2nd ILC Workshop 2005 8/18/2005
Thursday, 13:30-15:30, 25+10

Plans for KEK-ATF

J.Urakawa

Multibunch emittance study

High current injection is started. (160mA-210mA)

X, Y emittance will be confirmed by Laser Wire.

Fast Ion Instability (Measurement of bunch dipole motion) is under study.

nm resolution BPM test & demonstration

Development of new precise mover & new cavity-BPM electronics.

3nsec fast kicker demonstration

Reliability test and the upgrade are under way.

This fast kicker is ideal tool to study non-linear field of magnets with good turn-by-turn BPM.

Fast feedback or feedforward test & demonstration

Test by 1 bunch & 3 bunches (about 150nsec bunch spacing) extraction will be done.

Extracted beam stabilization will be started soon because the ideal beam to develop nm BPM and to find the emittance coupling source is essential.

Instrumentation developments

LW, XSR monitor, ODR monitor, Alignment study, etc

ATF2 is under Construction. The floor refurbishment will be done from June to Oct. 2007. Beam commissioning will start on Jan. 2008.

Multibunch emittance study

Monitors of MB emittance

MB (or projected) Laser-wire

Projected SR interference monitor,

X-ray SR monitor

MB (or projected) wire scanner:

(EXT-line coupling problem?)

Problem of MB emittance

Fast Ion Instability ?

Before extraction kicker replacement.

Scrubbing of DR was started

DR pressure should be < 7 x10^{-7} Pa for 1% emittance ratio

for 1.0 x10^{10} e^-, 20 bunches, (=67mA) 0.78Hz repetition

so far, >1 x10^{-6} Pa

After extraction kicker replacement from this Oct. operation.

Prospect of following beam operation

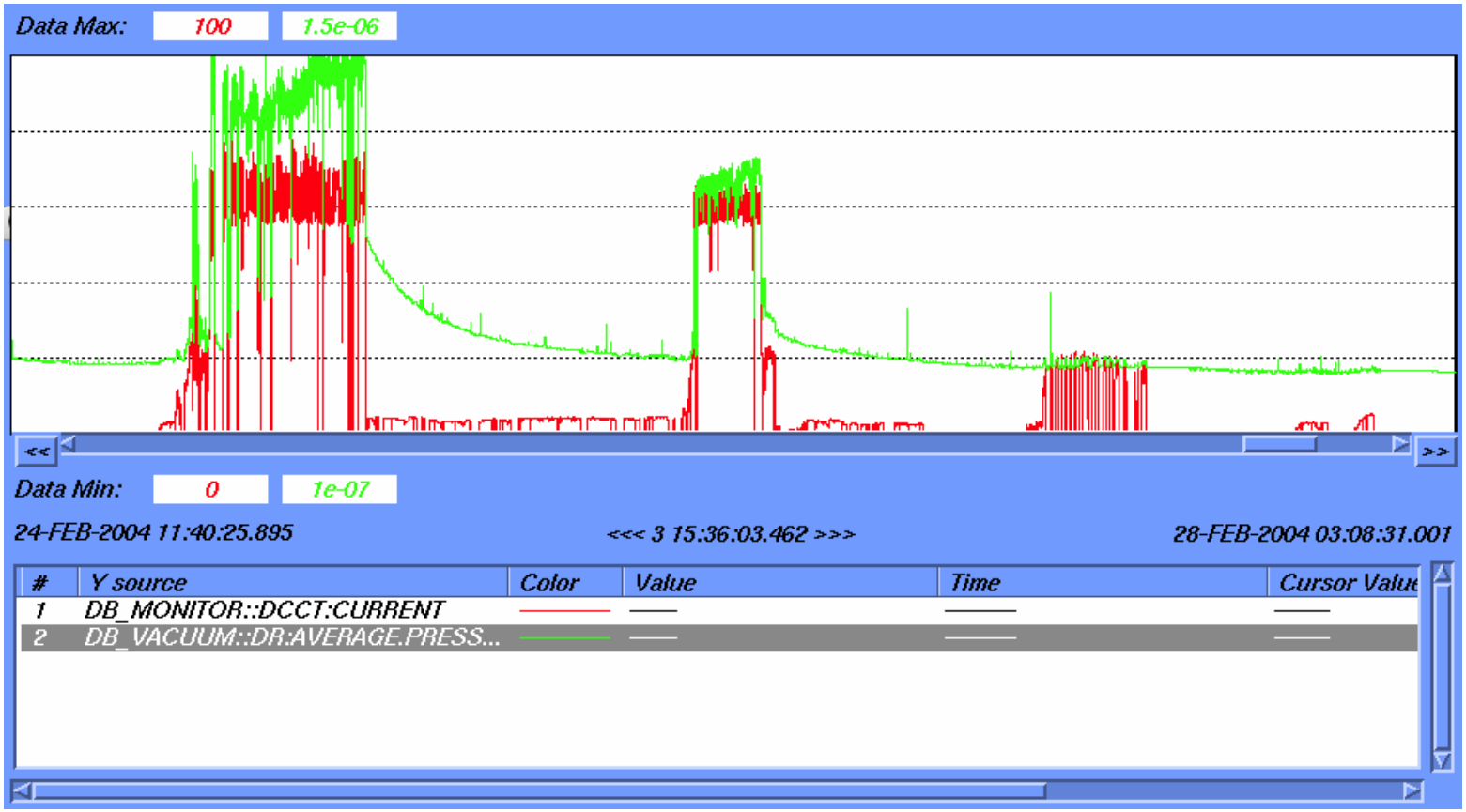
For beam scrubbing : ***1.0 x10^{10} e-, 20 bunches, (=67mA), 3 trains***

Total current : about 200mA

3 trains including 3 bunches will be supplied to EXT with about 150nsec bunch spacing.

DR pressure <7x10^{-7} Pa with beam will be realized soon.

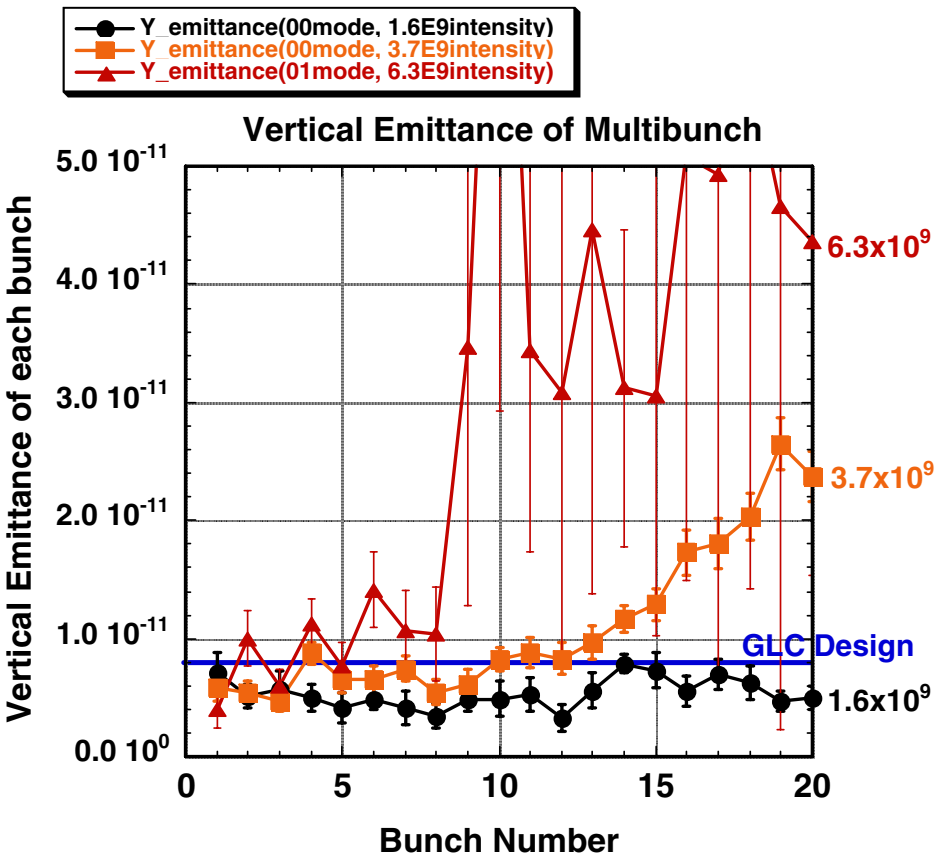
Scrubbing of DR example

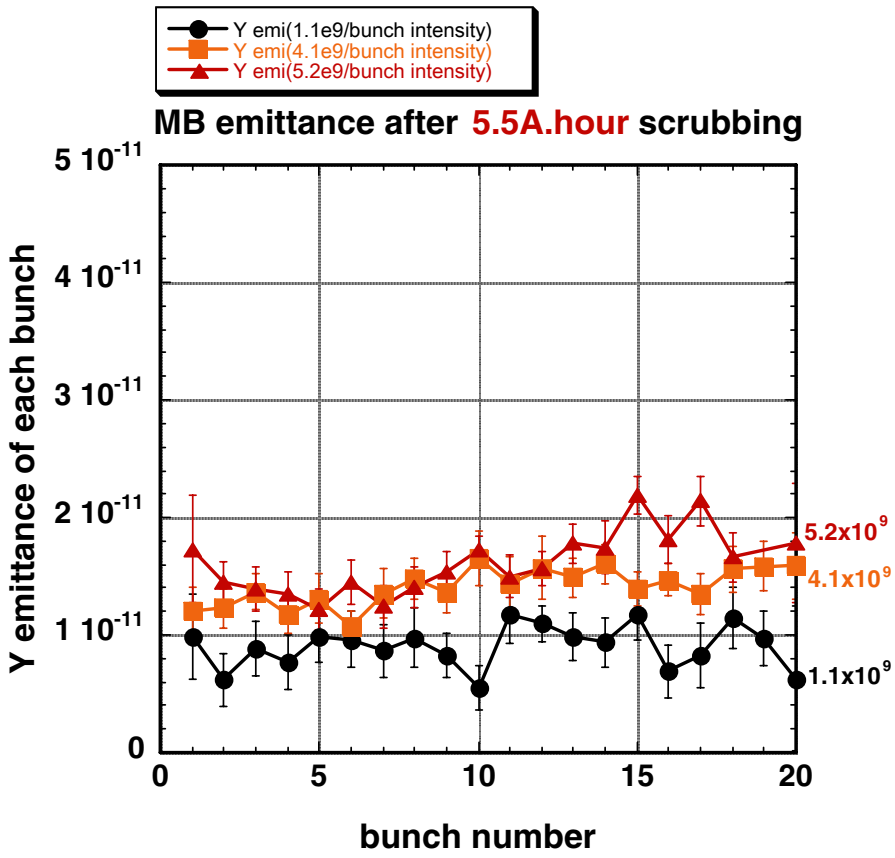


60~70mA (20bunch, 3train);

