ATF2 Instrumentation

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on behalf of the ATF2 international collaboration
(lots of material taken from SLAC ATF2 meeting Jan 2011, http://ilcagenda.linearcollider.org/conferenceDisplay.py?confId=4904)

Replacing N. Terunuma/T. Tauchi who cannot attend

Rushed talk, sorry if some(thing/body)is mis(represented/ing)

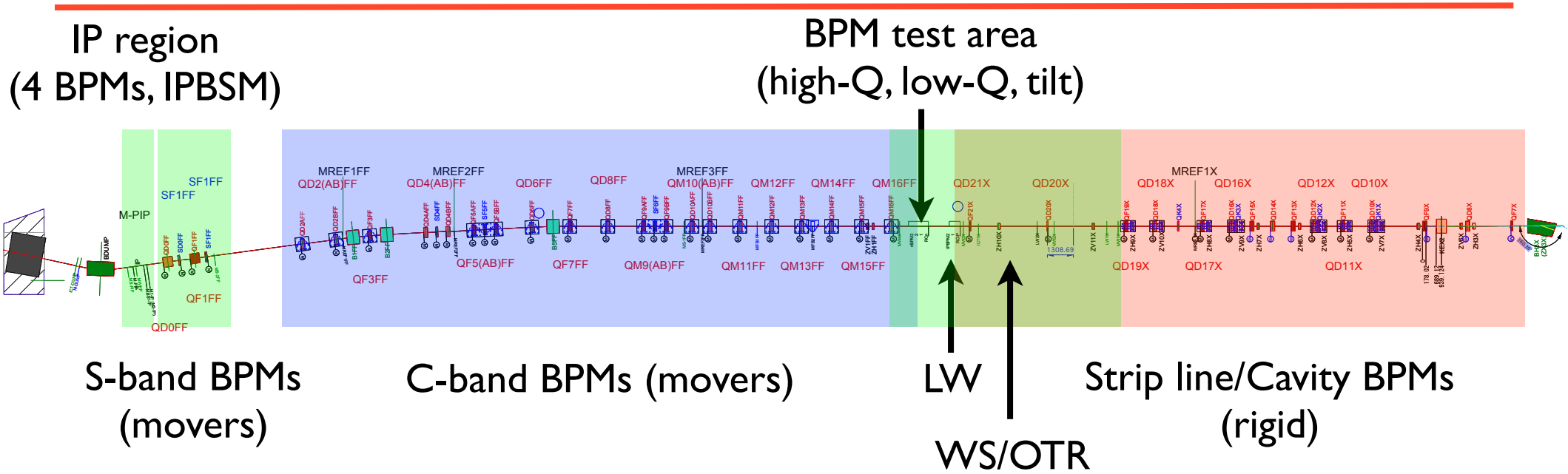
Outline

- Cavity Beam position monitor systems (KEK/SLAC/JAI)
- Interaction point beam size monitor (KEK/Tokyo)
- Optical transition radiation monitor (KEK/SLAC/IFIC)
- Laser wire system (JAI RHUL/Oxford)
- Feedback on nanosecond time scales
- Background monitoring (LLR)
- Interaction point BPMs
  - High Q (KEK/KNU)
  - Low Q (KEK/KNU)
- Tilt monitor (Tohoku)
- Straightness, alignment monitoring (Notre Dame)

Goal 1 : 35 nm spot

Goal 2 : nm level stabilisation

ATF2 Overview (instrumentation)

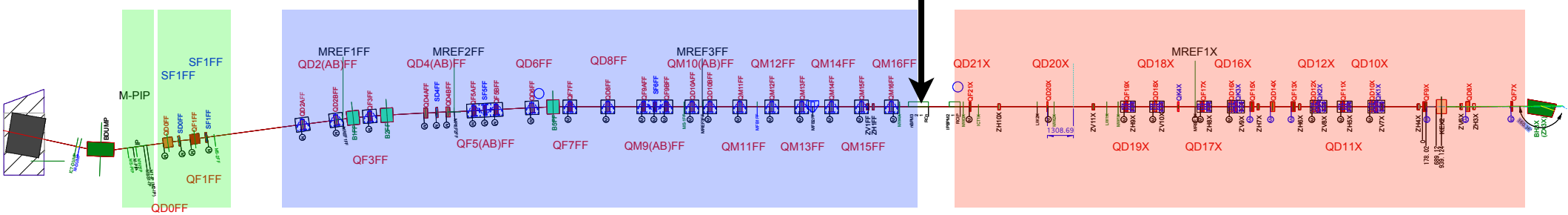


- Very dense with instrumentation
  - 2 independent emittance diagnostic systems (3 axis wires, OTR)
  - 2 independent IP systems (BPMs, IPBSM)

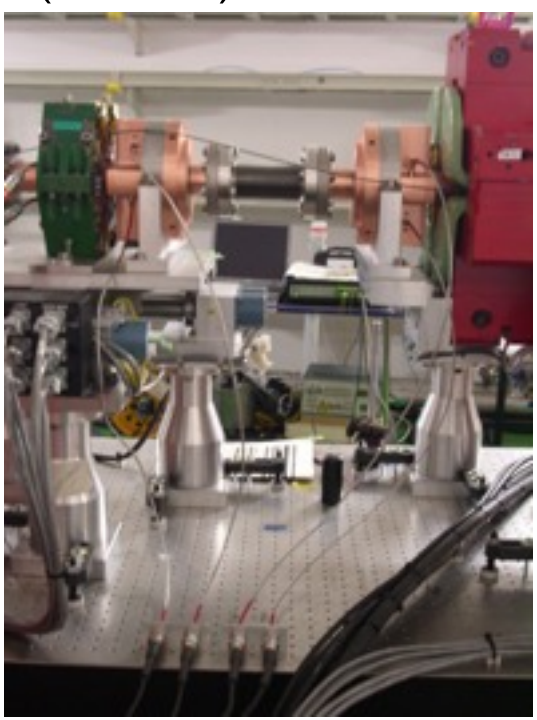
Cavity position monitor system

IP region
(4 BPMs)

BPM test area
(high-Q, low-Q, tilt)



S-band BPMs
(movers)

