Upcoming Run Plan at ATF

Junji Urakawa (KEK)

for

ATF International Collaboration

ATF (Accelerator Test Facility)

The ATF international collaboration include more than 200 researchers and the ATF MOU is signed by 20 institutions from all over the world.

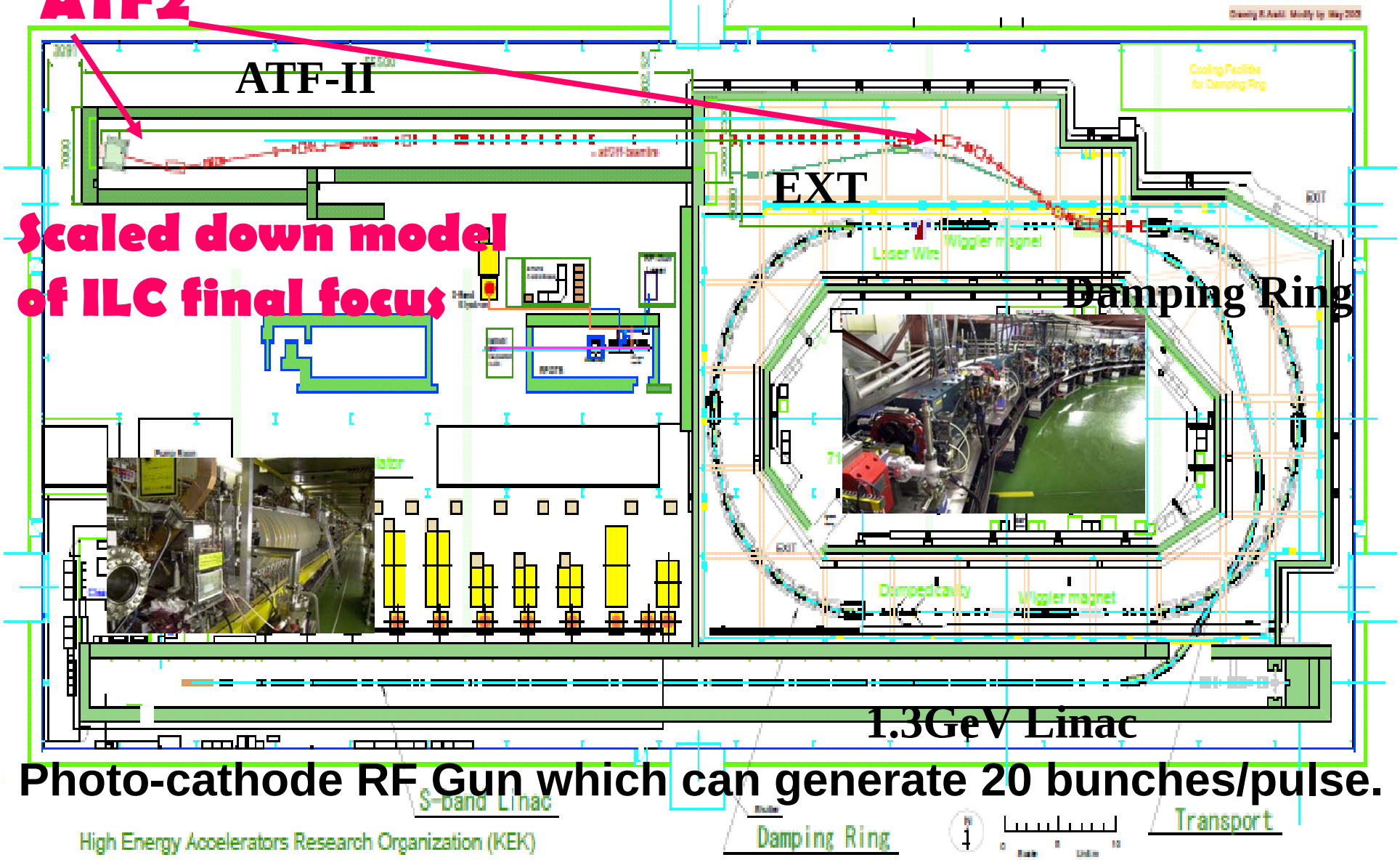


Photo-cathode RF Gun which can generate 20 bunches/pulse.

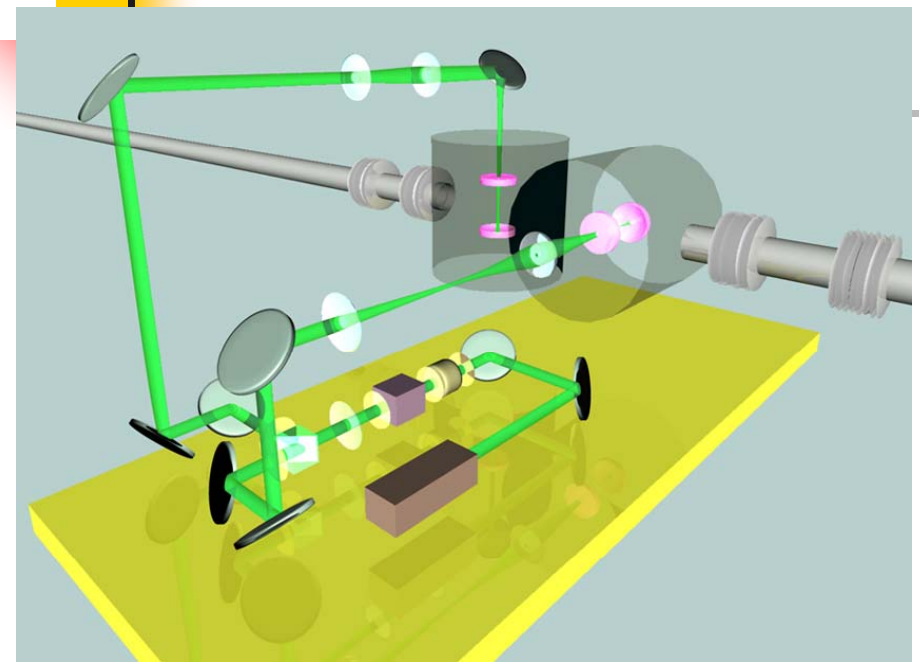
Achievement of ATF

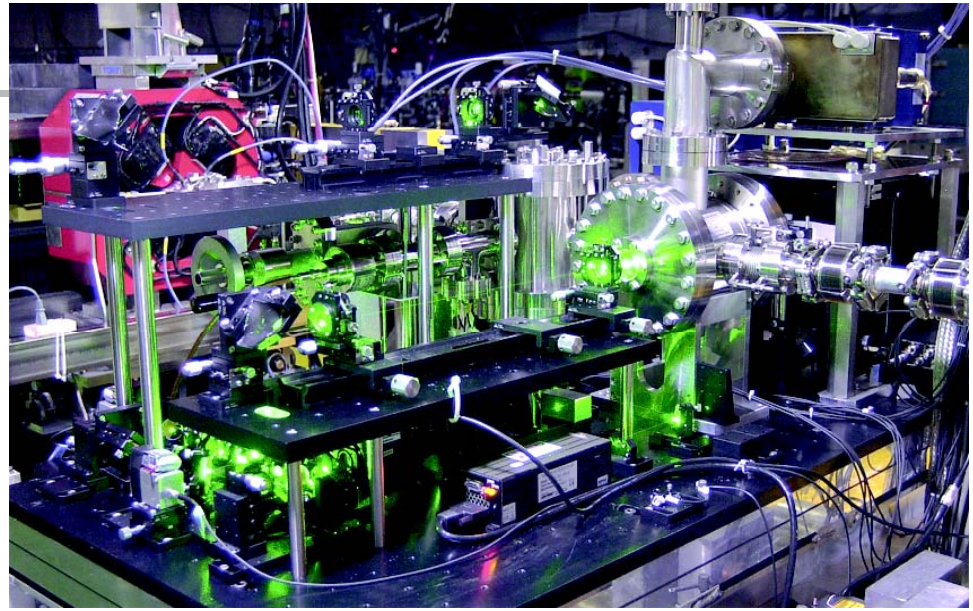
1. **Emittance in Damping Ring.**

1nm-rad horizontally, 4pm-rad vertically at low intensity

2. **ILC Fast kicker development.** **3ns fast rise time**
3. **DR BPM upgrade program.** **<1micron resolution. By SLAC and FNAL et al. collaboration**
4. **Multi-bunch turn-by-turn monitor.** **For FII study, kicker**
5. **nm BPM experiment.** **8nm to 16nm resolution achieved. By SLAC, LLNL, KEK et al.**
6. **FONT4 experiment.** **digital feedback. By Oxford et al.**
7. **Laser Wire at EXT-line.** **fast scan wire for ILC. By RHUL et al.**
8. **ODR BSM.** **Completed by KEK and Tomusk University.**

