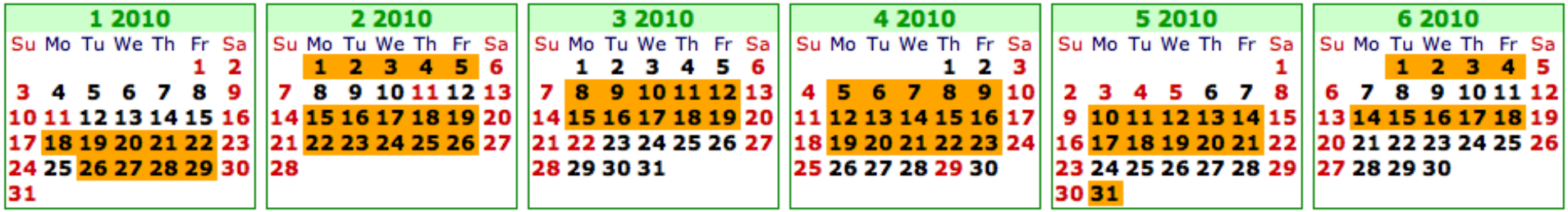
ATF status

Junji Urakawa, KEK

Contents of the status report

- Upgrade of Beam Instruments
  - DR BPM readout (FNAL digitizer)
  - EXT Strip-line BPM readout (SLAC-LCLS digitizer)
  - Multi-OTR monitors
- Upgrade of Accelerator
  - Two LINAC klystron Modulators
  - EXT corrector PS
- R&D
  - Fast Kicker
  - EXT Laser Wire
  - 4-mirror optical cavity installation
  - Cold BPM
  - Single- and Multi-bunch instability

ATF/ATF2: 2010 Jan.-Jun.



1 2010

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

2 2010

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
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28						

3 2010

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
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4 2010

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

5 2010

Su	Mo	Tu	We	Th	Fr	Sa
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2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

6 2010

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

Beam operation: 14 weeks

- Fast kicker mode … 3 weeks
- ATF2 continuous run … 1 week

Major hardware troubles

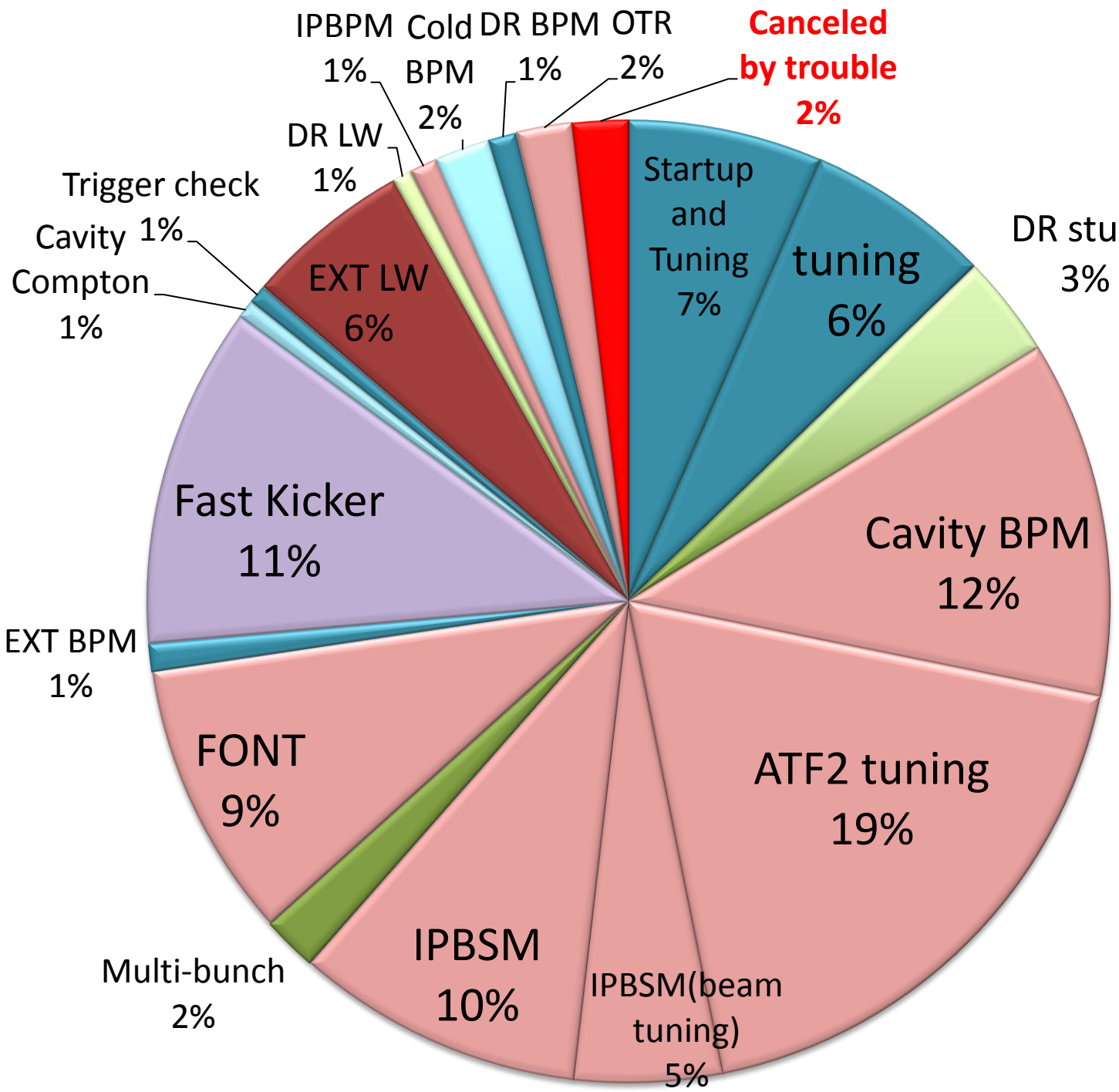
- PS for DR main dipole was broken (lost 2 days).
- CAMAC communication (several hours/day after April, hot days)
- Down of LINAC klystron modulators (several min/event)

Poor quality beams :

