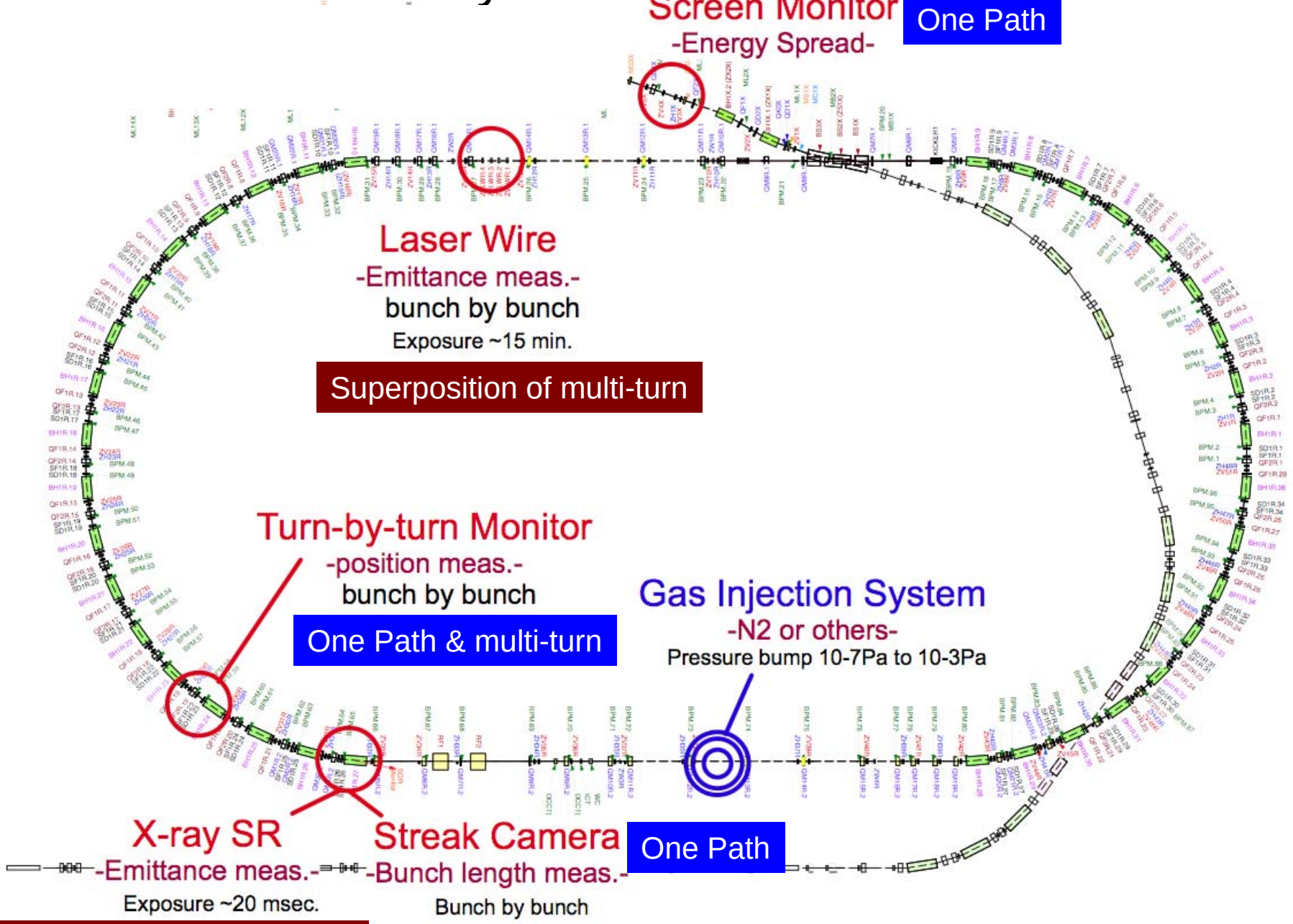
Status of ATF Fast Ion Study

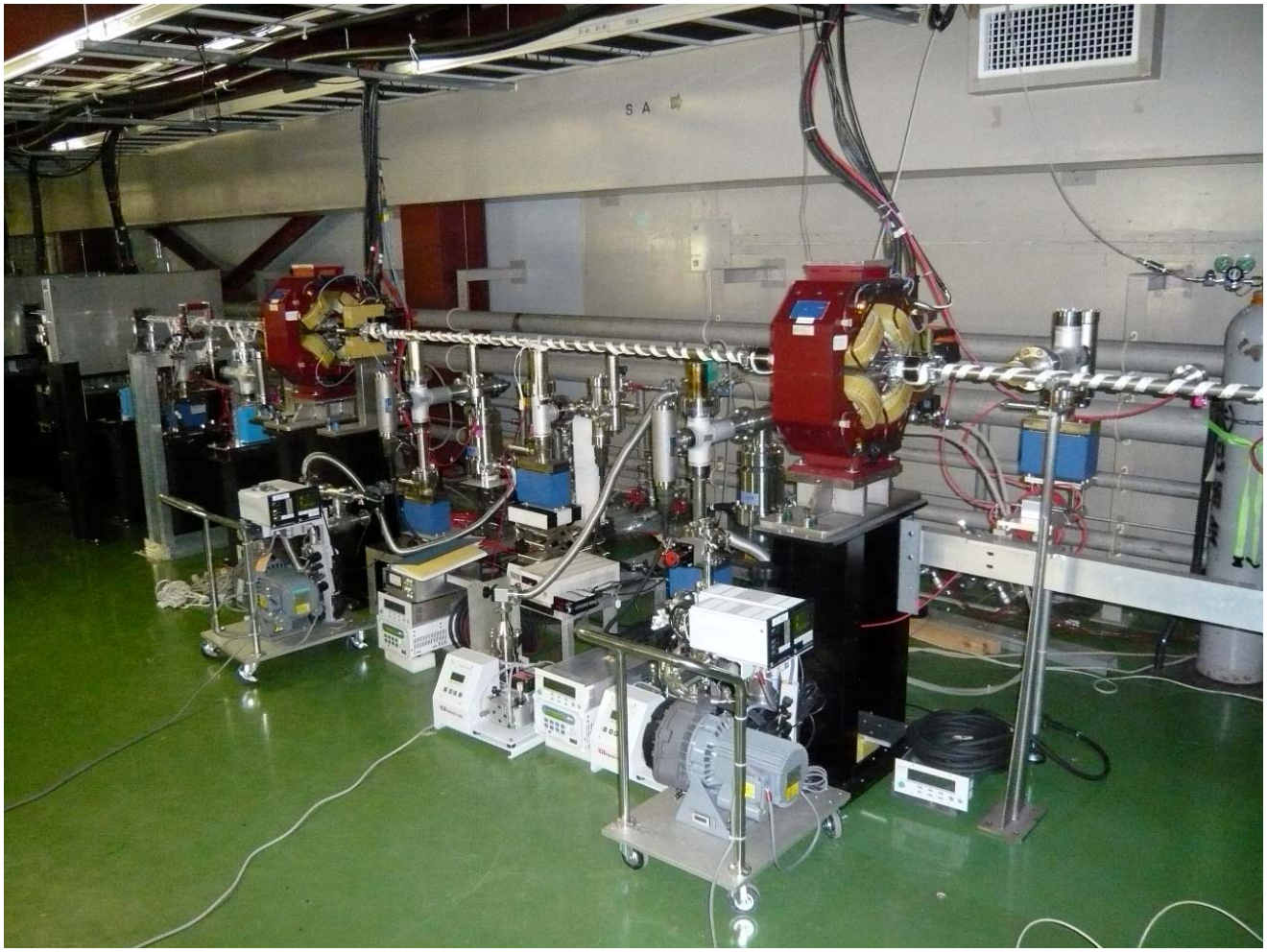
- Brief summary of past studies
- Results of the vertical emittance tuning
  - Tuning details will be reported by S.Kuroda (April 19)
  - Status of resumed Fast Ion Study
- Plan for coming months

