Instrumentation progress at ATF2

T. Tauchi, ATF2 group

IWLC 2010, CERN and CICG, 20 October 2010

ATF2 beam line

Final Focus System

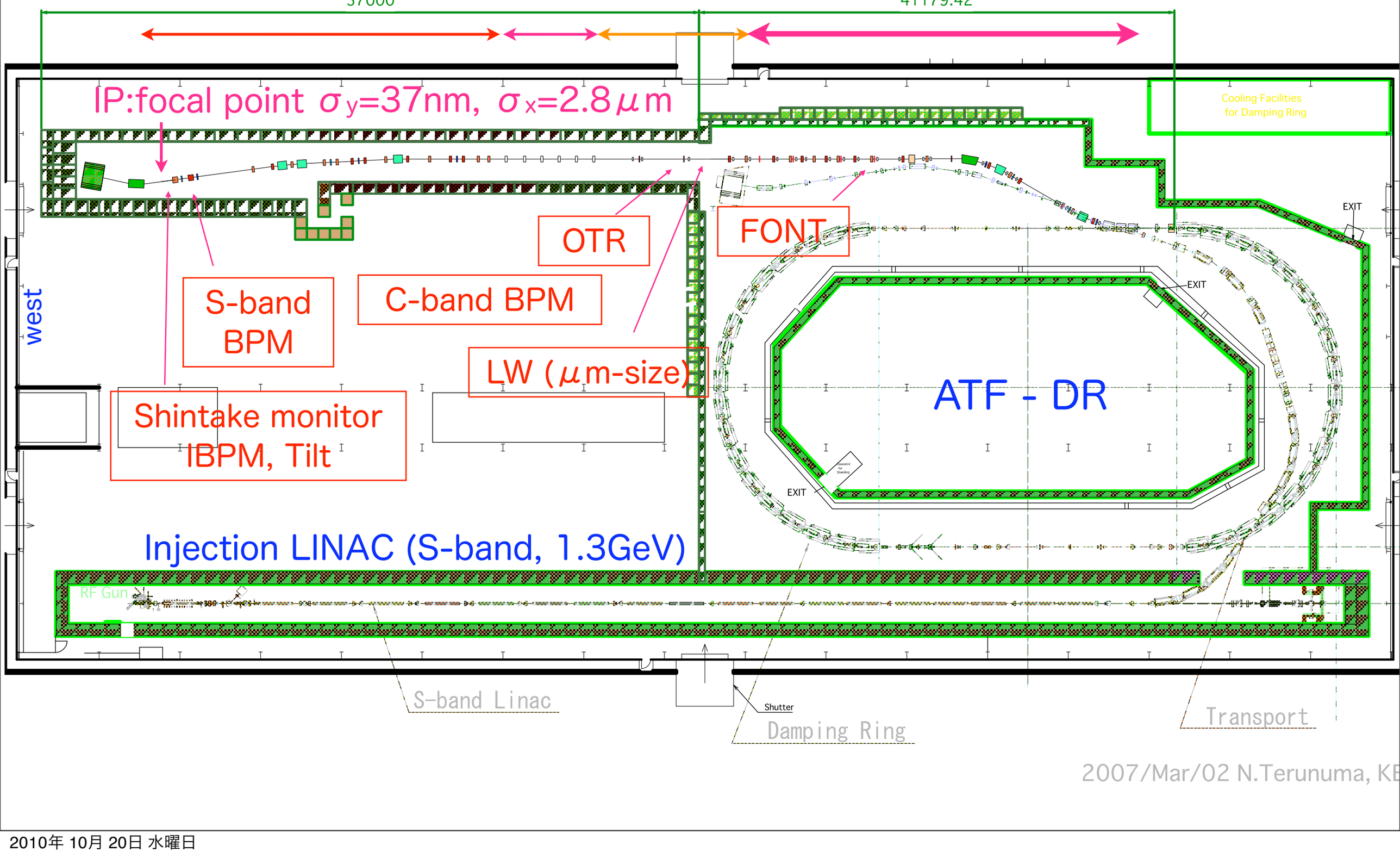
57000

β mat-ching

Diagnostic

Reconfiguration of extraction line for reduction of dispersion

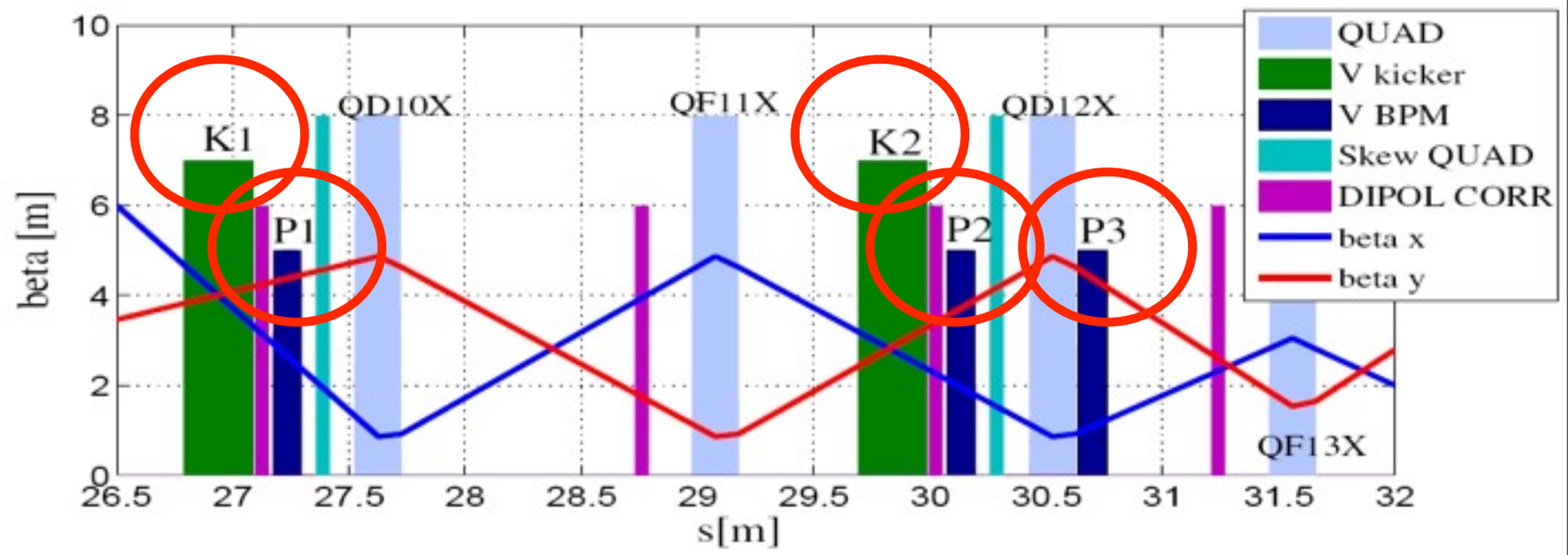
41179.42



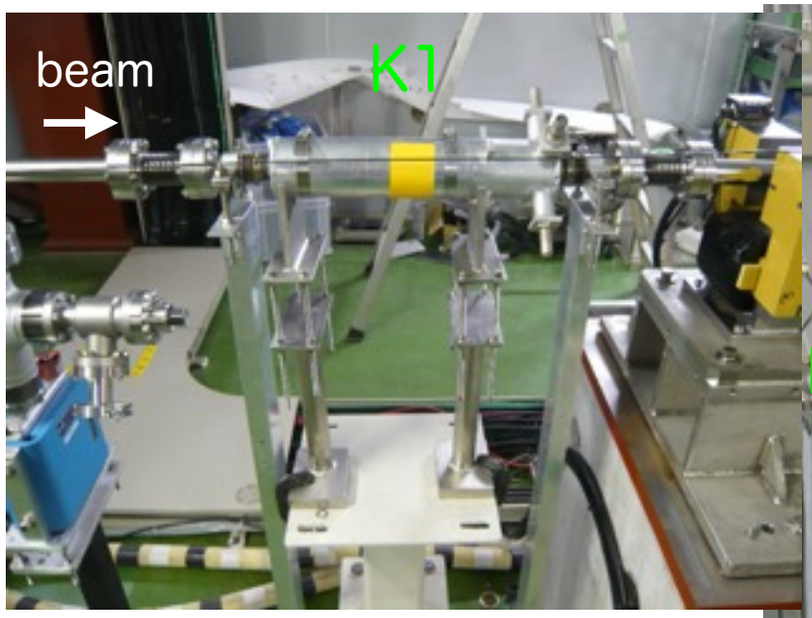
2007/Mar/02 N.Terunuma, KE

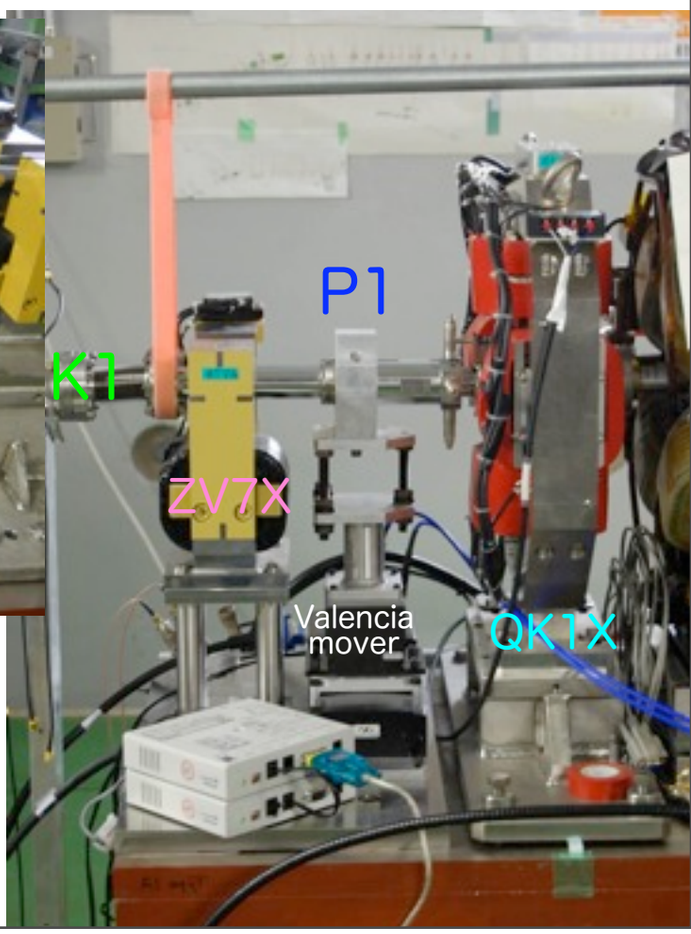
ATF2 FB system: FONT5 (Oxford,KEK)

Dedicated system:



- **2 stripline kickers (K1 , K2) + fast drive amplifiers**





- **3 stripline BPMs(P1,P2,P3) + fast analogue front-end electronics 9-channel digital FB processor**

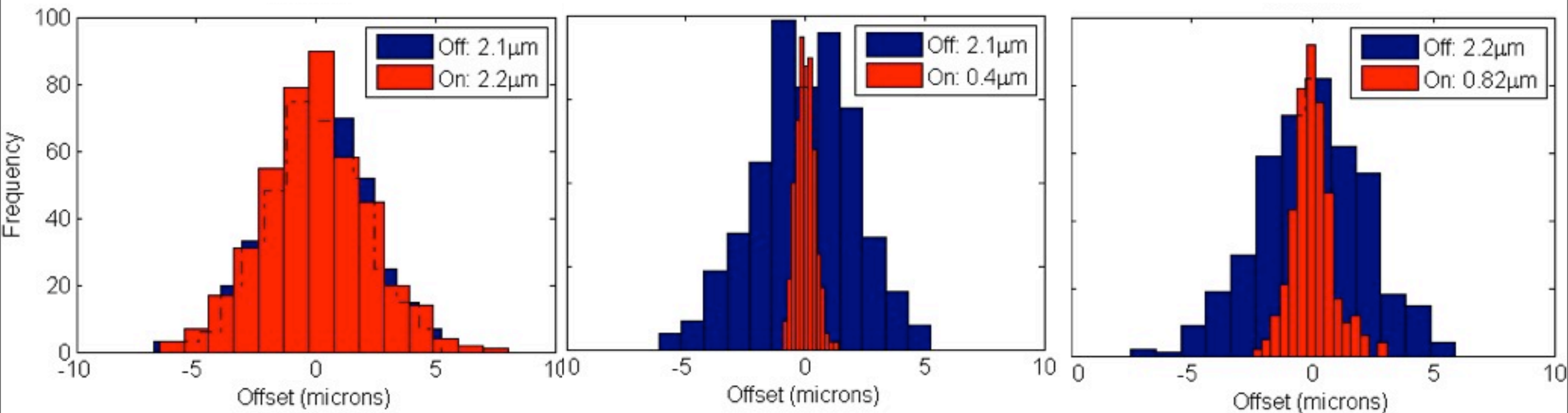
P2 → K1 loop jitter reduction

(April 16 2010)