1.3~1.5x10^{-6} Pa --> 1.0~1.1x10^{-6} Pa

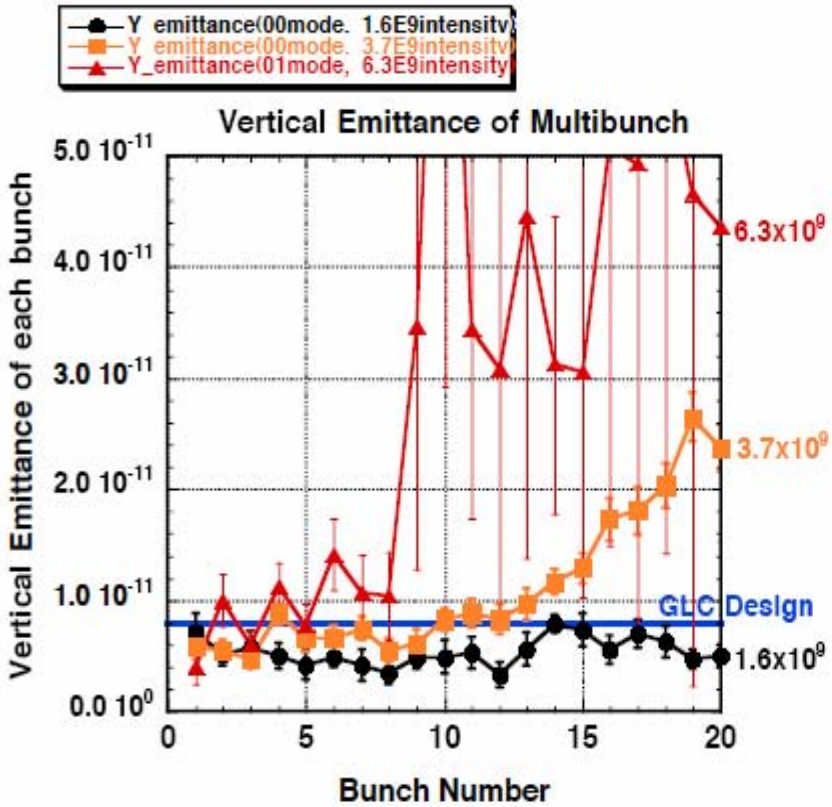
Fast Ion Instability: Experimental Results at ATF
Required vertical emittance : 1pm・rad for ILC



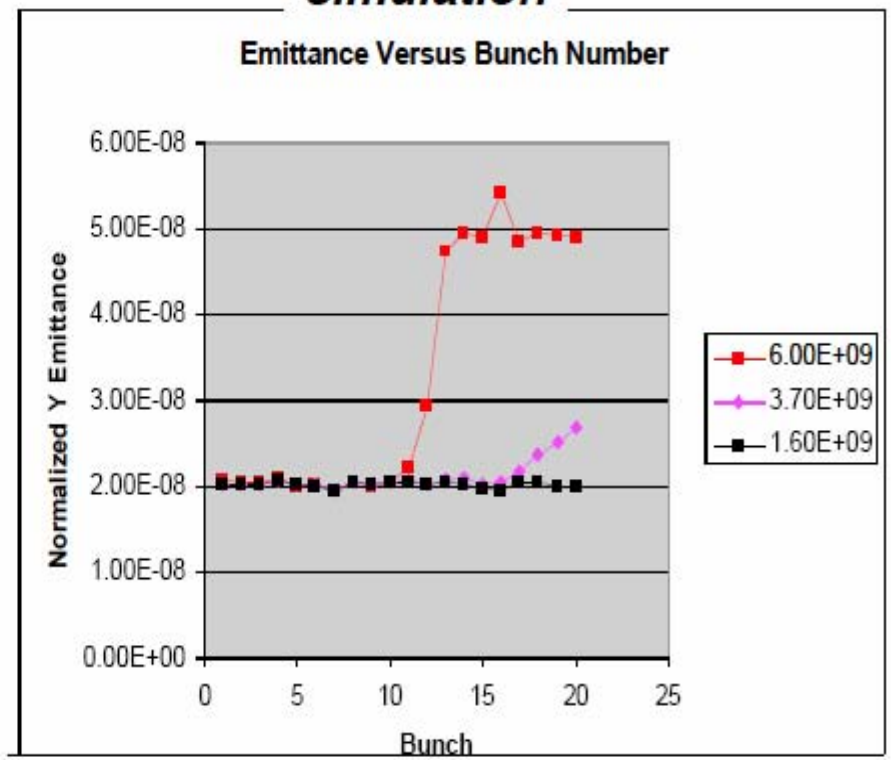


Vacuum Pressure<10^{-8} Pa

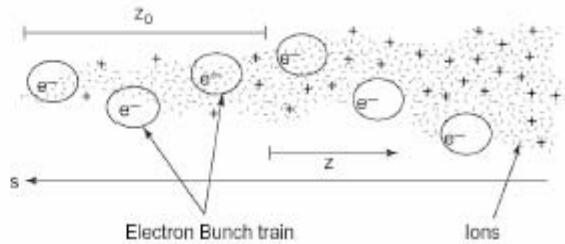
Preliminary result of Fast Ion Instability simulation



simulation

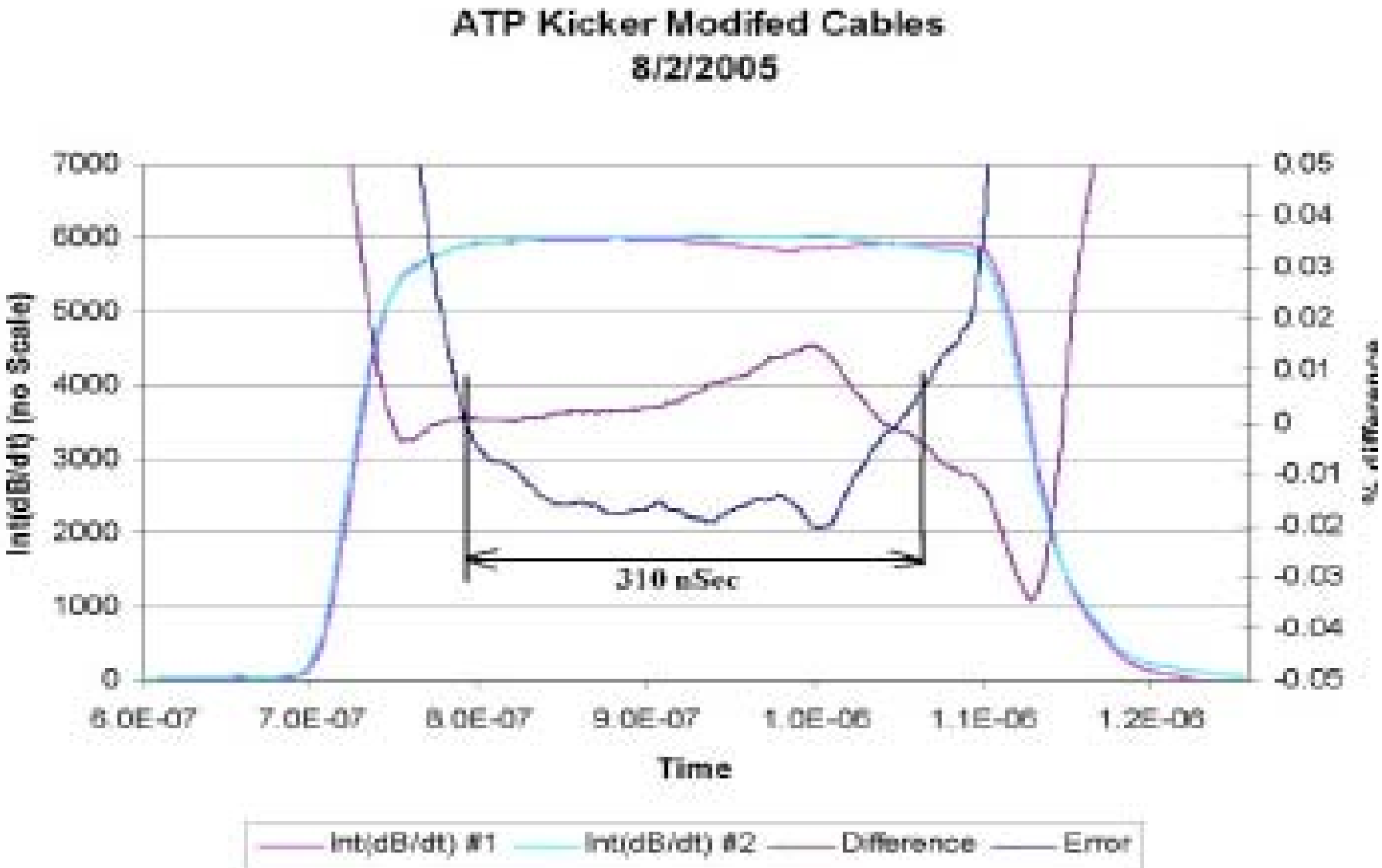


Behavior of Y emittance is very similar.



