# ATF Technical Board Report

**Philip Burrows**

***John Adams Institute***

***Oxford University***

***Thanks to: Andy Wolski***

# ATF Technical Board

http://atf.kek.jp/collab/ap/meetings/TB-SGC/TB-SGC-meeting.php

**Grahame Blair (RHUL)**
**Philip Burrows * (U. Oxford)**
**Eckhard Elsen* (DESY)**
**Jie Gao (IHEP)**
**Eun-San Kim (KNU)**
**Tor Raubenheimer (SLAC)**
**Marc Ross (FNAL)**
**Tomoyuki Sanuki (U. Tohoku)**
**Nobu Toge (KEK)**
**Andy Wolski* (CI/U. Liverpool)**
**Kaoru Yokoya (KEK)**
**Frank Zimmermann (CERN)**

* *Joint Chairs*

**7th Meeting:**

18 December, 2008

KEK

**8th Meeting:**

11 June, 2009

WebEx

**9th Meeting:**

16 December, 2009

KEK

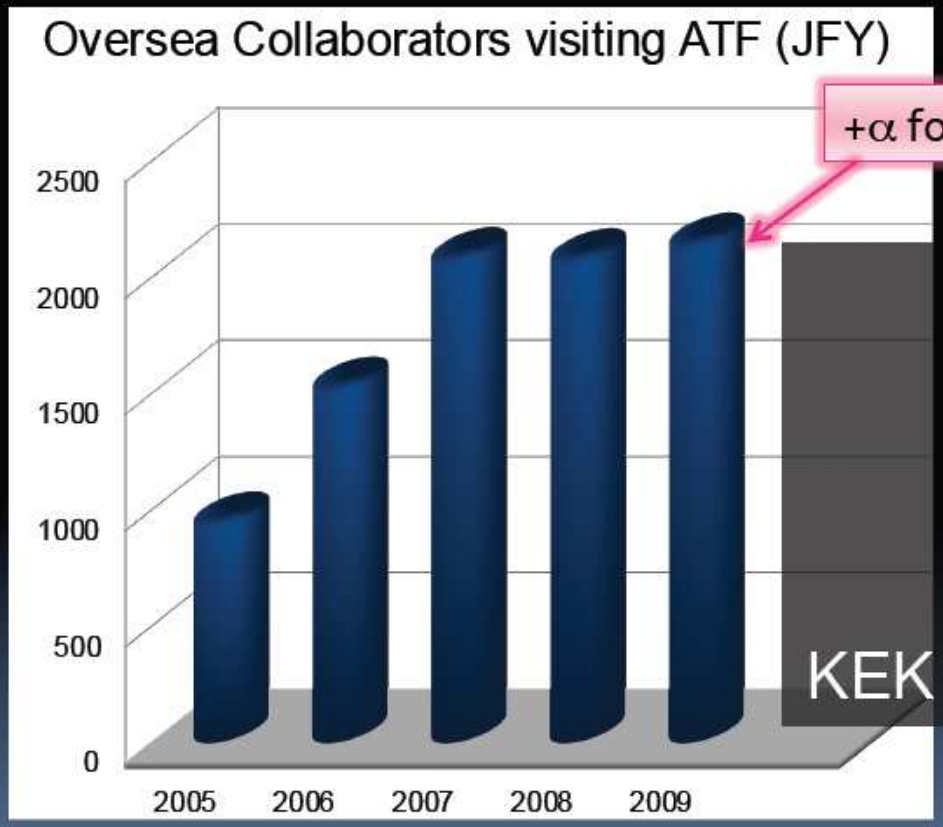
# Research activity reports

| Activity | Reported by |
|---|---|
| ATF2 | A. Seryi, T. Okugi |
| Extraction line laserwire | S. Boogert |
| Fast DR extraction kicker | T. Naito |
| FONT | P. Burrows |
| Cavity BPMs | H. Hayano, S. Boogert |
| New RF gun | N. Terunuma |
| Compton source | T. Takahashi |
| DR beam tuning | K. Kubo, S. Kuroda |
| IP beam size monitor | |
| SC FD magnets | B. Parker, N. Kimura |
| Beamline hardware status | N. Terunuma |

# R&D proposals

| Activity | Reported by |
|---|---|
| SC magnet upgrade for ATF2 FF | B. Parker |
| Test of PM FF quad in ATF2 | Y. Iwashita |
| Interferometer-based monitoring | M. Hildreth |
| EM + n background measurements | H. Guler, M. Verderi |
| SC FD magnets | B. Parker, N. Kimura |
| Multi-OTR system in ATF2 | A. Faus-Golfe, D. McCormick |
| Visible + x-ray SR monitor for ATF2 | T. Mitsuhashi, T. Naito, J. Flanagan |
| Tele-microscope OTR monitor for ATF2 | T. Mitsuhashi, T. Naito |
| Cavity beam orbit tilt monitor for ATF2 | T. Sanuki |
| Hydrostatic leveling system | M. Masuzawa |

# Activity of the ATF International Collaboration




Oversea collaborators
25 Institutes,
~70 people,
~2000 people-days
+
KEK and Japanese Universities(6)

# Maintenance Works in the summer shutdown

1. Magnet Power Supplies (1984~!!)
   FANs, Interlock circuit, …
2. Linac RF Modulator (1988~!!)
   Klystron PS, Control Units, RF Amp, Charging, …
3. Cooling Water System
   Valves, Filters, Temp sensors, Leaks, …
4. Air Conditioner for Electronics Huts
   Here and there
5. Alignment of the beam line
   DR, FF including Sextupoles and Final Doublet
6. More, …

Terunuma

# New Devices installed in the summer shutdown

1. Additional RF Gun Laser: 714/2 MHz for 5.6 ns bunch spacing for Fast Kicker
   → synchronization, Jan. 2010
2. Remote control of LINAC SLED tuner
   → Increased the beam energy margin
3. SR transporting line at EXT
   (Mitsuhashi-san, proposed in last TB)
4. New IP-BSM laser → laser power x3~4

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# Studies after the last TB meeting

1. Fast kicker at EXT-FF: strip-line checkout
2. RF Gun performance (80MeV runs)
3. Monalisa vacuum system and vibration
4. Straightness monitor at FF
5. HLS at FF

Continued Studies

Cavity Compton, FONT, Laser Wire, …

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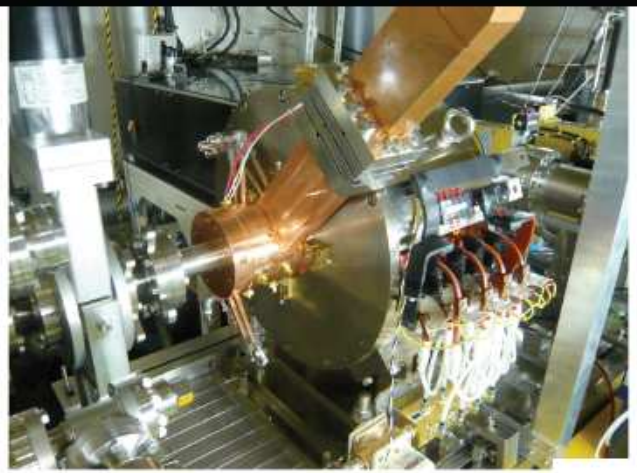
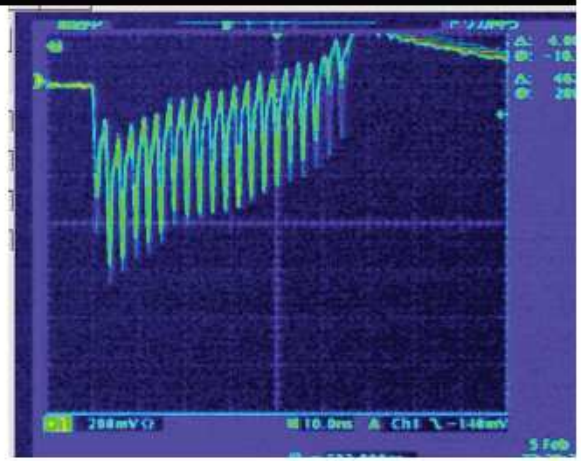
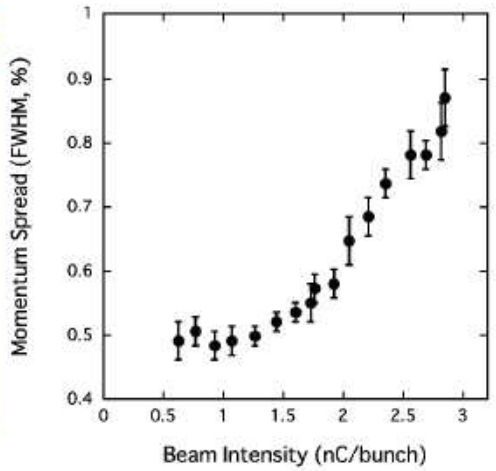
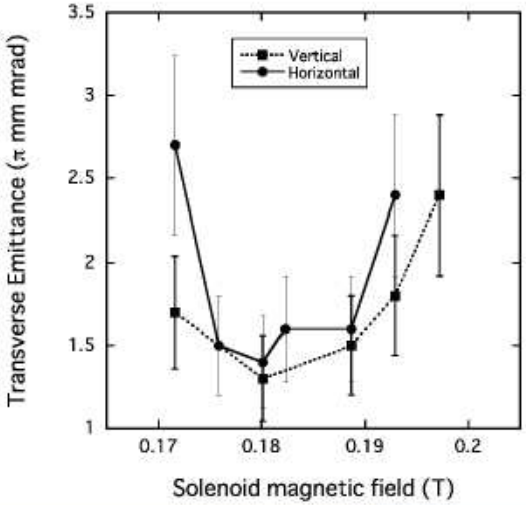
# RF Gun Performance Study

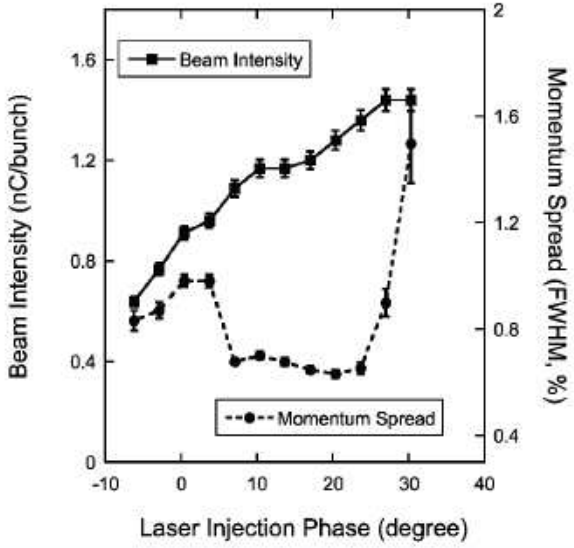
by 80MeV operation in June 2009

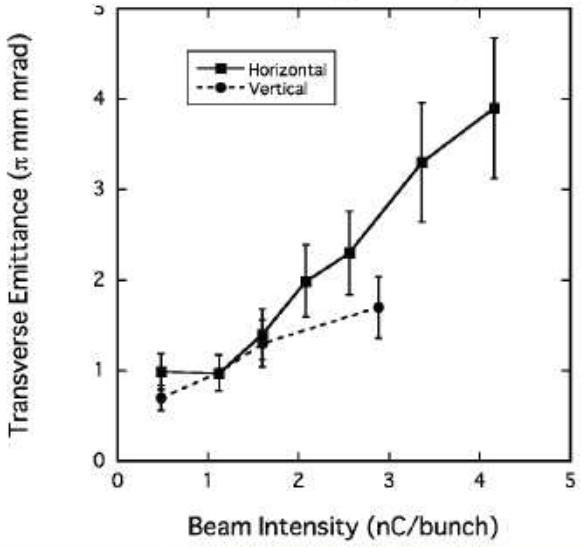







**Operation condition for ATF was optimized.**

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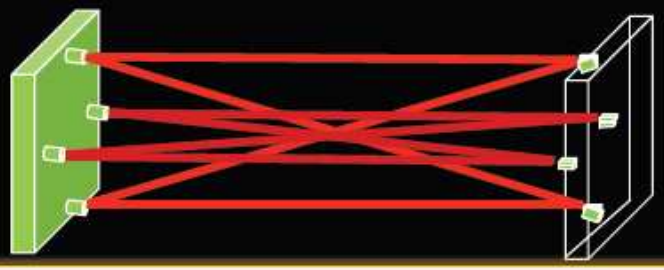
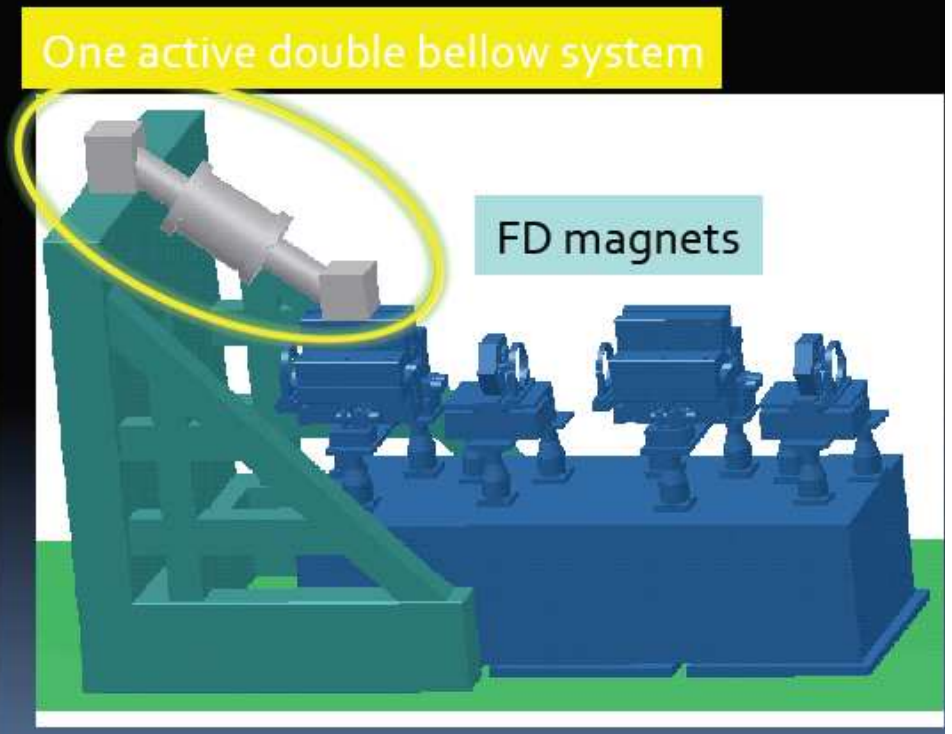
# MONALISA at ATF2

- **Monitor the relative motion between final focus quadrupole and the IP-BSM (Shintake Monitor).**
  - This avoids a false increase of the measured beam spot caused by motion of the Shintake monitor.



- Vacuum vessel of MONALISA was temporary installed to check the consistency with the FD+IP system, in July 2009.
- Re-installation with distance meters is not yet sceduled.