Bunch 1

Bunch 2

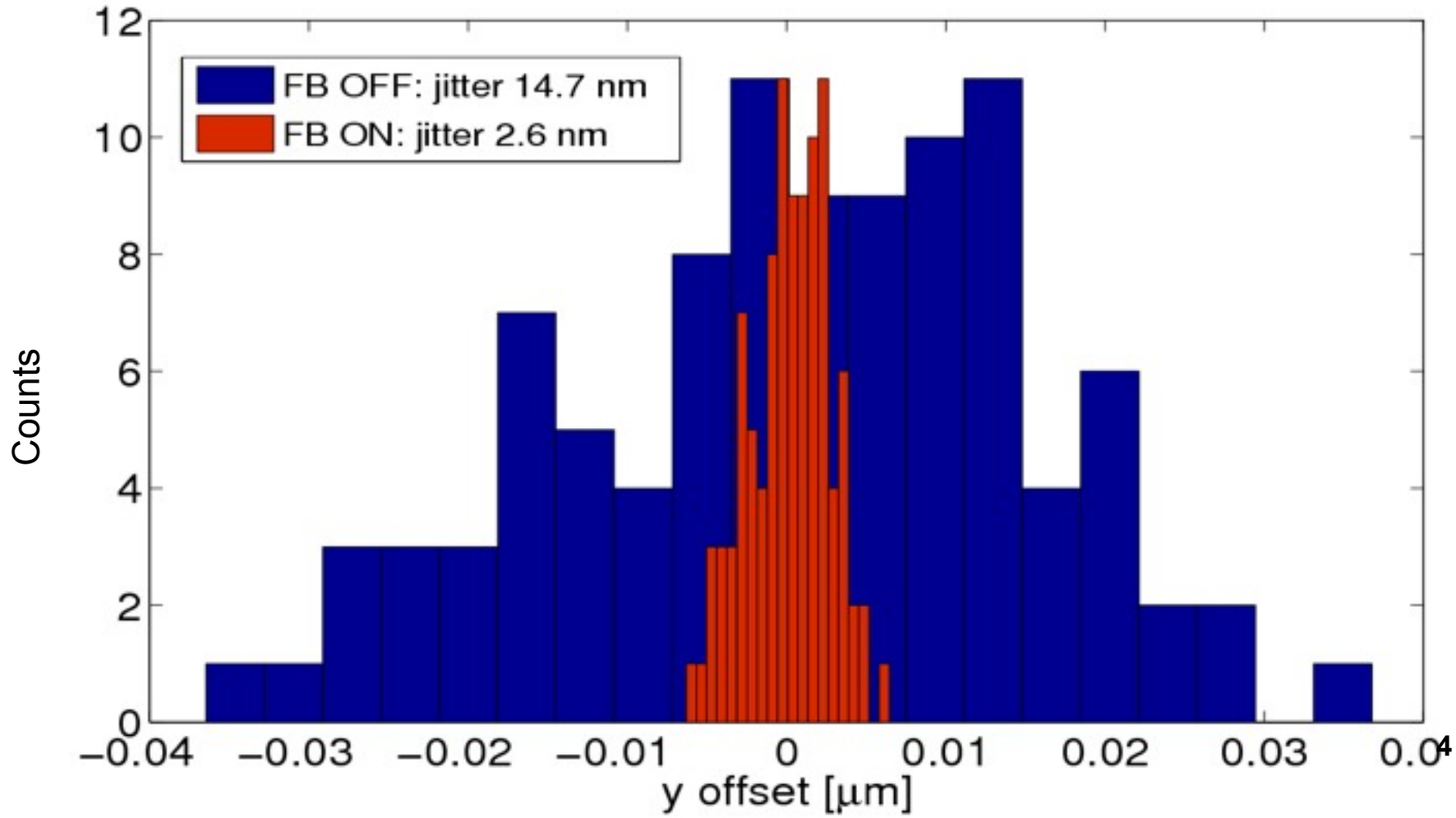
Bunch 3



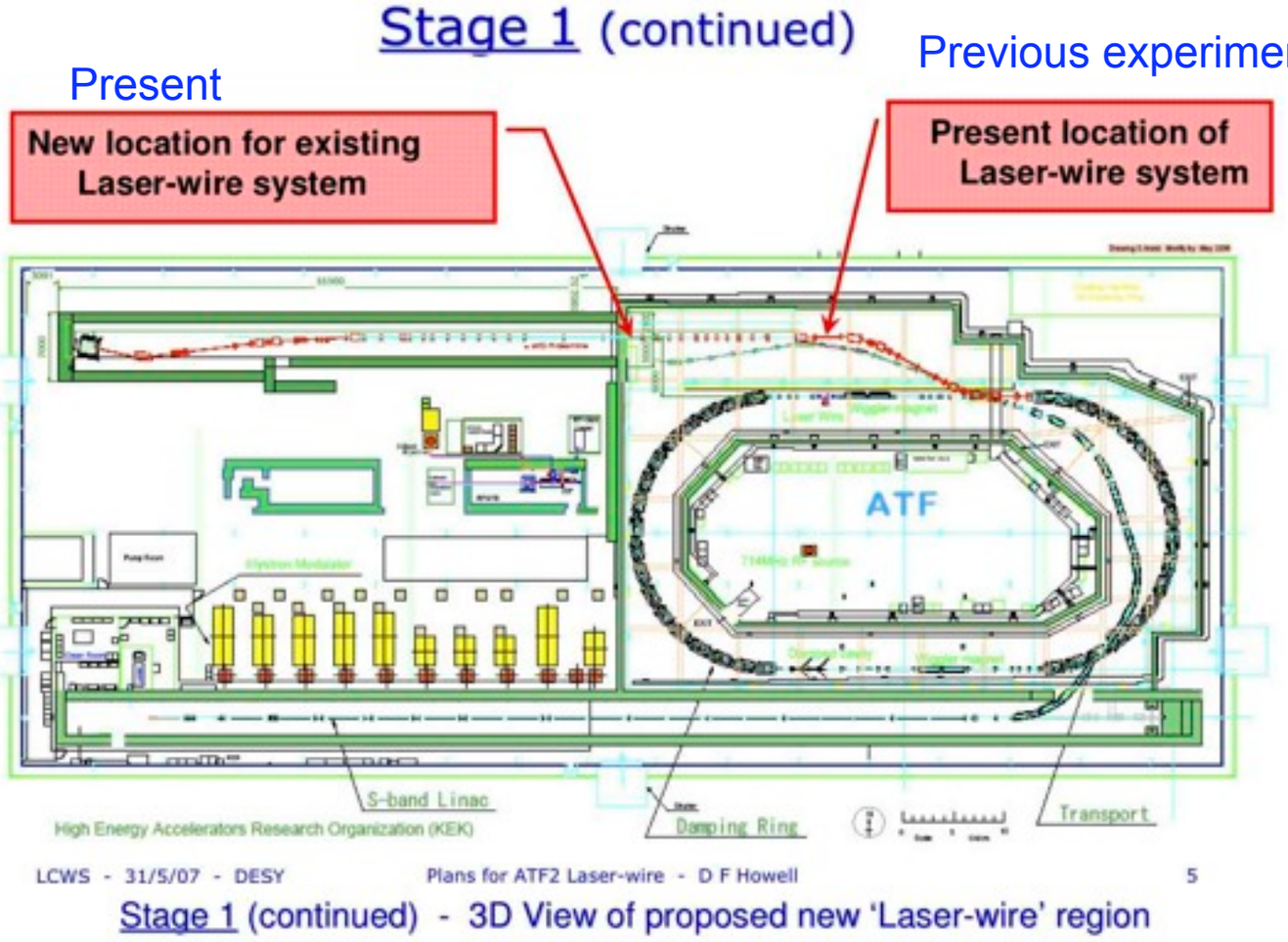
2.1 um → 0.4 um → 0.8 um

Jitter comparison at IP

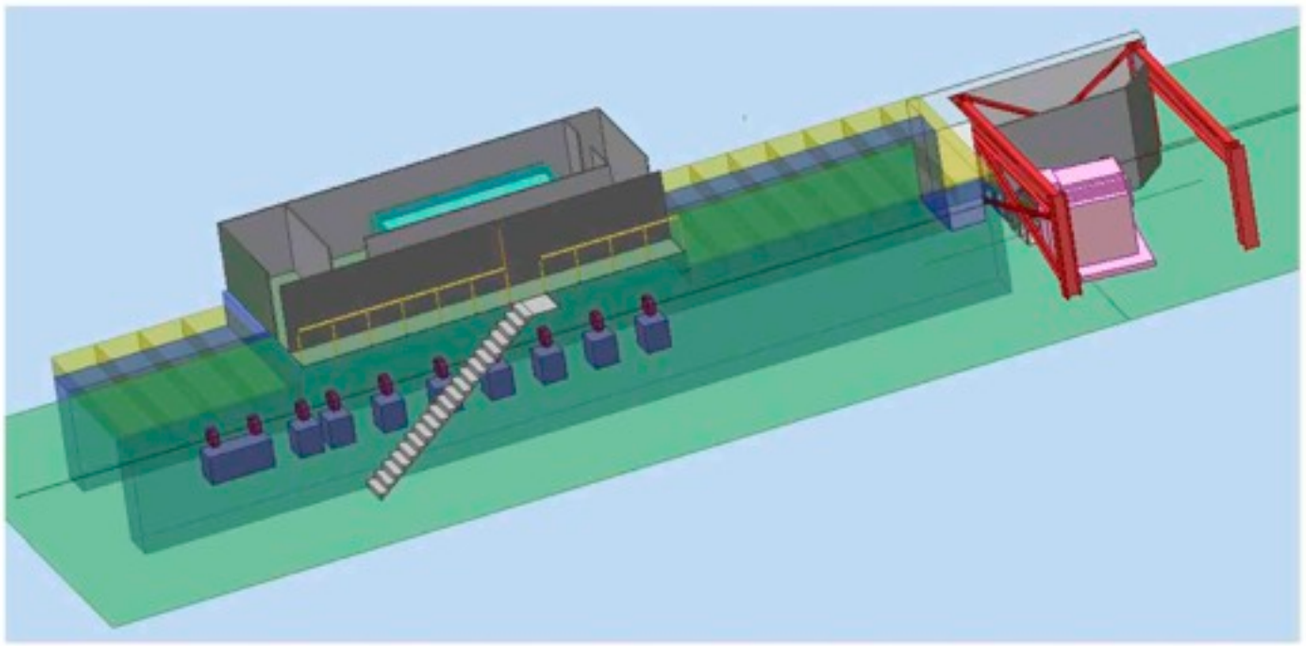
Assuming perfect lattice, no further imperfections (!)

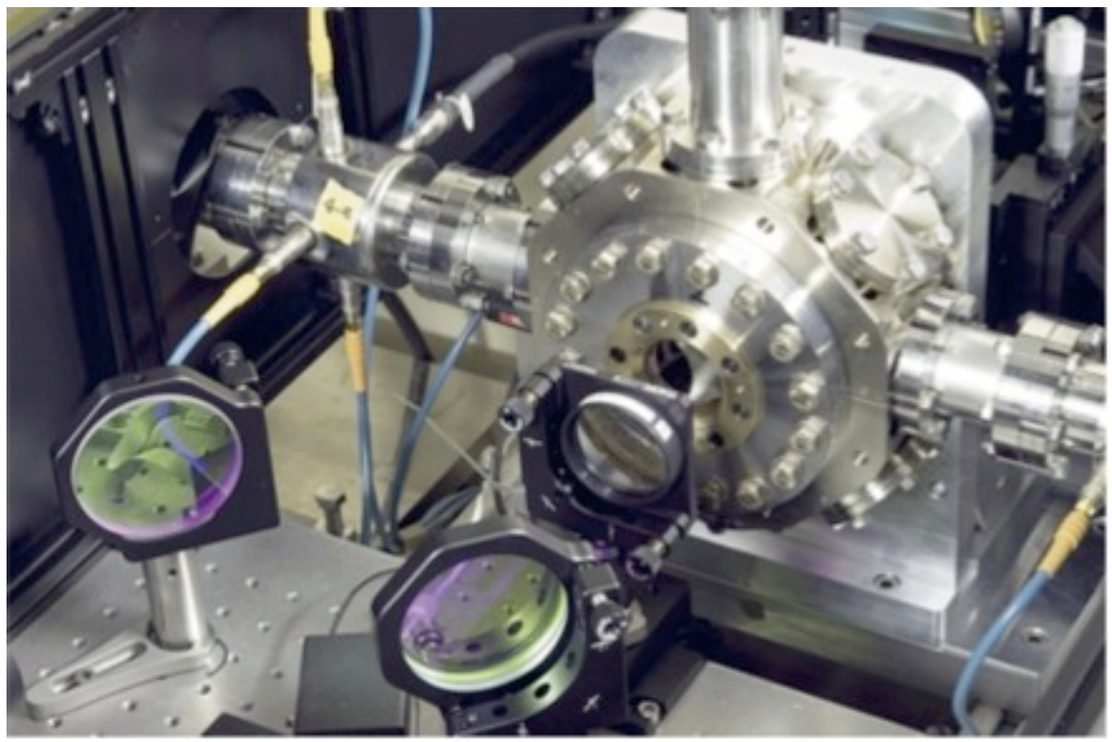


Laser Wire (JAI,KEK)



- **commissioning of the laser system**
- **commissioning of the laser transport and collision system (2010/Mar/22~)**





