Recent ATF2 results

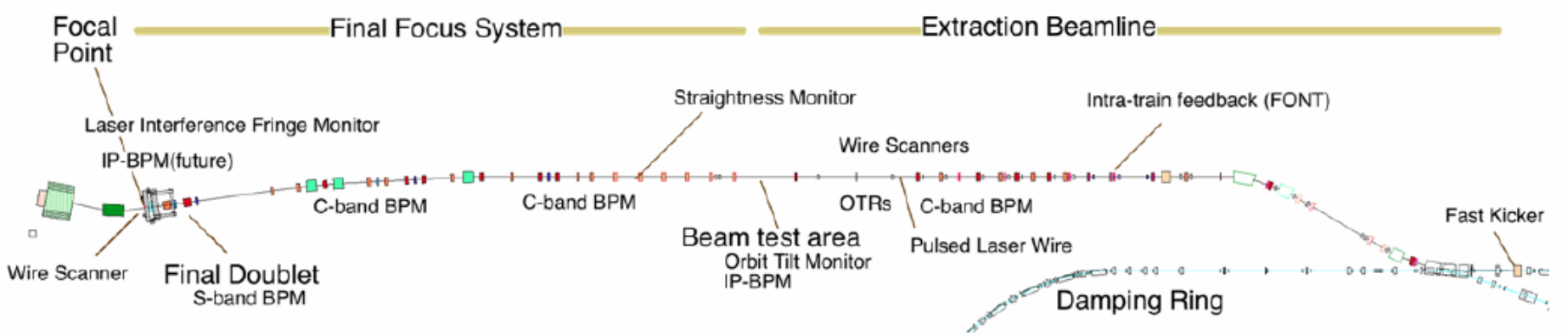
highlights from first dedicated beam tuning week