Schematic of the Fast-Beam Ion Instability

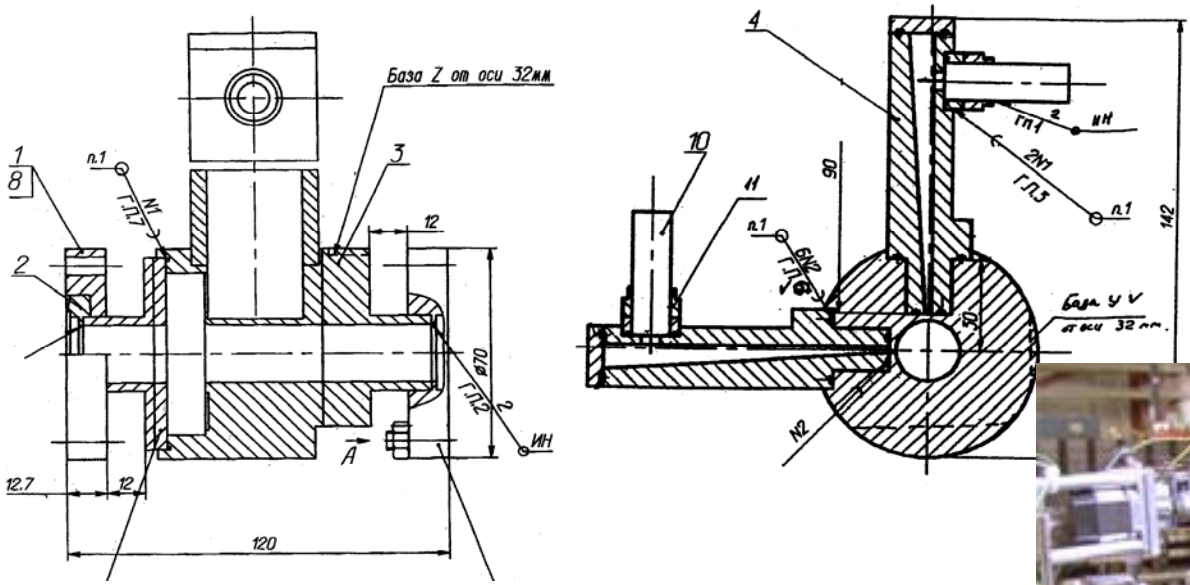
New extraction double kicker was manufactured and sent by SLAC. We are planning the performance test with beam from the end of Oct..



nm resolution BPM test & demonstration

- Two sets of 3 cavity BPM's on one table are prepared at EXT.
- Precise strip line kicker between the nano BPM system is installed.
- Beam orbit stabilization is necessary within 1mm because of the small dynamic range of the cavity BPM.

3 BPM setup for nm resolution study



June 2003

f = 6.426GHz

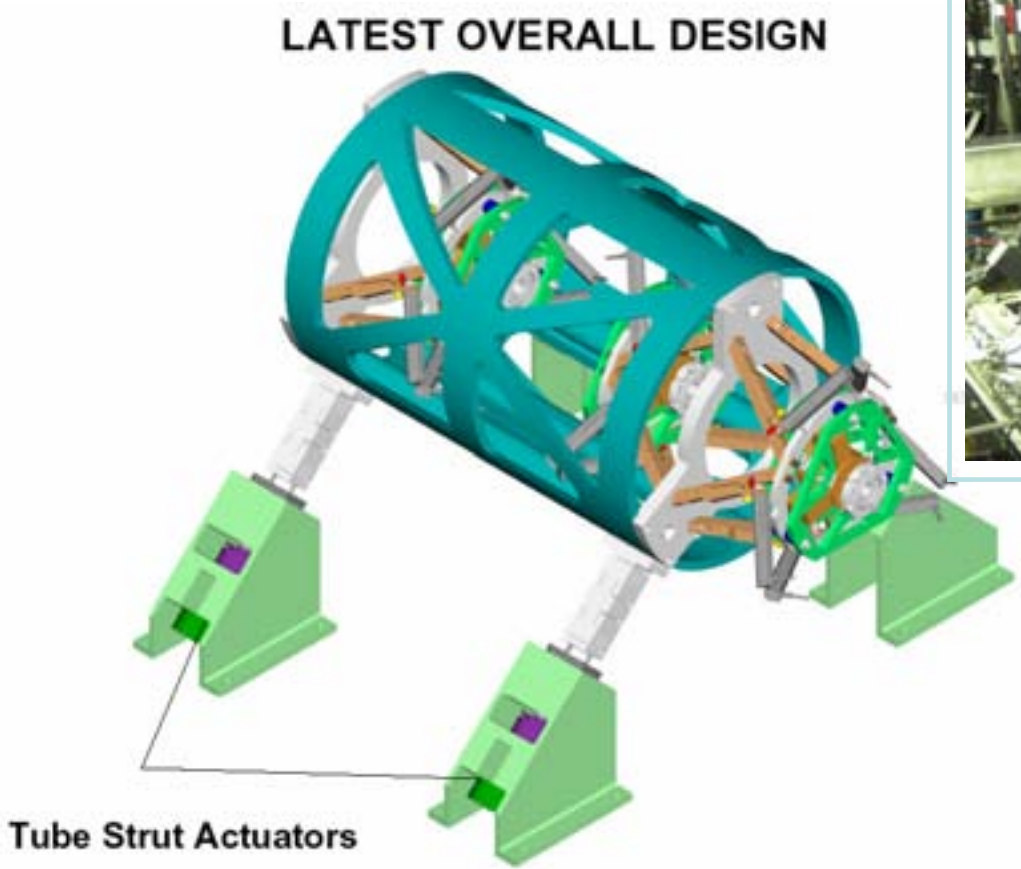
TM110 mode, single port coupling

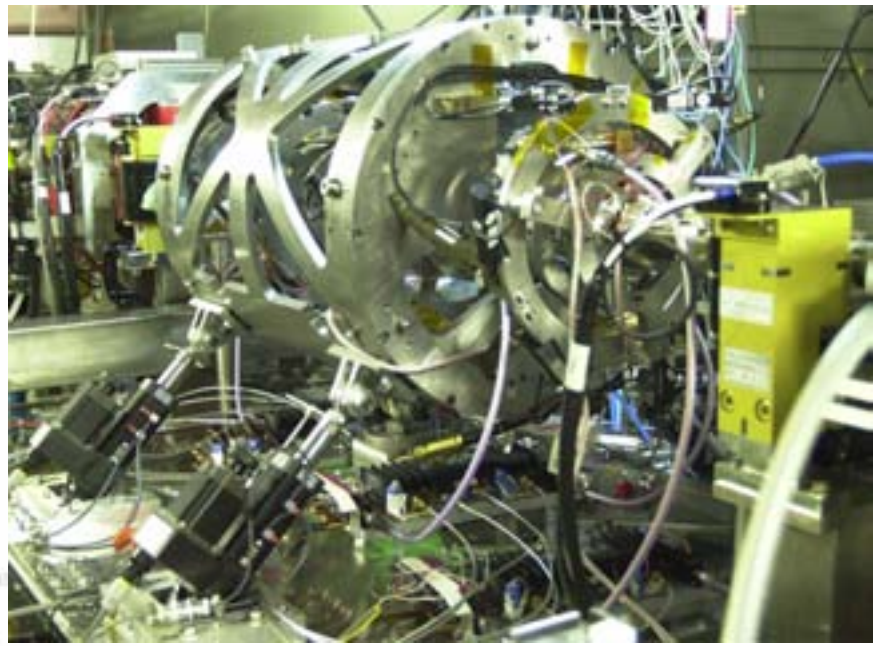
Achieved highest resolution 20 nm

Mover stage step 0.25μm(X) 0.37μm(Y)

With cavity tilt-mover

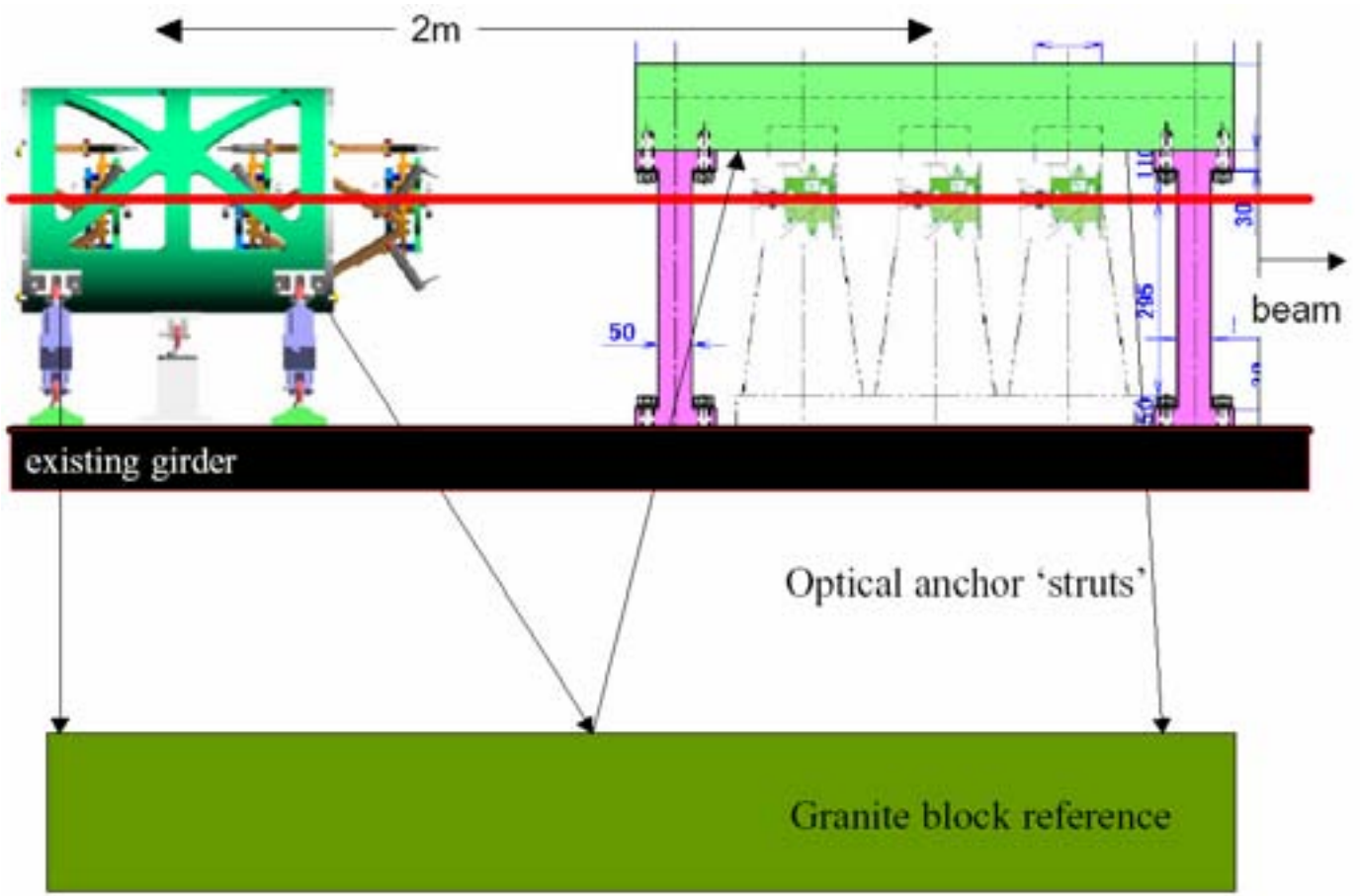
New precise Mover for nm resolution study





