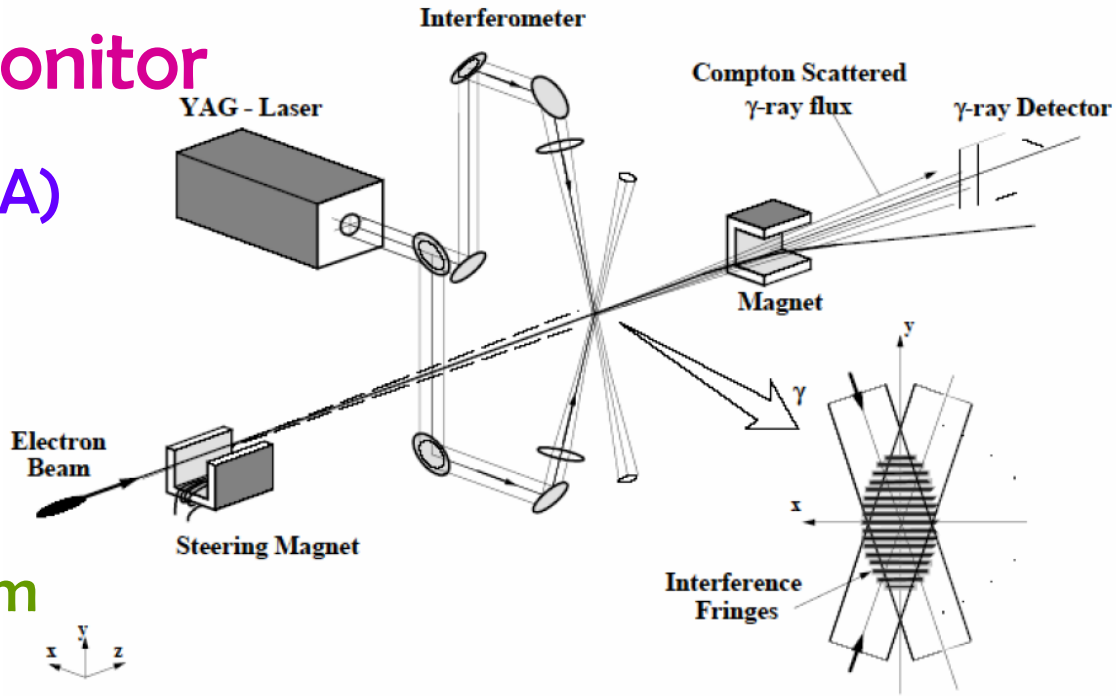
As ILC, ATF2 critically depends on instrumentation

- Beam Size Monitor to confirm 35nm beam size
  - shorter laser wavelength than what used at FFTB, to resolve 30nm
  - easier for single bunch, more difficult for each bunch in the train
- nano-BPM at IP to see the nm stability
  - complicated by large beam divergence, angle jitter and x-y coupling
- Laser-wire to tune the beam
- Cavity BPMs to provide stable orbit
- Movers,
  active stabilization,
  alignment system,
  etc.



Shintake beam size monitor

Essential for the goal (A)