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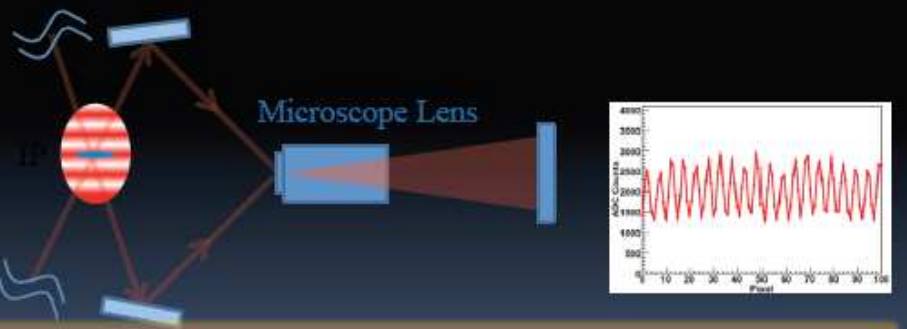
# Impact of Monalisa on vibrations

✓ With GM/flowing cooling water, relative motion of SM to QD0:

| | Tolerance | Without Monalisa | With Monalisa (Press/No press) |
|---|---|---|---|
| Vertical | 7 nm | 5.0nm | 5.7nm/5.8nm |
| Perpendicular to beam | ~ 500 nm | 16.7nm | 16.7nm |
| Parallel to the beam | ~ 10,000 nm | 17.2nm | 17.2nm |

Vibration measurements between

Phase Stability Measurement of IP-BSM




Results give the fringe position stability,
6 nm without MONALISA,
7 nm with MONALISA.

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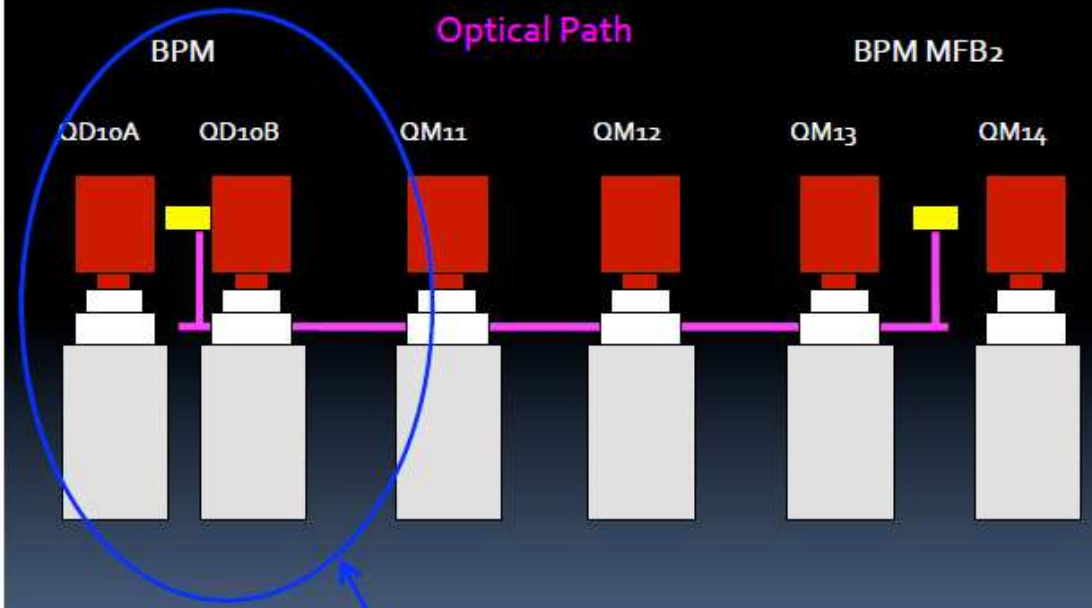
# Application of the Straightness monitor at ATF2 (Notre Dome Univ.)

**Full System (Installed in Oct. 2009):**

**monitor relative (later, absolute) vertical positions of the two IP Steering feedback BPMs**




Installed in July 2009

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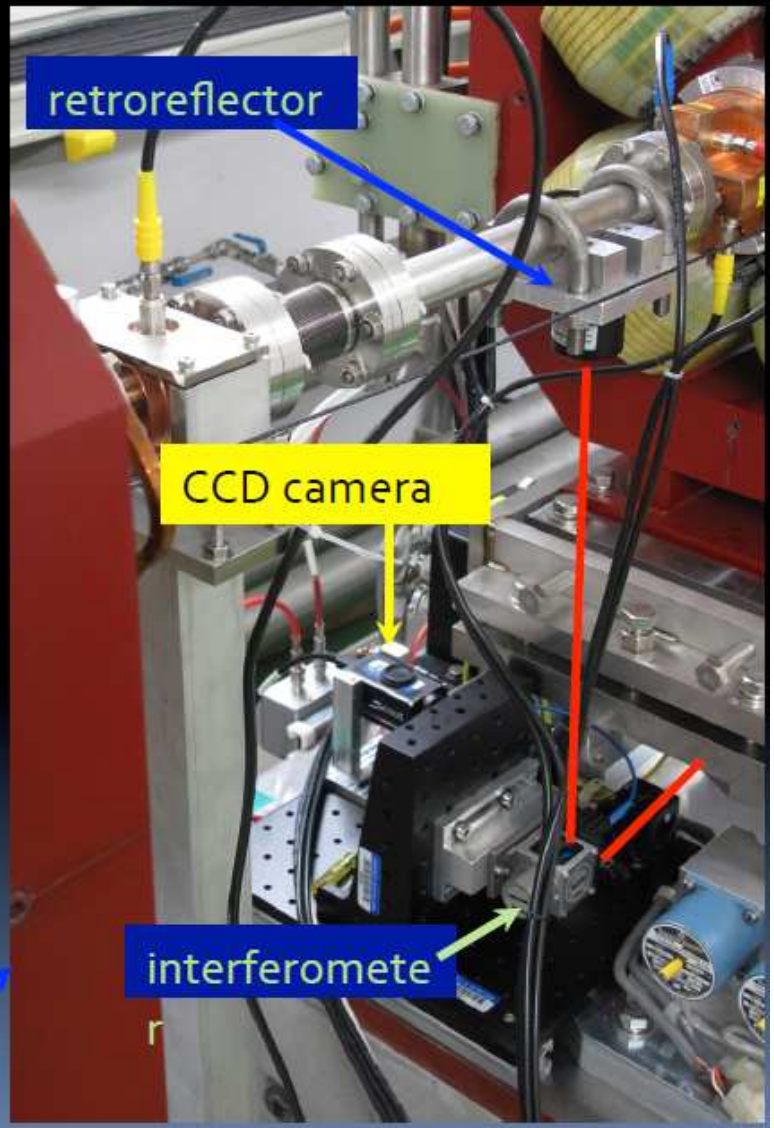
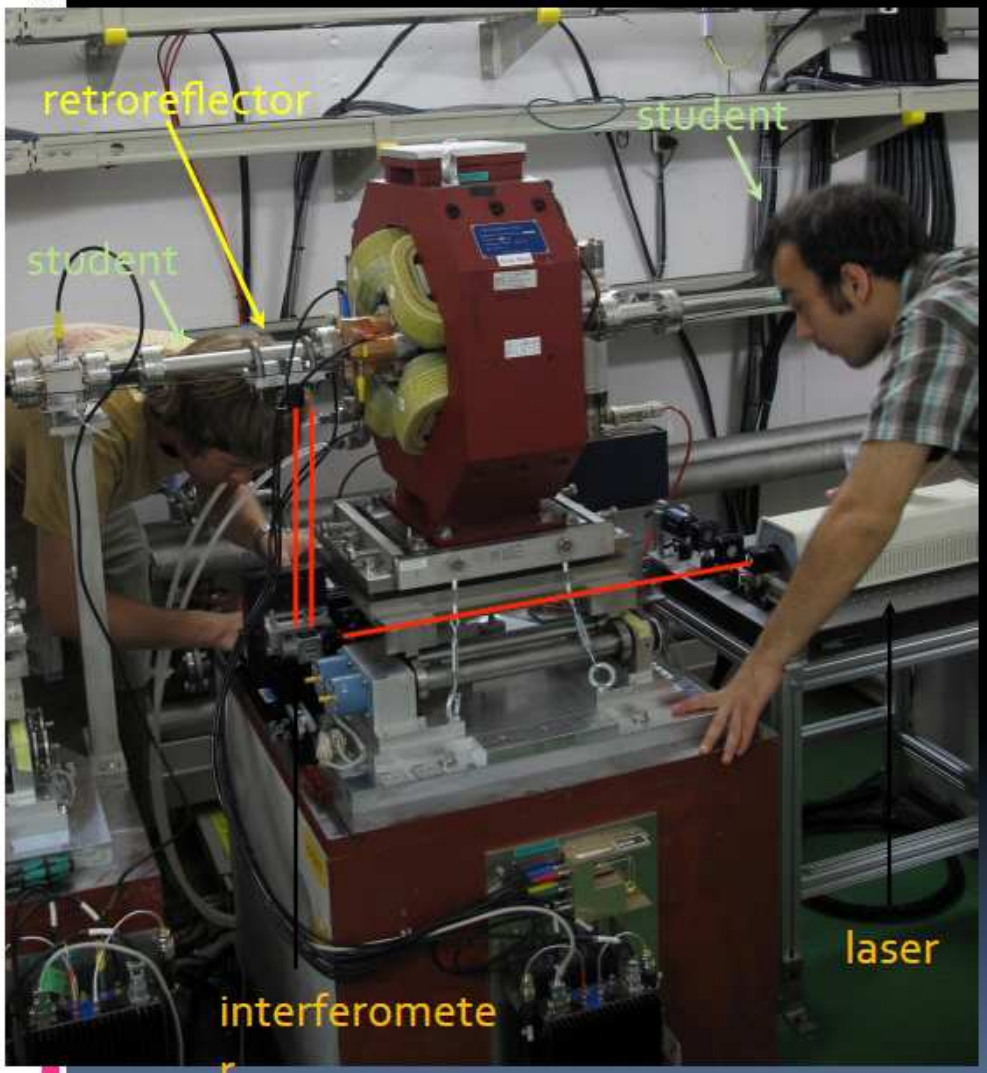
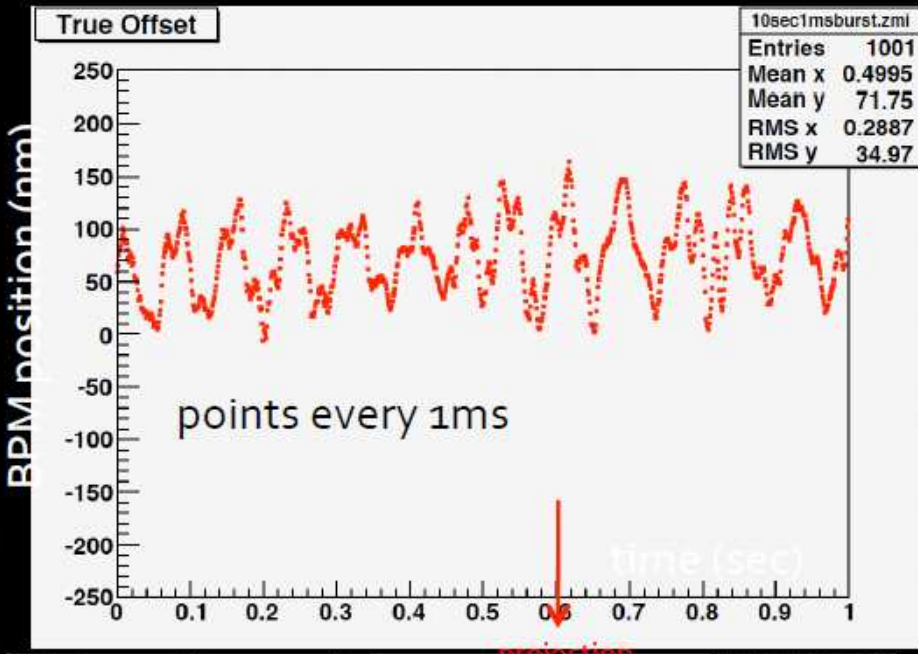
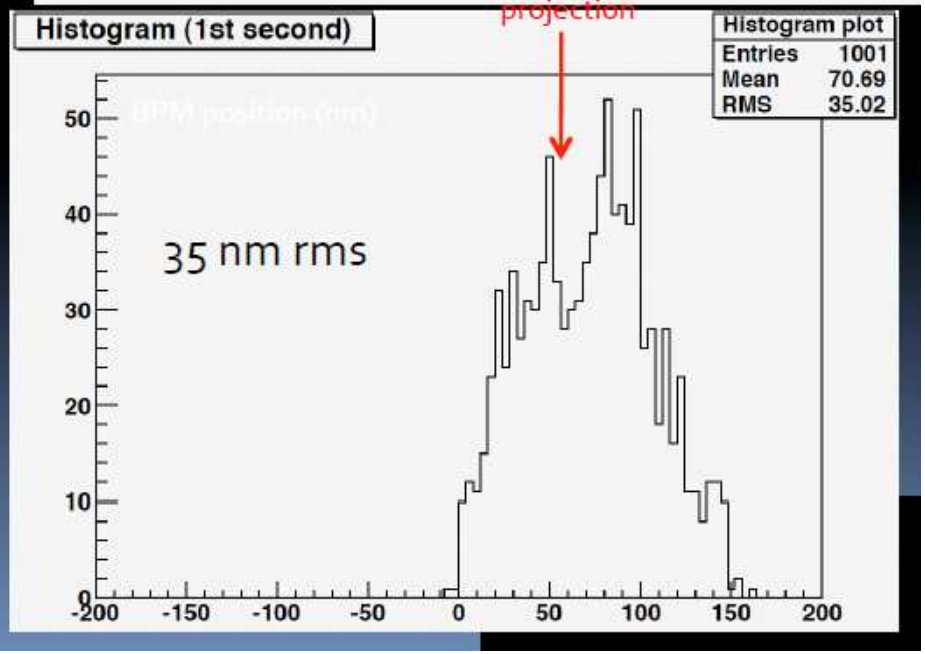


# Initial Data: BPM Vibration

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# Major Hardware Changes scheduled after this meeting

## New bi-polar power supply for EXT steers

- PSs (+-10A), 14 in total, will be delivered in next week.
- They are same-type PSs that are already exchanged for FONT (ZH6X and ZV6X).
- These will replace the old PSs (more than 20 years) and improve the control accuracy.
- Replaced PS should be used as a spare for DR trims.

## DR-BPM upgrade for 1 pm

- Some cables (LO,...) were already installed in DR during the summer 2009.
- Phased installation by 4 BPM stations will be started in May 2010.
- A month for installation and commissioning is planned.

## LCLS BPM Readout Electronics for EXT BPMs

- They will be installed in February 2010.

## New OTR in EXT/FF

- They will be installed in April 2010.