Philip Bambade

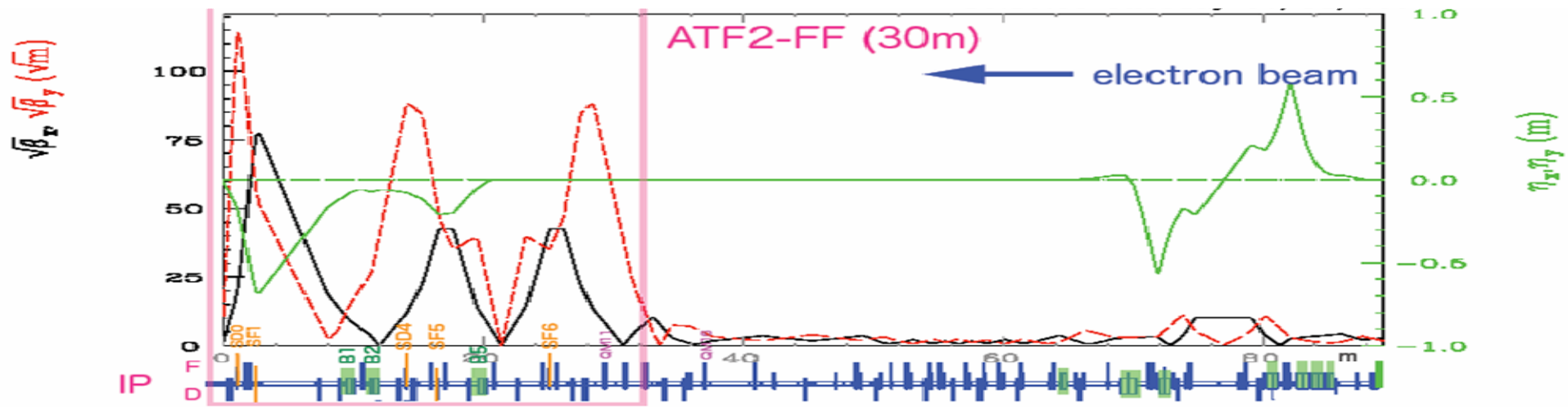
SC FF meeting at LAPP

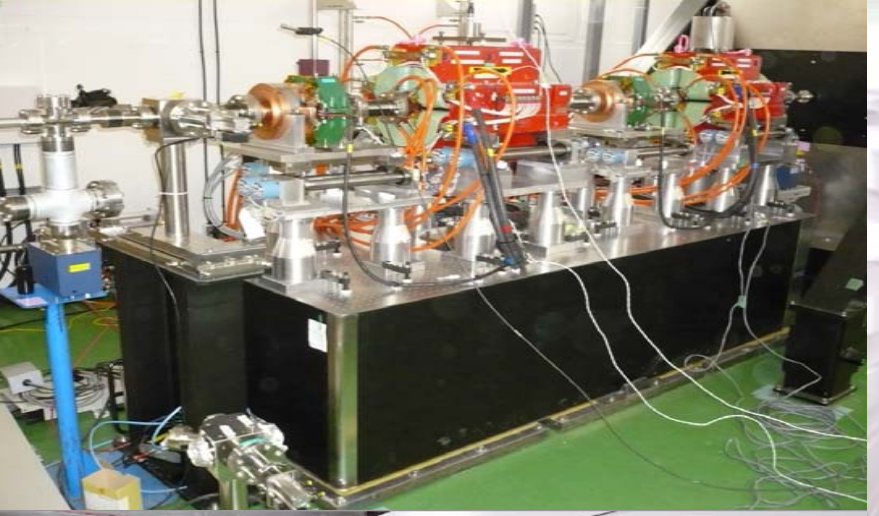
14 June 2010

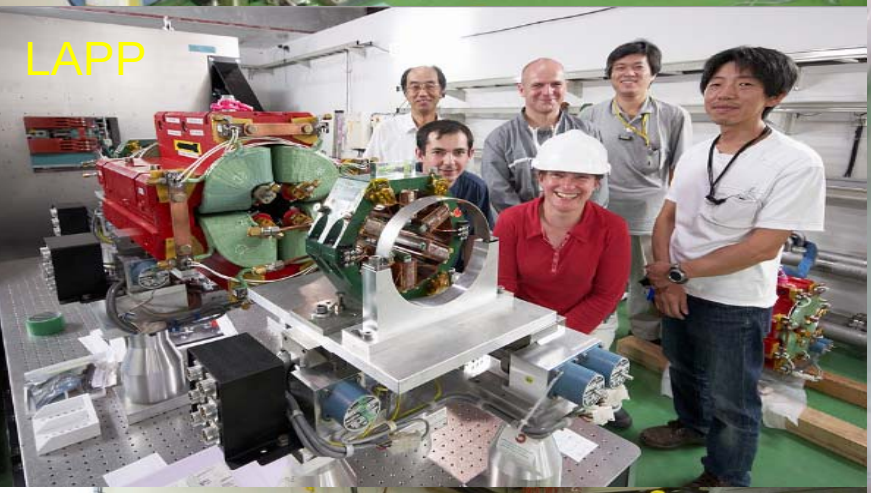
ATF2 operation & instrumentation R&D

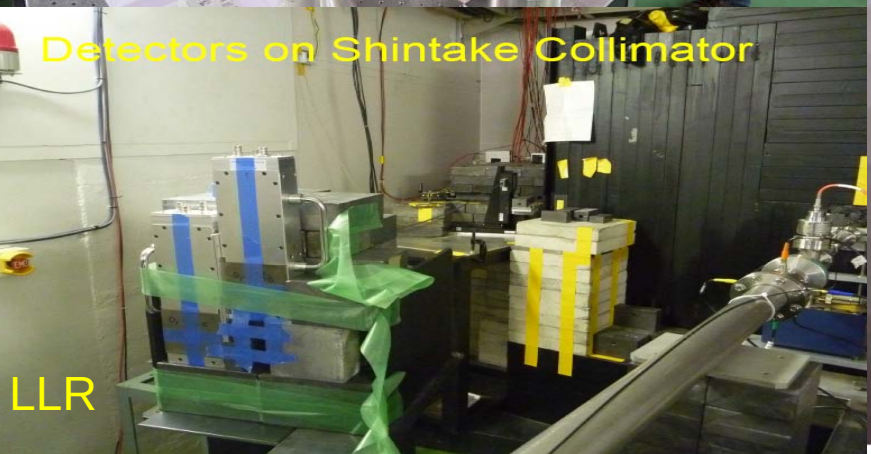


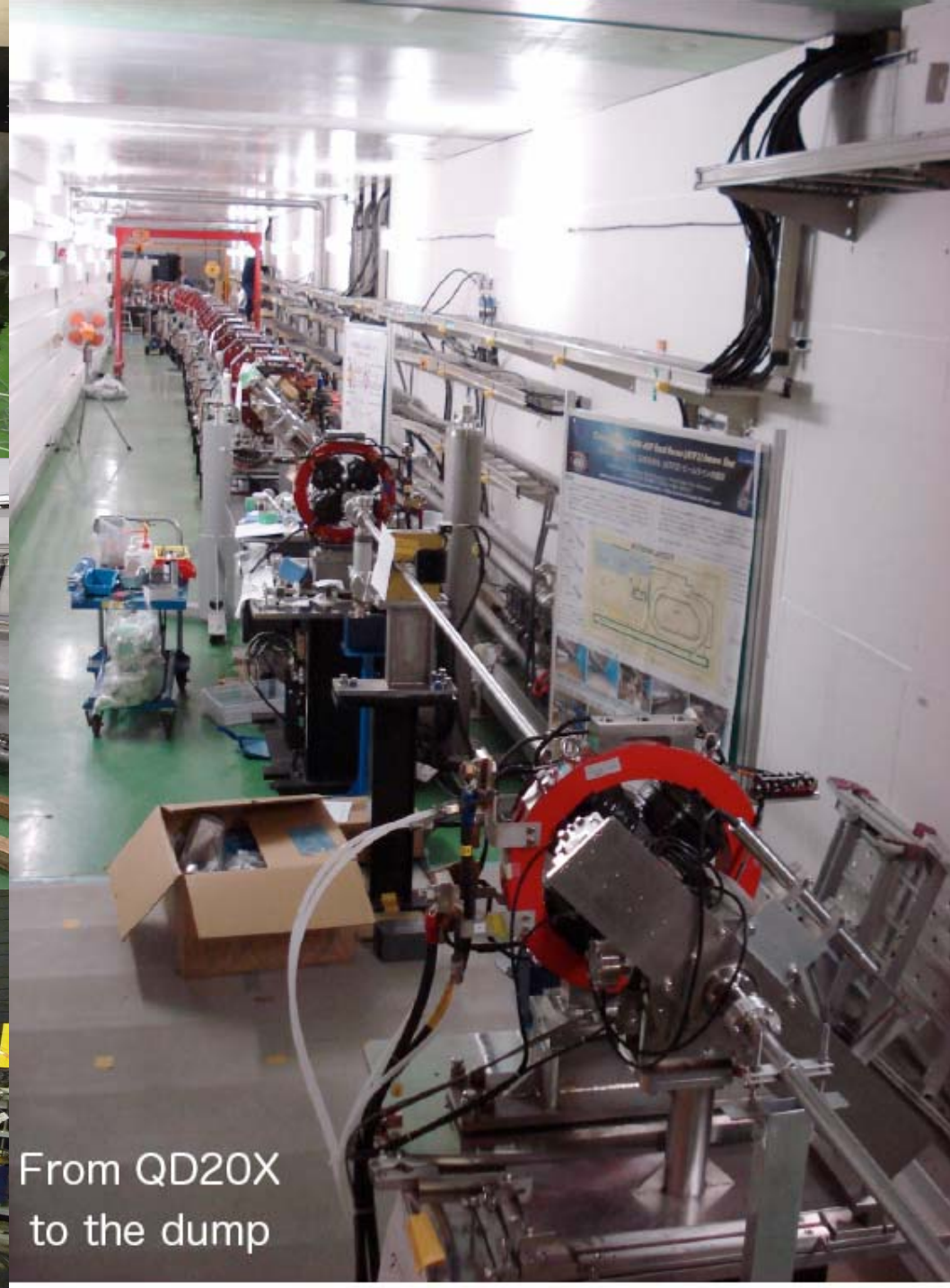
2nd order telescope	Match optics into FF	DR extraction
fine tuning of local errors	*buffer section for input errors*	*setup, stability*