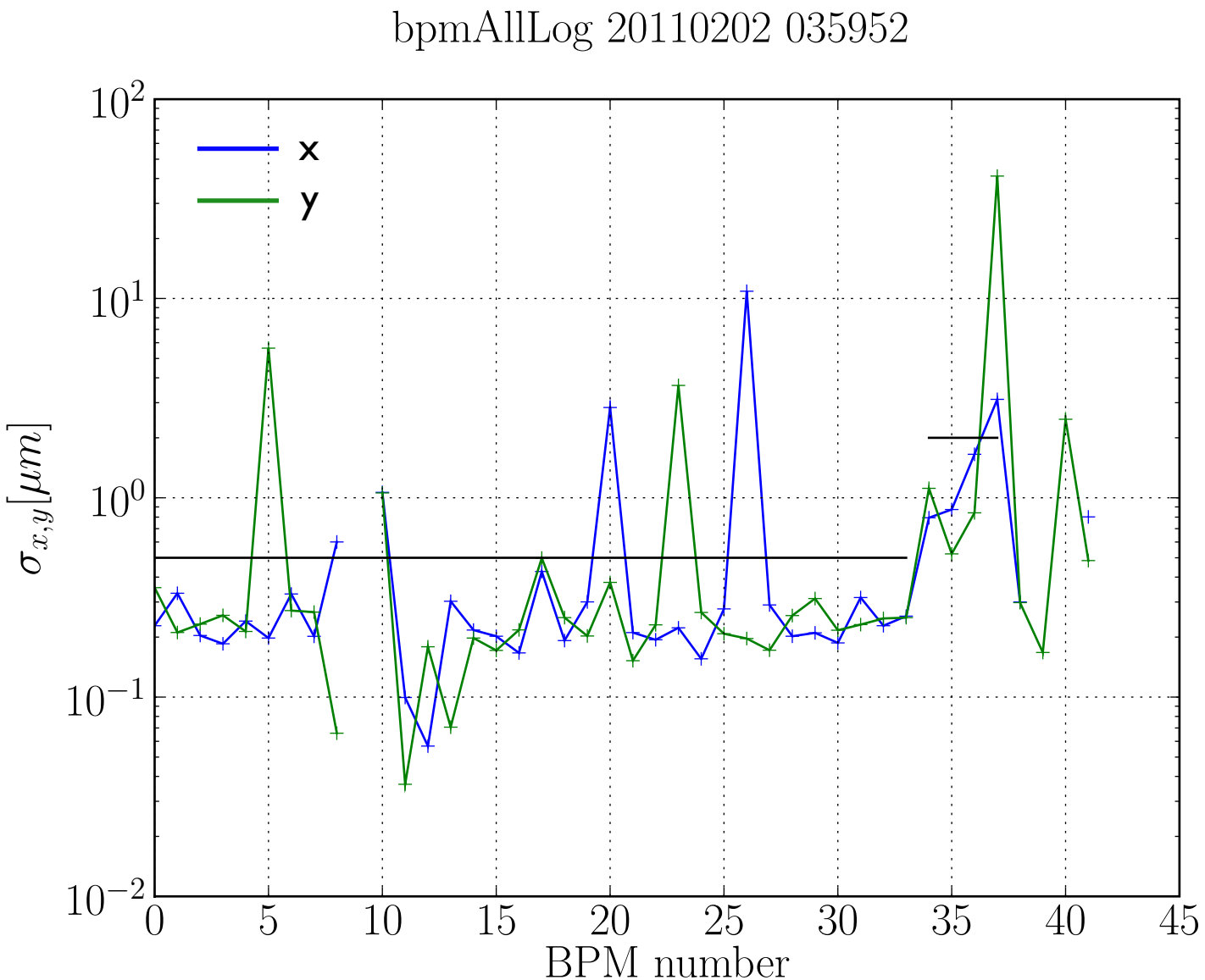


C-band BPMs (movers)

Strip line/Cavity BPMs
(rigid)

IP calibration 20110202

Boogert/Lyapin/Kim/Cullinan



IP calibration 20110202

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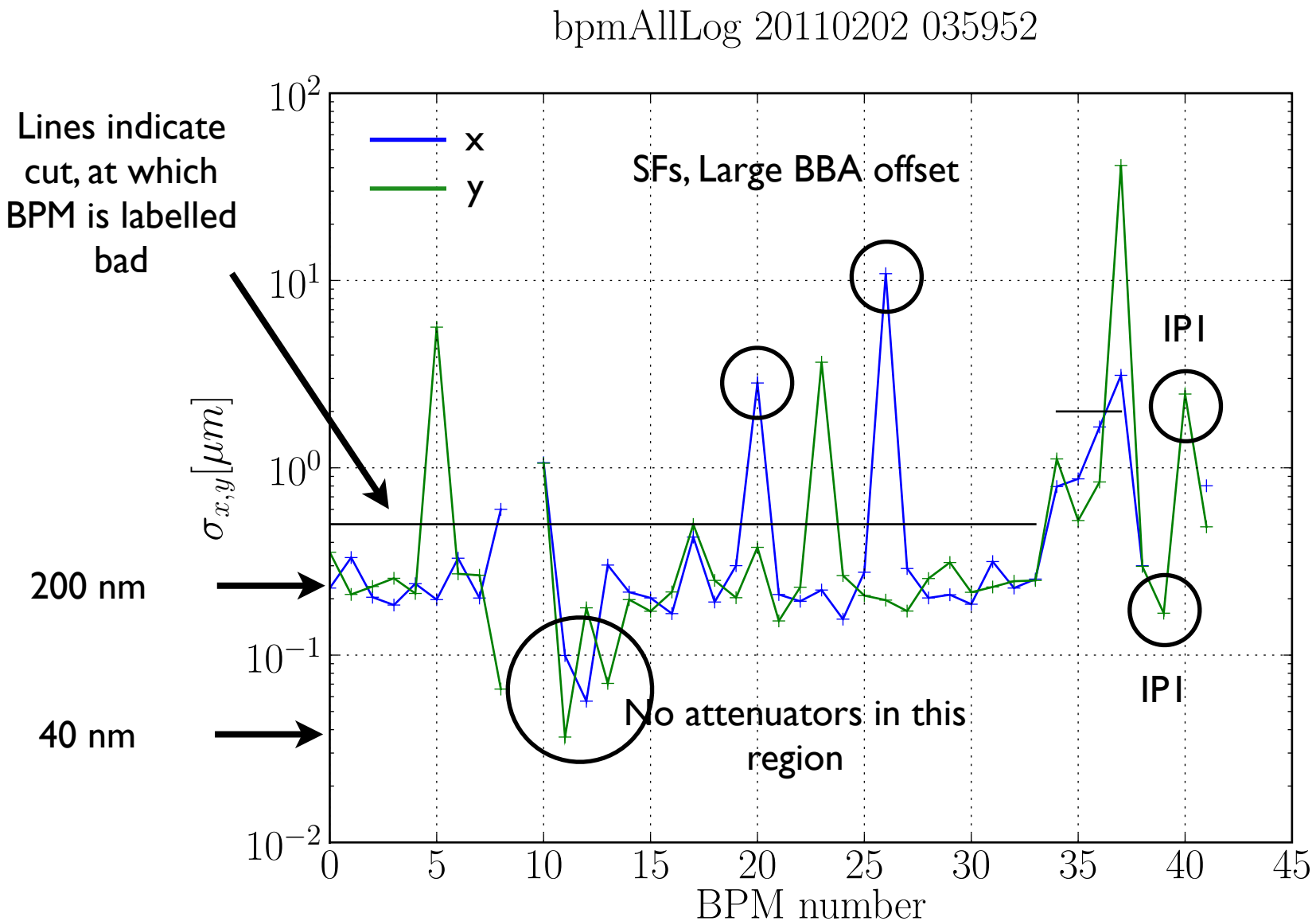
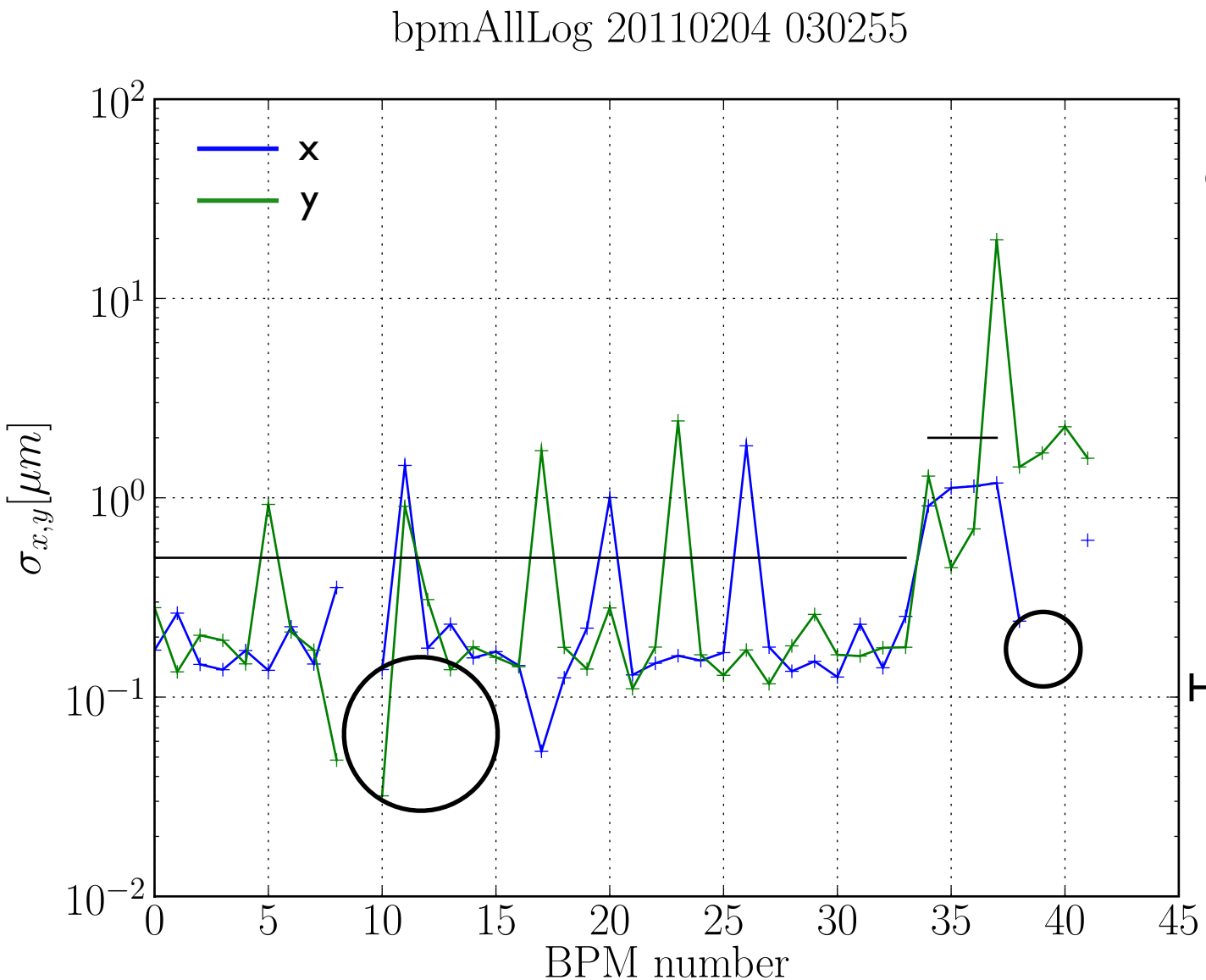


