



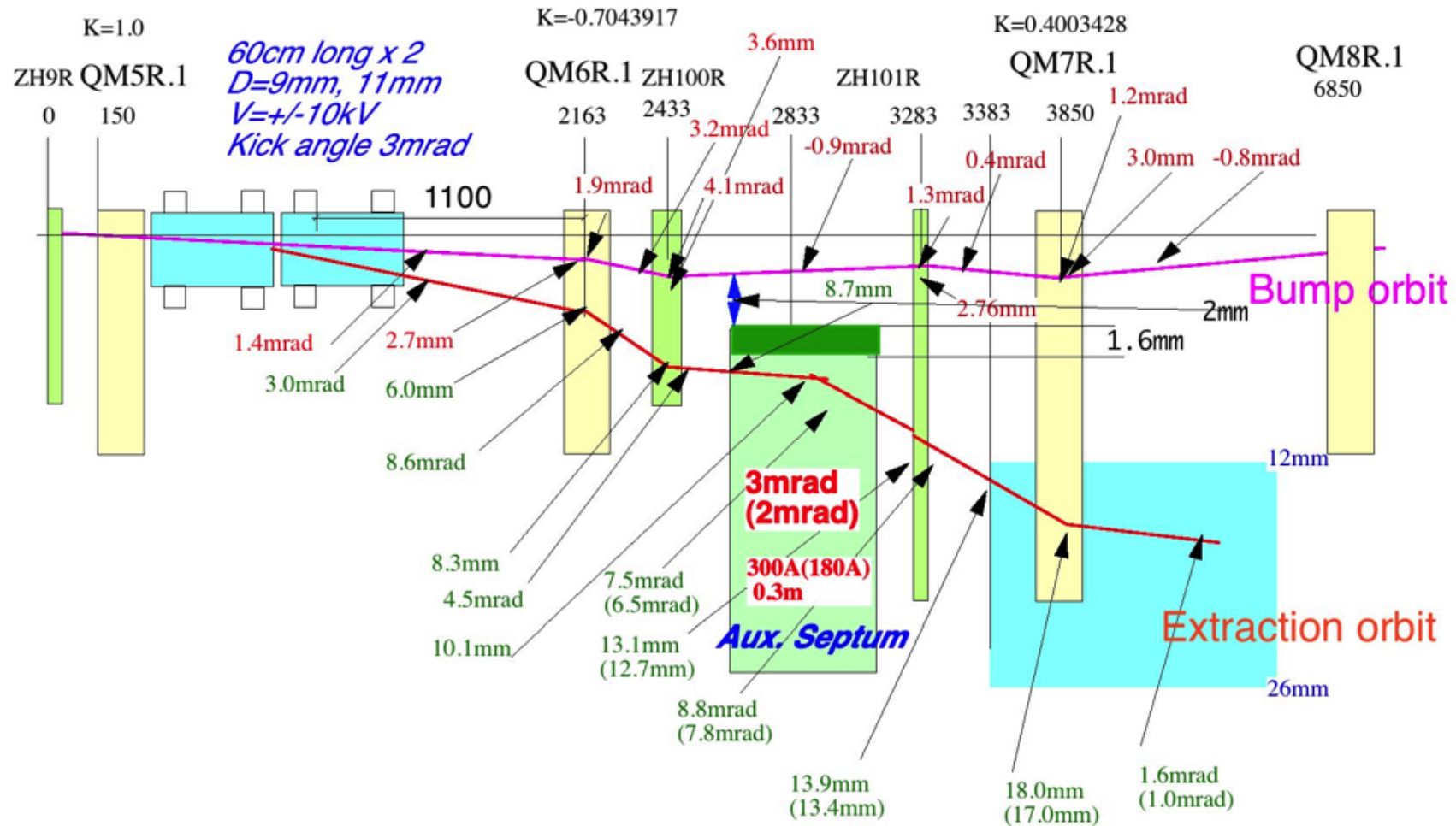
Fast kicker performance and plan

*ATF2 project meeting
2010/07/01 T.Naito*

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



3mrad kick angle





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.

