

Present Status of ATF2

T. Tauchi,
2nd BTR, 24 -27 October 2011,
DESY, Germany

ATF2 : Goal - I

A. Achievement of 37nm beam size

A1) Demonstration of a new compact final focus system;
proposed by P.Raimondi and A.Seryi in 2000,

A2) Maintenance of the small beam size
(several hours at the FFTB/SLAC)

Goal - II

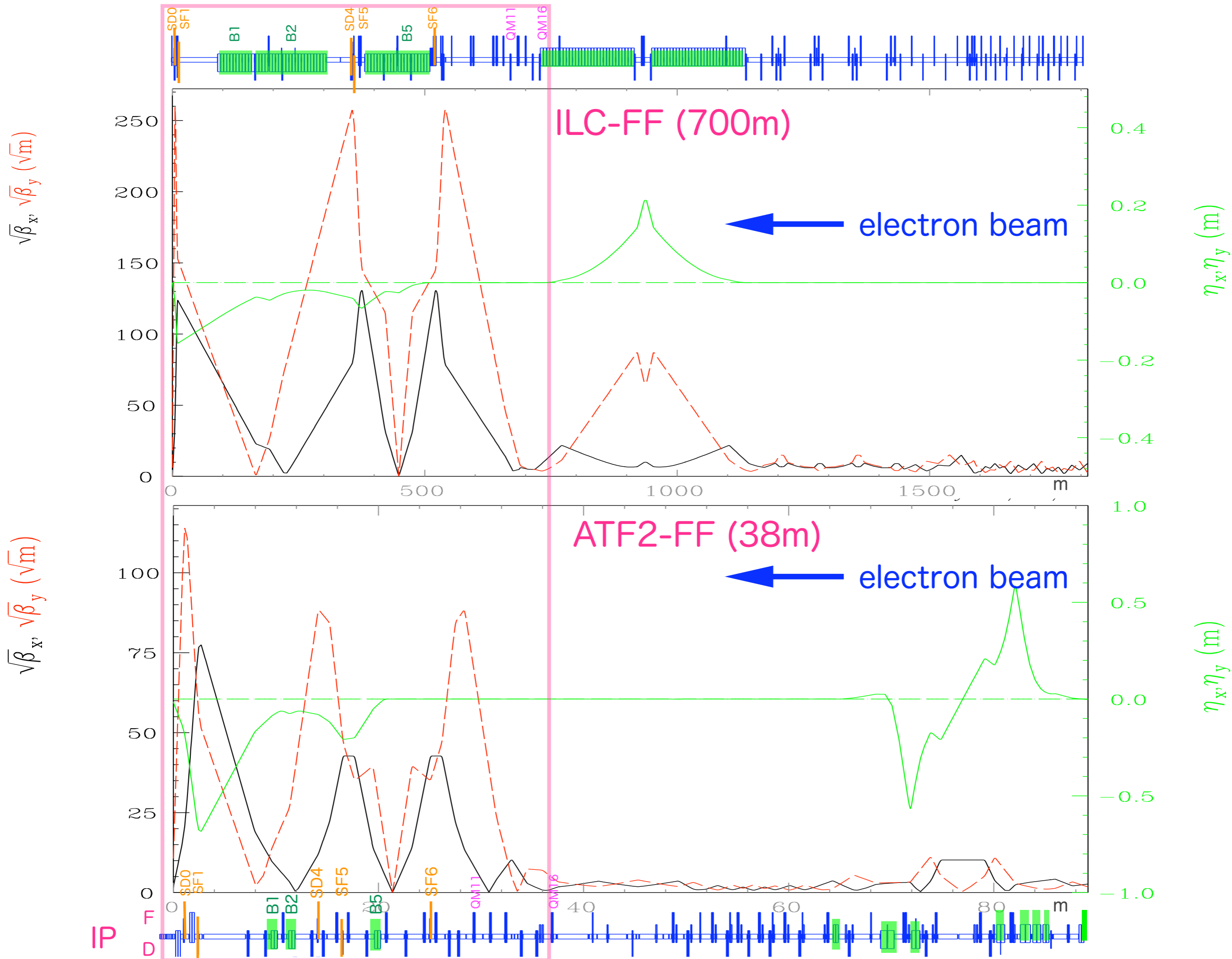
B. Control of the beam position

B1) Demonstration of beam orbit stabilization with
nano-meter precision at IP.

(The beam jitter at FFTB/SLAC was about 40nm.)

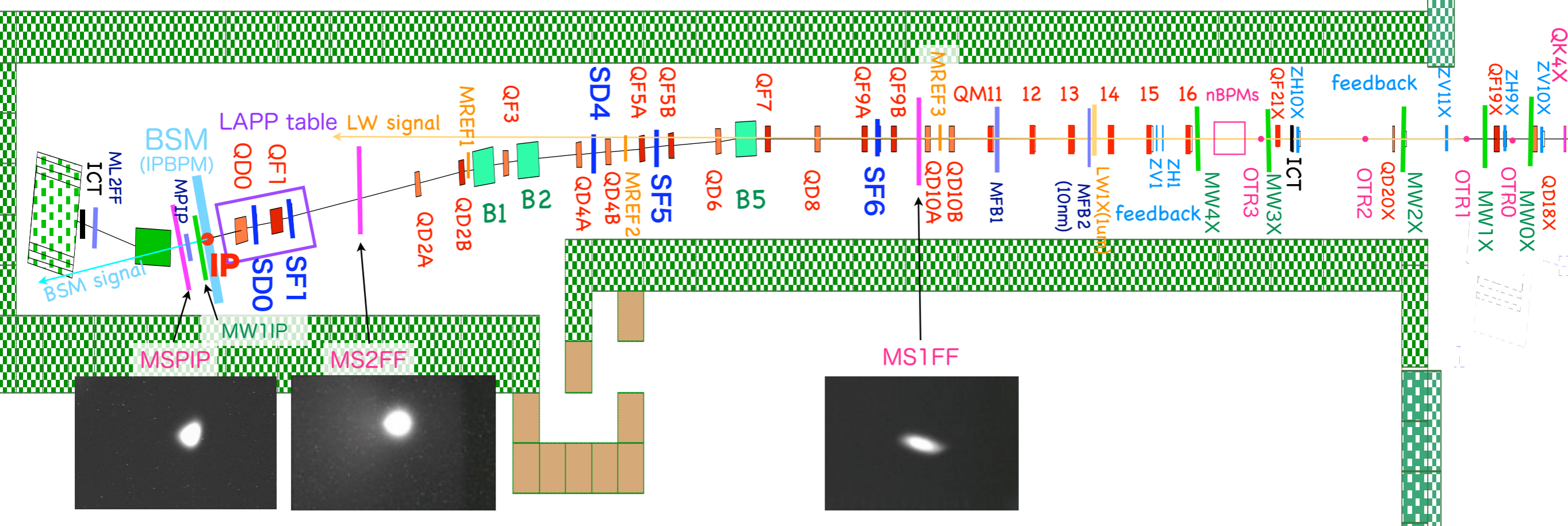
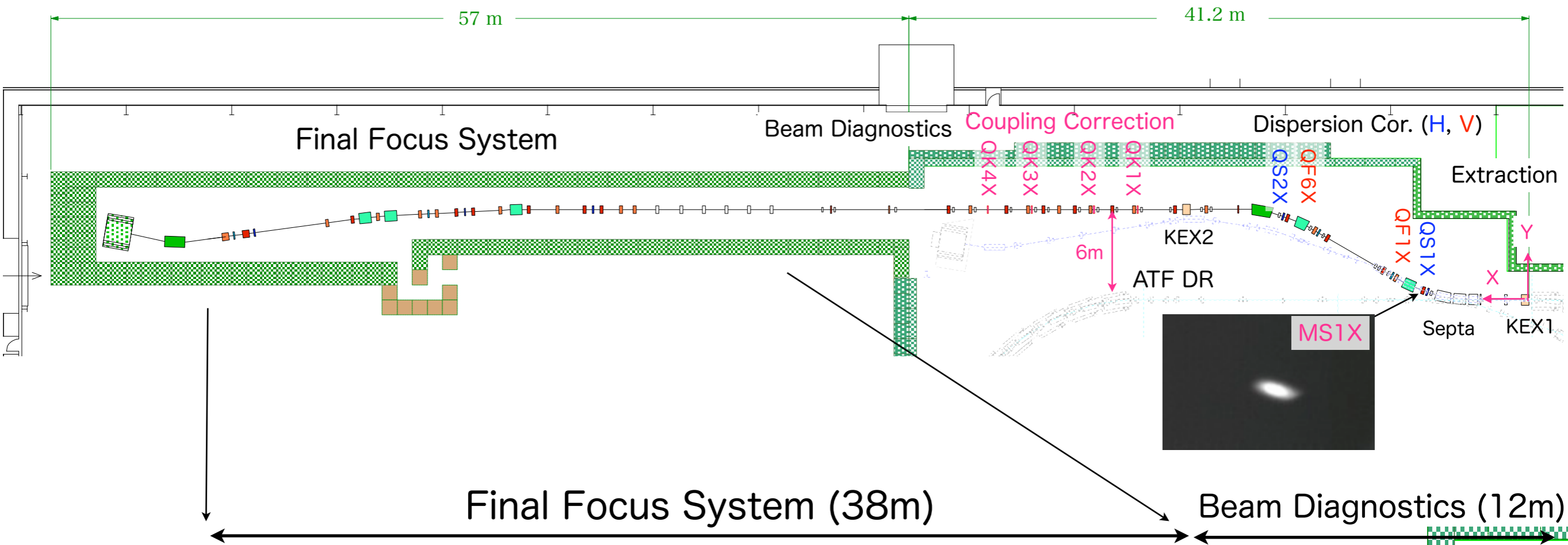
B2) Establishment of beam jitter controlling technique
at nano-meter level with ILC-like beam