End of week 20110204 (030908)

Boogert/Lyapin/Kim/Cullinan

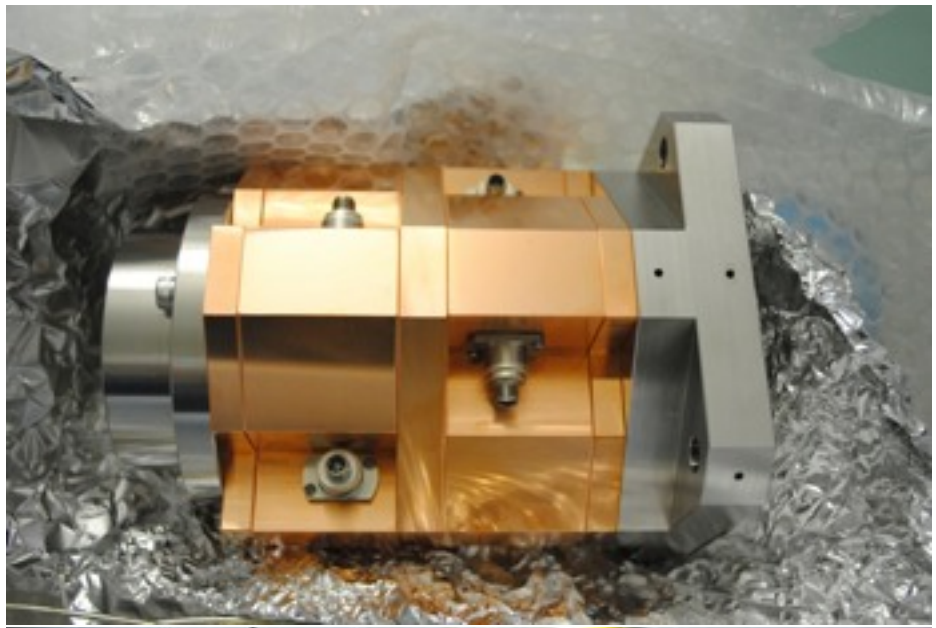


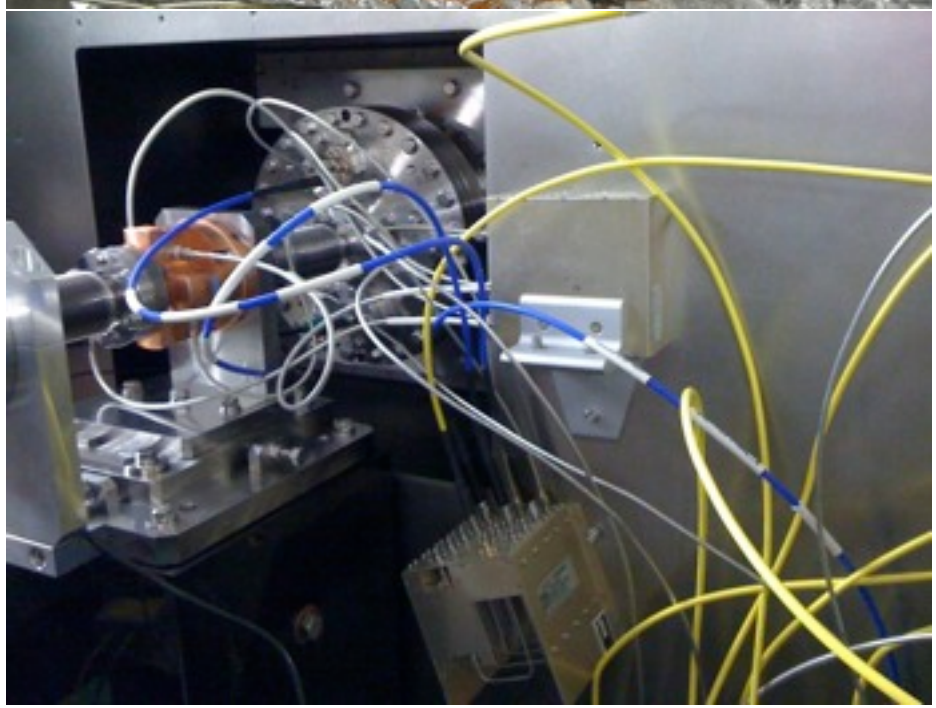
Pattern similar days later but some degradation of high resolution BPMs

