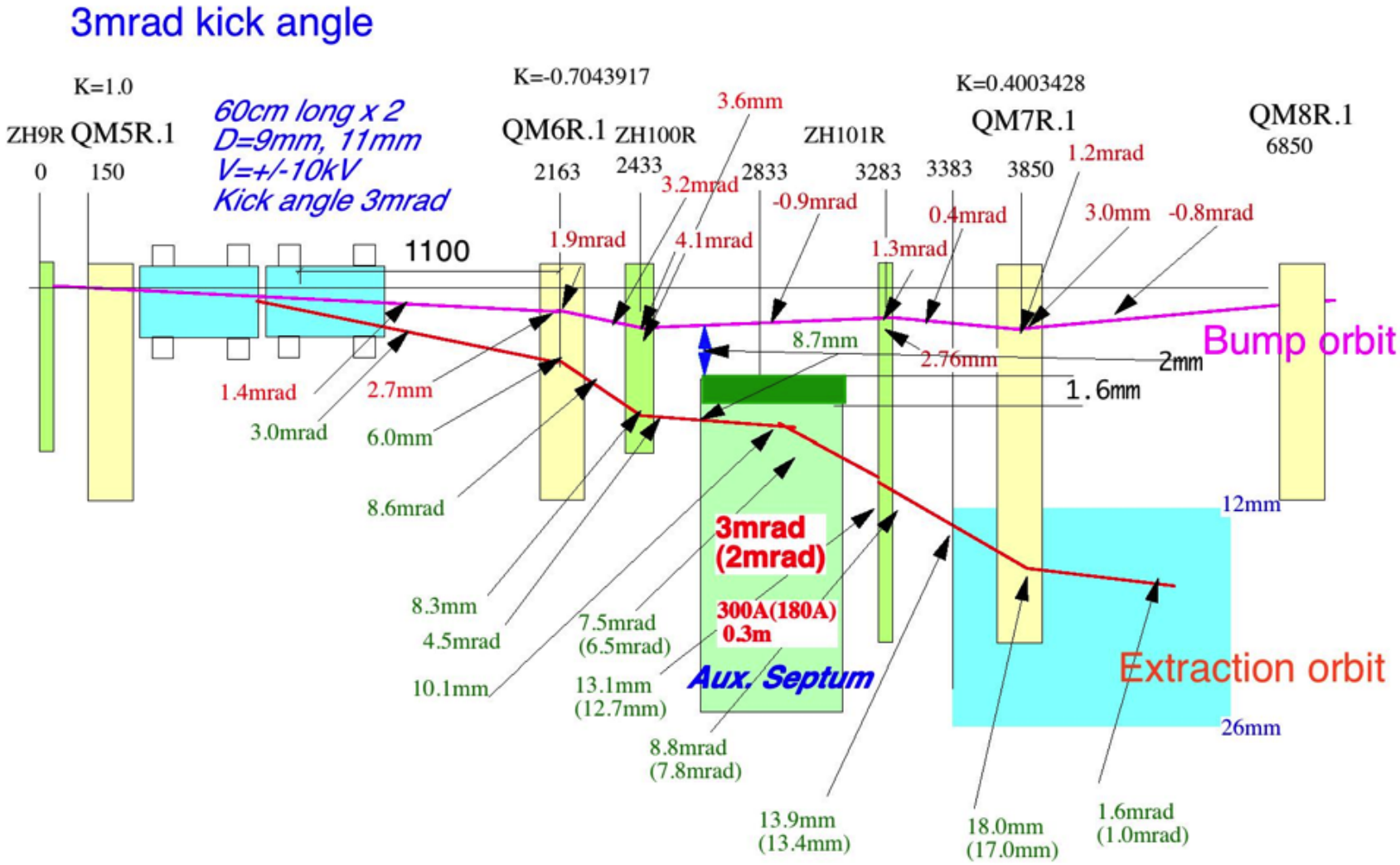
Fast kicker development

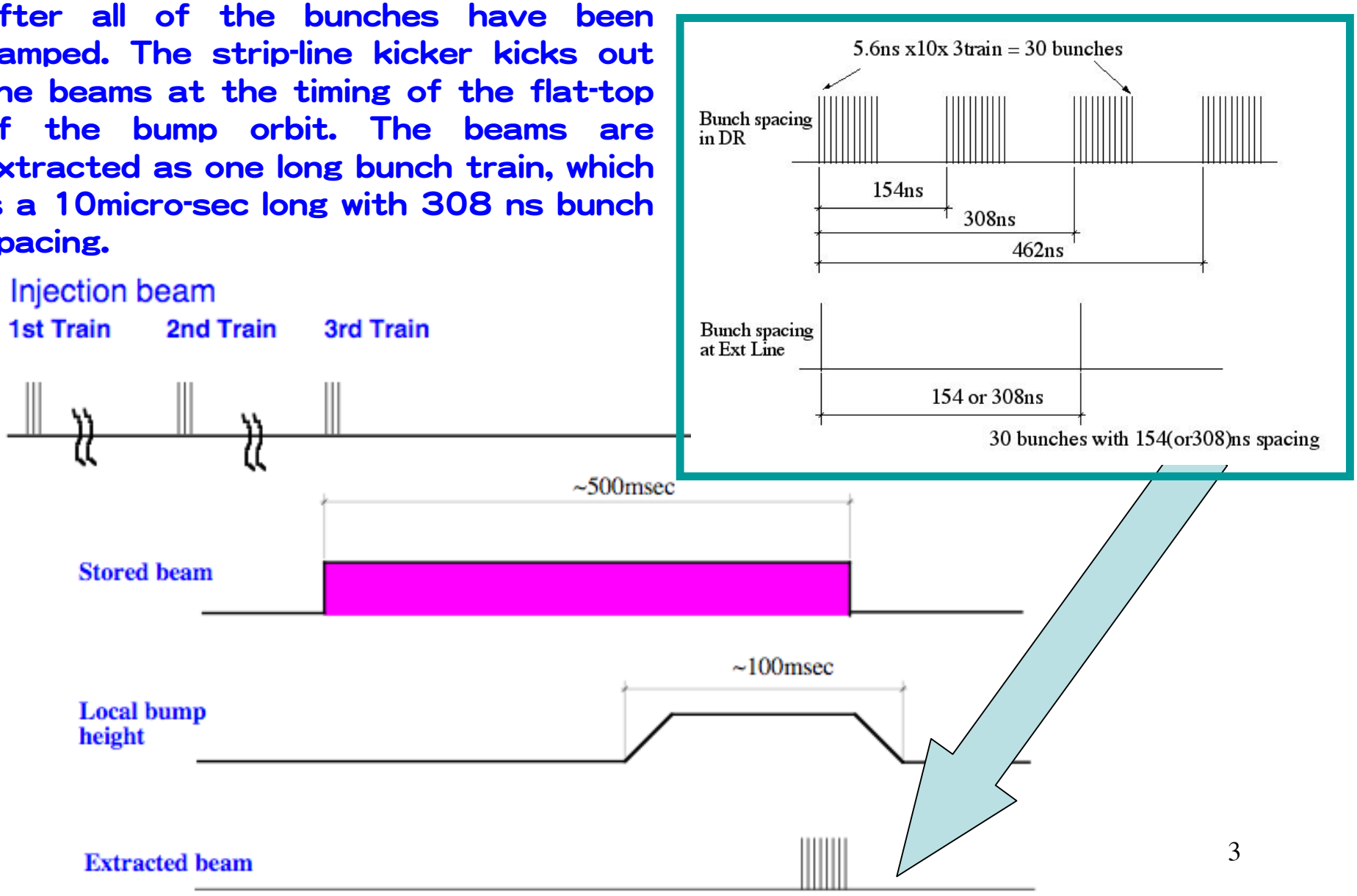
TB meeting
2010/07/02 T. Naito

Beam Extraction Orbit using Strip-line Kicker, Aux. septum & Pulse bump

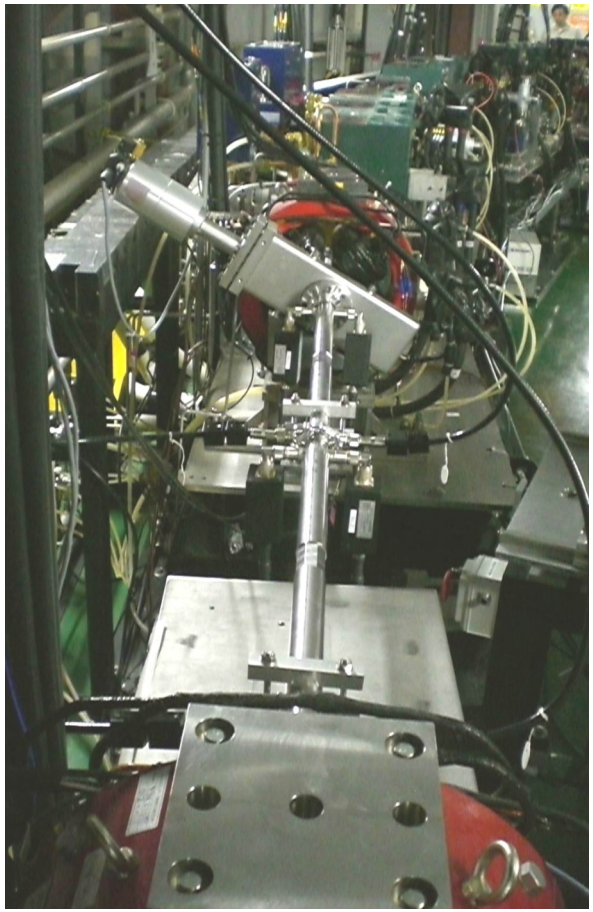


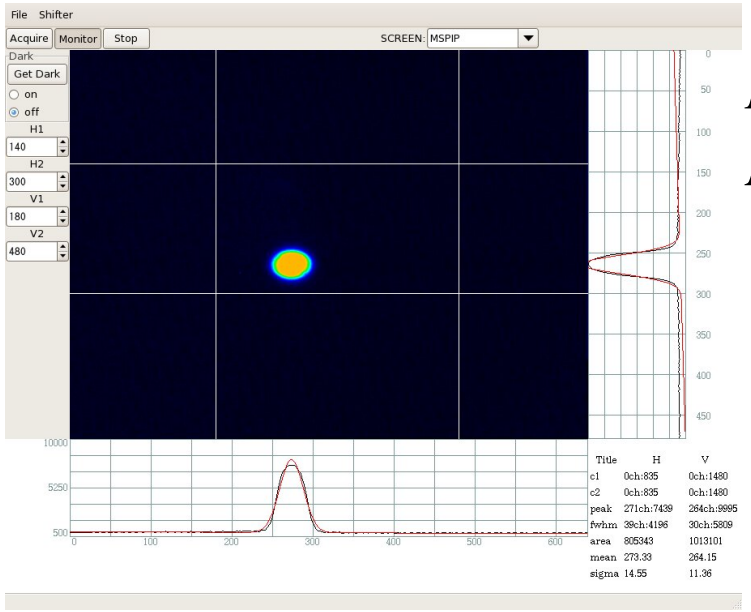
Timing chart of 30 bunches beam extraction

The bump orbit is gradually changed after all of the bunches have been damped. The strip-line kicker kicks out the beams at the timing of the flat-top of the bump orbit. The beams are extracted as one long bunch train, which is a 10micro-sec long with 308 ns bunch spacing.



Beam Extraction succeeded from DR to ATF2 2009.Oct. 22.





Beam profile at MS1X

Firs Beam extraction was confirmed 2009/Oct/22. However, the kick angle jitter was not so good(2x10-3) and the extracted multi-bunch was only 17 bunches not 30 bunches.