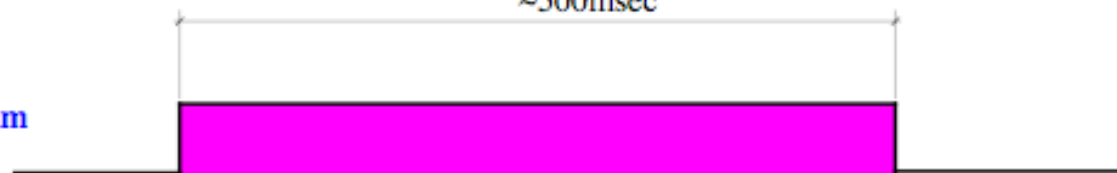
Injection beam

1st Train 2nd Train 3rd Train



~500msec

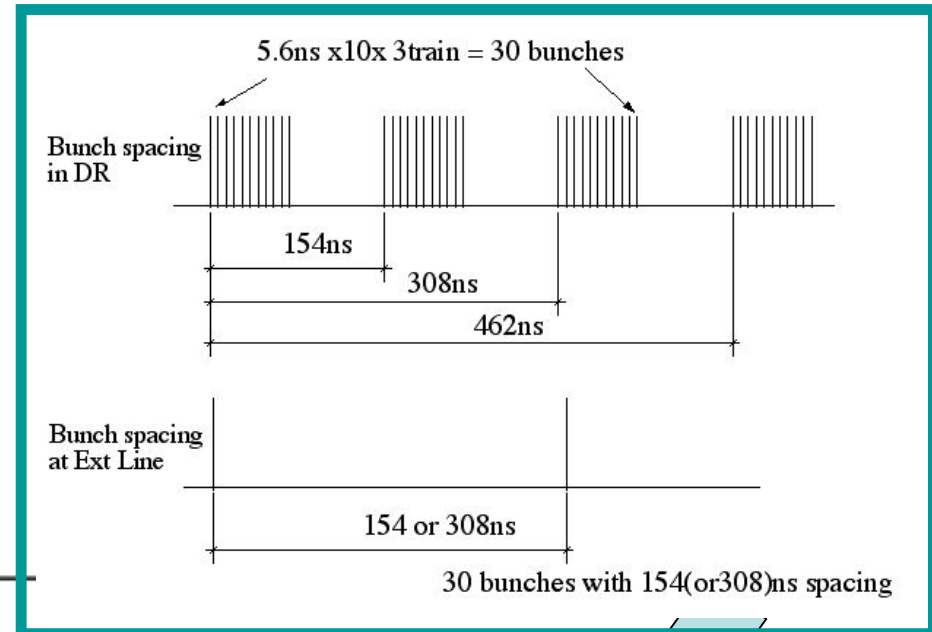
Stored beam



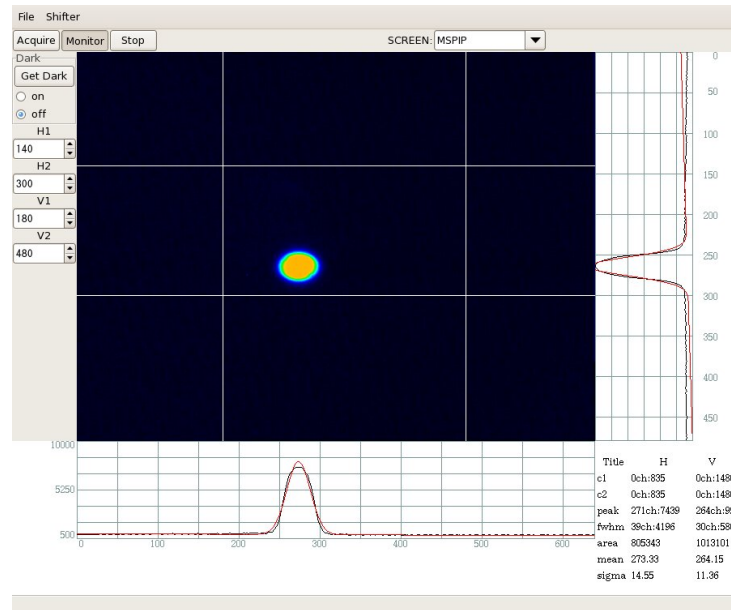
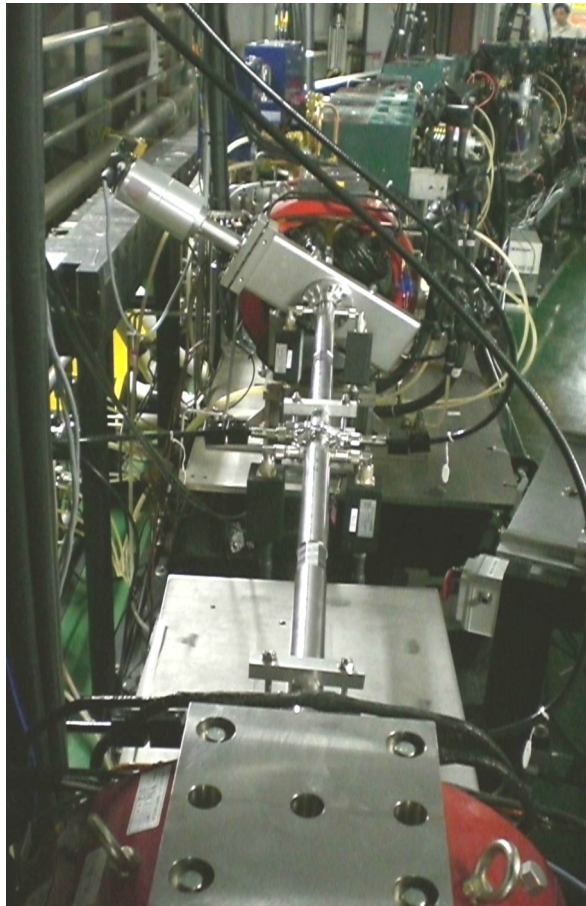
Local bump height



Extracted beam



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



*Beam profile at
MSIX*

*Firs Beam extraction was confirmed
2009/Oct/22. However, the kick angle jitter
was not so good(2×10^{-3}) and the extracted
multi-bunch was only 17 bunches not 30
bunches.*

Improvements from Oct09

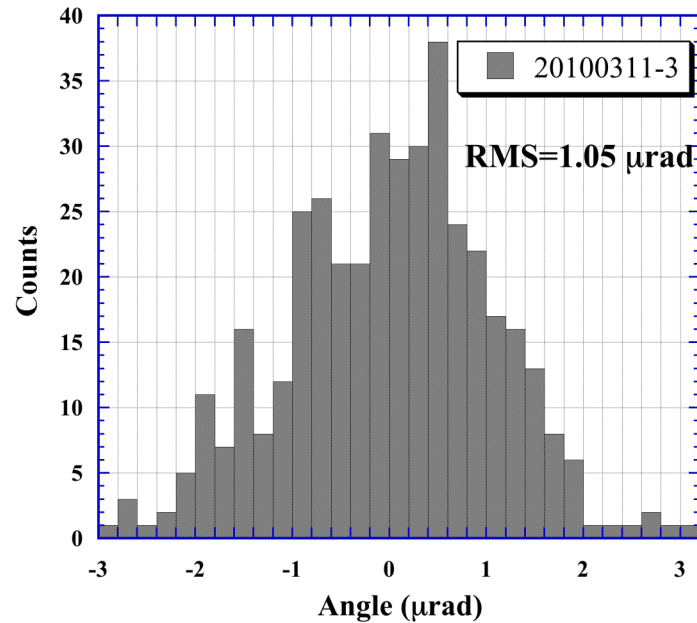
- 1. Wrong trigger timing for multi-bunch was corrected. We found that the multi-bunch were injected to the unintended bucket number of DR at Oct09.*
- 2. Pulsers were repaired. The waveforms were improved. One of pulsers did not work 3MHz at Oct09.*
- 3. Laser 2.8ns → 56ns*
- 4. Trigger circuit - fine 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 + 1 1mm to get aperture .*