Results of previous experiment

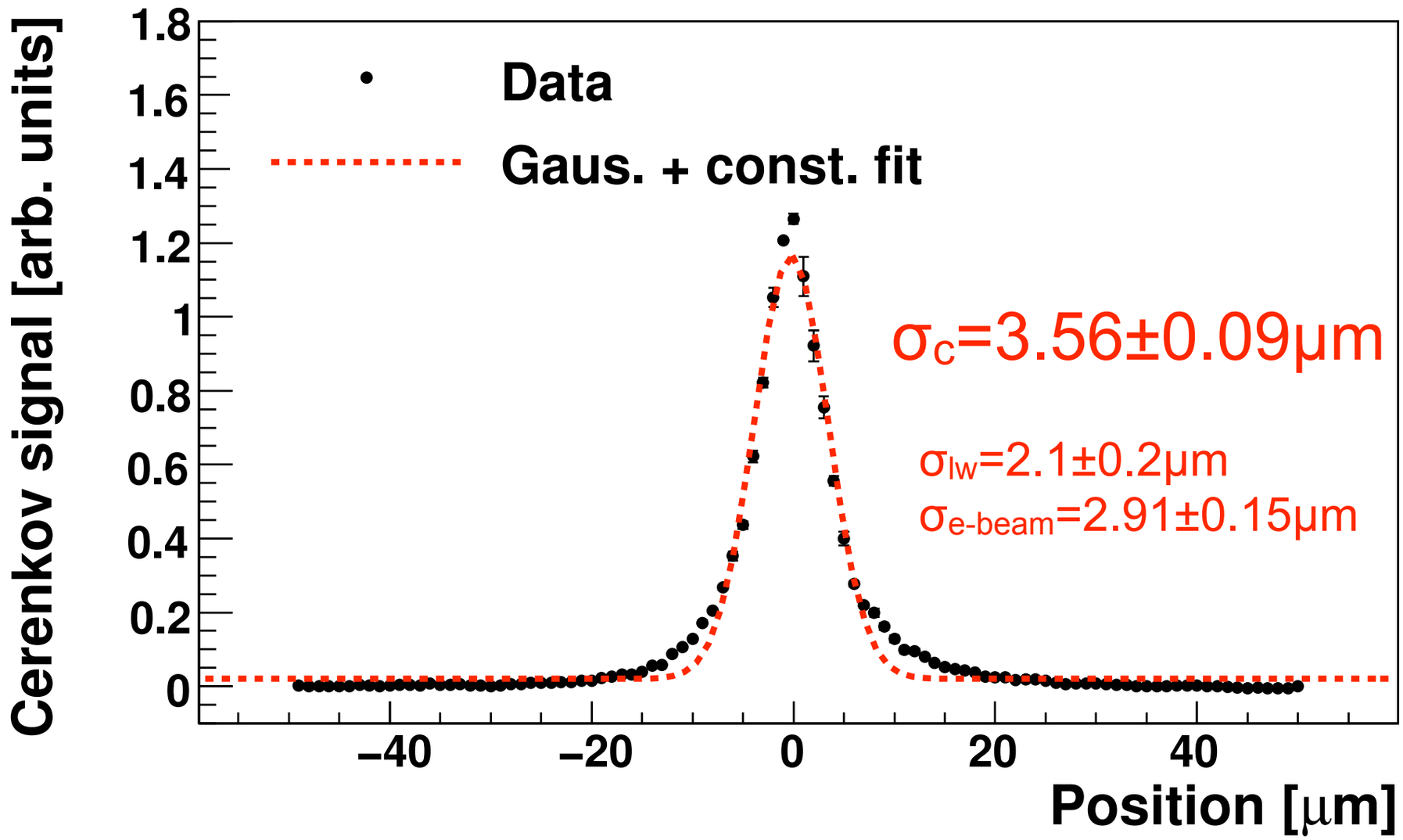


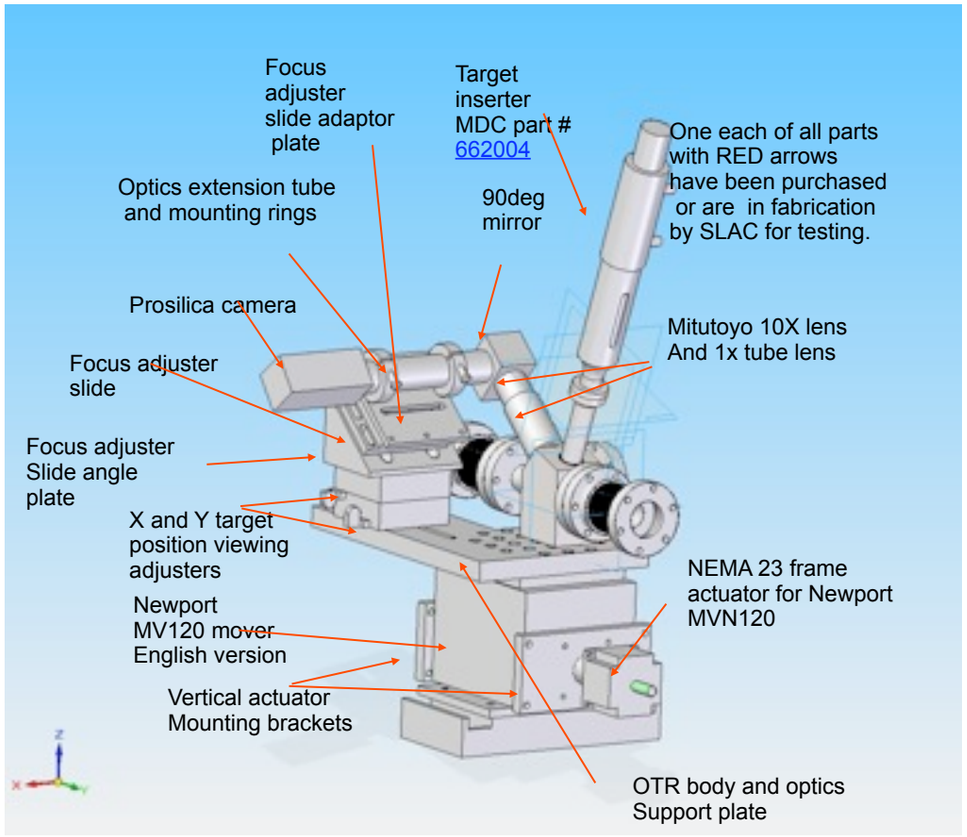
Figure 4.27: The smallest σ_c laser scan measured using the laser wire system. Gaussian + constant fit function is shown. The scan was performed on 29th May 2008 after skew quadrupole tuning.

L.Deacon, Dr thesis, RHUL, UK, April 14, 2009

Multi-Optical Transition Radiation System for ATF2

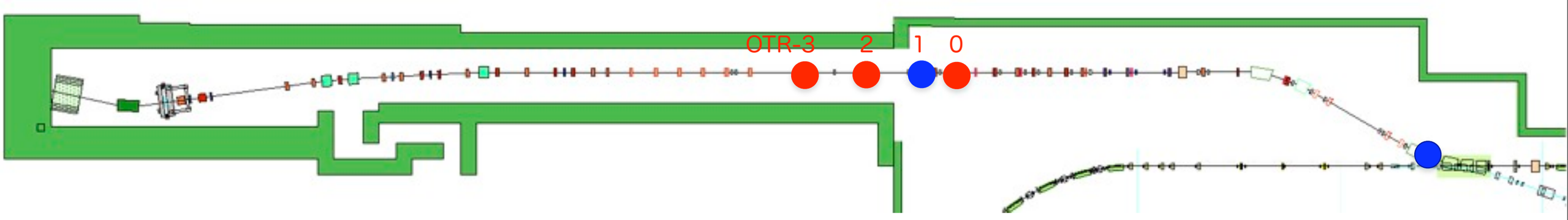
for Fast Emittance Measurement

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



1. Most parts have been arrived at ATF.
2. Two persons from IFIC visited ATF in March, 2010 and assembled the OTRs on the test stands.
3. Control cables were put between the beamline and a control hut.

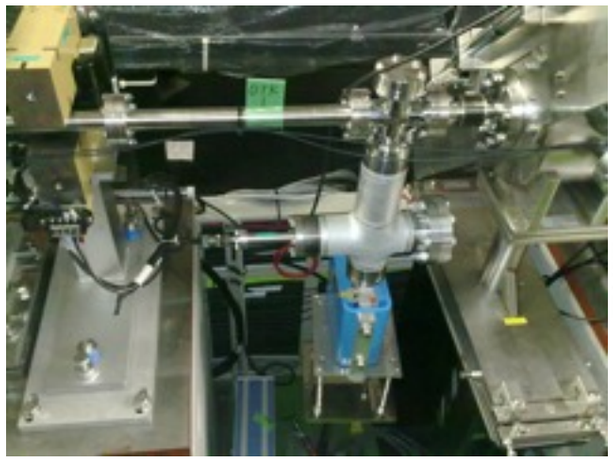
- One of 4 OTRs was installed in May, and 3 OTRs will be installed after IPAC10.