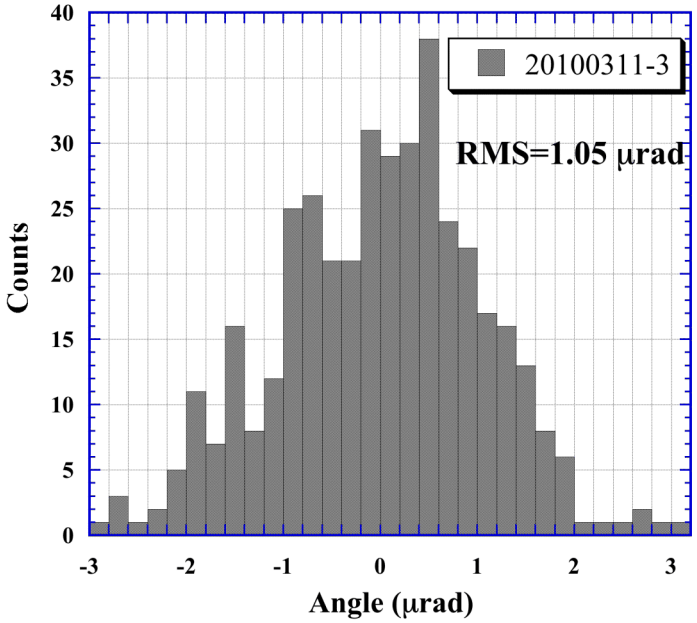
Improvements from Oct09

1. *Wrong trigger timing for multi-bunch was corrected. We found that the multi-bunch were injected to the unintended bucket number of DR at Oct09.*
2. *Puslers were repaired. The waveforms were improved. One of pulsers did not work 3MHz at Oct09.*
3. *Laser 2.8ns -> 56.ns*
4. *Trigger circuit - fine delays use same version, which was caused the trigger jitter.*
5. *Re-trigger circuit - a trigger from DR BPM is used for the kicker trigger to cure the 2.8ns jitter.*
6. *Strip-line - 9mm gap x2 -> 9mm + 11mm to get aperture .*

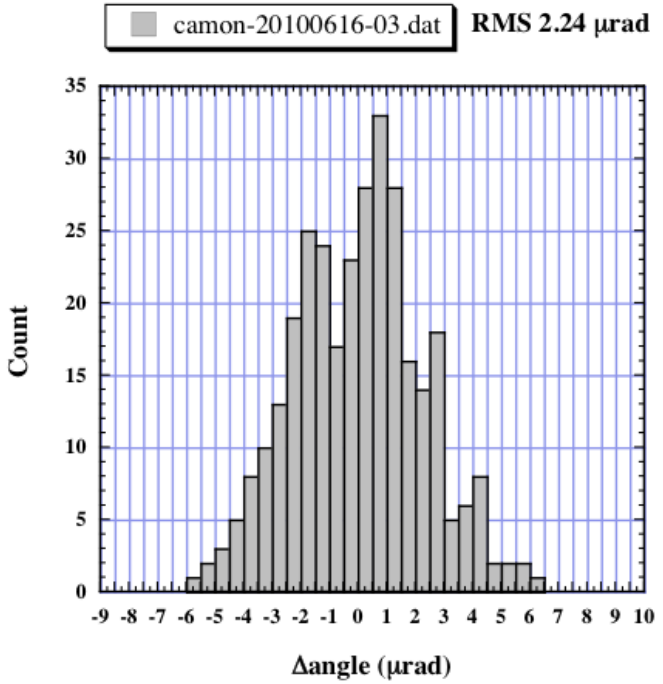
Distribution of fitted angle at EXT entrance

(single bunch)