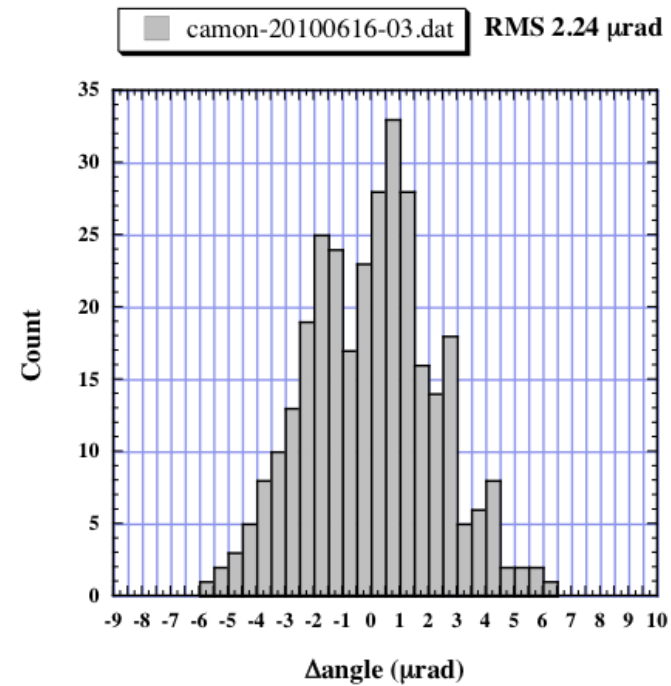
Distribution of fitted angle at EXT entrance

(single bunch)

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



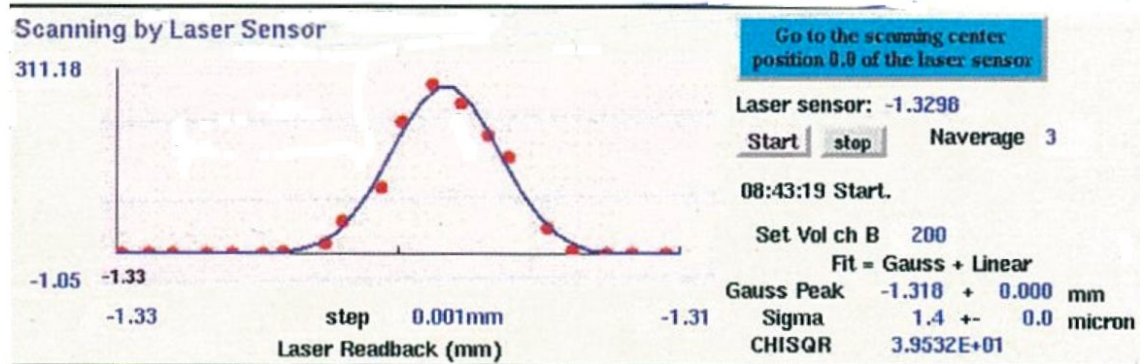
Jitter $2.24e-6/3e-3=7.4e-4$



K.Kubo

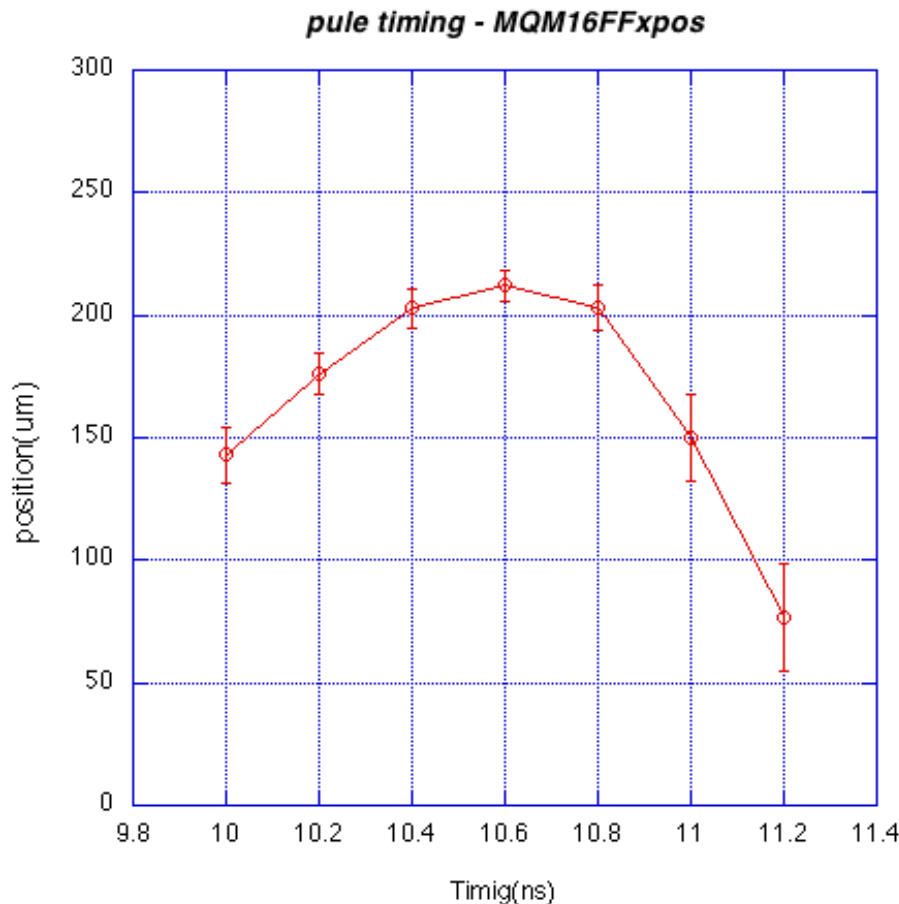


Use for ATF2 beam



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 1.4 μ m 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.

