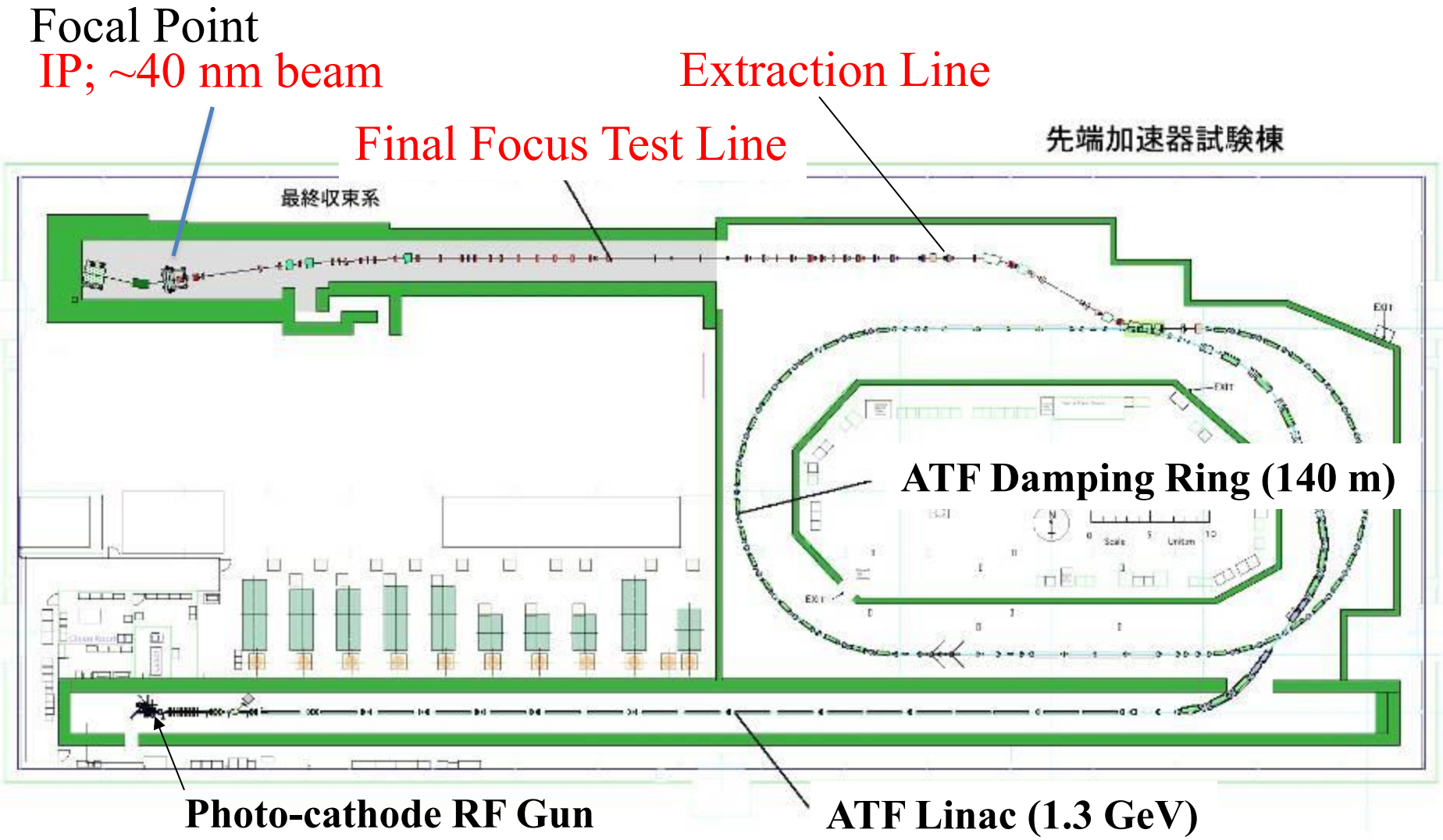
Continuous Run in May 2013

2013.05.29 K.Kubo

Accelerator Test Facility (ATF) at KEK



Strategy of the 2 weeks

Achieving (confirming) small beam size at low intensity is the top priority

- Optics 10x1
- Try all knobs

Other important issues to be studied

- Wakefield study
  - Effect of bellows hields.
  - Studies using bellows on mover
- Emittance in extraction line
- More reliable IP beam size measurement