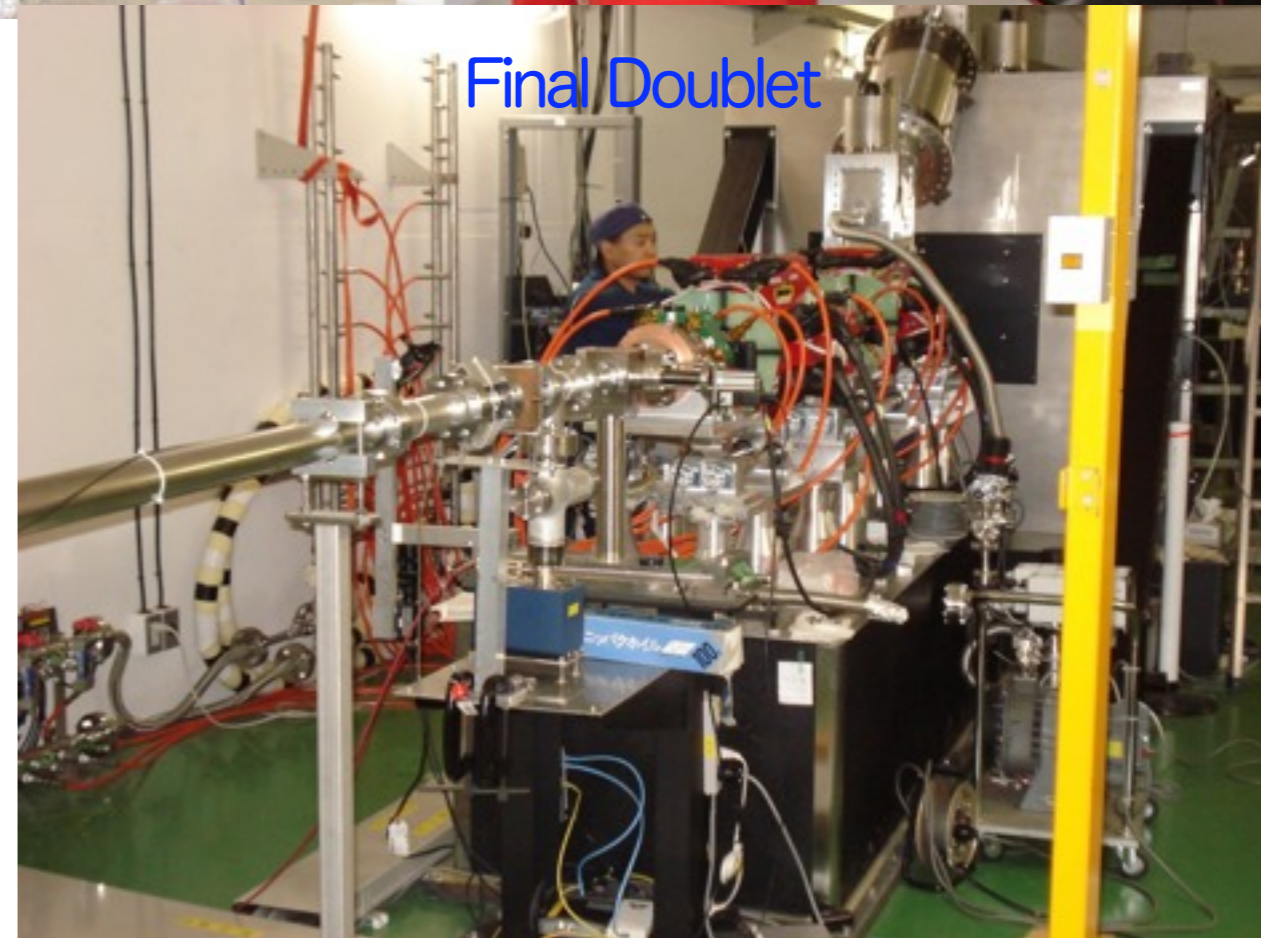
Parameters	unit	ATF2	ILC	CLIC	S-KEKB (LER/HER)
Beam Energy	GeV	1.3	250	3000	4/7
L^*	m	1	3.5-4.5	3.5	0.47/1.3
$\gamma \epsilon_x$	m-rad	5×10^{-6}	1×10^{-5}	6.6×10^{-7}	$2.5/3.3 \times 10^{-5}$
ϵ_x	nm	2	1.0 (DR)	0.1 (DR)	3.2/2.4
$\gamma \epsilon_y$	m-rad	3×10^{-8}	4×10^{-8}	2×10^{-8}	$1.0/1.2 \times 10^{-7}$
ϵ_y	pm	12	2(DR)	1(DR)	13/8.4
β_x^*	mm	4	21	6.9	32/25
β_y^*	mm	0.1	0.4	0.07	0.27/0.41
η'	rad	0.14	0.0094	0.00144	
σ_E	%	~0.1	~0.1	~0.3	0.08/0.06
Chromaticity	L^*/β_y^*	~ 10^4	~ 10^4	~ 5×10^4	$1.7/3.2 \times 10^3$
σ_x^*	μm	2.8	0.655	0.039	10.2/7.8
σ_y^*	nm	37	5.7	0.7	59/59



Parameters at ATF2

IP Parameter	nominal		April 2010	May 2010	Dec 2010
Beam energy	1.3GeV		1.3GeV	1.3GeV	1.3GeV
Emittance in x	2 nm		1.7nm	1.7nm	1.8-2.7nm
Emittance in y	12 pm		<10pm	<10pm	28-64pm
Beta function in x	4 mm		4cm	4cm	10mm
Beta function in y	0.1mm		1mm	1mm	0.1mm
beam size in x	2.8 μm		$\sim 10 \mu\text{m}$	$\sim 10 \mu\text{m}$	7.5 μm
beam size in y	35 nm		900 nm	300 nm	439(247) nm





2010 Autumn/Winter Run

ILC PAC

7 2010							8 2010							9 2010							10 2010							11 2010							12 2010														
Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa								
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Beam operation: 7 weeks

- Fast kicker mode ... 2 weeks
 - ATF2 continuous run ... 1 week
- 13 - 17 December 2010

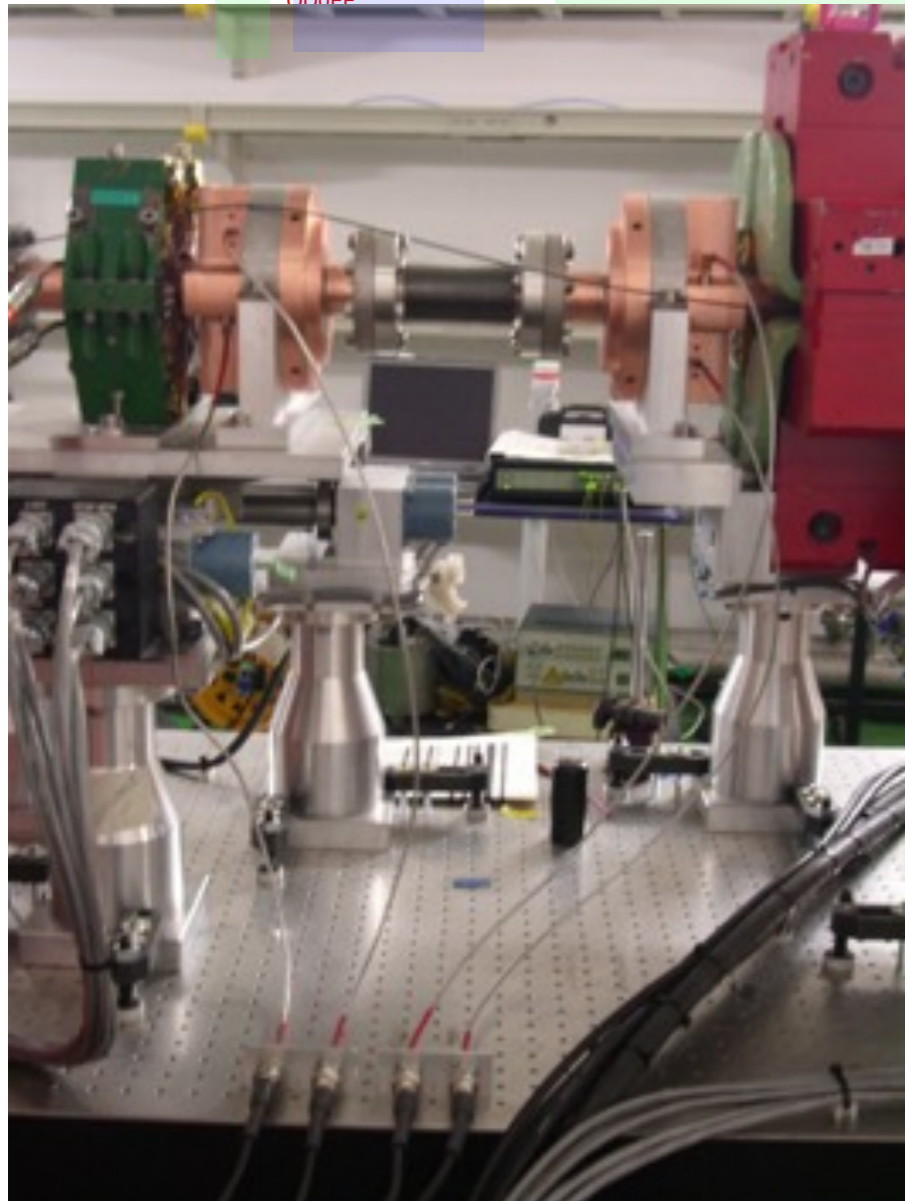
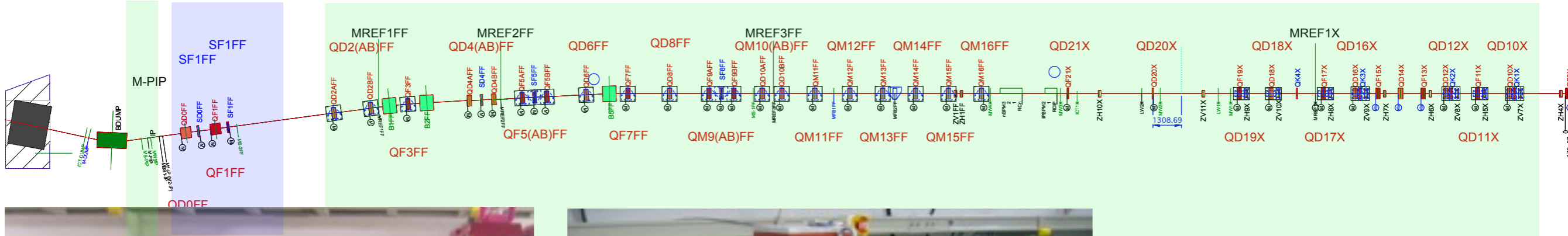
Nominal optics ($\beta^*_{x/y}=1\text{cm}/0.1\text{mm}$) was set since Nov. 2010, while the previous one has been the 10 times optics ($\beta^*_{x/y}=4\text{cm}/1\text{mm}$).