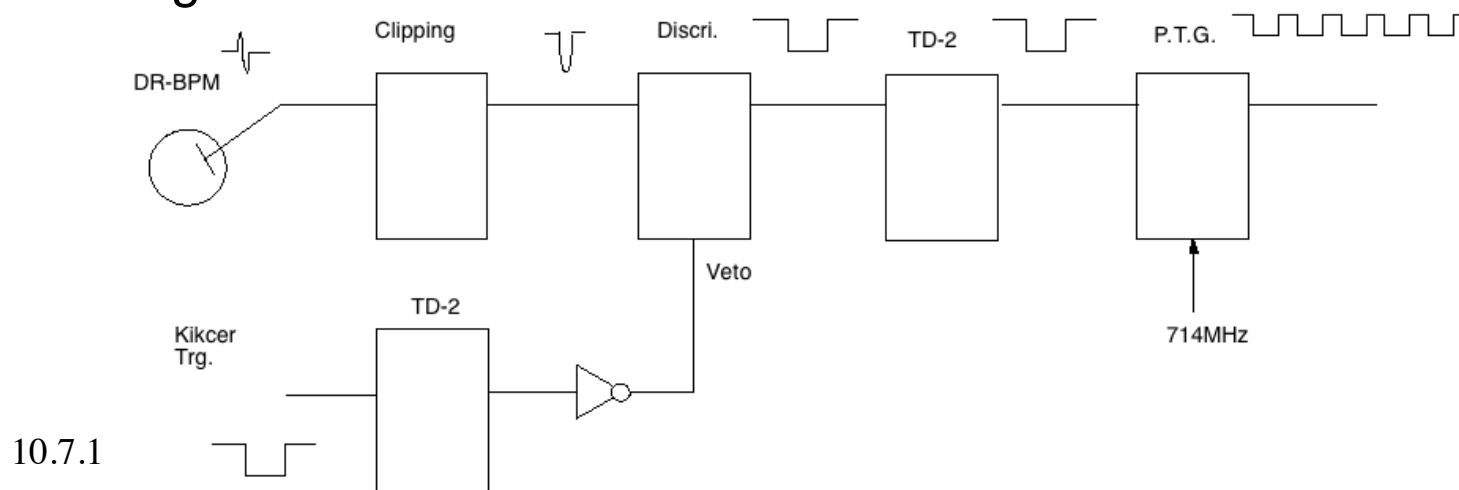
It needs to careful timing adjustment of four pulses.



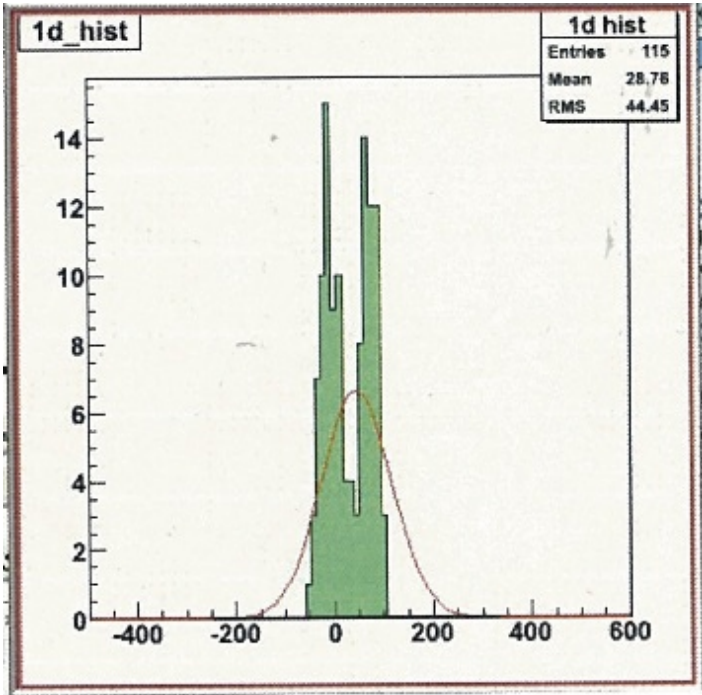
Re-synchronization circuit

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.

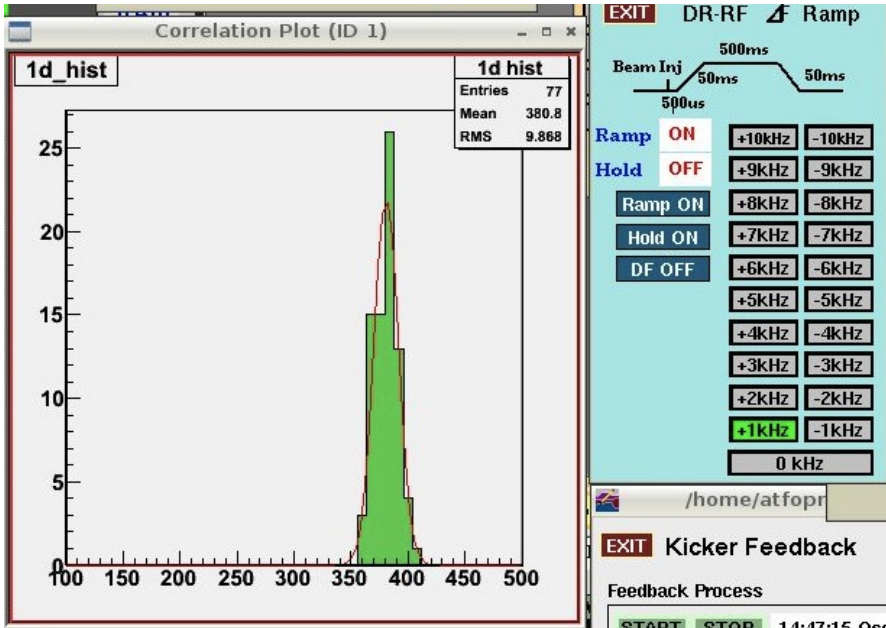
We introduced a re-synchronization circuit, which detects the beam timing from the DR BPM, then re-makes the trigger signal from the kicker trigger and BPM signal.