High resolution BPMs were where the circles are

IP region BPM installation

T. Smith/YI Kim/Y Honda



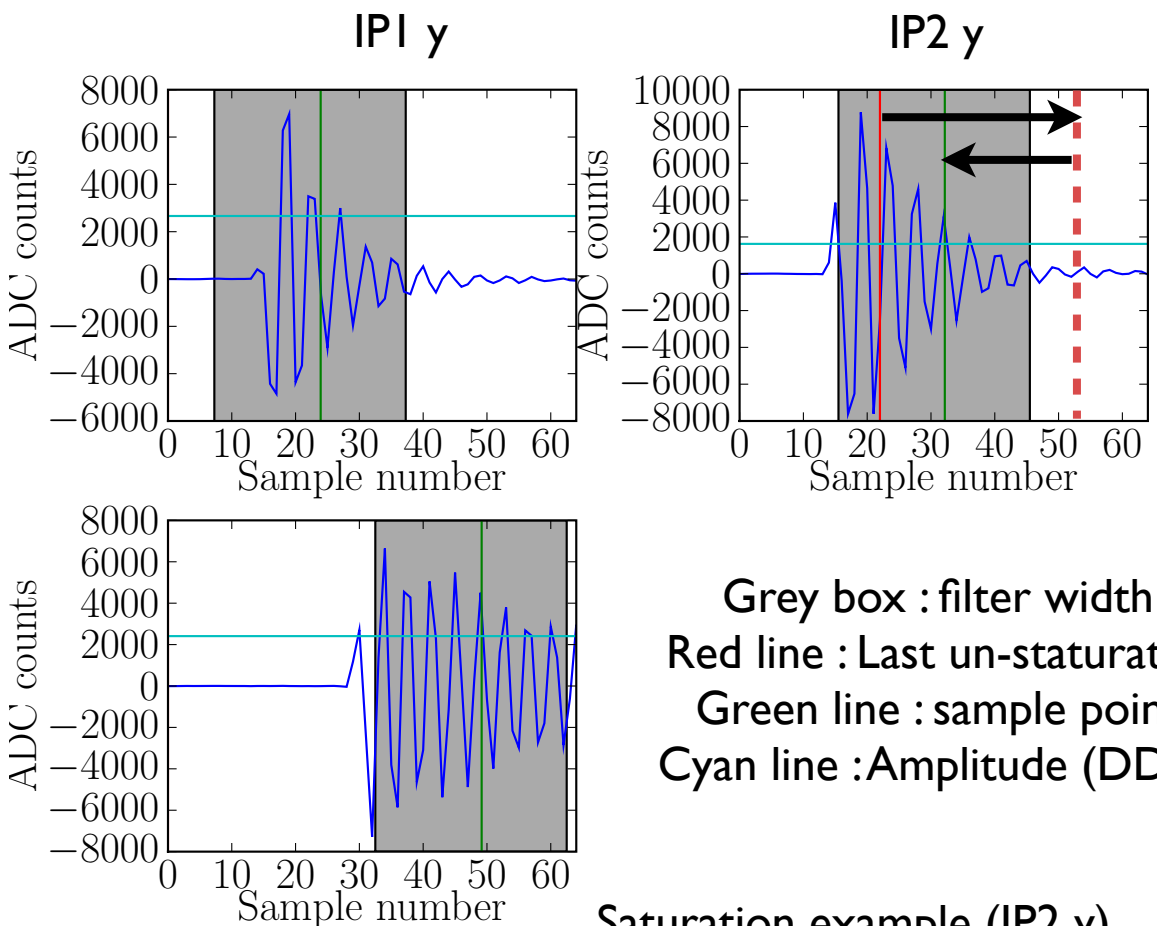


- Honda-san installed
  - 2 BPM, IPBPM block
- T. Smith installed
  - Mixdown electronics
  - 5.7 GHz source for x
- New SLAC 16 bit, 120 MHz digiziters
  - Excellent linearity
  - Low noise

IPBPM waveform processing

Boogert/Lyapin/Kim/Cullinan

- Filter width of 0.03, so 33 samples
- IPBPM decay time ~10 samples
- Increase filter to 0.1 and recalibrate
- More important with saturation (see IP2 y)



Reference

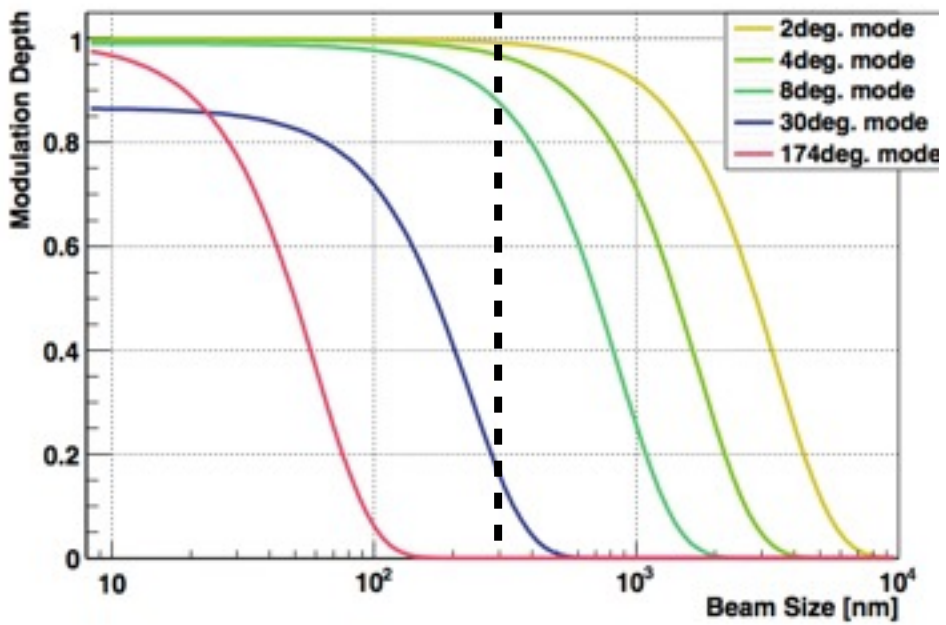
Grey box : filter width
Red line : Last un-staturated
Green line : sample point
Cyan line : Amplitude (DDC)

Saturation example (IP2 y). Nominal sample point (green) disturbed by saturation so sample at new point 1/BW later (red-dashed) extrapolate back (green)

Interaction point beam size

U of Tokyo

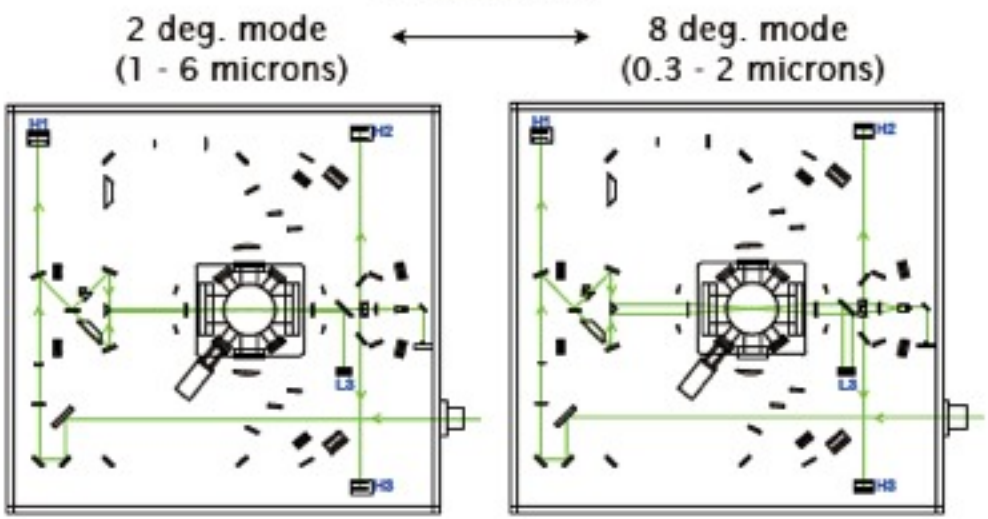
- Laser interference system
  - 5 different laser beam separations
  - Observe modulation of Compton rate
- Problematic
  - Backgrounds in detector
  - Mode switching
  - Laser power/timing ... (ok always an issue)