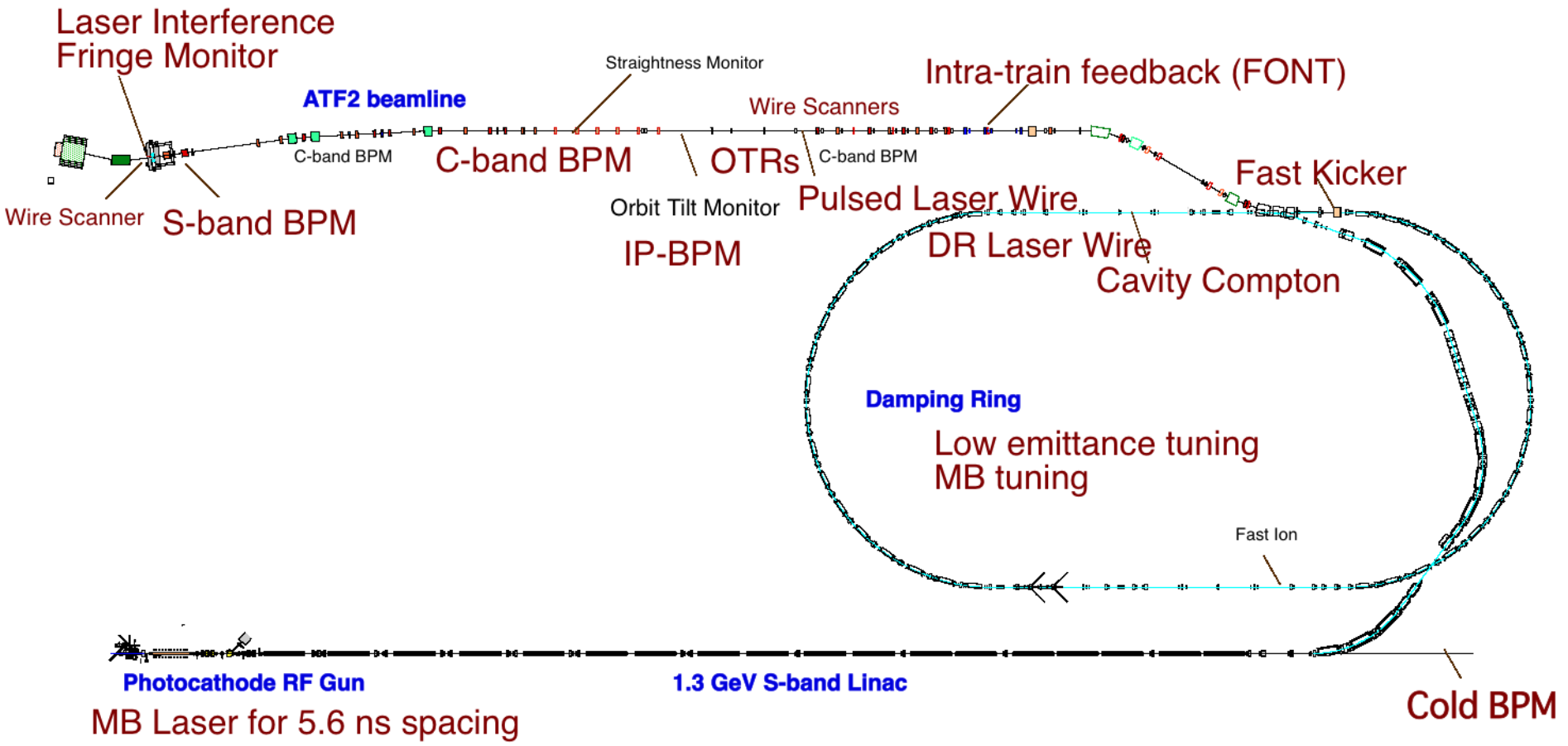
Due to multi bunch instability

lead the inefficient runs : FONT, Cavity Compton , Fast kicker, etc.

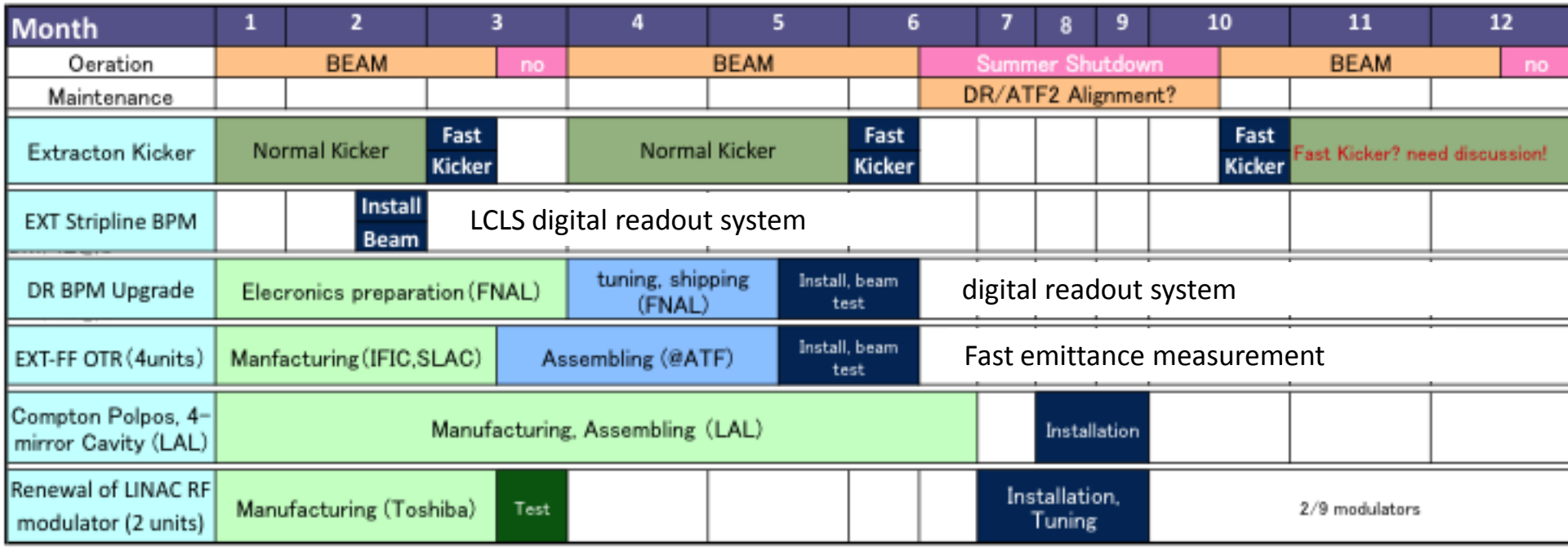
Beam Time Assignment in 2010 (Jan.-Jun.)



R&D: 2010 Jan.-Jun.



Major Hardware Installation in 2010



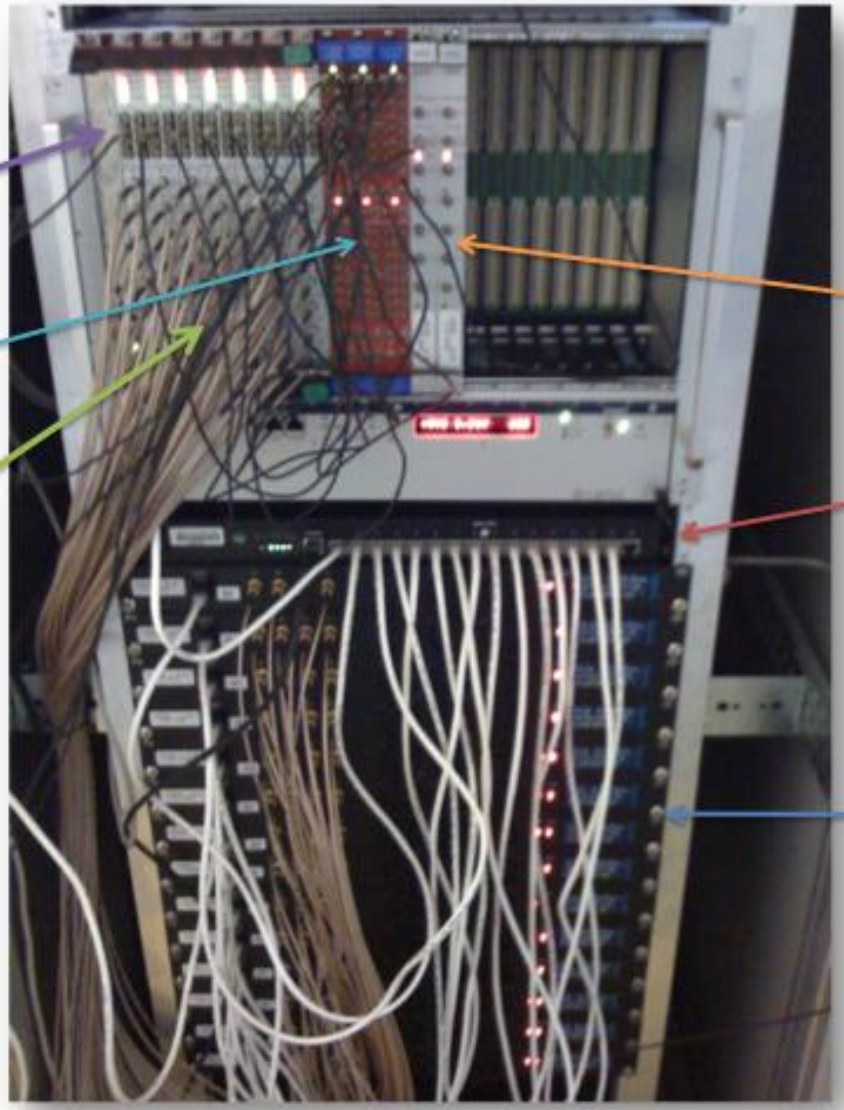
Stripline BPM Electronics Upgrade Report

Glen White

30 June 2010

10th ATF2 Collaboration Meeting

ATF2 Installation



Summary

- New EXT stripline BPMs all setup and available for use.
- Resolutions ~<10um, insensitive to Q.
- MQF4X now working ok after disconnecting and re-connecting cables!
- MQD5X, suspect cables responsible for high gain in x channel (and drift?).
- Configuration, monitoring and control through Matlab GUI
  - Instructions on wiki.

DR-BPM circuit upgrade

New Hardware

Improvements on the analog downconverter

- CAN-bus controls, IF filter, remote diagnostics, etc.

New RF, DC & CAN-bus distribution. Grounding of tunnel hardware.