Jitter measurement @ df on condition



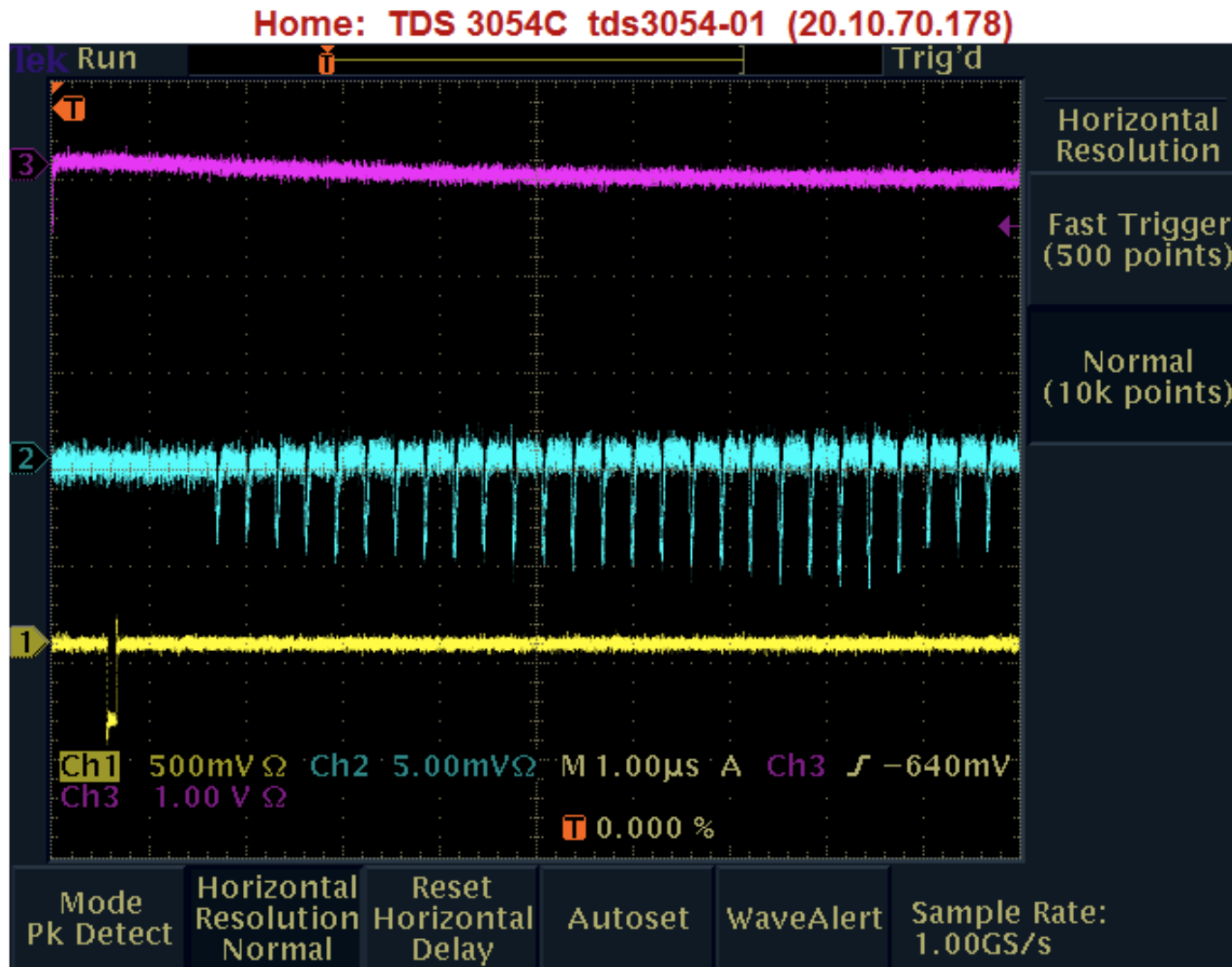
Without Re-synchronization



With Re-synchronization

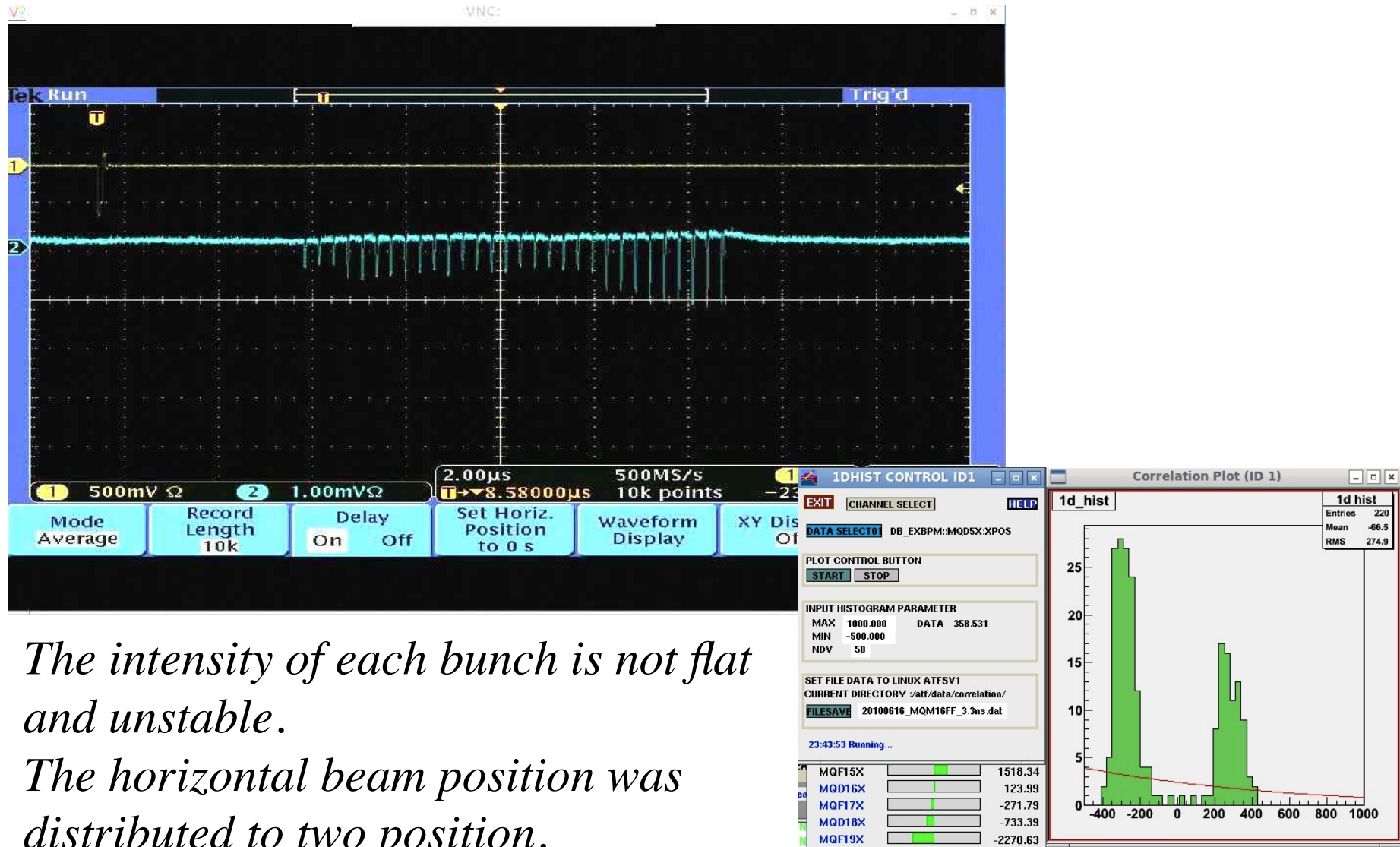


Multi-bunch extraction (27 bunches) with 308ns bunch spacing 2010/03/17





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.



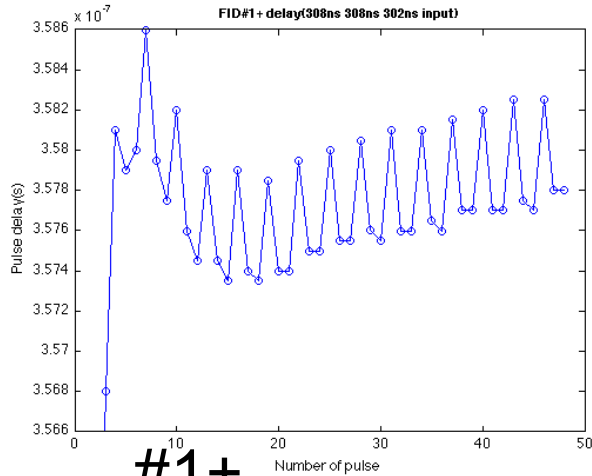