Devices for FII study



Gas Injection system at ATF-DR

-South straight section-



Pressure bump at ATF-DR

Gas Injection System

-N2 or others-

Pressure bump 10-7Pa to 10-3Pa

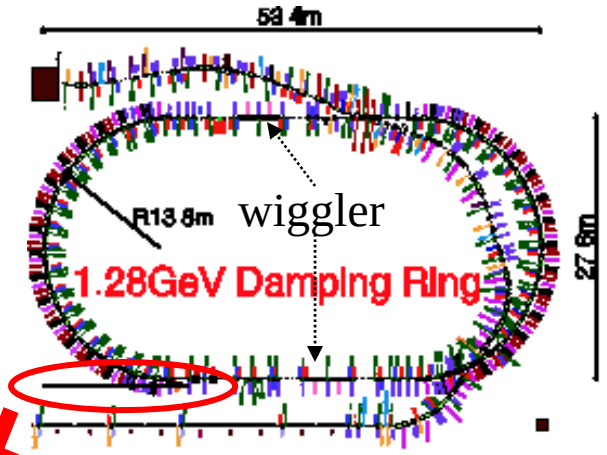
Scaled by
monitored pressure.

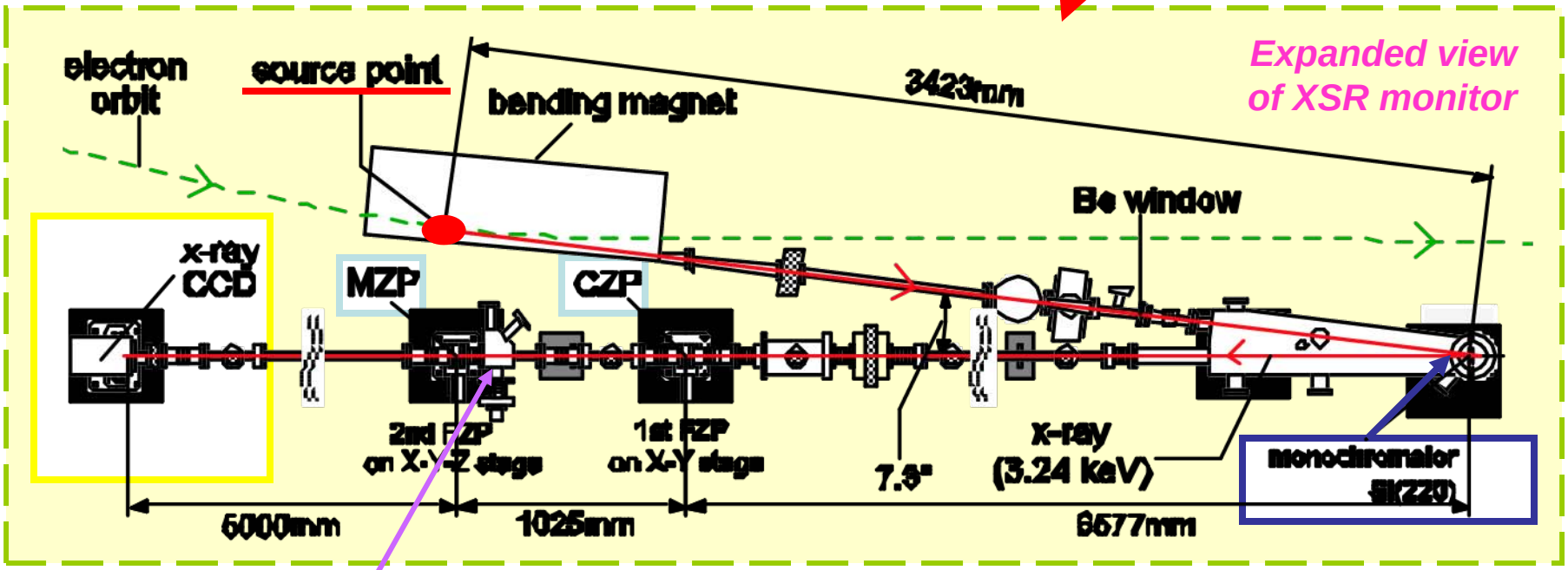
RF Cavity

Setup of XSR monitor

Principle

- Monochromated **X-ray SR(3.235keV)** is used.
  ⇒***Reduce the diffraction limit from SR-light.***
- ***Two*** **Fresnel zone plates (FZPs)** are used。
  ⇒***Obtain 20 times magnified beam image on CCD.***

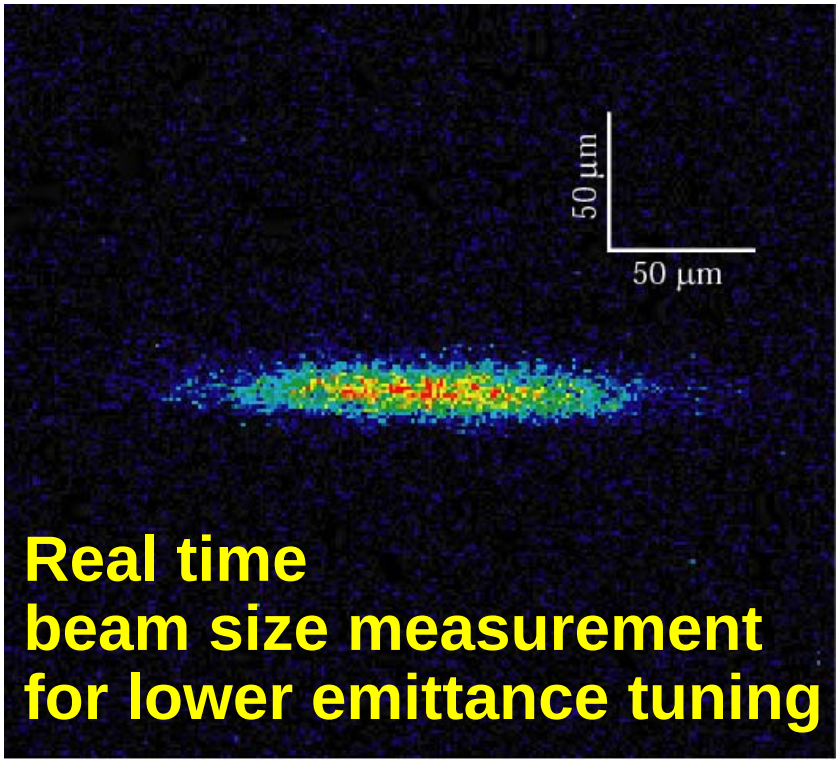




Mechanical shutter installed on April 2005 (opening shutter time <1ms) [previous >20ms]