Jitter 1.05e-6/3e-3=3.5e-4

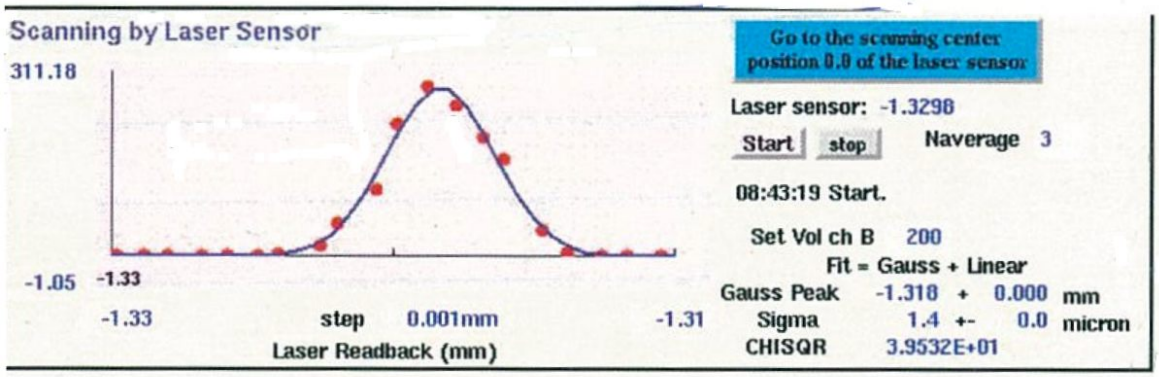


Jitter 2.24e-6/3e-3=7.4e-4



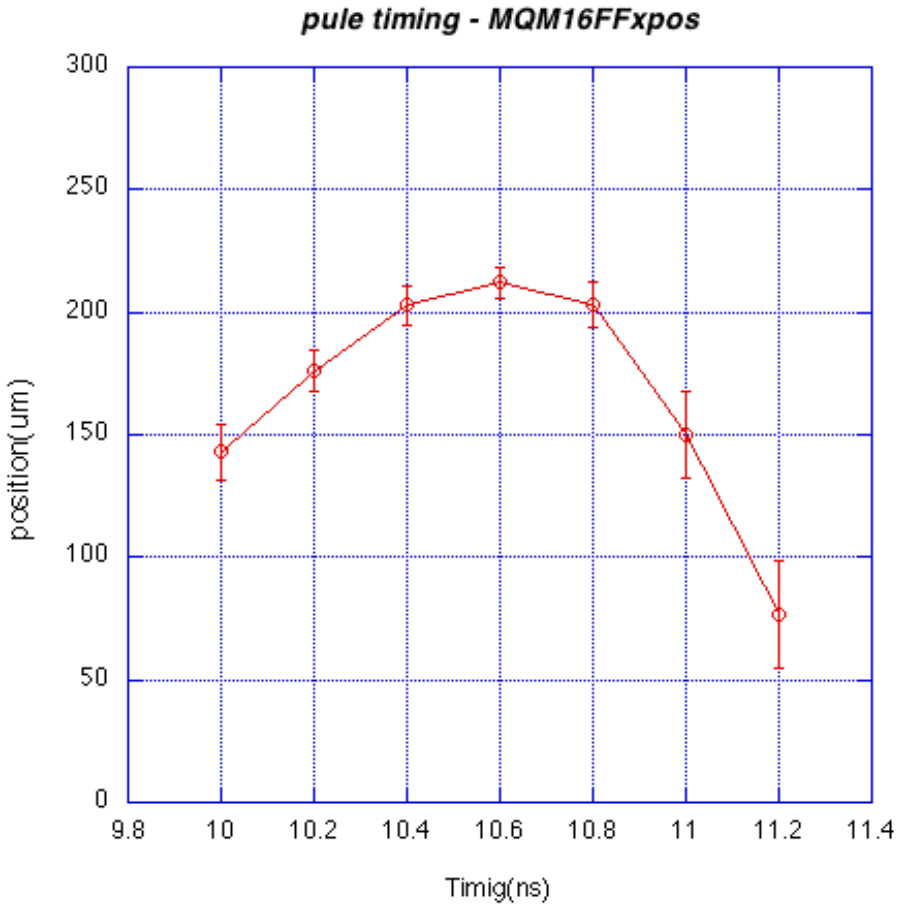
K.Kubo

Use for ATF2 beam



The beam tuning at the focus point was done at the ATF2 beam line including the dispersion correction by looking the beam profile change of the MS1IP wire scanner. The measured size was limited to 1.4um due to the wire size.

Flattop of the kick field and the jitter



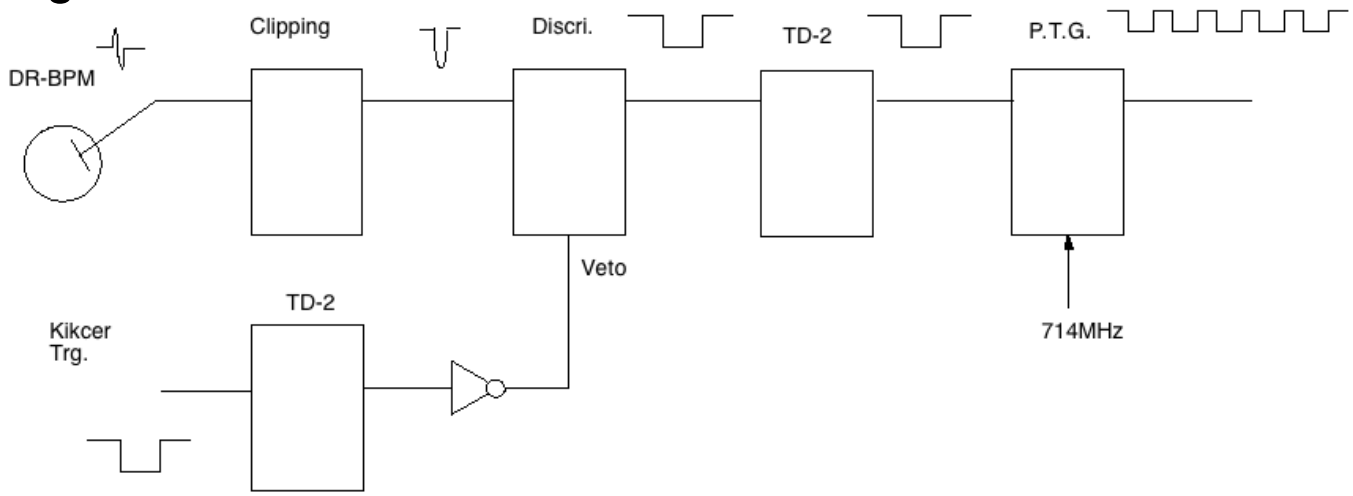
Plot shows the beam position at MQM16FF BPM. The flattop of the kick field is only 400ps and the jitter increased at the both side of the flat top.

It needs to careful timing adjustment of four pulses.