Switch to in-house VME digitizer

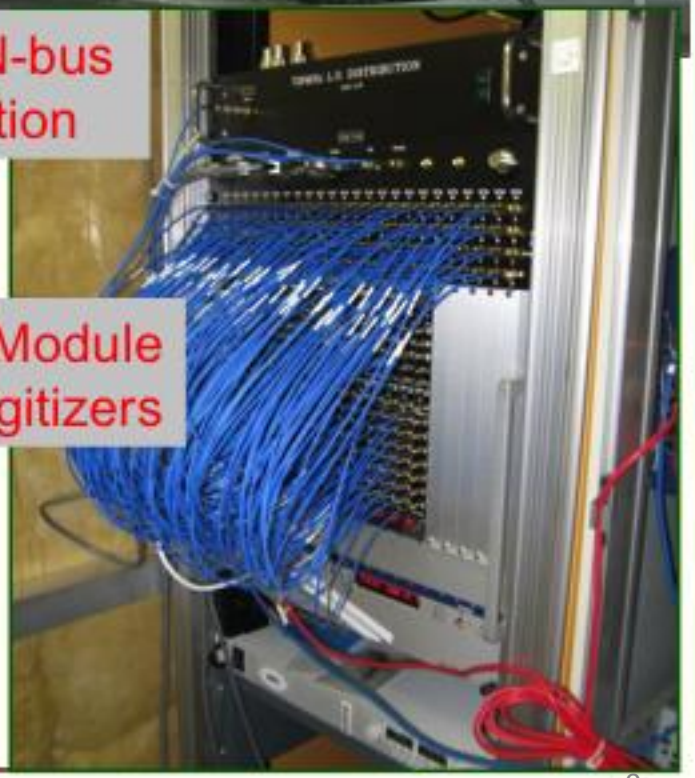
- 8-ch. ,125 MSPS ADC (serial outputs), Cylcone III FPGA, PLL-locked CLK distribution

- Able to measure Injection TBT, Narrowband Orbit, Narrowband Calibration , and Last Turn on every injection

New Downmix & Calibration

LO & CAN-bus Distribution

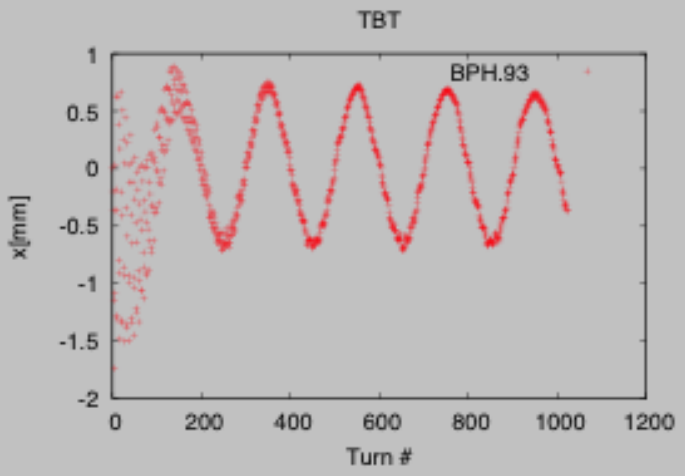
New Timing Module & Custom Digitizers

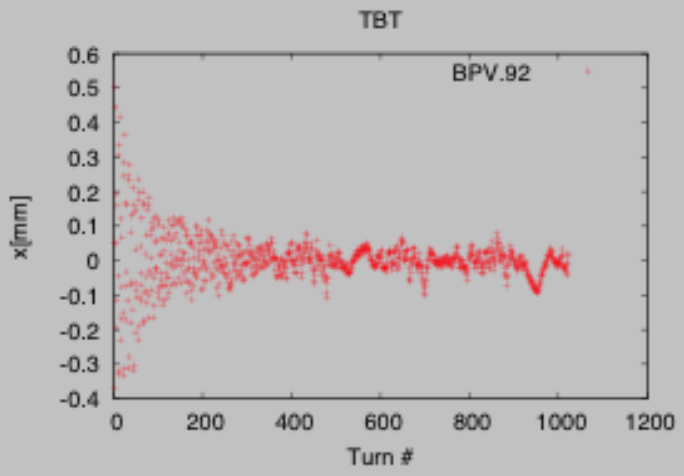


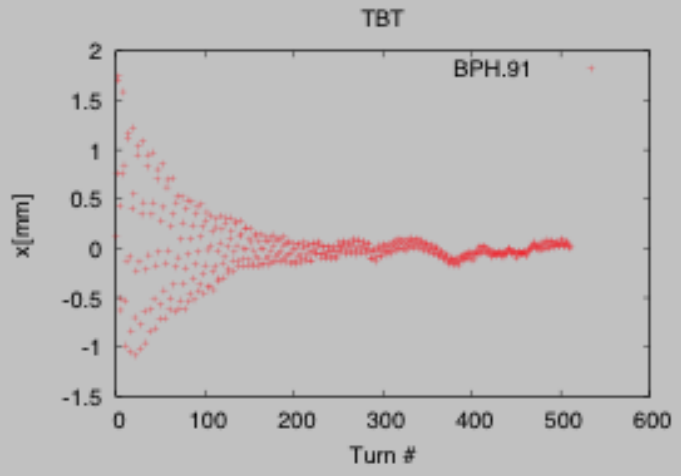
Current Status

- 95 of 96 Ring BPMs were switched to the new system during the May shutdown
- Beam commissioning began the last week of May
  - Initial Timing tests revealed an issue with clock synchronization
  - The echoteks used a 69.2MHz clock (32 samples/turn) synthesized from the 714MHz
    - The turn by turn data collection was initiated by an external turn marker
    - Fine for 1024 turns
  - The new system counts turns internally from injection to provide turn by turn data at any turn and last turn data
    - The synthesized 69.2MHz clock was found to drift over a full machine cycle
    - This caused problems with the turn by turn data at the end of the cycle
  - The solution was to bypass the clock synthesizer on the Timing Module
    - Simply use the clock divider, 714MHz/10 = 71.4MHz (33 samples/turn)
    - Solved the locking issue but required a major system modifications
- Operation of all bpms was demonstrated over the remaining shifts
  - Orbit data was read into the ATF control system
  - First beam studies
    - Two Sets of Narrowband Orbits were collected, without and then with calibration
    - Several Turn by Turn data files were collected both at injection and by kicking the beam after 500k turns

Injection data show large synchrotron oscillations in the horizontal plane.





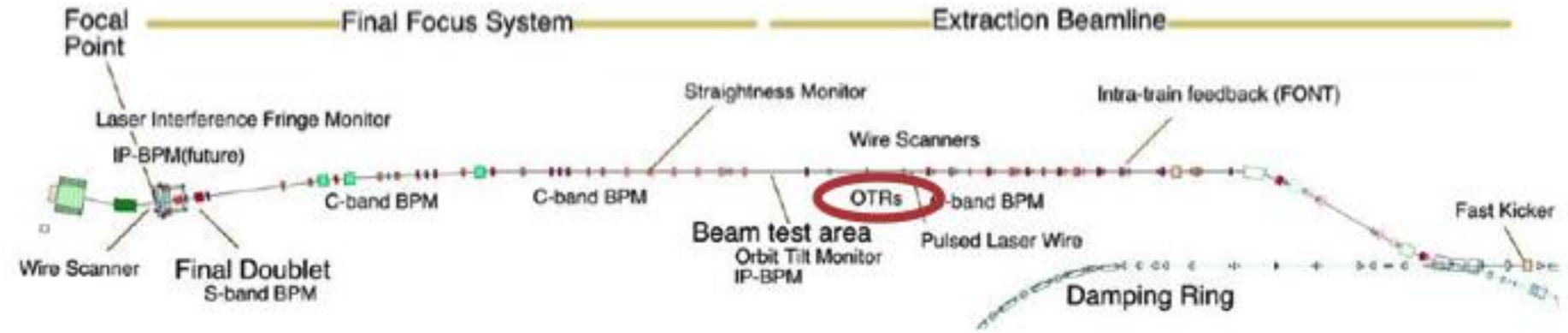


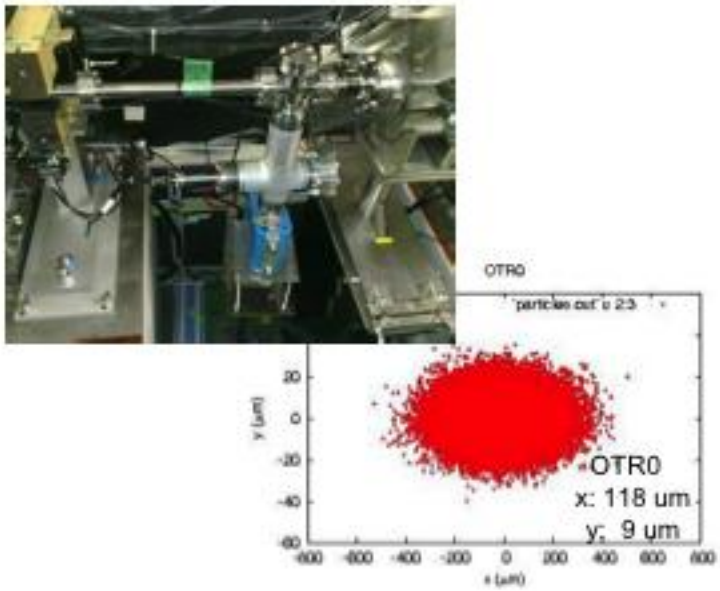
The synchrotron oscillation is fitted and subtracted from horizontal TBT data.