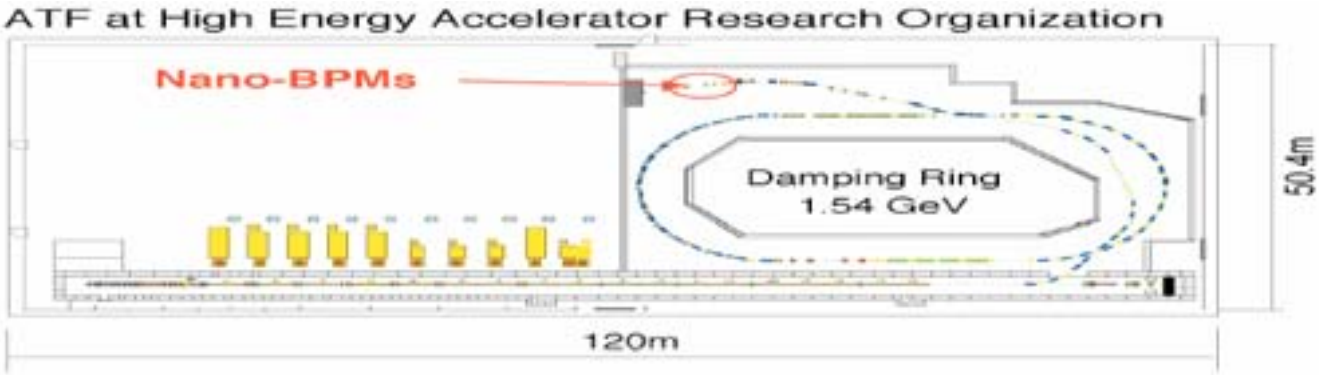
LLNL Design mover, Improved electronics, installed Mar. 2004

Nano-BPM project is on going in the frame of International Collaboration at ATF-EXT.

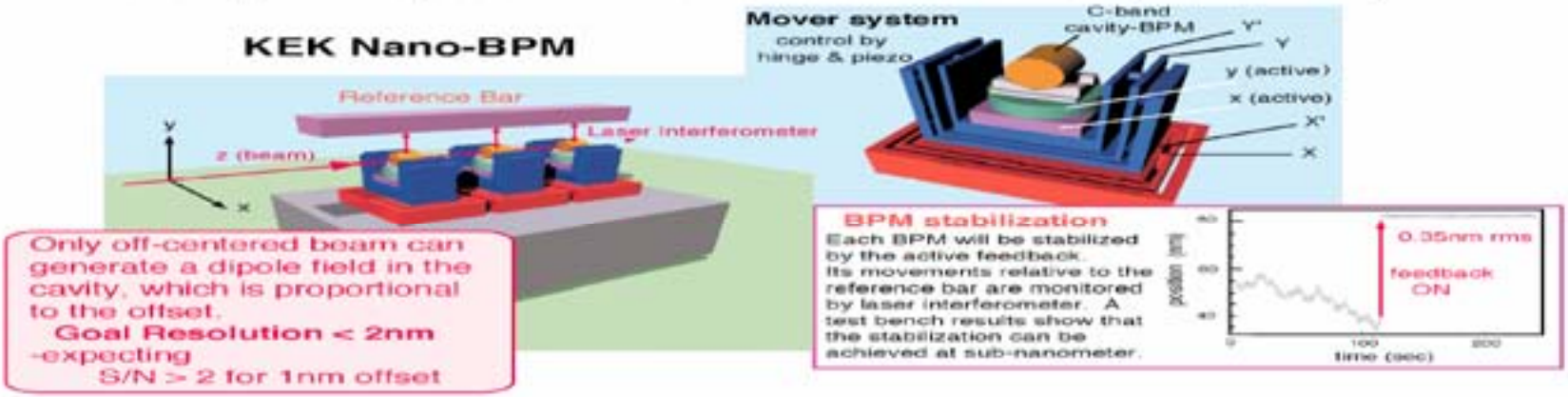


Beam orbit stabilization is necessary within 1μm.

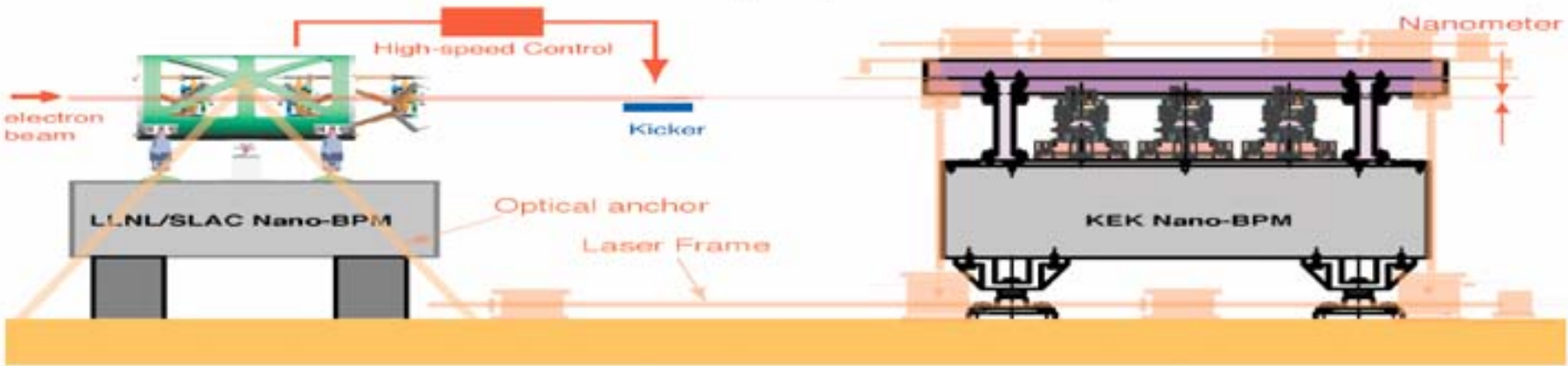
Important study at ATF is Nano-BPM & Feed-forward for Final Focus System.



Cavity-BPM system with nanometer resolution (Nano-BPM)

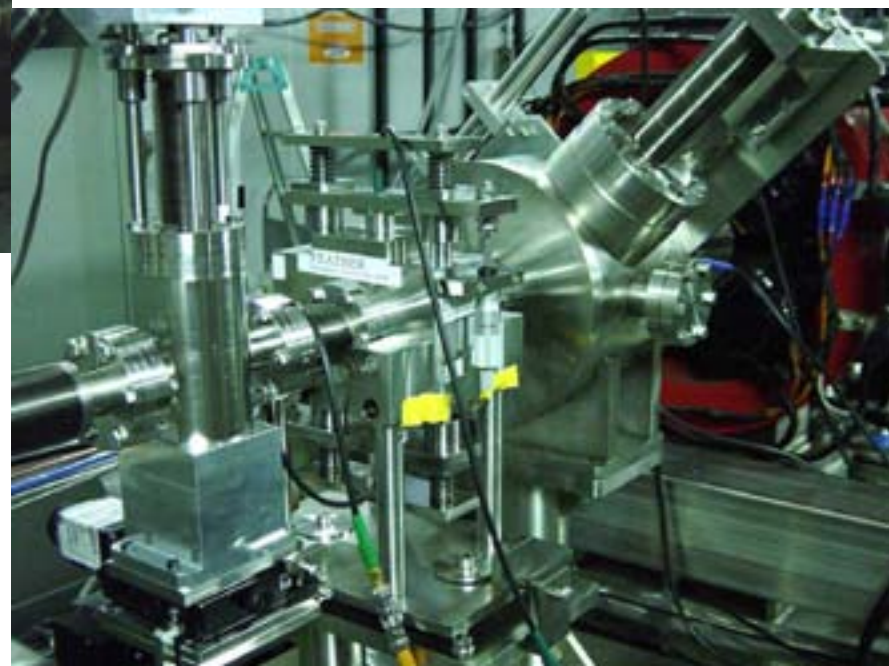


Two Nano-BPMs and High-speed Control System



New precise kicker & BPM for nm position feedback control study

FEATHER strip line Kicker



FEATHER BPM

3nsec fast kicker demonstration

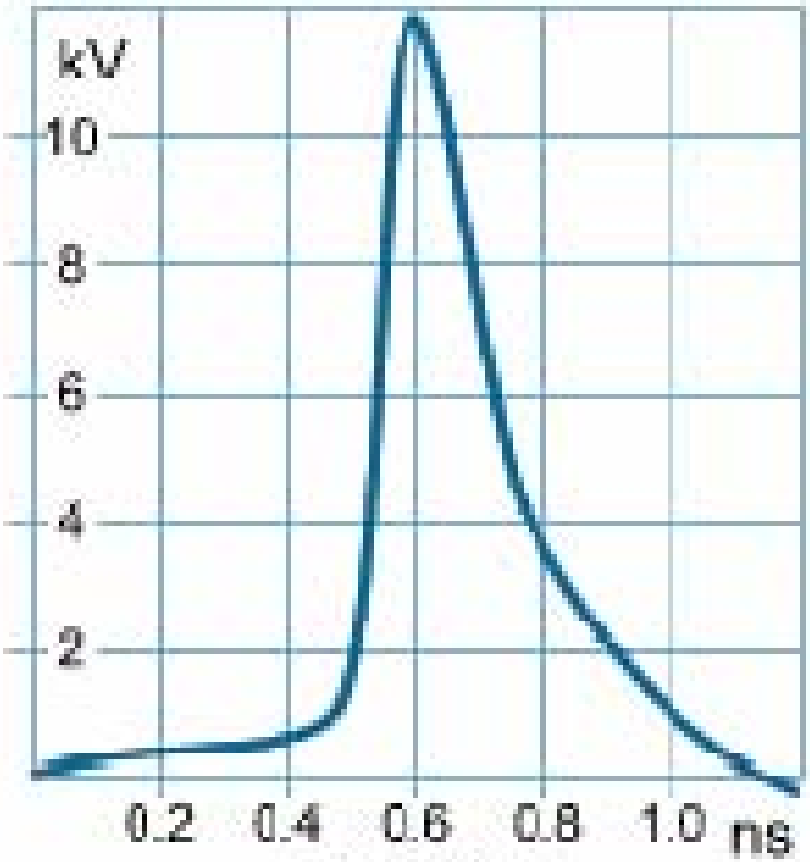
Reliability test and the upgrade are under way.

- We have to make more reliability because many fast strip line kickes will be used.
- In the future if we want to confirm the real performance of the fast kicker, we should install several fast kickes into the ATF damping ring to extract each bunched beam from 20 bunches train with 2.8nsec bunch spacing.