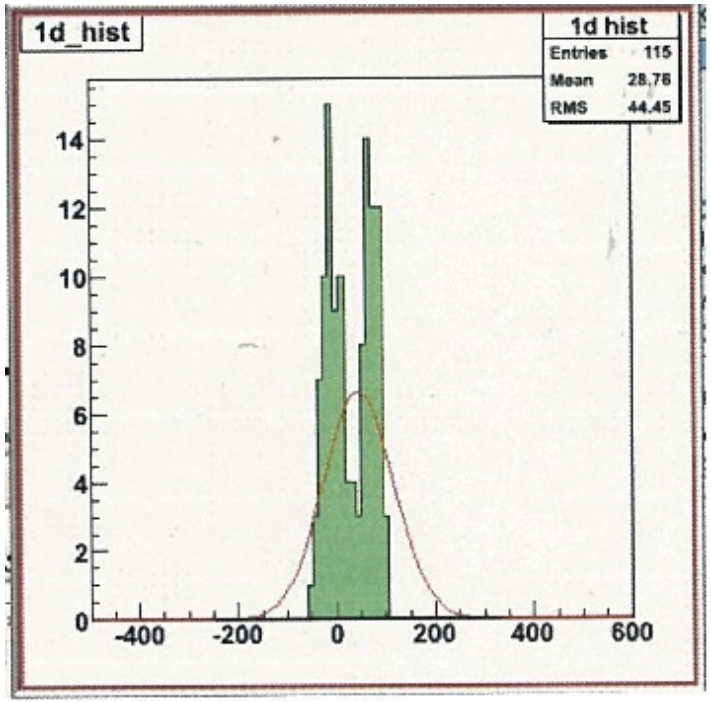
Re-synchronization circuit

The frequency scan is needed for the dispersion measurement. The problem is the count error at the frequency scan when the clock signal moves across the input trigger timing, some of the counter counts one and the others counts zero. Because the phase of the clock signal is different for each counter, there is a probability that the count error happens at the frequency scan for the kicker trigger. If the count error happens, then the trigger shifts 2.8ns(1.4ns) and the orbit of the extracted beam changes so much.

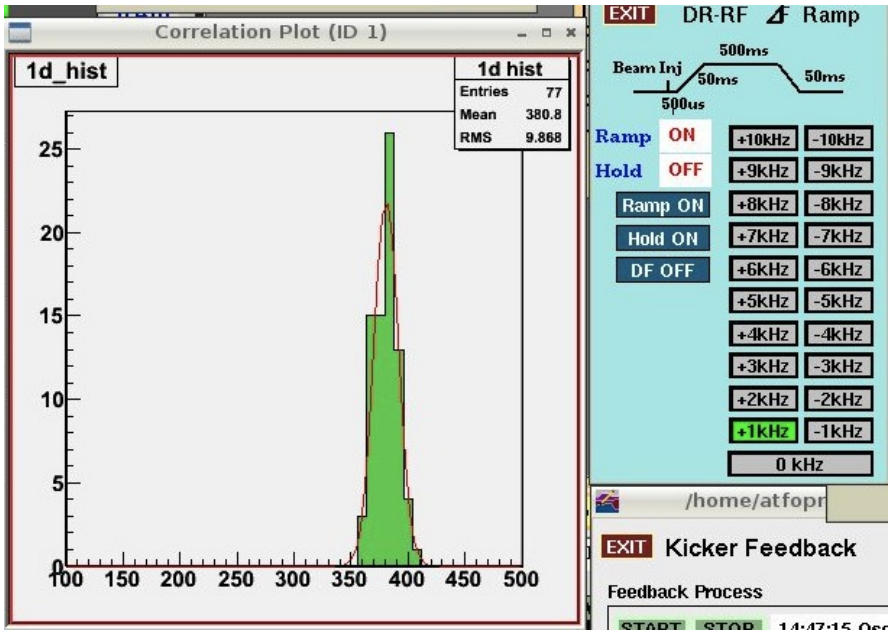
We introduced a re-synchronization circuit, which detects the beam timing from the DR BPM, then re-makes the trigger signal from the kicker trigger and BPM signal.