Laser wire beam size monitor in DR

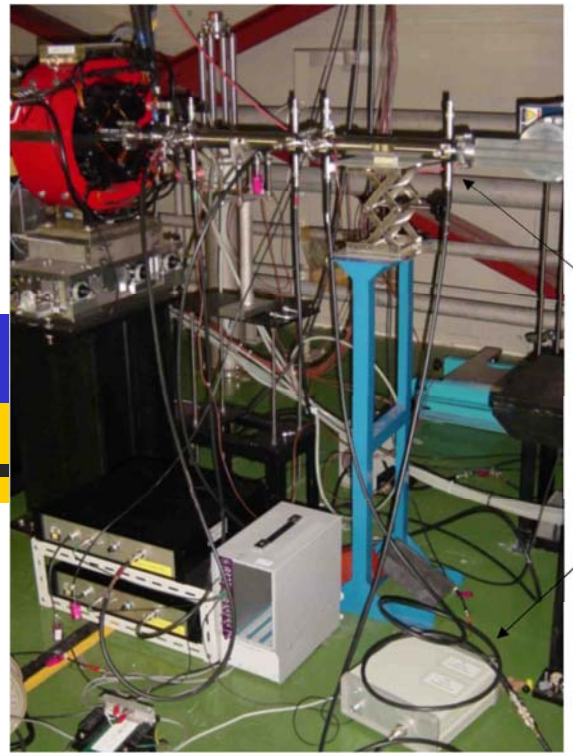


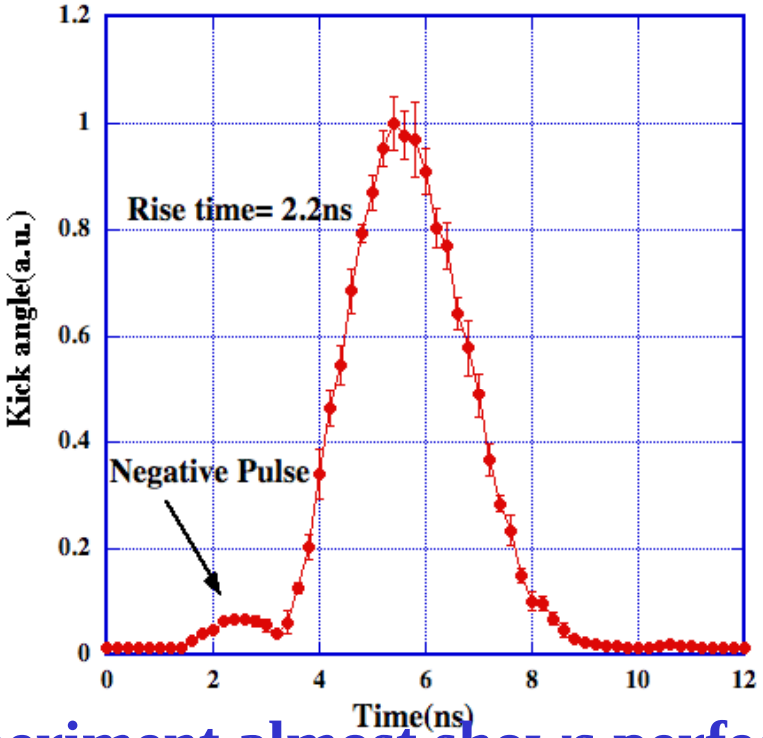


300mW 532nm Solid-state Laser fed into optical cavity

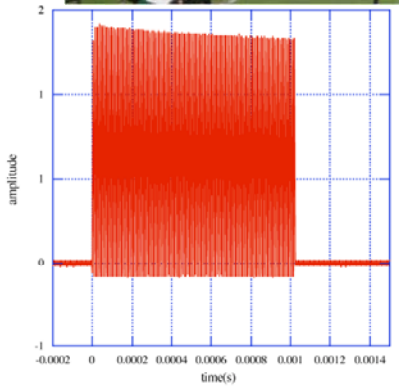
14.7μm laser wire for X scan
5.7μm for Y scan
(whole scan: 15min for X, 6min for Y)

Beam Kick test of ILC Fast kicker (KEK, LLNL, SLAC, LNF,DESY, FID Co.)





This experiment almost shows perfect kick timing control.

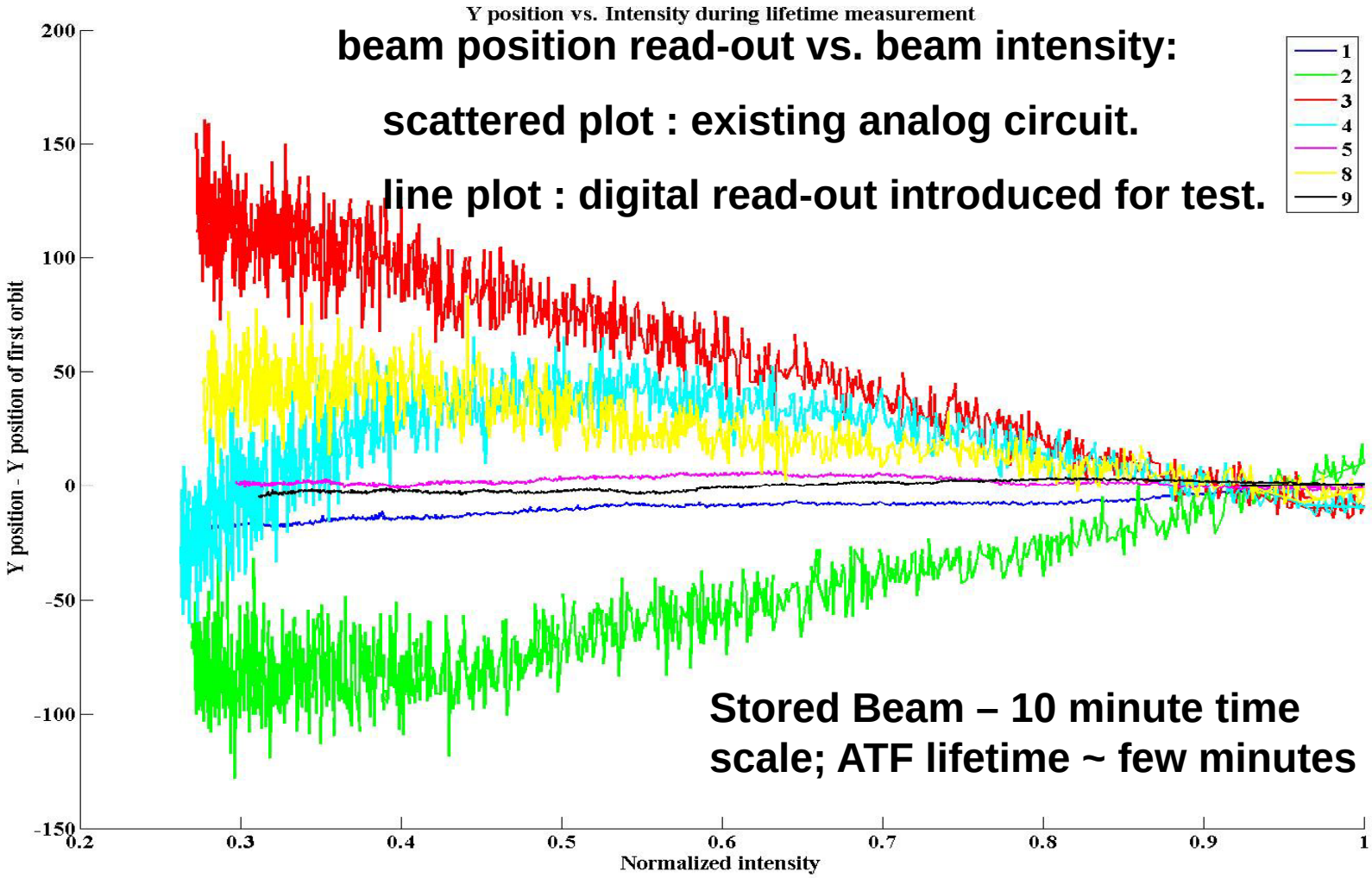


Pulse Train (3000 pulse)
Output from FID Pulser

rise time improvement
by using waveform compensator.

3 ns -> 2.2 ns

DR BPM resolution improvement by digital read-out system (SLAC, FNAL, KEK)



beam position read-out vs. beam intensity:

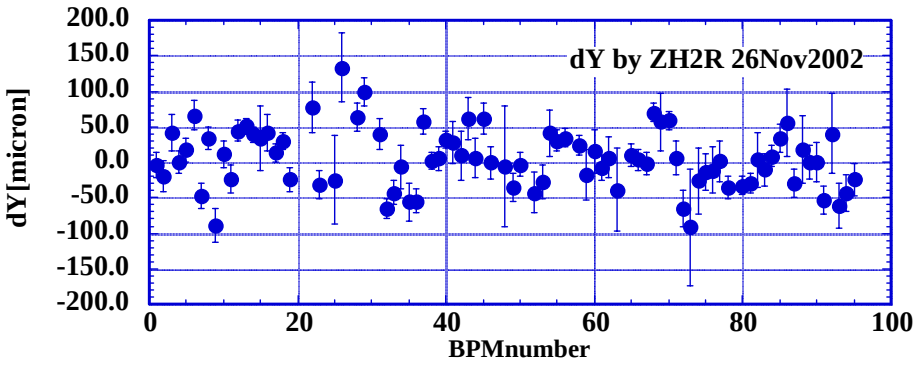
scattered plot : existing analog circuit.