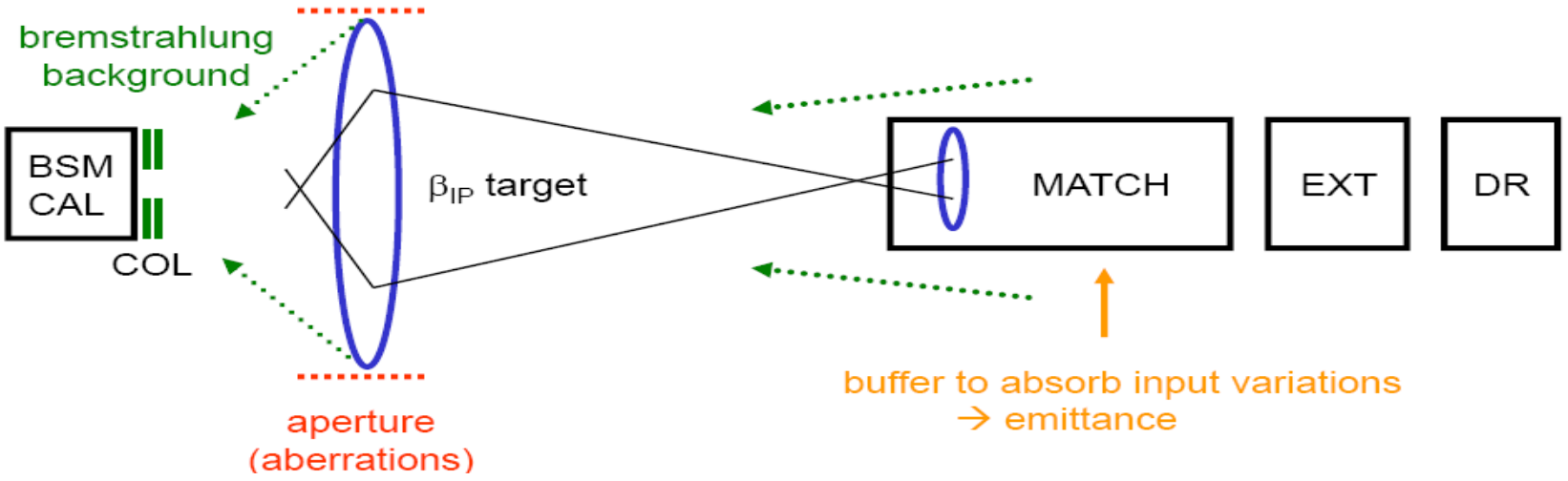

LAPP

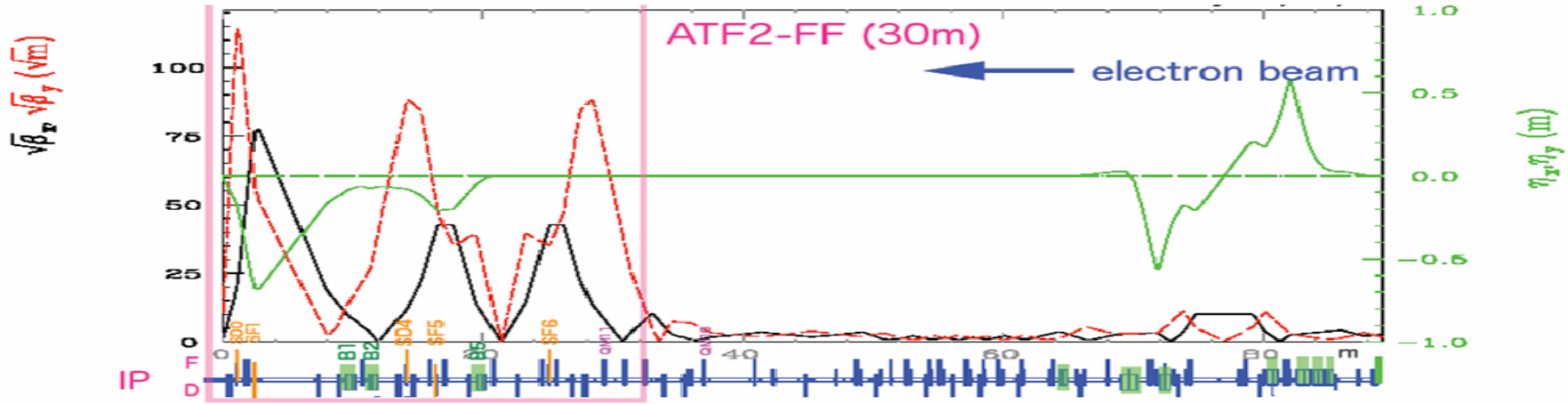

Detectors on Shintake Collimator
LLR


From QD20X
to the dump

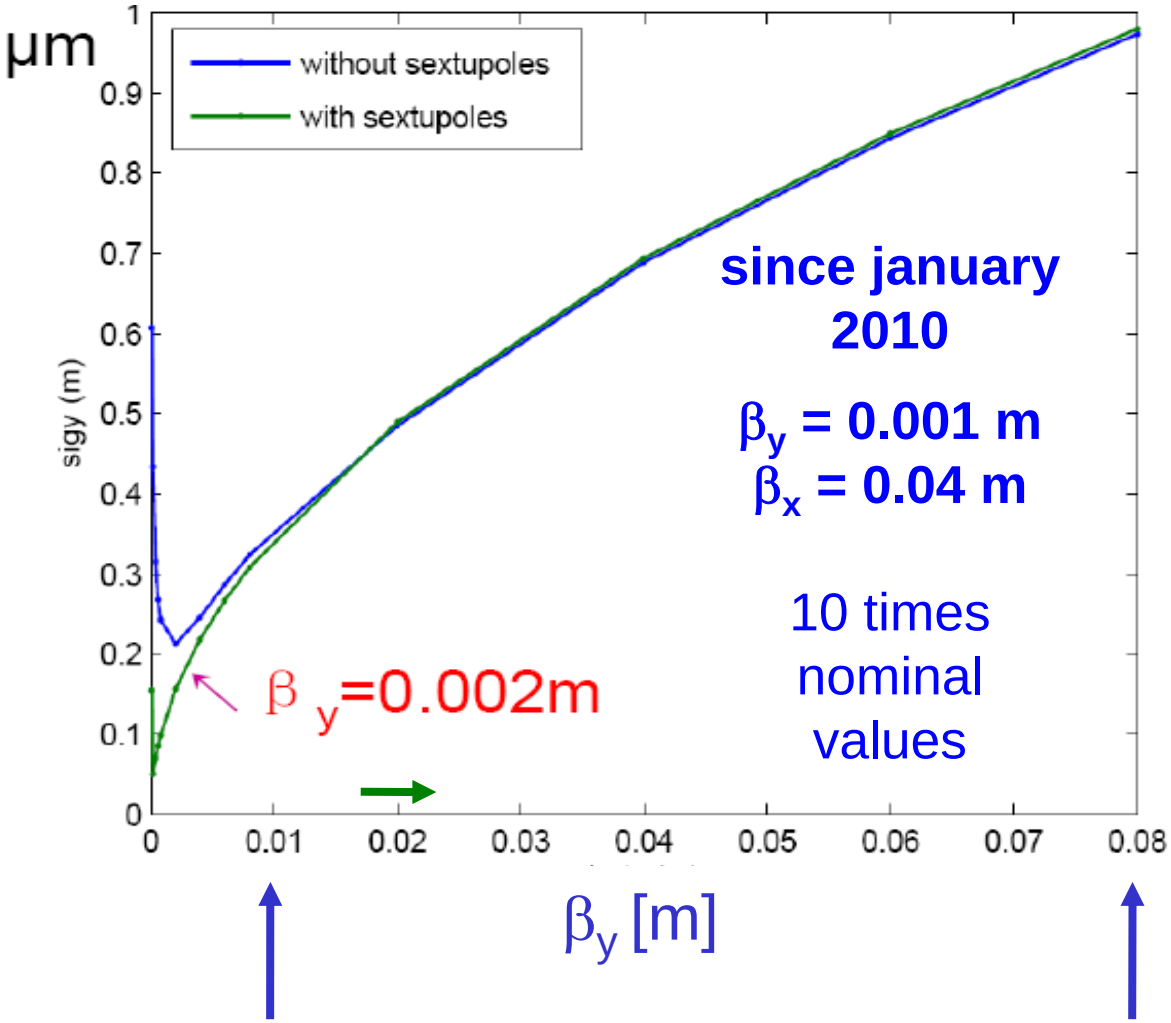
Commissioning → gradual $\beta_{x,y}$* (demagnification) reduction paced by