Jitter measurement @ df on condition

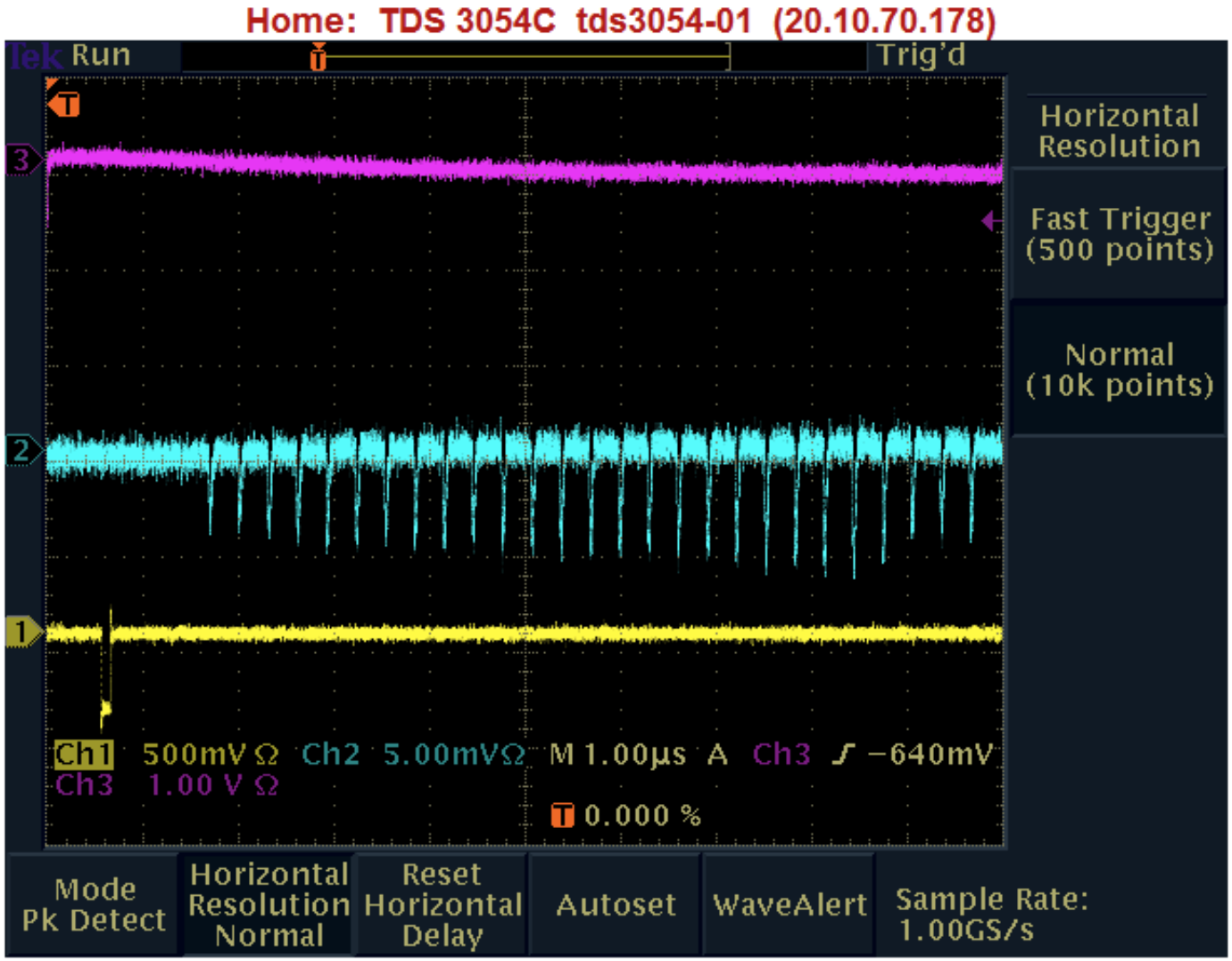


Without Re-synchronization

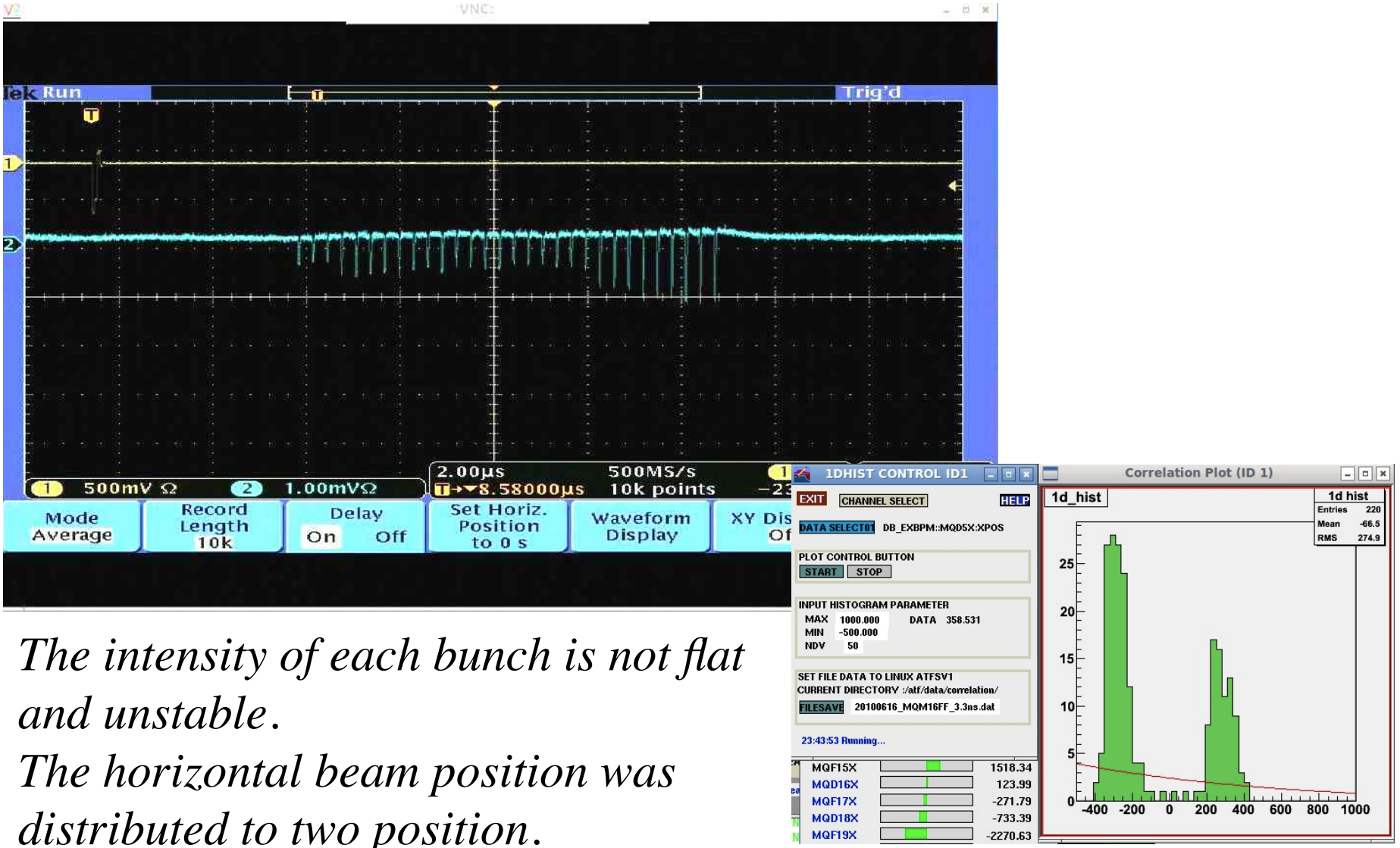


With Re-synchronization

Multi-bunch extraction (27 bunches) with 308ns bunch spacing
2010/03/17



Multi-bunch extraction (30 bunches) with 308ns bunch spacing 2010/06/17



The intensity of each bunch is not flat and unstable.

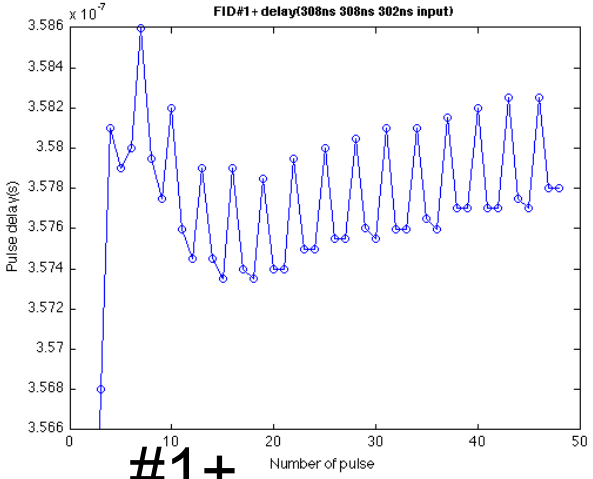
The horizontal beam position was distributed to two position.

Multi-bunch beam extraction

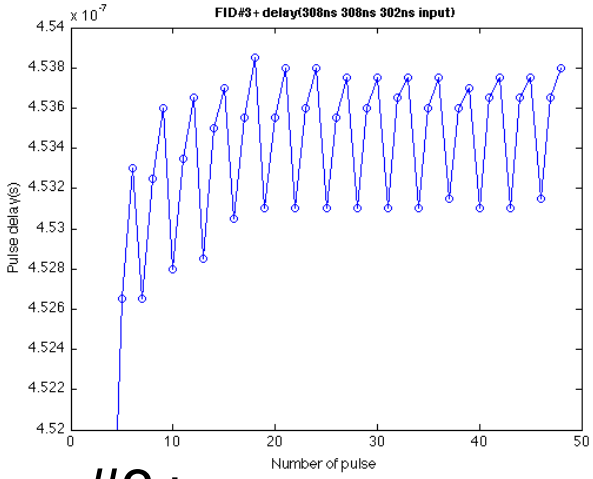
There is two problems,

- *Pulse timing of FID pulser - the timing delay of each pulse is different.*
- *Multi-bunch(Multi-train) instability - It makes unstable storage current.(K.Kubo)*

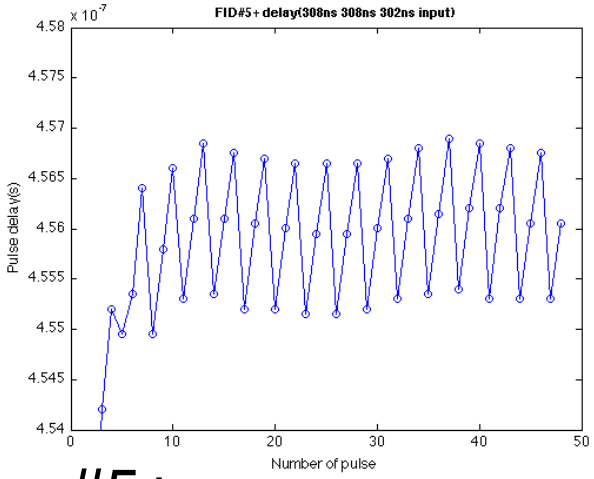
FID10-3000G timing delay from the input to the output