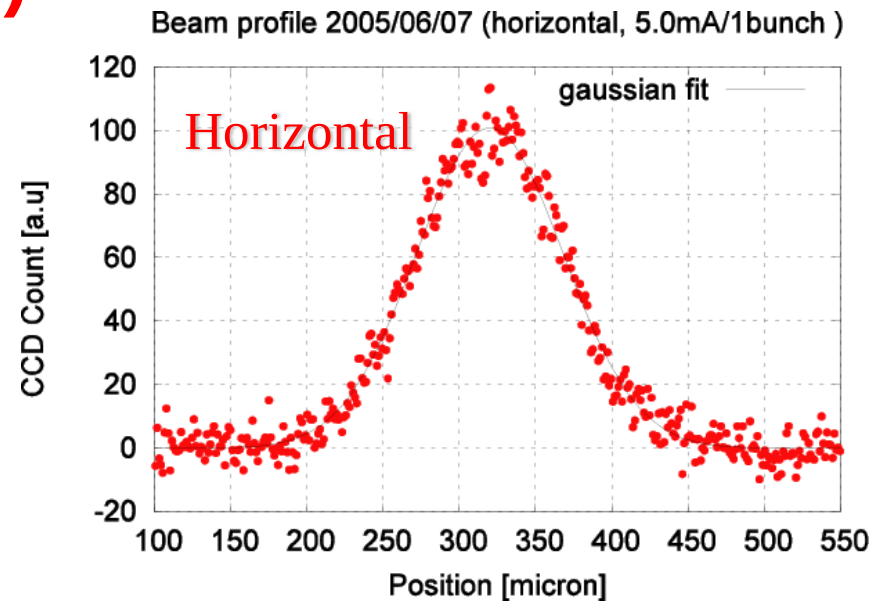
Expected spatial resolution is less than 1μm.

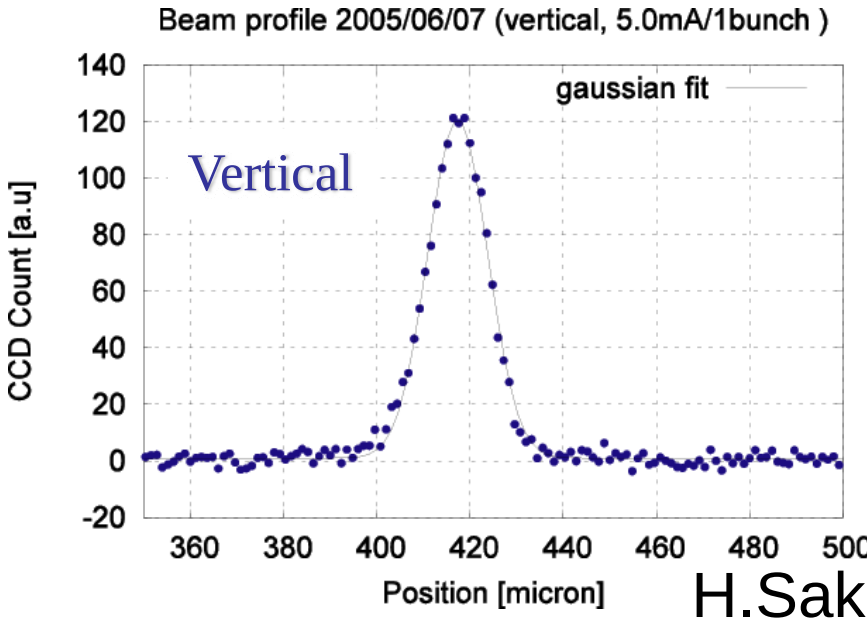
Example of beam image (with new shutter 1ms)



I=5.0mA, Shutter time = 1ms
(2005/06/07)

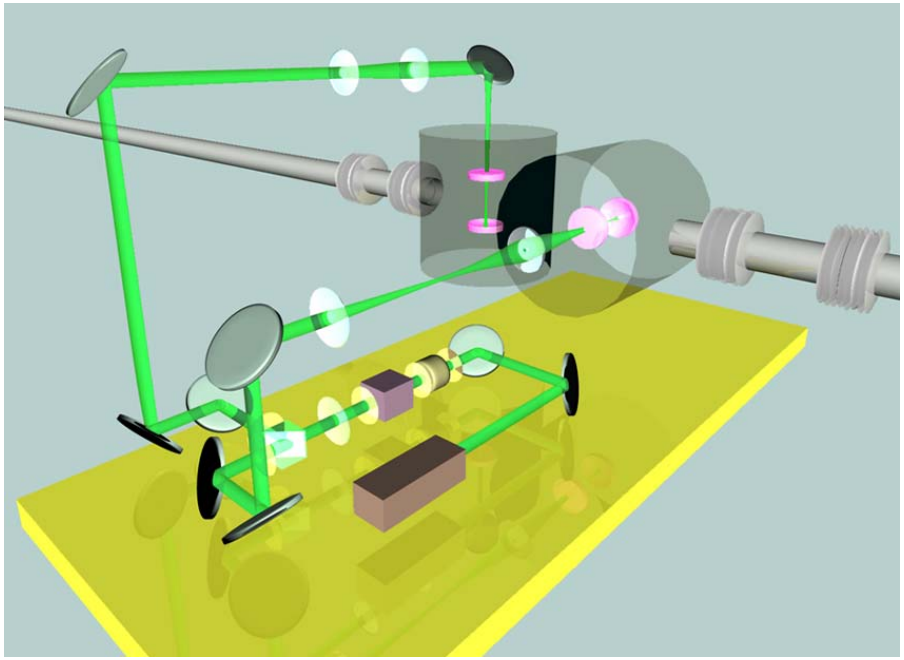
σ_x = 48.2 ± 0.5 [μm]
σ_y = 6.4 ± 0.1 [μm]