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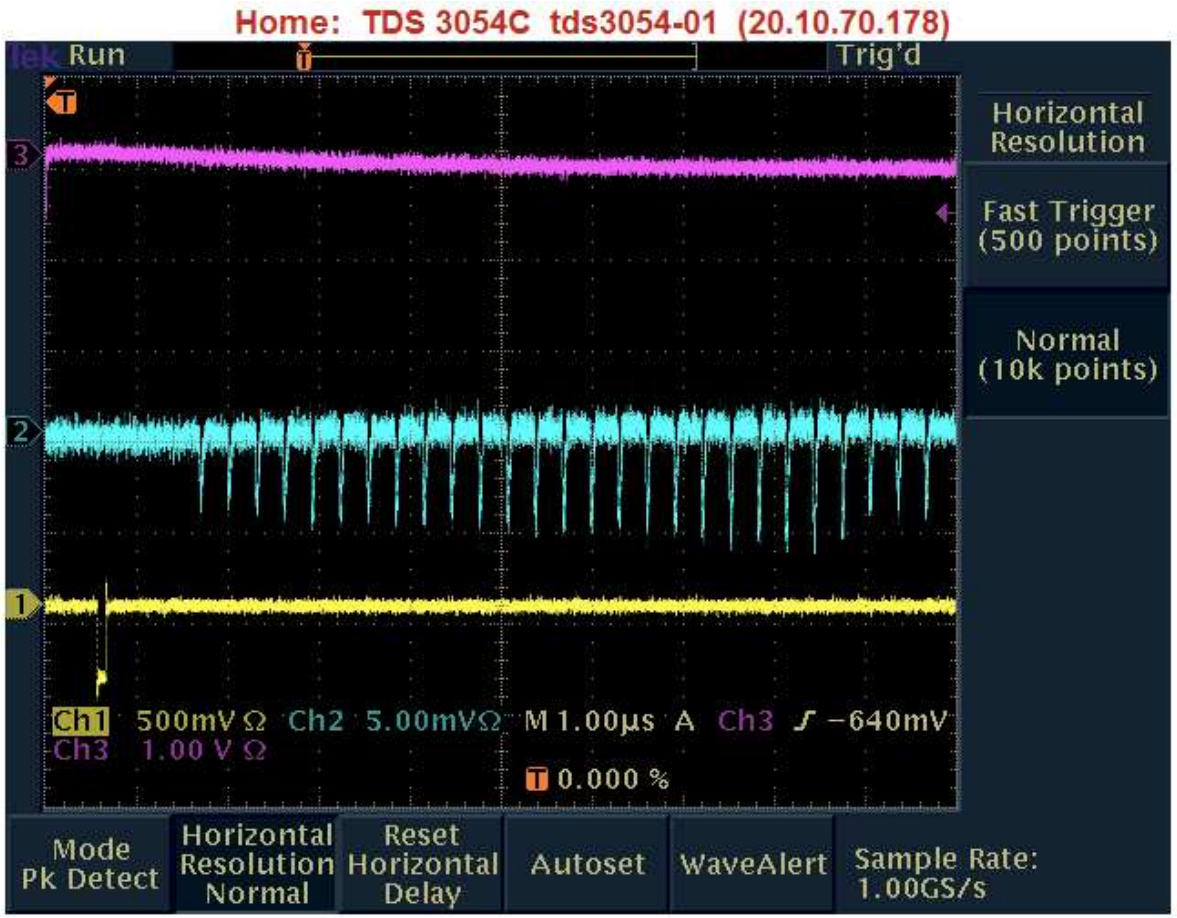
# Fast kicker report (Naito)

**December 2009:**

- **Number of extraction tests performed in 2009**
- **Problems:**
  - **stripline fabrication errors**
  - **bunch-bunch charge uniformity**
  - **timing system**
  - **peak voltage jitter at 10**-3 level**

# March 2010 results

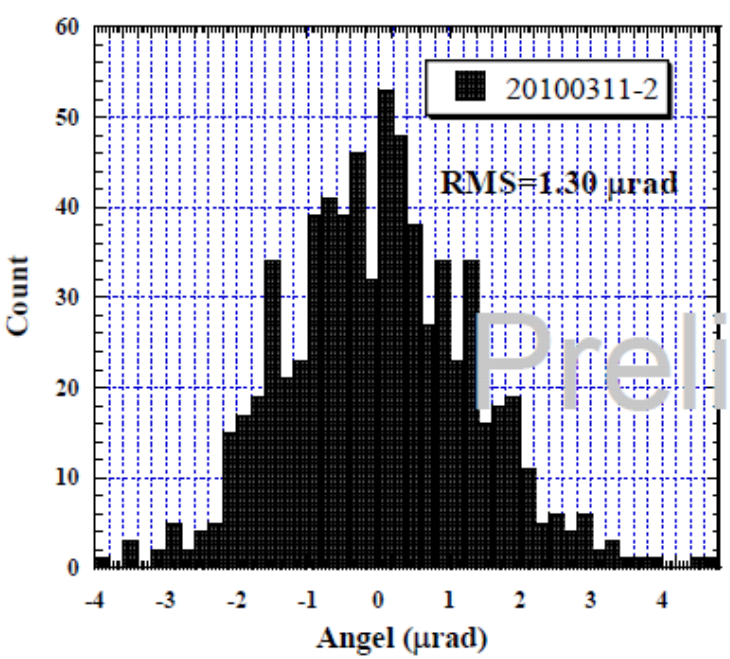
## Extraction of 27 bunches w. 308ns spacing

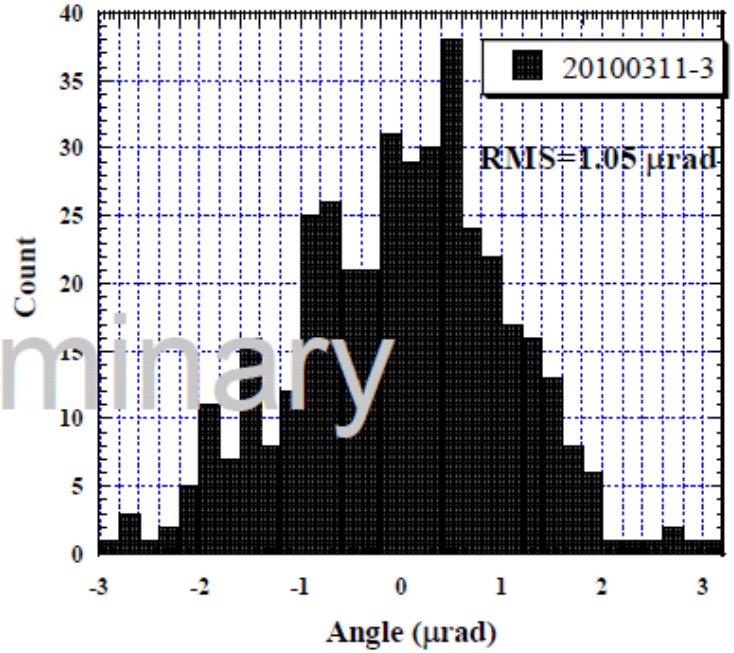


# Distribution of fitted angle at EXT entrance

## Single bunch

Jitter 1.3e-6/3e-3=4.3e-4

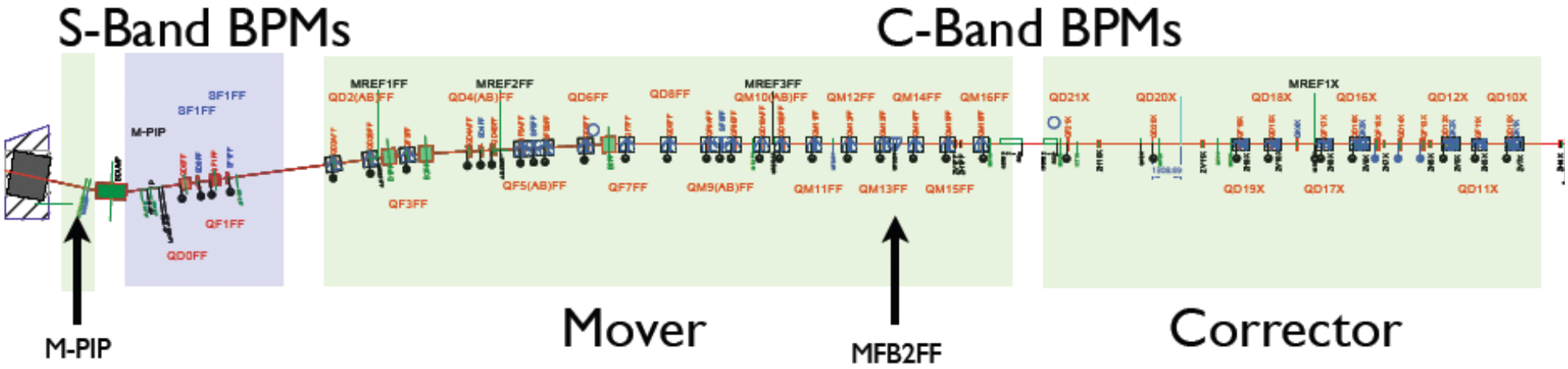


# Cavity BPM report (Boogert)

- Progress since last major report
  - Stable operation with C-band BPMs
  - Improved insensitivity to timing problems
    - C-Band and S-Band diode timing references
  - Improved amplitude extrapolation
    - Should be able to reconstruct large offsets
- Software improvements too numerous to list (all plots are online plots)
  - S-band still has some phase (but not amplitude problems)
- Full calibrate entire system, mover, non-mover, C and S band in approximately 4 hours.
  - C-band calibration stable for ~ 3 days (see White's talk)

# ATF2 BPM layout



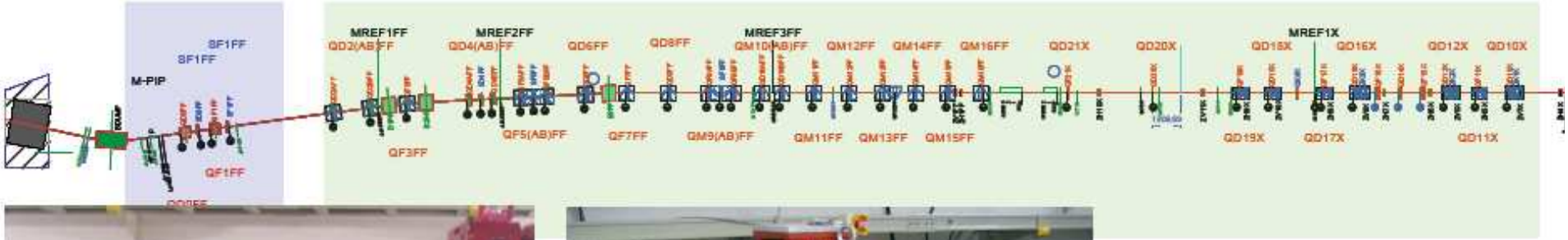

- S-band : 4 (dipole) +1 (ref)
  - Variable attenuation and gain, unlocked local oscillator
- C-band : 33 (dipole) + 4 (ref)
  - Locked LO system
  - Attenuation : 20 db in all channels (1 removed for tests)
  - 10 corrector calibrated
  - 23 mover calibrated

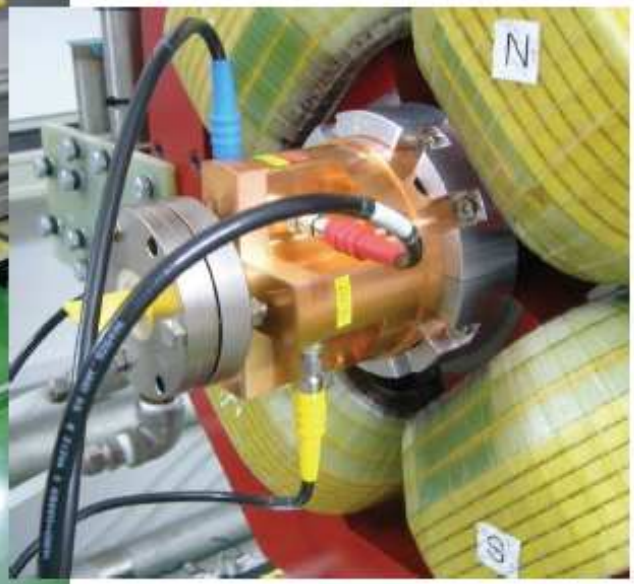
Boogert

# ATF2 BPM layout

## S-Band BPMs

## C-Band BPMs

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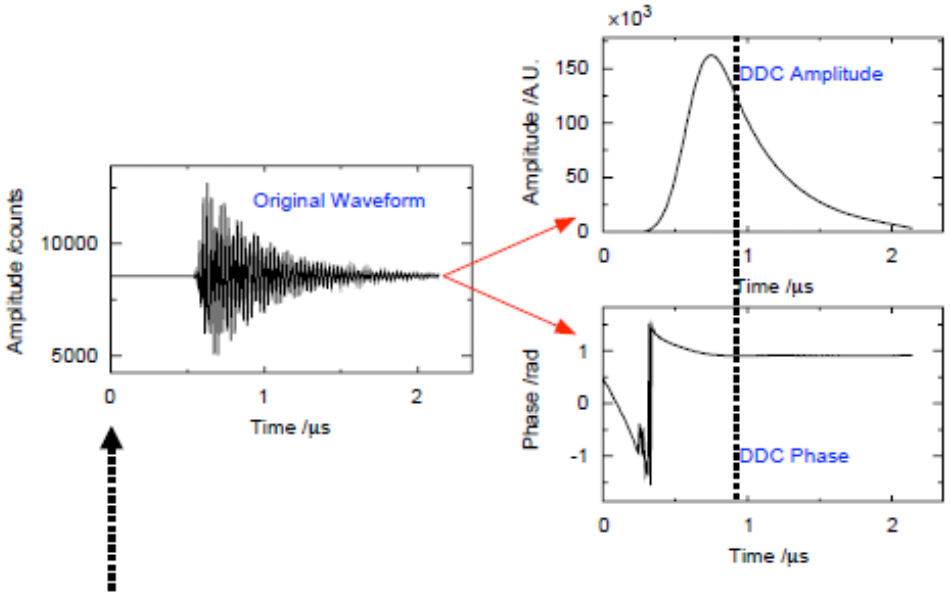
# Digital processing algorithm (DDC)