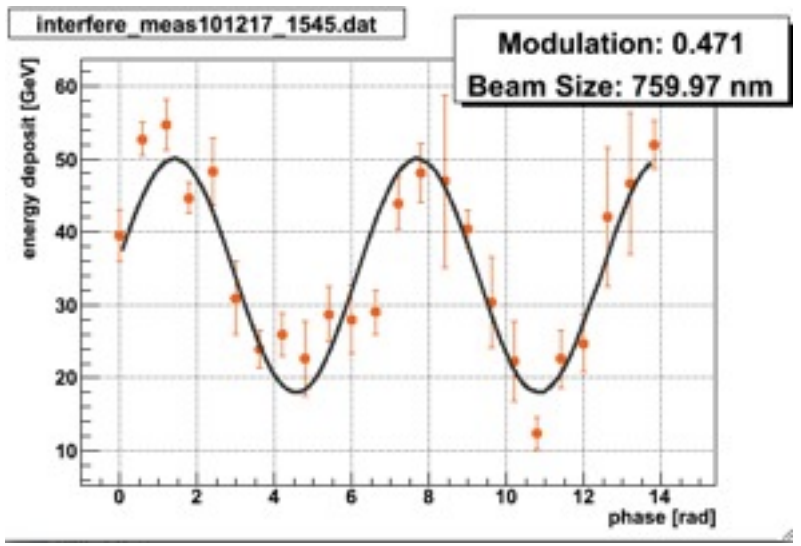


Modulation size	6	8	30
300	0.92	0.88	0.17
250	0.95	0.91	0.27
200	0.96	0.94	0.42

2-8 degree mode

U of Tokyo

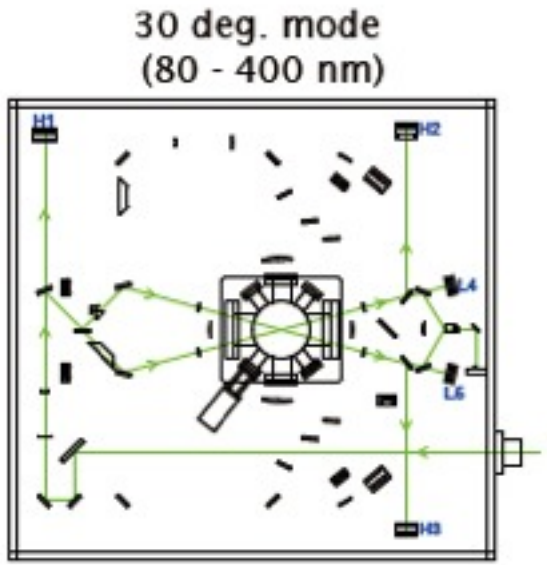


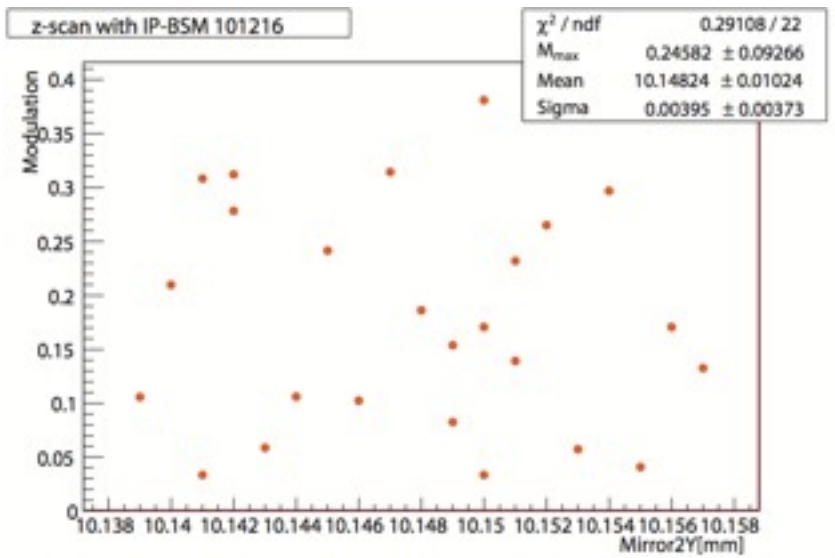


- Modulation clearly observed
- Knob scans conducted
- Optimise beam size down to ~300-400 nm

30 degree mode

U of Tokyo



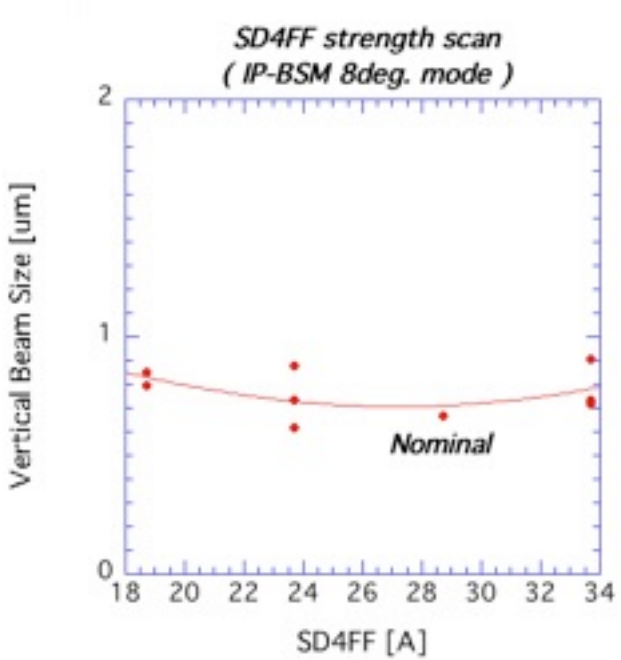


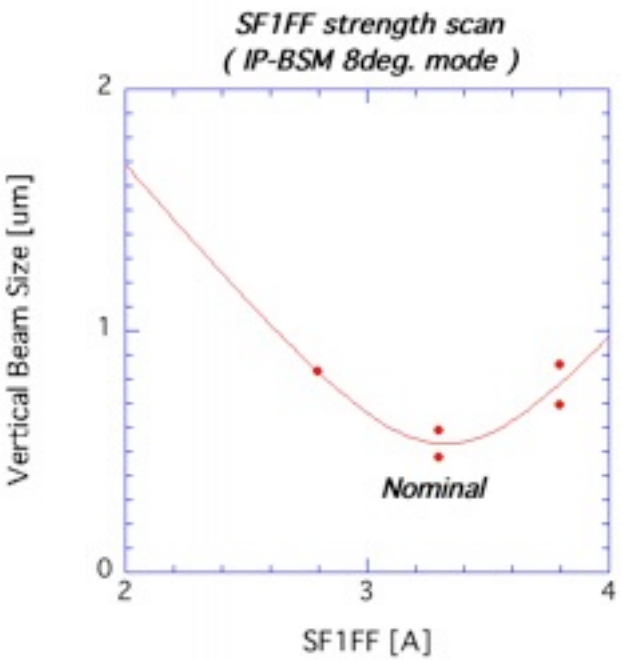
- Signal not observed in 30 degree mode
  - Backgrounds, other drifts
  - Collision geometry
  - Beam size itself

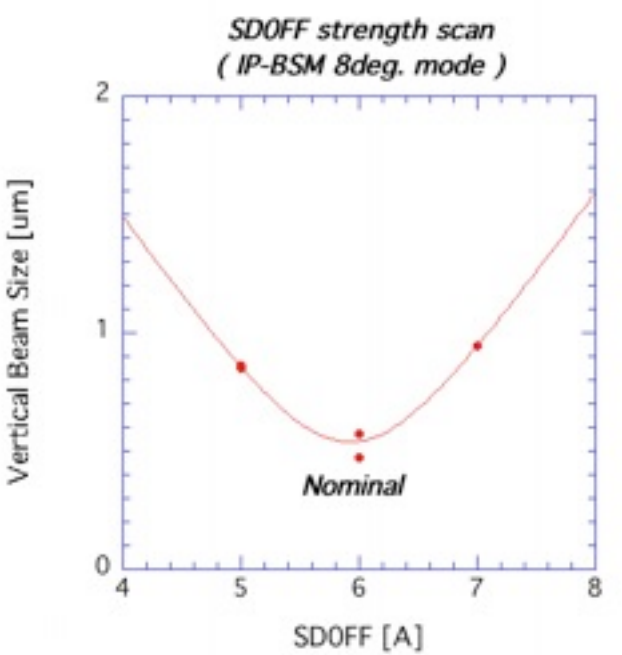
Optics scans with IPBSM

KEK/Okugi

- Sextupole strength scans, to check the chromaticity correction
- SD4FF, SF1FF, SD0FF







Emittance measurement

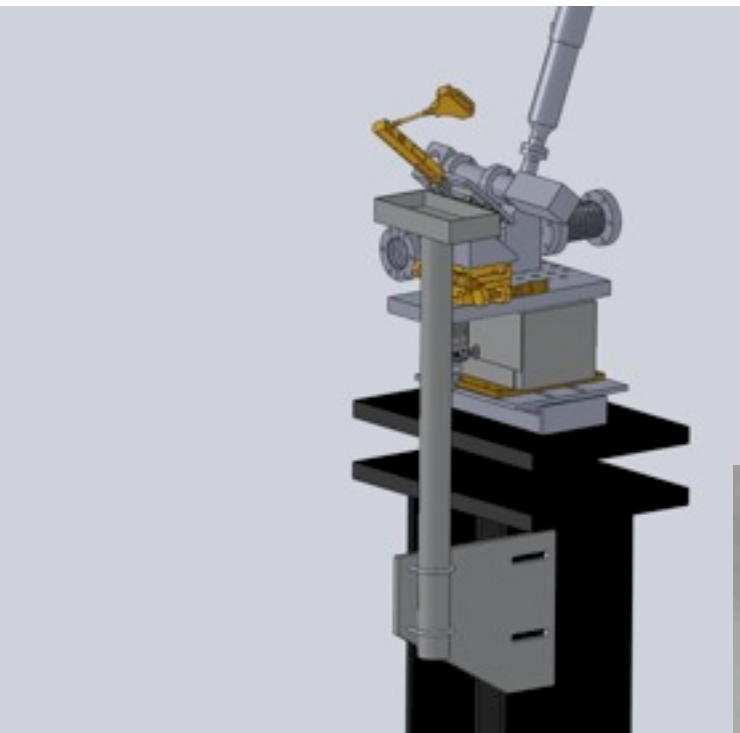
SLAC/IFIC

- Wire scanners
  - From old ATF extraction line
  - Relatively slow and projected measurement (coupling etc)
- Installed new multi OTR system (SLAC/IFIC)
  - Fast measurement
  - Can extract full emittance and coupling in few minutes