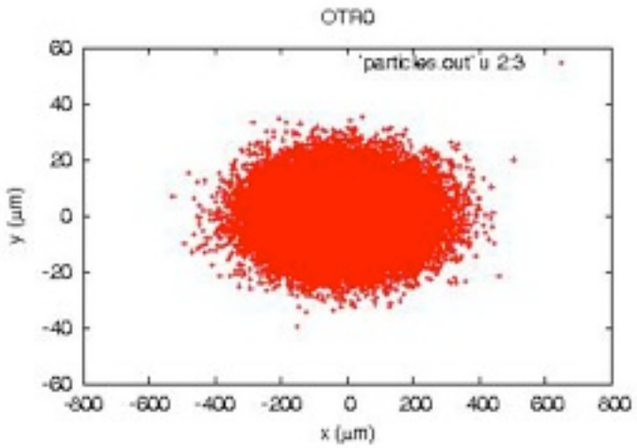


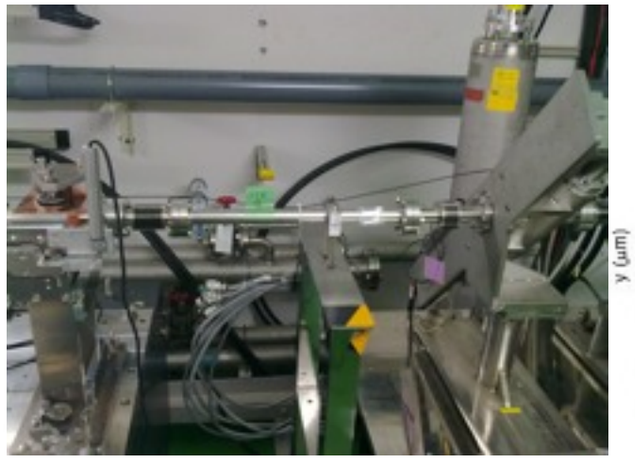
H/W

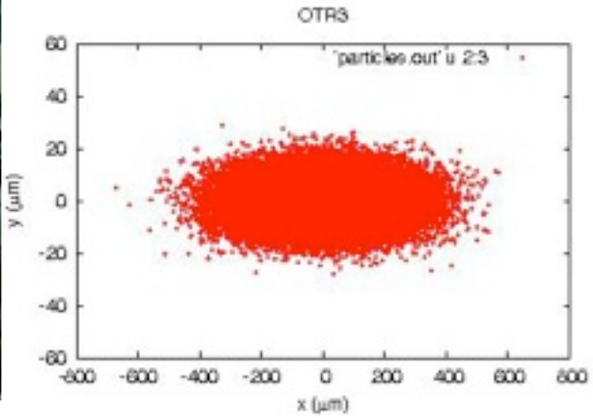
Summary of multi-OTR Status

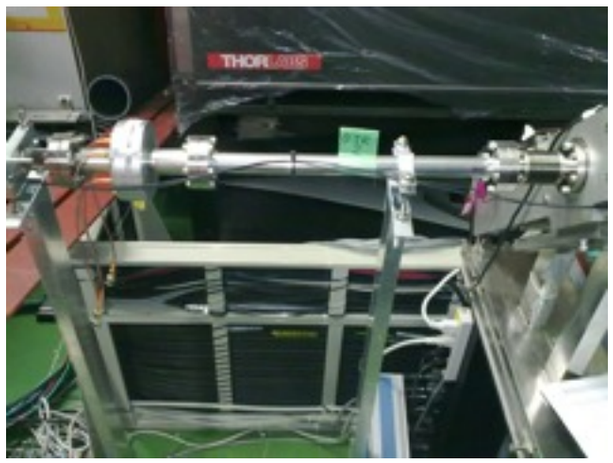
Locations

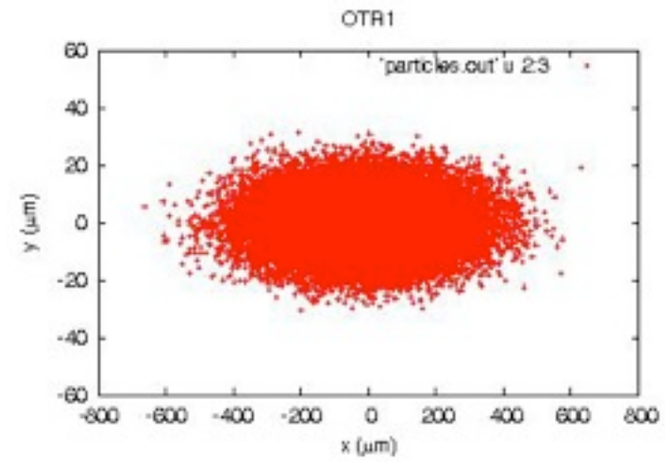


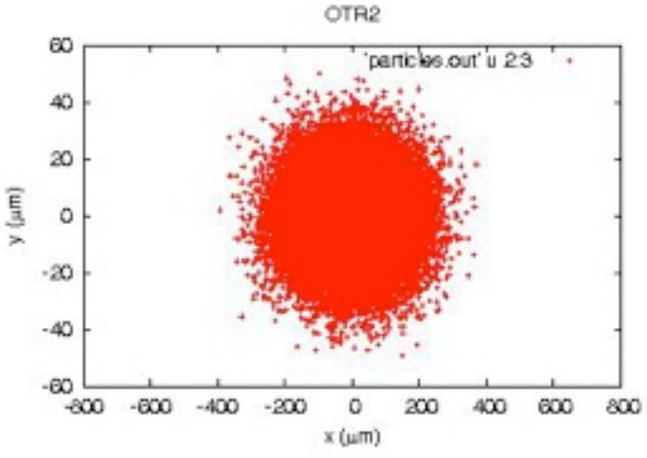










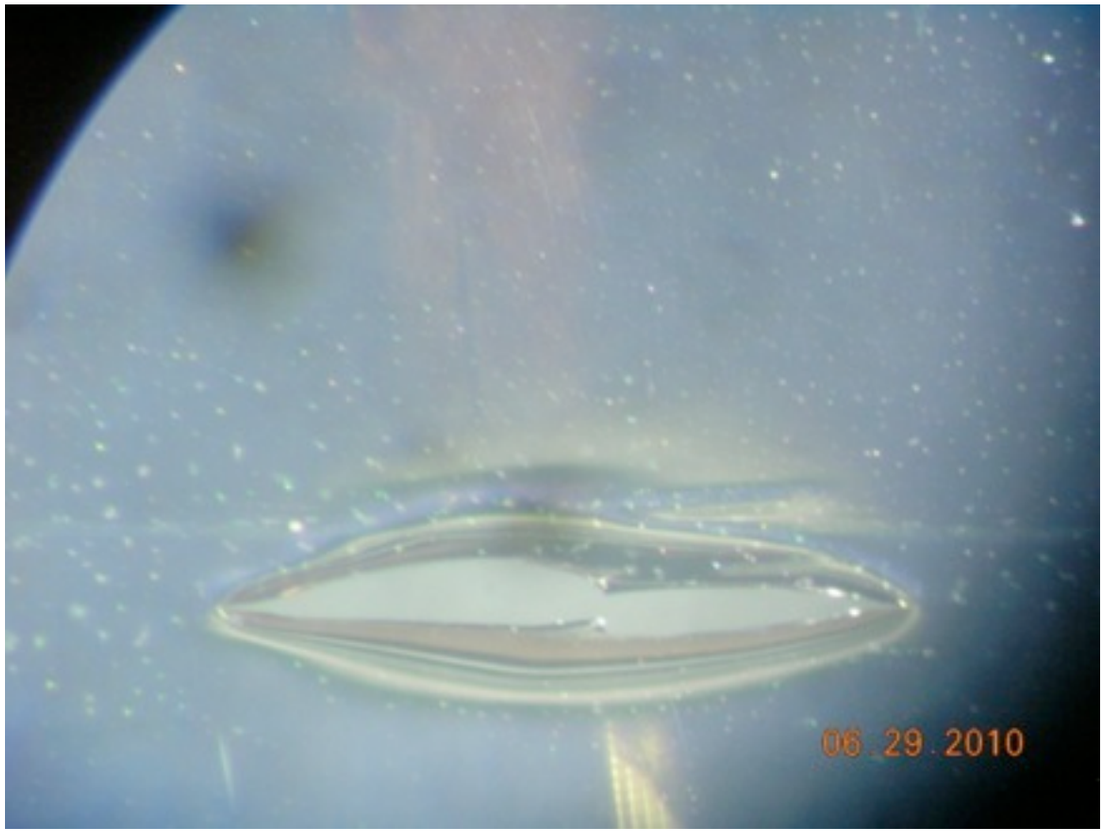


Tracking comparison with
Wire Scanners

OTR0 σx: 118 um σy: 9 um	WS0 σx: 82 um σy: 11 um
OTR1 σx: 148 um σy: 8 um	WS1 σx: 157 um σy: 7 um
OTR2 σx: 92 um σy: 12 um	WS2 σx: 88 um σy: 13 um
OTR3 σx: 144 um σy: 7 um	WS3 σx: 151 um σy: 6 um

OTR resolution = 2 μm

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:

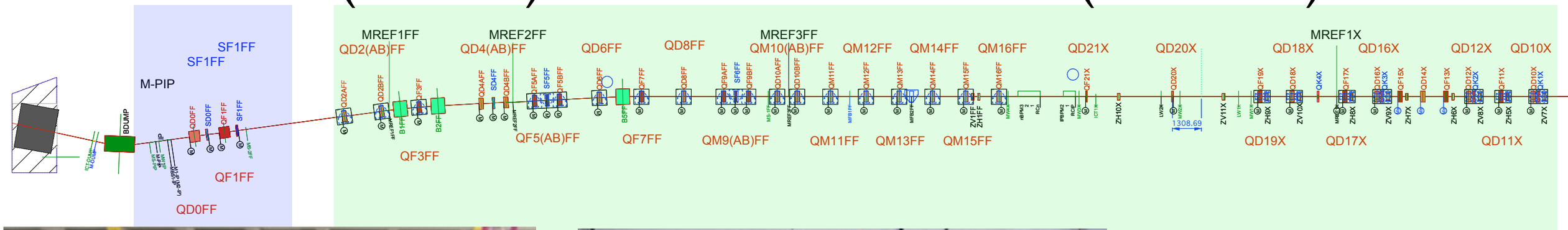
-Research about most adequate target material is on going. Possible candidates for the fall running are: aluminum coated mylar, aluminum coated kapton or 100um aluminum foils

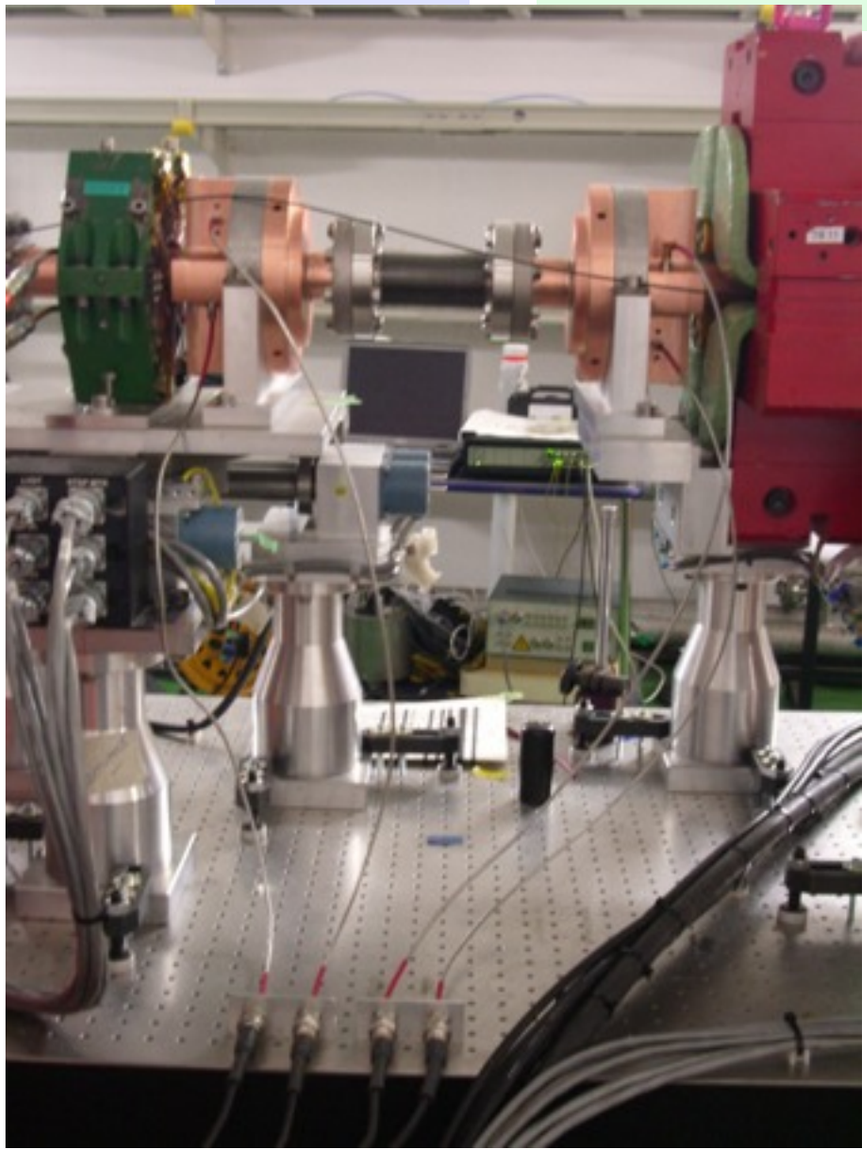
- In addition to the new types of targets, we are going to modify the existing target holders to hold a vertical and horizontal 10um tungsten wires. By using the vertical and horizontal movers each OTR can be used as a wire scanner. The normal step size in the vertical plane is 2um and 10um in the horizontal. 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.

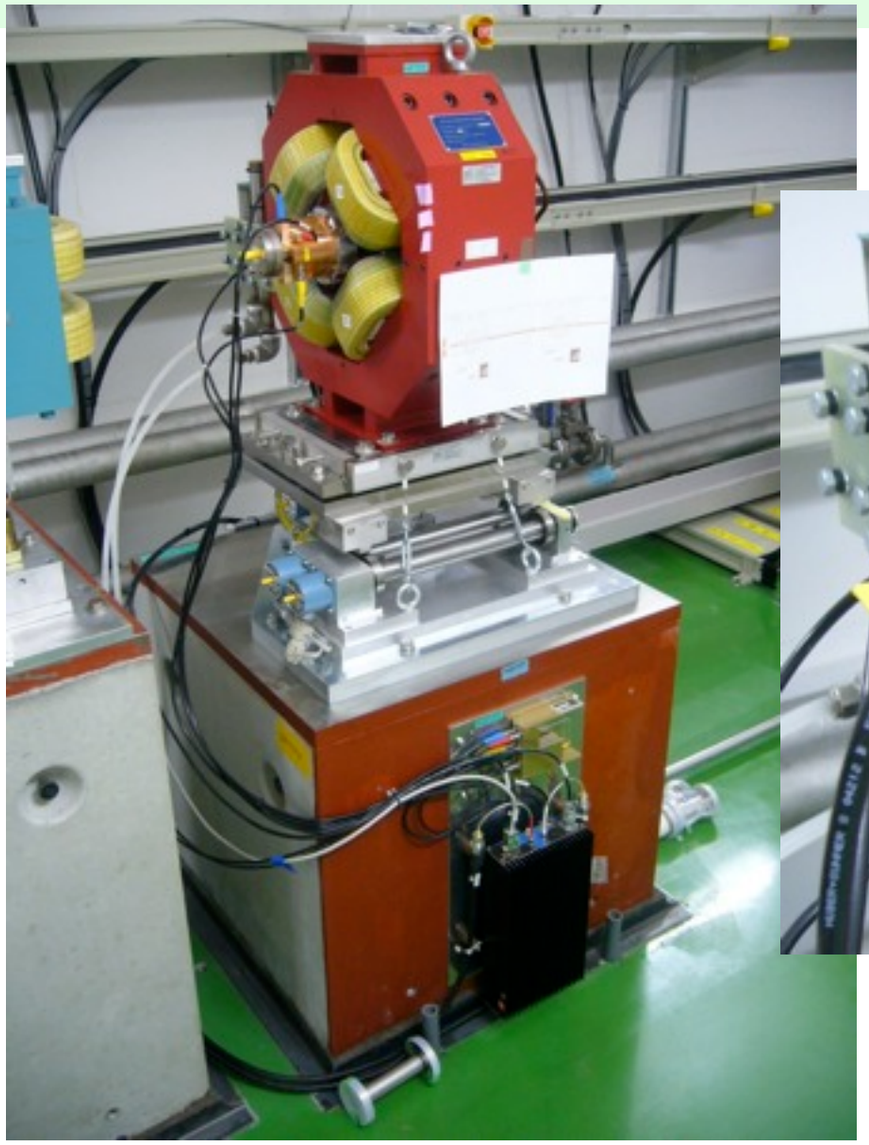
ATF2 BPM layout

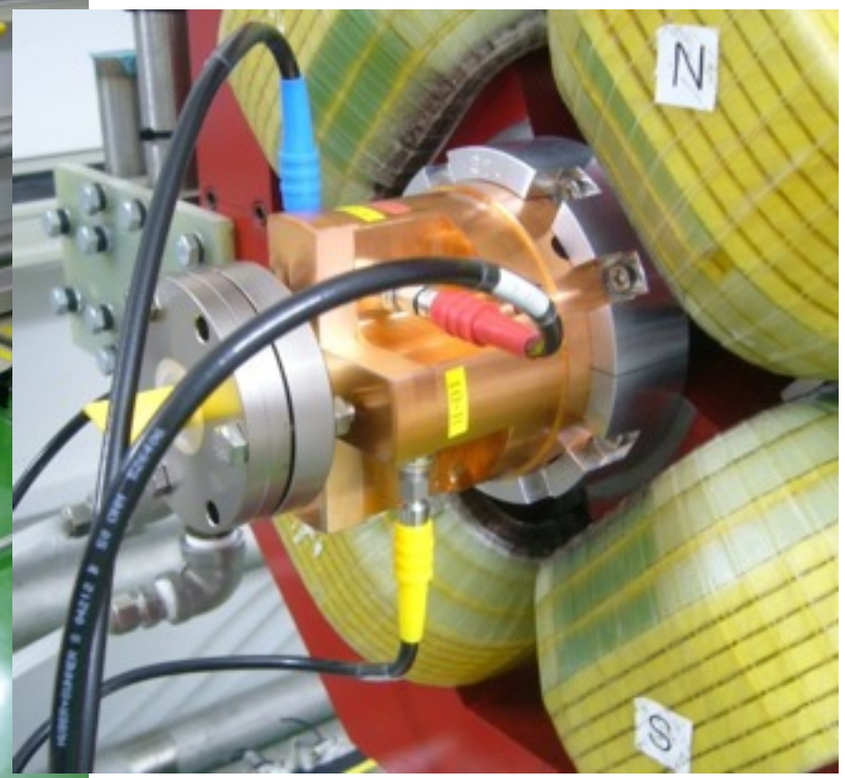
S-Band BPMs (4+1 ref.)

C-Band BPMs (33+4 ref.)