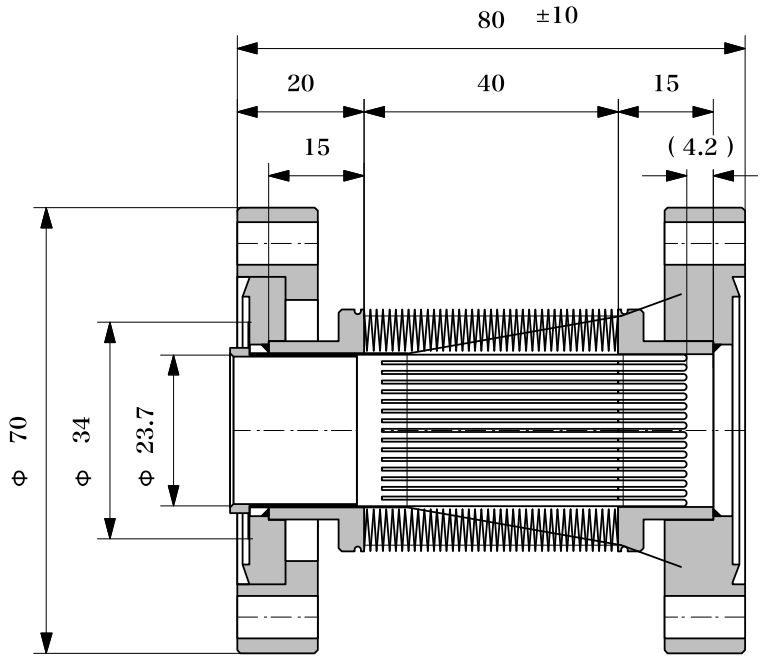
Procedure

Scenario of 2013 May continuous operation
(by T. Okugi in meeting 2013 May 10)
1) DR tuning and optimize the frequency.
- tuned on the DR orbit FB??
2) EXT tuning
- orbit, dispersion and coupling tuning.
- emittance measurement
(if we can not use OTR3X, we measure the emittance OTR0-2X and MW3X).
- matching to FF.
3) IP beam size measurement with MWIP
- IP horizontal dispersion correction by changing QF1FF.
- IP horizontal waist optimization by changing AX knob.
- IP vertical waist optimization by changing QD0FF.
- BBA of sextupoles and tuned on the sextupoles.
4) Startup the IP-BSM
- Linear knob optimization by 2-8 deg. mode
- Linear knob optimization by 30 deg. mode
- Beam orbit was set and optimize the mover bellows
to be small intensity dependence of IP beam size.
- tuned on the FF orbit FB.
- Linear knob optimization by 30 deg. mode again.
5) IP beam size measurement by IP-BSM 174 deg. mode.
- Fringe tilt & pitch optimization
- Linear and nonlinear knob tuning

Continuous Run, May 13-24

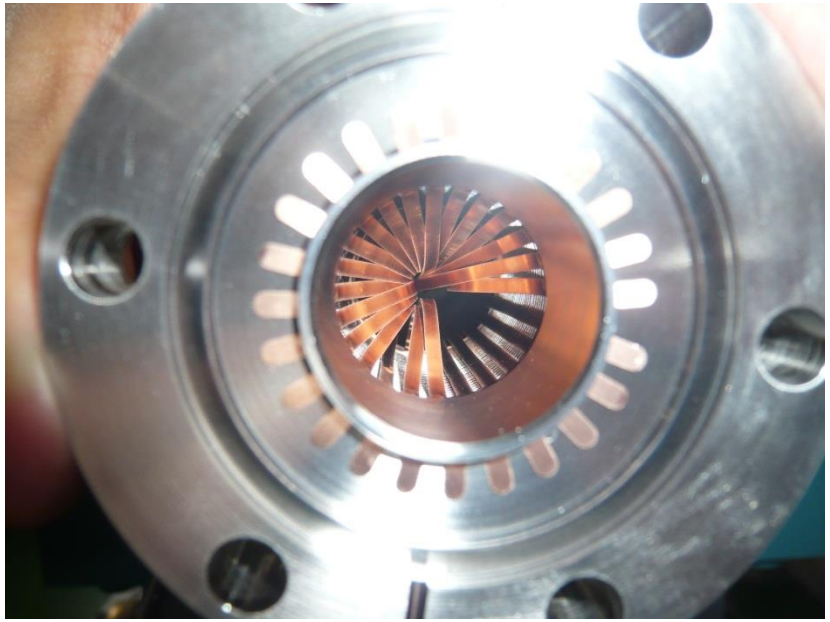
13 (Mon)	Start and tuning
14 (Tue)	Problem with Bellows Shield.
15 (Wed)	Solved Wed. Day / tuning
16 (Thr)	Problem with Linac RF #4
17 (Fri)	Study Cancelled
18 (Sat)	High modulation 30deg -> 174 deg mod.
19 (Sun)	Struggled to squeeze beam.
20 (Mon)	30deg high mod -> knobs 174deg -> lost mod. -> back to 30deg
21 (Tue)	30 deg tuning was quick.
22 (Wed)	~70 nm not difficult, mimimum ~60nm
23 (Thr)	Change optics (betax* and betay*)
24 (Fri)	Intensity dependence, etc.

Bellows shields inserted



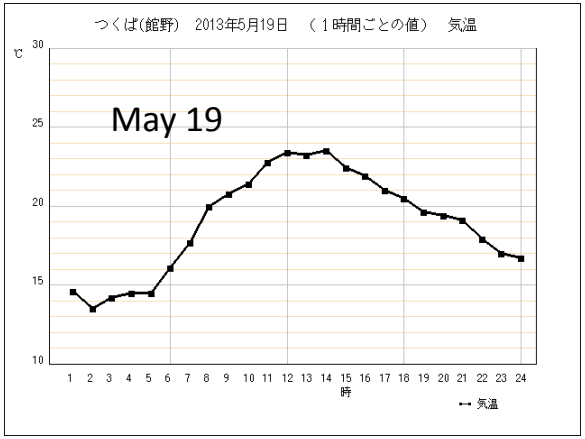
Shields were inserted
for most of bellows in high-beta region in May 2013.