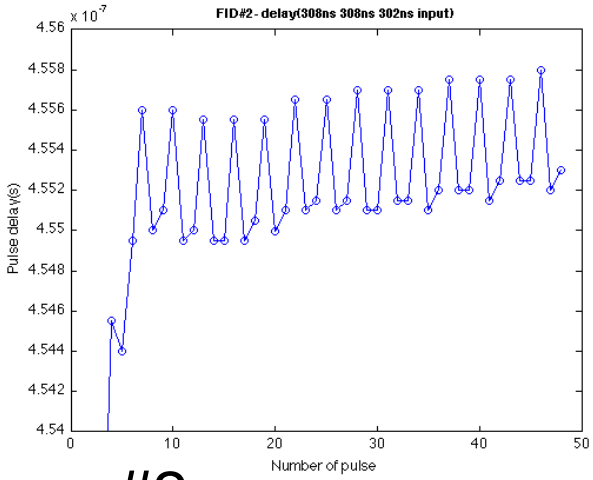
#1+



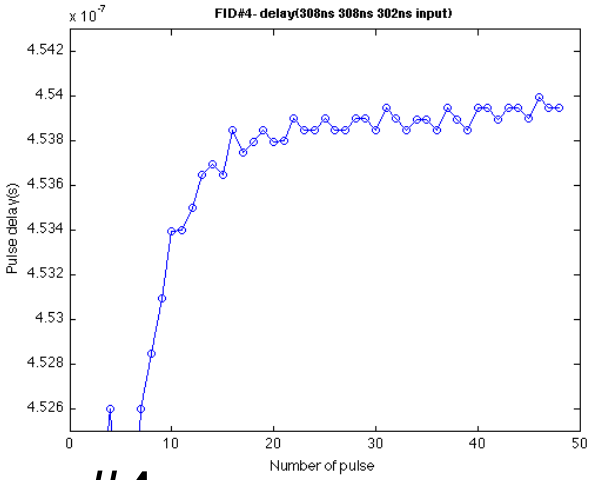
#3+



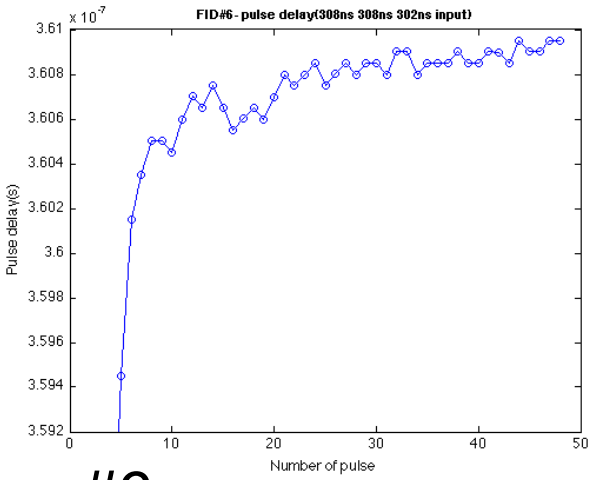
#5+



#2-



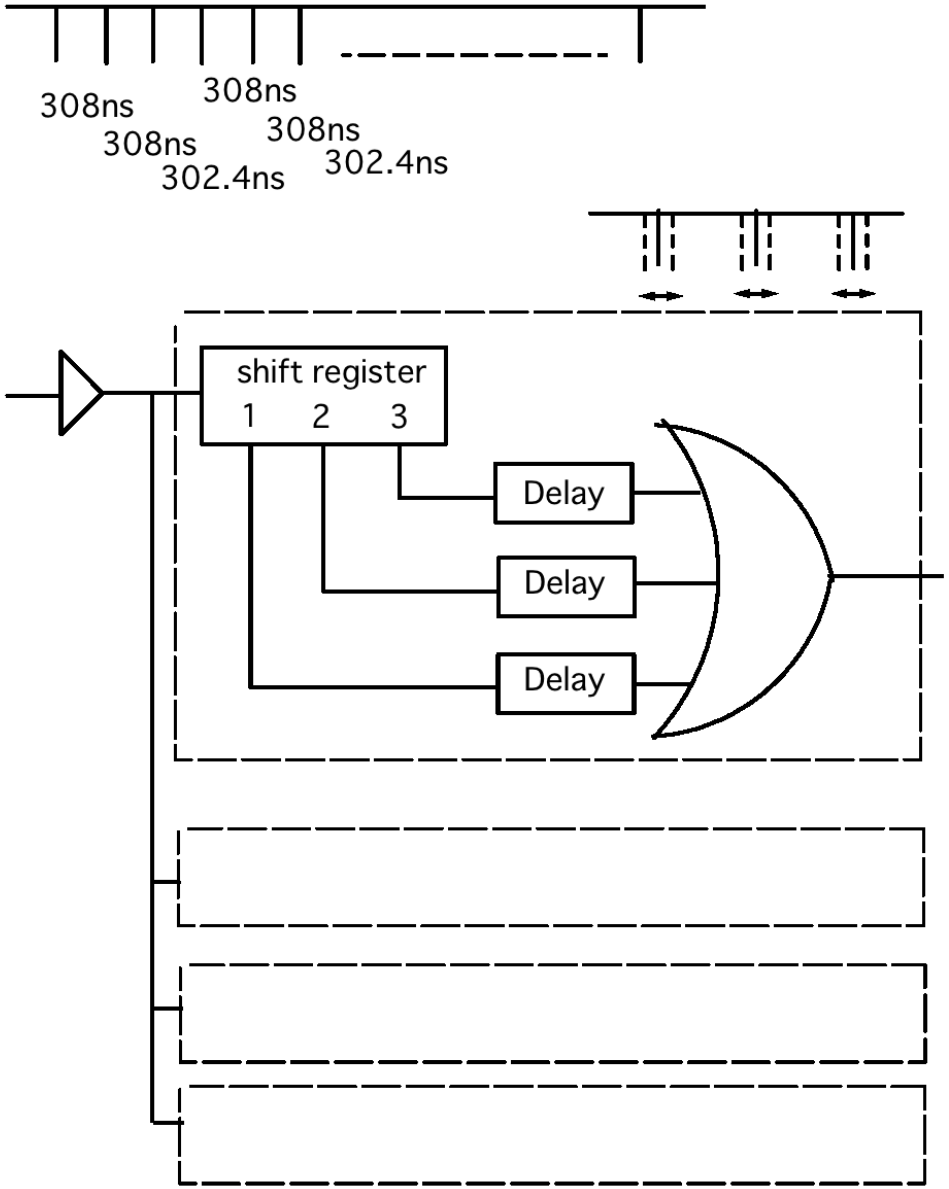
#4-



#6-

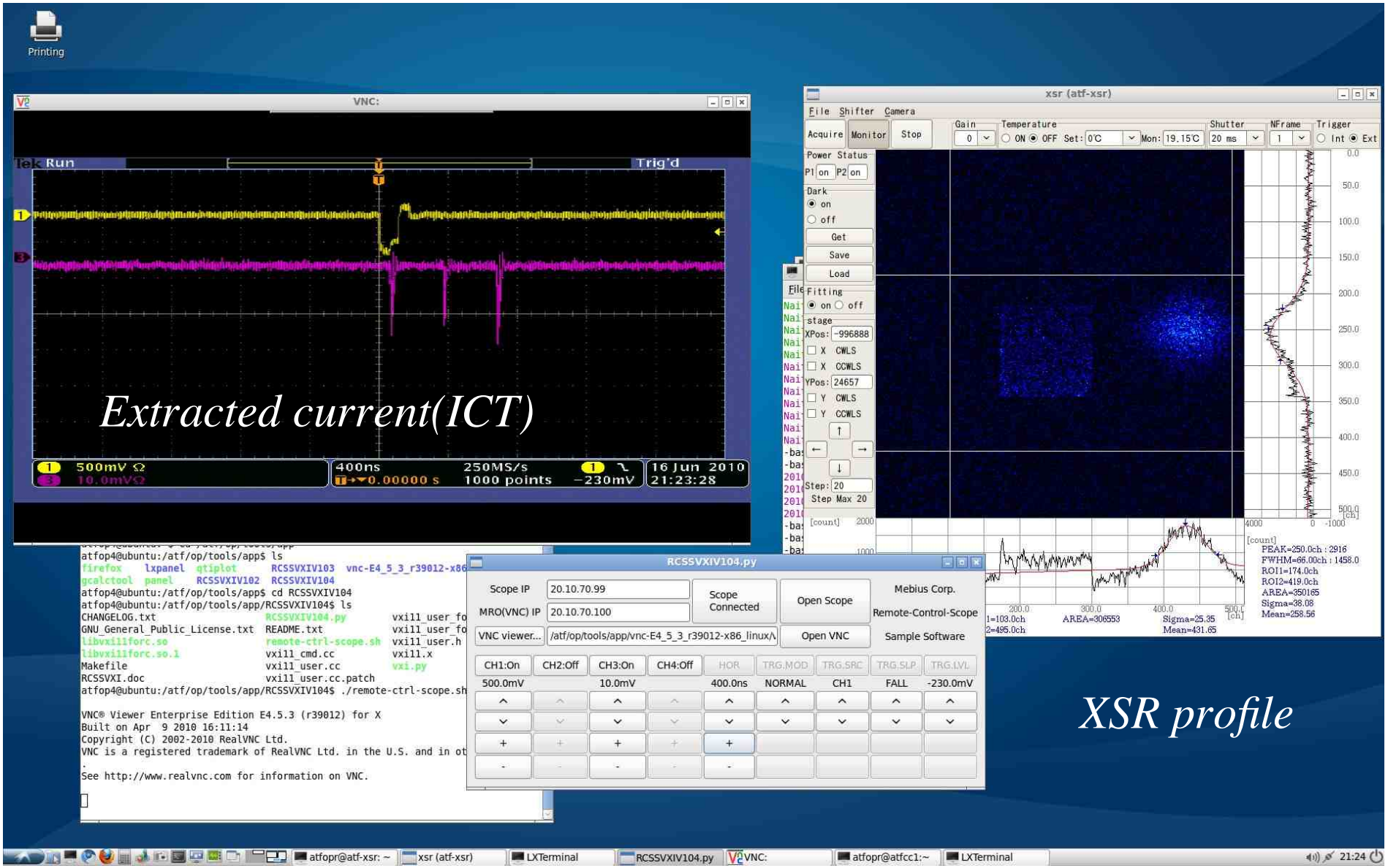
Hor: number of pulse, Ver: timing delay(200ps/tic)
measured by a oscilloscope with 50ps/sample resolution