For preparation of the continuous run : calibration of BPM system, checkout of IPBPMs, OTRs, digital PLIC, IP carbon wire scanner and ATF2 model/lattice and study, i.e. BBA, background for IPBSM, dispersion and coupling corrections, emittance measurement by the OTRs as well as the wire scanners

ATF2 BPM layout

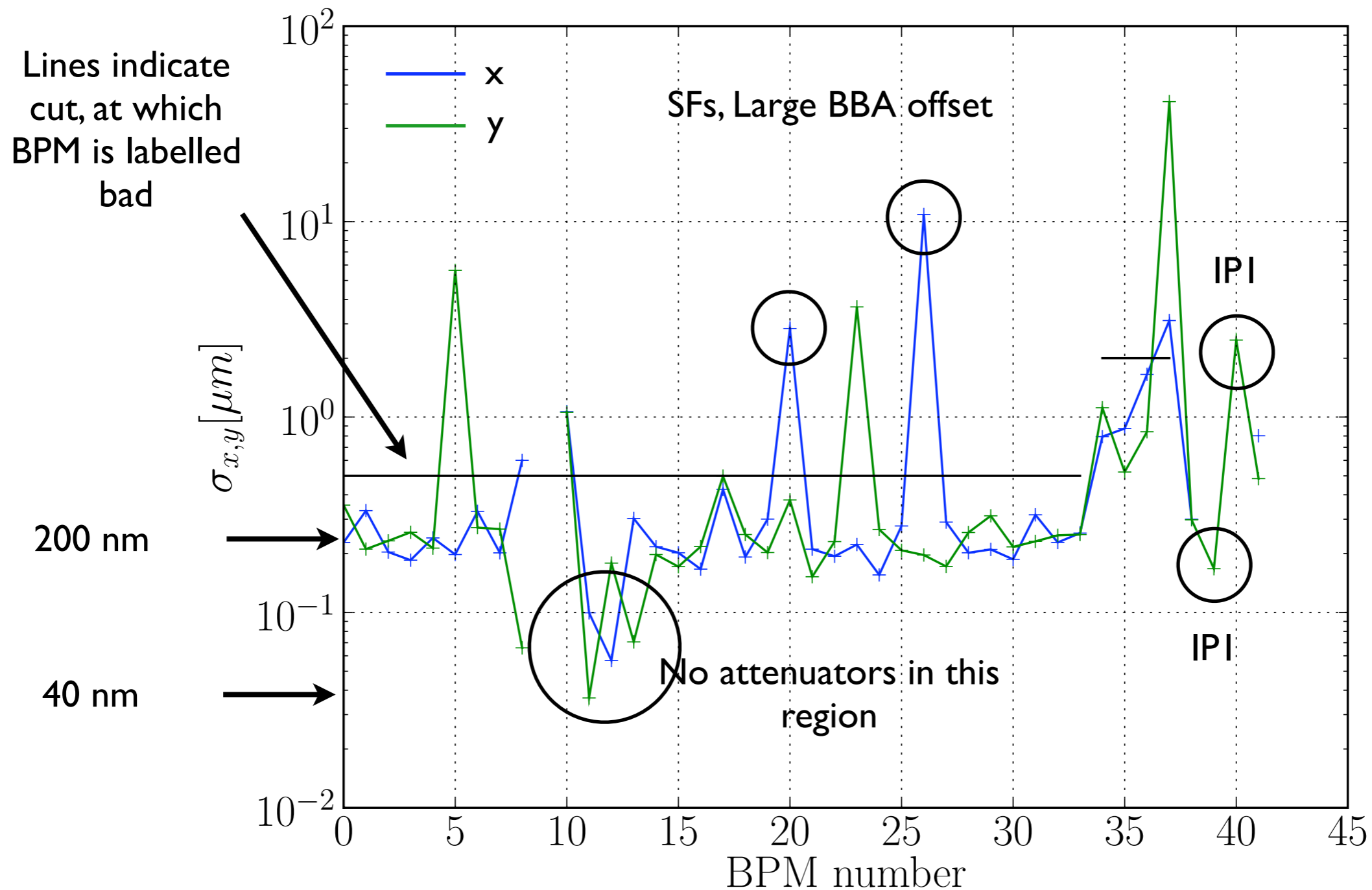
S-Band BPMs

C-Band BPMs



Resolution (in detail)