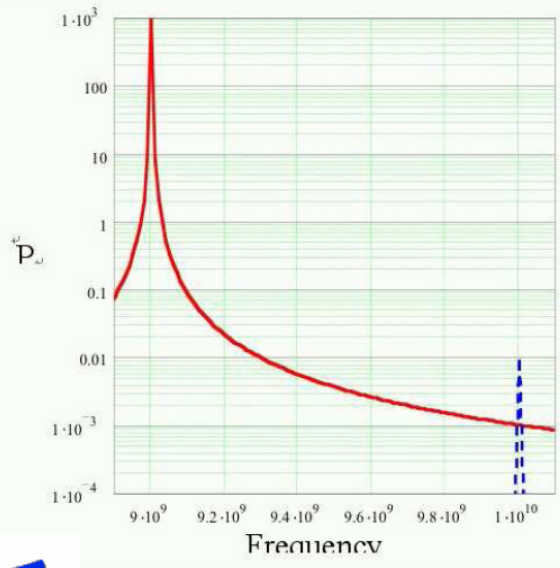


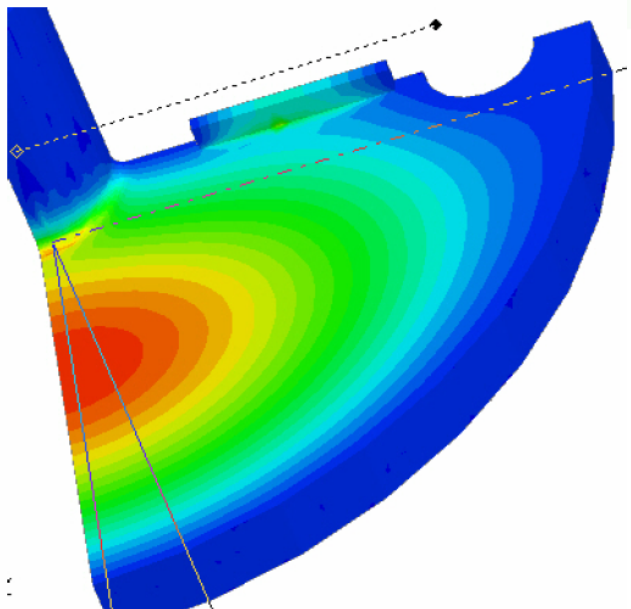
- Modification for ATF2 will be based on 2nd harmonics of Nd doped laser to produce 532nm wavelength for 30nm beam size measurements
- 10μJ pulse focused in 100μm to obtain ~700 x-ray photons (statistics)
- Similar laser system was developed for DESY TTF (up to 140μJ at 3MHz)
  - Much simpler system could be built if beam size of only one bunch in the train need to be measured: low cost diode pumped frequency doubled Nd:YAG