beam tuning | instrumentation (BSM / other) | background study



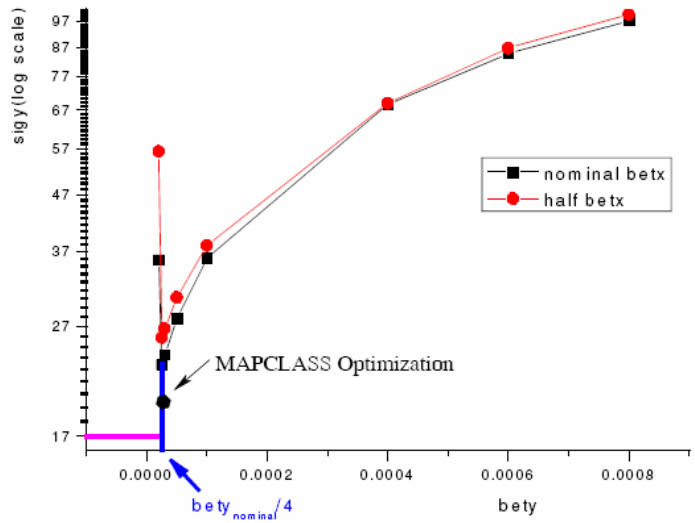


Variable β_{IP} at ATF2



nominal value
β_y = 0.0001 m
β_x = 0.004 m

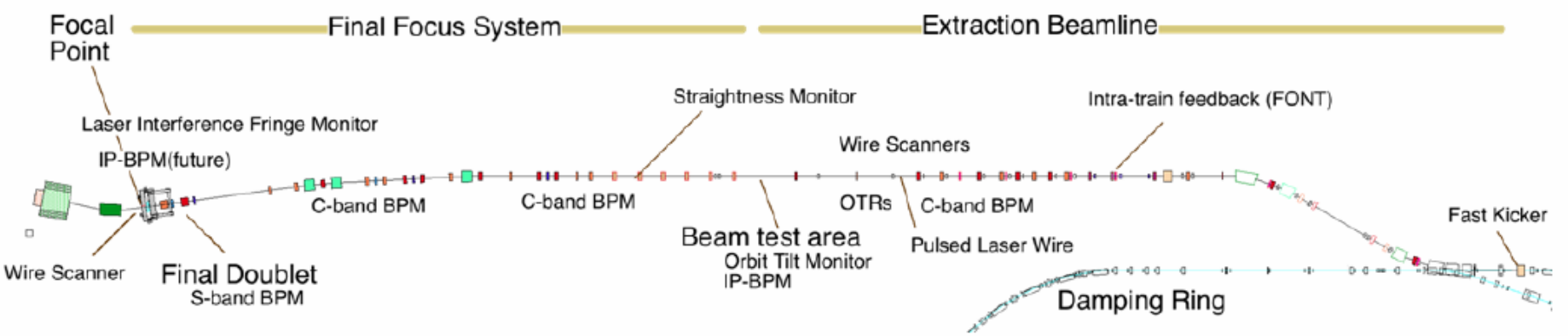
ultra-low β upgrade
factors 2-4



April - December 2009

March 2009

Instrumentation preparation and R&D



- Stripline BPMs, C and S band cavity BPMs, BSM “Shintake”, wire-scanners
  - ➔ in most part commissioned and operating satisfactorily (few improvements underway)
- IP-cavity BPMs, tilt monitor, OTR profile, LW, FONT
  - ➔ actively studied as R&D in preparation for goal 2 (and 1)
- Background monitors: PLIC optical fibre + dedicated instrumentation
  - ➔ simulation effort coupled to measurements needed to assess ultralow β^* feasibility

Commissioning periods

Dec. 2008 → 3 weeks

2009 → 21 weeks (=1+2+4+3+3+1+2+2+3)

Jan. – Jun. 2010 → 14 weeks (=3+2+2+3+2+1+1) **1st cont. week**

Autumn 2010 → 7 weeks (=2+2+3) **2 continuous weeks ?**

Beam time scheduling

→ 50% fraction for ATF2 & 4 days per week operation

Individual RD tasks & common goals

KEK, KNU, Tokyo, Sendai, **SLAC**, IHEP, UK, France, Spain, **CERN**,…

→ # ATF2 educational function

Several PhD & young post-doc researchers in accelerator science

Daily operation meeting in control room

1st ATF2 continuous tuning run May 17-21, 2010

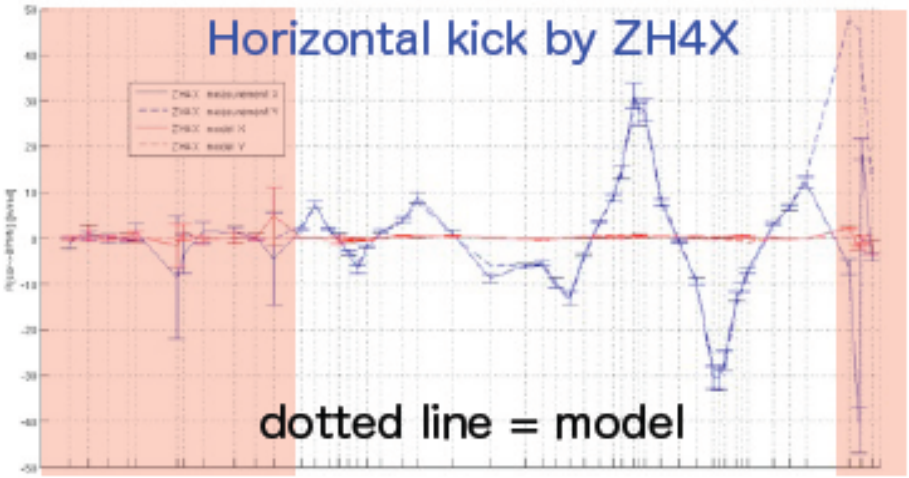
Day	Owl Shift	Day Shift	Swing Shift
MON		[2] **Araki / Miyoshi**	[2,3] **Kubo / Akagi** *Woodley,Edu*
TUE	[3,4] **Hayano / Kim** *White*	[5,6] **Furuta / Bambade** White, Nelson, Edu, *Bambade*	[6,7,8] **Omori / Woodley** Wang, Seryi, *Bolzon*, Jones
WED	[7,8] **Okugi / Shimizu** *White, Edu*, Wang, Jones	[8,9] **Mitsuhashi / White** *Bambade*, Nelson, Kamiya, Yamaguchi	[10,11,(14)] **Terunama / Bolzon** *Woodley*, Seryi, Oroku, Edu
THURS	[12,13,(14)] **Fukuda / Sugiyama** *Woodley*, Wang, Jones, Yamaguchi	[15,16] **Toge / Aryshev** *Okugi*, Neslon, Bambade, Jones, Kamiya, Edu	[15,16] **Naito / Abhay** Seryi, *White*, Bolzon, Oroku, Tauchi
FRI	[15,16] **Kuroda / Kurihara** *Woodley, Edu*, Wang, Kamiya	[15,16] **Sato / Oroku** *Okugi*, White, Nelson, Bambade, Jones, Oroku	[15,16] **Okugi / Yamaguchi** *White*, Bolzon, Seryi, Jones, Yamaguchi