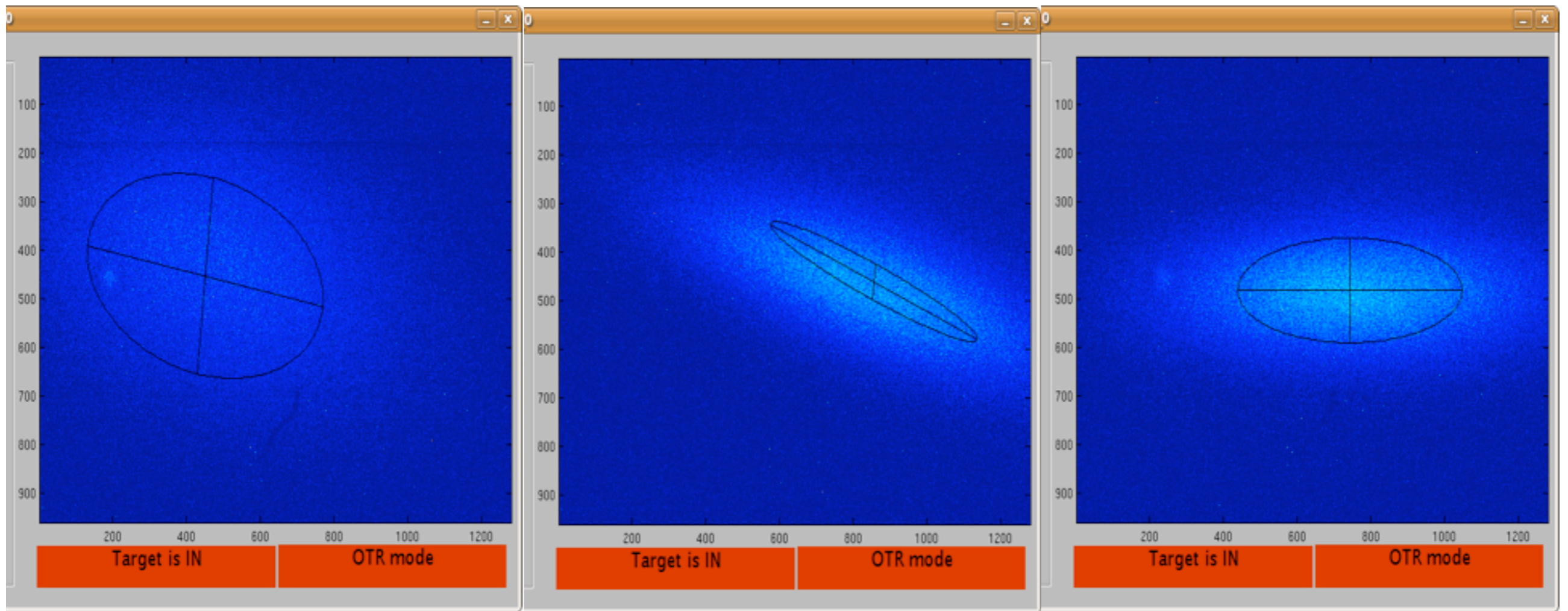
bpmAllLog 20110202 035952



S. Boogert, presented at ALCPG11, 22 March 2011

Multi-OTR system

commissioned in Nov. - Dec., 2010

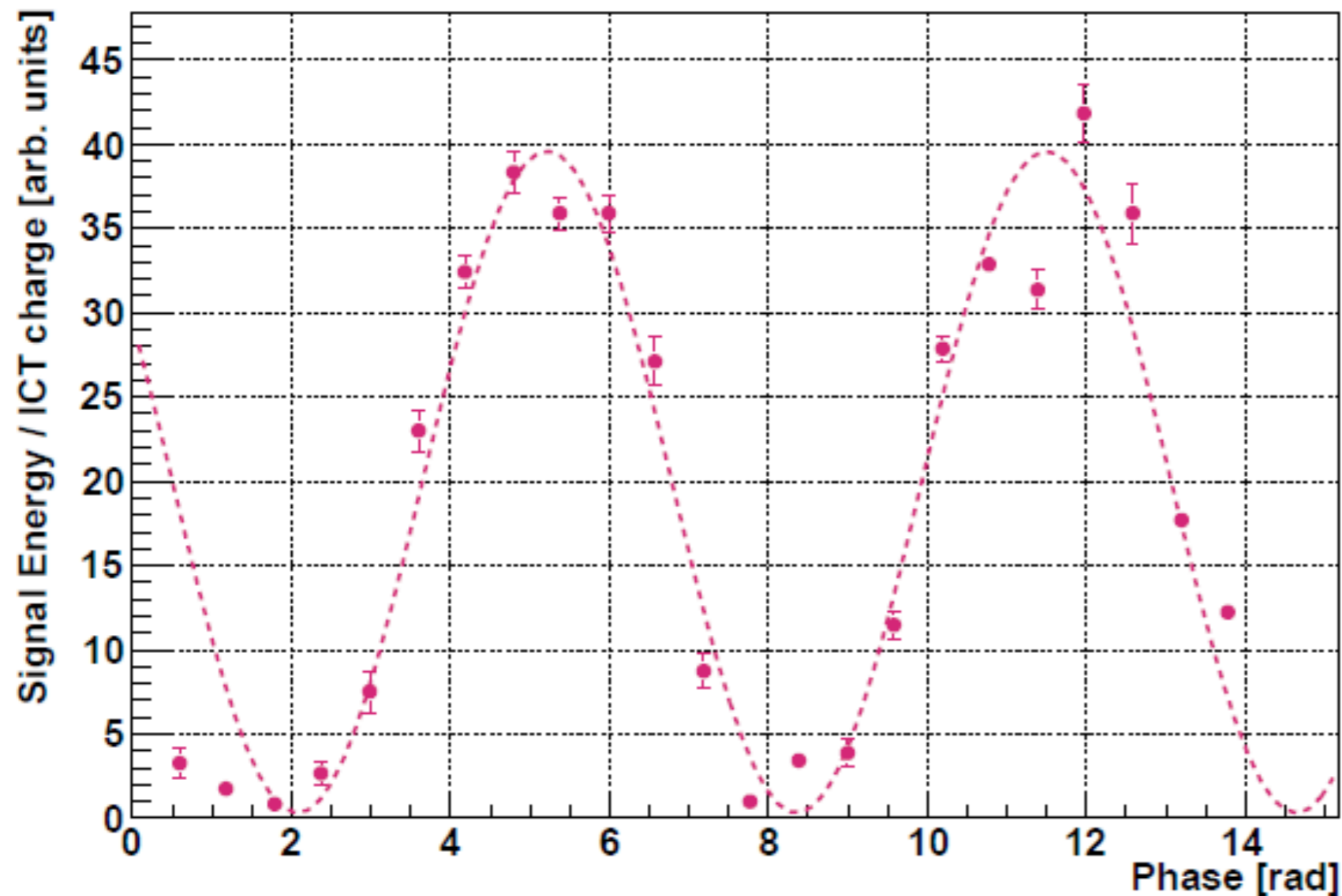


before corrections

after dispersion correction

after coupling correction

Results of the continuous run in December, 2010



Interference scan plot for one of the smallest beam sizes measured at 5.96 degree on Dec 16, 2010.

$$\sigma_y^* = 280 \pm 90 \text{ nm}$$
$$M_{\text{meas}} = 0.918 \sim 0.984$$

$$\beta_x^* = 10 \text{ mm}$$
$$\beta_y^* = 0.1 \text{ mm}$$

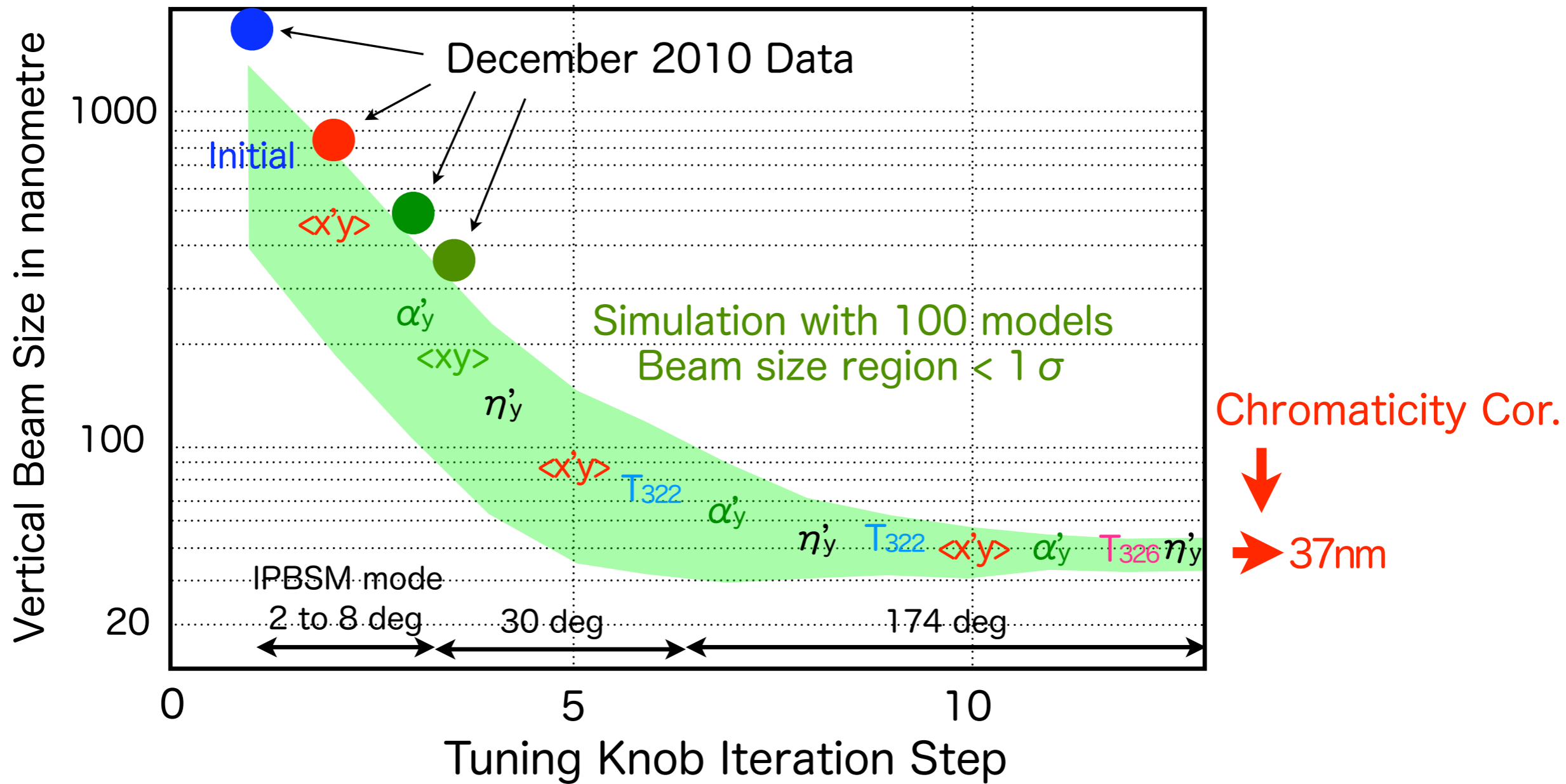


Figure 10-1 : Performance of beam size tuning at IP. The experimental data in December 2010 are plotted together with the expectations ones. First data shows the initial beam size before any correction with the beam size measurement by the IPBSM, and $\langle x'y \rangle$, $\alpha'y$, $\langle xy \rangle$, $\eta'y$, T322 and T326 are tuning knobs of horizontal angle, the vertical waist, coupling, vertical dispersion, second order aberrations of horizontal angle (T322) and dispersion (T326), respectively.

2011 before summer

1 2011							2 2011							3 2011							4 2011							5 2011							6 2011											
Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa					
						1			1	2	3	4	5			1	2	3	4	5						1	2			1	2	3	4	5	6	7							1	2	3	4
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23	24	25	26	27	28	29	27	28						27	28	29	30	31			24	25	26	27	28	29	30	29	30	31					26	27	28	29	30							
30	31																																													

Recovery from the earthquake damage

The 30 degree mode of IPBSM was studied in Jan. to Feb.

Excellent beam stability in February.

However ;

16 Feb. fire at the modulator #0 at the ATF-LINAC

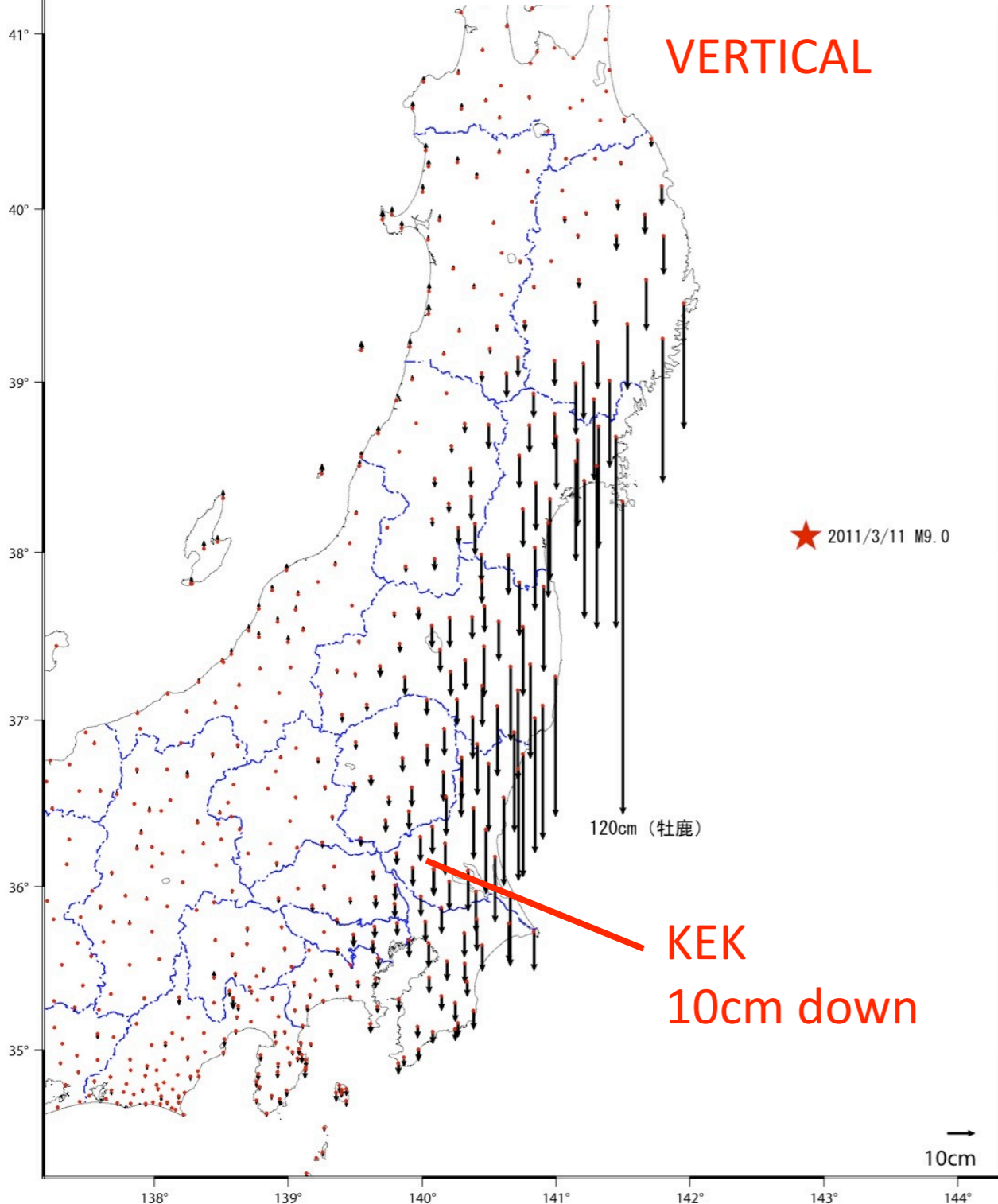
10 Mar. resume the ATF operation and ATF2 beam tuning
the stability was re-produced, i.e. stable !