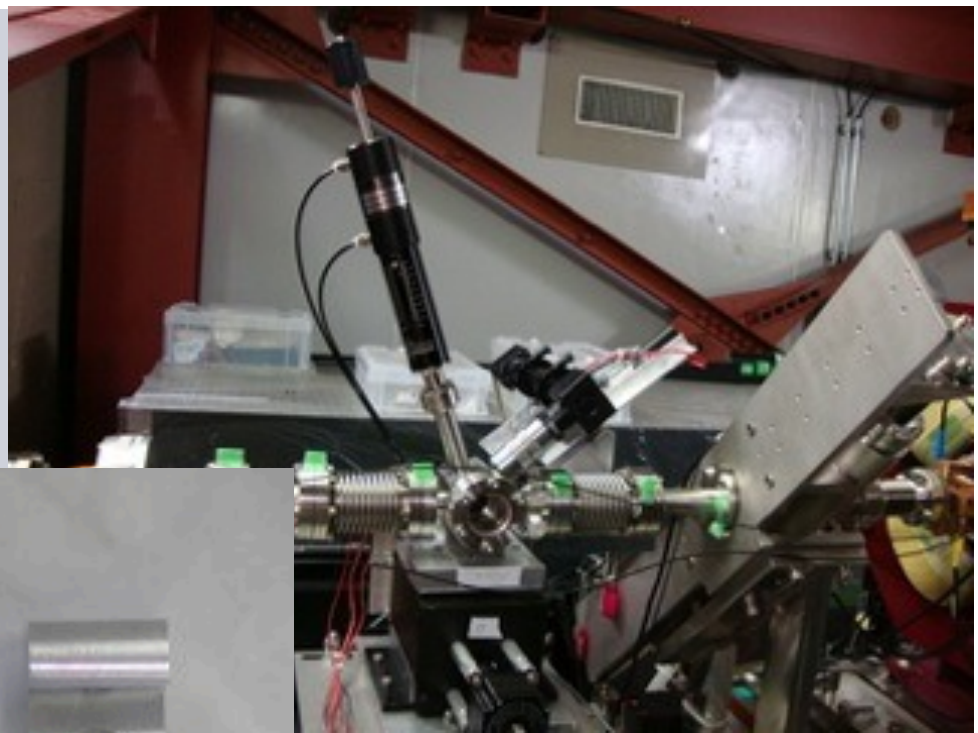
OTR station

SLAC/IFIC

Mechanical design



Installed on beam-line

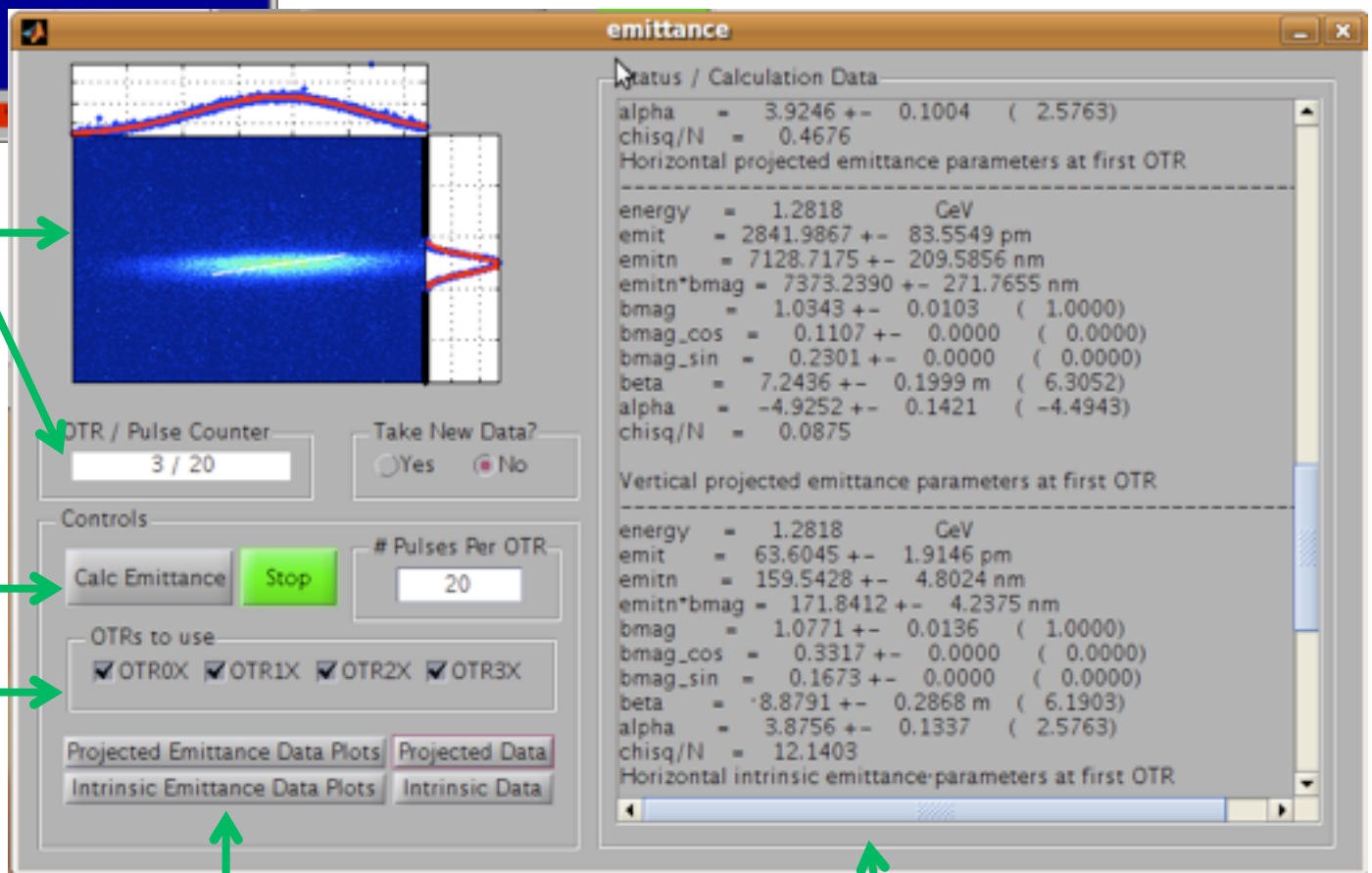


New targets

Beam measurement

SLAC/IFIC

Emittance panel



Current OTR info

Start/stop emittance procedure

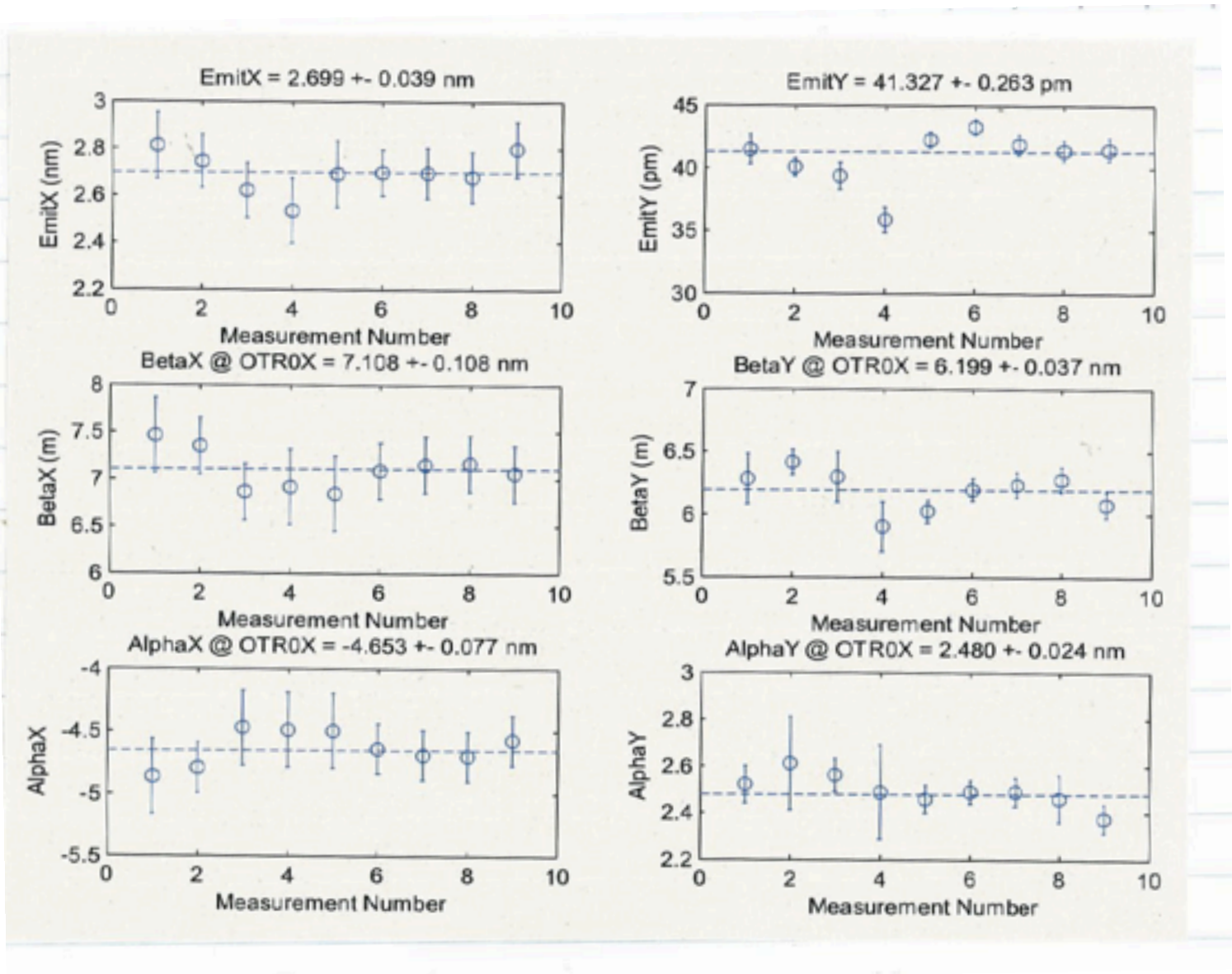
Number of OTR to be used

Data analysis and plots

Calculation data

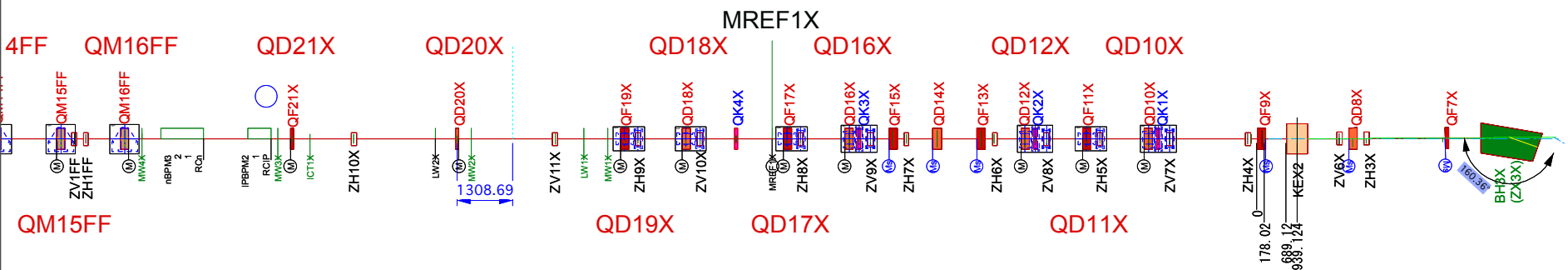
Emittance measurement stability

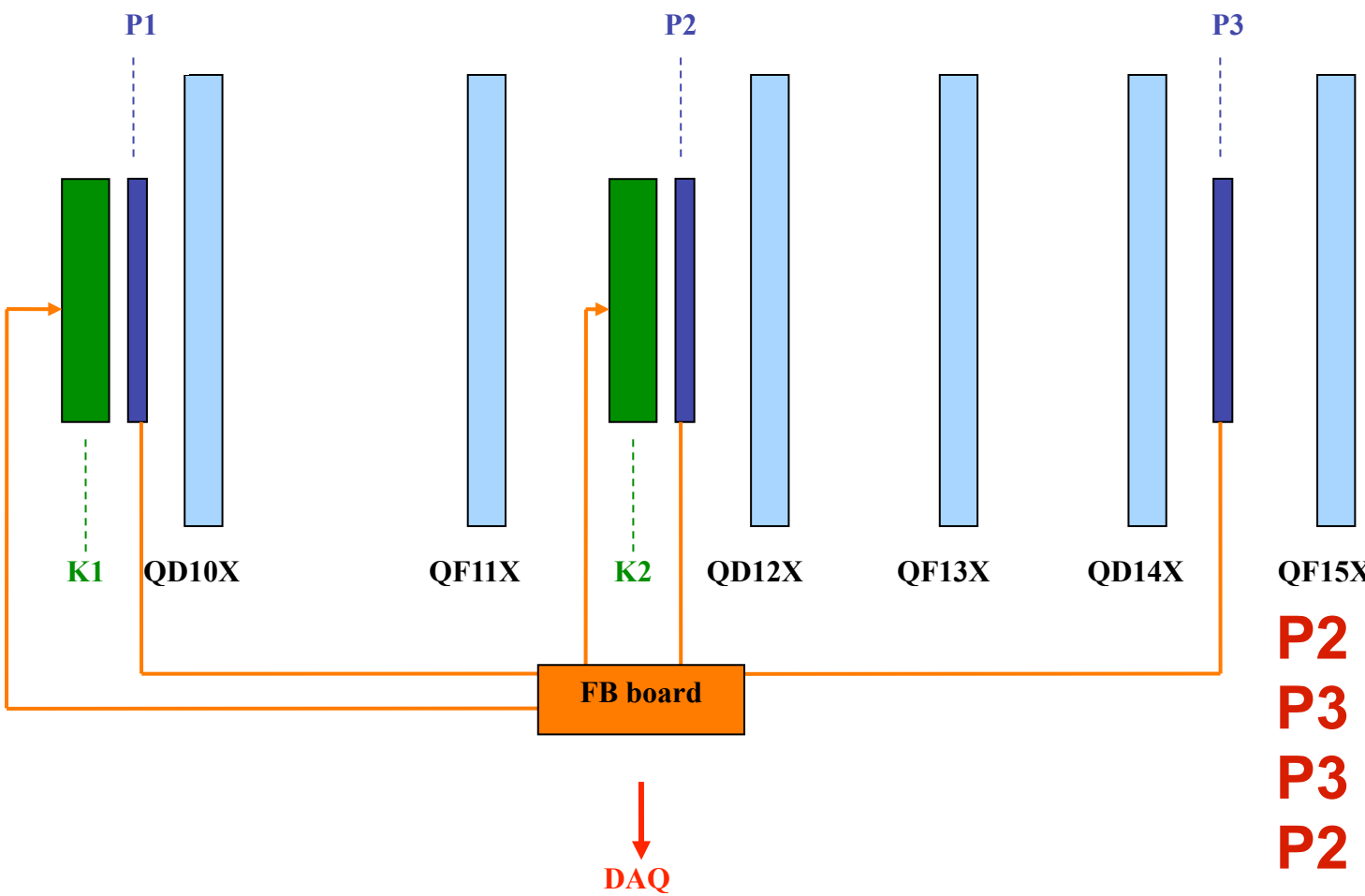
G. White



FONT

Oxford JAI





P1,2,3 SL BPMs
K1,2 SL kickers

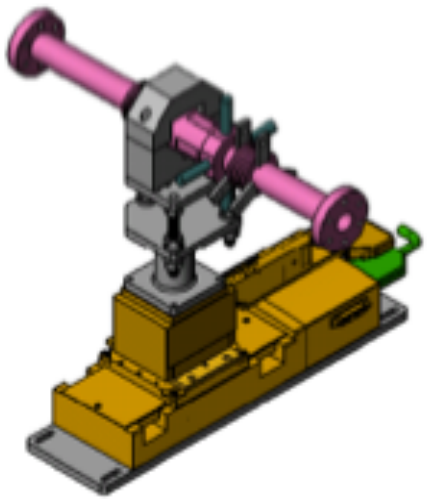