Multi-OTR Status

A.Faus-Golfe, J.Alabau, C.Blanch,
J.V.Civera, J.J.García Garrigós
IFIC (CSIC-UV)
D.McCormick, G.White, J. Cruz
SLAC
and
KEK team

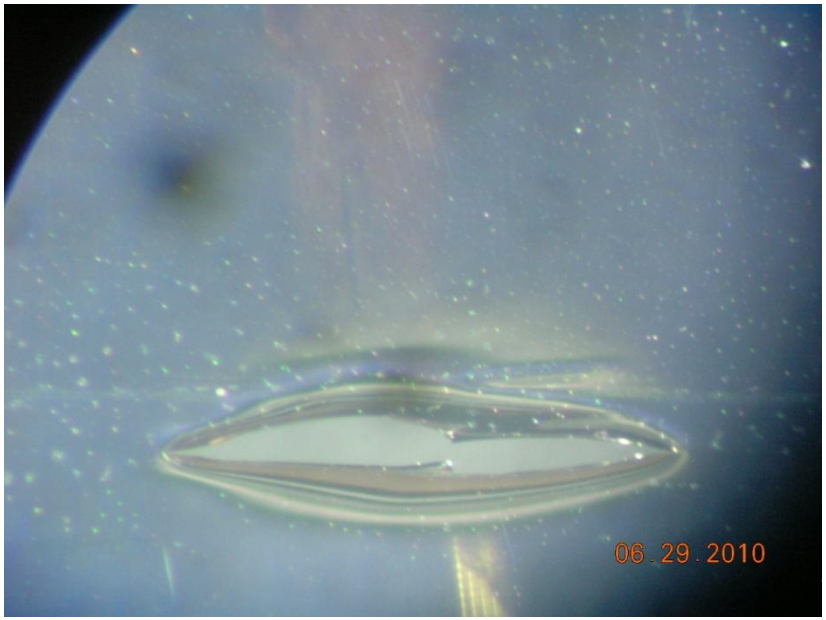
Overview





- **4 OTR monitor** has been installed in the zero-dispersion part of EXT line
- They will take **fast size and emittance measurements** with high statistics
- Design based on existing OTR1X with improved features and **2um resolution**
- They are **installed near WS** for comparison and confirmation of OTR as a beam emittance diagnostic device

First calibration tests with beam



June 2010:

- Exercise and **calibration** of vertical and horizontal **movers** and read-back **potentiometers**

-Tests of 4 OTRs during beam time: beam seen but 3 **targets** (nitrocellulose coated aluminum) **were damaged** ($4x10^9$ e^- per pulse)

-Cameras suffer from radiation, some pixel are dead.

Target research

Ongoing:

-Research about most adequate target material is on going. Possible candidates for the fall running are: aluminum coated mylar, aluminum coated kapton or 100um aluminum foils

- In addition to the new types of targets, we are going to modify the existing target holders to hold a vertical and horizontal 10um tungsten wires. By using the vertical and horizontal movers each OTR can be used as a wire scanner. The normal step size in the vertical plane is 2um and 10um in the horizontal. That way we can compare the size measured by the wire and the size measured by the OTR. Both measurements will be in the exact same Z position so calibration will be easy and unquestionable.

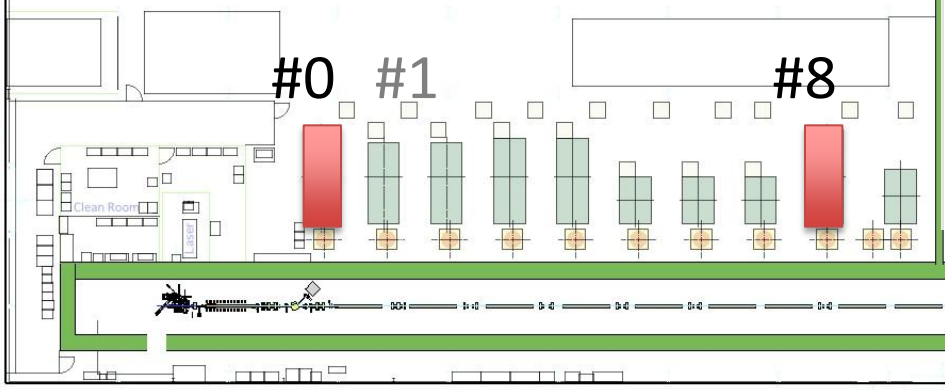
Renewal of the LINAC klystron modulators(#0 and #8)

Manufactured in 1988

- **Availability**
  We had a lot of troubles in past beam operations
- **Stability**
  Inverter charging

Two modulators were manufactured in JFY2009 by stimulated/supplemental budget.

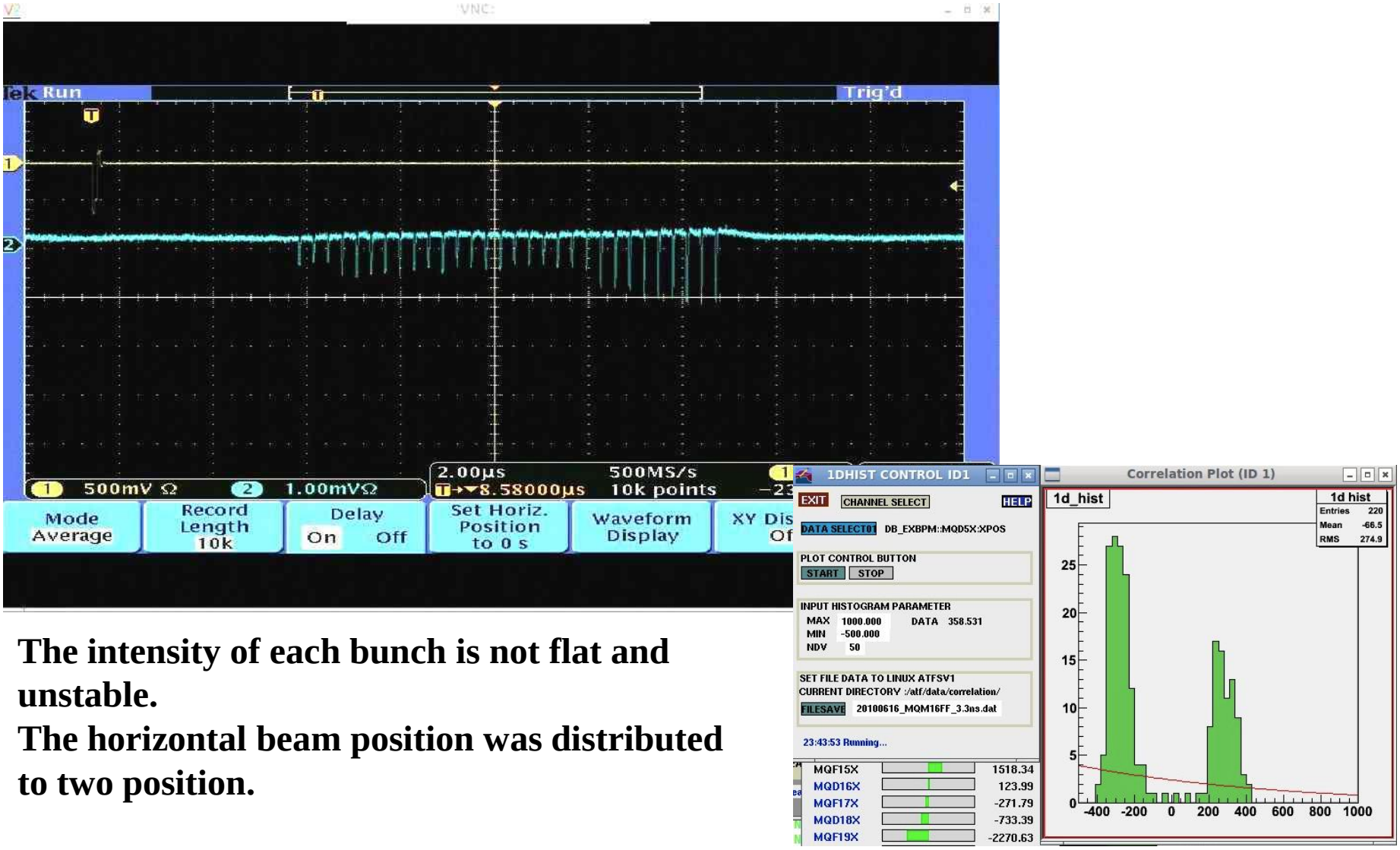
Old modulators were removed.
Operation test of new modulators was done in August.