11 Mar. Great Eastern Japan Earthquake (M9.0)

基準期間 : 2011/03/01 21:00 - 2011/03/09 21:00
比較期間 : 2011/03/11 18:00 - 2011/03/11 21:00

基準期間 : 2011/03/01 21:00 - 2011/03/09 21:00
比較期間 : 2011/03/11 18:00 - 2011/03/11 21:00

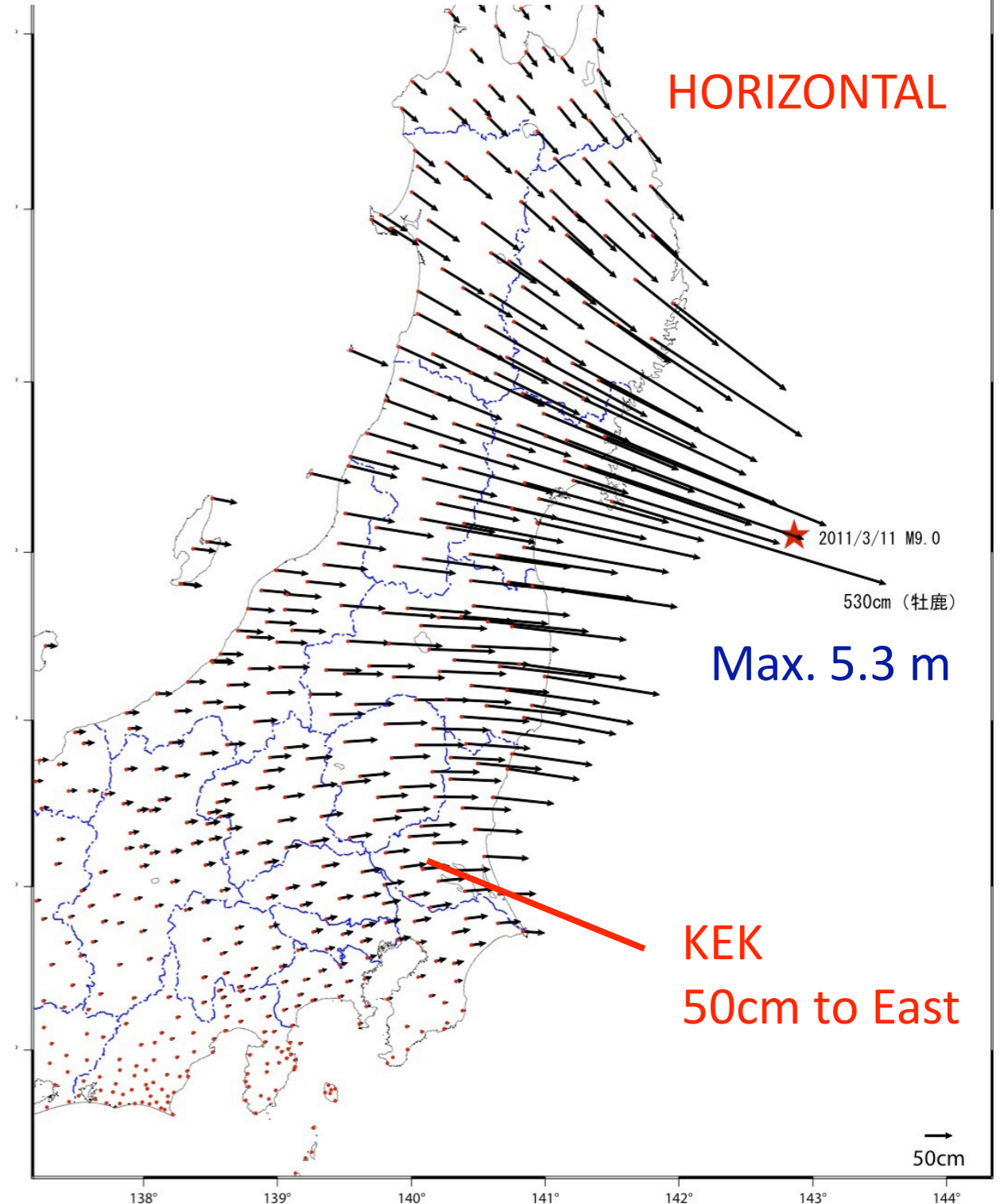
GPS by the National Geographical Survey Institute



[基準 : R3速報解 比較 : Q3迅速解]

☆固定局 : 三隅 (950388)

国土地理院



[基準 : R3速報解 比較 : Q3迅速解]

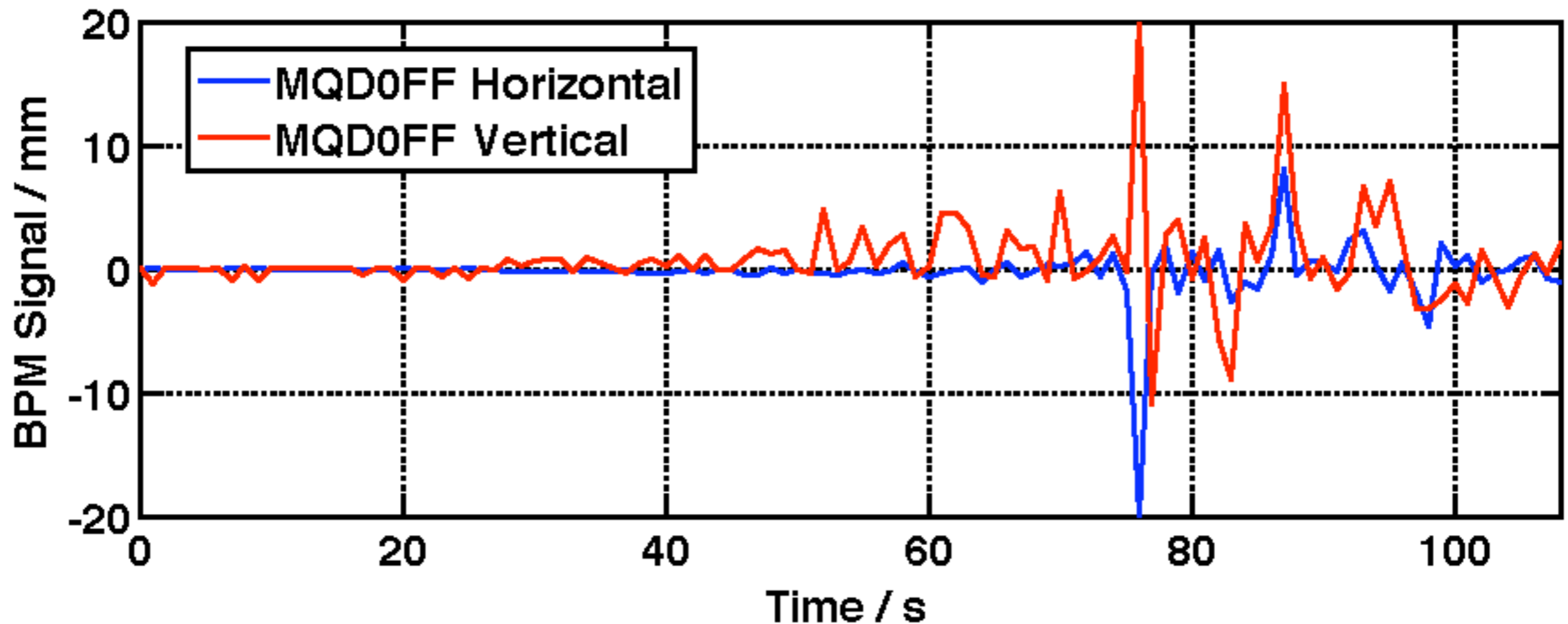
☆固定局 : 三隅 (950388)

国土地理院

N. Terunuma, ALCPG11

We could see the earthquake effect in the BPMs.

Archived BPM readings from the last quadrupole magnet BPM in the ATF2 FFS during the Eastern Japan M9.0 earthquake, March 11, 2011, at 14:46:23 local time. Data from just before the onset of the earthquake until the beam was aborted a few seconds after is shown. KEK is about 320km from the earthquake center.