Multi-bunch beam extraction

There is two problems,

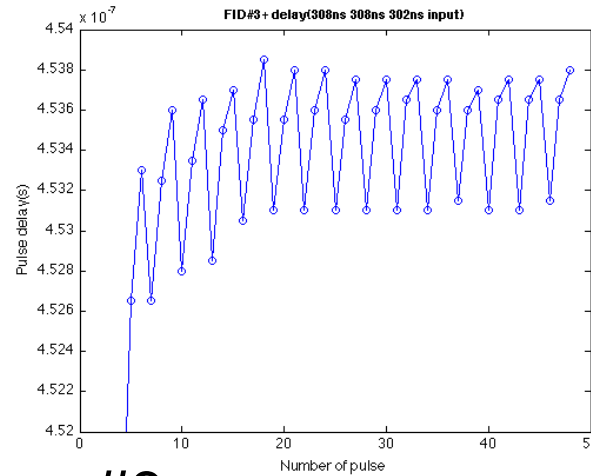
- *Pulse timing of FID pulser - the timing delay of each pulse is different.*
- *Multi-bunch(Multi-train) instability - It makes unstable storage current.(K.Kubo)*



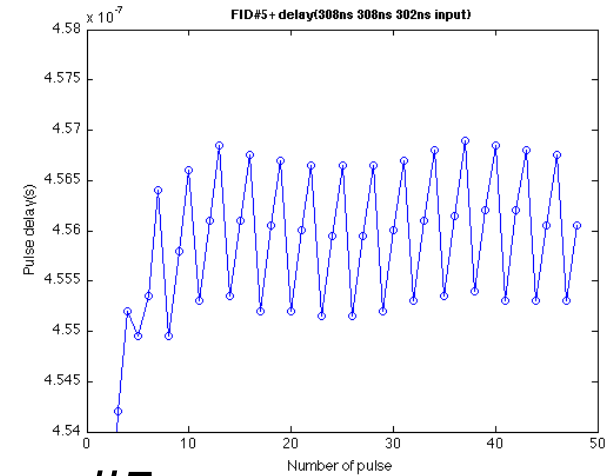
FID10-3000G timing delay from the input to the output