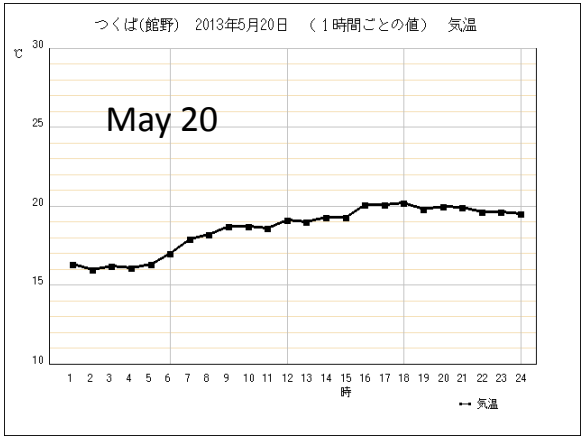
Troubles with bellows shield

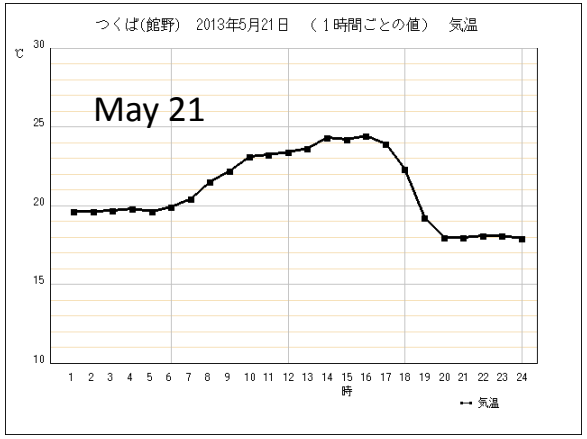


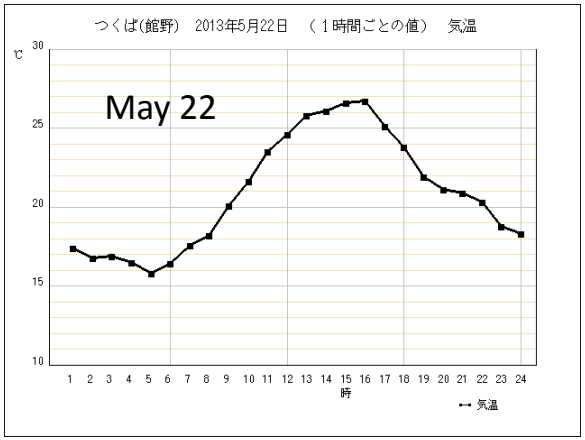
Found and removed Wed., May 15.

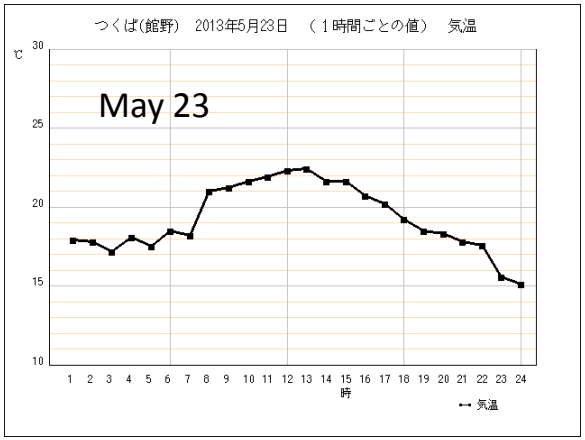
Big daily temperature change in sunny days
Machine was not very stable (DR circumference change)

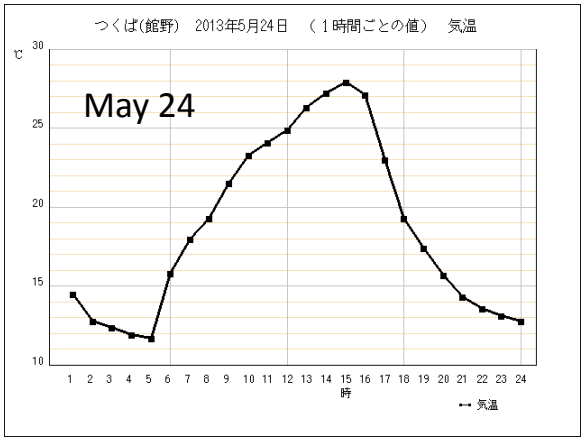












Graphs from Japan Meteorological Agency http://www.data.jma.go.jp/obd/stats/etrn/

Study Shift

Study leaders: Okugi, Kuroda, Kubo, White, Marin, Terunuma, Tauchi
Sub leaders:
A: Young-Im Kim, Janice Nelson
B: Sha Bai, Shan Liu
C: Yves Renier y, Juergen Pfingstner, Andrea Jeremie(1st week)
D:Neven Blaskovic, Jacqueline Yan, Robert Ainsworth

	1:00~9:00	9:00~17:00	17:00~25:00
13 (Mon)			Kubo
14 (Tue)	Kuroda	Tauchi, (Okugi)	Okugi, A
15 (Wed)	White, B	Tauchi, C	Kuroda, D
16 (Thr)	Cancelled	Cancelled	Cancelled
17 (Fri)	Cancelled	Cancelled	Cancelled
18 (Sat)	Cancelled	Kubo, D	Terunuma, A
19 (Sun)	Okugi, B	Tauchi, C	White, D
20 (Mon)	Kubo, A	Okugi, B	Kuroda, C
21 (Tue)	White, D	Marin, A	Kubo, B
22 (Wed)	Kuroda, C	Okugi, D	White, A
23 (Thr)	Kubo, B	Kuroda, C	Marin, D
24 (Fri)	Terunuma, White, A	Kuroda, Okugi, B	

Emiitance in Extraction Line (multi-OTR monitors)

- QS magnets were used for coupling correction.
  - We had used only QK magnets before.
  - QSs had been used only for dispersion correction.
  - Strength of QK magnets significantly reduced.