To dump →

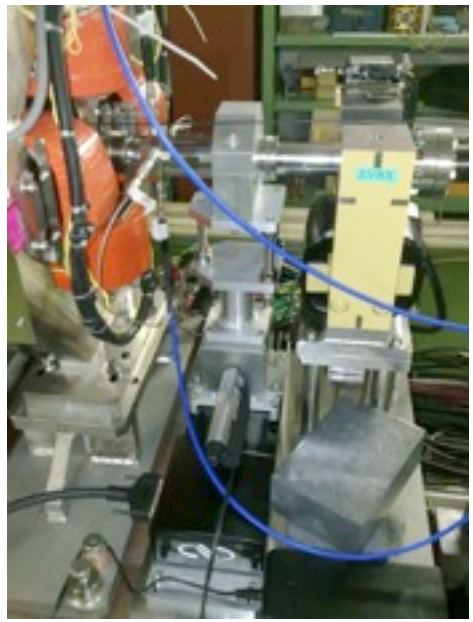
P2 → K1 ('position')
P3 → K2 ('angle')
P3 → K1
P2 → K2

FONT summary

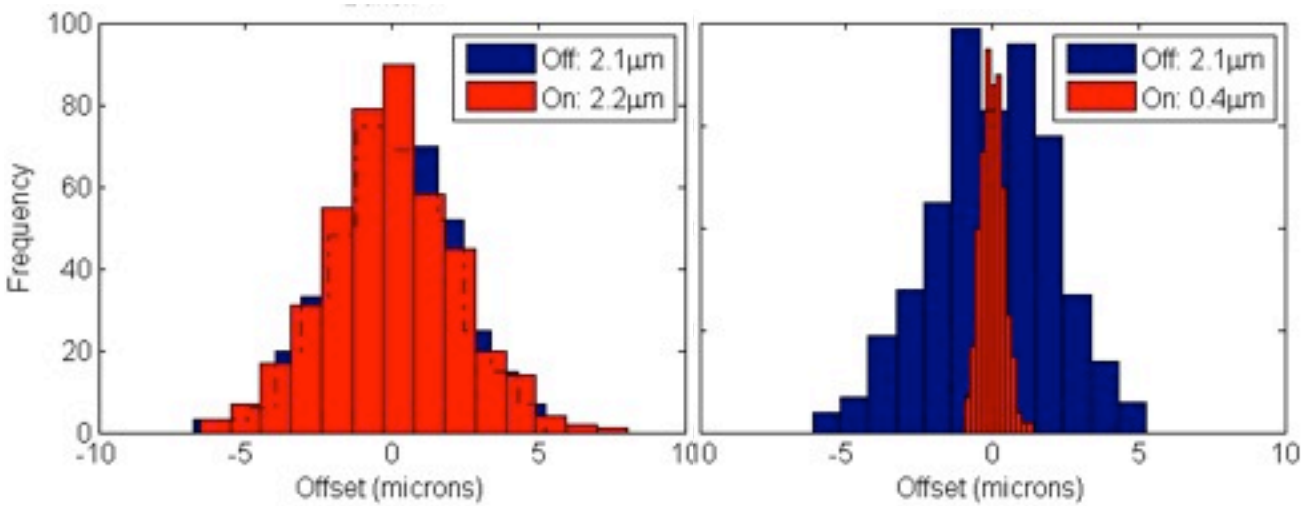
Oxford JAI

- Improvements to FONT5 board
- Latency 44 ns (irreducible)
- Electronics 87 ns
- BPM mover calibration
- Investigation of bunch to bunch correlations





Bunch 1 **Bunch 2**



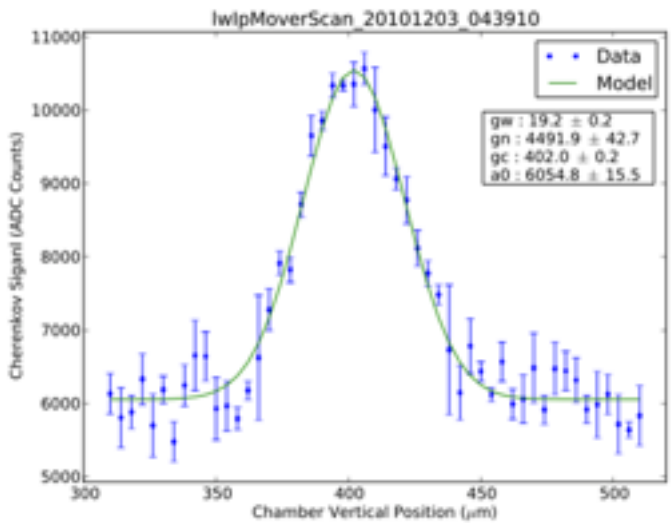
2.1 um → **0.4 um**

Laser-wire

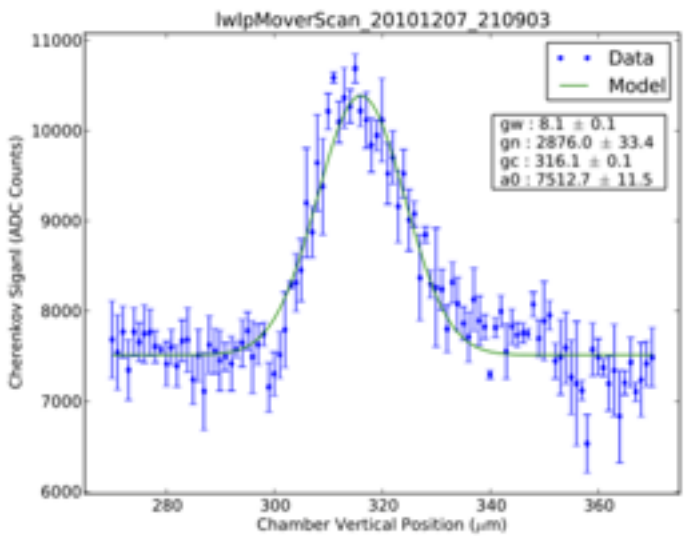
John Adams (RHUL/Oxford)

- Difficult commissioning due to ~25m Compton transport
- Fixed using alignment laser and 2 wire scanners in drift around LWIP
- Best results thus far ~8 micron
- Previously ~4 micron

$19.2 \pm 0.2 \mu\mathrm{m}$



$8.1 \pm 0.1 \mu\mathrm{m}$



Summary

- Cavity BPM system performing well around 200 (20 dB) and 50 (no attenuators) nm
- Commissioned new OTR system
- Re-commissioned laser-wire system, aim to reach 1 micrometer
- IPBSM used by tuning operators but problems using 30 degree mode
- Other diagnostics development proceeding well (not discussed in this talk)
- Difficult times for ATF/ATF2 firstly because of a modulator fire and more importantly the Sendai earthquake.