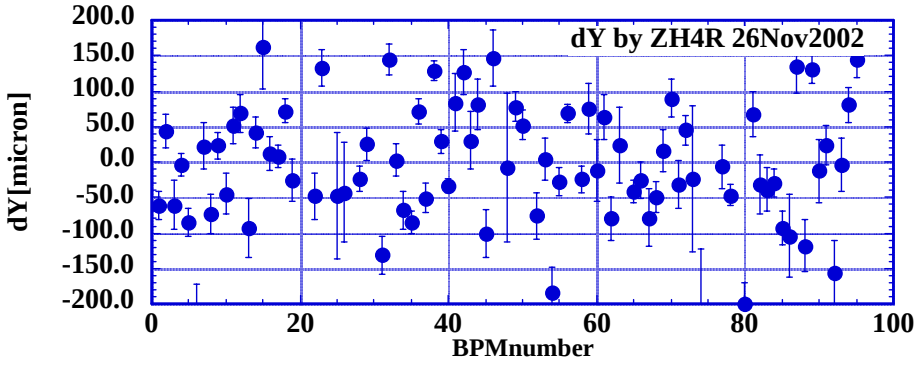
line plot : digital read-out introduced for test.

Stored Beam – 10 minute time scale; ATF lifetime ~ few minutes

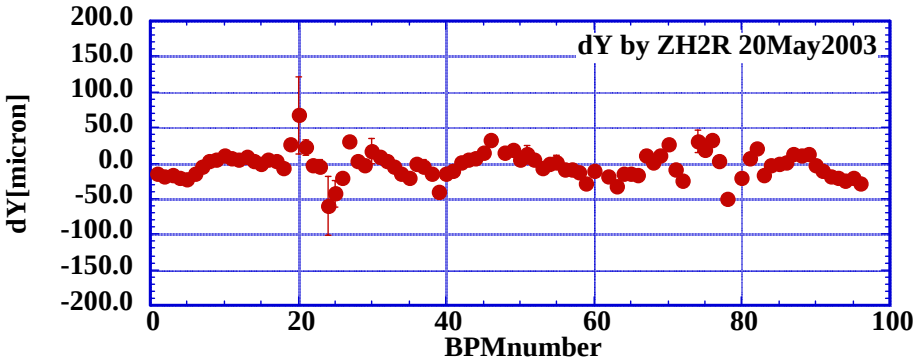
X to Y coupling Improvement

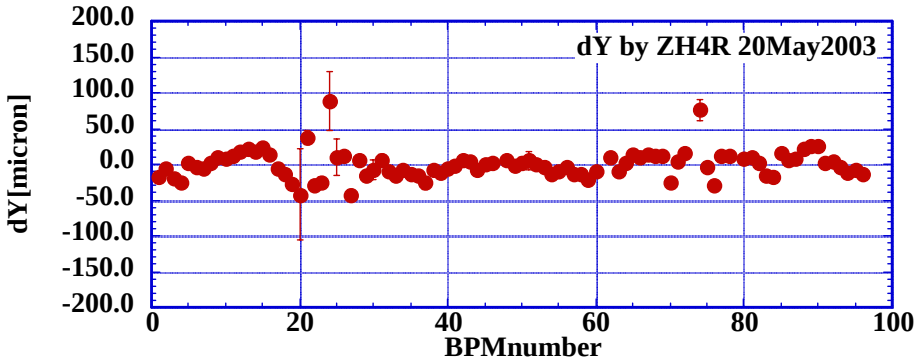
20μm BPM Resolution with old circuit (1997-2002)





3μm BPM Resolution with present circuit (2003-2008)



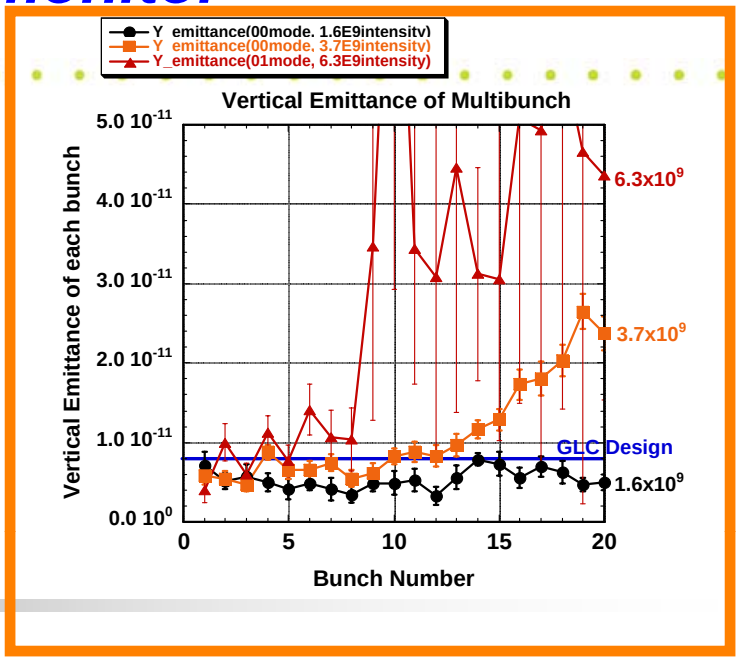


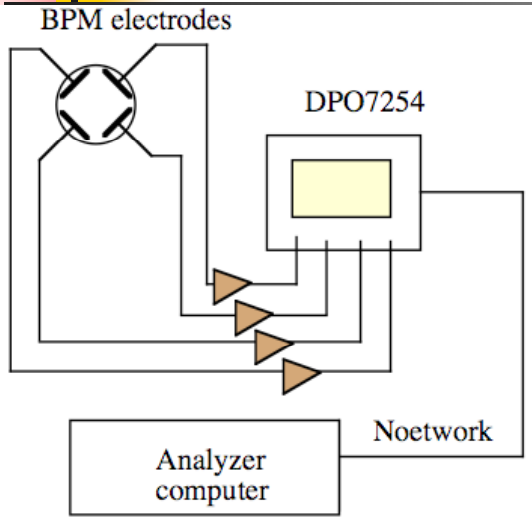
Upgrade of BPM Resolution (~ 0.1μm) with new circuit by SLAC and FNAL. Surely, we will achieve 2pm-rad. Possibly 1pm.

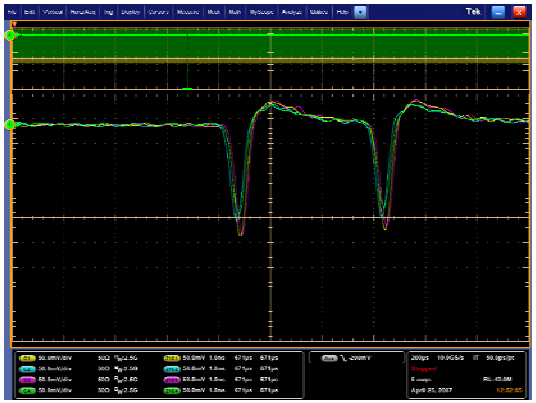
Multi-bunch Turn-by-turn monitor

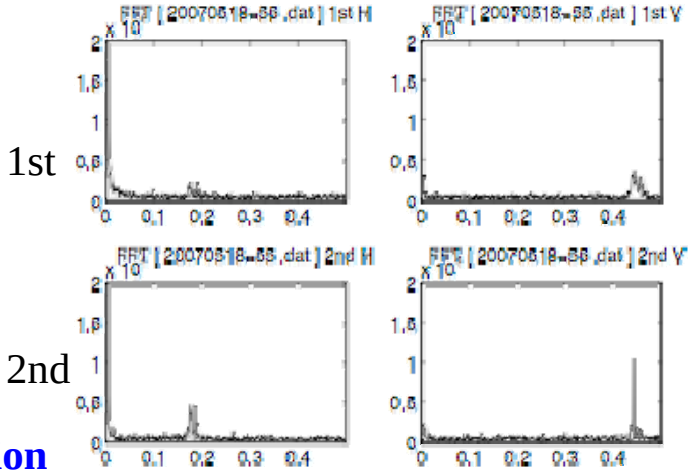
T. Naito (KEK)

The beam blowup at tail bunches was measured by the laser wire in ATF, which is assumed come from FII effect. In order to observe the individual beam oscillation in the multi-bunch beam, multi-bunch turn-by-turn monitor is developing. This monitor consists of front end circuits(amplifier and filter) and DPO7254 scope. The scope can store the waveform up to 2ms with 100ps time resolution.