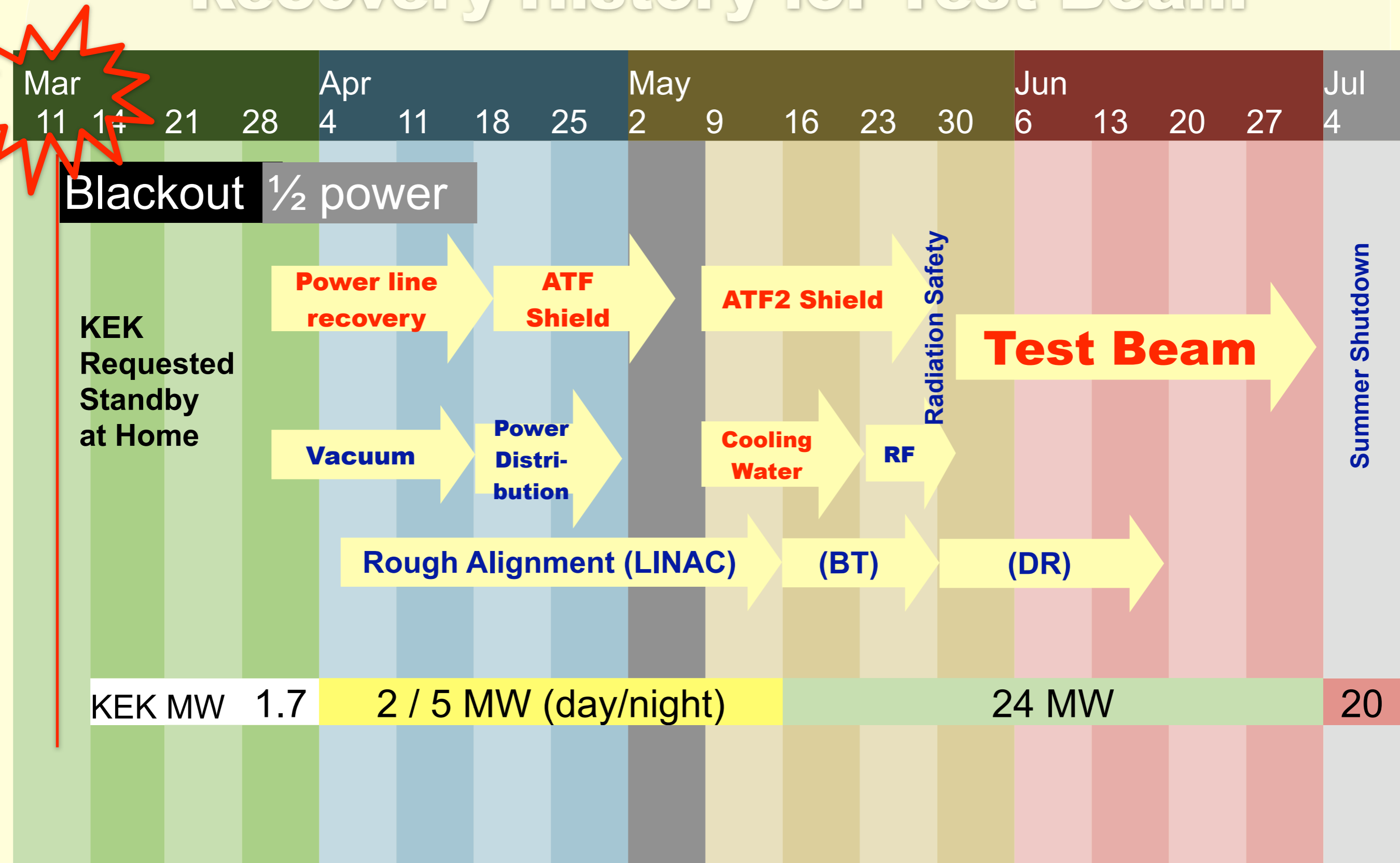


FD/IP shield works



N. Terunuma, ATF2 weekly Meeting, 11 May 2011

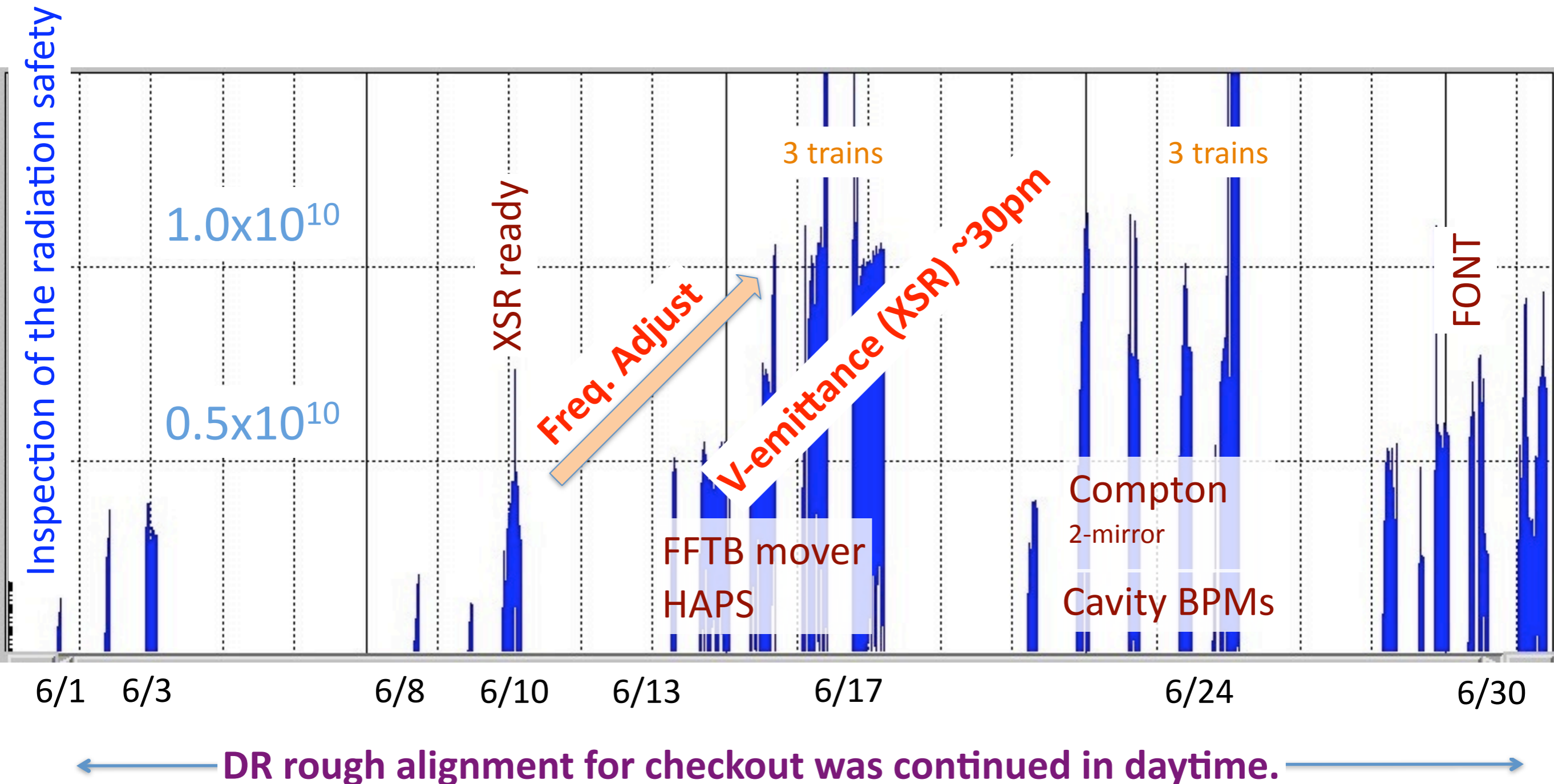
Recovery History for Test Beam



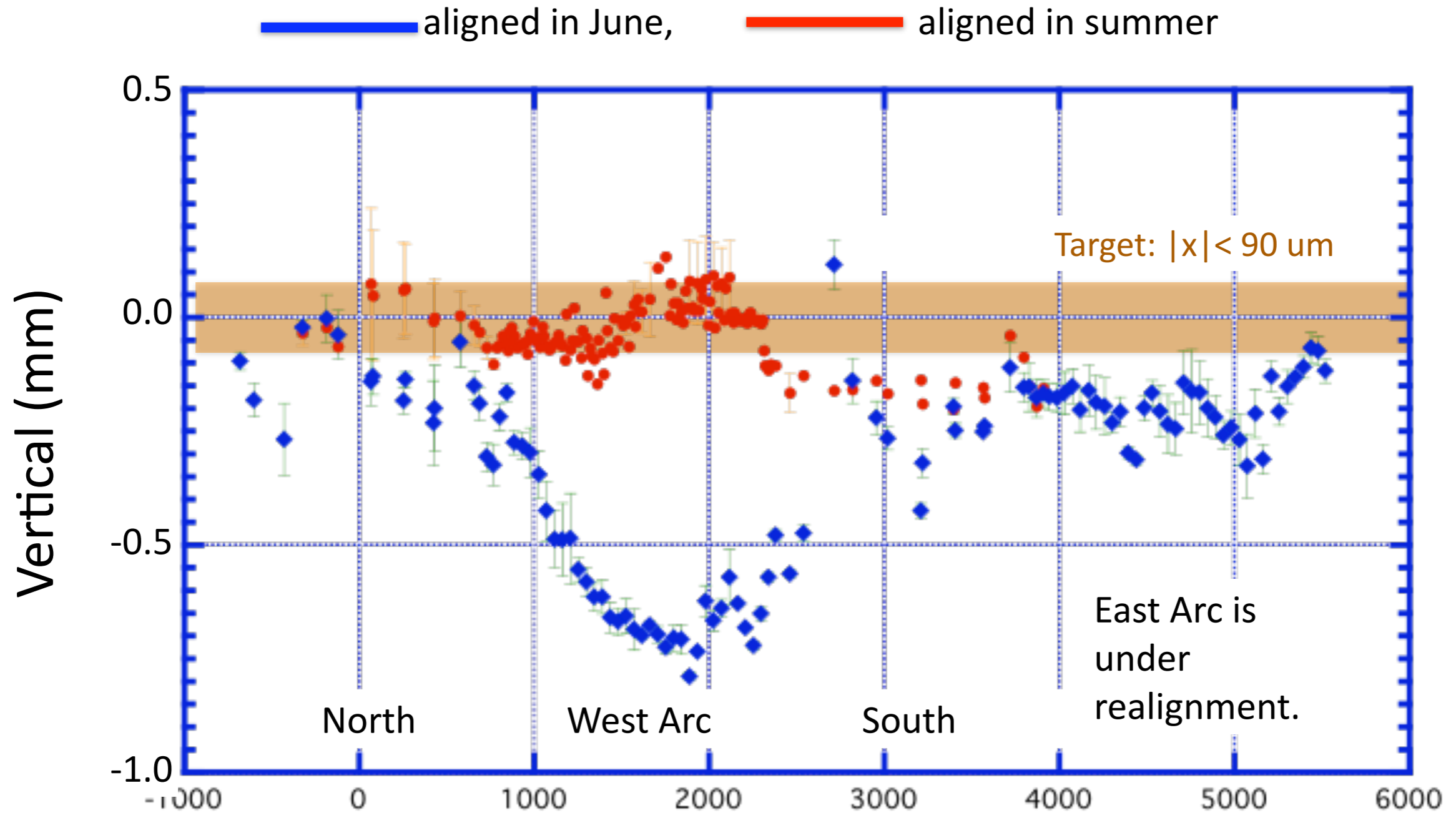
Stored beam in DR ($\times 10^{10}$ e/bunch)

A stored beam was delivered to the dump of ATF2.

No critical damage on the accelerator was found.