Fast Kicker R&D : Present Technology on Pulse PS

Pulser	Output voltage	Rise time	Pulse width	Pulse repetition frequency	Size (mm)	Delivery (months)
FPG1	1 kV	<0.7 ns	1 - 2 ns	500 kHz	260x110x260	3
FPG5	5 kV	<0.7 ns	1 - 2 ns	200 kHz	260x110x260	3
FPG10	10 kV	<0.7 ns	1 - 2 ns	100 kHz	260x110x260	3
FPG20	20 kV	<1 ns	1 - 10 ns	10 kHz	260x110x320	4
FPG50	50 kV	<1 ns	1 - 10 ns	2 kHz	340x140x310	4
FPG100	100 kV	<1 ns	1 - 3 ns	1 kHz	340x140x310	4
FPG2P	2 kV	<0.1 ns	0.2 - 3 ns	300 kHz	260x110x260	3
FPG5P	5 kV	<0.1 ns	0.2 - 3 ns	200 kHz	260x110x260	3
FPG10P	10 kV	<0.1 ns	0.2 - 3 ns	100 kHz	260x110x260	3
FPG20P	20 kV	<0.15 ns	1 - 2 ns	10 kHz	260x110x320	4
FPG50P	50 kV	<0.2 ns	1 - 2 ns	2 kHz	340x140x310	4
FPG100P	100 kV	<0.2 ns	1 - 2 ns	1 kHz	400x400x200	4
FPG200P	200 kV	<0.3 ns	1 - 2 ns	1 kHz	500x500x300	5

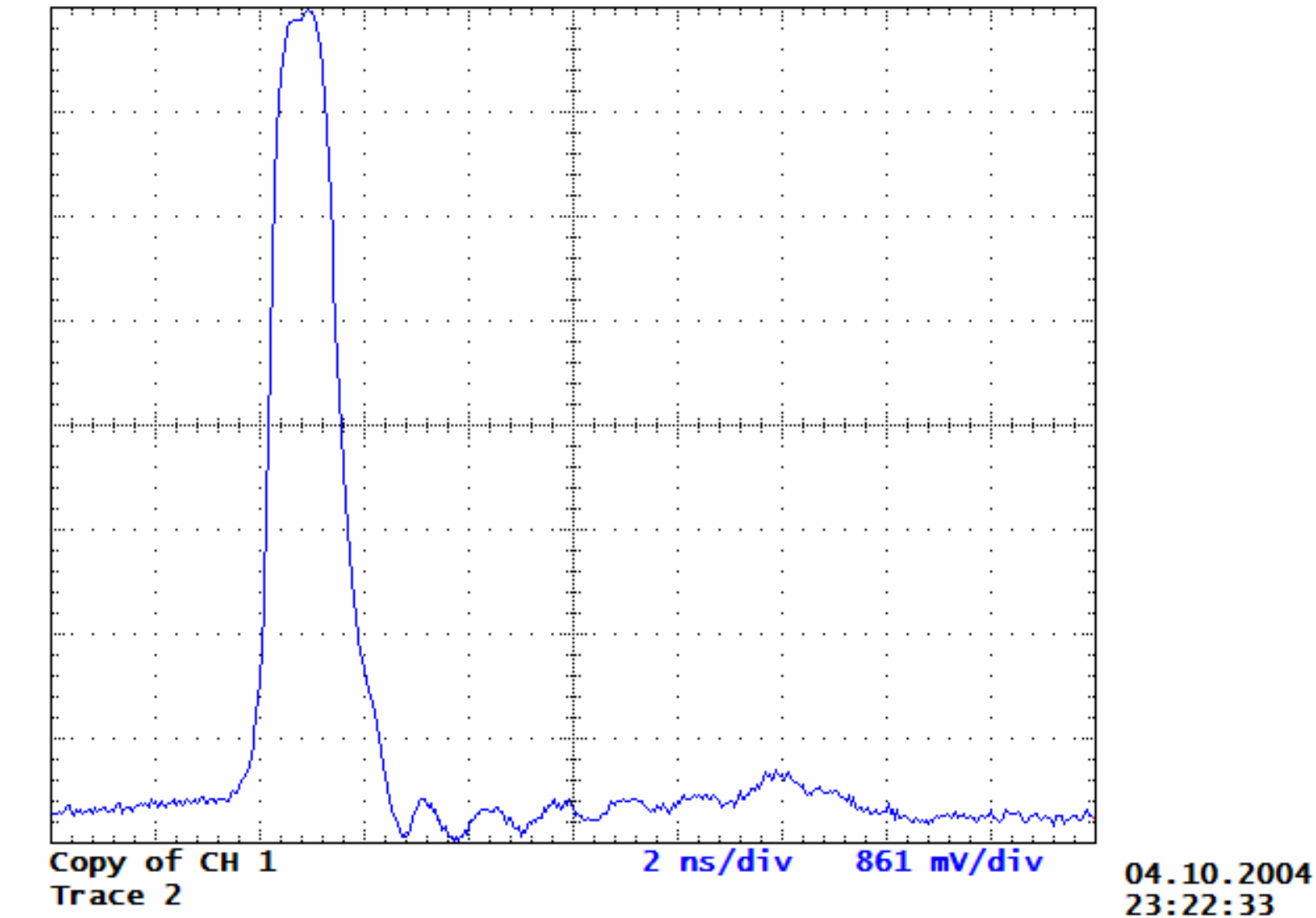
FID GmbH



FPG10P

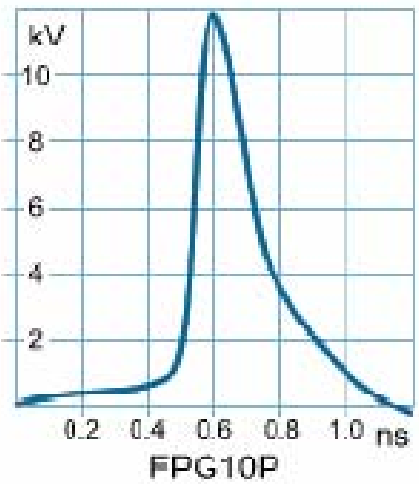
FPG10 & FPG 20

VMOS Technology



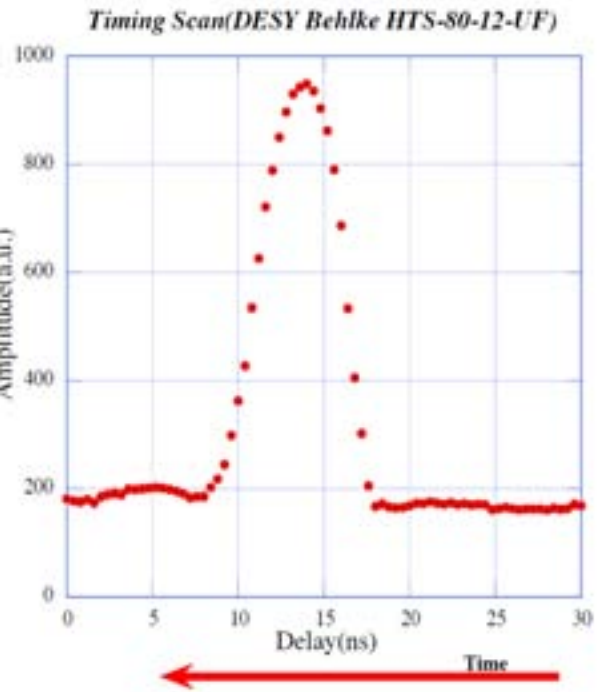
Horizontal : 2 nsec/div, Vertical : 624 V/div