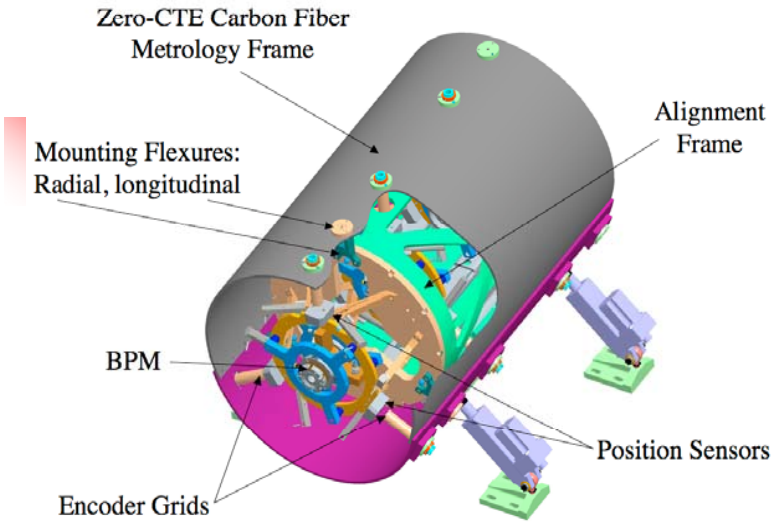


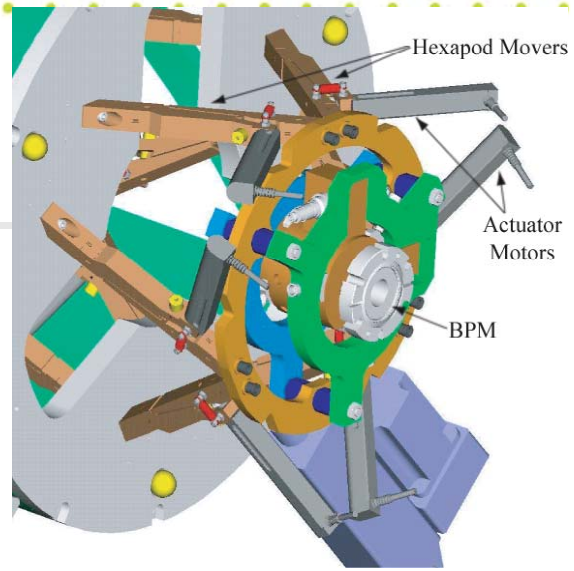


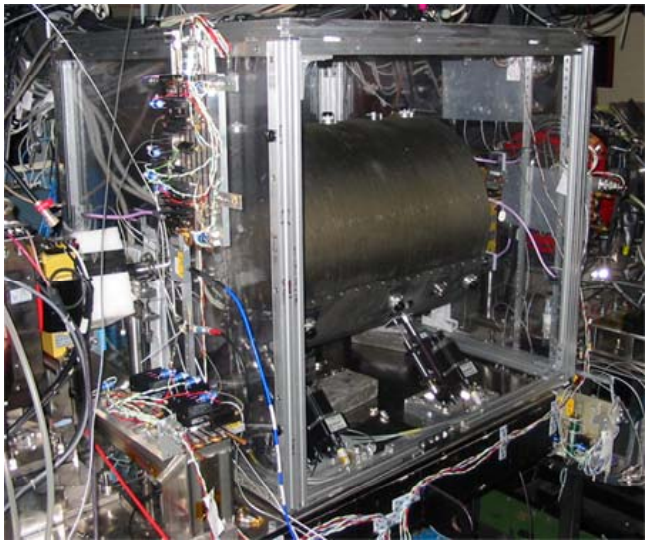
The preliminary results shows the different oscillation amplitude of the tune-X and the tune-Y for the 1st and 2nd bunches at just after injection.

nm resolution BPM

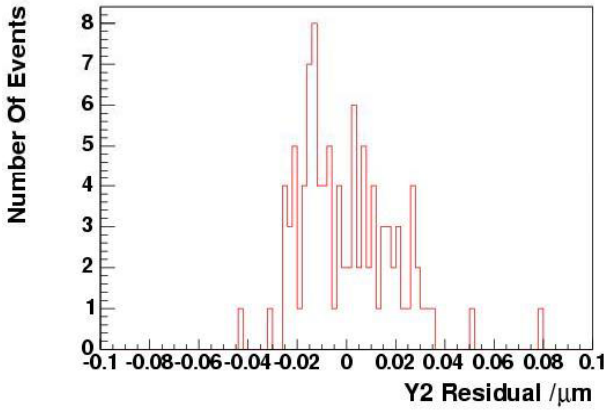
(SLAC, LLNL, UK-University, KEK)







ATF single bunch beam test

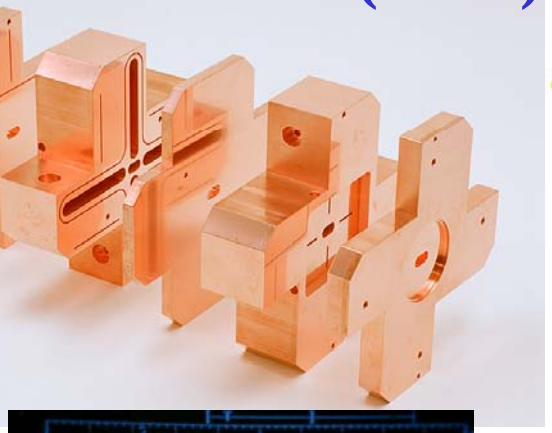


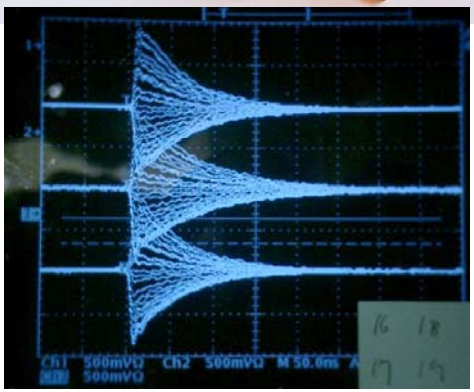
16nm resolution achieved

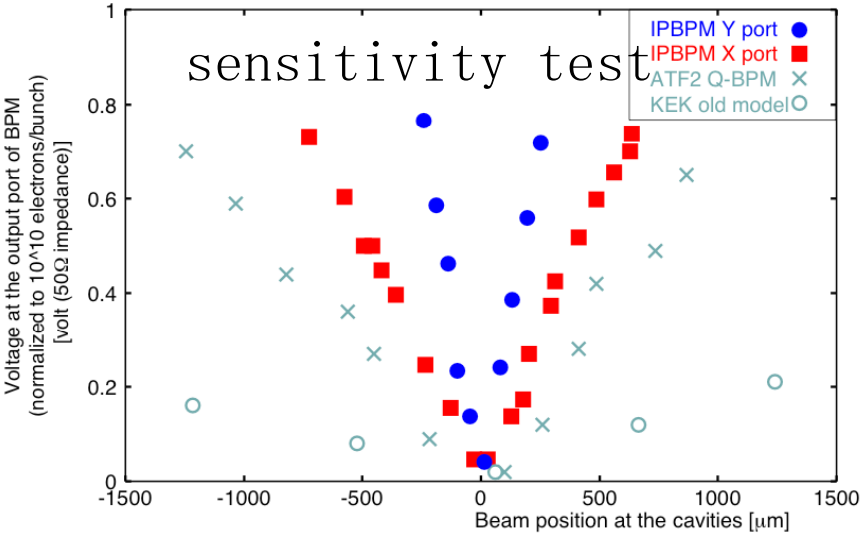
ATF2 IP-BPM

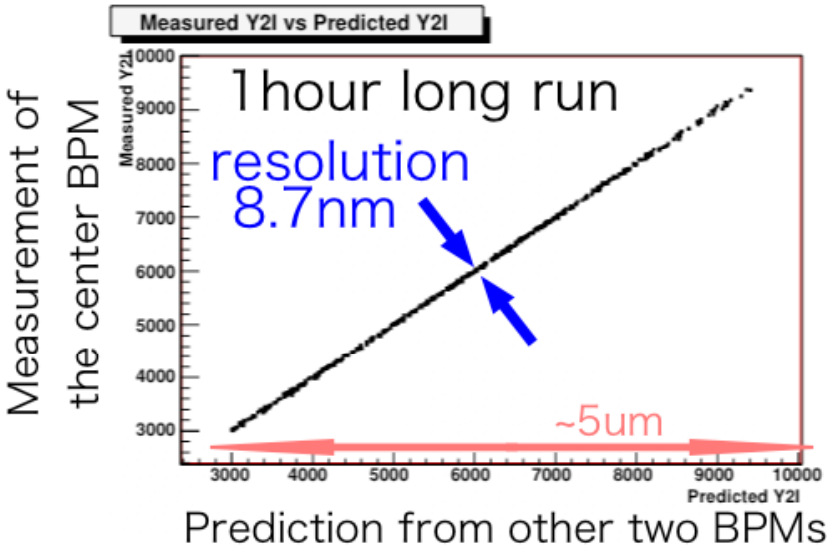
By Yosuke Honda (KEK)

- goal
  - measure beam jitter at the focal point of ATF2
  - produce a feedback signal for beam stabilization
- requirements
  - ultimate high resolution (a few nm)
  - less sensitivity for beam angle
- special cavity BPM
  - rectangular shape (X:5.7GHz, Y:6.4GHz)
  - thin cavity for angle signal reduction
  - small beam tube for high sensitivity
- status
  - various properties were checked with beam (position sensitivity, angle sensitivity, etc.)
  - 8.7nm reslution was achieved by 3-bpm measurement