    QS: upstream of EXT line, in dispersive region

    QK: Just before beam size measurement. Dispersion free region.
- Rotation of OTR monitor Adjusted

Magnet	2012/12/21	2013/05/15
QS1X	-0.140	-1.500
QS2X	-0.140	0.600
QK1X	-11.097	-1.456
QK2X	0.005	-0.341
QK3X	-3.019	1.929
QK4X	7.276	-1.327

Vertical emittance

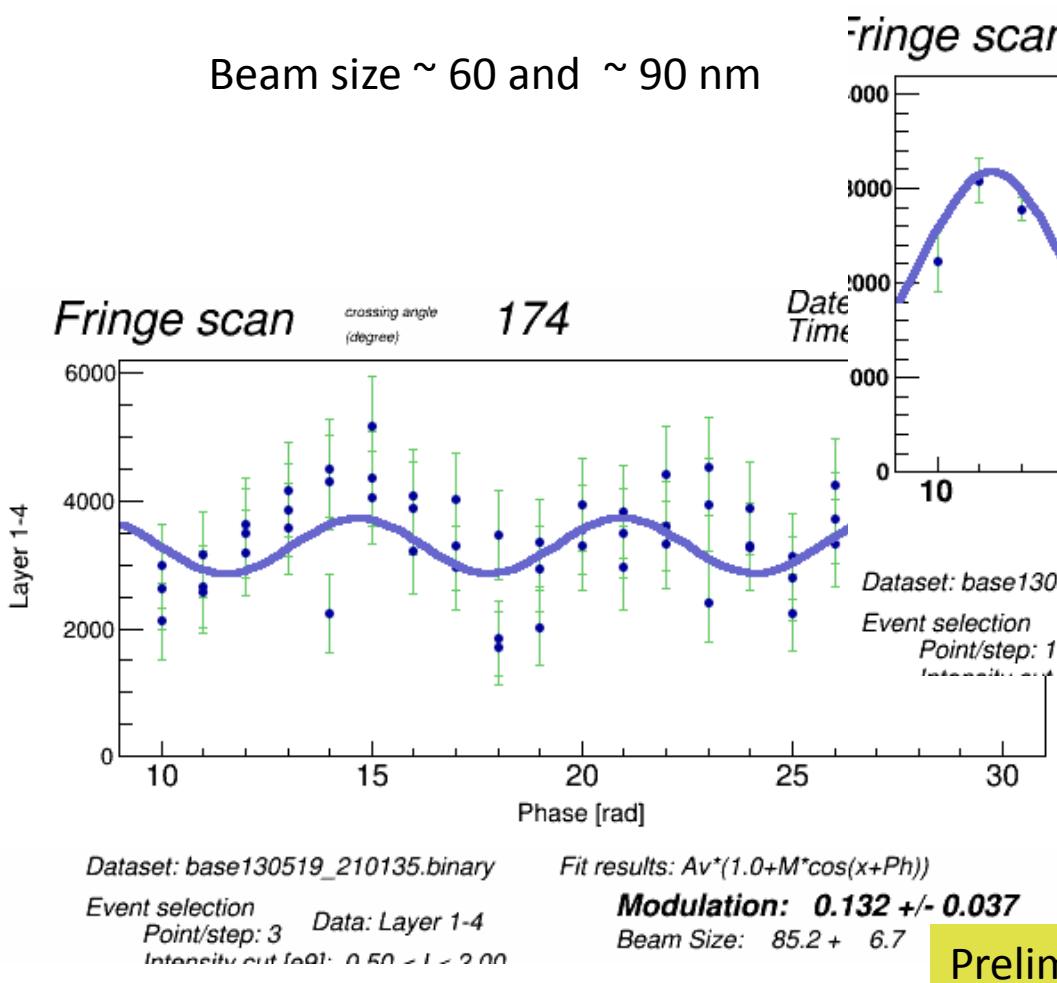
~13 pm at N=6e9

~10 pm at low intensity

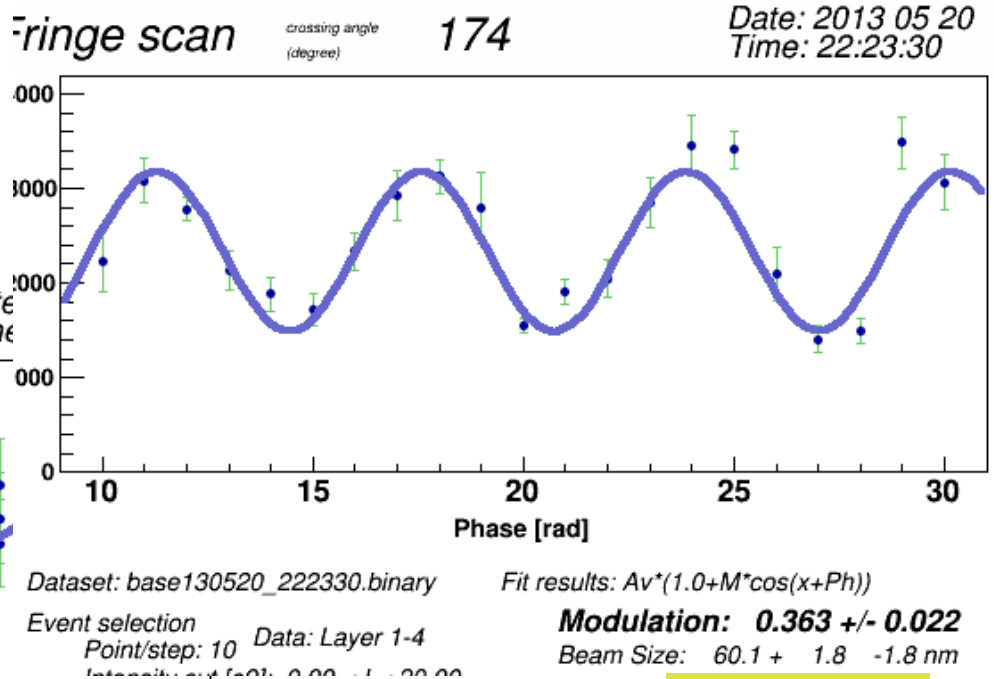
Improved