pulse train delay adjustment circuit



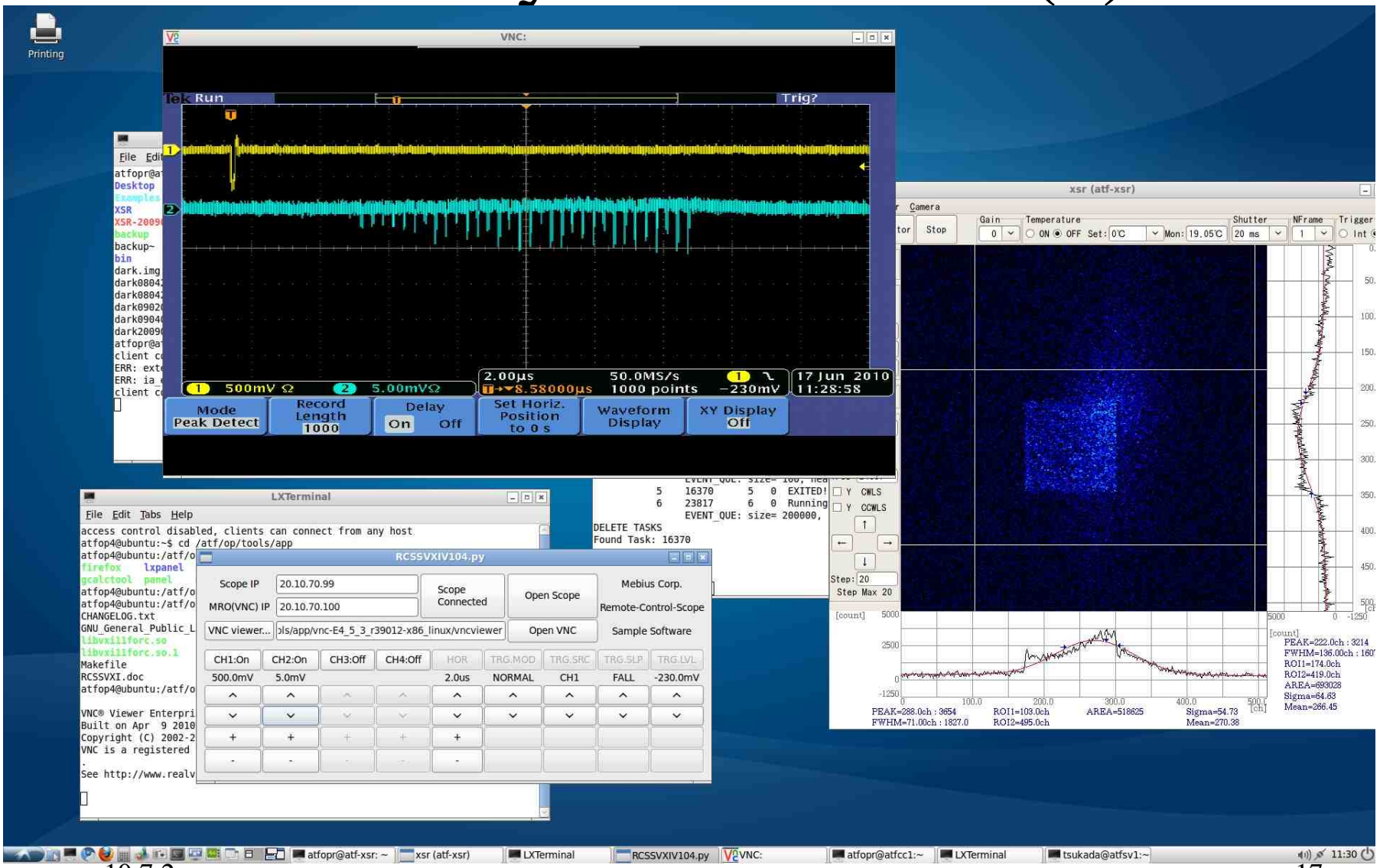
The pulse train of the input signal is separated every three pulses and delayed independently for compensate the output pulse timing of FID pulsers.
The different timing delay of FID pulsers will be compensated by using this circuit.

Instability@multi-train(1)