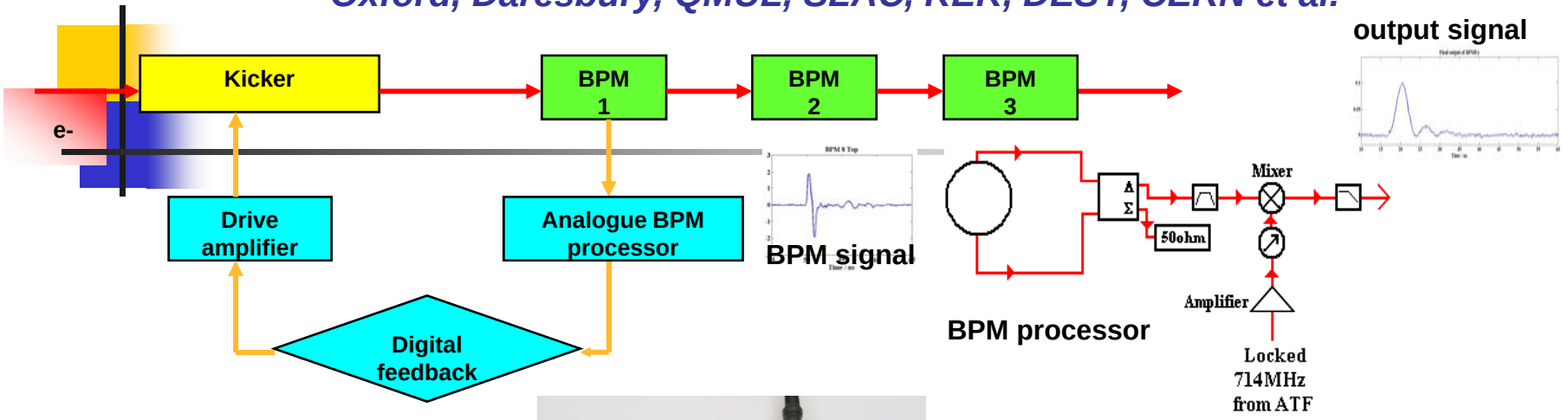






FONT4 : Digital IP feedback R&D at ATF

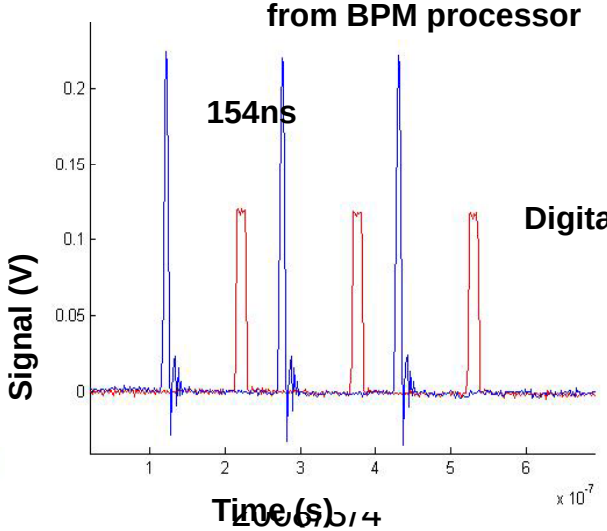
Oxford, Daresbury, QMUL, SLAC, KEK, DESY, CERN et al.



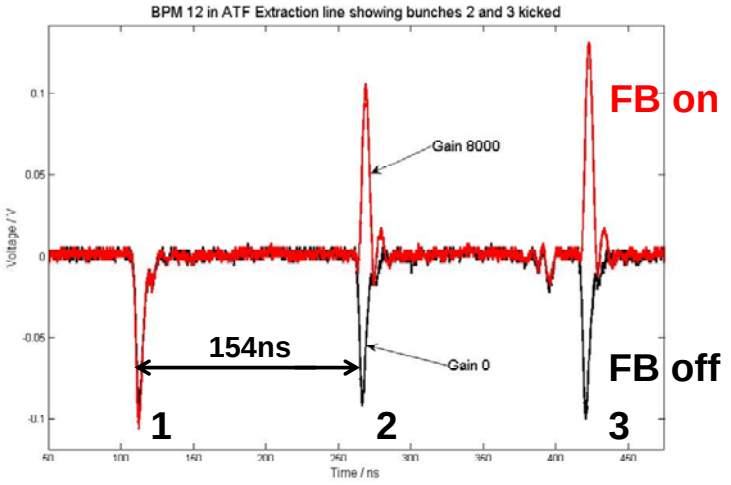
signal pass latency : 25ns
BPM processor:7ns
Digital board:68ns
drive amplifier:40ns ***total:140ns***

Digital Board development

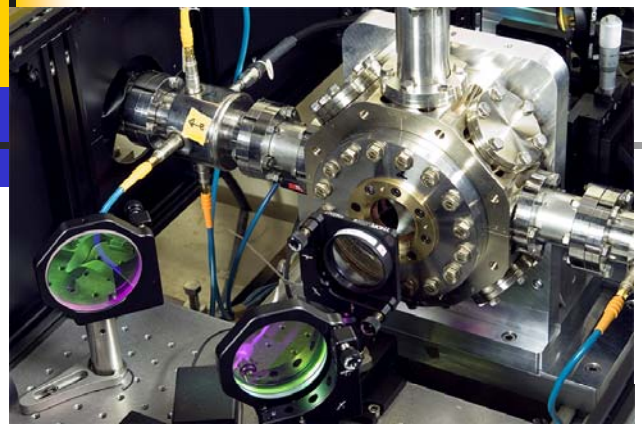
Analogue input from BPM processor

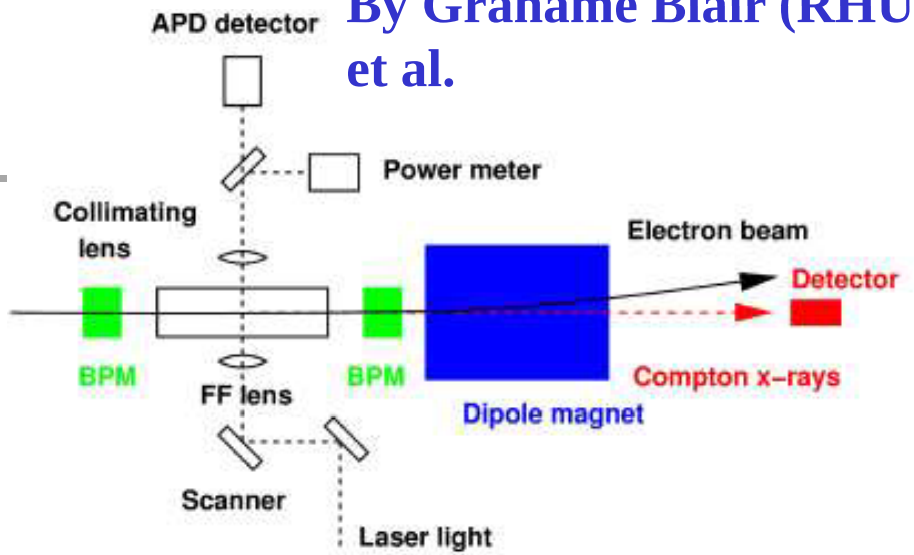


Digital processor output

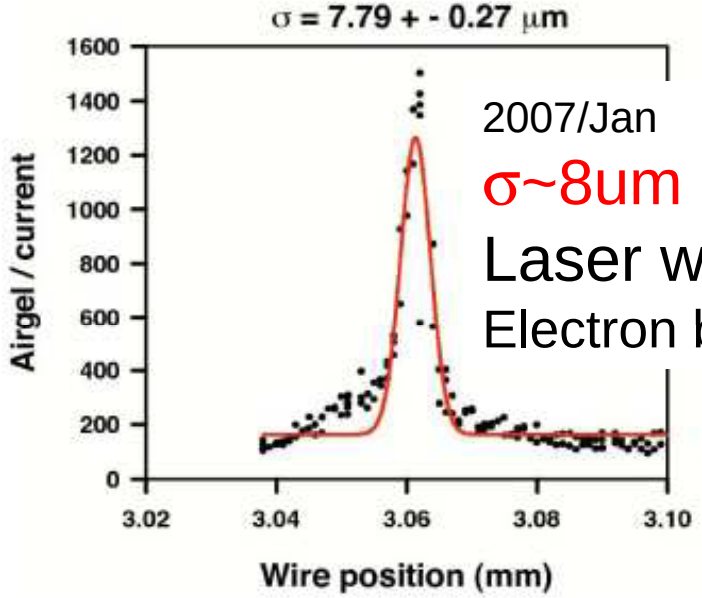


Pulsed Laser Wire R&D





By Grahame Blair (RHUL) et al.