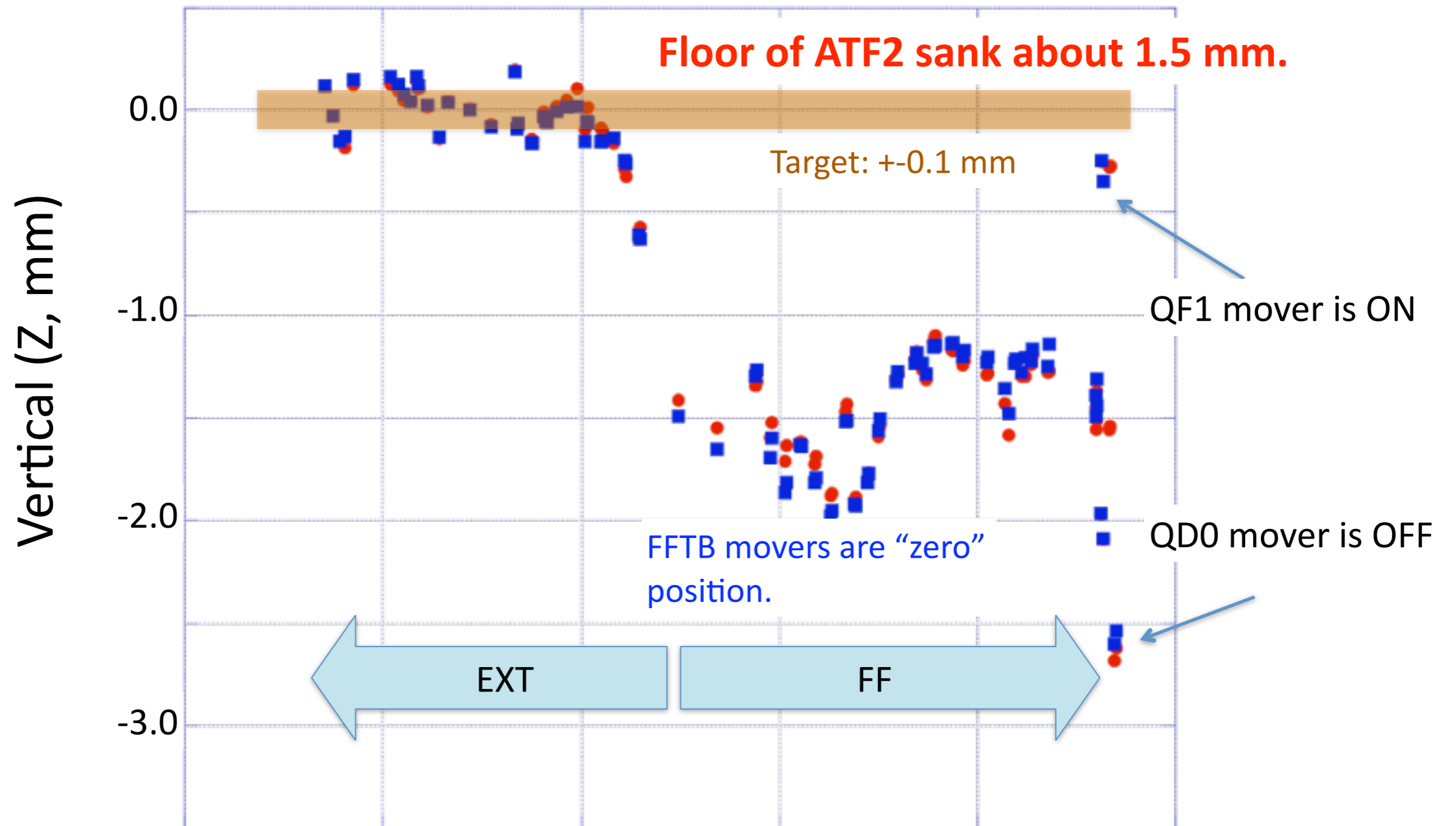


Alignment: DR level

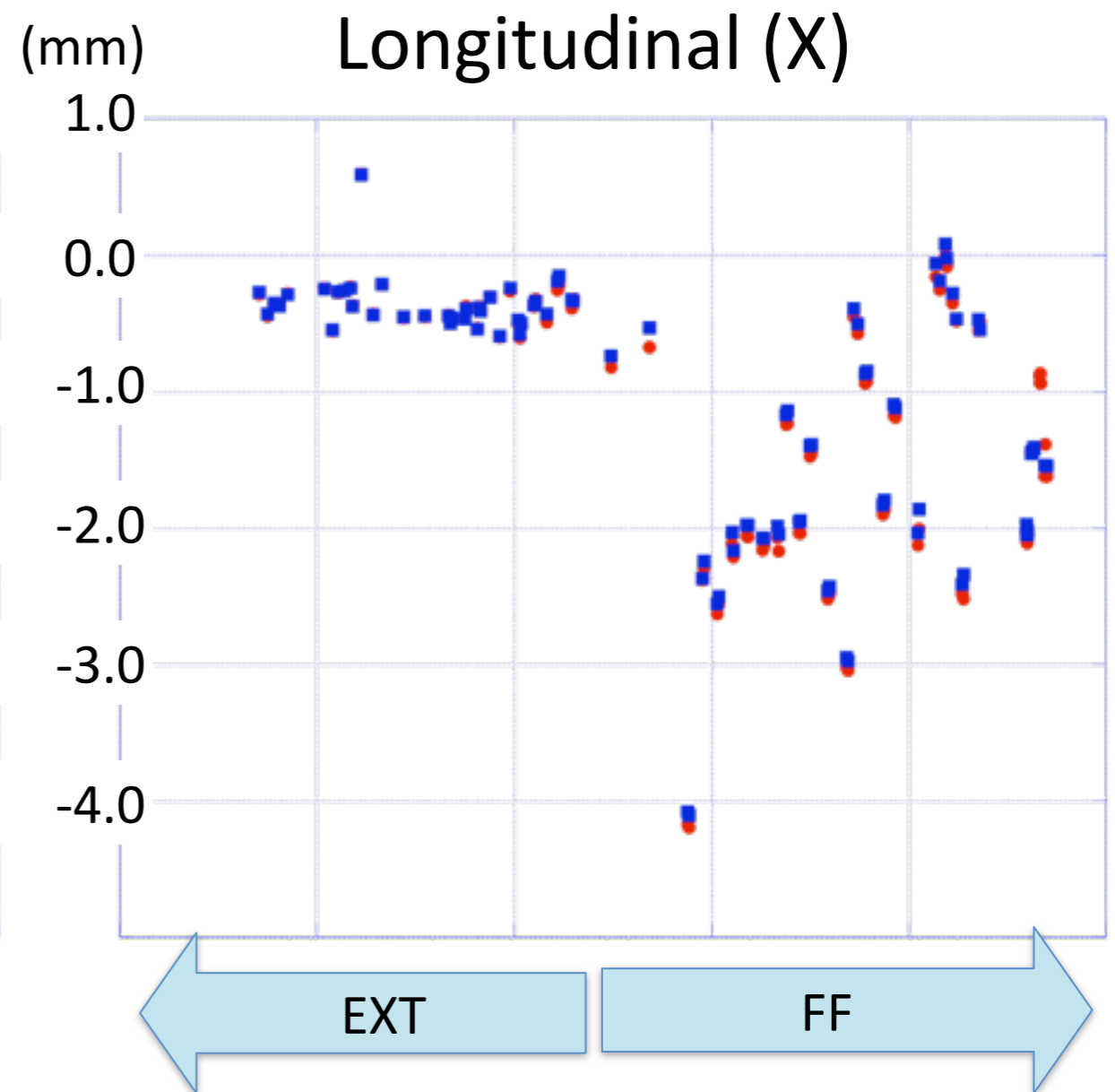
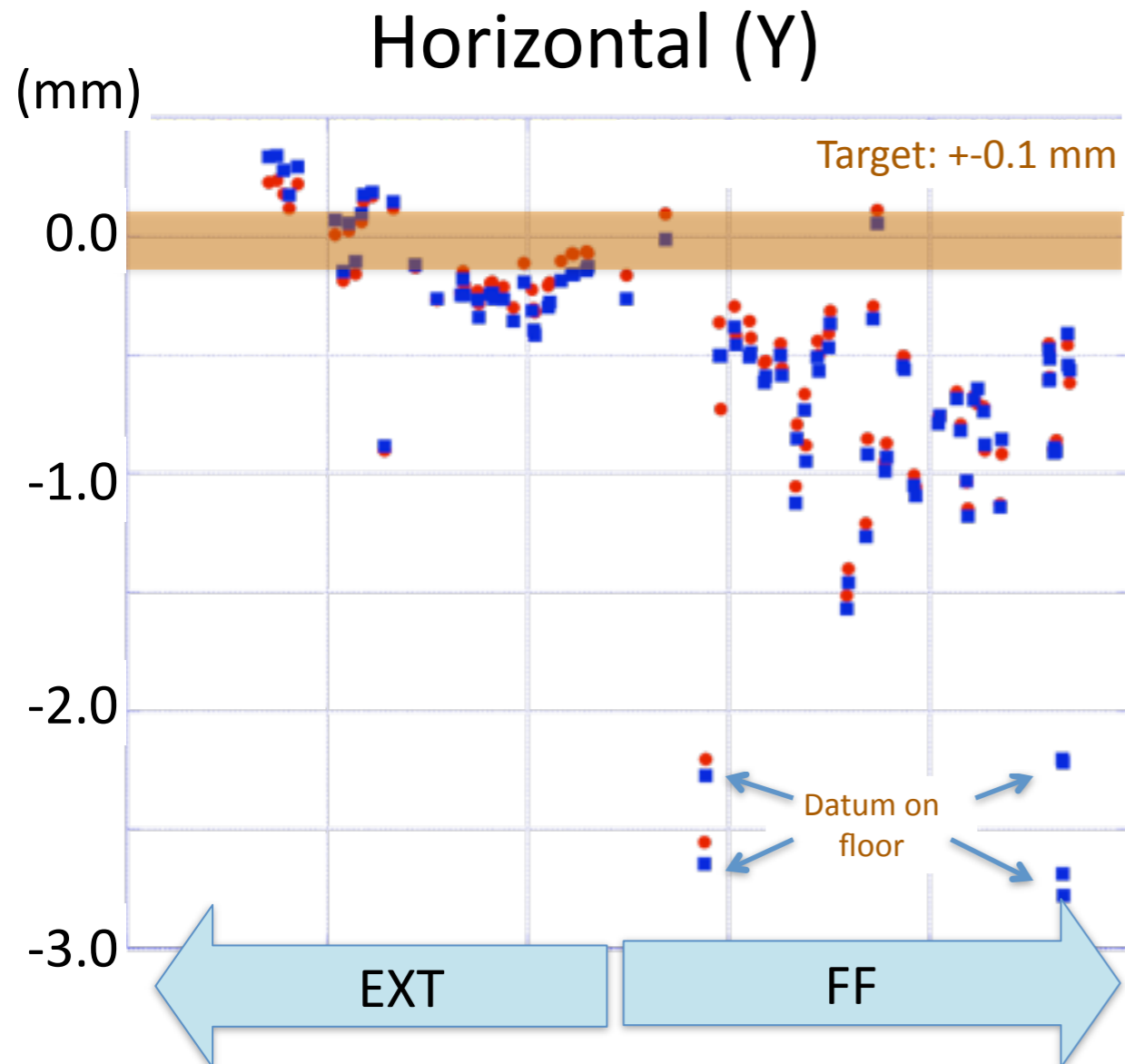