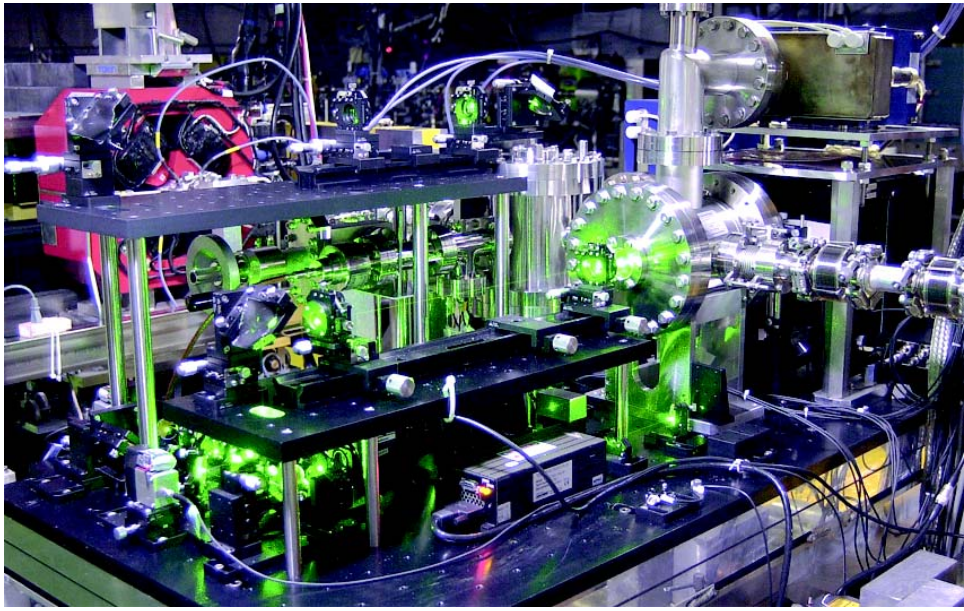




H.Sakai

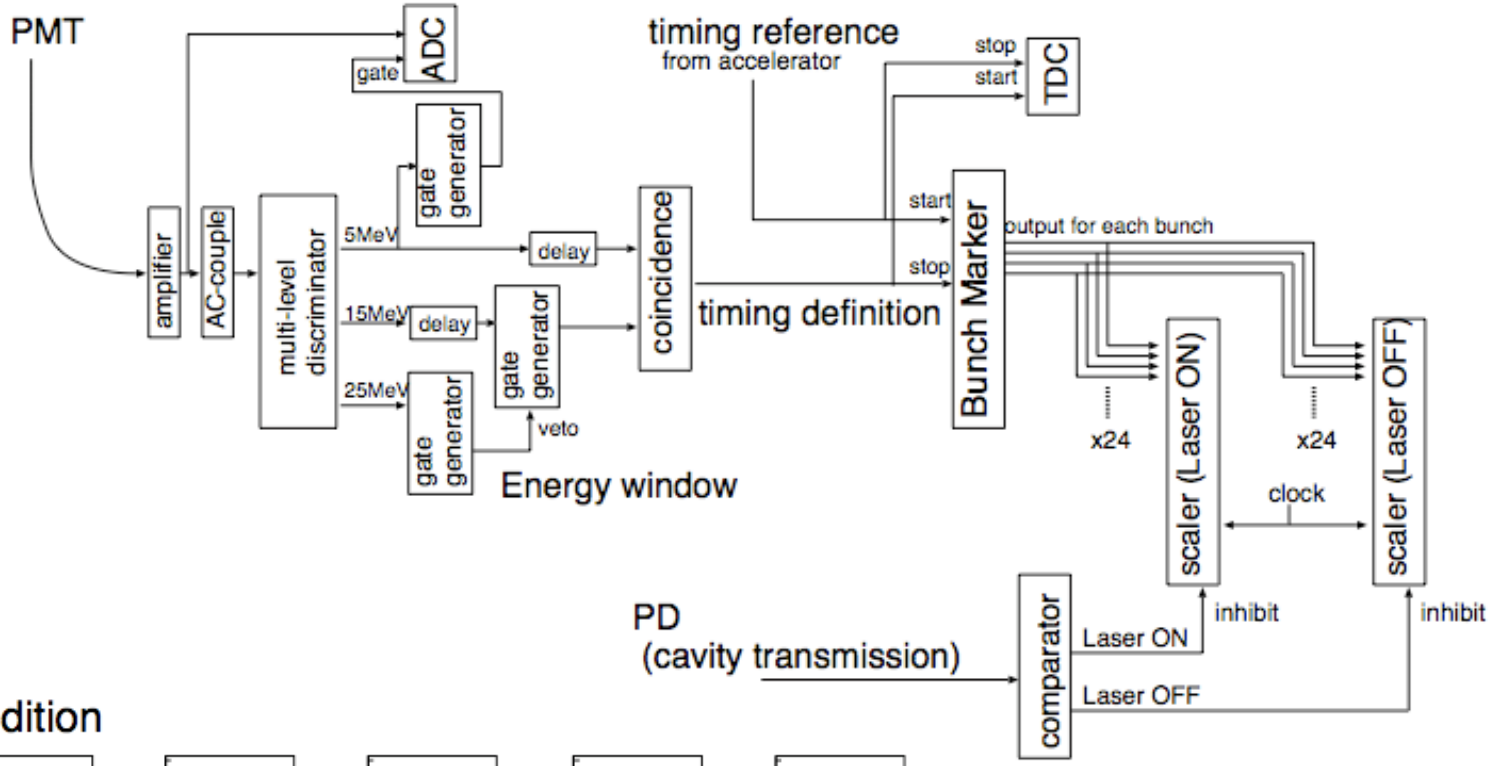
Laser wire beam size monitor in DR



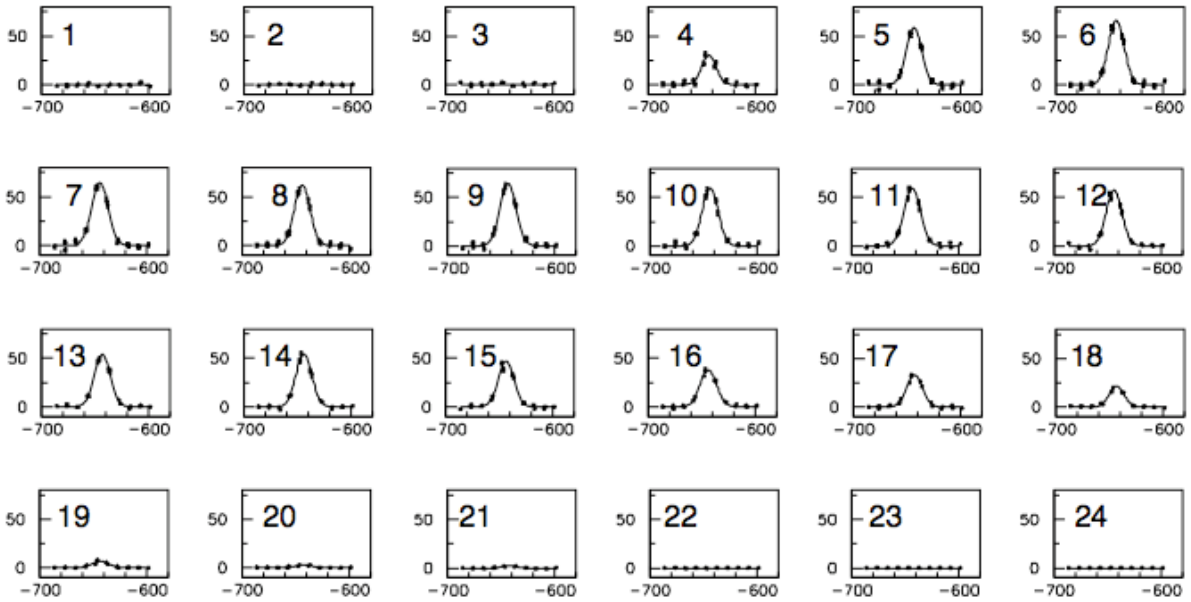


300mW 532nm Solid-state Laser fed into optical cavity

14.7μm laser wire for X scan
5.7μm for Y scan
(whole scan: 15min for X, 6min for Y)