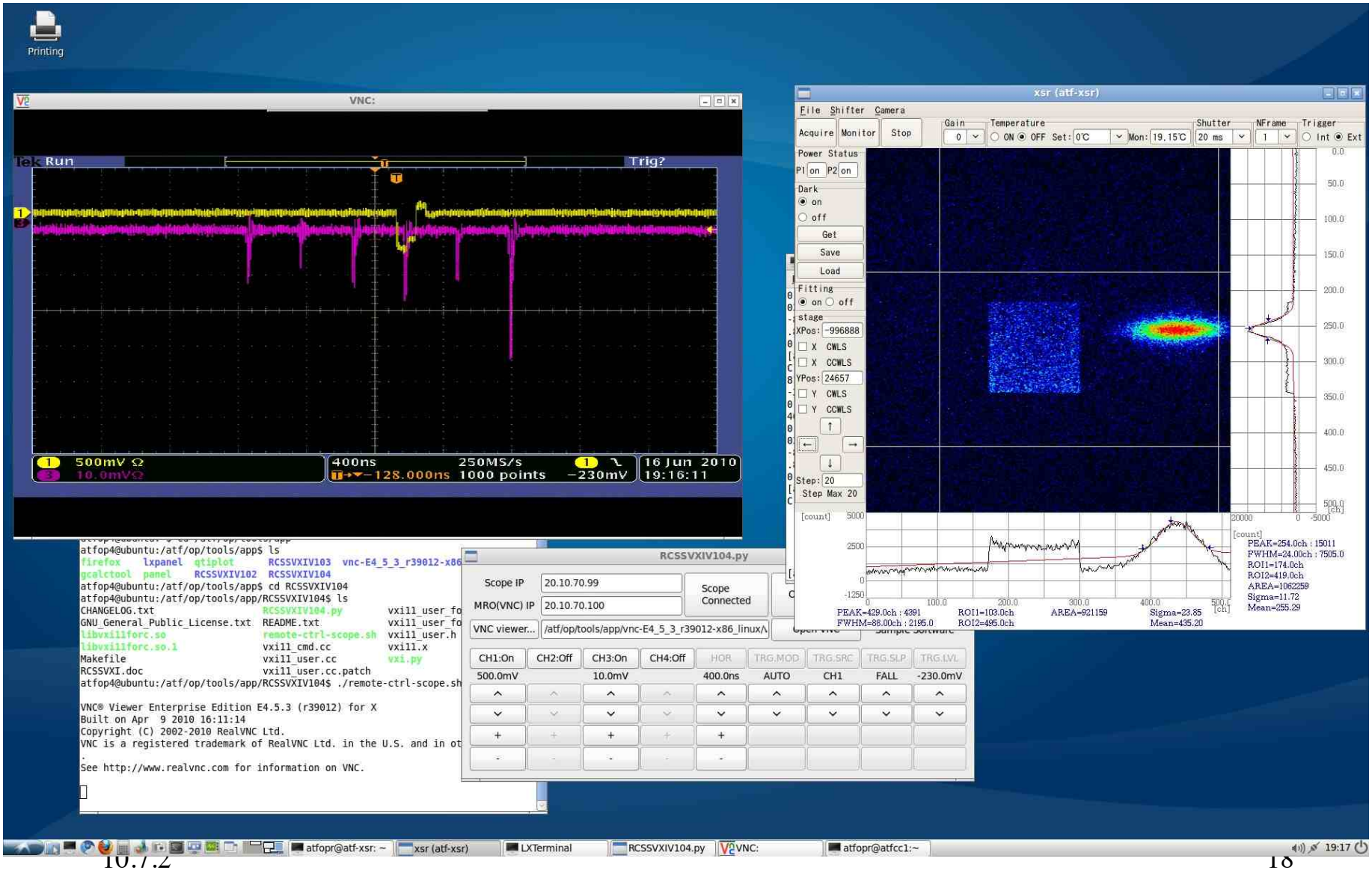


XSR profile

Instability@multi-train(2)



Instability@multi-train(3)

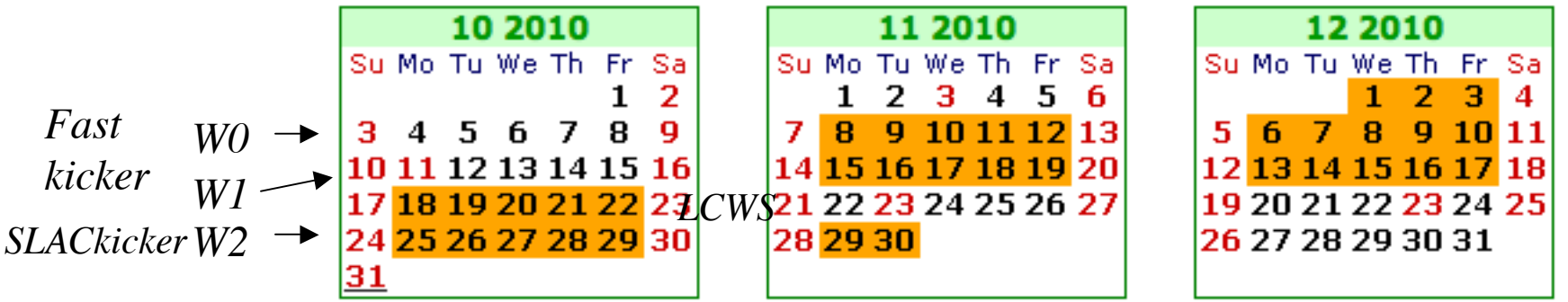


Next Beam Test

Fast kicker beam test,
2010 Oct 2weeks

Goal of the next beam test,

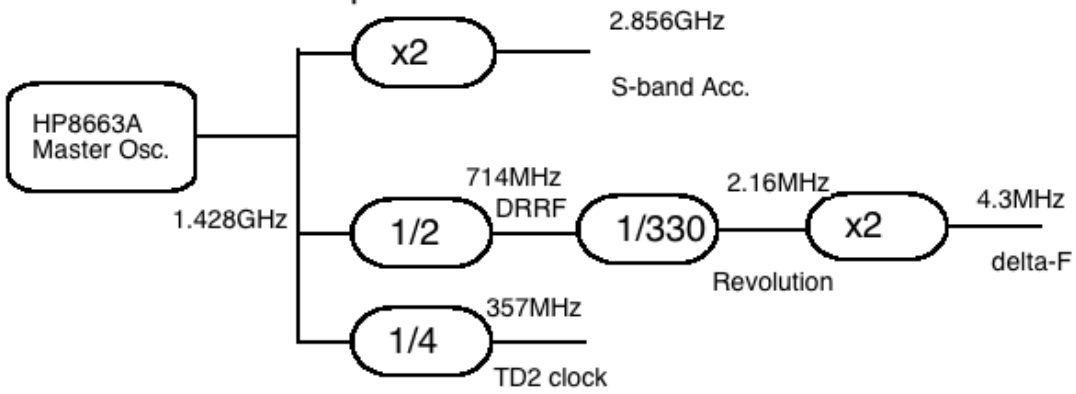
1. To install and test of the pulse train delay circuit.
2. To confirm the stable beam extraction up to 30 bunches, to measure the each orbit of multi-bunch.
3. To confirm the long term stability of the fast kicker.



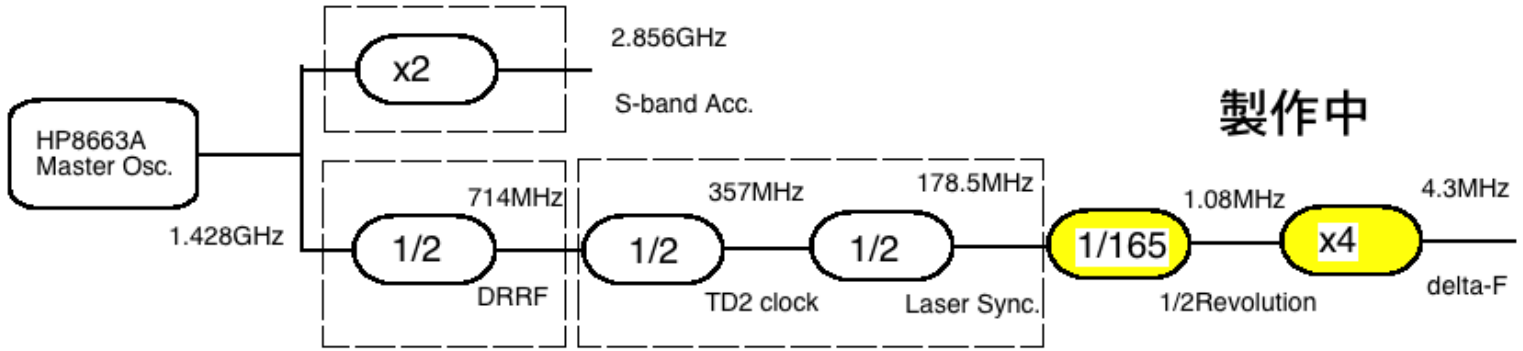
Start up(W0, W1)
Linac tuning, timing system, DR circumference, monitors(CPBPM)

Renewal of Reference Frequencies

2010.06 Reference frequencies



2010.10 Reference frequencies



Fast kicker until 2013

"Replace from pulse magnet to strip-line and use as ordinary kicker"

Single bunch : same quality of the double kicker

-> The extracted beam can use for the other study

-> The extracted beam need to check long term stability

Multi bunch : 30 bunches extracted

-> To cure the problem of FID pulser timing

-> To cure the instability in DR

-> To check the quality of each bunch