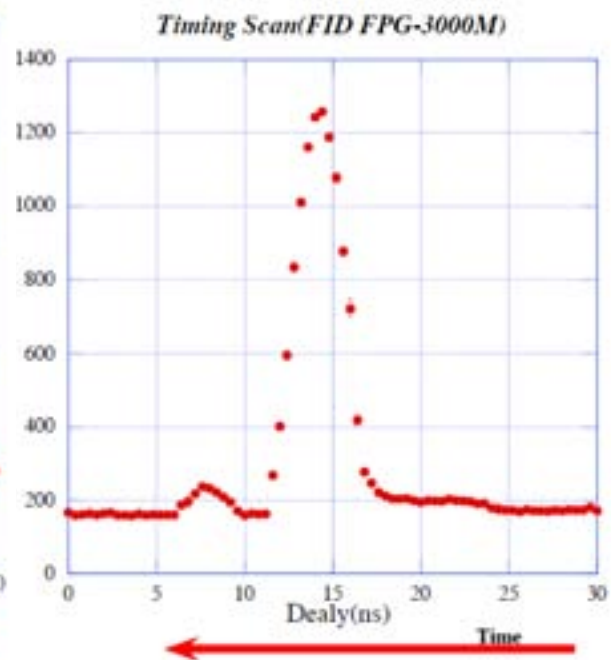
ILC like beam by fast kicker

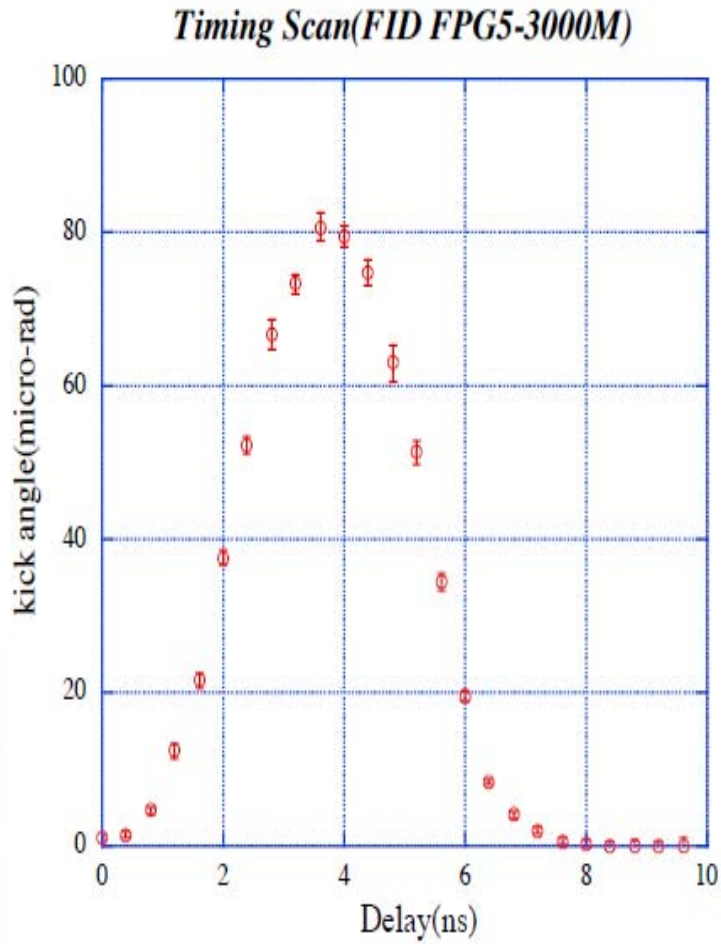


FPG10P


FPG10 & FPG 20







80μrad kick

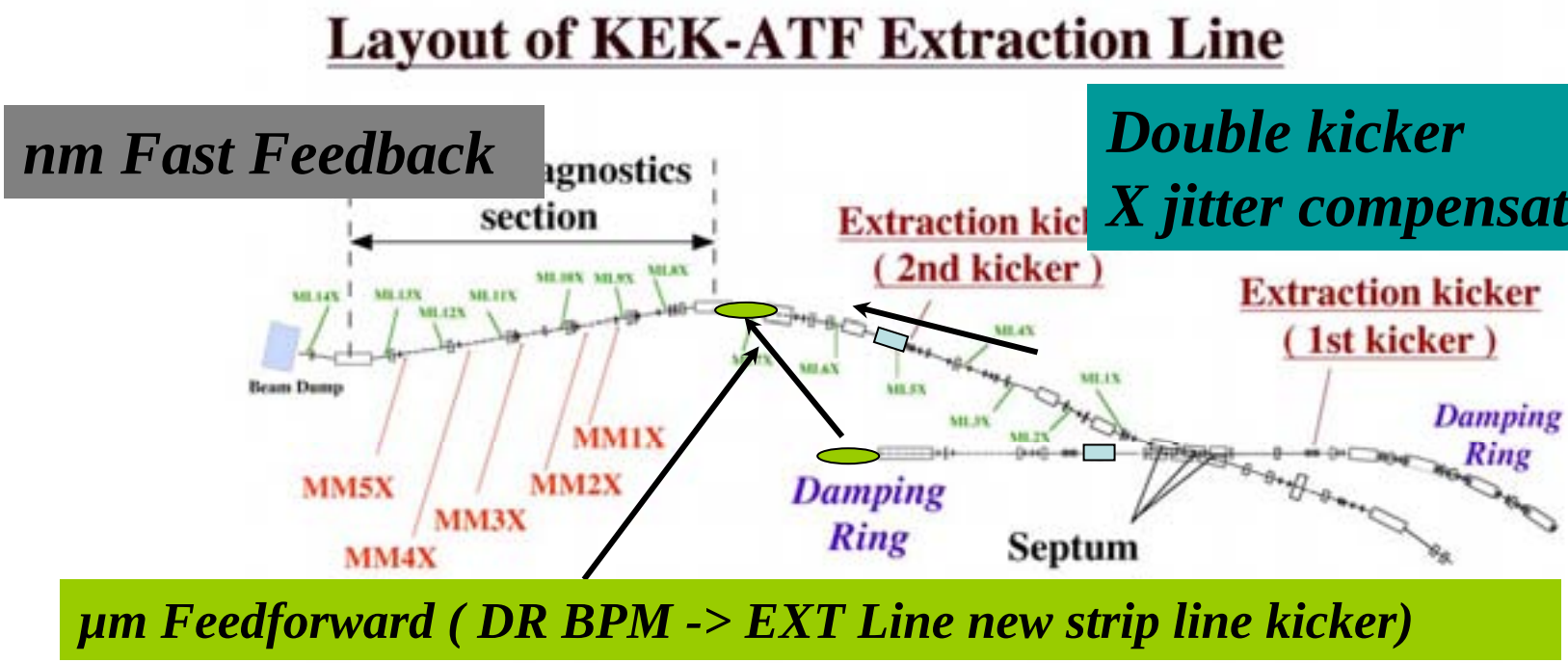
Fast feedback or feedforward test & demonstration

Test by 1 bunch & 3 bunches (about 150nsec bunch spacing) extraction will be started.

Extracted beam stabilization will be started soon because the ideal beam to develop nm BPM and to find the emittance coupling source is essential.

- If SLAC double kicker system is worked well, we can generate 3 bunches train with about 150nsec spacing.
- We are planning to implement the feedforward system for the beam stabilization at EXT.

Feedforward to Extraction Line

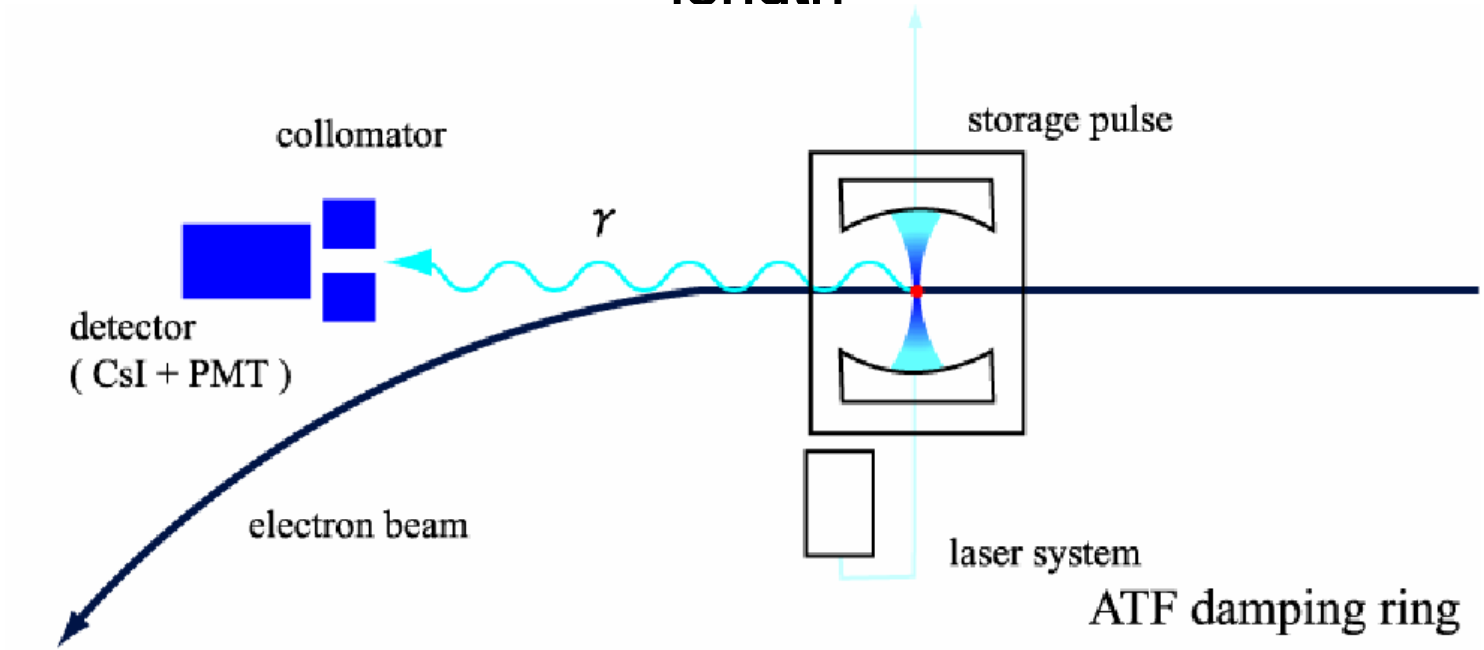


Instrumentation developments

LW, XSR monitor, ODR monitor, Alignment study, etc

- Since laser wire system in the ring is successfully improved, bunch length monitor with pulsed laser wire and plan of laser wire development at EXT are explained.
- Development of one pass ODR monitor will be completed soon.
- Proposal of new dynamic alignment study.

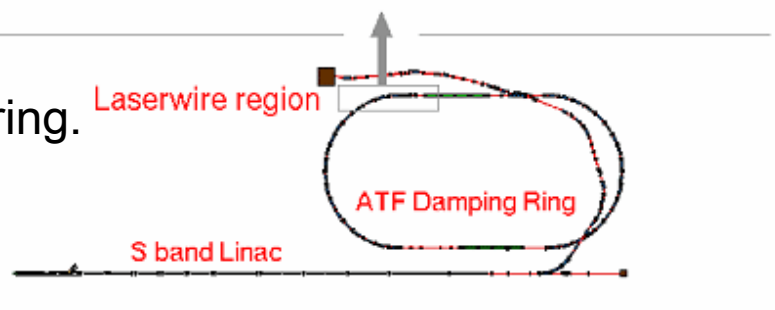
Plused Laser and Electron Beam Collision to measure bunch length



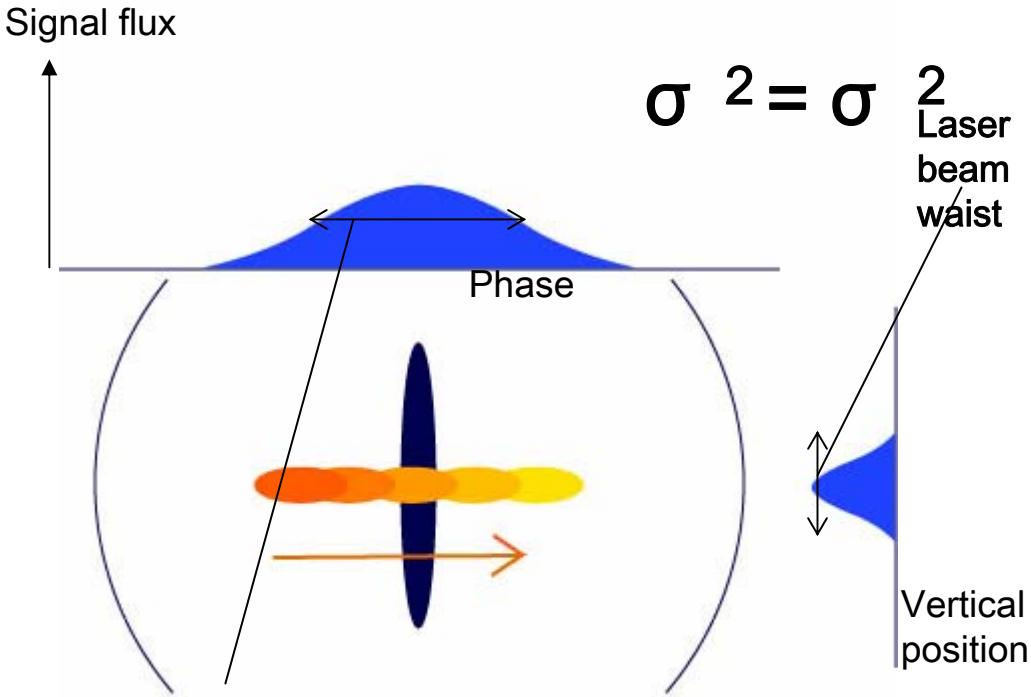
Pulse Laser Wire

(Storage laser pulses in optical cavity):

New bunch length monitor at a storage ring.