Upgrade of the ATF2 corrector PSs

- 18 corrector dipoles
- recycled from TRISTAN collider
  - before 1986, 10bits resolution
  - Can not repair (except FAN)
  - No spares
- PLC controlled 16bits
- EPICS
- Installed in Feb.

Fast Kicker Test Results by Naito
Multi-bunch extraction (30 bunches) with 308ns bunch spacing 2010/06/17



The intensity of each bunch is not flat and unstable.
The horizontal beam position was distributed to two position.

Next Beam Test

- **Fast kicker beam test, 2010 Oct. 2weeks**

- **Goal of the next beam test,**

1. **To install and test the pulse train delay circuit.**
2. **To confirm the stable beam extraction up to 30 bunches, and to measure the each orbit of multi-bunch.**
3. **To confirm the long term stability of the fast kicker.**

Royal Holloway
University of London

Micron Size Laser-Wire System at the ATF-II Extraction Line

Alexander Aryshev [c], Stewart Boogert [a], Grahame Blair [a], Gary Boorman [a]
Lawrence Deacon [a], Pavel Karataev [a]
Nicolas Delerue [b], Laura Corner [b], Brian Foster [b]
David Howell [b], Laurie Nevay [b], Roman Walczak [b]
Hitoshi Hayano [c], Nobihiro Terunuma [c], Junji Urakawa [c]

[a] John Adams Institute at Royal Holloway, Egham, Surrey, TW20 0EX, UK
[b] John Adams Institute at Oxford University, Nuclear and Astrophysics Laboratory, Keble Road, Oxford OX1 3RH, UK
[c] KEK, 1-1 Oho, Tsukuba, Ibaraki 305-0801, Japan

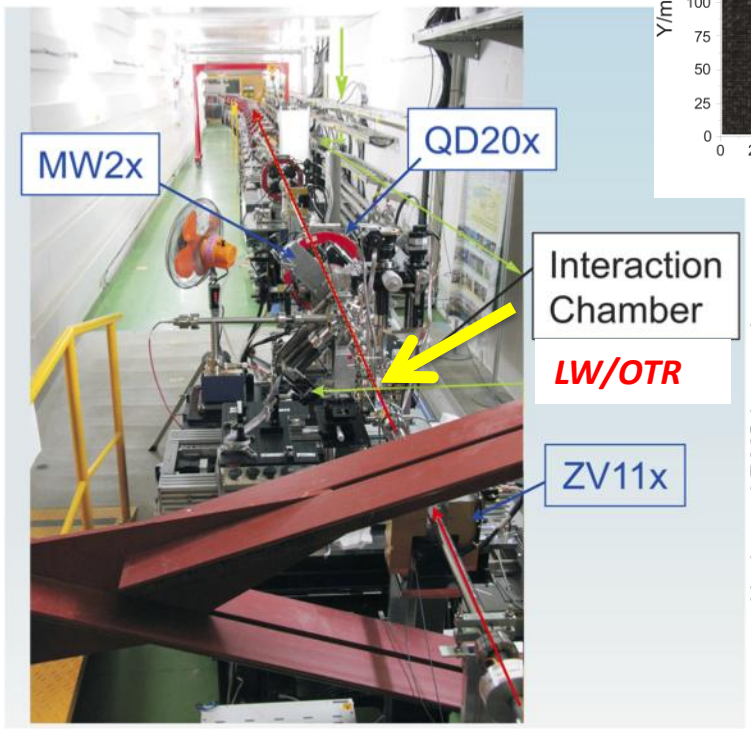
Upgrade of Laser wire monitor

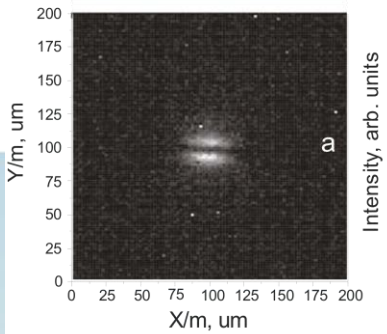
JAI(RHUL,Oxford) / KEK

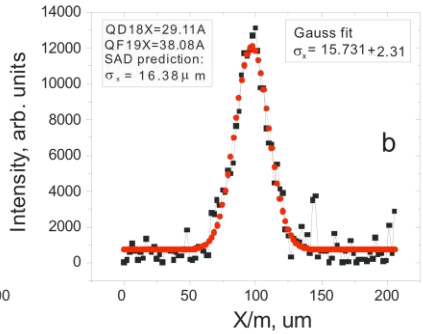
The system has been re-commissioned in the ATF2 after the re-location.

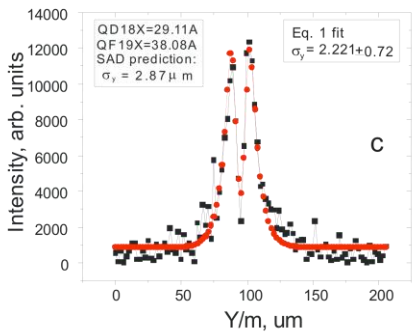
Improvement for ATF2

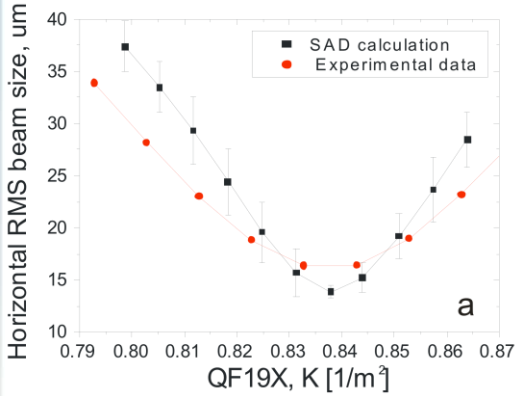
*inclusion of an **OTR target** in the system for **collision optimisation** and **cross calibration**.*