Trigger start

Extract phase and amplitude at some specific time

$$I = \frac{A_d}{A_r}\cos\left(\phi_d - \phi_r\right)$$

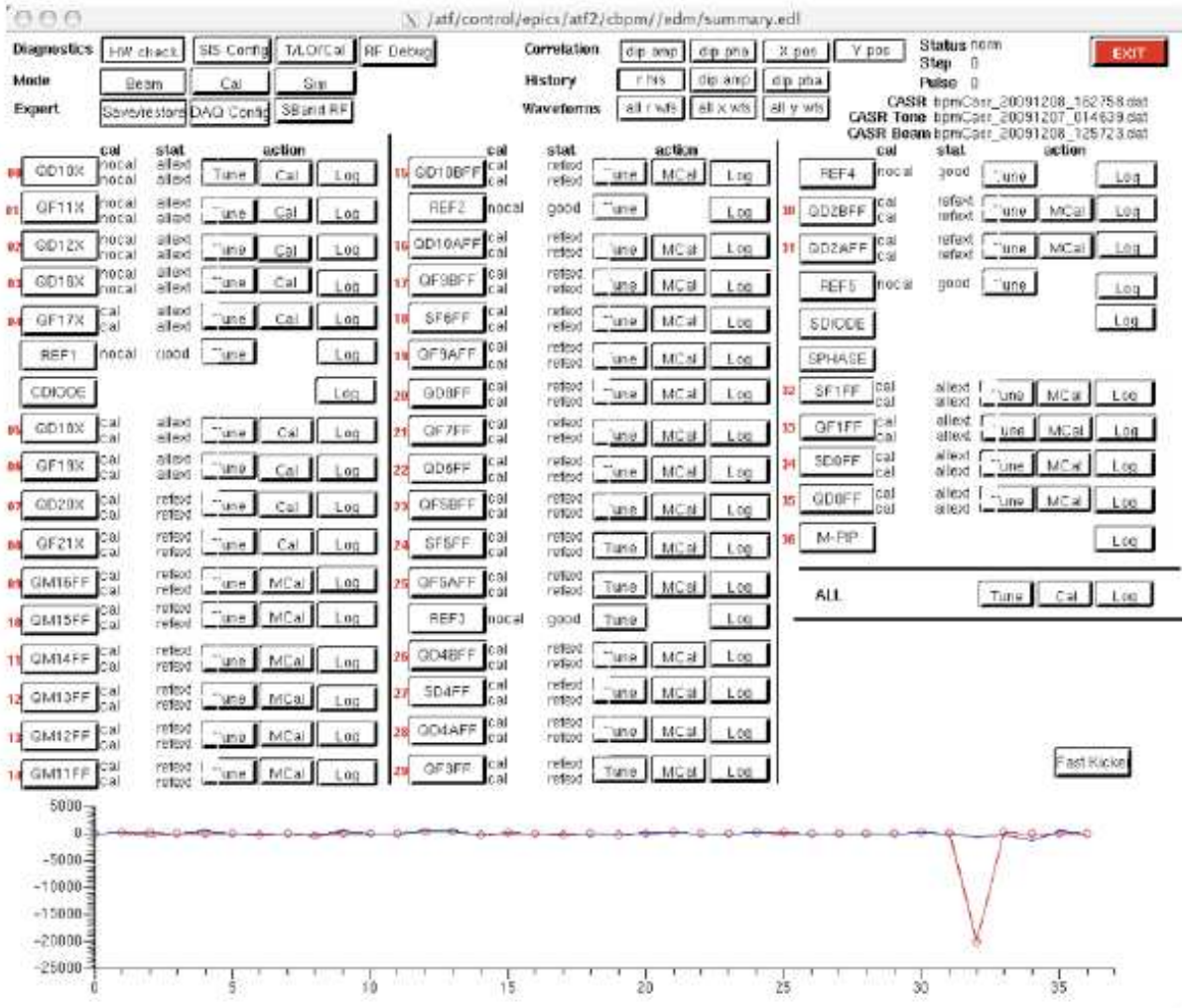
$$Q = \frac{A_d}{A_r}\sin\left(\phi_d - \phi_r\right)$$

- I and Q depend on
  - start trigger
  - beam arrival
  - DDC sample point
- E.g. change in trigger start, beam arrival or saturation levels causes change in I and Q and hence calibration
  - Compensate for changes in code

Boogert

# Software system

- Key element for cavity BPM usage
  - Quick control of all BPM functionality and operating algorithms
  - EPICS based + EDM + python + scipy + matplotlib + catools + ...
- Complete control of entire system
- Easy to integrate new tests
  - IP-BPM electronics + tilt monitor

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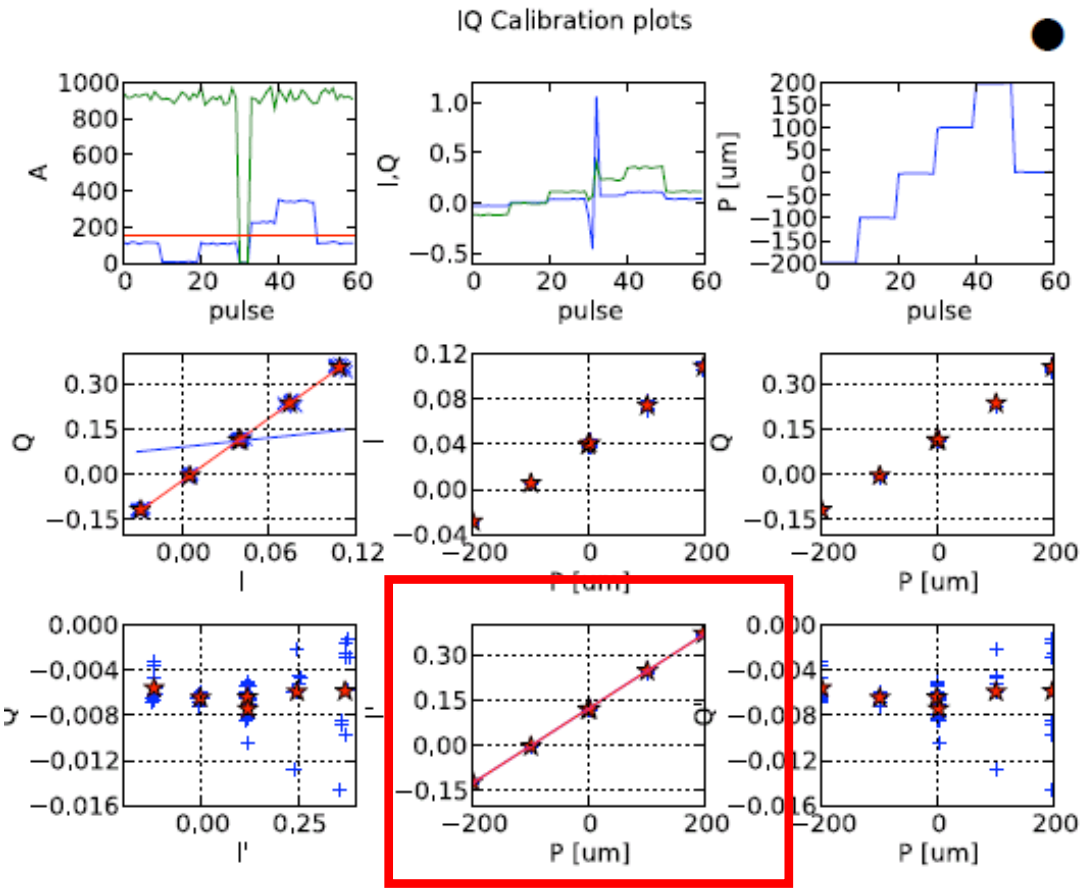
# Calibration




Every pulse : Blue points
Average at location : Red stars

- Calibration method
  - Move BPM typically +- 200 um
  - Record I-Q
  - Determine I-Q rotation such that all variation is in rotated-I

$$I' = I\cos\theta_{IQ} + Q\sin\theta_{IQ}$$
$$Q' = -I\sin\theta_{IQ} + Q\cos\theta_{IQ}$$

- Scale

$$x = S_x I'$$

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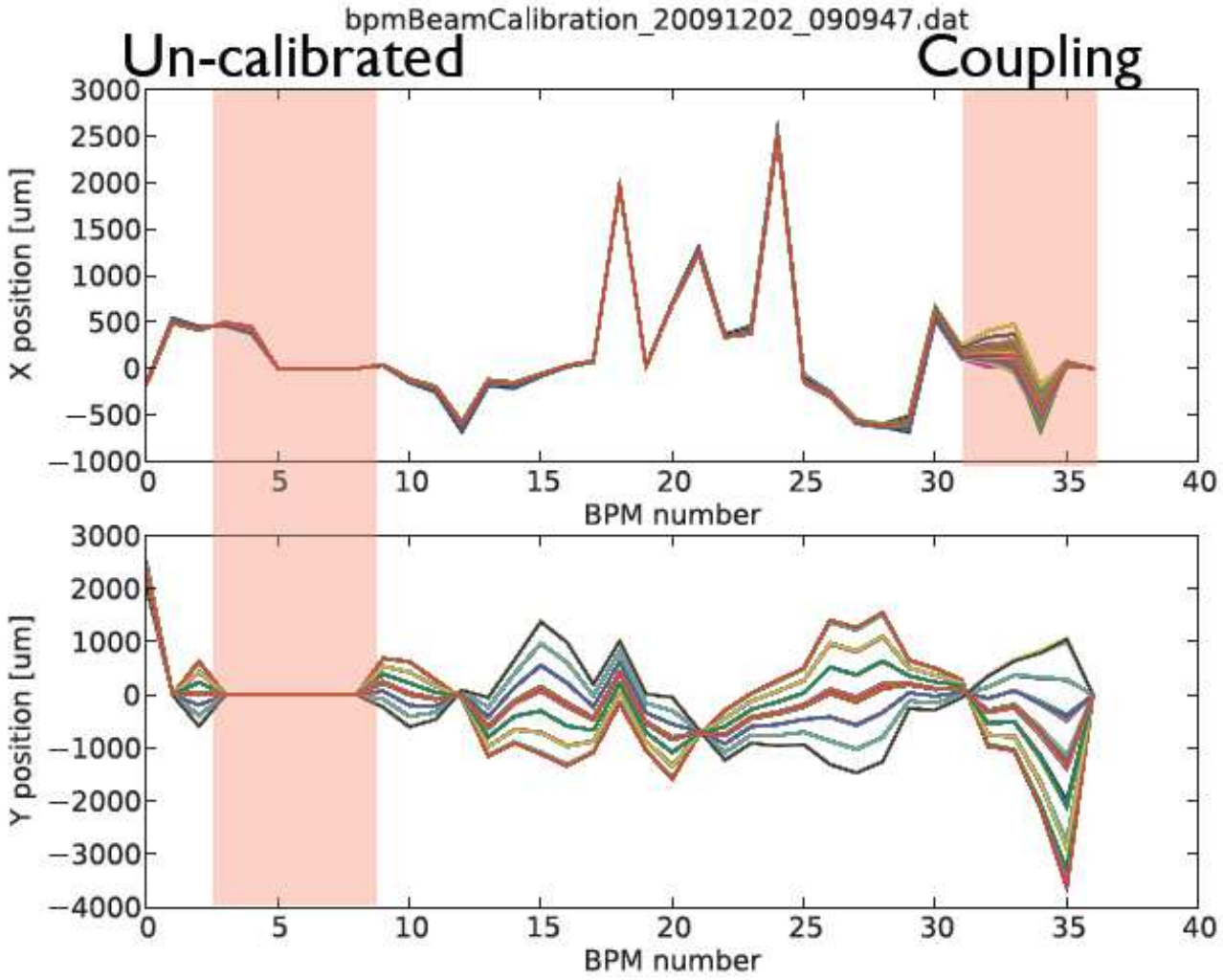
# Linearity at large offset

Vertical corrector scan ZV7X




- Good linear dependance!

Boogert

# C-band calibration

| | | 08/12/2009 AM | | 09/12/2009 AM | |
|---|---|---|---|---|---|
| | | θ | S | θ | S |
| QM13FF | x | -0.4429 | 730.6016 | -0.4344 | 766.3729 |
| | y | -0.5583 | 572.9346 | -0.55217 | 538.1593 |
| QM11FF | x | -1.0601 | 723.4036 | -1.07427 | 733.3487 |
| | y | -1.0132 | 590.5859 | -1.01145 | 571.2461 |
| QD10AFF | x | -1.1935 | -599.1746 | -1.19559 | -579.5771 |
| | y | -0.5458 | 732.6153 | -0.5535 | 747.6142 |
| QF7FF | x | -1.1745 | -649.7678 | -1.17508 | -764.88304 |
| | y | 0.1271 | 637.3934 | 0.11279 | 633.4649 |
| SF5FF | x | -0.1483 | -733.4521 | -0.20396 | -721.3833 |
| | y | 0.2932 | -616.1576 | 0.29688 | -613.8675 |
| SD4FF | x | 0.2479 | 634.7448 | 0.24642 | 737.3457 |
| | y | -0.3946 | -669.6132 | -0.38895 | -672.46778 |
| QD2BFF | x | 0.6555 | -514.9741 | 0.6606 | -496.1783 |
| | y | 0.5636 | -615.7744 | 0.5793 | -594.6615 |

- Excellent calibration for most of operation week
- Phase shifts 0.01 or less at C-band
- Amplitude variation of order 5 to 10 %
- Need calibration tone to correct final scale problems

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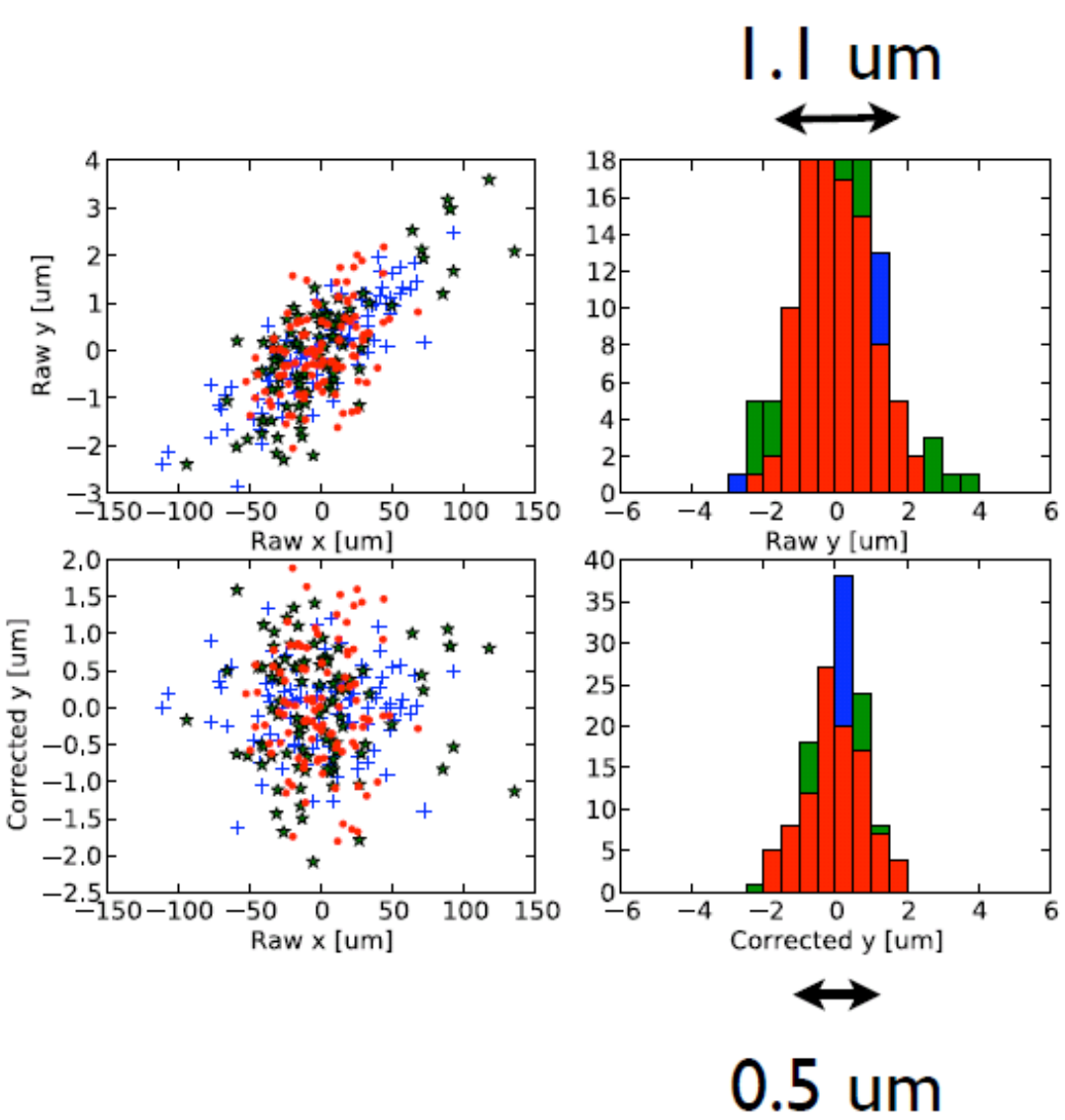
# Best resolution (MFB2FF)




- Sub-micron "resolution" confirmed
  - MFB2FF at waist, so beam jitter low
  - BPM rolled
  - Beam size ~3 um
  - RMS ~ 0.5 um
  - Includes beam drift and jitter
  - Will correct for this effect this evening (see later) **Boogert**

# S-band phase problem

| BPM | | 08/12/2009 AM | | 09/12/2009 AM | |
|---|---|---|---|---|---|
| | | θ | S | θ | S |
| SF1FF | x | -0.7064 | 2337.6932 | -1.297 | 1370.8098 |
| | y | 0.1932 | 5573.9676 | -0.3856 | 5606.9855 |
| QF1FF | x | 0.0656 | -4206.818 | -0.5275 | -6115.9601 |
| | y | -1.4801 | 3038.1829 | 1.0234 | -3038.7735 |
| SD0FF | x | 0.9269 | 3593.66 | -0.6671 | 3922.61 |
| | y | -0.213 | 62200 | -0.807 | 57386.7 |
| QD0FF | x | 0.3181 | -1862.4049 | -0.3421 | -1891.254 |
| | y | -1.3504 | -6065.5702 | 1.10605 | 5687.257 |

- S-Band BPMs have not had as much attention
  - BPM crew has been joined by two student from Kyungpook National University (Aeyoung Heo, Youngim Kim)
  - Plus Professor HyangKyu Park
  - Calibration, stability and performance study of S-band system

**Boogert**

# Summary

Boogert

- C-band system looks excellent
  - Easy to calibrate and use
  - Stable within 5% (calibration tone)
- S-band still has a little way to go, but progress is being made
  - Need to improve S-band cable plant
  - Possible software problem for S-band calculations
  - Cables + electronics seem good
  - Problems will be resolved this week
- High resolution mode being tested now (no attn)
- 300 ns separation readout possible (resolution?)