- There will be significant overlap of laser development for ILC polarized source and for ATF2

IP nano-BPM

Essential for the goal (B)

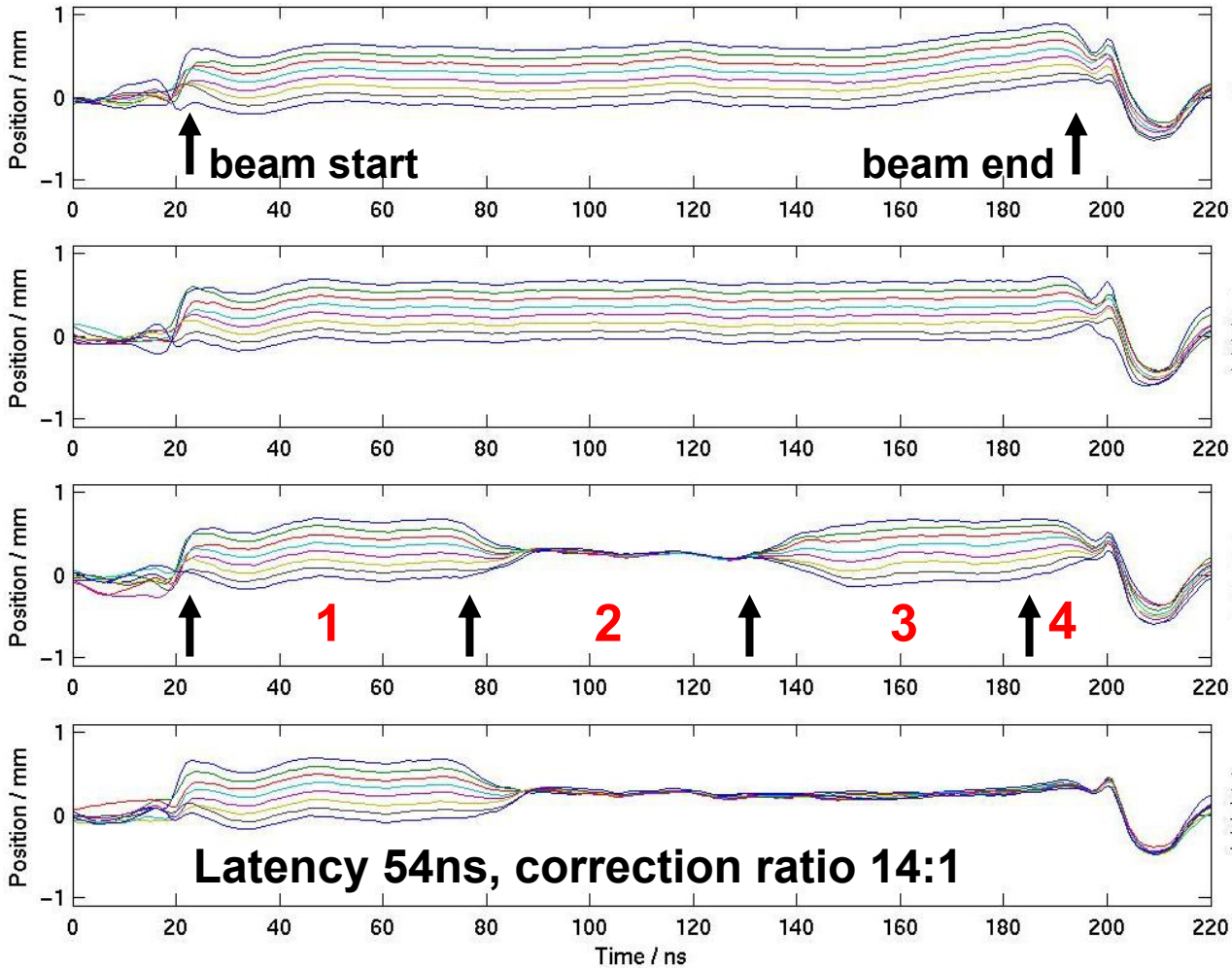
- nm resolution for 8mm long bunch with larger divergence (~300μrad)
- Triplet of cavity BPMs
- To reduce coupling of x-y modes, split their frequency by 1GHz
- To reduce sensitivity to angle, use short cavity with small aperture