Tuning steps for 1st ATF2 continuous tuning run

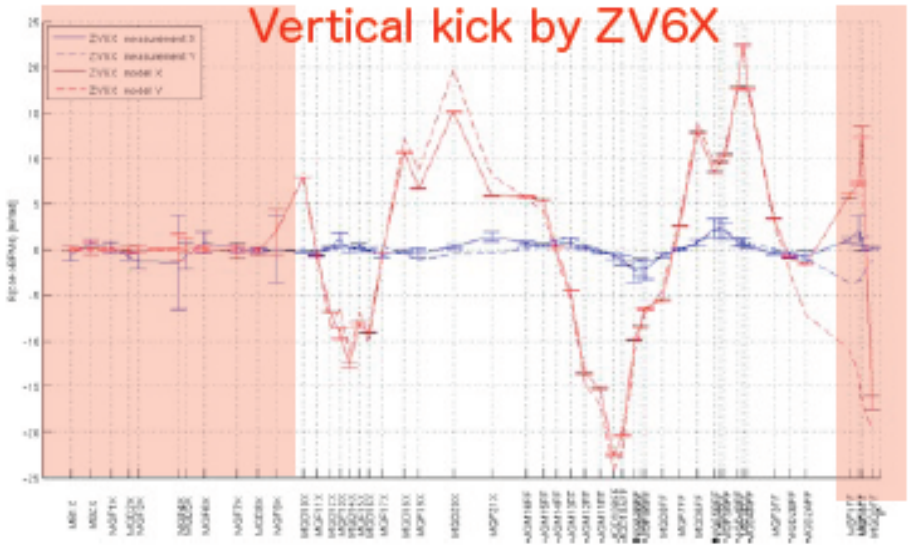
1. **Startup**
2. **DR tuning**
3. **EXT & FFS C-band BPM calibration**
4. **FFS S-band BPM calibration**
5. **Initial EXT & FFS setup**
6. **EXT dispersion measurement and correction (x & y)**
7. **EXT Twiss + emittance calculation at IEX match point (x & y)**
8. **EXT coupling correction**
9. **IPBSM preparation**
10. **Horizontal IP diagnostics**
11. **Horizontal IP re-matching (if required)**
12. **Vertical IP diagnostics**
13. **Vertical re-matching (if required)**
14. **FFS Model diagnostics (if required)**
15. **IP multiknob tuning with IPBSM vertical beam size mode**
    - **IP y waist, dispersion, coupling scans**
    - **IP x waist, dispersion scans**
    - **Higher-order terms with dK / tilts**
16. **IPBSM study**
    - **Study required at changeover points between crossing modes**
    - **2/8 degree mode >~350nm**
    - **100nm ~< 30 degree mode ~< 350nm**