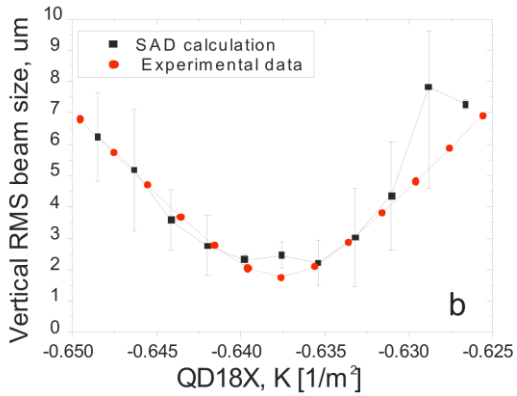












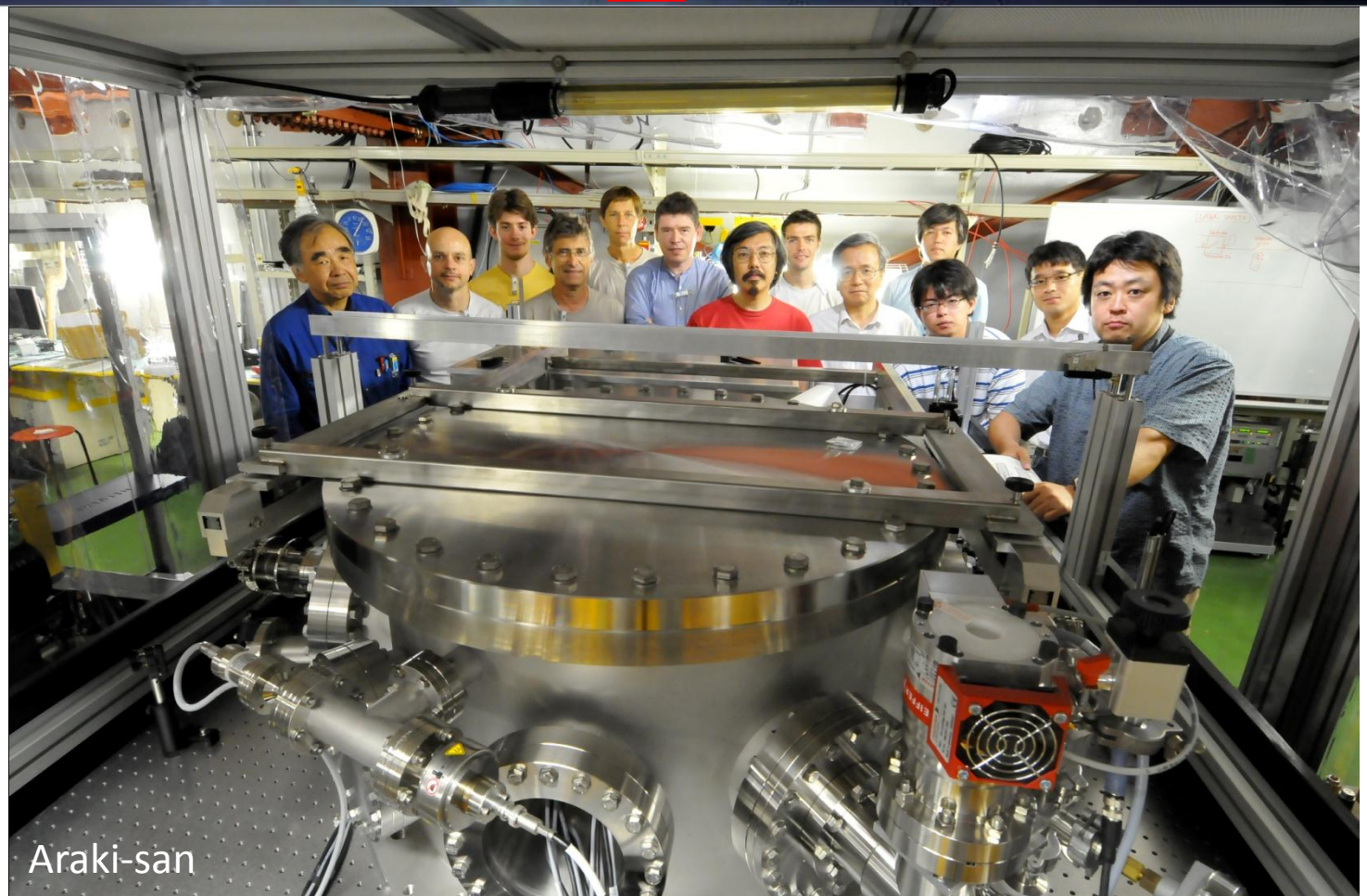
Beam size scanning by LW-OTR

Four-mirror Fabry-Perot cavity R&D at ATF

French Japanese Collaboration

F. Labaye, E. Cormier, CELIA CNRS Université Bordeaux 1, Bordeaux, France
T. Akagai, S. Miyosohi, S. Nagata, T. Takahashi, Hishoshima University, Hiroshima, Japan
S. Araki, S. Funahashi, Y. Honda, T. Omori, H. Shimizu, T. Terunuma, J. Urakawa, KEK, Tsukuba, Japan
J. Bonis, R. Chiche, R. Cizeron, M. Cohen, J. Colin, E. Cormier, P. Cornebise, D. Jehanno, F. Labaye, M. Lacroix,
Y. Peinaud, V. Soskov, A. Variola, F. Zomer, LAL CNRS/IN2P3 Université Paris-Sud 11, Orsay, France
R. Flaminio, L. Pinard, LMA CNRS/IN2P3, Lyon, France

N. Delerue]



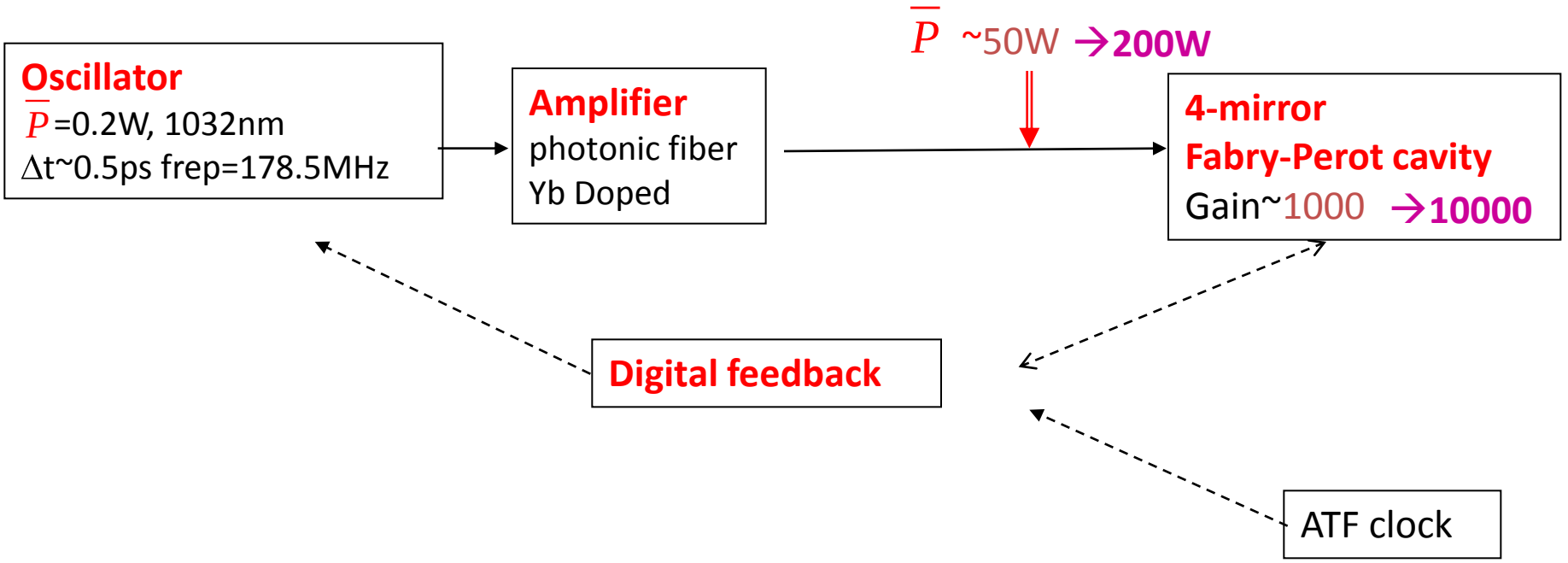
Araki-san

2 steps R&D

Started end 2008

STEP ONE: commissioning a 4-mirror cavity at ATF by end 2010

STEP TWO: upgrade mirrors & laser power



STEP ONE
With cavity laser/coupling ~50% → Power_cavity~25kW

~50x1.5 vs 2-mirror cavity
→~5 E9 γ/s (Emax=28MeV)

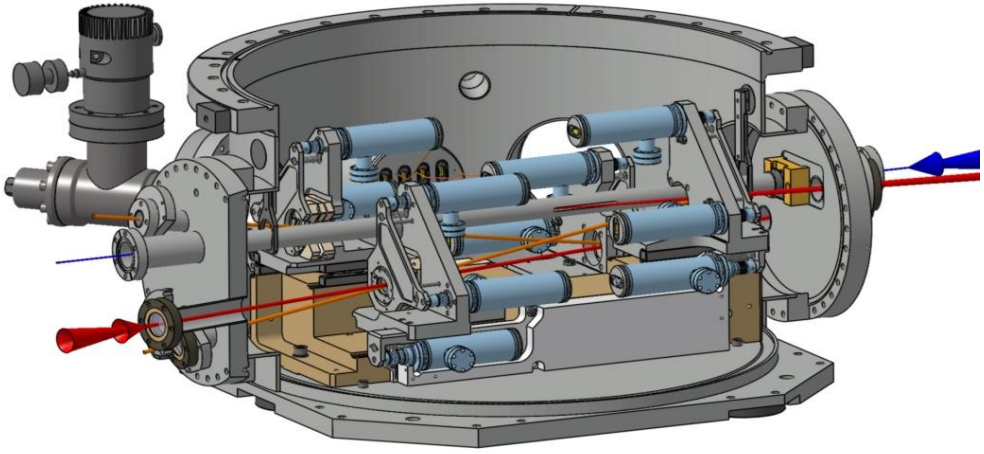
STEP TWO
With cavity laser/coupling ~50% → Power_cavity~500kW