Waiting for alignment: ATF2

Level of the EXT-ATF2 magnets

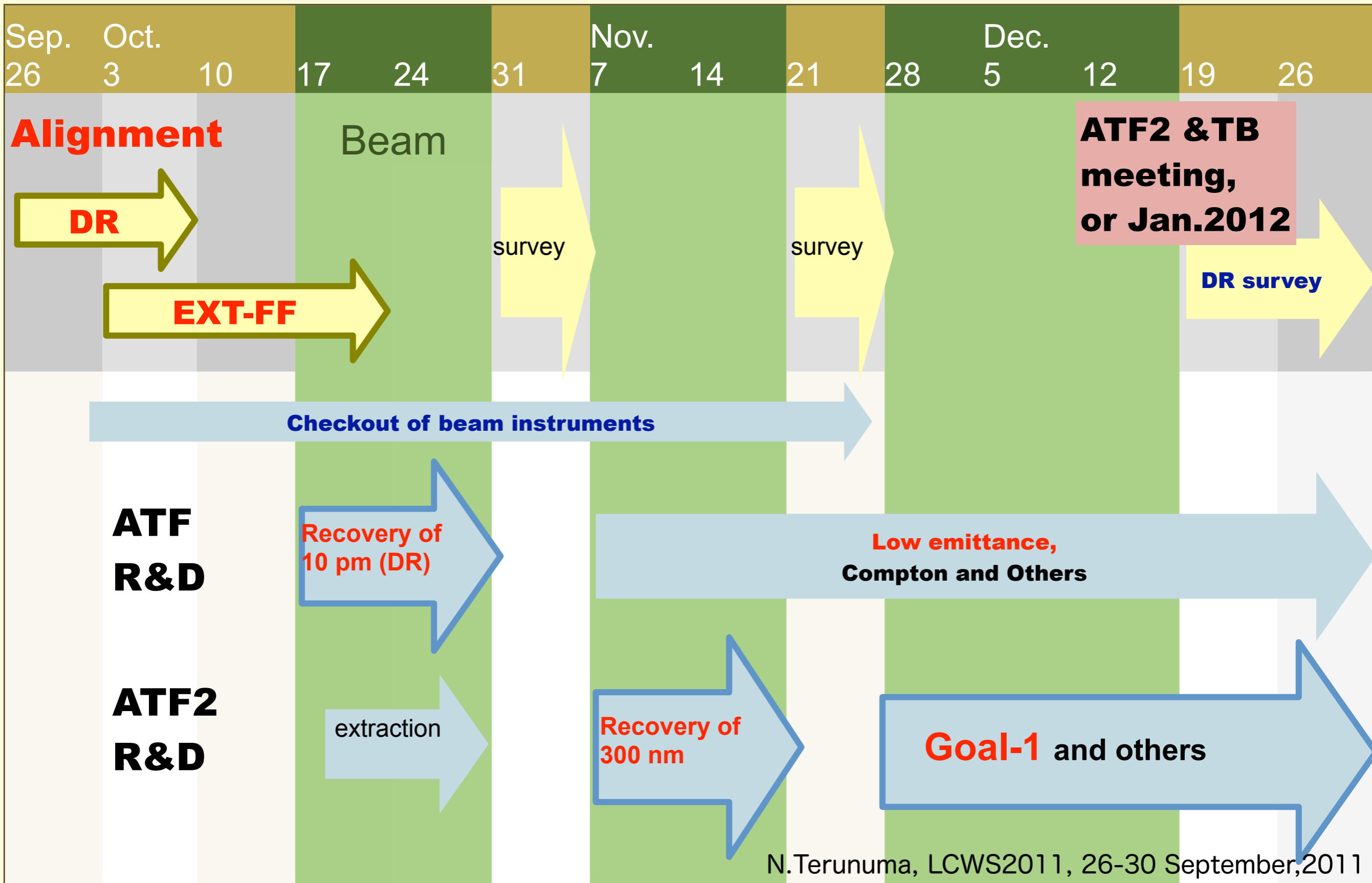


(Waiting for) alignment: ATF2



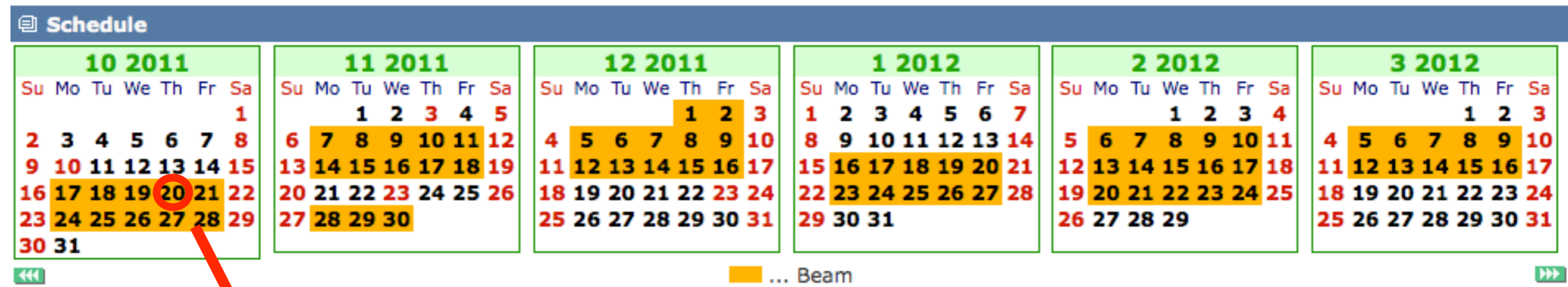
We are checking the definition of the datum on the floor used at the ATF2 construction. Offset?

Schedule (draft for discussion)



N.Terunuma, LCWS2011, 26-30 September, 2011

Beam time in JFY 2011 and Present Status



Present Status at the DR, 21 October, 2011

vertical emittance = 12.7 pm (XSR)

beam intensity = $0.5 \times 10^{10}/\text{bunch}$

repetition rate = 1.56Hz

Major issues

1. Commissioning of the 30 degree mode at IPBSM

good collaborate between beam tuning and Tokyo groups
signal, i.e. laser focus is a key issue
background control is a key issue

2. Choice of optics, i.e. $\beta^*_x = 1$ cm and $\beta^*_y = 0.1$ mm

background in IPBSM - 2nd collimator in the chamber
jitters of incoming beam monitored by BPM system with IPBPMs

3. Vertical emittance growth in EXT

DR to EXT ?, e.g. monitoring the orbit and re-productibility

4. Large coupling correction needed at IP

rotation of IPBSM fringes ?

5. Effect of the Multipole components in the FF

especially important for beam less than 100 nm
mitigation by 2.5 times nominal horizontal beta function at IP

ATF Future beyond JFY 2012

In Feb. 2010, KEK Domestic review committee authorized by KEK directorate recommended the reconsideration of ATF international collaboration for ILC beyond JFY 2012 and for new ATF international collaboration which will be started from April 2013.

Then, KEK directorate requests us to make a good proposal for the research programs beyond JFY 2012 if we want to keep our facility and activity.

Proposal of research program after JFY 2013 has been discussed at the 10th and 11th ATF TB/SGC meetings, June 2010 and January 2011, respectively. The proposal was submitted to the KEK directorates in July 2011.

Also, new MoU is needed after JFY 2013 for new ATF international collaboration, while the present MoU will be extended until end of March 2013.

J. Urakawa, 6th ICB meeting, ALCPG11

Major Research Targets from JFY 2013

1. Ultra small beam, ~ 20nm

verification of ultra low beta optics - for CLIC and also for ILC-upgrade. At the ultra low beta, the chromaticity becomes from 20,000 (ATF2-nominal) to 70,000 at CLIC. The beam size can be reduced to about 20nm with replacing the present QF1 with a SC-Q. if no SC-Q, CERN will supply a warm one. In addition, SC wigglers of CLIC prototype could be installed. Also, CERN/CLIC will supply non-linear correction magnets.

2. Nanometer scale orbit control

The 2nm stabilization at IP is needed further R&D beyond 2012, which needs three bunches at least. The present experiment (FONT5) has results of demonstrating stability from 2.1um to 0.2 um. Also, R&D of feedforward system for correction of ground motion proposed by CLIC, CERN.

3. Laser cavity for the PLC (Photon Linear Collider)

There is a 4 mirror cavity (LAL) at present, which is based on similar technique.

4. Non-linear and strong QED physics ; high field physics with collisions between the electron beam and a new 200TW laser.

Conclusions

1. Brisk recovery works by end of June, 2011
2. Prepared improved operation
 - re-aligned all beam lines ; FF in 24-28 Oct. last of all stable timing and operation (already in Feb. 2011)
 - understanding of multipole components
 - full-commissioning of IPBSM etc.
3. Resumed the operation in 17 October, 2011
 - checked out the instrumentations and
 - tuning the DR at the first setout.
4. ATF plan beyond JFY 2012 was submitted to KEK-DG
 - ATF/ATF2 will operate until 31 March 2014, at least.