Y. Renier

BPM system performance



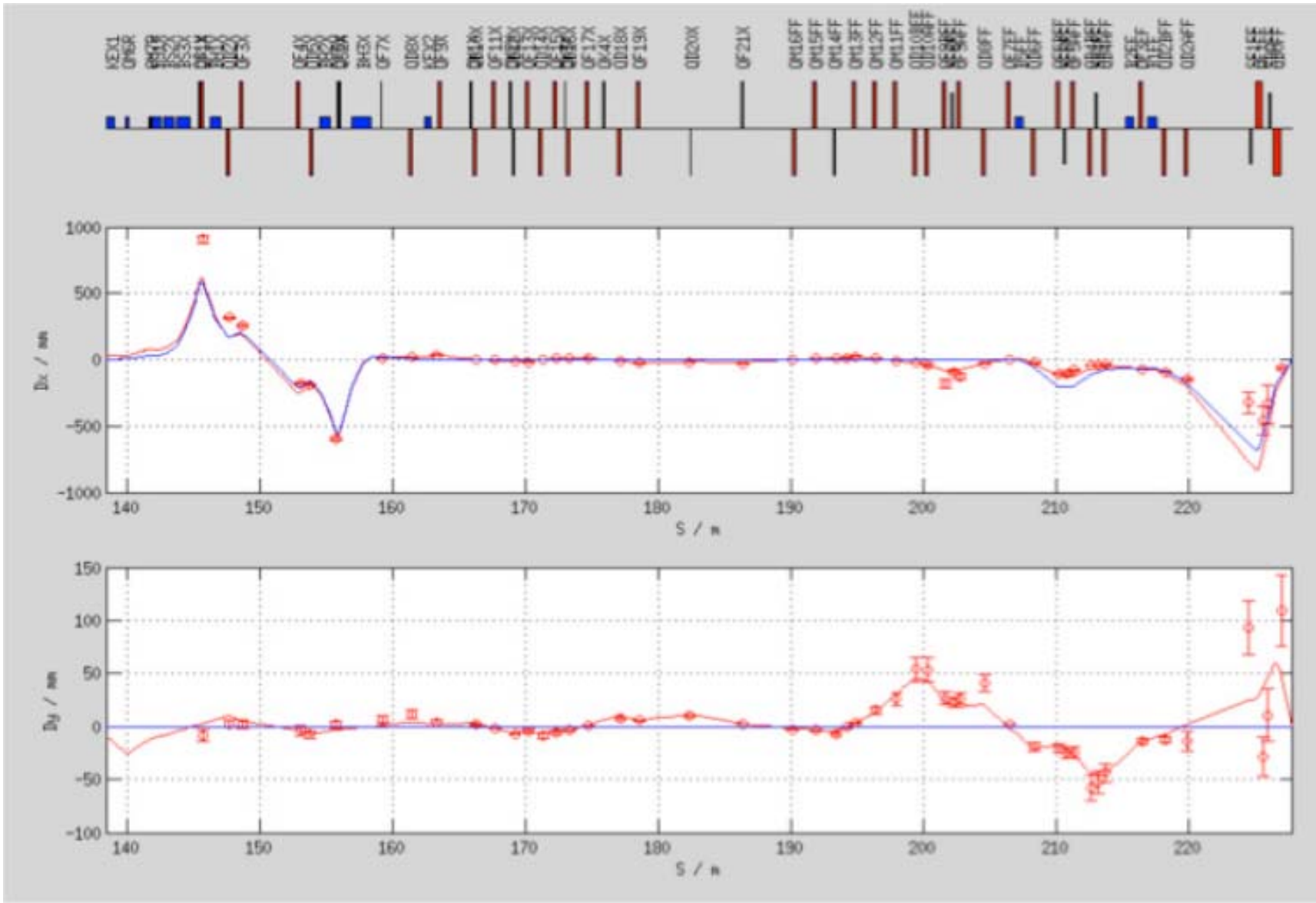
StriplineBPM Cband BPM Sband BPM



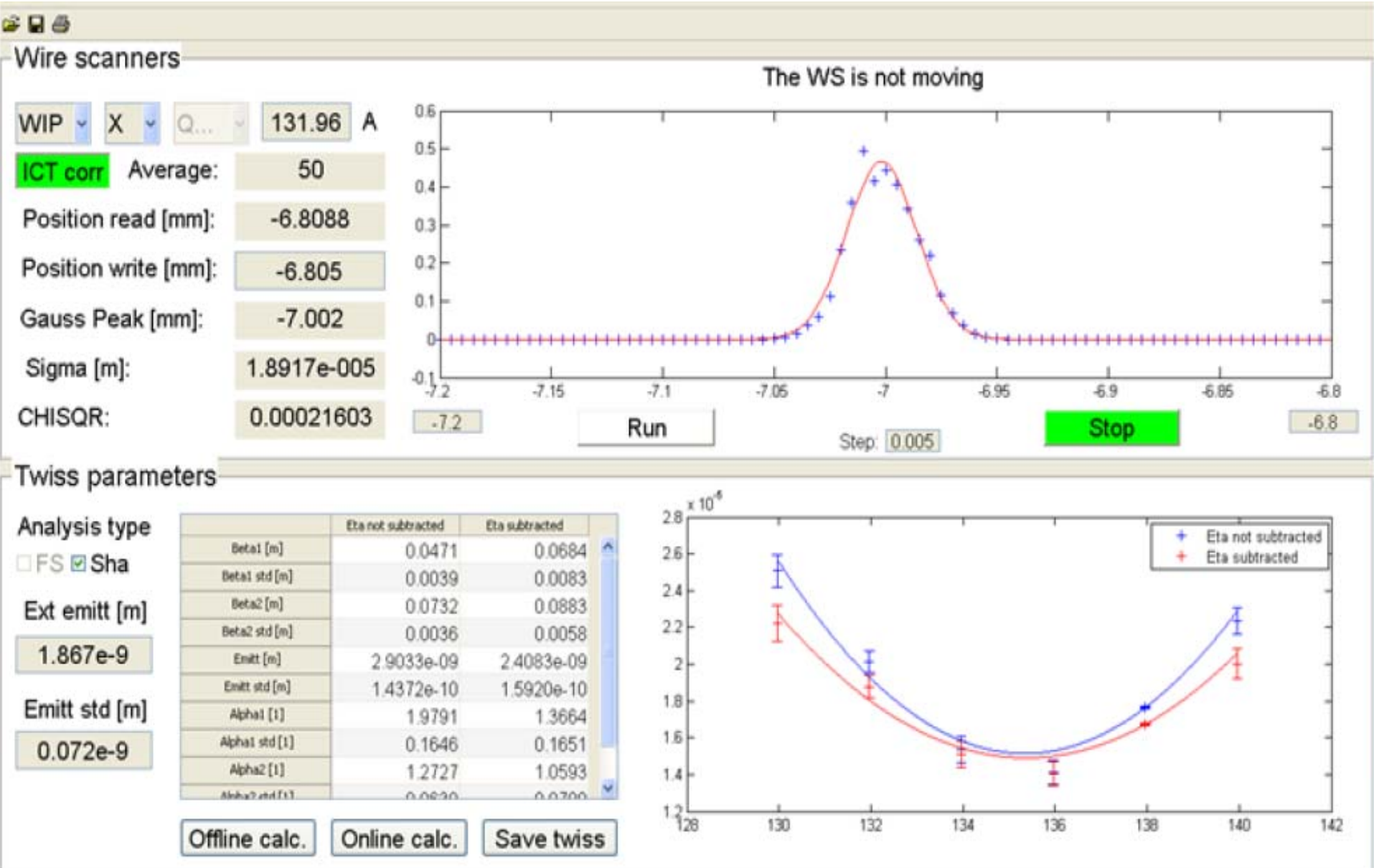
present stability of ~5%
(calibration)