# Works for ATF DR

Kuroda

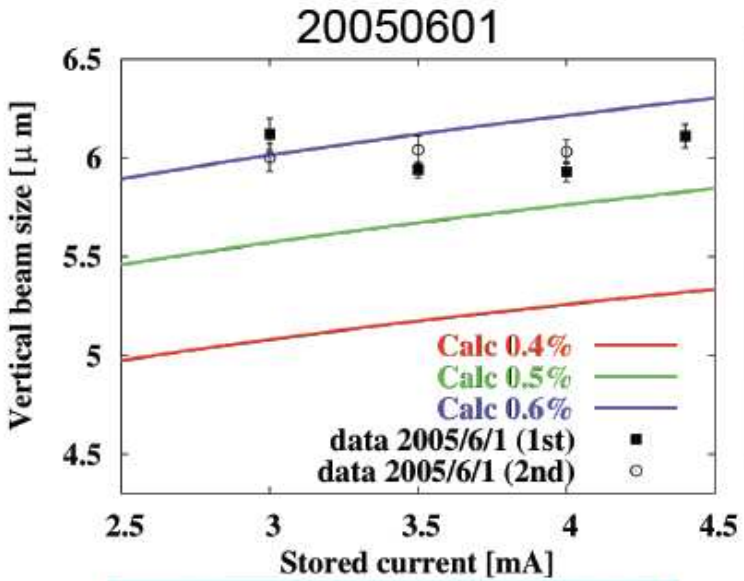
- Hardware issue
  - Re-alignment in summer shutdown
  - Beam size monitor improvement →following slides
- Beam tuning method
  - $\beta$ beat correction
    - Correction with QM18R.1&QM15R.2 trim. ←K.Kubo
  - Dispersion correction
    - $\eta_x$ in straight section is corrected by QM trim
    - $\eta_y$ is corrected by correctors
  - Coupling correction
    - Correction of vertical leakage of the horizontal kicks by a couple of horizontal correctors.
    - Correction is done by Skew Q winding trim coil of SX.

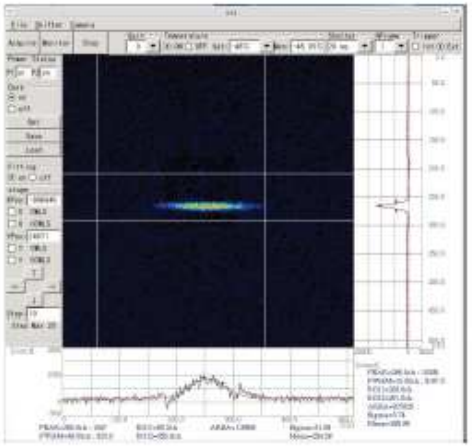
# Improvement of Vertical Emittance measurement (½ )

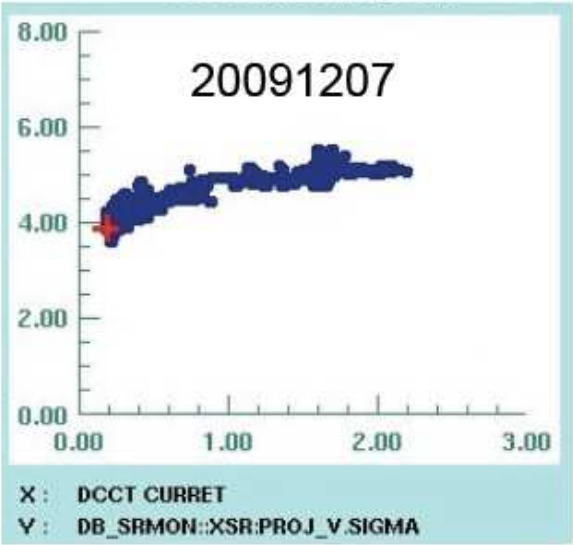
## XSR monitor

**Kuroda**

T.Naito



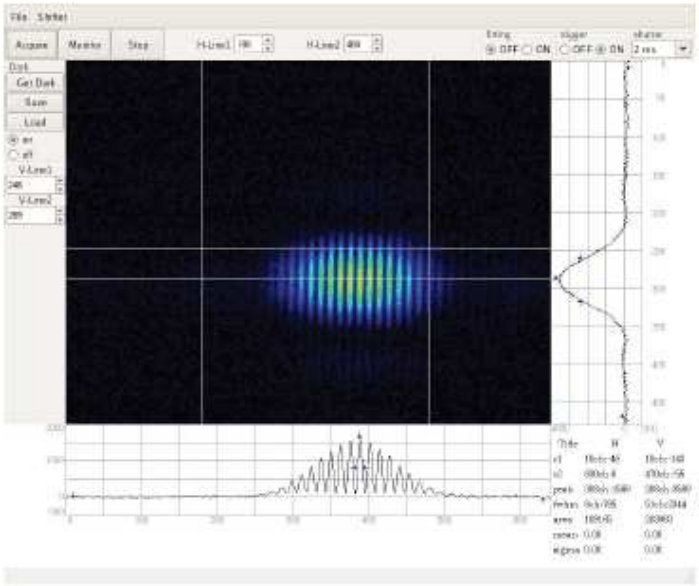

The X-ray SR monitor(XSRM) was affected by the mechanical vibration of the air blower for the RF waveguide. The air blower was located near the grating mirror of the XSRM. The beam profile was smeared and the measured vertical beam size was always larger than 6um. After insert air cushions between the air blower and the ground, the measured vertical beam size was recorded less than 4um, which is not yet limited by the monitor.

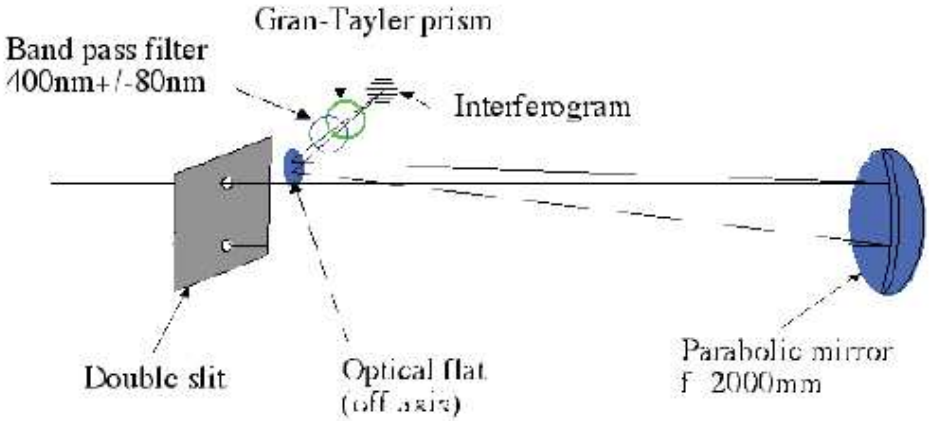
# Improvement of Vertical Emittance measuremen(2/2 )

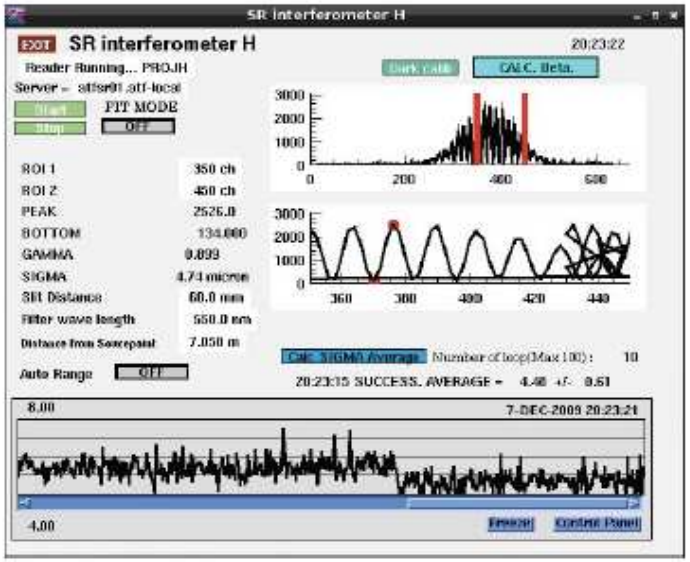
## SR interferometer

**Kuroda**

T.Naito





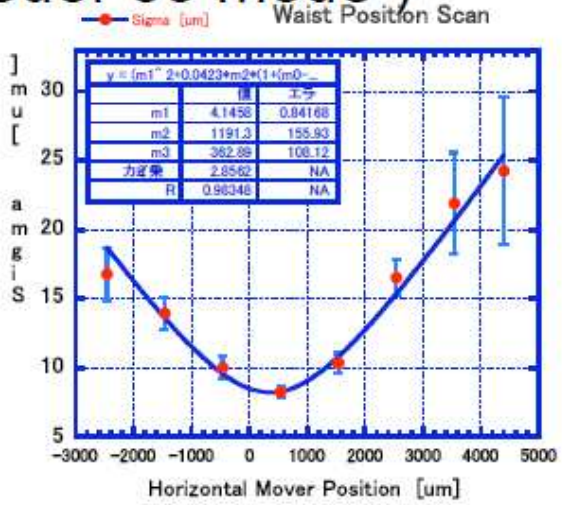

Double slit separation of 40mm was mainly limited by effective aperture of optical path between the source point and interferometer. In this time, the optical path was re-aligned, and as a result, the effective aperture was increased. According to this re-alignment the double slit separation was expanded up to 60mm. To reduce air turbulence, the optical path was covered with air tight duct. To reduce mechanical vibration of the mirrors on the optical table, the optical axis was rotated 90 degree. After these treatment, the measurement could clearly respond the beam size change from 5um to 4um. (left)

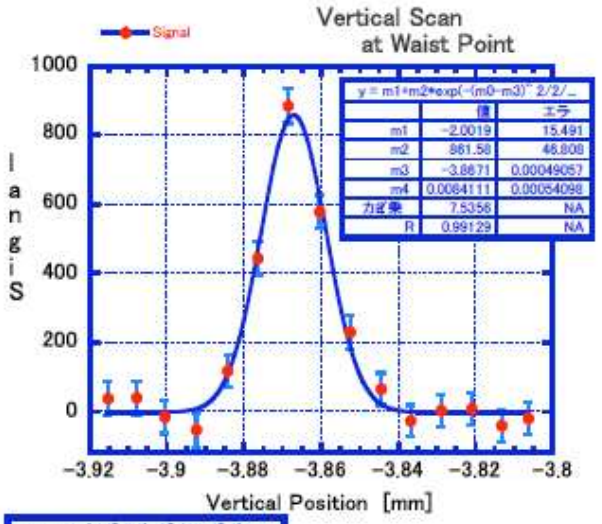
# Laser Wire Measurement in DR

H.Shimizu

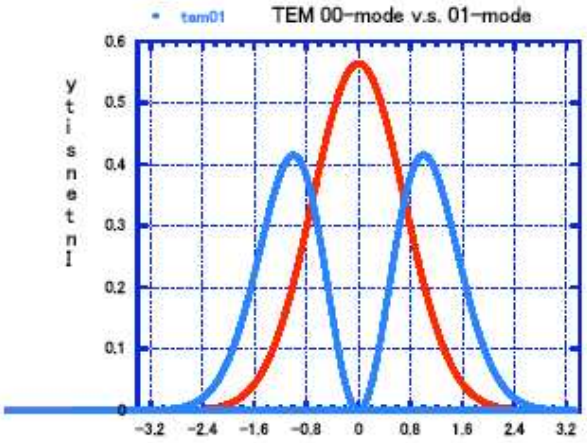
## Fundamental mode( 00 mode )