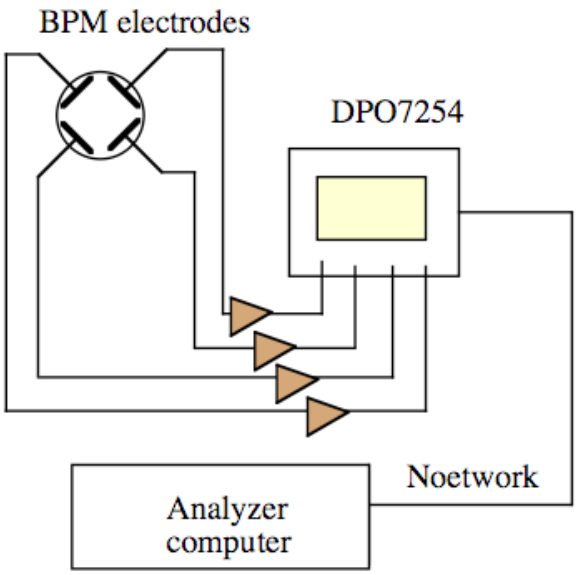
Normal condition



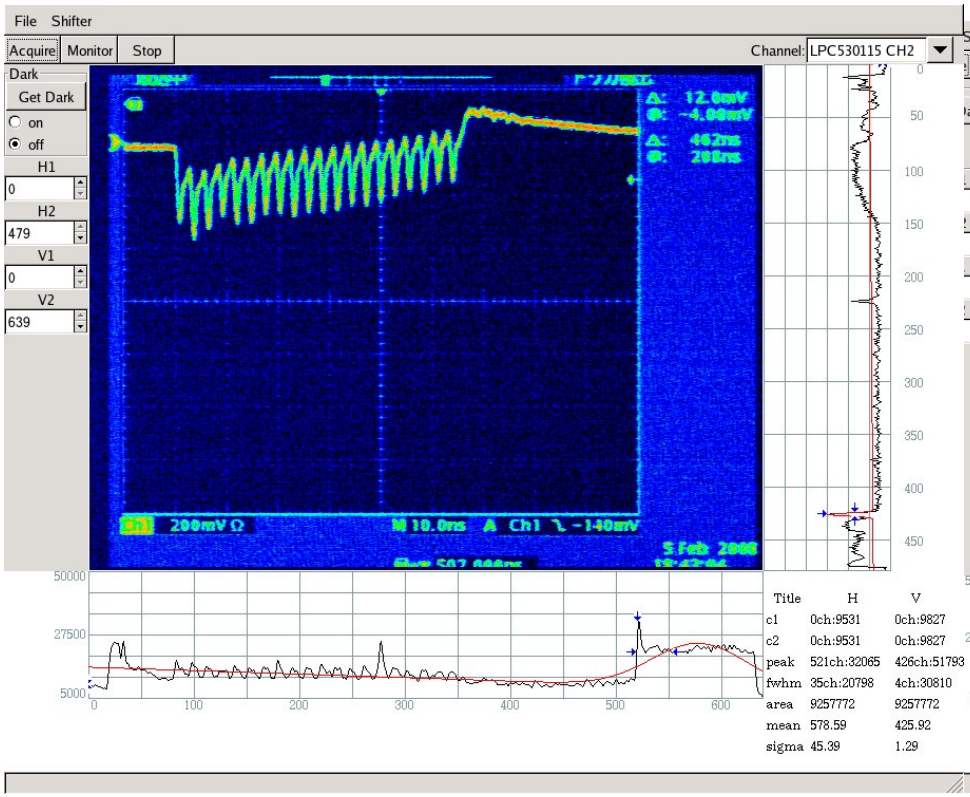
Multi-bunch profiles scanned by Laser Wire

Turn by turn position monitor

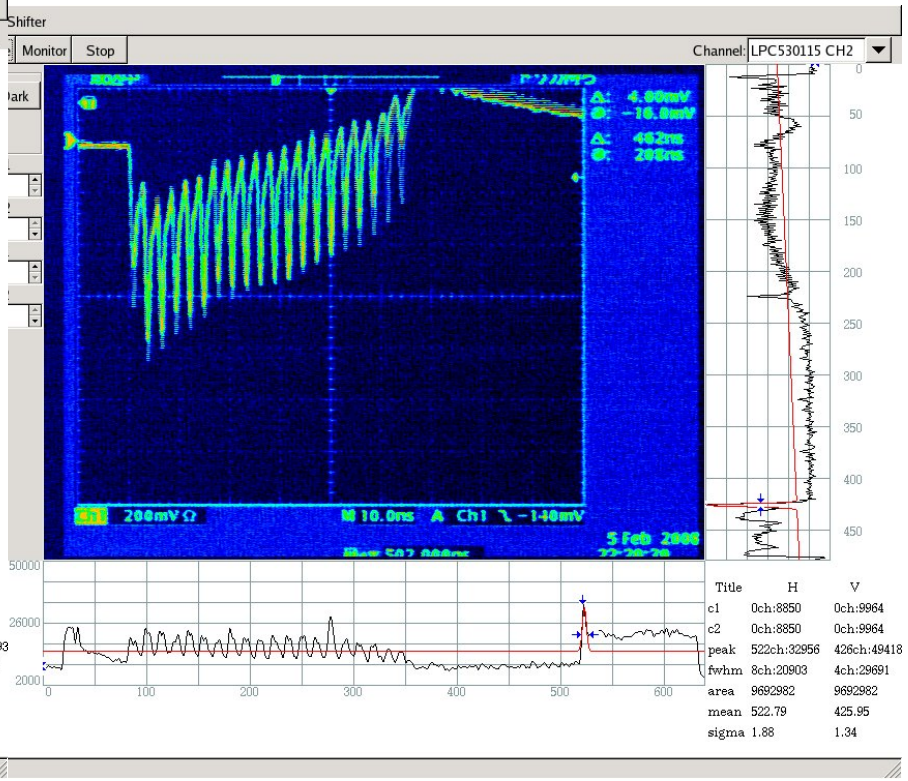
The scope can store the waveform up to 2ms with 100ps time resolution.



Previous R&Ds at ATF



0.4E10/bunch, 20bunch



1.0E10/bunch, 20bunch

FII study on 2007/3/13-14

5mA/20bunches

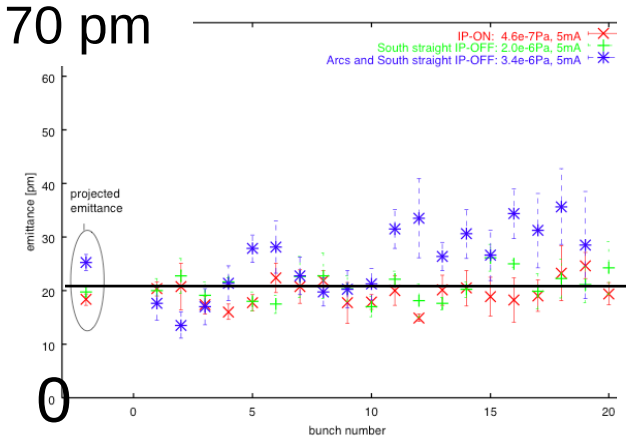


Figure 7: emittance of multi-bunch beam at 5mA/20bunches

10mA/20bunches

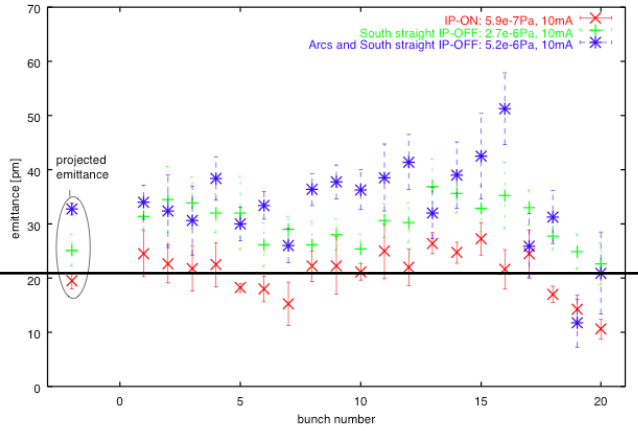


Figure 8: emittance of multi-bunch beam at 10mA/20bunches

20mA/20bunches

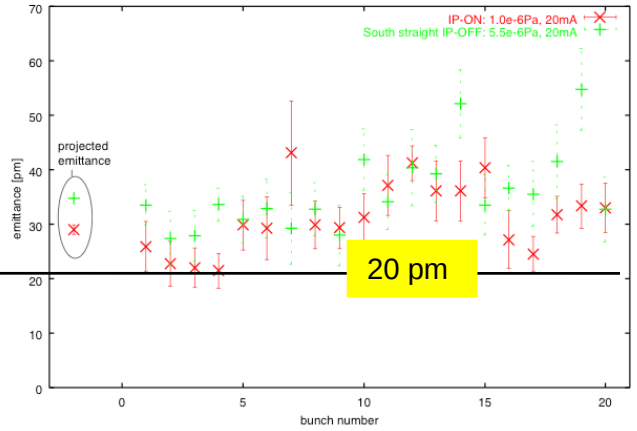


Figure 9: emittance of multi-bunch beam at 20mA/20bunches

We measured emittance of each bunch in a 20-bunch beam in the DR with a laser-wire monitor. No clear emittance blow-up along a train was observed up to 20mA/train.