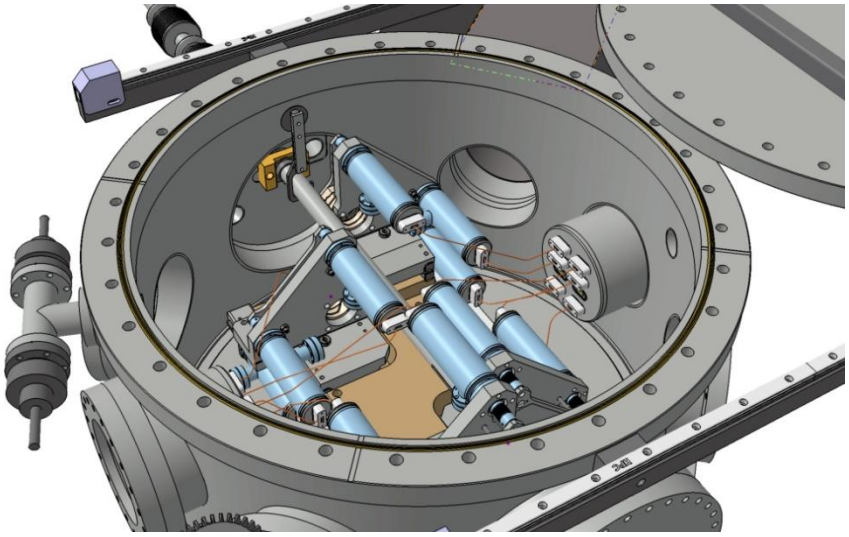
~2000x1.5 vs 2-mirror cavity
→~2 E11γ/s

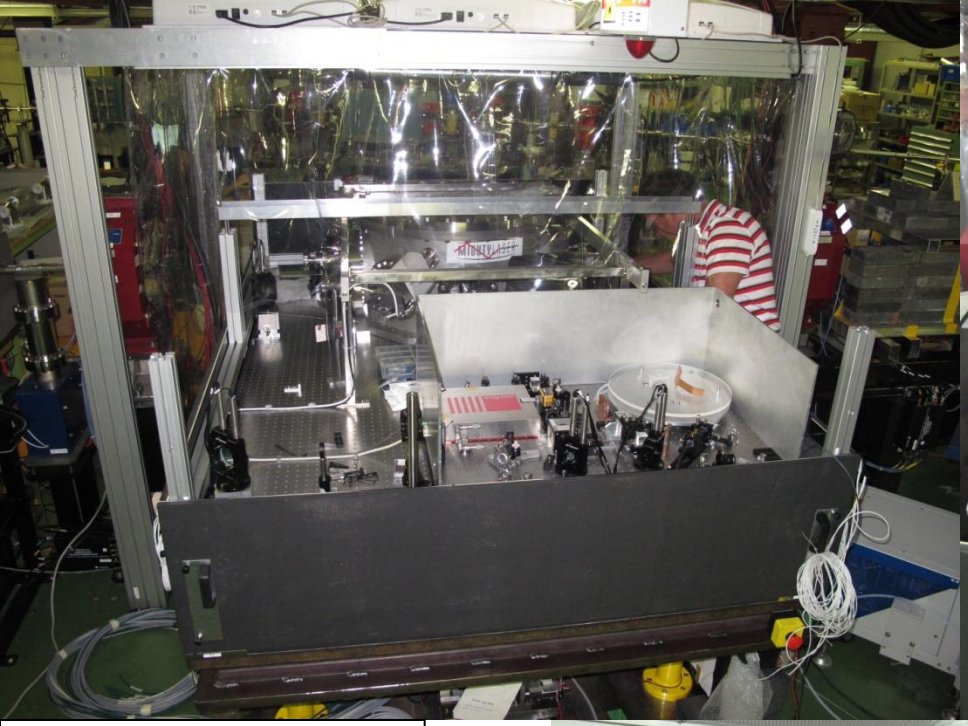
Goal: to reach the MW average power

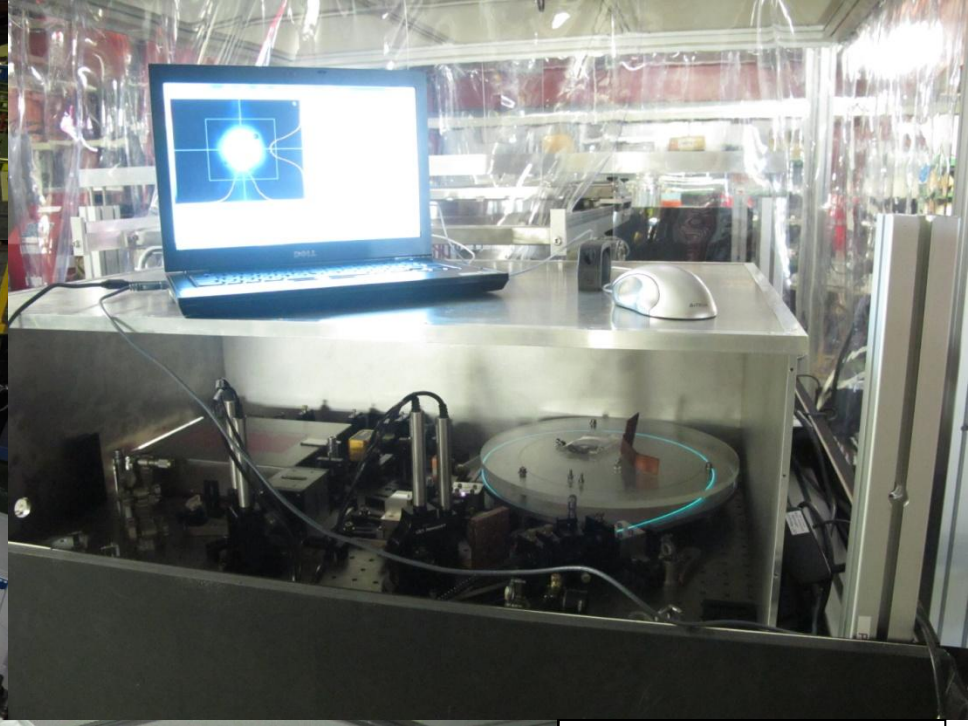
ATF 2-mirror cavity paper: Miyoshi, arXiv:1002.3462v1

Vacuum vessel for ATF









Optical elements mounted

10th August laser turned on (low power) To start cavity mirrors installation

Compton scattering is a very useful process

- But X-section is small➔huge laser power required➔R&D
- There is now a new 4-mirror fabry-perot cavities in ATF to contribute to this R&D effort

2-mirror cavity pulsed laser

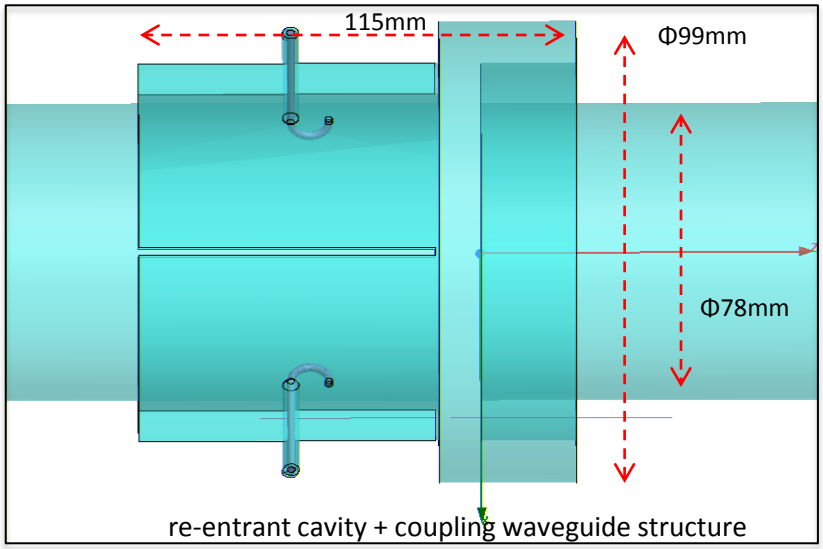
4-mirror cavity pulsed laser

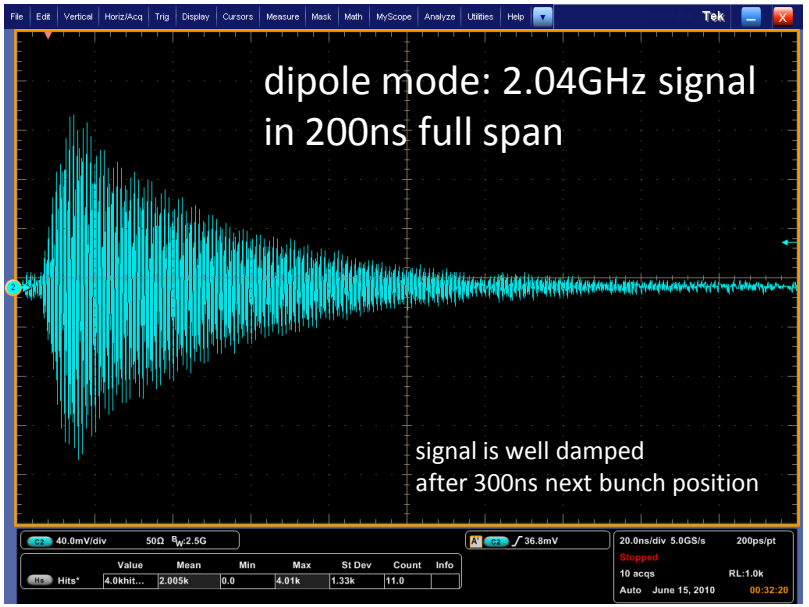
2X 2-mirror cavities cw laser (laser-wire)