Feedback On Nanosecond Time scale (FONT)

- Essential for achieving the nm stability of the bunches at IP
- Critical for the goal (B) of ATF2. See the talk by Phil Burrows



Beam starting positions

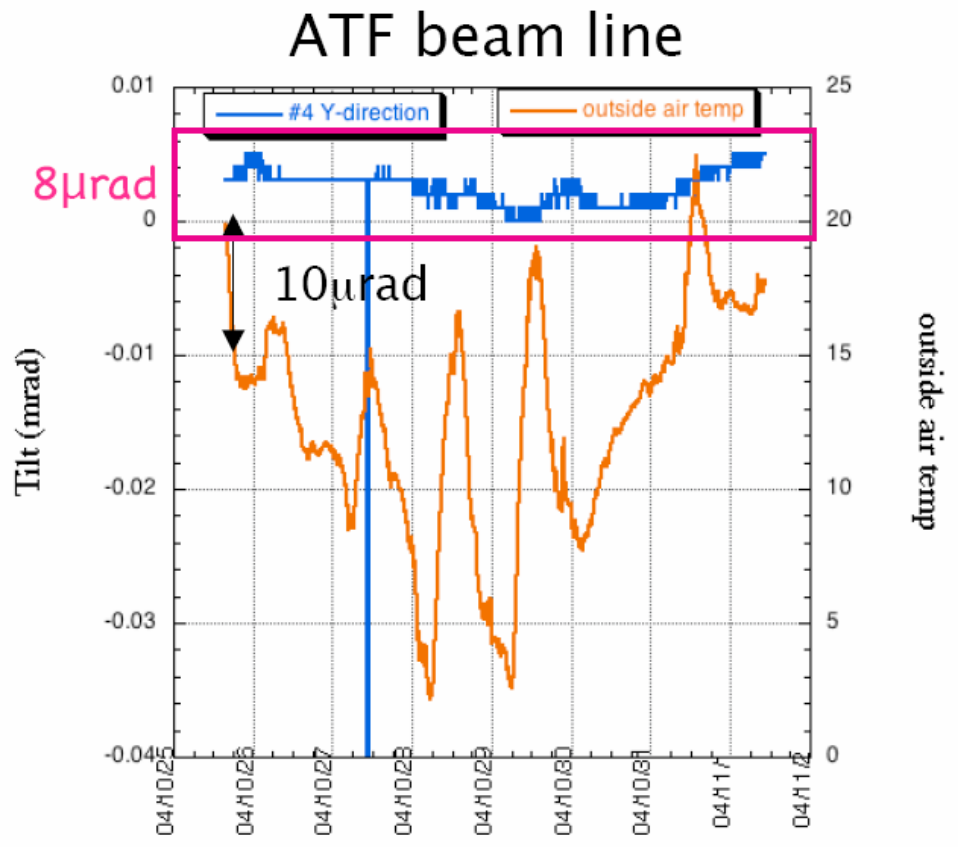
Beam flattener on

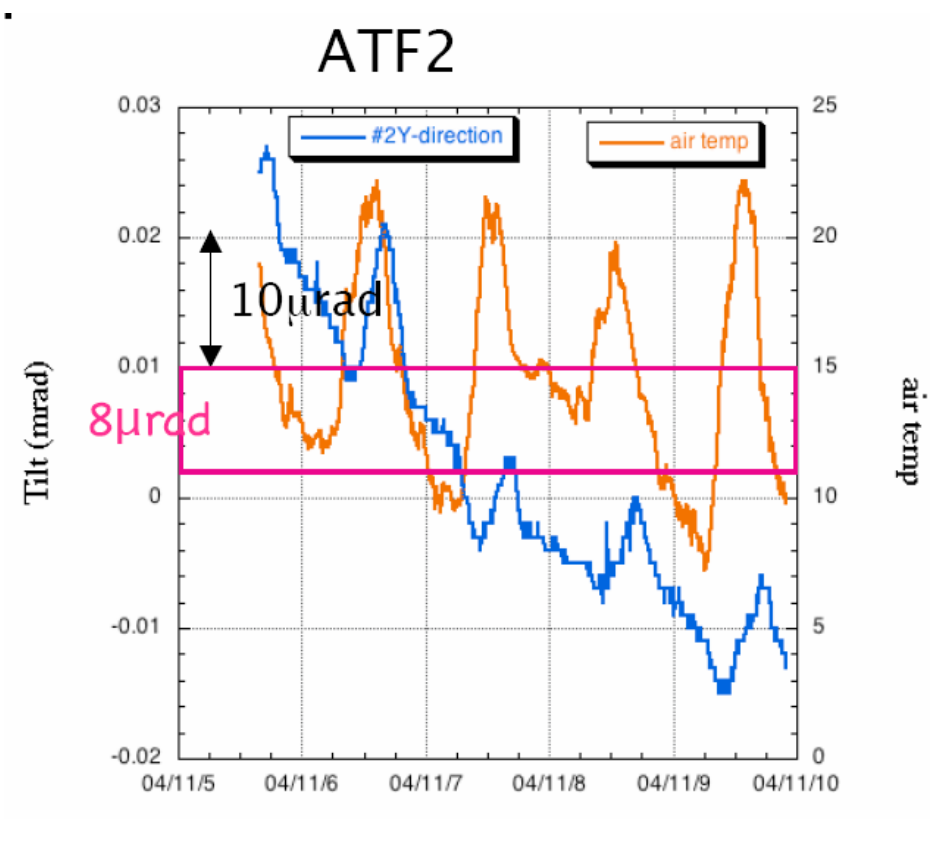
Feedback on

Delay loop on

FONT2 results (January 2004)