One of the reason may be the bigger vertical emittance compared with the data taken in 2004.

FII study on 2007/3/13-14 (2)

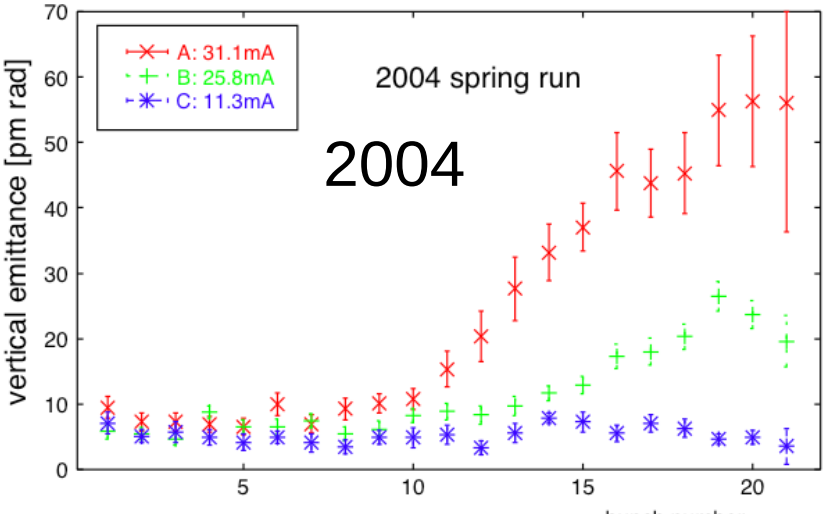
Vertical emittance of 20 bunches in ATF DR

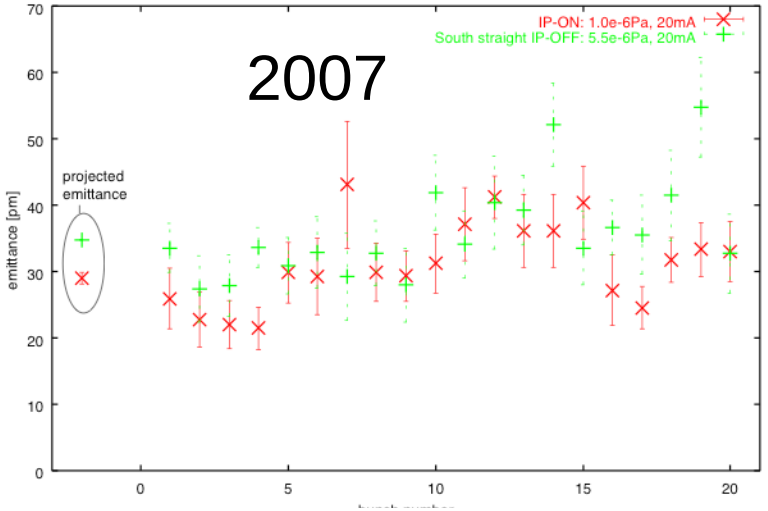
Table 2: vacuum pressure in 2004

ion pump status	11mA	26mA	31mA
normal	4.0×10^{-6} Pa	6.0×10^{-6} Pa	6.5×10^{-6} Pa

Table 1: vacuum pressure in the measurements

ion pump status	5mA	10mA	20mA
normal	4.6×10^{-7} Pa	5.9×10^{-7} Pa	1.0×10^{-6} Pa
south straight OFF	2.0×10^{-6} Pa	2.7×10^{-6} Pa	5.5×10^{-6} Pa
both arcs and south straight OFF	3.4×10^{-6} Pa	5.2×10^{-6} Pa	



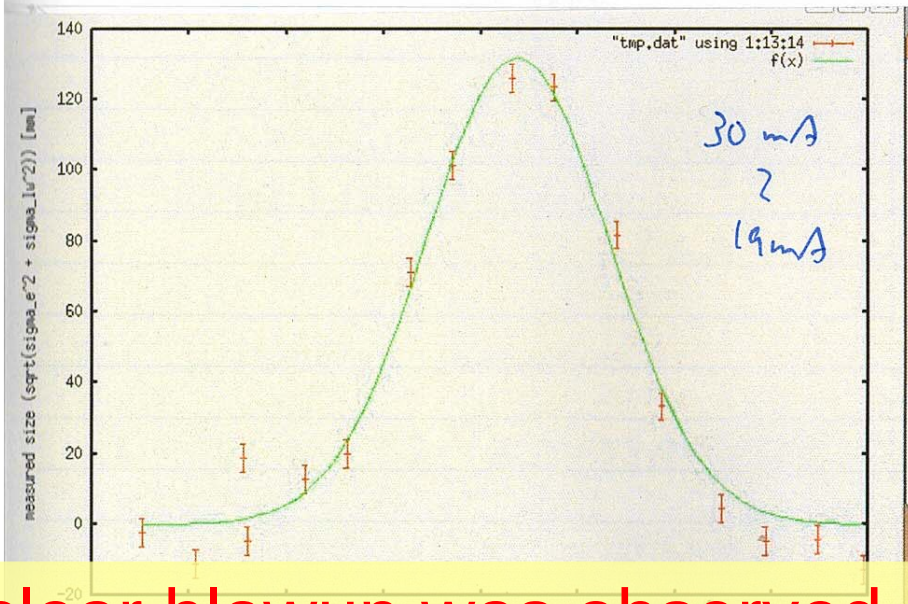


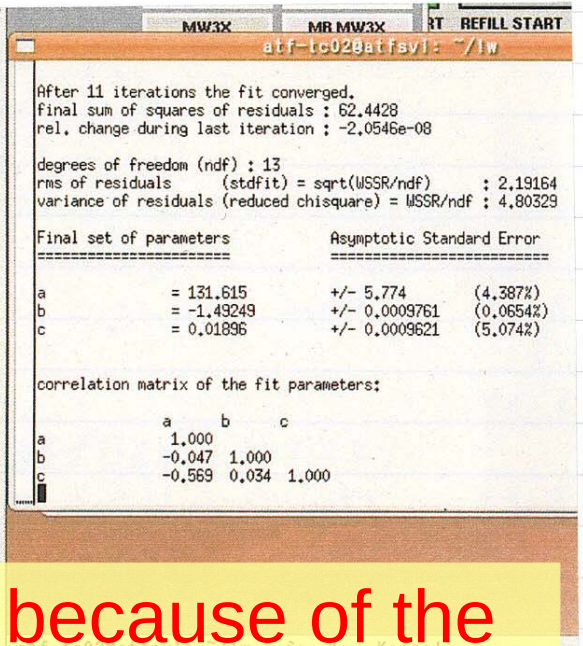
Single bunch is less than 10pm.

Bunches are already bigger.
Single bunch is also bigger.