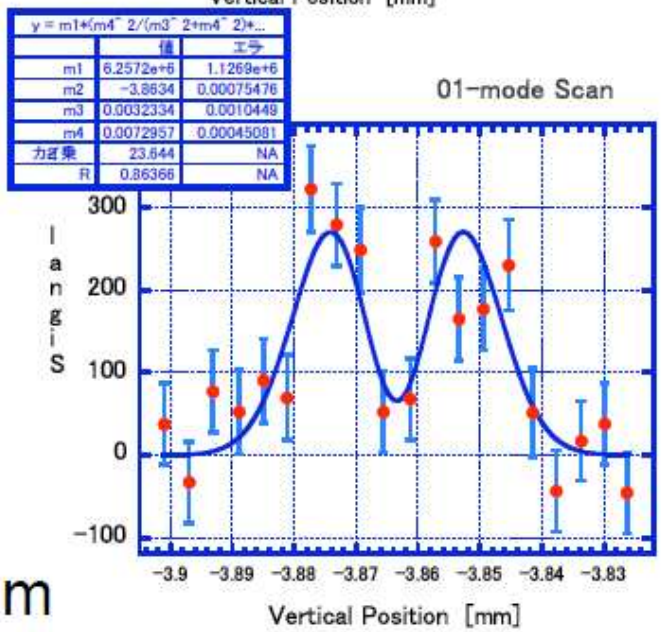
$\sigma_e$=4.1±0.8um




## Higher order mode( 01 mode )

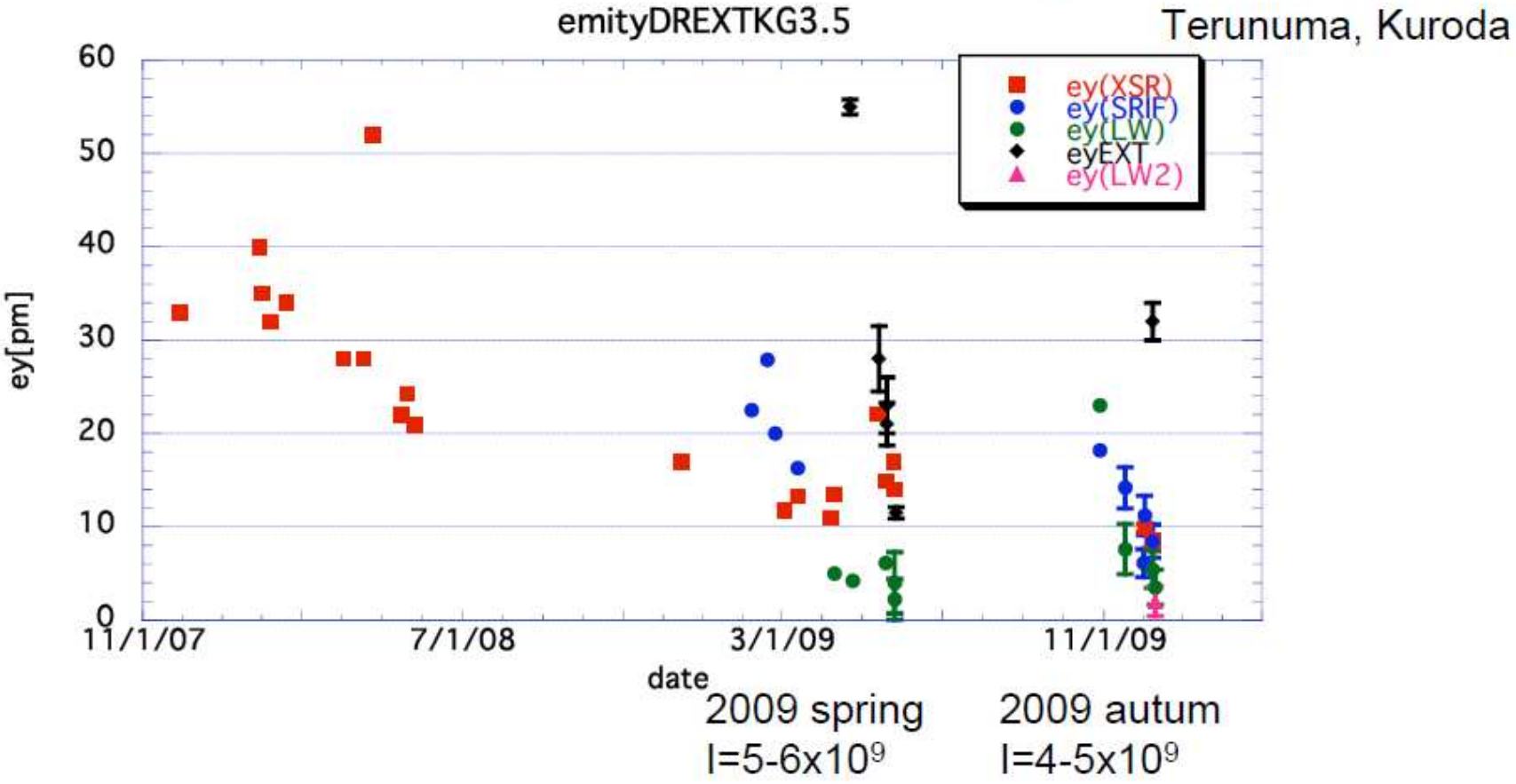



**Kuroda**

$\sigma_e$=3.2±1.0um

# DR Emittance Summary




Emittance situation is similar to that in May 09.
Measured $\varepsilon_y$=8.56±0.46/ 8.43±1.79/ 3.50±1.78/ 2.00±1.61pm
by XSR/ IF/ LW00/ LW01.
Study for the discrepancy is still on going.

**Kuroda**

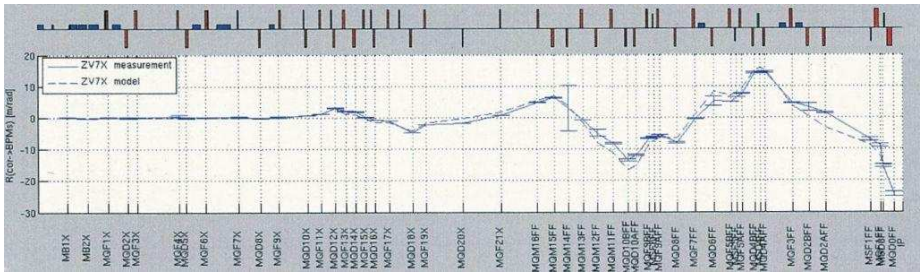
# Optics Modeling ( Orbit Response Matrix )

Okugi

•Orbit response measurement was used for the R12 response test.
- The precision of the optics modeling was improved with cavity BPM improvement.
- DAC readback was used to calculate the magnet strength instead of ADC.

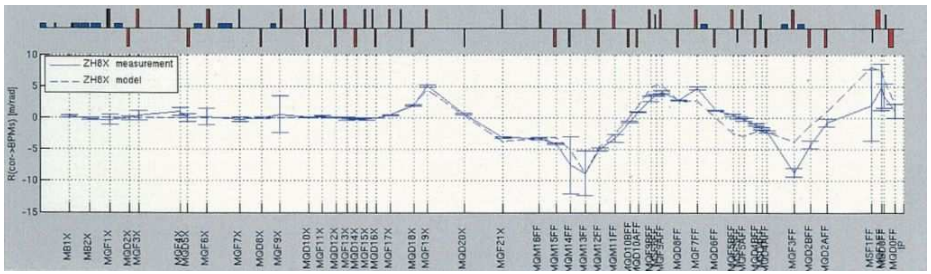
***For example***

ZV7X




Good agreement

ZH8X




Not Good

Some correctors are consistent with the model, but some are not. (?)

•The orbit response measurement was also used for quick test of the cavity BPM calibration.

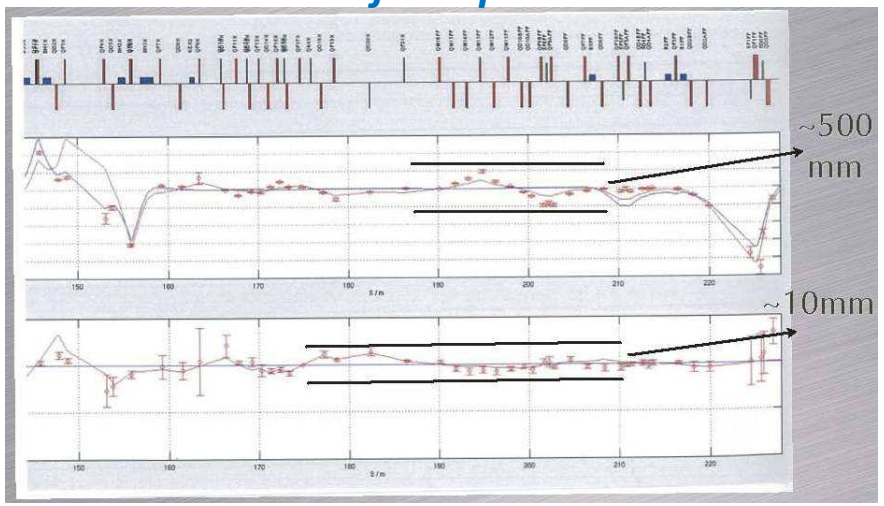
# Dispersion correction

Okugi

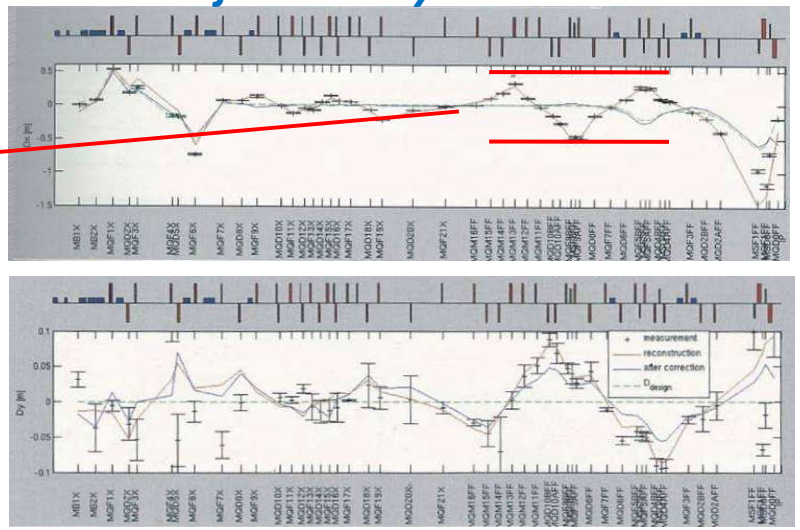
•Dispersions were evaluated with 2 methods.
1) Delta-f ramp in DR
2) Orbit jitter analysis SVD matrix
The results are consistent each other.

•The vertical dispersion correction is improved not only with QS1X, QS2X sum-knob, but also with ZV5X, ZV6X and ZV7X local bump.

**Delta-f ramp in DR**




**Orbit jitter analysis SVD matrix**




•Vertical dispersion for all ATF2 beam line is corrected within 10mm.

•Large horizontal dispersion at the end of straight line (500mm) sometimes exists.

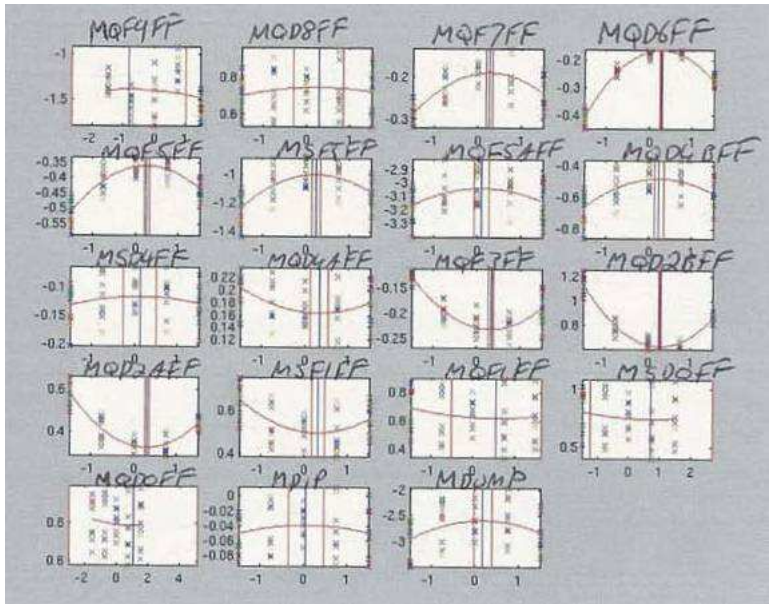
# BBA

Okugi

•BPM offsets with respect to magnets are measured and put to the database.
All quadrupoles are aligned within 1mm range, but some BPMs for sextupoles has large offsets.

•Mechanical alignment of sextupoles are measured with respect to nominal beam orbit for the preparation of nominal optics.
First 3 sextupoles are aligned within 1mm, the FF sextrupoles are not yet measured.

### Example : SF6FF Horizontal Scan




### Summary Table of Sextupole BBA

| FFS Sextupole | Magnet -> Beam (mm) | Magnet -> BPM (mm) |
|---|---|---|
| SF6FF | 0.29 +/- 0.01 (x)<br>-0.106 +/- 0.02 (y) | 1.75 +/- 0.16 (x)<br>0.604 +/- 0.034 (y) |
| SF5FF | -0.811 +/- 0.06 (x)<br>0.012 +/- 0.02 (y) | 2.315 +/- 0.11 (x)<br>0.205 +/- 0.083 (y) |
| SD4FF | 0.226 +/- 0.026 (x)<br>0.0729 +/- 0.034 (y) | 0.395 +/- 0.038 (x)<br>0.375 +/- 0.029 (y) |
| SF1FF | 0.537 +/- 0.159 (y) | 0.42 +/- 0.16 (y) |
| SD0FF | | |

Okugi

# IP-BSM Improvement

## The hardware works in 2009 summer shutdown

We align the Final Doublet and all of the sextupole magnets.

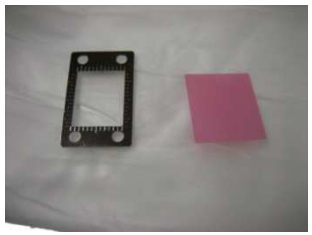
We prepare the wide aperture vacuum camber to BDMP.

We prepare new IP target with Screen, knife edge and wire scanner.

We install the new IP-BSM laser (400mJ/pulse -> 1500mJ/pulse).

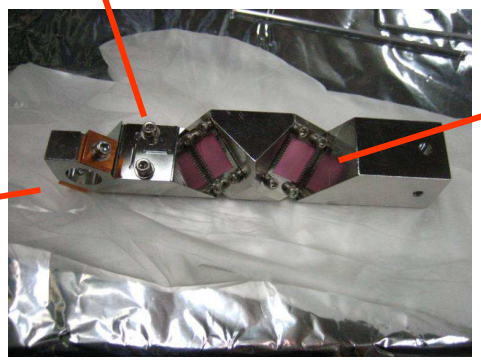
***Laser beam size measurement***

Prepare knife edge target to make 10μm laser spot at IP



***Electron beam size measurement***

Attach10μm tungsten wire at the tip of the holder to make 1μm beam size at IP



***- Laser-laser collision for all laser mode***
***- Electron-laser collition***

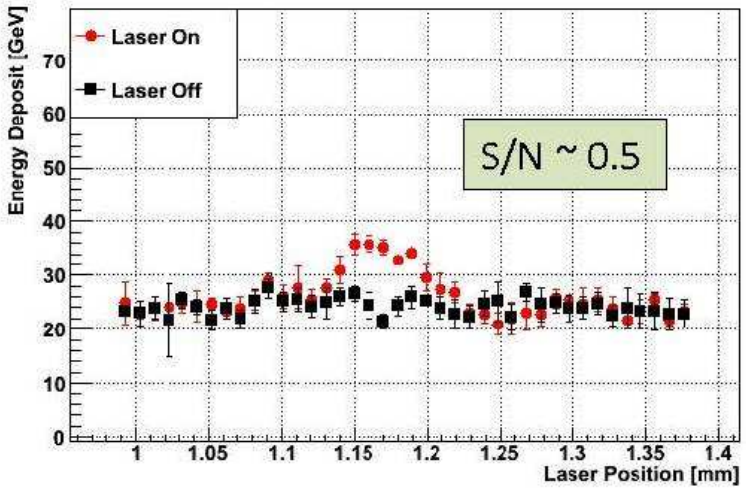
Prepare 2 screen monitor

# *Improvement of S/N ( Laser wire mode )*

**Okugi**

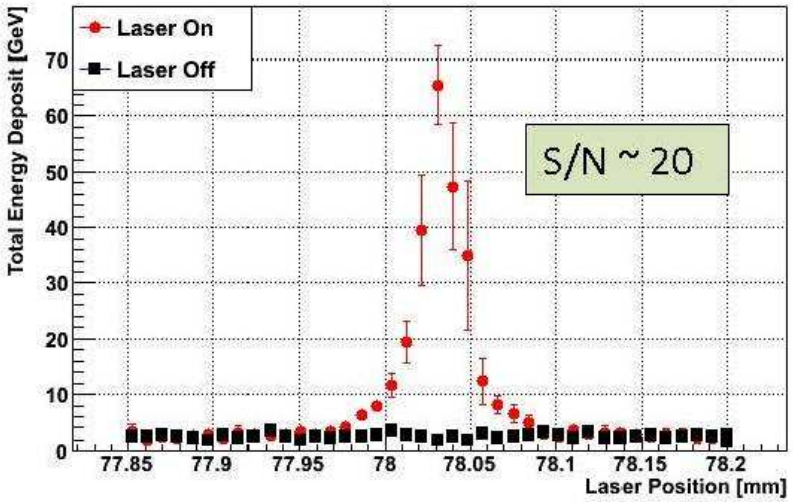
- Elecrtron beam size tuning and Laser –beam collision is easy with new target.
- Signal was increased by the factor 4 with new intense laser.
- Noise was reduced by the factor 1/10 by various hardware improvements.