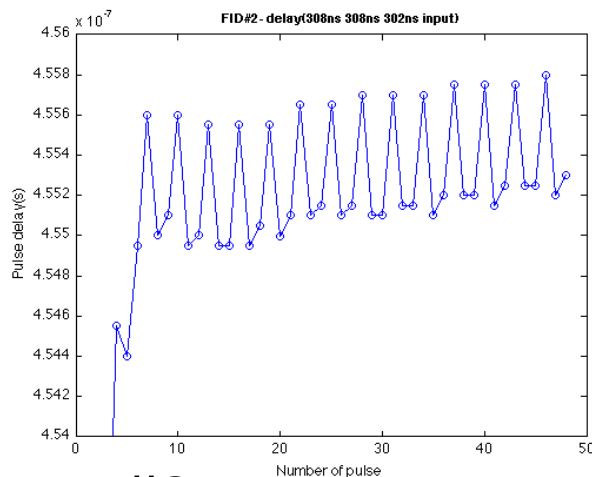
#1+



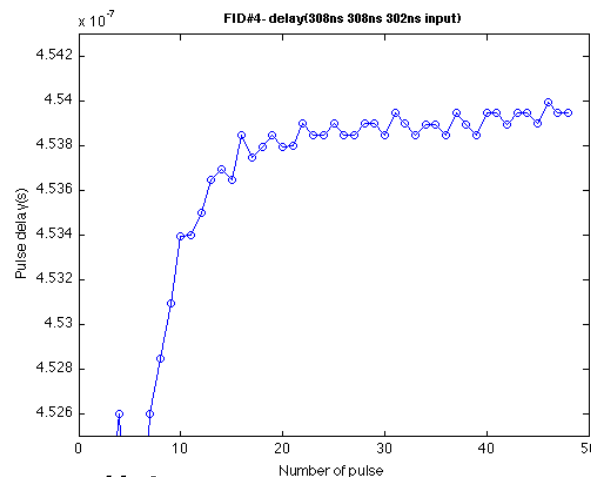
#3+



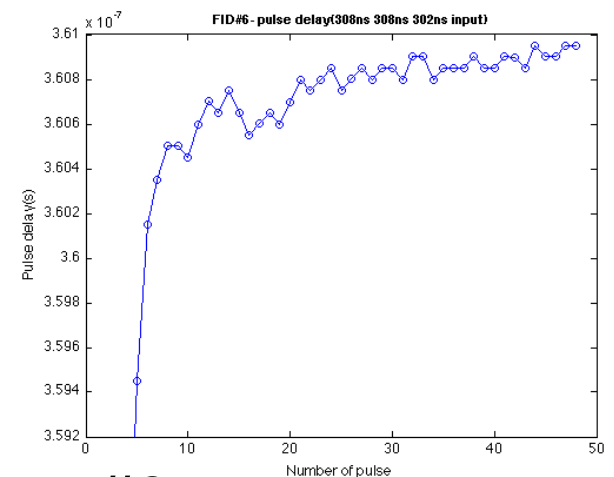
#5+



#2-



#4-

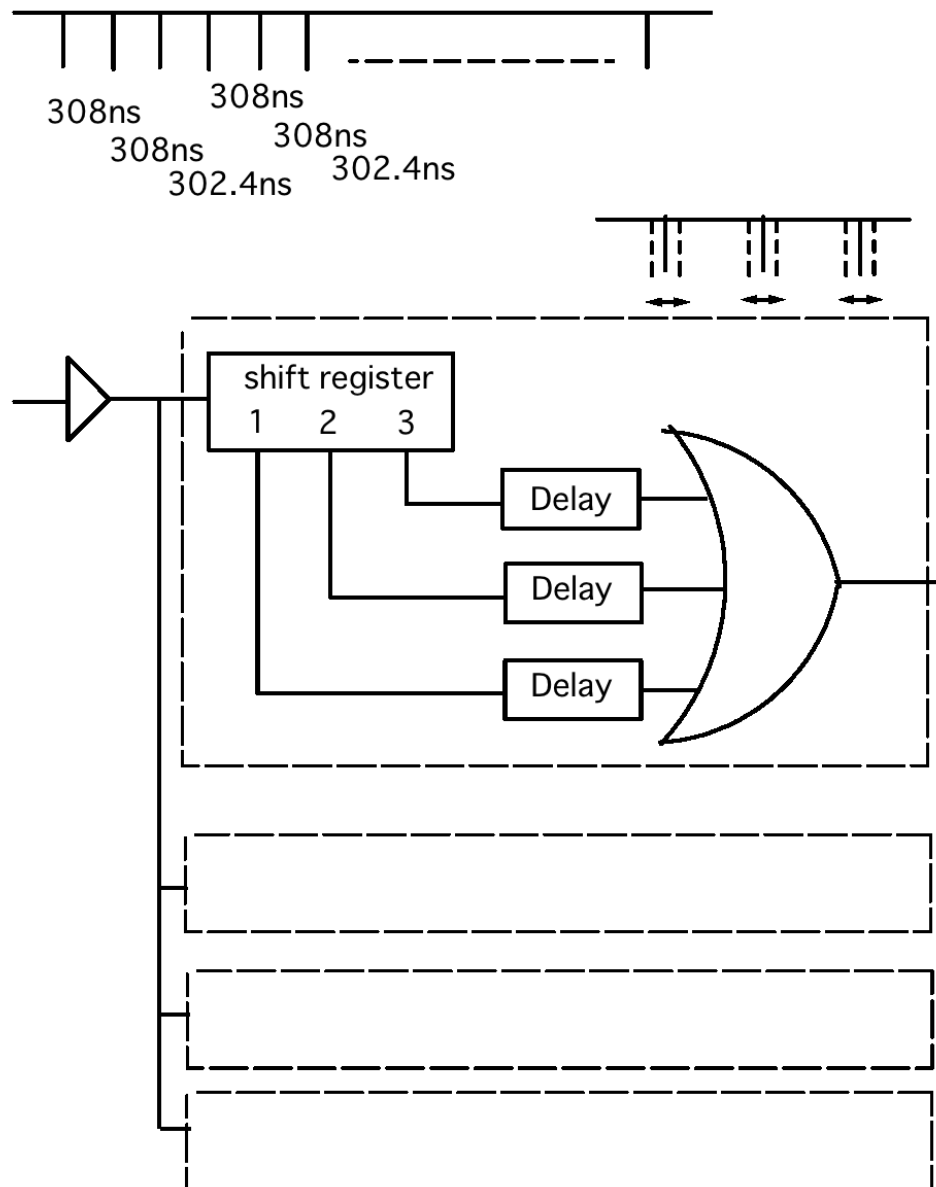


#6-

Hq: number of pulse, Ver: timing delay(200ps/tic)
10.7.1 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)

The screenshot displays a desktop environment with several windows:

- VNC Viewer:** Shows a Tektronix oscilloscope interface with two waveforms. The text "Extracted current (ICT)" is overlaid on the plot. The scope settings at the bottom indicate 500mV vertical scale, 400ns horizontal scale, and a trigger level of -230mV.
- Terminal Window:** Shows a series of shell commands and their outputs, including file listings and the execution of a remote-control-scope script.
- RCSSVXIV104.py Window:** A configuration window for a remote-control-scope, showing fields for Scope IP (20.10.70.99) and MRO(VNC) IP (20.10.70.100).
- xsr (atf-xsr) Window:** Displays an XSR profile, which is a 2D histogram of counts. The profile shows a distribution of counts with a peak at approximately 250.0 counts. The window includes various control buttons and a list of fitting parameters.

The XSR profile window includes the following fitting parameters:

Parameter	Value
PEAK	250.0ch : 2916
FWHM	66.00ch : 1458.0
ROI1	174.0ch
ROI2	419.0ch
AREA	350165
Sigma	38.08
Mean	258.56

The XSR profile window also displays a histogram of counts with the following statistics:

Channel	Count	Area	Sigma	Mean
1=103.0ch	~1000	306553	25.35	431.65
2=495.0ch	~1000	~1000	~1000	~1000

XSR profile



Instability @ multi-train(2)

The screenshot displays a multi-windowed environment. The top window is an oscilloscope titled 'VNC:' showing two waveforms: a yellow one at the top and a cyan one below it. The yellow waveform shows a sharp spike. The cyan waveform shows a series of smaller spikes. The oscilloscope settings at the bottom indicate a scale of 500mV and 5.00mV, a time base of 2.00μs, and a trigger level of -230mV. The date and time are 17 Jun 2010 11:28:58.