Examples of 174 deg mode fringe scans

Beam size ~ 60 and ~ 90 nm



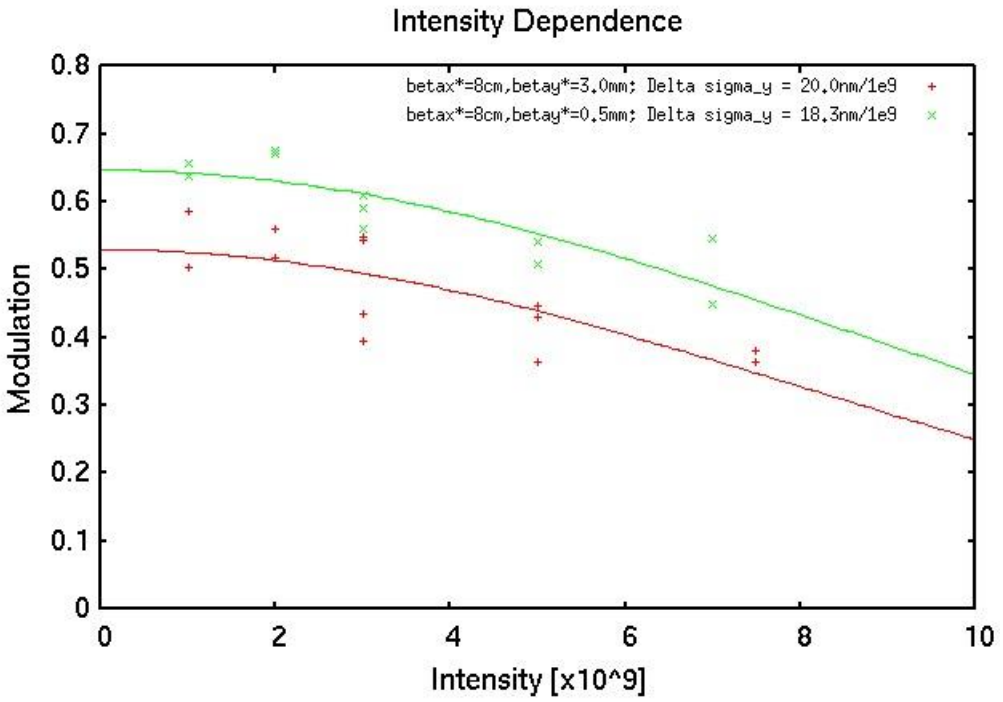
Preliminary



Preliminary

Intensity dependence

Modulation (30 deg.) vs. intensity for different betax* and betay*



By T.Okugi

Fitting

$$\sigma^2(N) = \sigma^2(N=0) + a^2 N^2$$

One exception?

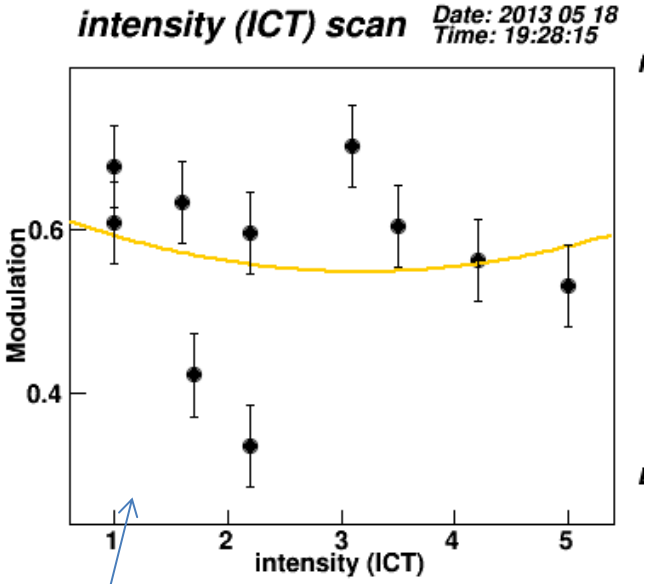
Almost the same dependence for all cases, $a = 20\text{nm/1e9}$

This is slightly larger than in April.