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

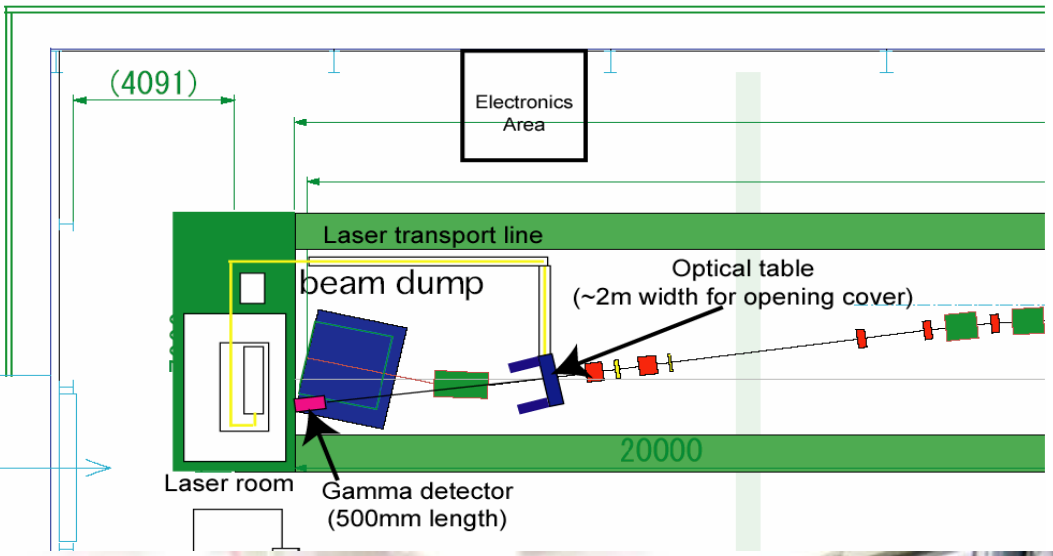
Automated dispersion measurements

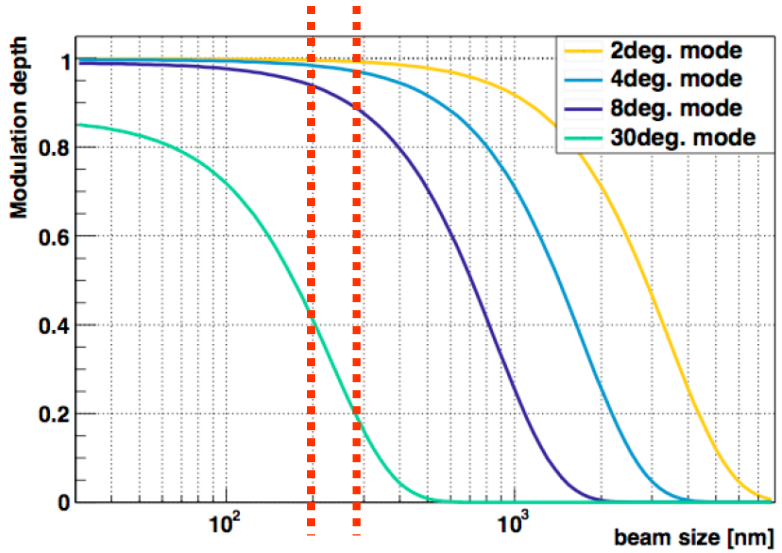


Automated IP waist scans & Twiss measurements

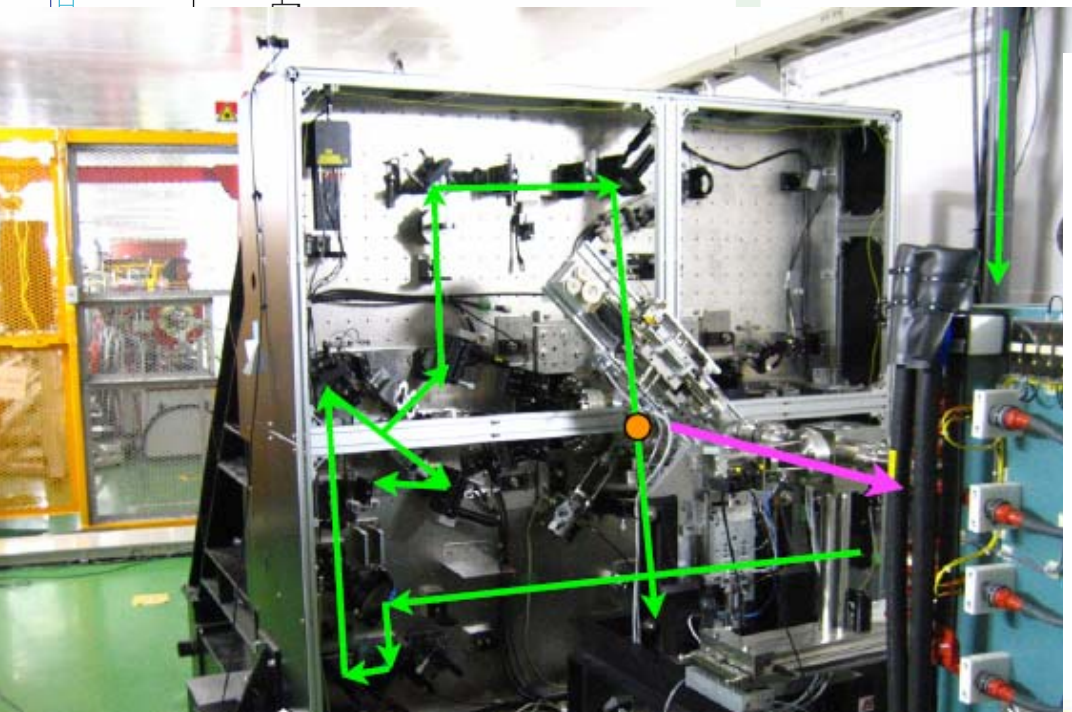


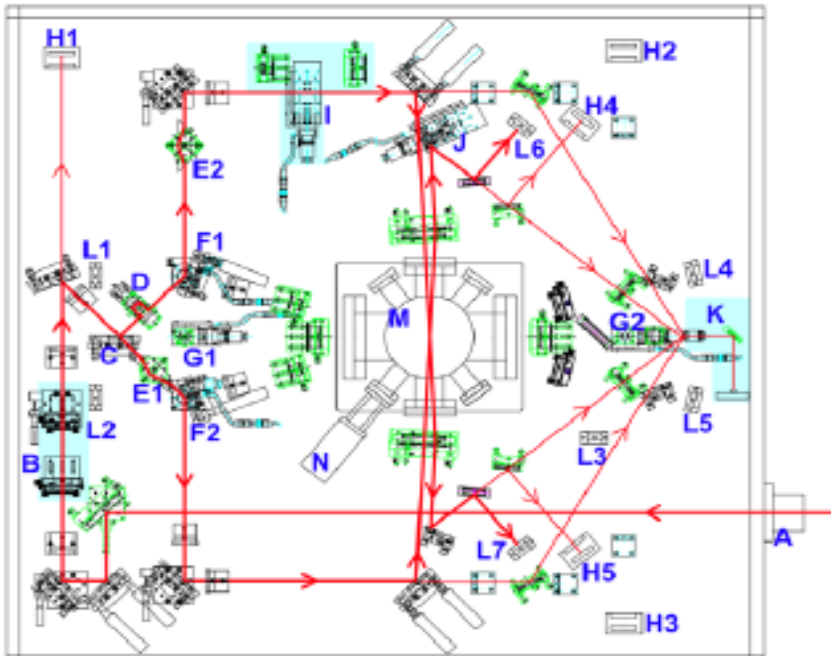
“Shintake” beam size monitor at IP





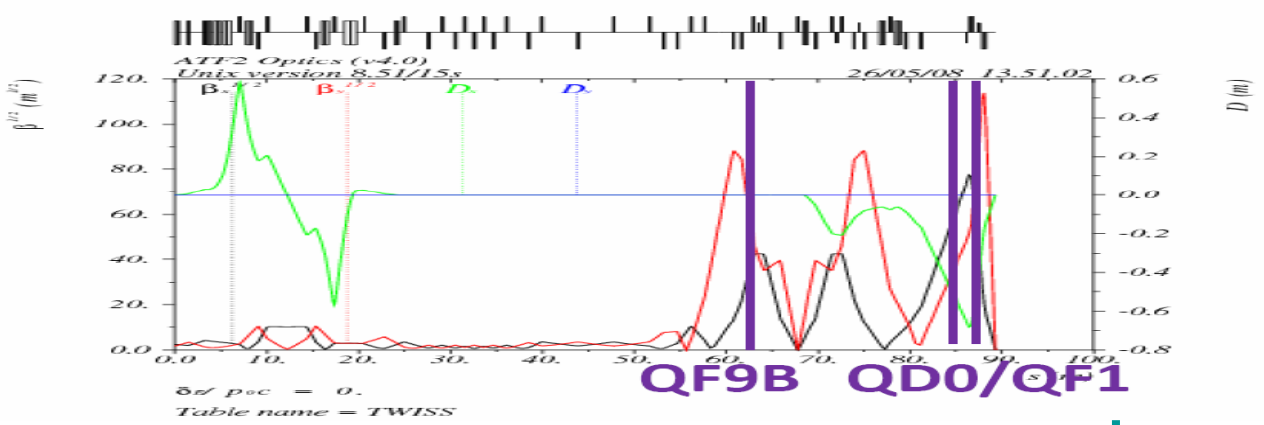
Sensitivity ranges of crossing angles





Multiknobs for <xx'>, <yy'>, <yx'>, <xδ_E> and <yδ_E > control

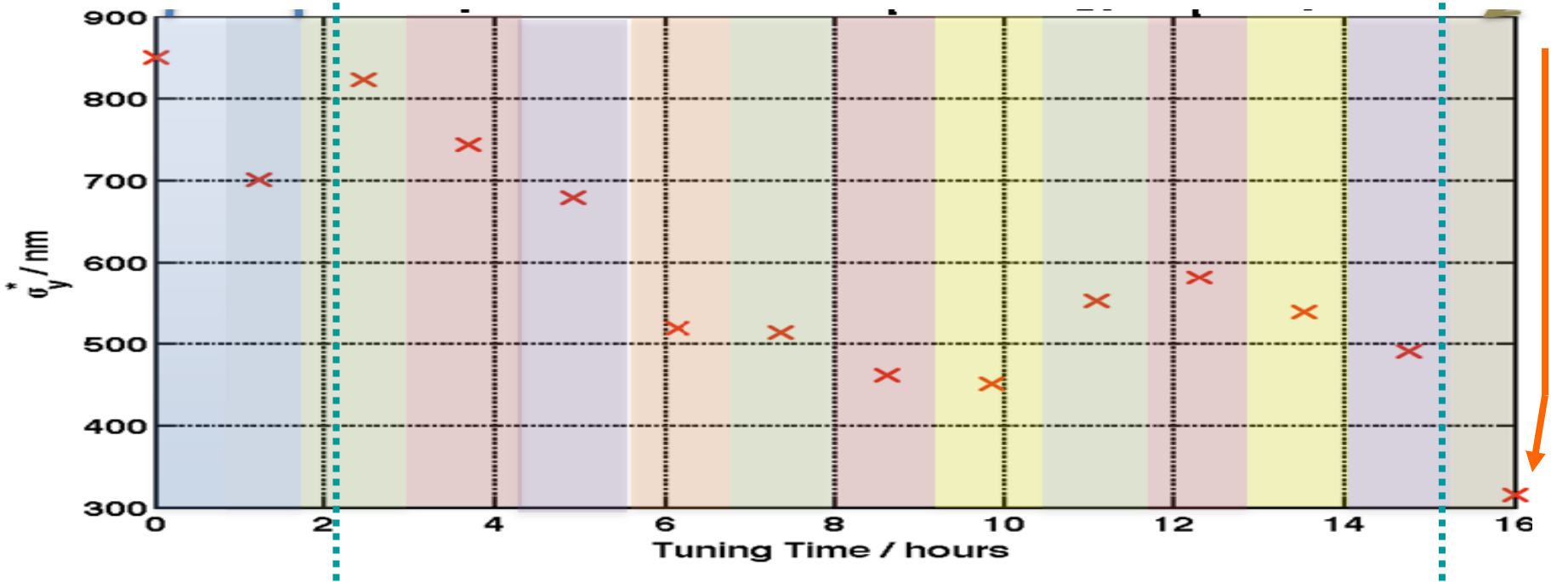
Example with 3 FFS quads
for x&y waists and hor. disp.



Setup with wire-scanners

α η k θ α η <yx'> α η <yx'> k

laser tuning



Best modulation from “Shintake” at IP

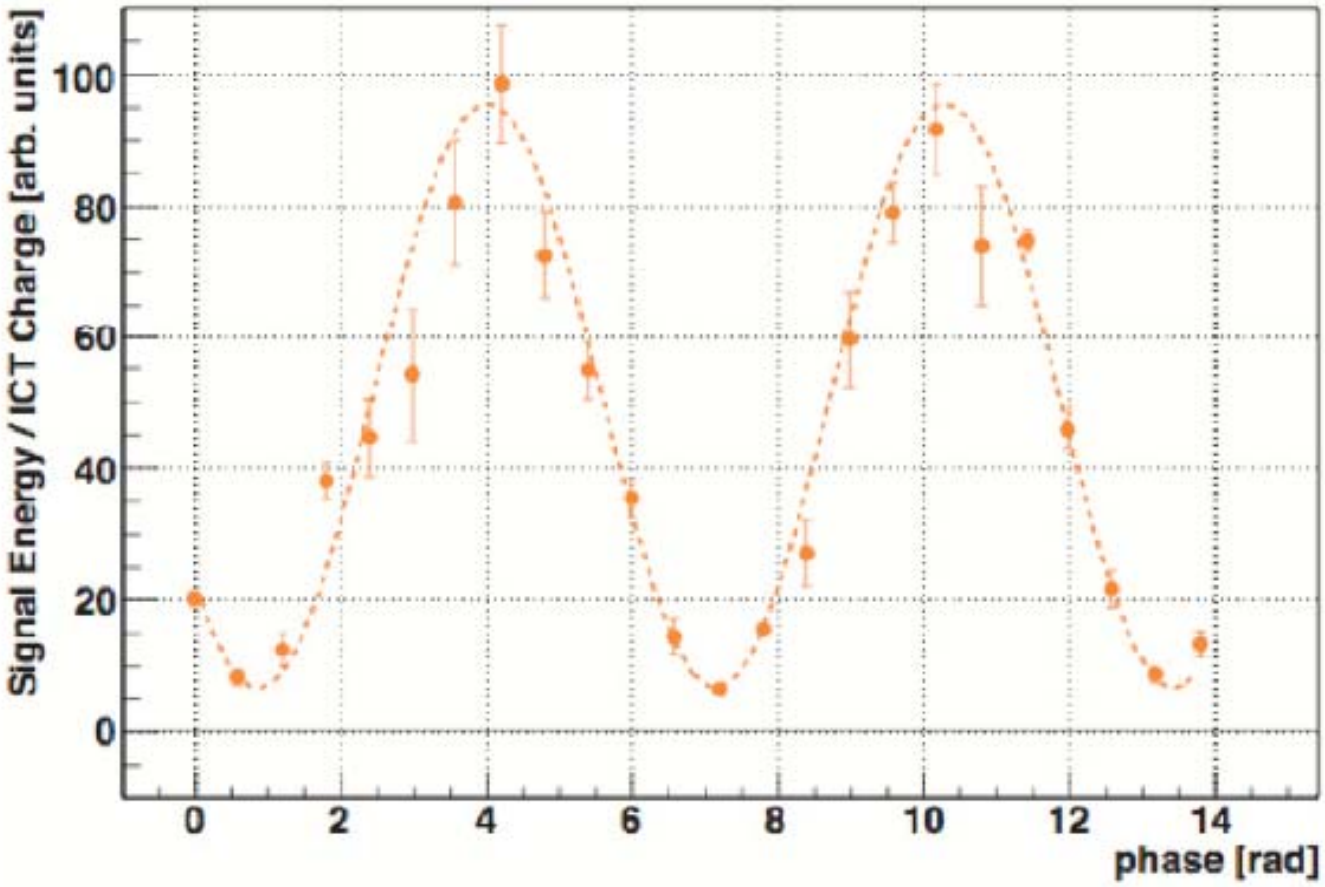


Figure 3: IPBSM Scan of tuned IP vertical beam, 310 +/- 30 (stat.) +/- 40 (syst.) nm

Some conclusions

- Steady progress with instrumentation preparation over past year, especially BPMs (striplines and cavities), BSM and several other R&D
- Great progress in 1st ATF2 continuous beam tuning run in May
→ Plan 2 such dedicated weeks during November and December
- 300 nm vertical spot (target ~ 100 nm)

and prospects & issues

- Final doublet mounting & alignment precision ➔ issue of field quality ?
→ re-measure + assessment…
- Precision analyses of beta. osc. propagation to reconstruct R and T mat.
→ check sextupole correctness, any abnormal higher order fields and transfer matrices between sextupoles
- Systematic monitor IP size versus beam fluctuations & explicit changes
- Review / encourage software tools, especially for automated controls
- Background simulation & measurement to assess lower β^* feasibility