Count rate & Measurement



$$\sigma^2 = \sigma^2_{\text{Laser beam waist}} + \sigma^2_{e^- \text{ v-beam waist}}$$

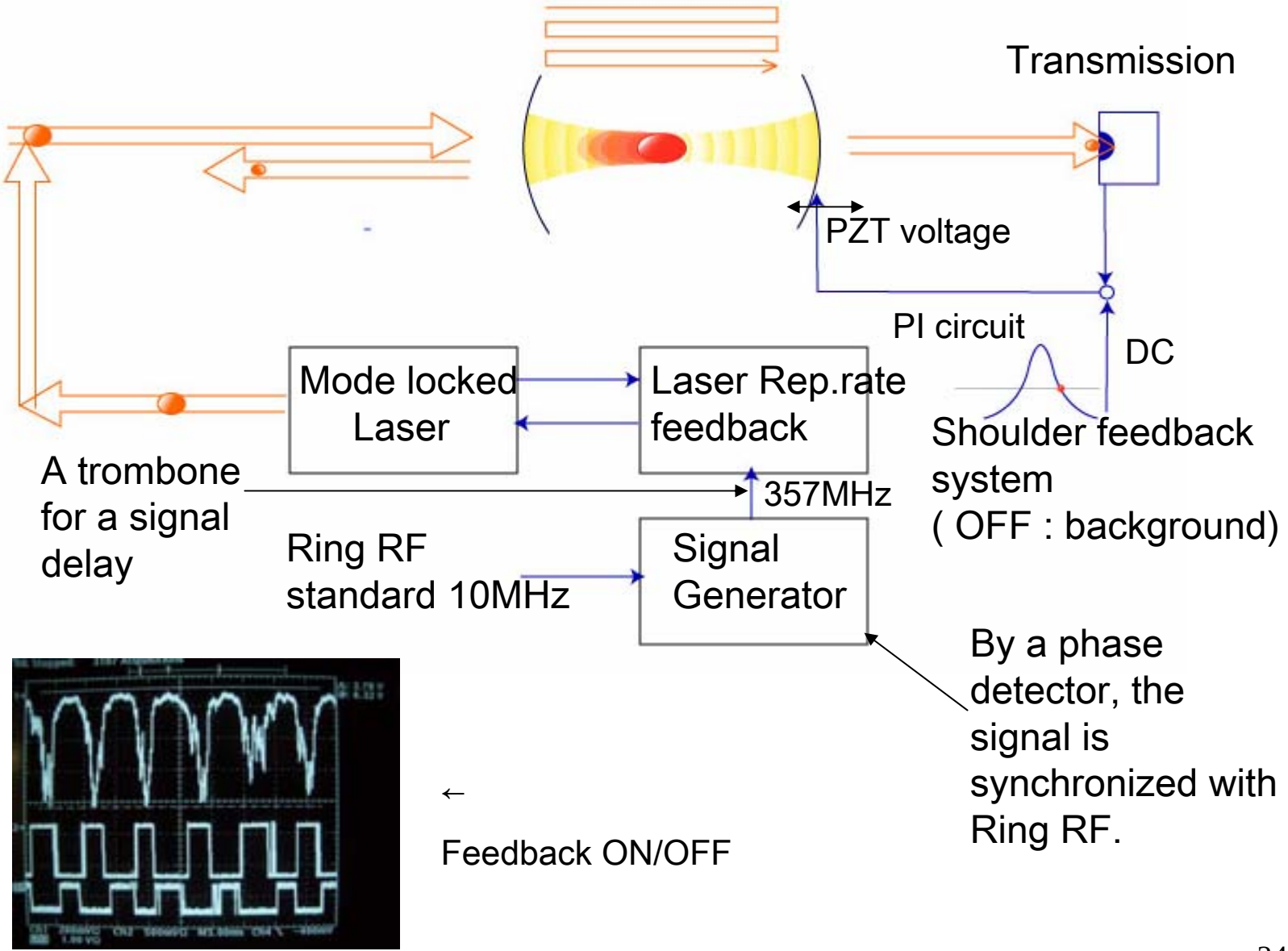
Suppose both electron bunch and laser pulses have a Gaussian intensity distribution, the measured profile is also a Gaussian shape.

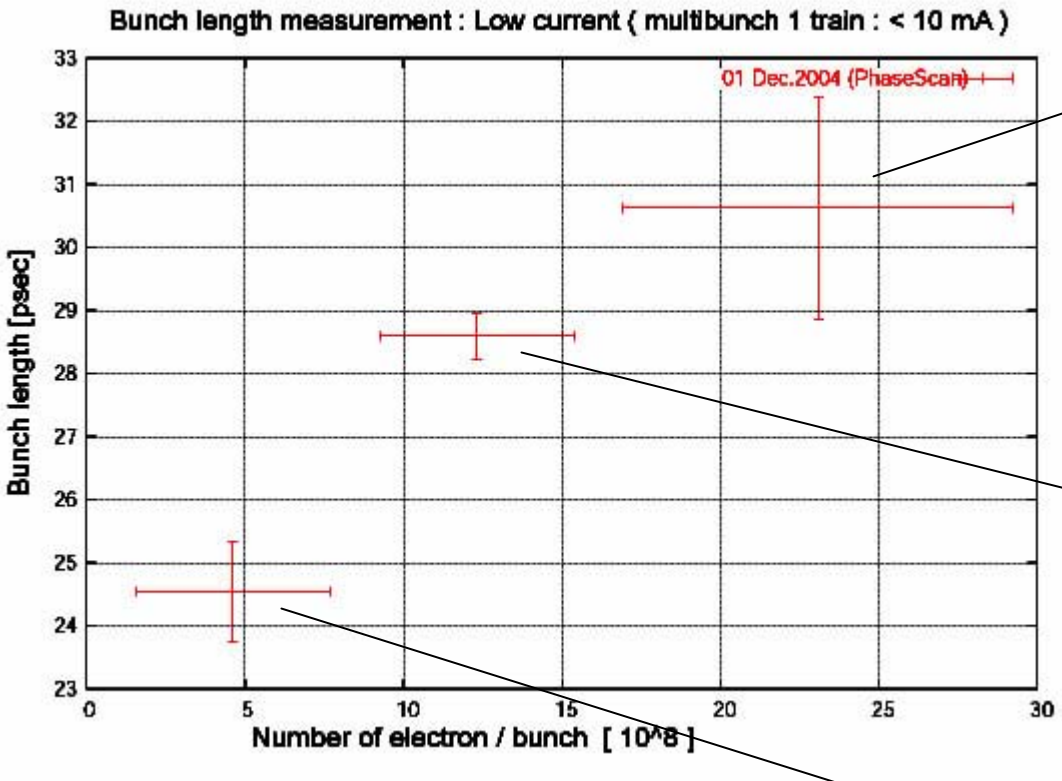
$$\sigma^2 = \sigma^2_{\text{Laser pulse width}} + \sigma^2_{e^- \text{ bunch length}} + \sigma^2_{\text{Laser beam waist}} + \sigma^2_{e^- \text{ h-beam size}}$$

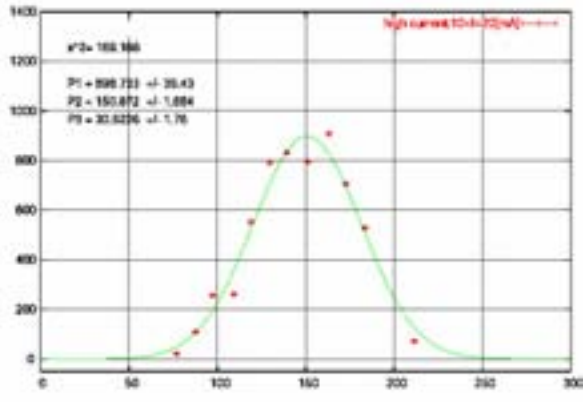
$$\sim \sigma^2_{e^- \text{ bunch length}}$$

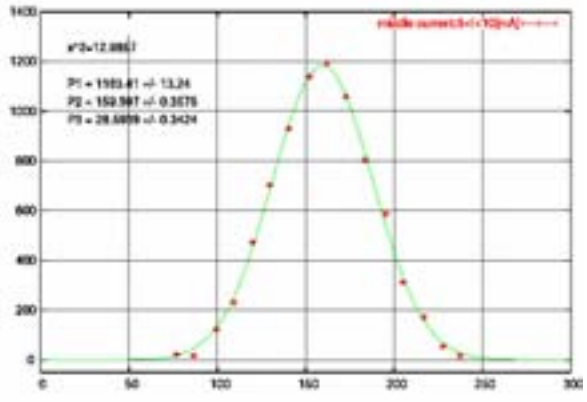
The electron bunch length is 20 ~ 40 psec (10mm)
Laser pulse width (FWHM =7 psec ; 1 mm)
Laser wire beam waist(120um), electron's horizontal beam size (100um)

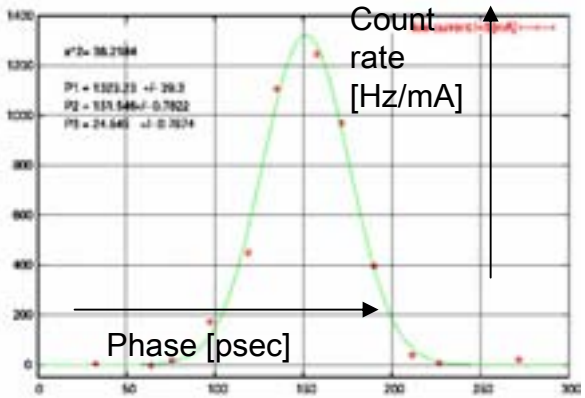
OPTICAL CAVITY : feedback circuit











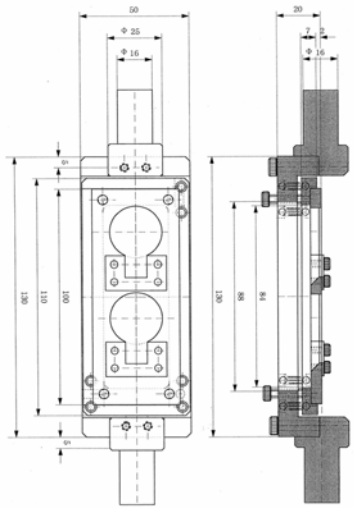
When bunch current is increased , the Gaussian shape of photons count rate changes.