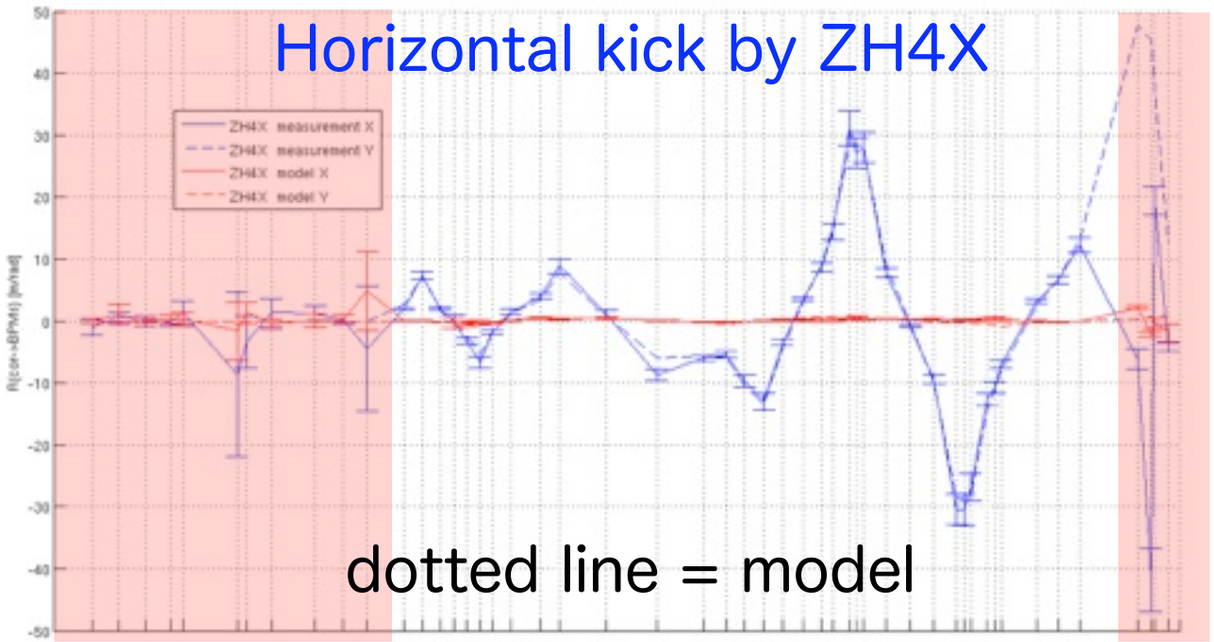


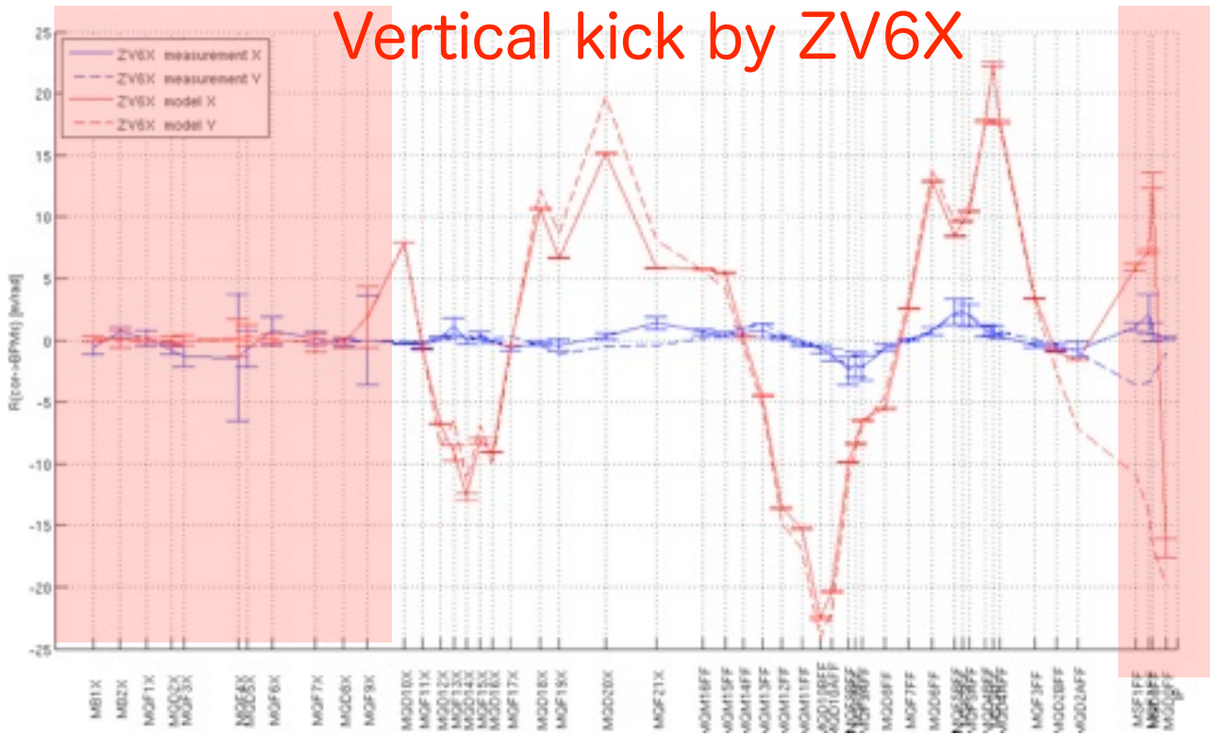




Y. Renier

BPM system performance



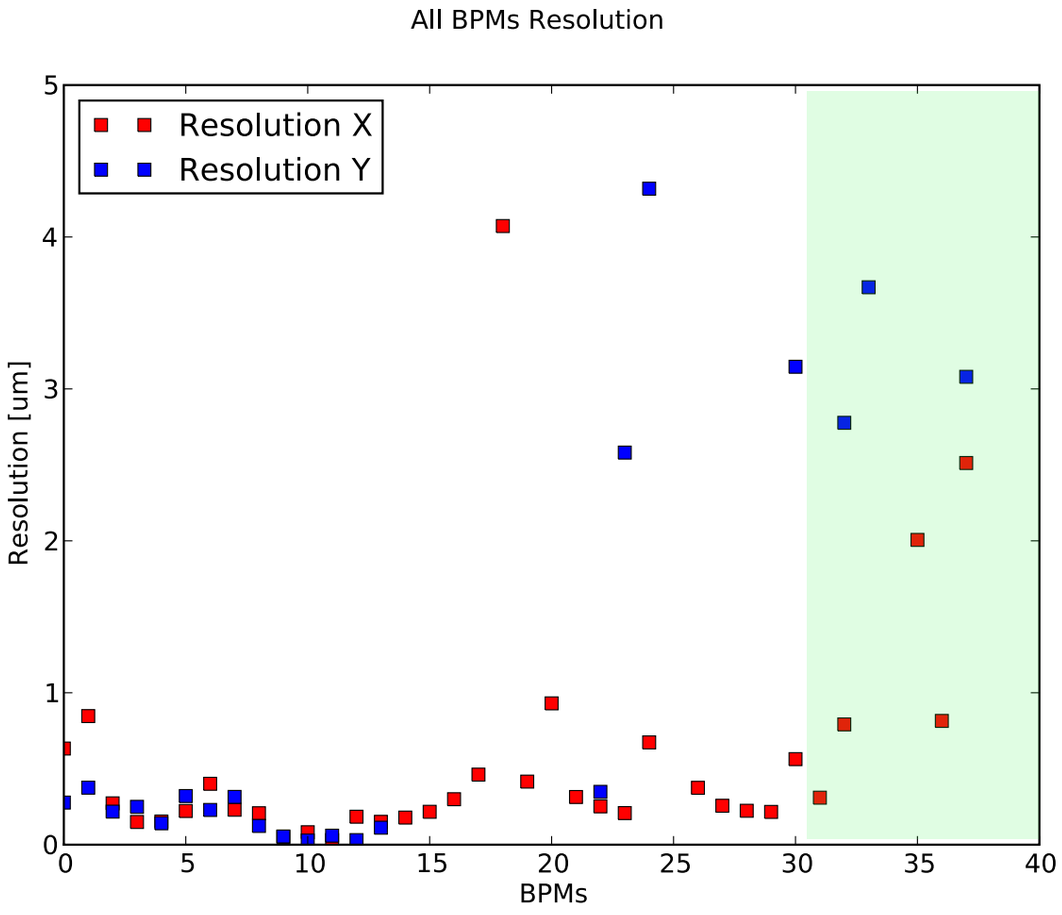


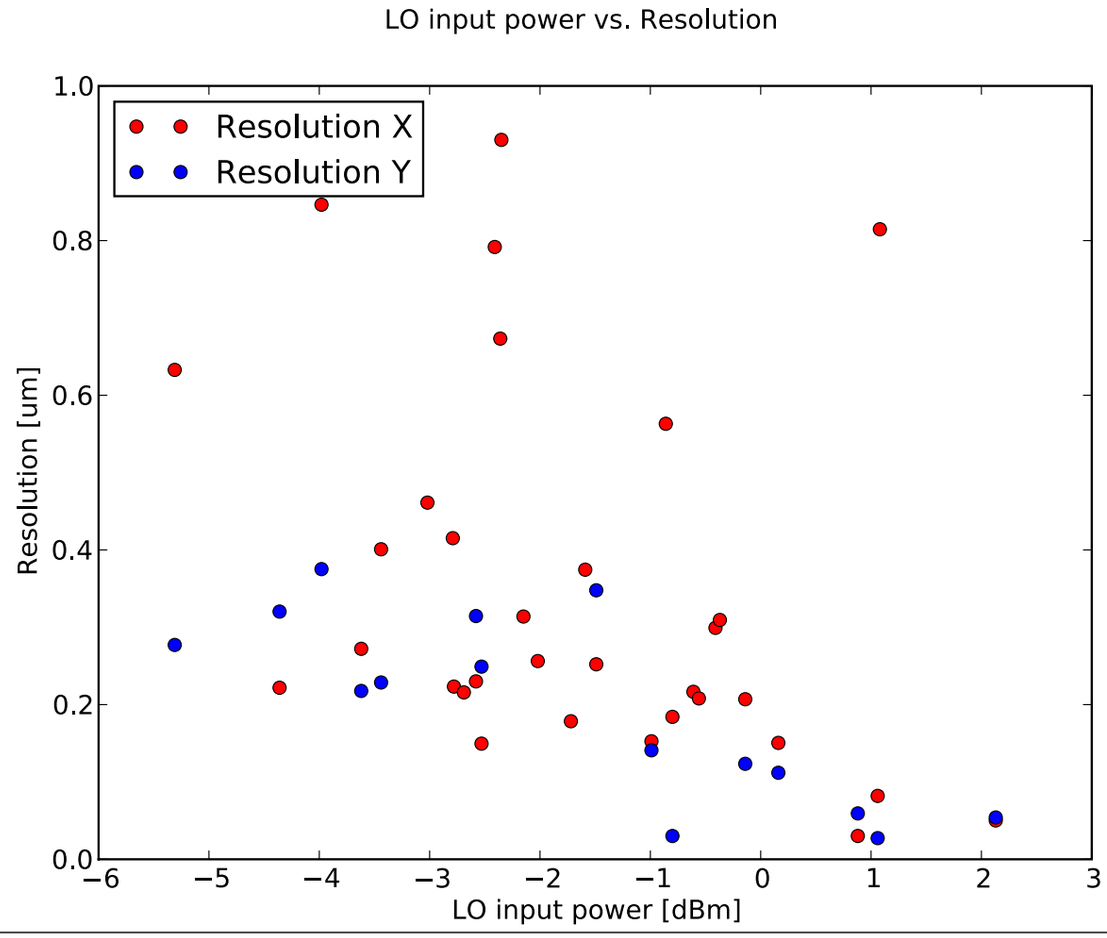
present stability of ~5%
(calibration)

- Kick beam using correctors
  - ZH4X
  - ZV6X
- Compare
  - Optics model (R matrices)
  - Orbit response with BPM measurements normalised by kick strength

Overall BPM performance

- Typical C-band performance with attenuators
  - Between 400 to 200 nm
  - 25 nm for BPMs without attenuators
  - Depends on Local Oscillator power
  - Variation in resolution depends on electrons gain