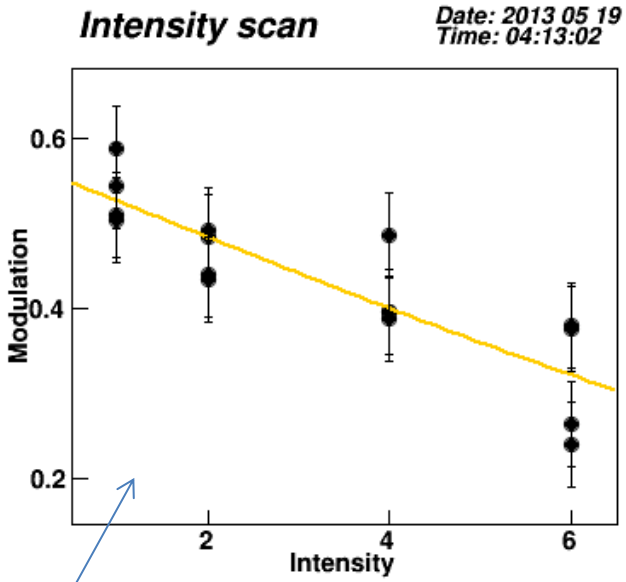
Orbit dependence was not systematically studied yet.

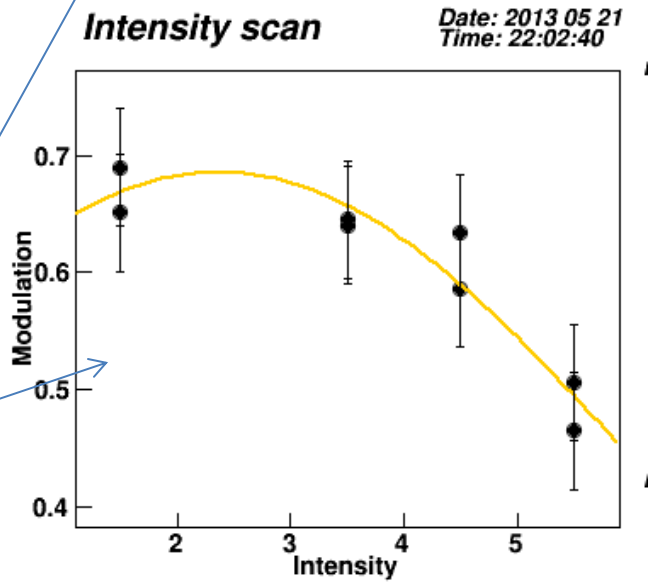
Intensity dependence

Examples of modulation (30deg) vs. intensity



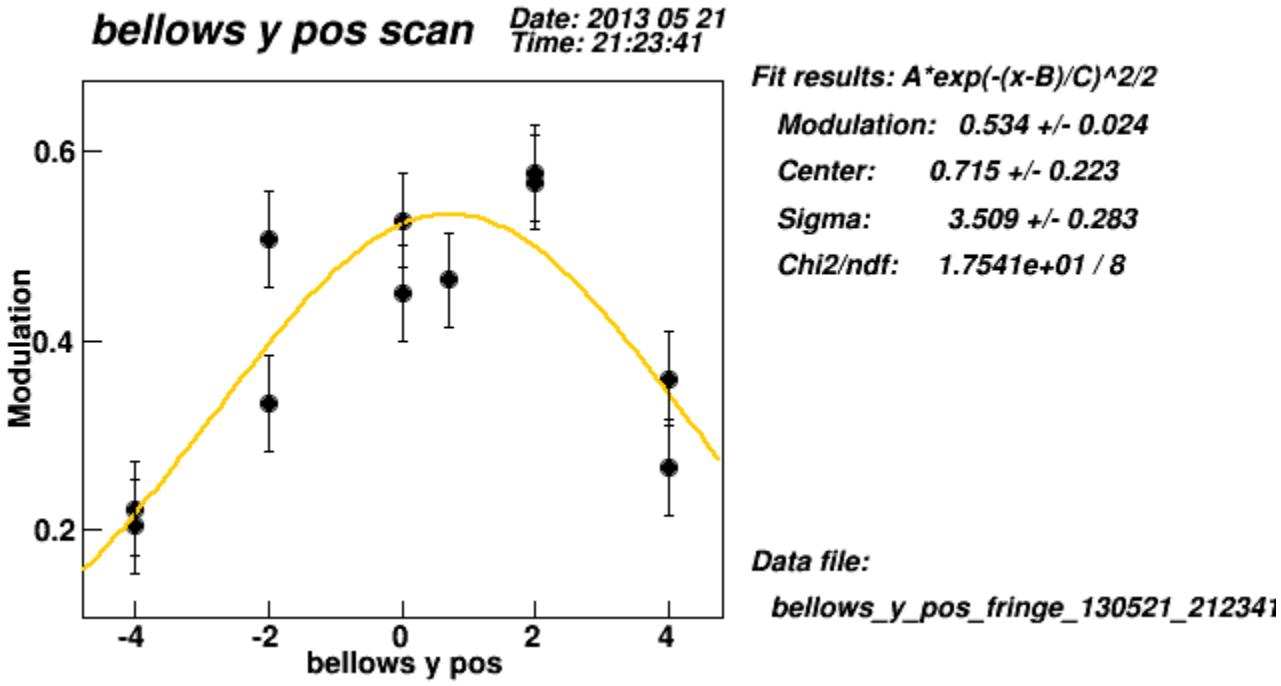
Only this scan shows weak dependence.





Others are all similar.