ATF2 floor stability

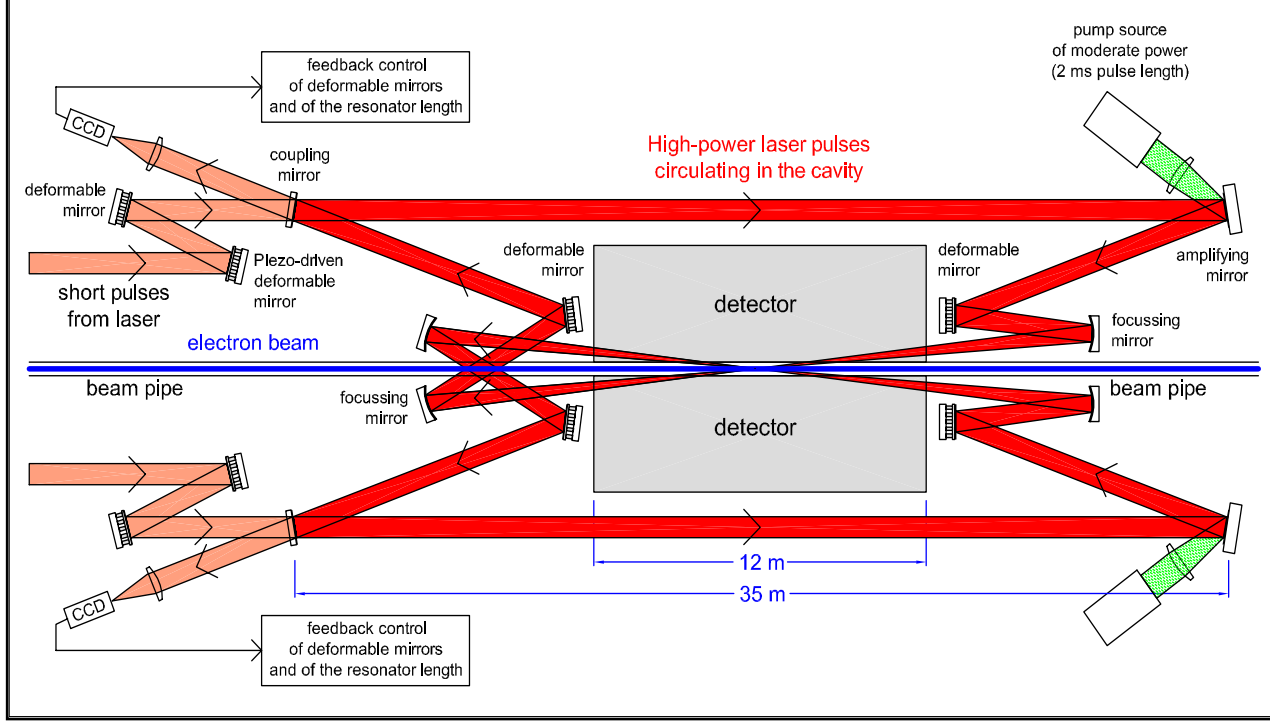


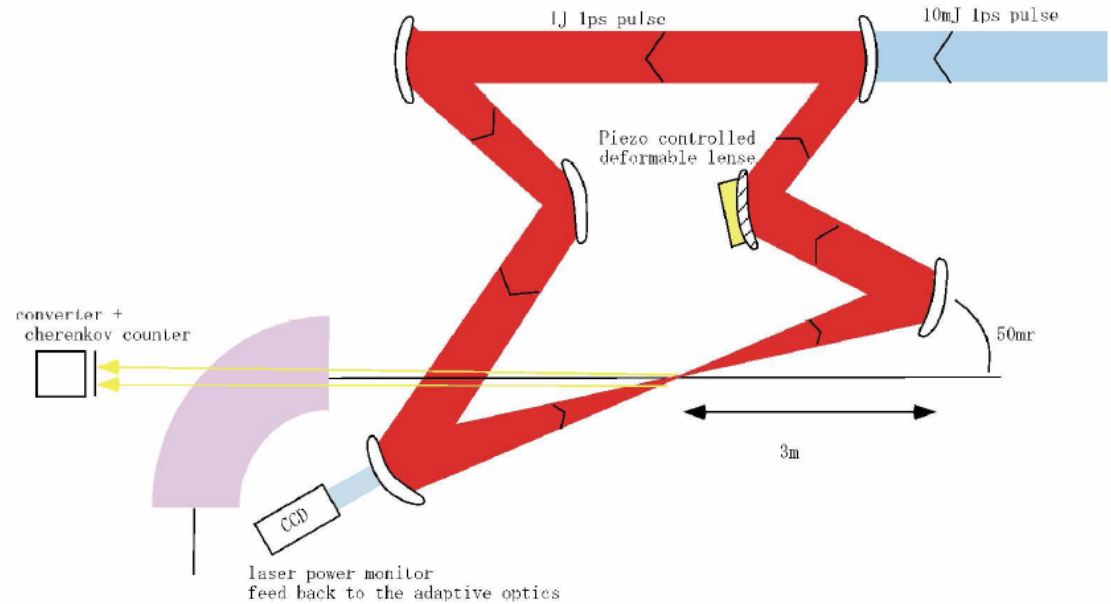


- The floor under ATF was reinforced with many piles and show much more stable behavior and less sensitivity to temperature than the floor outside of DR
- The floor under the ATF2 will be improved in a similar way

PLC facility at ATF2

Desy-Zeuthen / MBI Cavity design exploits ILC bunch structure to reuse pulses





The ATF2 can provide a facility for demonstrating the laser / electron beam integration

A working facility could provide an intense ~ 40 MeV photon beam for a positron source test bed

Summary

- ATF2 proposal would test the essential design elements of ILC Beam Delivery System, will teach us to achieve and maintain nm scale beam size, and will reinforce our ability to work together, in collaboration
- ATF 2 proposal is developed by international collaboration of more than 60 people
- The collaboration is open, there is a lot of interesting work
- Please join!
- The ATF2 project would be built in ILC-model, purely international, with contributions from all participating institutions