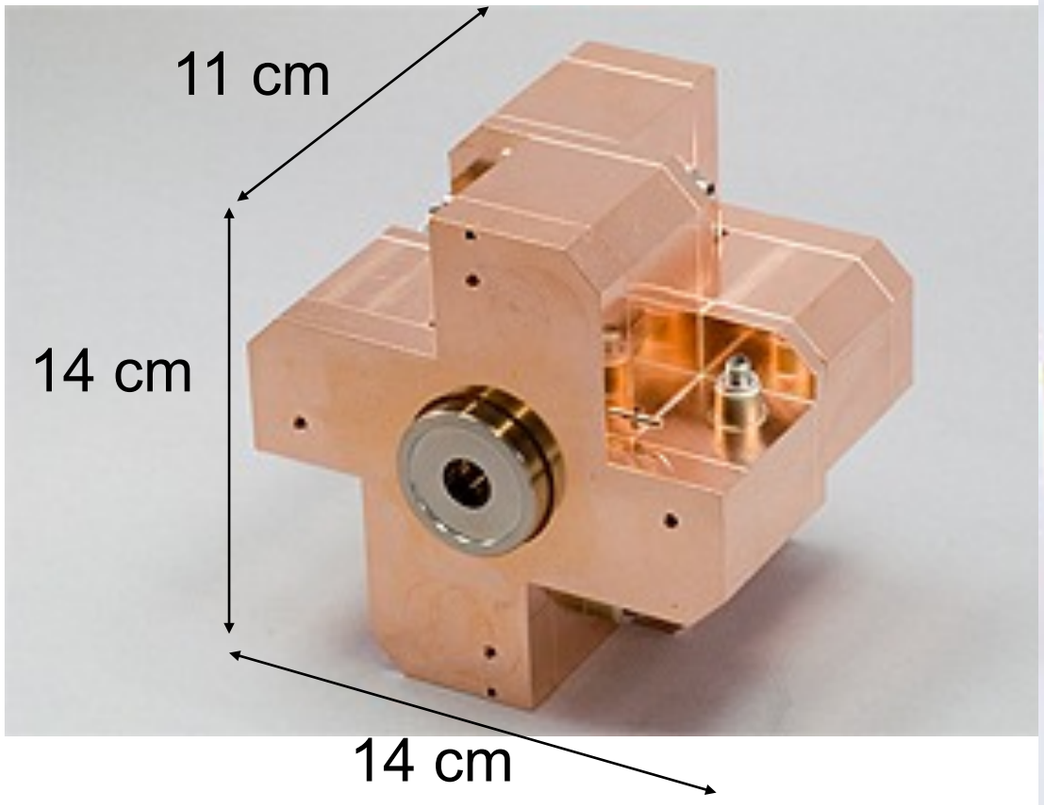


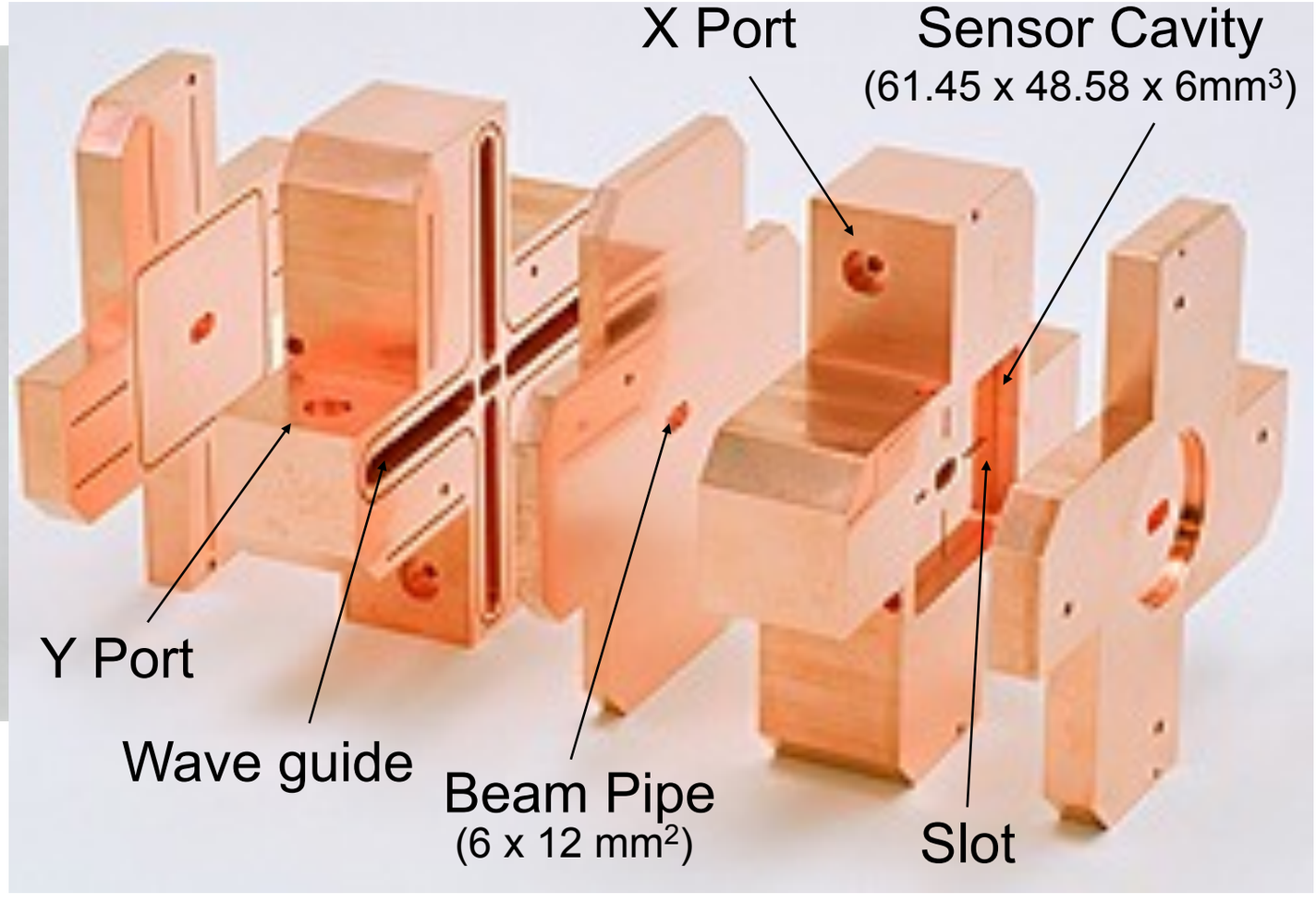
(KEK, KNU)

IP-BPM

Goal : 2nm position resolution

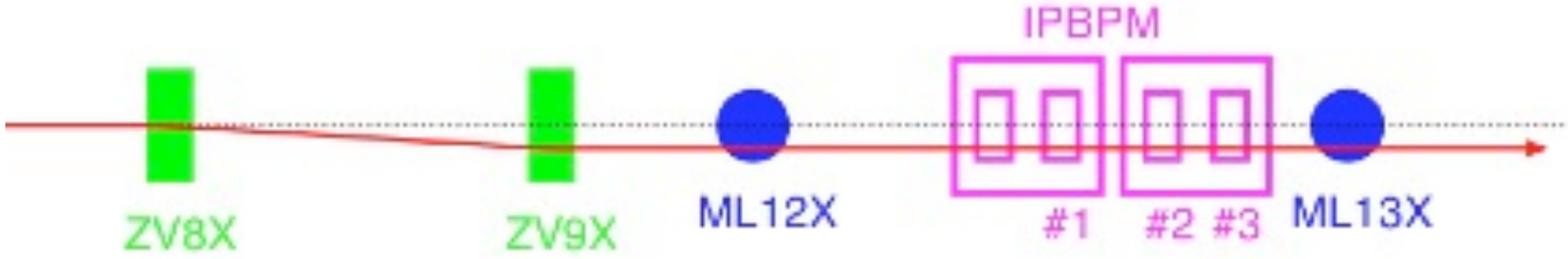
Rectangular cavity for X-Y isolation (-50dB)
- **2 Cavities in 1 block**
- **2 Y ports and 2 X ports in 1 Cavity**





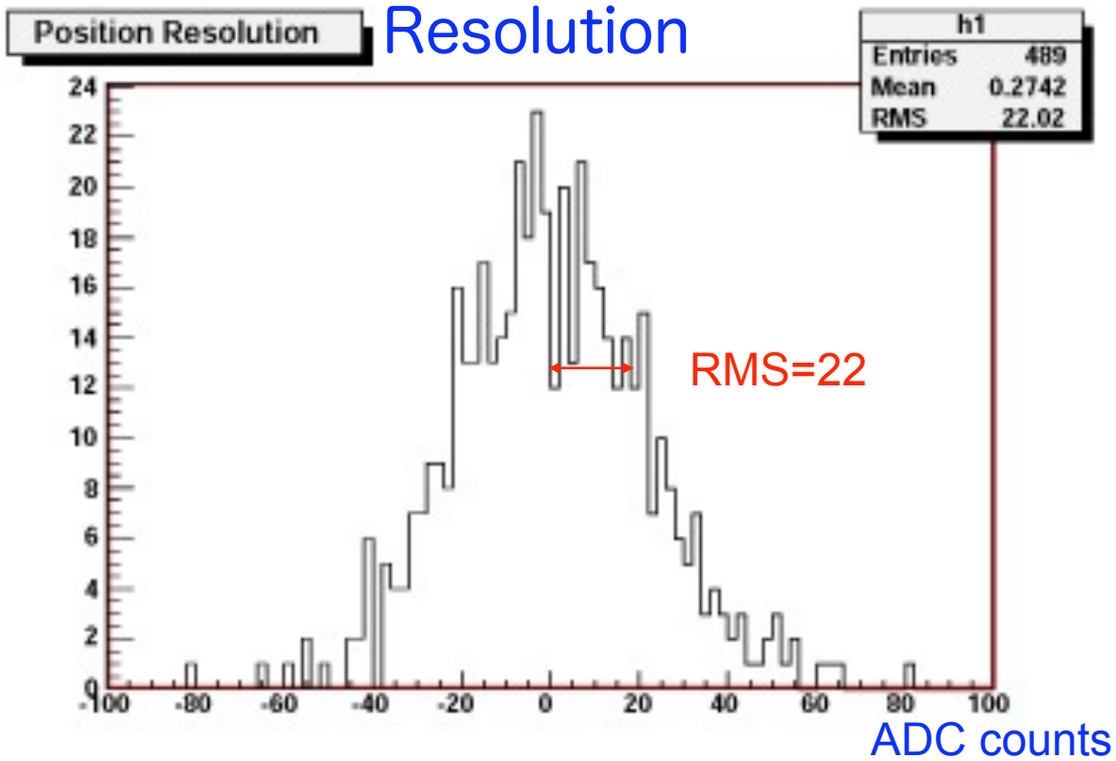
IPBPM : resolution and stability

Test Setup



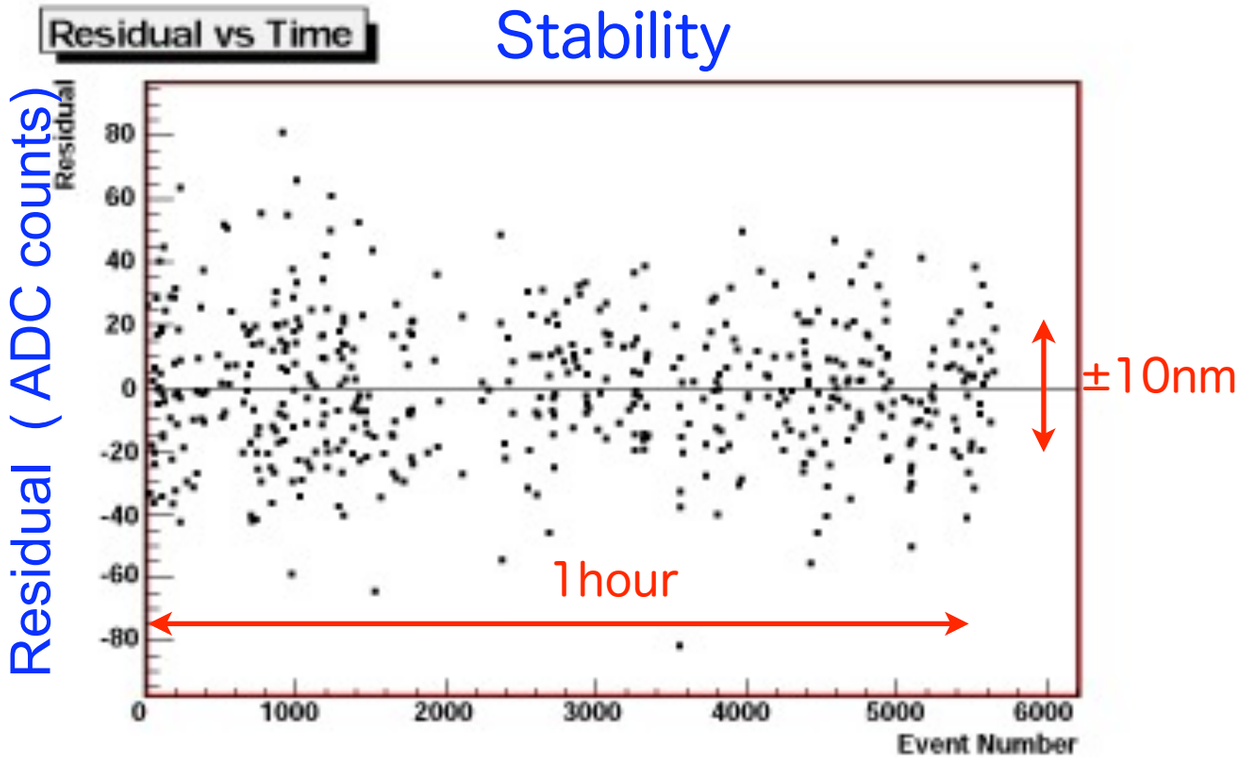
Calibration : 2 ADC counts/nm

Resolution



Residual of (Y2I – $Y2I_{predicted}$)

Stability



Time (event number, 1.5Hz)

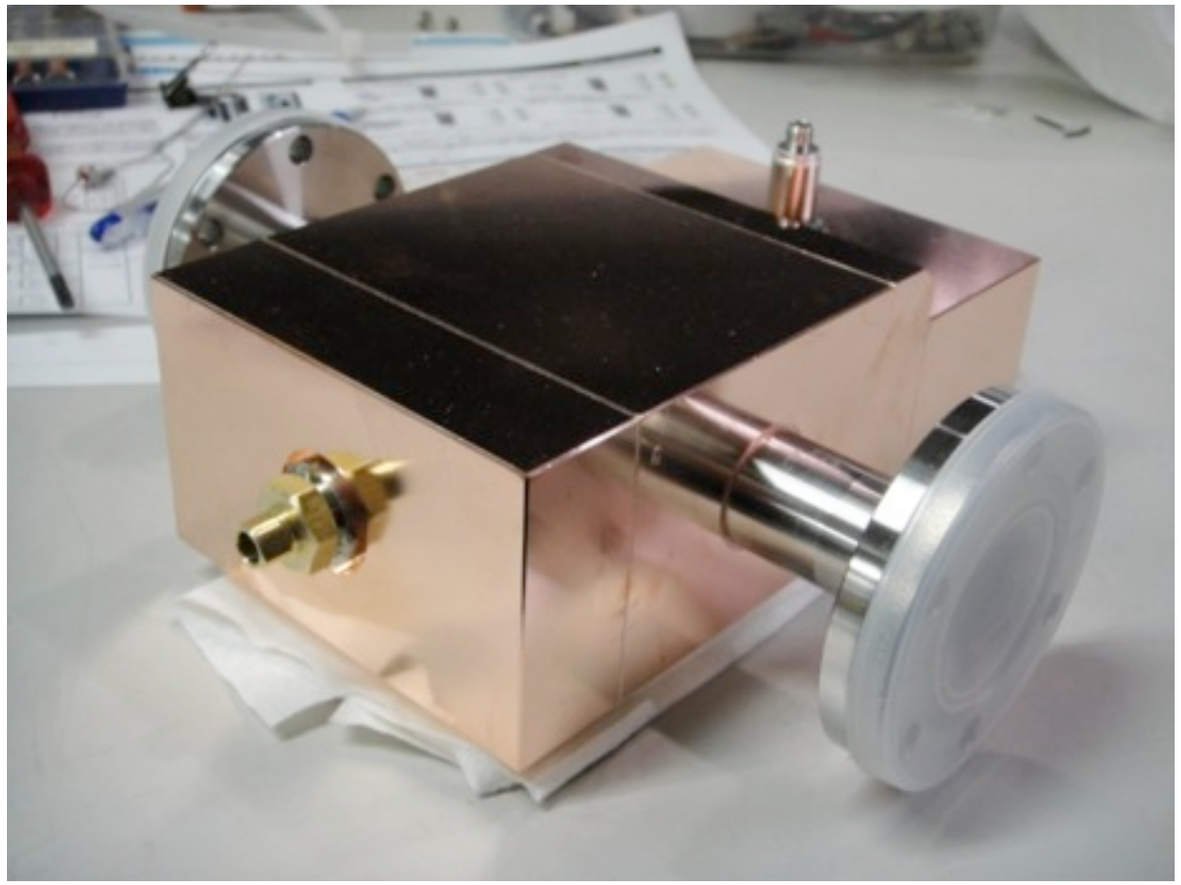
condition : beam intensity =0.7x10^{10}/bunch, dynamic range = 5μm

Resolution(1 hour) = 8.7±0.3(stat.)±0.4(sys.) nm

2nm-goal :1x10^{10}/bunch, temperature, signal intensity, active support ..