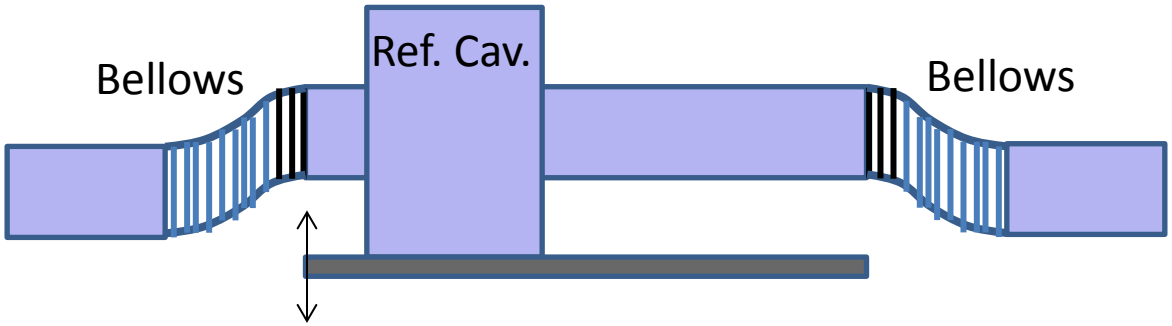
Modulation (30deg) vs. position of on-mover bellows Example