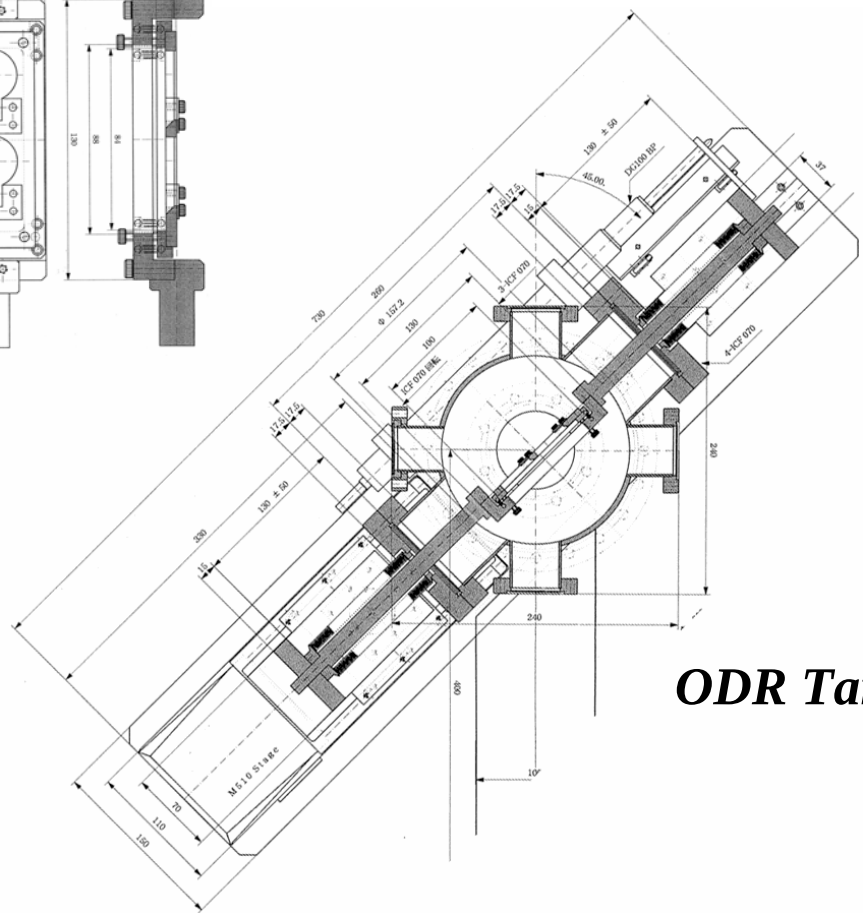
UK laser wire group wants to make first collision between about 1μm electron beam and pulsed laser beam at EXT in this year.

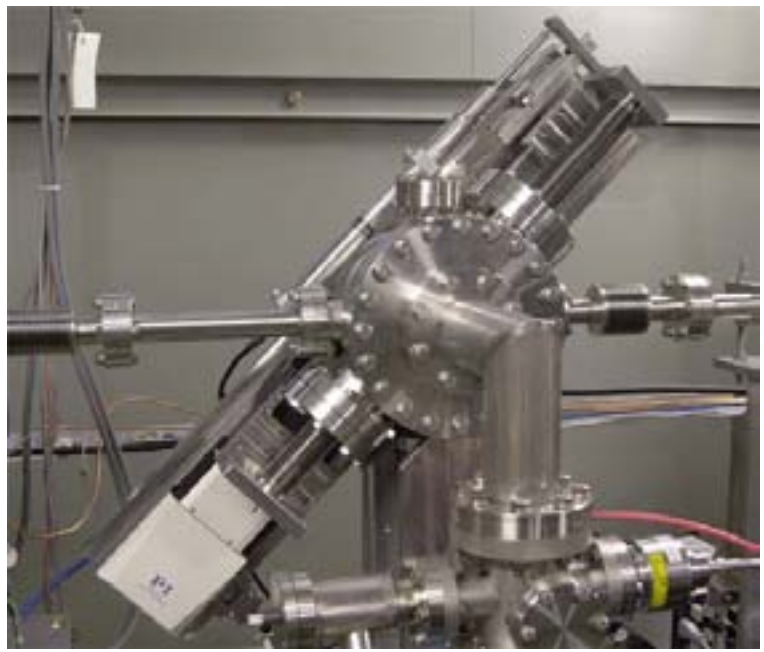
- ATF pol. positron group finished their experiment successfully. Now, they transfer their technique to UK laser wire group.
- ATF and UK group are preparing new laser wire system at the EXT for the first collision experiment.
- We already established 1μm electron beam and young physicists learnt how to make small electron beam size.

One pass ODR Monitor development with disphase target

ODR Target Holder



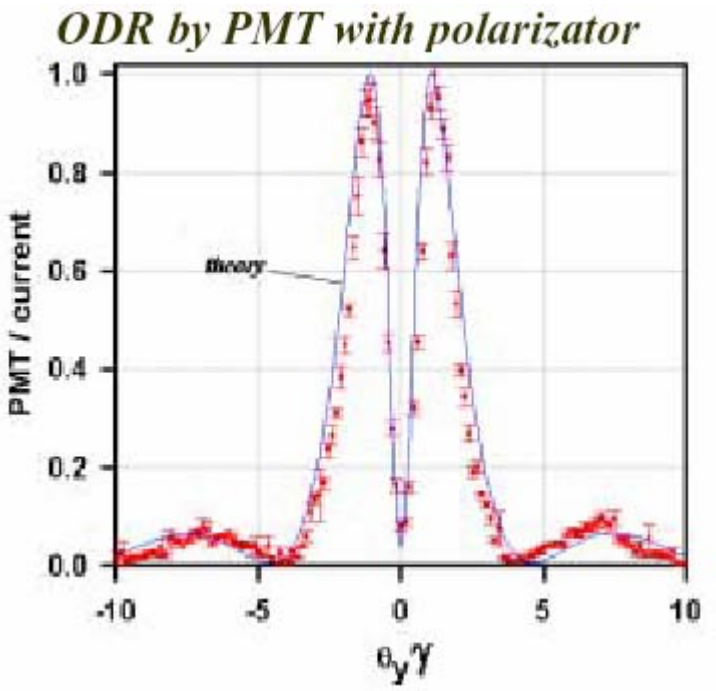


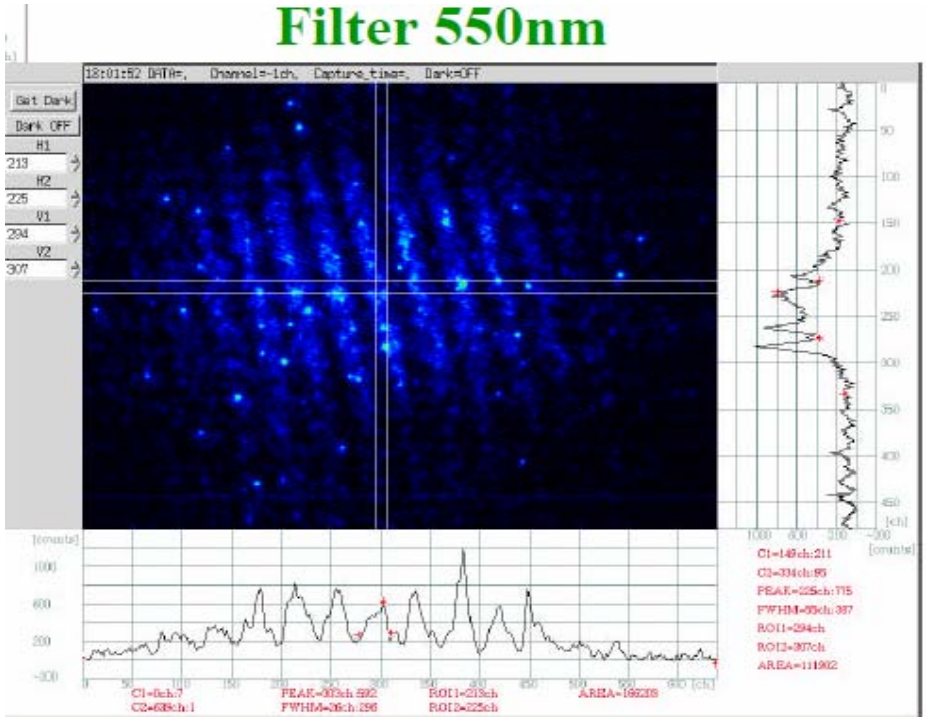


ODR Target chamber

Multi-shots Measurement

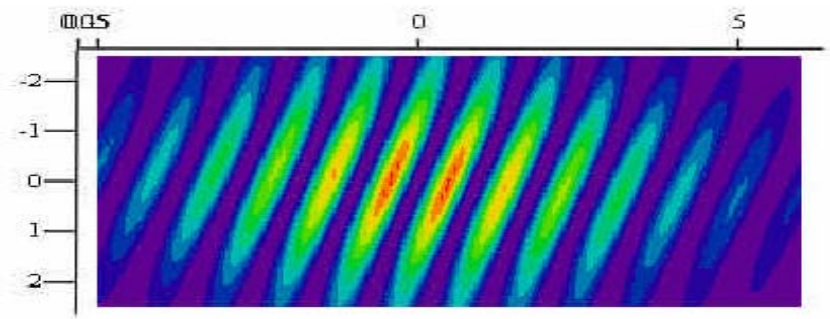
Single-shot Measurement





Disphase target is a Russian physicist's idea to reduce the distance between detector and radiation source.

Consider pre-wave zone effect.



Example of Calculation

ATF Plans for 2005 and 2006

- ***Beam Dynamics Study***

  CSR

  Nonlinear field beam dynamics using fast kicker and turn-by-turn BPM.

- ***MB emittance study***

  High current injection will be started. (200mA)

  X, Y emittance will be confirmed by Laser Wire.

  Fast Ion Instability (Measurement of bunch dipole motion) is under study.

- ***nm resolution BPM test & demonstration***

  Development of new precise mover & new cavity-BPM electronics.

- ***3nsec fast kicker demonstration***

- ***Fast feedback and feedforward test & demonstration***

  Basic test of BPM & kicker at first.

  Feedback test by 1 bunch & 3 bunches extraction will be started soon.

- ***Instrumentation developments***

  LW, XSR monitor, ODR monitor, etc

- ***ATF2***