2007/Jan

σ~8um

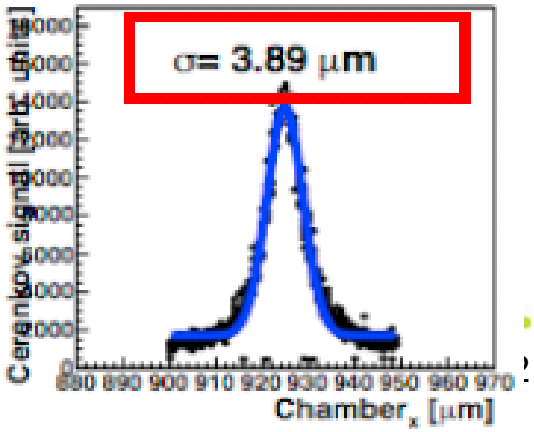
Laser waist :large

Electron beam:σ~1um

ILC design requirement:

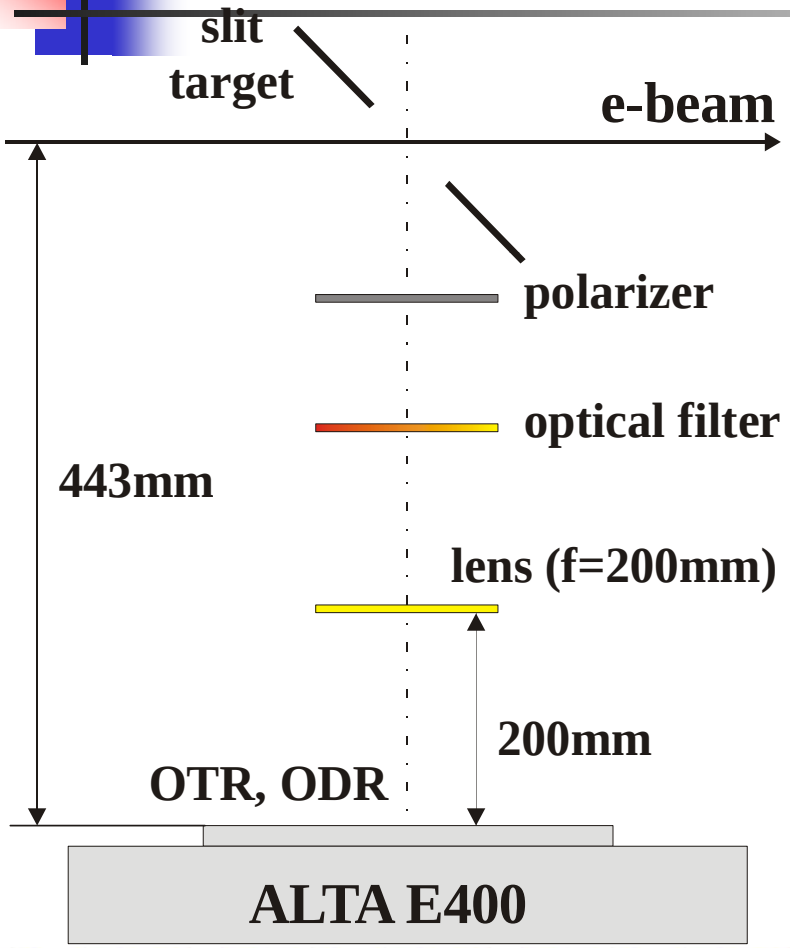
≤1 μm laser wire scanner

2007, Dec. 3.89μm

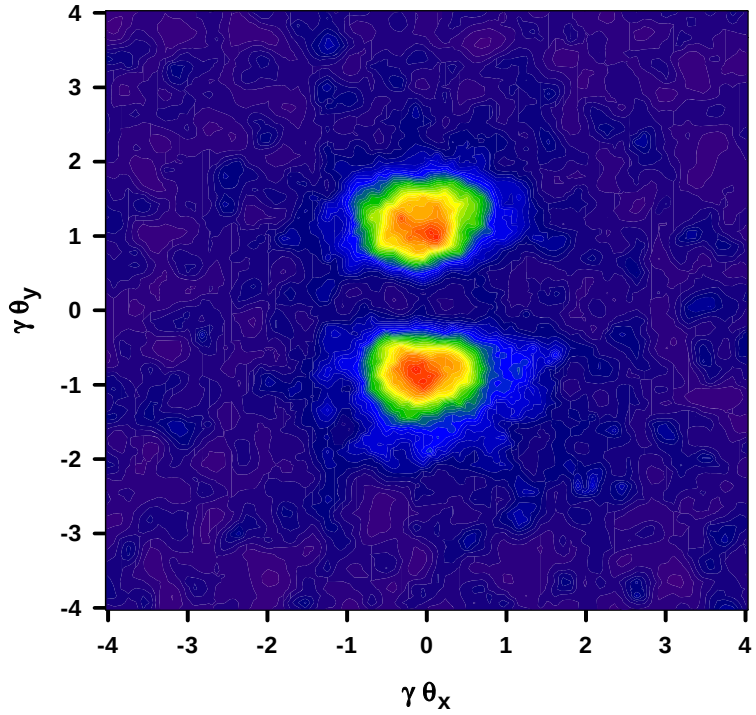


Optical Diffraction Radiation (ODR) beam size monitor (BSM) at KEK-ATF

Experimental layout



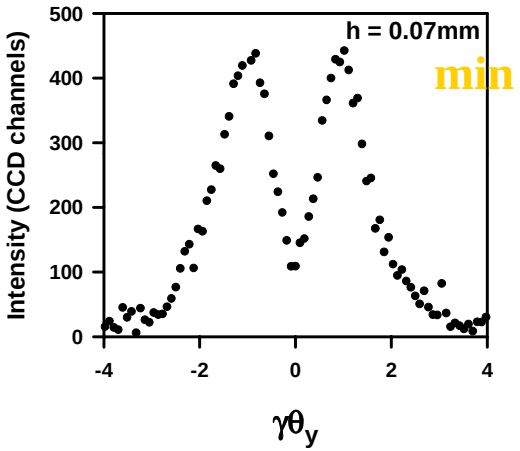
Typical CCD image of ODR vertical polarization component

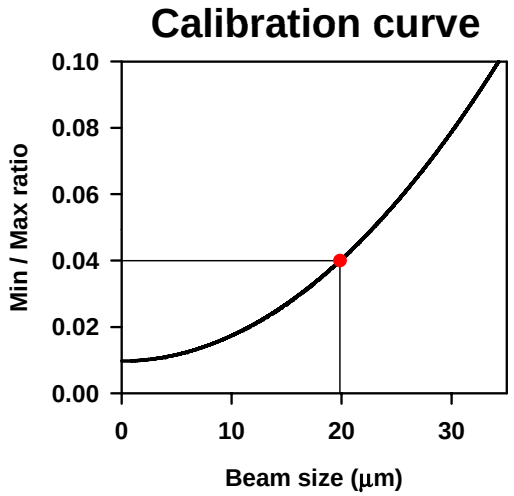


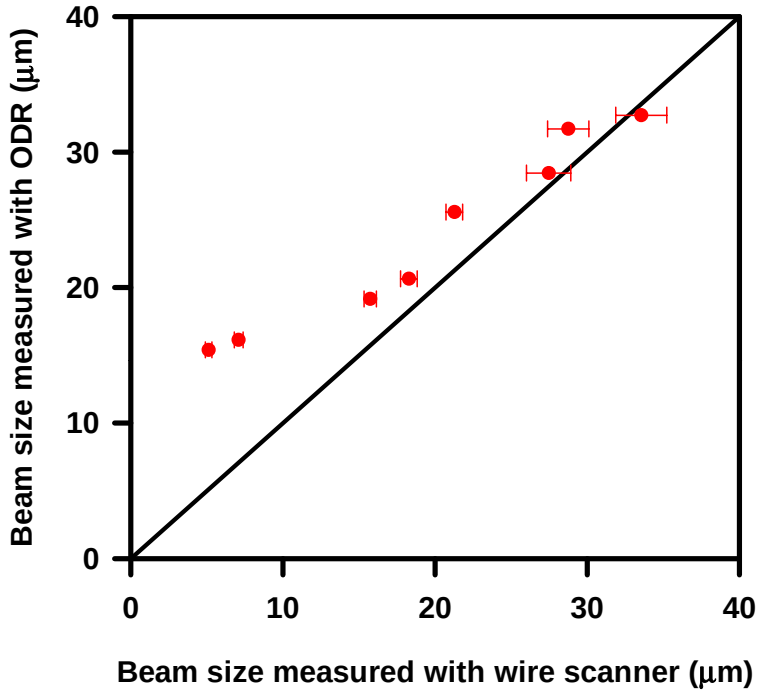
Single-short beam size measurements using ODR

max

Beam size was changed by a quadruple magnet







Plans

In the future we plan to integrate the ODR monitor into the Laser Wire chamber at the ATF2 in order to cover the beam sizes in the range 15-100μm. We also consider synchronization of the ODR measurements with ATF main control system to be able to acquire Beam Position Monitor and current data. In this case a real single shot beam size measurement with ODR will be possible.