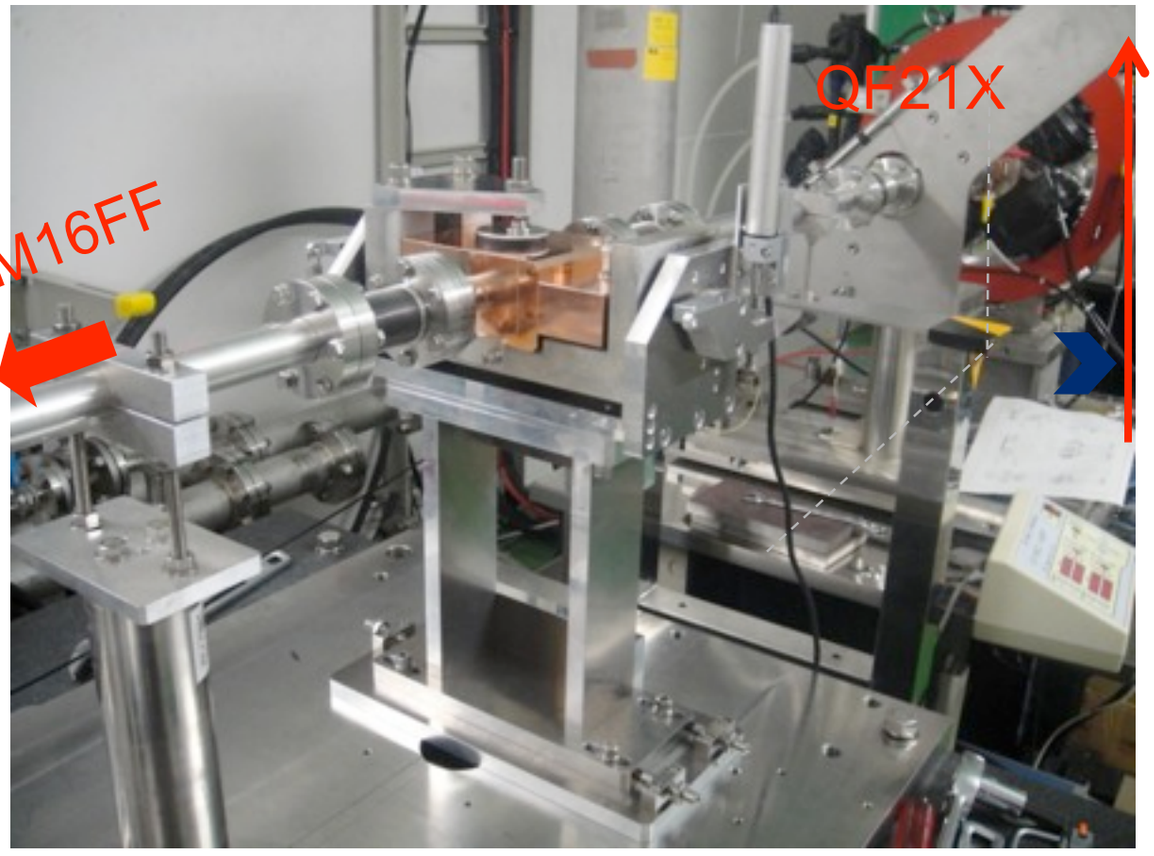
Y. Inoue et al., Phys. Rev. ST Accel. Beams 11, 062801 (2008)

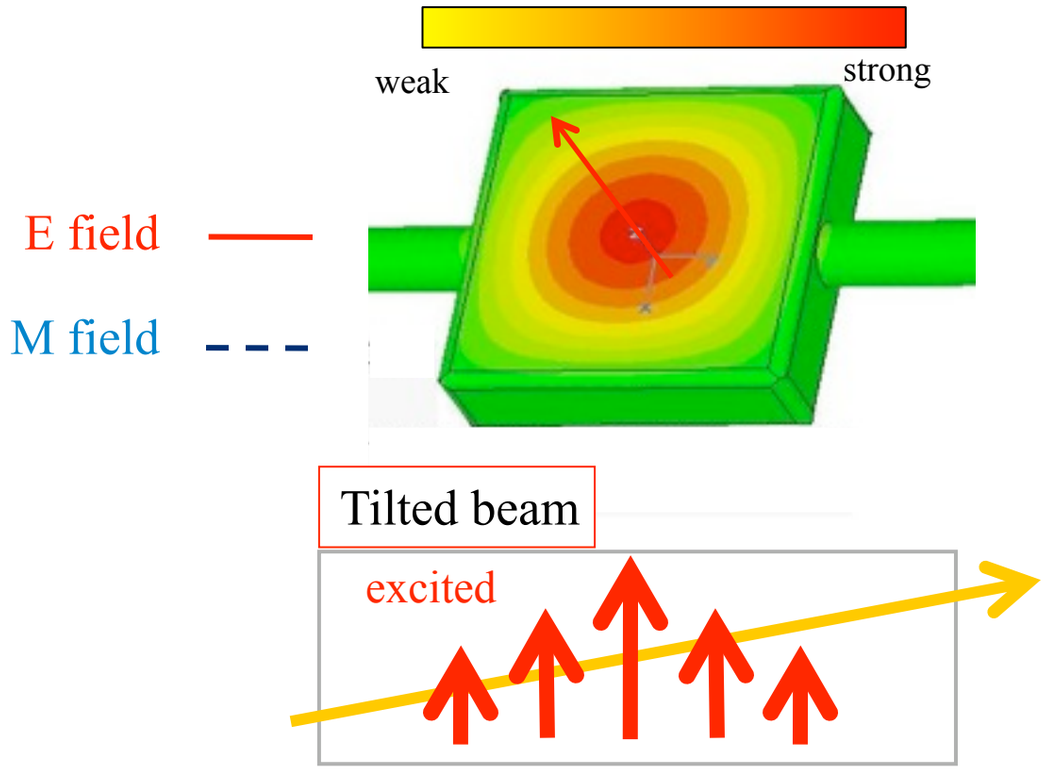
Tilt Monitor : Prototype and tested



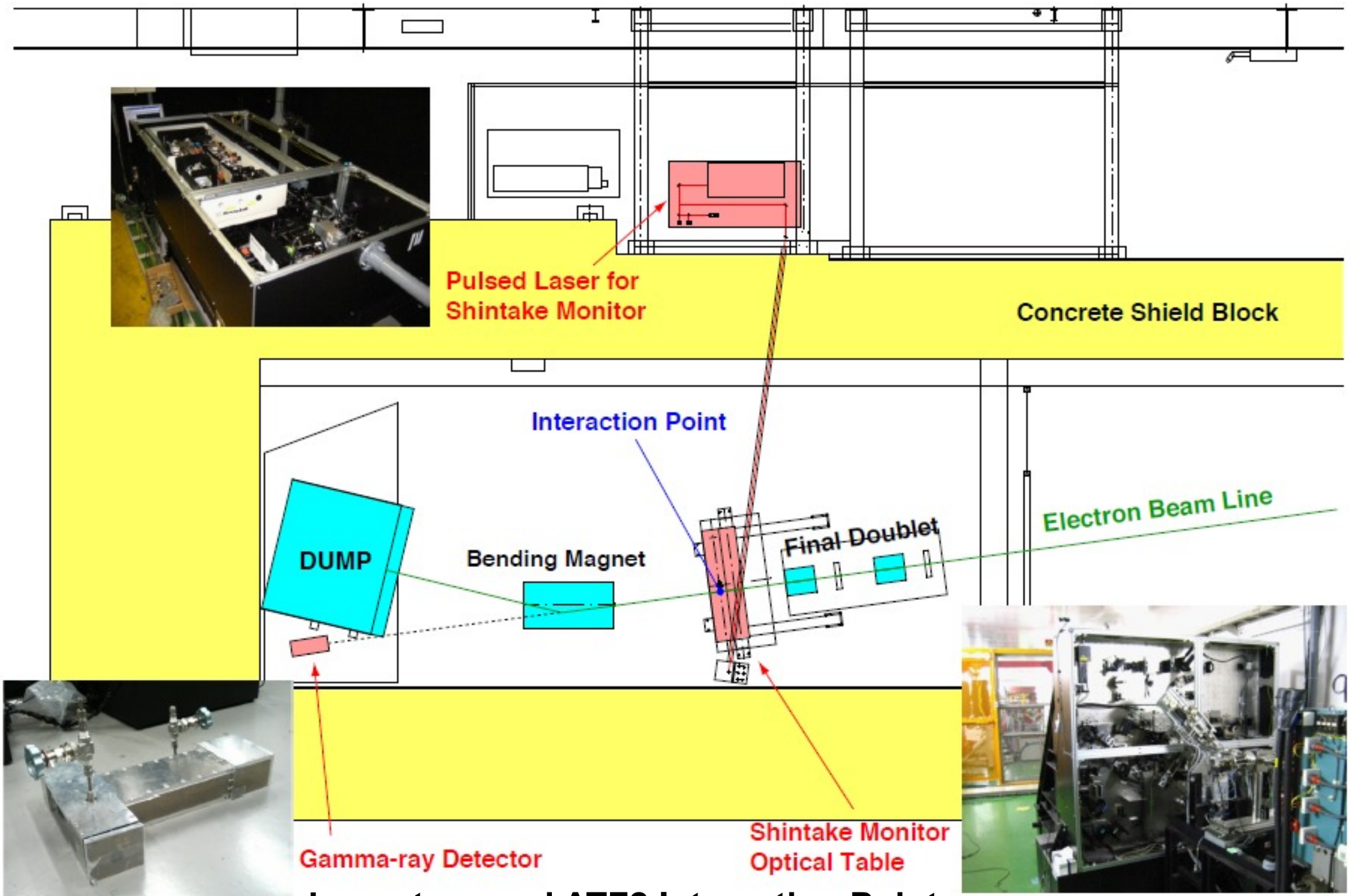
	Parameters measured	**Design**
frequency	2.8553 GHz	2.856 GHz
Loaded Q	2978	2650
Qwall	10128	10000
Qext	4220	3350
Decay time	156nsec	150nsec