R&D results on Dec 2007

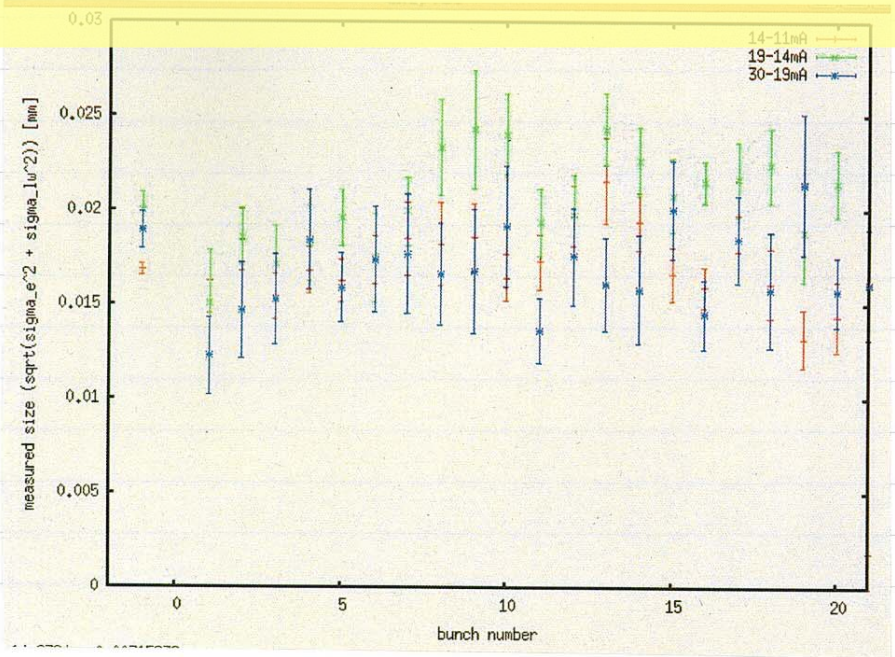
- **First shift with the gas injection system.**
- **Vertical emittance was about 40pm but we need 10pm or less.**
- **Multi-bunch beam was not well tuned.**
- **Vacuum in DR, North/South, was higher than usual.**
  - Beam line was opened to install Gas system, Laser-Compton system and the fast kicker chambers in fall 2007.





No clear blowup was observed because of the bigger emittance.

Vertical beam size by LW 2008/Feb/5



Vertical emittance became larger

- 5~10 pm had been achieved after emittance tuning described.
- Recently, about 20~30 pm, after the same procedure of the tuning. **from 2006?**
- Apparent vertical dispersion and x-y coupling are worse. (? may not be always ?)
- Optics model may be bad. (e.g. tunes and orbit response to steering magnet do not fit with the calculation.)

We need to solve the problem.

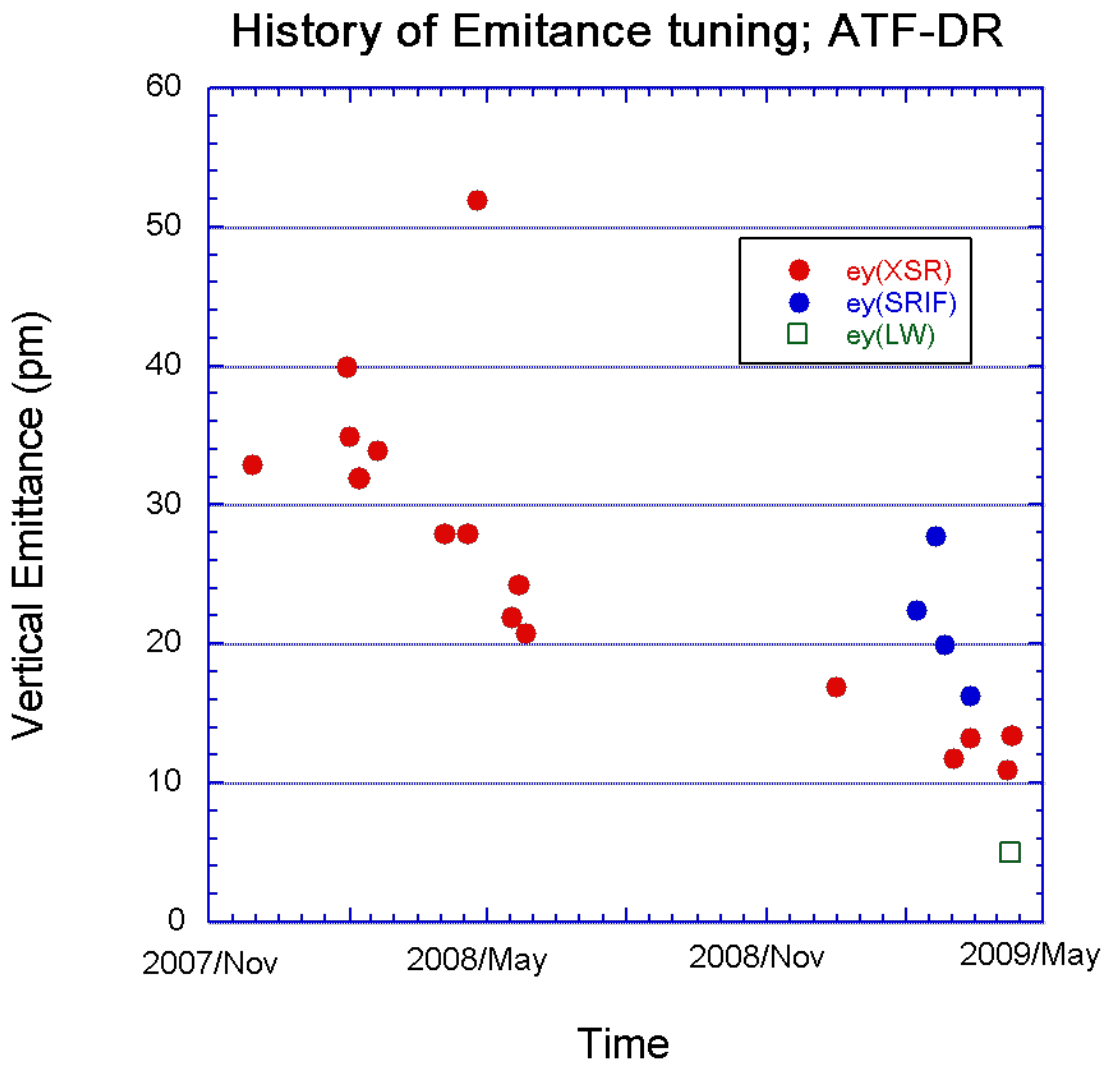
- ATF2 assumes ~10 pm.
- Many instrumentation development need small beam size. **and Fast Ion Study!**
- ILC damping ring requirement is 2 pm.

By K. Kubo

What should be done for FII study at ATF

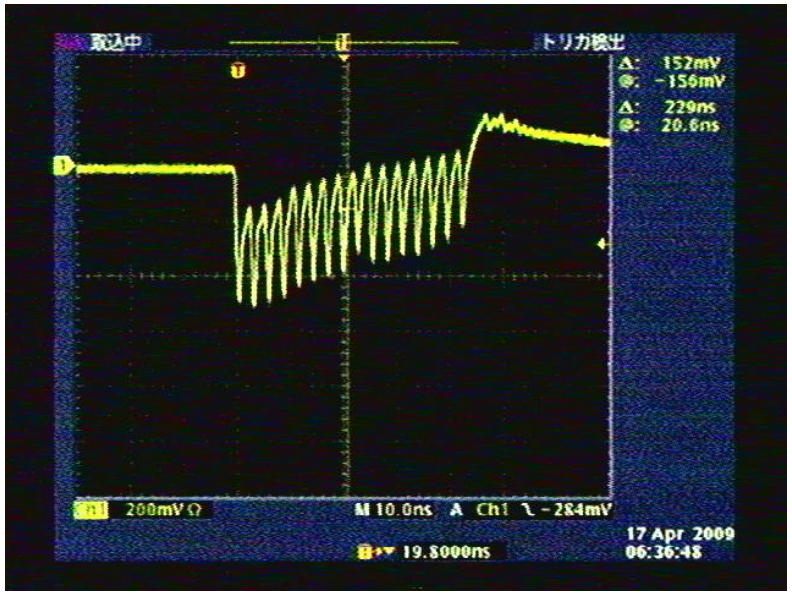
- **Vertical emittance recovery/tuning**
  - Need to understand what makes 20~50pm emittance in recent DR.
  - Re-align the DR magnets and see what is happened.
  - keep DR tuned for each operation period
- **Multi-bunch beam tuning**
  - because DR is usually tuned for the single bunch beam for other R&Ds
  - It will take at least one shift just before FII shifts.
  - RFgun and Linac tuning due to beam loading, capturing in DR
  - We will Improve the timing system of the RFgun laser to avoid the rise and fall edge of pockels cell voltage.
- **Minimize the effect by vacuum breaks to see a clear effect**
  - Beam extraction R&D by Fast Kicker
    - Exchanging chambers and kickers every time for 2 weeks R&D
  - Laser-Compton system for pol. e+ R&D