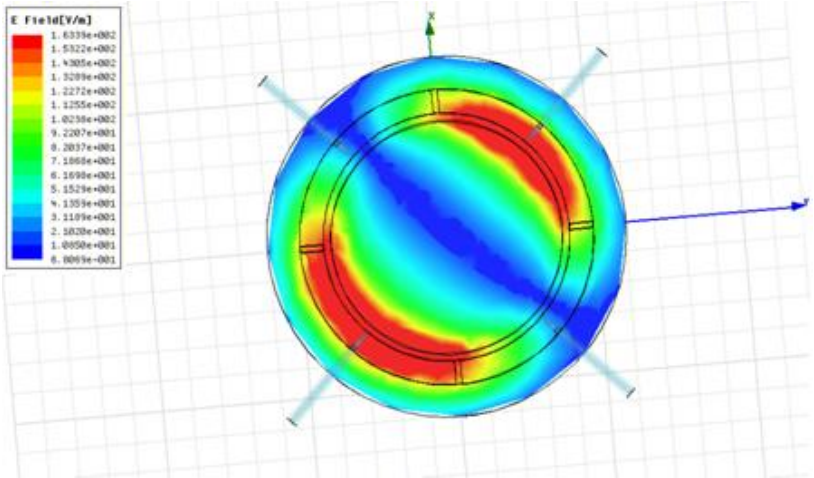
The new cavity has 4 mirrors and is non-planar to match requests of futur Compton e+ polarised sources or compact X-ray machines

R&D of Cold BPM for ILC-ML at the end of ATF LINAC
Beam test of Re-entrant BPM (2.0GHz) for ILC Main Linac

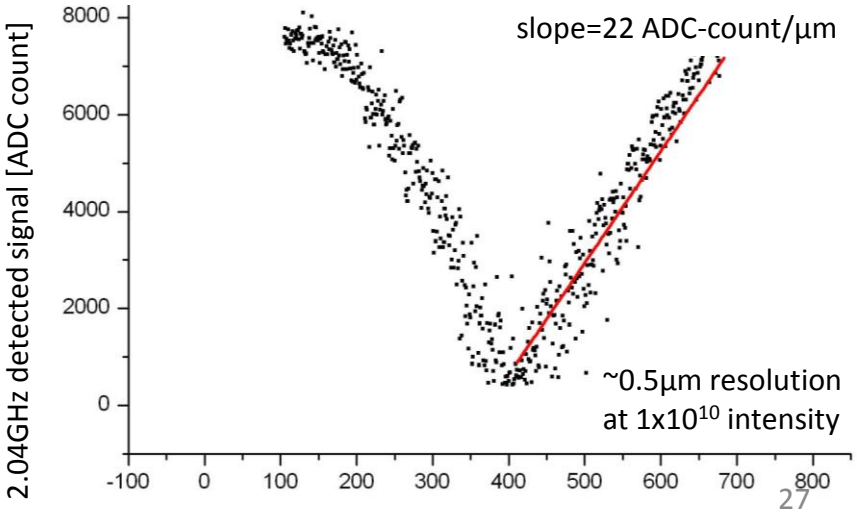
YoungIm Kim (KNU), Jinyeong Ryu (KNU), Sunyoung Ryu (PNU), H. Hayano (KEK)







dipole mode: 2.04GHz



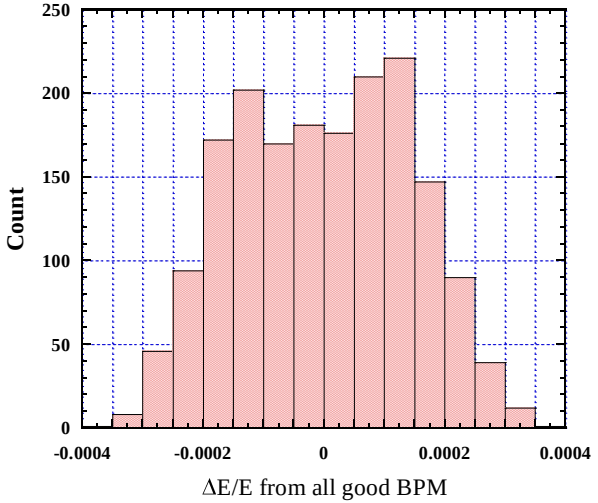
Single bunch - measured longitudinal jitter

Energy: $\Delta E = \Delta x / \eta$ at any location in DR
Use as many BPMs
Energy deviation is expressed as

$$\Delta E = \sum_{\text{BPM}} \Delta x \, \eta_x \Big/ \sum_{\text{BPM}} \eta_x^2 , \quad (\Delta x = x - x_{\text{mean}} \text{ for each BPM})$$

assuming all BPM have the same resolution.

The shape (Non-Gaussian) of distribution suggests synchrotron oscillation.
RMS is about 1.4E-4.
(Natural energy spread ~ 5E-4)



Single bunch - measured transverse jitter

Fit ***a*** and ***b*** for each pulse, using measured position at i-th BPM as

$$x_i = a\beta_{xi}\cos\phi_{xi} + b\beta_{xi}\sin\phi_{xi}$$

$$x_i : \text{measured position (subtracted by } \Delta E\,\eta_{xi}),$$

$$\beta_{xi} : \text{betafunction}, \quad \phi_{xi} : \text{betatron phase}$$

East arc and west arc, separately

	east+west	east-west	**correlated**	uncorrelated
x cos-like (a)	6.114e-6,	3.130e-6	**2.62e-6**	1.57e-6
x sin-like (b)	5.976e-6	3.739e-6	**2.33e-6**	1.87e-6
y cos-like (a)	6.244e-6	5.942e-6	**0.96e-6**	2.97e-6
y sin-like (b)	3.305e-6	3.982e-6	**Imaginary**	1.99e-6

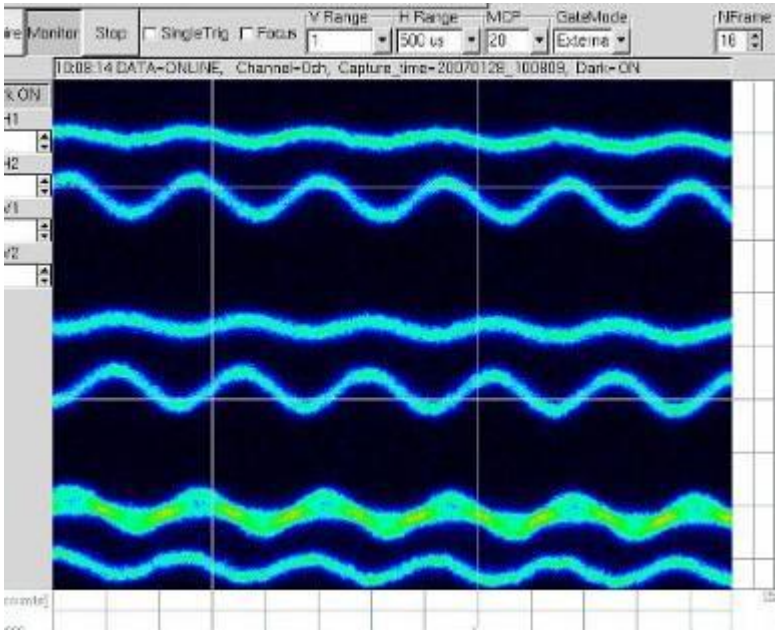
Correlated: Real betatron oscillation

Uncorrelated: Noise (limit of measurement)

→**Horizontal oscillation: 0.1 σ_x (if emittance = 1 nm)**

→**Vertical oscillation: < 0.5 σ_y (if emittance = 4 pm)**

Longitudinal oscillation in tail bunches



Streak camera,
Multi bunch single train
Horizontal axis: long range time
Vertical: short range time
Each line is from one bunch.
(Should be flat for stable bunch)

Tail bunches oscillate larger than head bunches.

[by Naito]

Each line shows on bunch in a train, not in order.

Transient transverse oscillation growth

Can be explained by cavity wakefield

Effectively increase damping time, but should be damped at last.