Expected resolution : 30nrad





Shintake Monitor : Layout

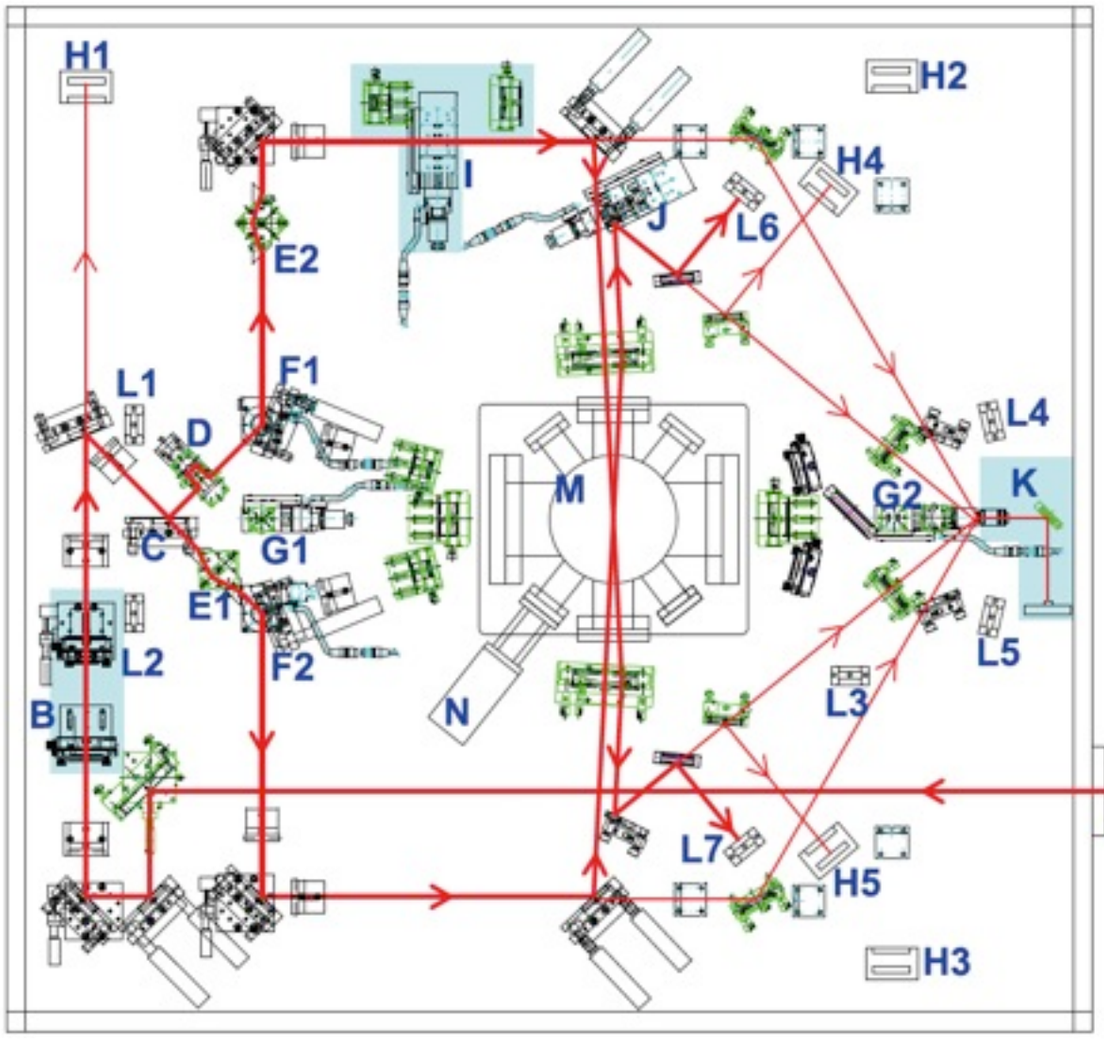


Layout around ATF2 Interaction Point

Shintake Monitor, i.e. BSM at IP

Oroku@The Univ. of Tokyo

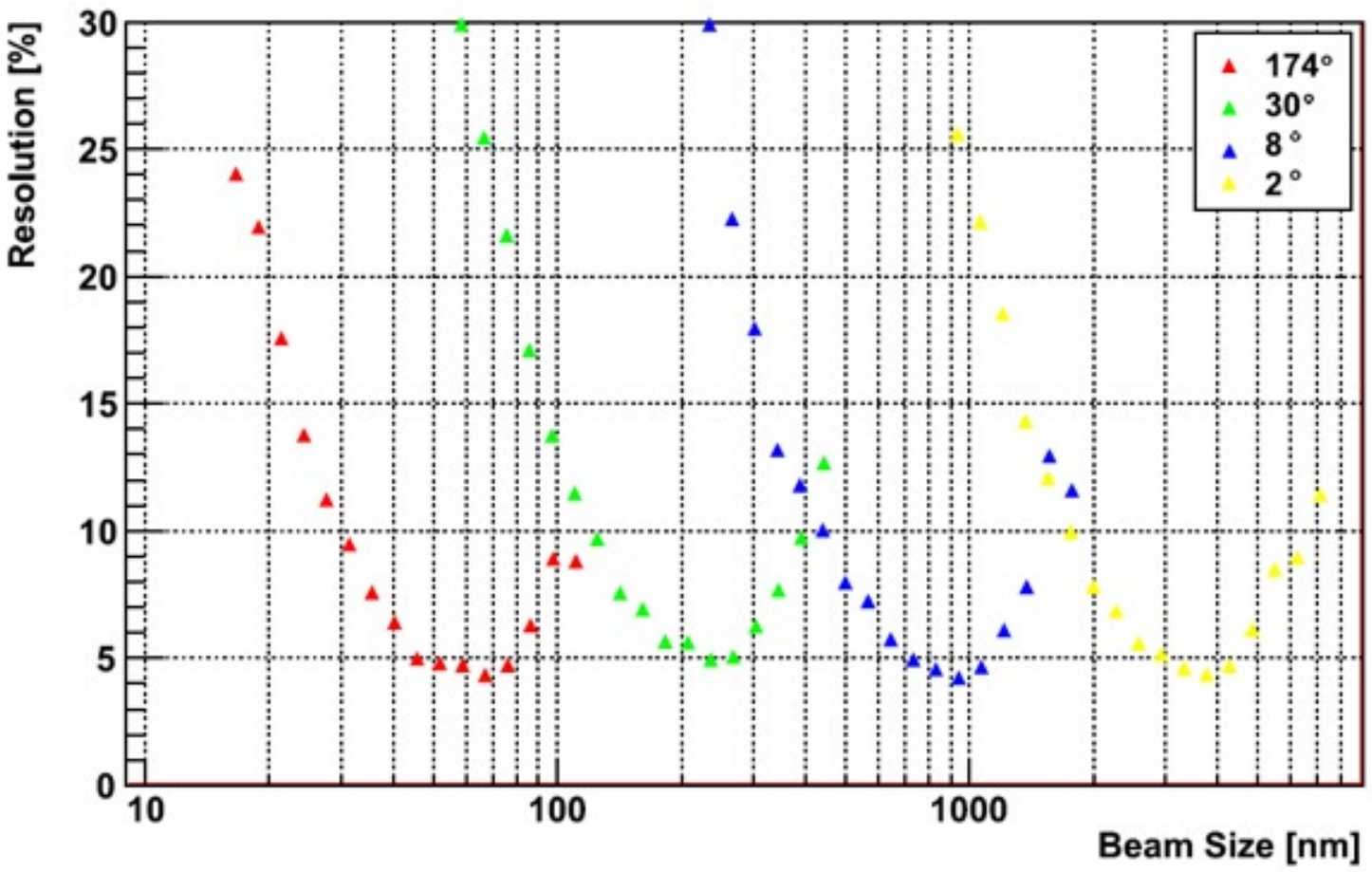
Shintake Monitor



Laser path diagram (174 deg crossing angle)

Picture of the vertical optical table installed at ATF2 beam line

Expected Beam Size Resolution



Simulation condition

- Statistical error of the Compton scattered photons (including background subtraction): 10%
- Electron beam position jitter: 30 % of beam size
- Jitter of interference fringe phase: 400 mrad
- Jitter of laser pulse energy: 6.8%
- 1 measurement time : 1 min.

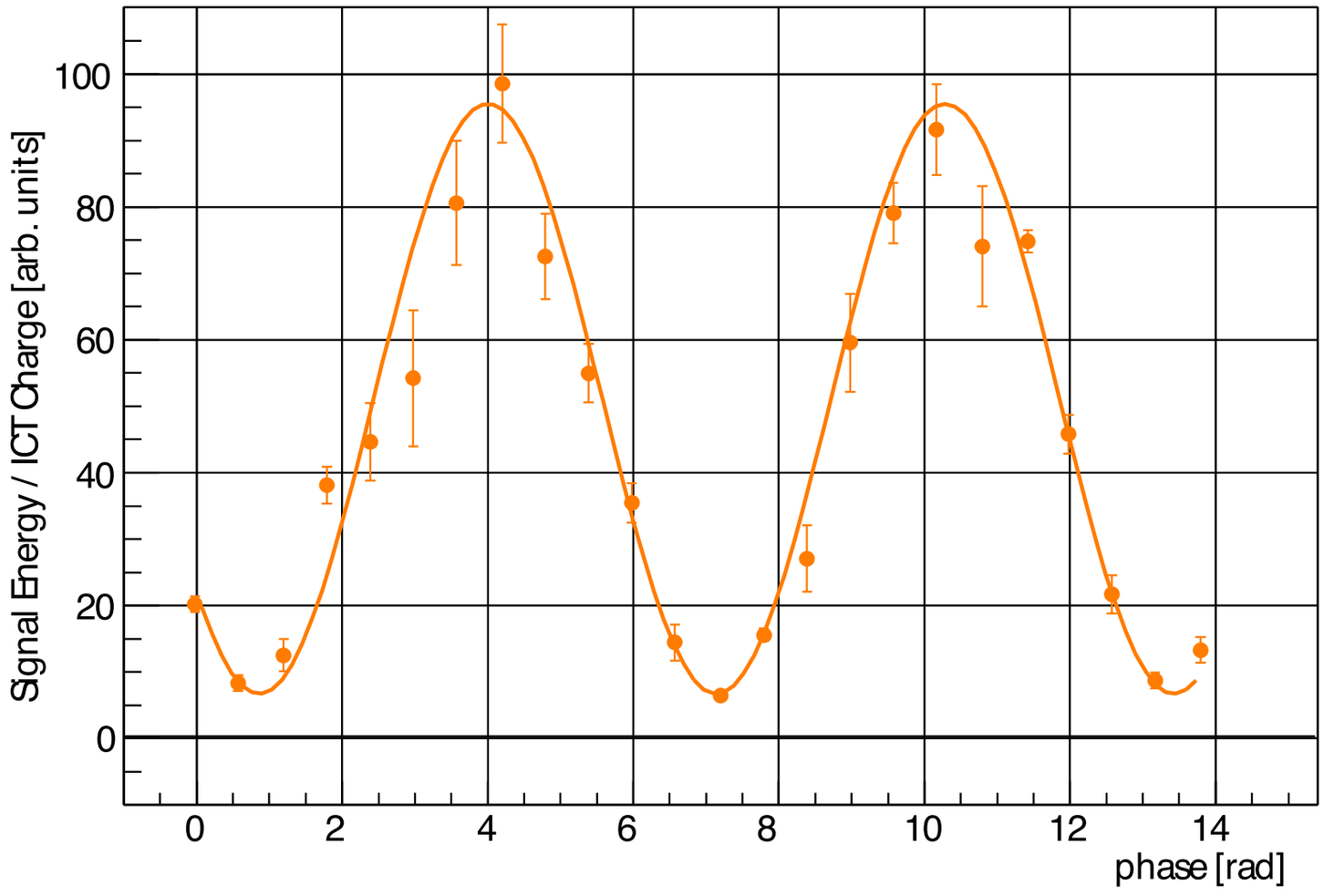
◆ Expected resolution (statistical error) is evaluated by simulation considering the probable error sources

◇ in 25 nm ～ 6 μm range
: less than 12 %

◆ Systematic error also need to be evaluated.

	174°	30°	8°	2°
Fringe pitch	266 nm	1.03μm	3.81μm	15.2μm
Minimum	25 nm	100 nm	360 nm	-
Maximum	100 nm	360 nm	-	6 μm

Result of continuous run



Beam condition
- β_x^* ~ 4 cm (setting)
- β_y^*~ 1 mm (setting)

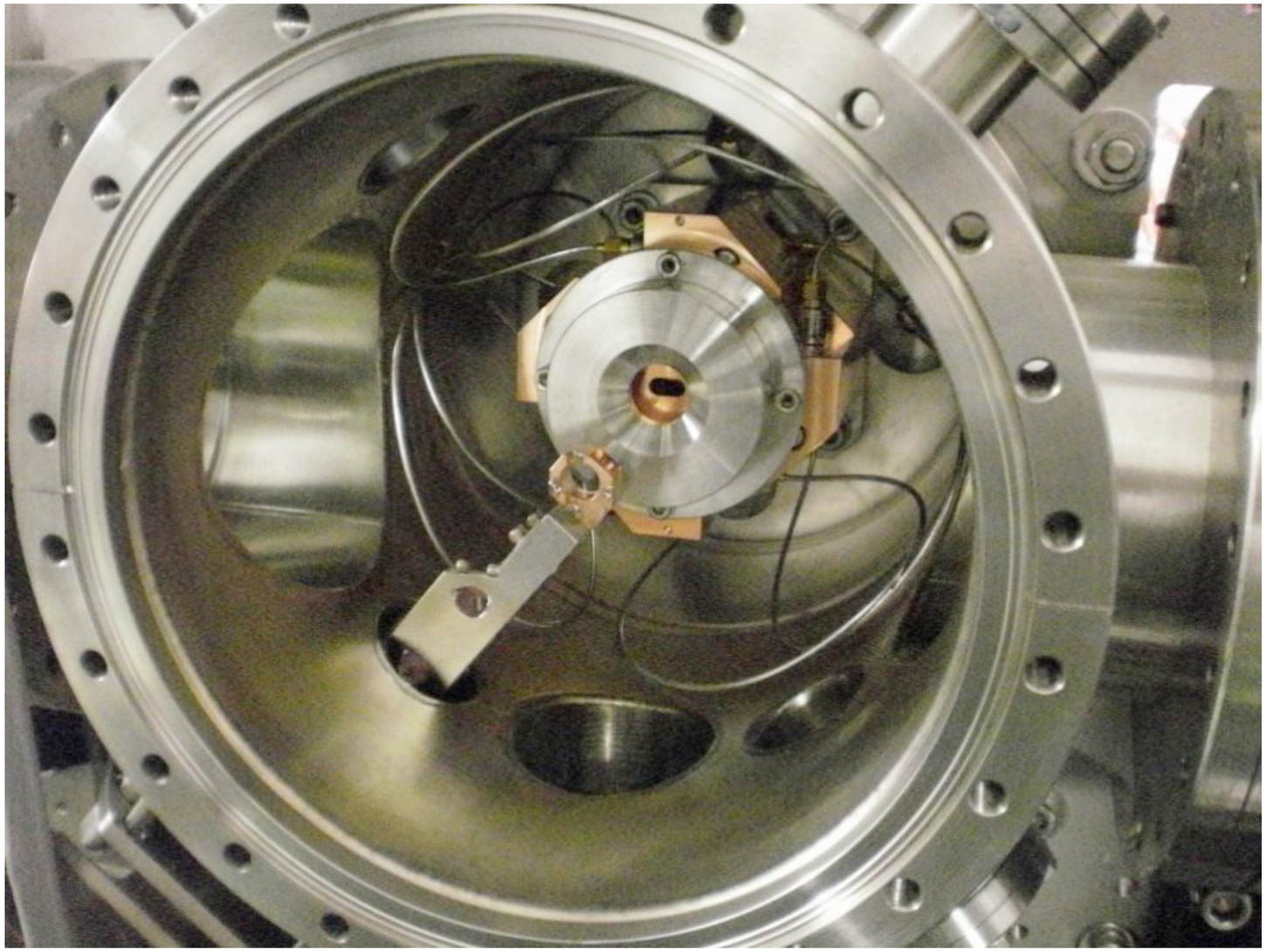
- BG 6.5GeV
- S/N 30

Measurement condition
- Crossing angle ~ 7.96 deg
  = fringe pitch ~3.83 μm

Modulation ~ 0.85

$$\sigma_y = 313 \pm 31\ (\mathrm{stat.})\ {}^{+0}_{-40}\ (\mathrm{sys.})\ \mathrm{nm}$$

IP chamber



- 10 micron tungsten wires (H:1 V:2) installed
- BPM installed
- BPM cables are connected in the cable,(but not connected to the outside of the shield)

Summary

1. BPM system has been commissioned except for 4 S-band BPMs.
2. Shintake monitor system has been commissioned with improving performances.
3. Multi-OTR system is commissioning.
4. Laser wire system in Intensive R&D.
5. FONT, IPBPM and Tilt monitor systems also in R&D towards the second goal