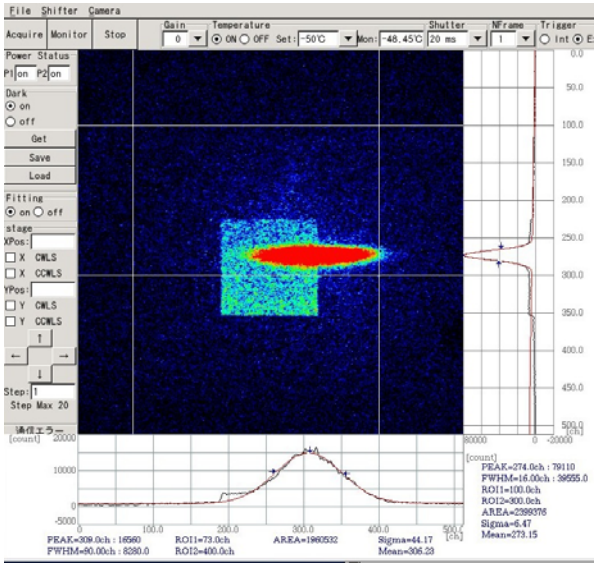
Vertical emittance recovery



- Beam tuning
- Magnet alignment
- …

Resuming the FII study

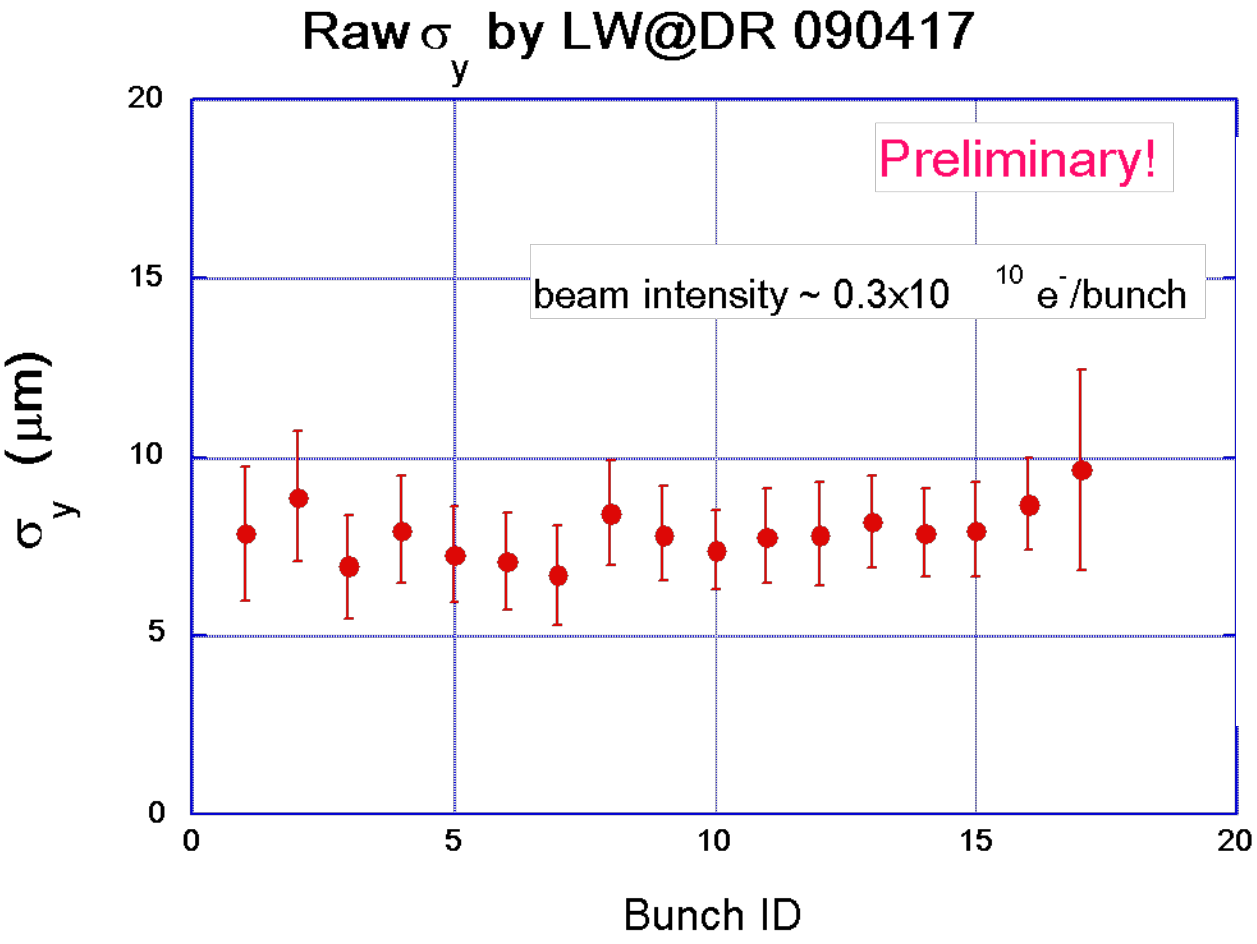




- Multibunch study for FII was tried yesterday.
- 1 shift time; ~8h

- System check for …
  - tunability of the multi-bunch beam injection
  - availability of the Laser-wire monitor

Resuming the FII study



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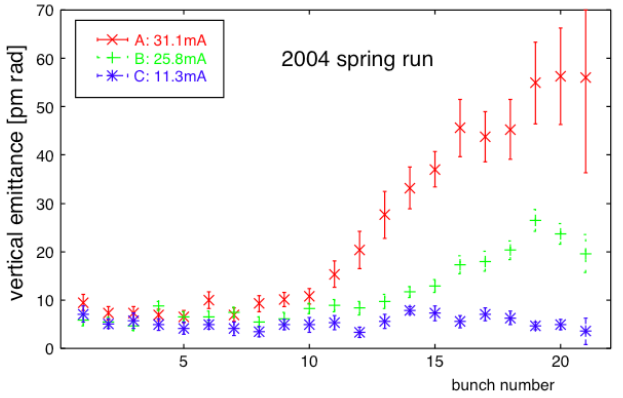

Summary

- Vertical emittance in DR is almost recovered about less than 10 pm.
- Fast ion study should be well scheduled with other ATF/ATF2 programs.
- Multi-bunch beam tuning should be well done just before the FII study.

Local and remote participation for FII beam time are welcome.

backup files