Future plans

- ATF-II project
- Fast ion instability study with flat beam
- Fast Kicker R&D
- Feed-forward to stabilize the extracted beam
- High Intensity pol. gamma-ray generation based on Compton Scattering-→Omori's talk

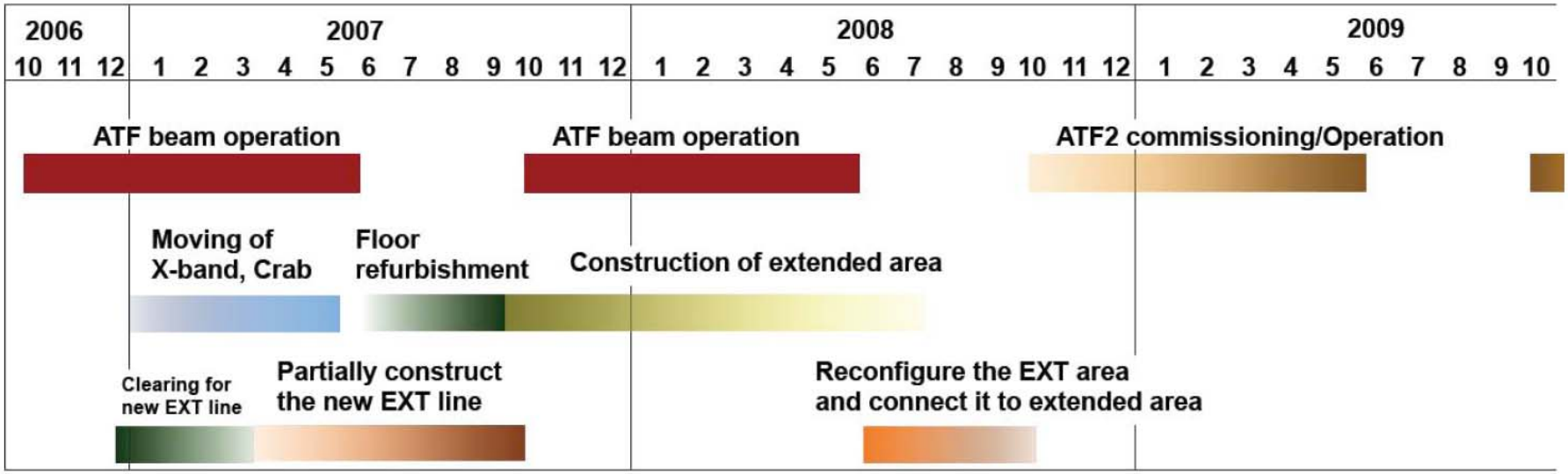
ATF-II Status for BDS R&D

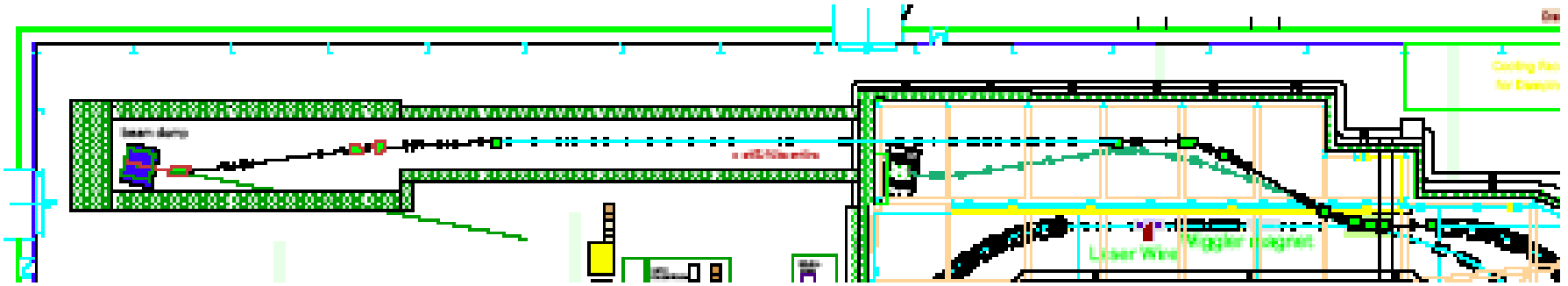
ATF-II Project (35nm Final Focus beam line)

Status

- **Optics&beam line design fixed.**
- **Construction Schedule re-planed and fixed.**
- **Q-magnet from IHEP.**
- **Q-BPM from PAL.**
- **Electronics for Q-BPM from SLAC.**
- **High Availability power supply for magnet from SLAC,**
- **IP-BPM under beam test. (KEK, KNU)**
- **Laser Interference monitor upgraded. (Tokyo Univ.)**
- **Flight Simulator R&D program started.**

ATF2 construction schedule





- **ATF2 beam will come in October, 2008.**

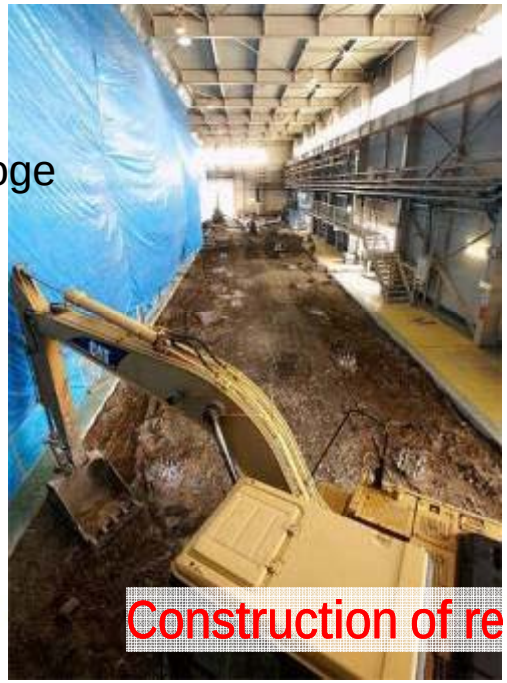
progress in 2007

May – December

Assembly hall before construction

Assembly hall emptied for construction

Photos:
Nobu Toge



Construction of reinforced floor

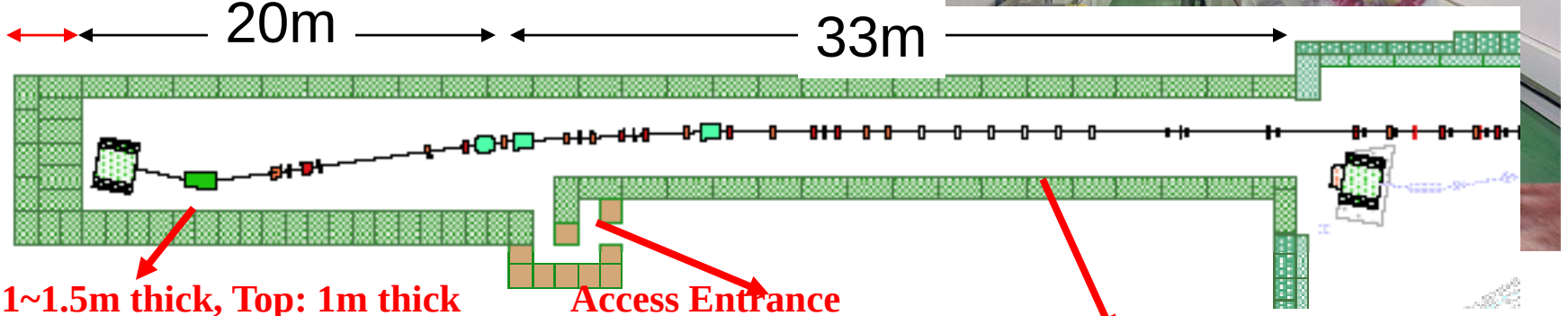
Construction of shielding

ATF2 construction – January 2008

The last regular quadrupole is going to the destination

- ~20 sets of supports, movers & quads were installed in January. R.Sugahara et al.

ATF2 construction present status



Side: 1~1.5m thick, Top: 1m thick

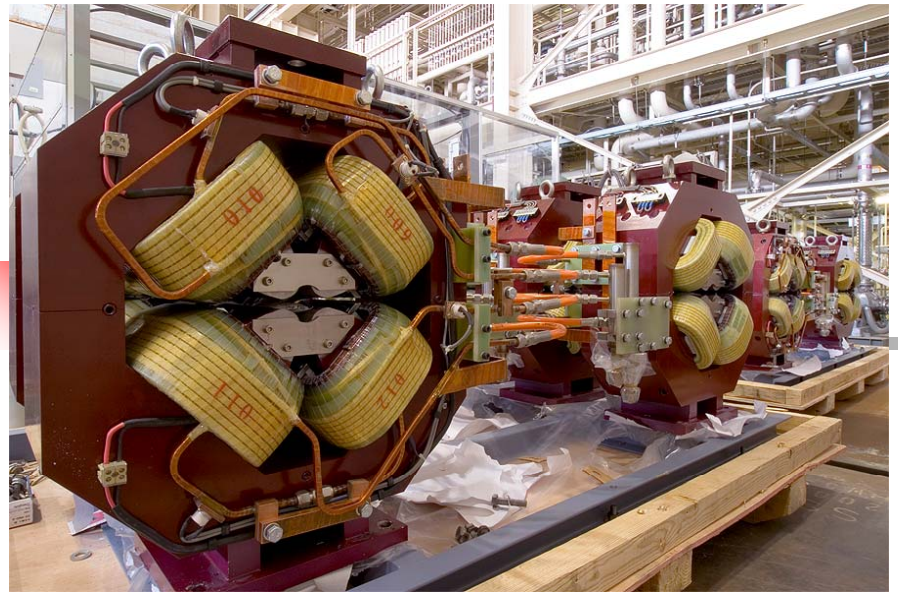
Inner width: 5m

Access Entrance

Moving shield door

Side: 1m, Top: 0.5m, Inner width: 3.5m

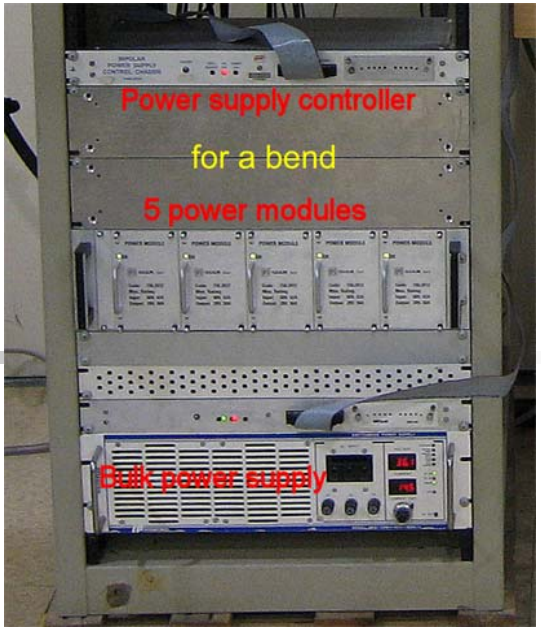
ATF2 development Highlights



Q-magnet from IHEP
(IHEP, SLAC, KEK)
~ 30 magnets were delivered.