***In 2009 spring run***




laser wire mode measurement on May 29, 2009

***In 2009 autumn run***




laser wire mode measurement on Nov. 13, 2009

Laser was focused at IP, and the laser spot size was around 20um.

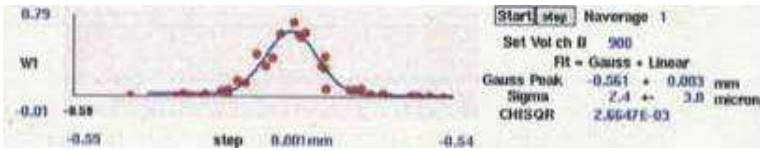
The measured beam size by the laser wire mode was 20um.

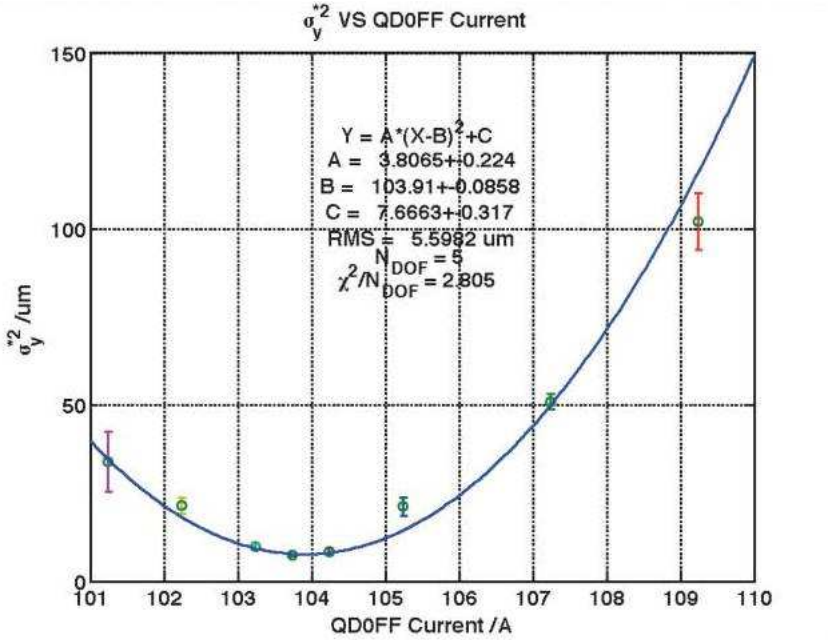
# IP tuning

Okugi

- We concentrate to minimize the vertical beam size only.
  We did not measure the horizontal beam size in 2009 autumn operation period.
- We can achieve the vartical beam size almost the resolution limit (around 3um) of 10um tungsten wire at IP.
- We minimized the vertical beam size to be 1.5um at post-IP with carbon wire scanner.

## Beam size measurement with Carbon wire



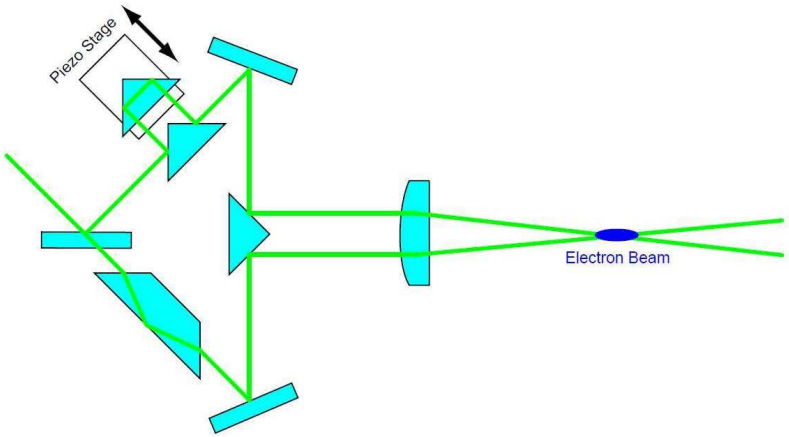
# Observation of the Fringe Pattern ( Interference Mode )

Okugi

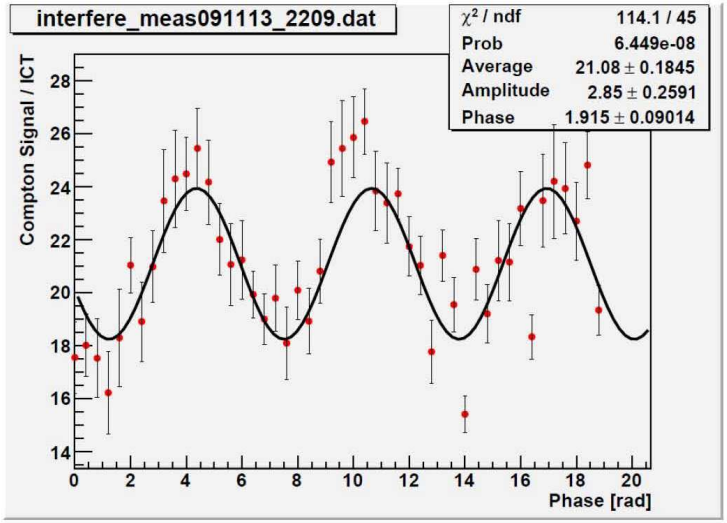
•Elecrtron beam size tuning and Laser –beam collision is easy with new target.

•The first observation of the fringe pattern is 2009/11/13.
The beam test at 2009/11/13 is the first trial of the fringe pattern observation in the 2009 autumn beam operation period.

•The fringe pattern is measured by changing the path length of one laser.




Schematic of the phase scan




First observation of the fringe pattern signal

# Summary of IP-BSM status

Okugi

## *Improved from the 8th TB&SGC meeting*

- The new IP target is very useful for beam size tuning and laser-beam collision.
- The background was reduced to be 1/10.
- We observed the laser interference patterns with beam for 2-4 degrees mode.
  We measured 3 times the interference patterns (11/13, 11/20 and 12/4).
- We established the procedures of the beam size measurement by interference mode.
  It spend about 4 hours for the preparation work for IP-BSM measurement.

## *The present problems to be solved*

- We did not yet established to evaluate the beam size from laser interference patterns, because the many systematics are not yet understood.
- The seed laser was broken twice in 2009 autumn operation period.
  We must solve the problem.

# TB comments

**Acknowledged excellent ongoing hardware support.**

**Would welcome a plan for deployment of Monalisa system**

**Noted excellent progress and achievements in emittance measurements. Hoped new laser amplifier will allow measurement discrepancies to be resolved.**

**Recognised impressive progress on fast extraction kicker**

**Acknowledged impressive progress with BPM system**

**Noted significant progress towards achieving ATF2 beam size goal**

# ATF2 milestones

**End 2010: demonstrate nominal optics for 37nm beam**

**End 2011: achieve 37nm reliably and stably**

**2013: demonstrate beam stability at 0.05 sigma level**

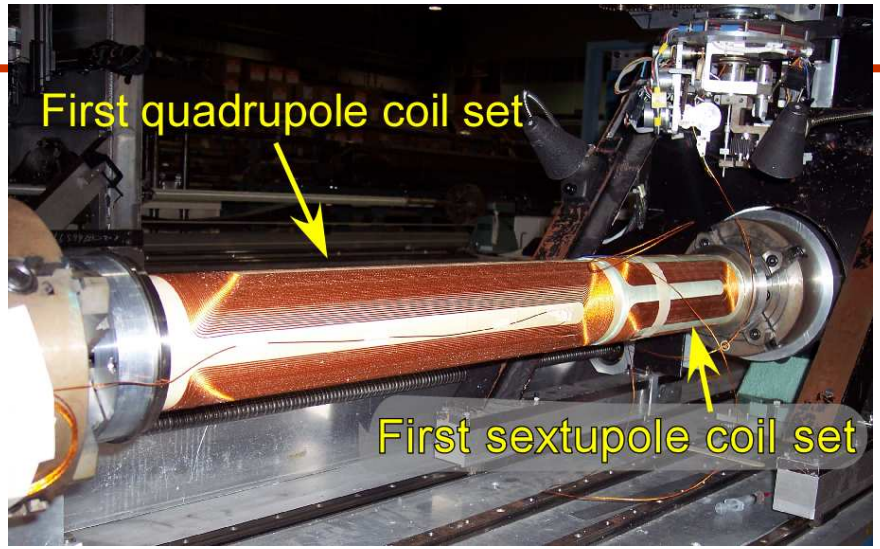
**Technical Board agreed that the proposed changes to the milestones were sensible, and the schedule more realistic**

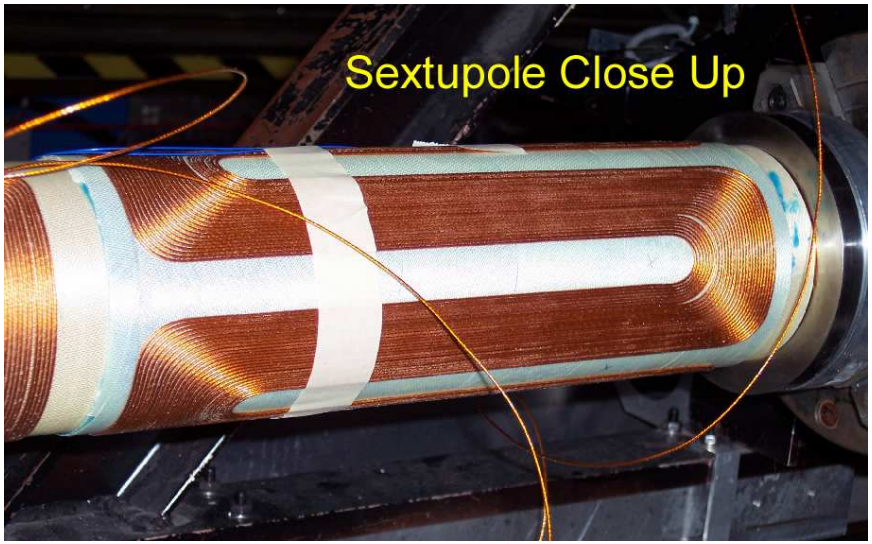
# A Superconducting Magnet Upgrade of the ATF2 Final Focus: Collaboration List

Michael Anerella, John Escallier, Ping He, Animesh Jain, Andrew Marone, Brett Parker, Peter Wanderer, and Kuo-Chen Wu (BNL), Rogelio Tomas Garcia, Claude Hauviller, Eduardo Marin Lacoma and Frank Zimmermann (CERN), Nobuhiro Kimura, Kiyoshi Kubo, Tatsuya Kume, Shigeru Kuroda, Toshiyuki Okugi, Junji Urakawa, Toshiaki Tauchi, Nobuhiro Terunuma, Takayuki Tomaru, Kiyosumi Tsuchiya and Akira Yamamoto (KEK), Philip Bambade (LAL), Andrea Jeremie and Benoit Bolzon (LAPP), Paul Coe and David Urner (Oxford University), Andrei Seryi, Cherrill Spencer, and Glen White (SLAC)

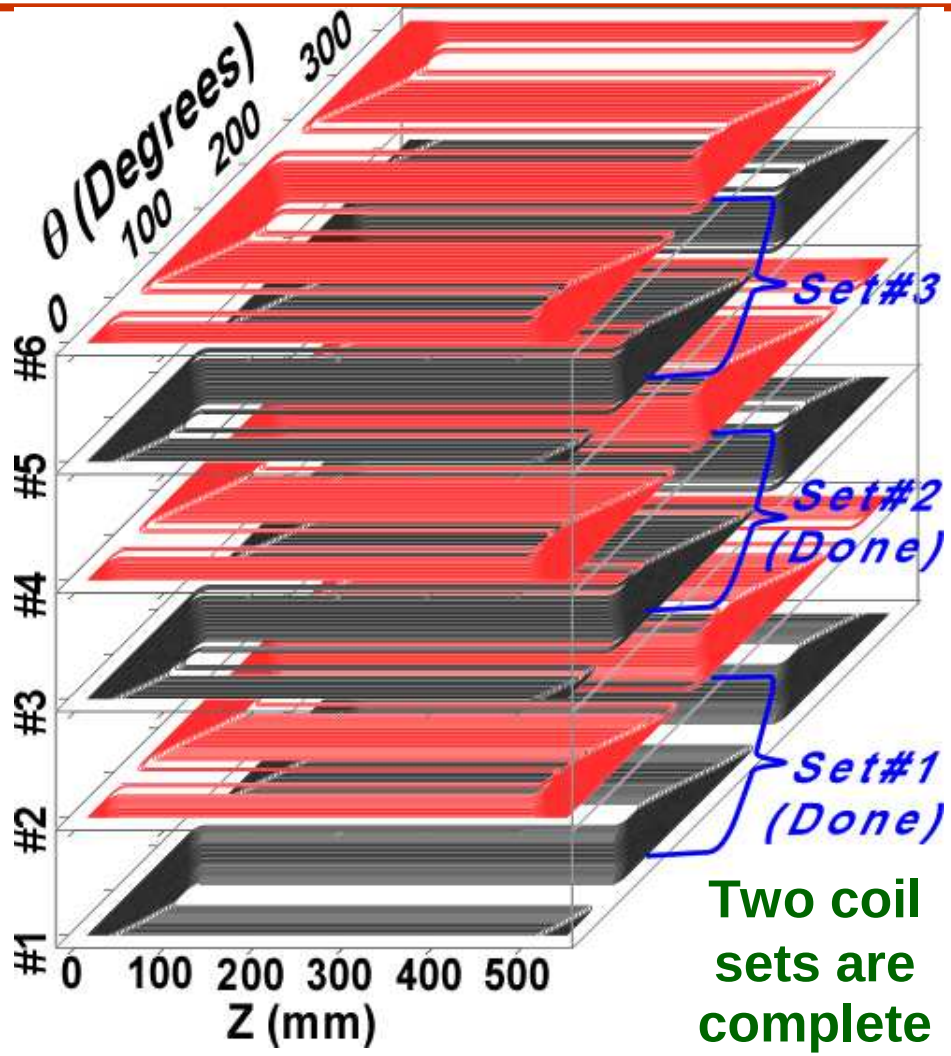
Co-Spokesmen: Brett Parker (BNL), Andrei Seryi (SLAC) and Toshiaki Tauchi (KEK)