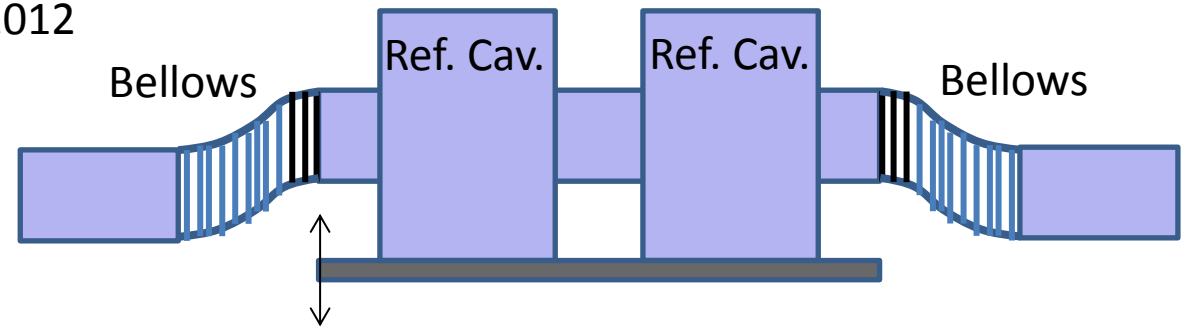
Peak was observed

on-mover wakefield source

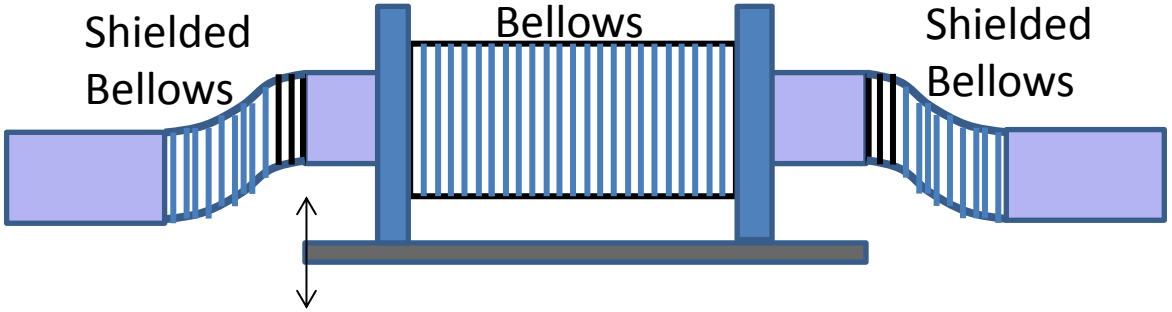
Dec.2012



Dec.2012 – April 2012

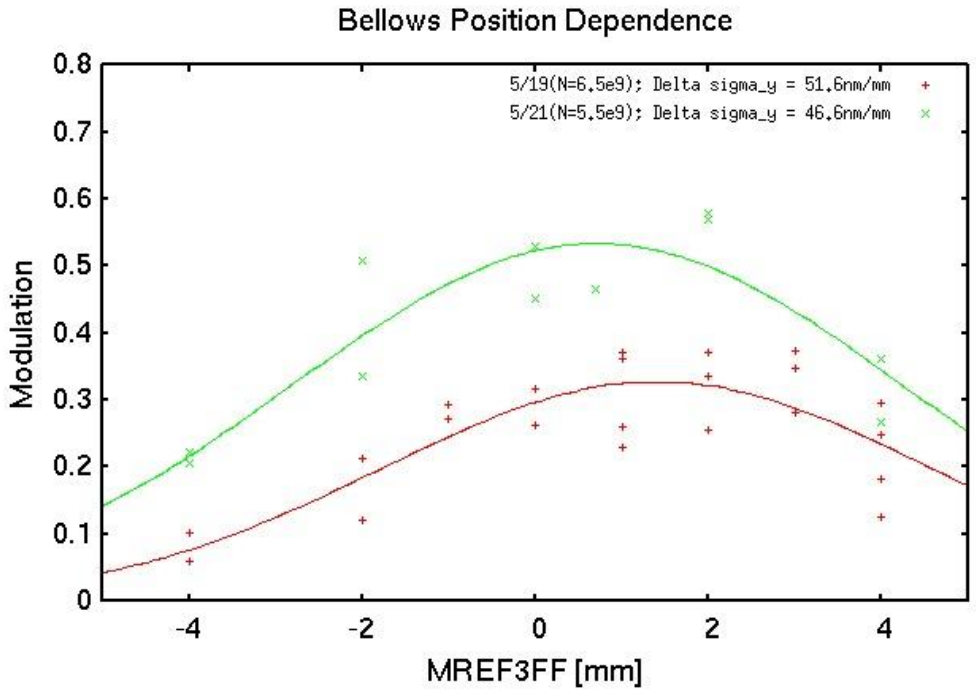


May 2012



Studies using on-mover wakefield source

Modulation (30 deg) vs. position of bellows



By T.Okugi

1 Bellows +2 shielded bellows for movement :	7.9-8.5nm/mm/1e9
2 Ref. Cavities +2 bellows for movement:	27-28nm/mm/1e9
1 Ref. Cavity +2 bellows for movement:	14-19nm/mm/1e9

Tuning knobs

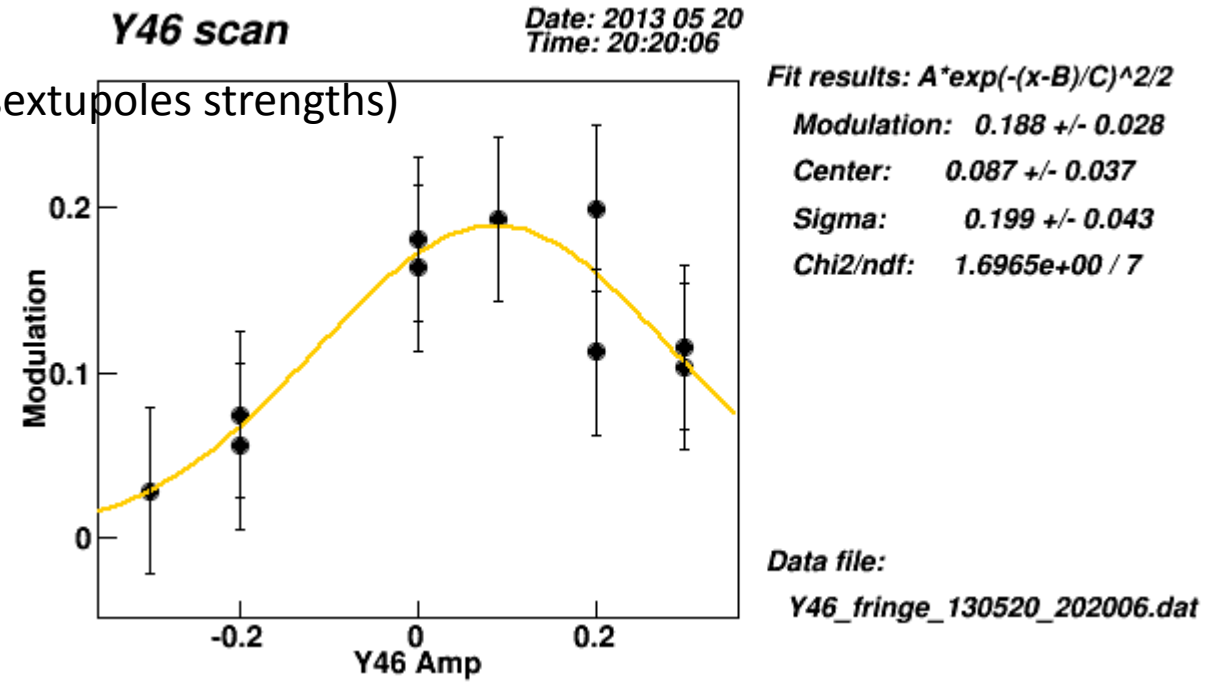
		Corrected coupling
Linear knob	Horizontal move of sextupole magnets	yy’
	vertical move of sextupole magnets	Ey
		x’y
Non-linear knob	Strength change of sextupole magnets	x’yy’
		Eyy’
	Strength change of skew sextupole magnets	xxy
		Exy
		EEy
		yy’y’

5 sextupole magnets (on mover), 4 skew-sextupole magnets

Effect of Non-linear knob

Most non-linear knob scans were not effective.
Very few exceptions.
(Effective just because linear knob scan was not optimized??)

Change sextupoles strengths)



Could not find effective skew-sextupole knobs scan. (?)

Conclusion of the weeks (1)

- Small beam size at low intensity?
  - Repeatedly achieved < 70nm beam size at low intensity by tuning, and kept hours.
  - Minimum beam size ~60nm
  - Could not reduce further
- Multi-pole field
  - We did not see clear effect of the skew-sextupole correctors.

Conclusion of the weeks (2)

- Wakefield
  - Effect of bellows shield was not clear. Intensity dependence did not reduced.
  - Cannot explain beam size growth 40nm -> 60nm at low intensity (N~1e9)
- Similar intensity dependence for different betax* and betay*, suggesting dependence is from wake field, not from multi-pole field.
- Emittance in Extraction Line
  - Improved. Vertical emittance about 10 pm (low intensity) ~ 13 pm (N~6e9), weak intensity dependence.
  - Coupling correction in upstream part
  - Tuning of OTR monitor