Cavity-BPM for Q-magnet from PAL (PAL, KEK)
~ 40 BPMs were delivered.

ATF2 development Highlights

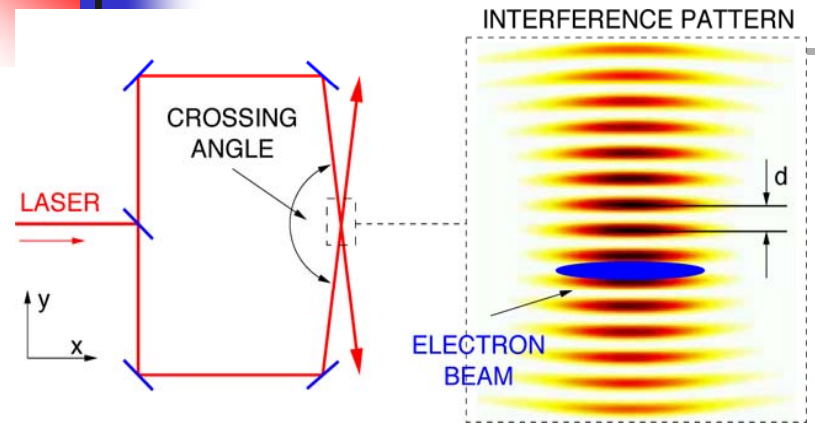


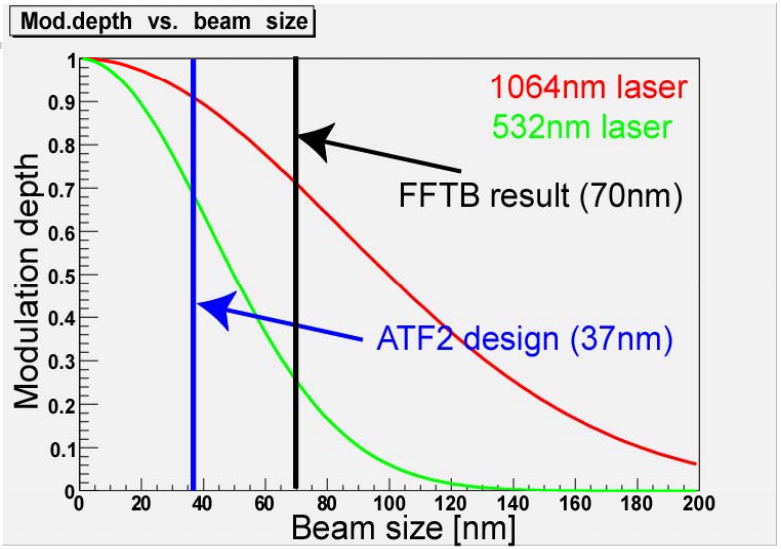
BPM electronics for cavity-BPM (SLAC)
Unit was tested in ATF.
Delivery in 2007.

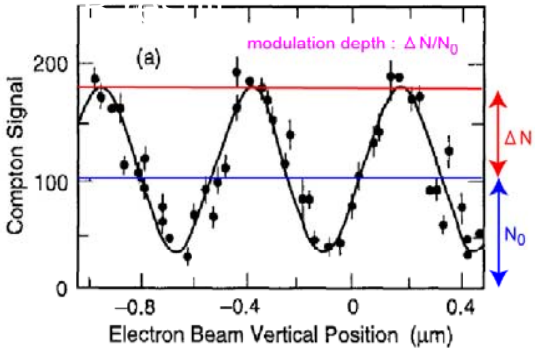
High Availability P.S.
for Q-mag, Bend and Sext (SLAC)
1 unit was tested.
Delivery in 2008.

ATF2 development Highlights

Laser Interference Monitor at ATF2 IP(Tokyo Univ.)







Shintake-monitor result in FFTB

Shintake-monitor from FFTB

FFTB ~70nm -> ATF2 35nm
modification : Laser wavelength
fringe stabilization FB
new gamma detector

Feedforward to Extraction Line to supply stable and very flat beam : Establishment of position stability 1μm (rms) and 10prad vertical emittance at EXT until end of 2009.

Layout of KEK-ATF Extraction Line

nm Fast Feedback

Double kicker
X jitter compensation

μm Feedforward (DR BPM -> EXT Line new stripline kicker)

Cavity BPM (MM1X-MM5X)
sensor cavity

By FONT group

Comments : Schedule for ATF2

- ~~10/1 to 3/31~~ : Beam Dump, Radiation Shield System (mainly concrete blocks), Water Cooling System, Cable Tray and Air-conditioning System
- With above works and effort balance, Rough Alignment, Installation of Racks, Girders and Devices
- Be careful the limitation of the manpower and budget. Also safety.

ATF2 goals

- ~~ATF2 goals~~
  - prototype ILC Final Focus system
  - develop FF tuning methods, instrumentation (laser wires, fast feedback, submicron resolution BPMs)
  - learn achieving ~35nm size & ~nm stability reliably
  - possibly test ILC Final Doublet prototype with beam
- ATF2 final goal – help to ensure collisions of nanometer beams, i.e. luminosity of ILC

Research ATF2 & synergy

- ATF2 design and operation in general
  - give experience in advanced accelerator physics and instrumentation
  - applicable to any linear collider
  - applicable to any single path beamline such as LCLS, XFEL, etc

- Advanced instrumentation & hardware developed at ATF2
  - Laser wires – applicable to x-fels, etc
  - Ultra-fast feedback – can be used e.g. for orbit stabilization in undulator of light source
  - Cavity BPM system & their calibration procedures – applicable to LCLS cavity BPM system
  - High Availability Power Supplies – applicable to sr-light and coherent x-ray sources, e.g. NSLS2 or other user facilities

For consideration of “plan B”

- Essential information
  - Major parts of still undelivered hardware from US: Final Doublets, High Availability Power Supplies, sextupoles – every effort is placed to deliver this hardware as originally planned-→end of April or early May
  - However, the teams for hardware commissioning, which originally were planned to be sent for HAPS, QBPMs, Movers, Extraction line upgrade, will be significantly reduced, with more emphasis on minimal on- or off- site supervision and main work by team of KEK or other collaborator
  - Beamline commissioning – availability of the teams may be reduced, with more emphasis on remote participation
- This, the main effect for the ATF2 schedule is
  - Reduced availability of personnel
  - Reduced motivation may also be an issue

Elements of “plan B” for 2008

- **Focus on studies which may help not to loose time in future, and those that provide opportunities for remote participation**
  - **Improvement in beam quality and stability in the damping ring, reduction in intensity jitter; routine production of <10 pm vertical emittance; production of stable multi-bunch beam; fast reproducibility of machine conditions for high beam quality**
  - **Improvements of beam quality in the extraction line**
- **Hardware priorities in 2008**
  - **Modification of extraction line**
  - **Min hardware for ATF2 beamline – power bends & several quads, with temporary power supplies, to pass the beam to beam dump**
- **Preparation for ATF2 commissioning in 2008**
  - **Focus on developments of the needed tools and of the control system that would allow wider participation in tuning algorithms developments by all collaborators**

ATF2 schedule & Plan B

- ATF2 **original** schedule
  - start of commissioning with beam: Autumn 2008
  - commissioning & beam size studies: 2009
  - assessment of beam size studies: beginning of 2010-2013
- A guess of schedule in the Plan B
  - start of commissioning with beam to dump in min configuration of ATF2 beamline: Autumn 2008
  - finish hardware commissioning for ATF2 beamline: 2009
  - ATF2 beamline commiss. & beam size studies: 2010
  - assessment of beam size studies: 2011-2012
- A more accurate schedule require more information, which is not yet known

At present, our schedule is almost original, not plan B.

Prospect of ATF

- ATF International R&D will generate necessary results for ILC, especially how to control high quality beam, develop many kinds of advanced instrumentation, educate young accelerator physicists and engineers.
- ILC like beam which means 60 bunches with bunch spacing 154nsec, in the future.
- Realization of 35nm beam for long period.