# ATF2 Coil Winding Status



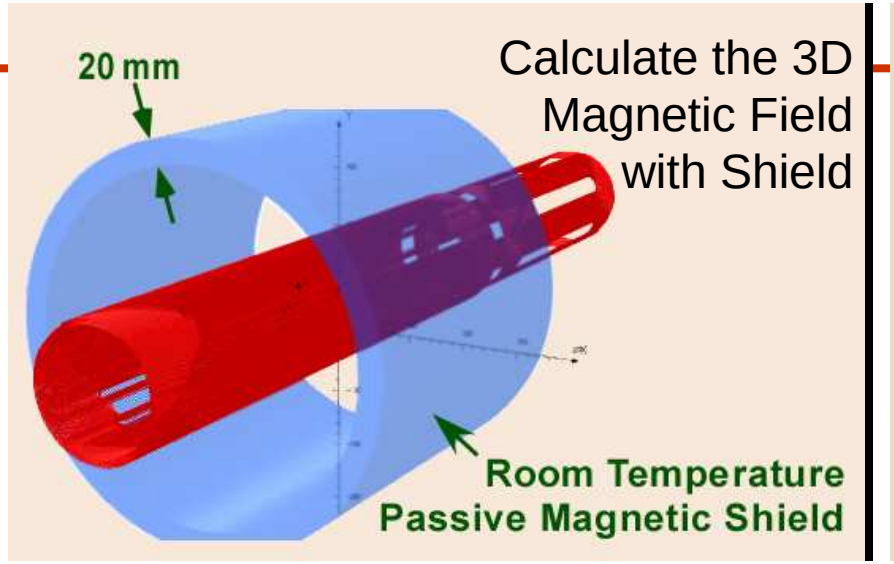



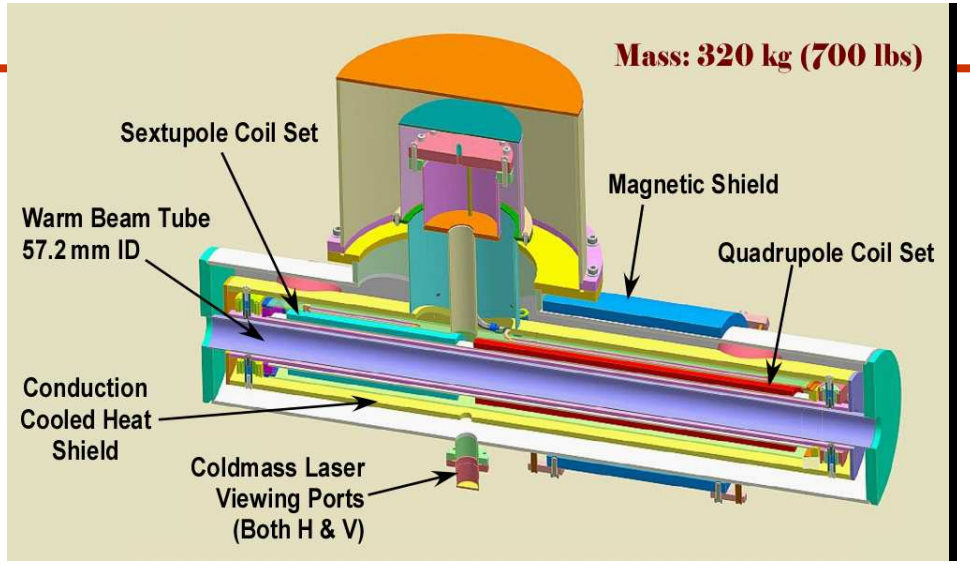

## Winding Schematic for ATF2 Quad

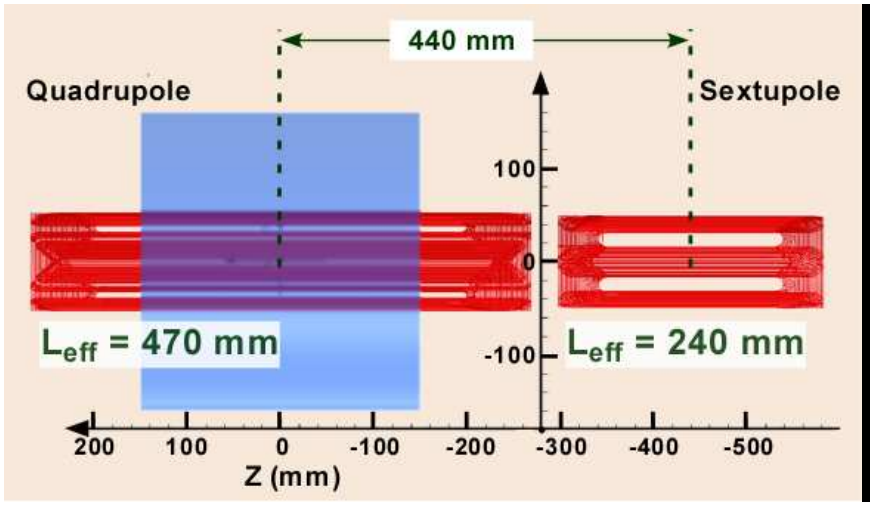



**Two coil sets are complete**

# Laser View Port Interface Status



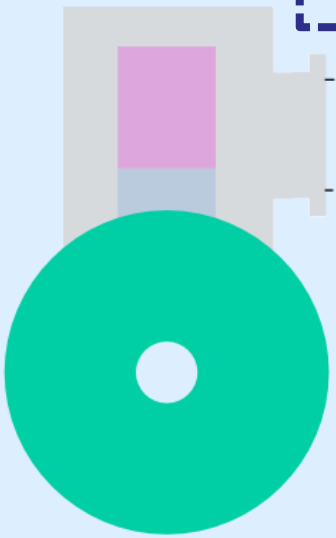

With newest heat shield design it is fairly straightforward to add laser viewing ports. At our recent "Face To Face" meeting we tentatively decided to have these ports positioned at the respective magnetic centers. Before making a final decision we have to evaluate the impact of putting small holes in the quadrupole magnetic shield.

# Cryogenics Interface Status

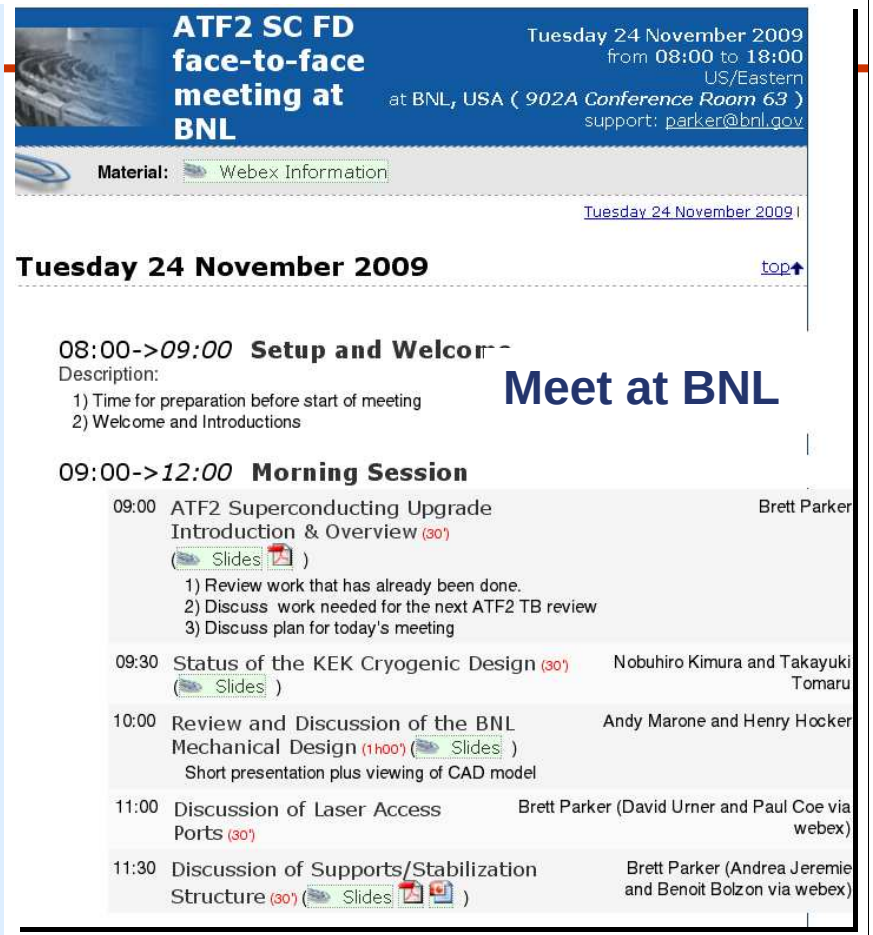
ATF2 magnet & cryostat design (BNL Produced)

New box at ATF2 with cryocoolers, control valves, current leads etc. for 4.2K operation.

4.2K LHe Interface



**Cryo' interface as discussed at ALPG'09.**



ATF2 SC FD face-to-face meeting at BNL

Tuesday 24 November 2009
from 08:00 to 18:00
US/Eastern
at BNL, USA ( 902A Conference Room 63 )
support: parker@bnl.gov

Material: Webex Information

Tuesday 24 November 2009 |

**Tuesday 24 November 2009** top

08:00->09:00 **Setup and Welcome**
Description:
1) Time for preparation before start of meeting
2) Welcome and Introductions

09:00->12:00 **Morning Session**

| | | |
|---|---|---|
| 09:00 | ATF2 Superconducting Upgrade Introduction & Overview (30') ( Slides ) 1) Review work that has already been done. 2) Discuss work needed for the next ATF2 TB review 3) Discuss plan for today's meeting | Brett Parker |
| 09:30 | Status of the KEK Cryogenic Design (30') ( Slides ) | Nobuhiro Kimura and Takayuki Tomaru |
| 10:00 | Review and Discussion of the BNL Mechanical Design (1h00') ( Slides ) Short presentation plus viewing of CAD model | Andy Marone and Henry Hocker |
| 11:00 | Discussion of Laser Access Ports (30') | Brett Parker (David Urner and Paul Coe via webex) |
| 11:30 | Discussion of Supports/Stabilization Structure (30') ( Slides ) | Brett Parker (Andrea Jeremie and Benoit Bolzon via webex) |

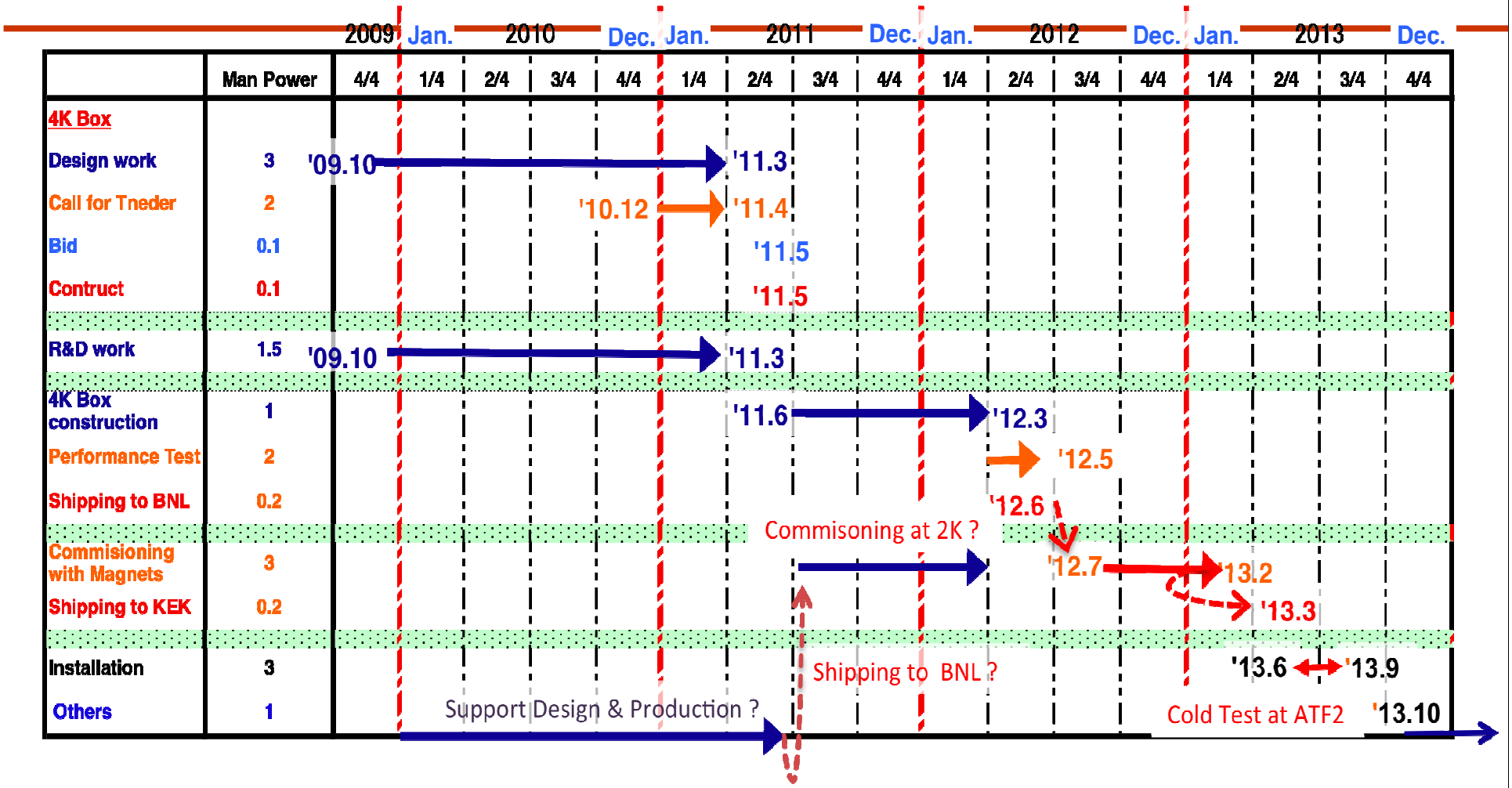
**Meet at BNL**

**A lot of progress was made at a recent all day meeting held at BNL.**

**"Update on SC Magnets and Schedule"**
**Brett Parker, BNL-SMD**

# Kimura

## Proposed Schedule (Construction & Installation)



# TB discussion

**Answers supplied to previous TB questions – thanks!**

**SC FD prototype at ATF2 would:**

**Address many technical issues required … for ILC**

**Provide an existence proof of such a system for ILC**

**Capitalise on ATF2 high beam stability (unique) for characterising cold mass vibrational stability**

**TB strongly supported proposed project, provided it does not have negative impact upon achieving goals A, B**

**Concerns: availability of resources, consequences of any delays, timeliness to feed results into TDP2**

**Further set of questions**

# Final comment

**The Technical Board would like to express its appreciation for the hard work of all the researchers; but particularly to the team at KEK for their continued hard work that has enabled an extremely successful collaboration to be maintained.**