To the right is a camera interface window titled 'xsr (atf-xsr)'. It shows a dark image with a blue square region of interest. Below the image is a histogram showing a distribution of counts. The histogram has a peak at approximately 222.0ch. The camera settings include Gain, Temperature (19.05C), Shutter (20 ms), and NFrame (1).

At the bottom is an LXTerminal window showing a terminal session. The user is at 'atfop4@ubuntu' and has run 'cd /atf/op/tools/app'. The terminal output shows 'access control disabled, clients can connect from any host' and 'Found Task: 16370'. There is also a window titled 'RCSSVXIV104.py' with various control buttons for the scope.

Instability @ multi-train(3)



The screenshot displays a VNC desktop environment with several windows:

- Terminal Window:** Shows a shell prompt at `atfop4@ubuntu:/atf/op/tools/app$` with the following commands and output:

```
ls
firefox lxpanel gtiplot RCSSVXIV103 vnc-E4_5_3_r39012-x86
gcalctool panel RCSSVXIV102 RCSSVXIV104
atfop4@ubuntu:/atf/op/tools/app$ cd RCSSVXIV104
atfop4@ubuntu:/atf/op/tools/app/RCSSVXIV104$ ls
CHANGELOG.txt README.txt vxill user fo
GNU_General_Public_License.txt README.txt vxill user fo
libvxillforc.so remote-ctrl-scope.sh vxill.x
libvxillforc.so.1 vxill_cmd.cc vxill.x
Makefile vxill_user.cc vxill.py
RCSSVXI.doc vxill_user.cc.patch
atfop4@ubuntu:/atf/op/tools/app/RCSSVXIV104$ ./remote-ctrl-scope.sh
```
- Scope Control Panel:** A window titled `RCSSVXIV104.py` with the following settings:

Scope IP	20.10.70.99	Scope Connected
MRO(VNC) IP	20.10.70.100	
VNC viewer...	/atf/op/tools/app/vnc-E4_5_3_r39012-x86_linuxA	

CH1:On	CH2:Off	CH3:On	CH4:Off	HOR	TRG.MOD	TRG.SRC	TRG.SLP	TRG.LVL
500.0mV		10.0mV		400.0ns	AUTO	CH1	FALL	-230.0mV
^	^	^	^	^	^	^	^	^
v	v	v	v	v	v	v	v	v
+	+	+	+	+	+	+	+	+
-	-	-	-	-	-	-	-	-
- Scope Window:** A Tektronix oscilloscope window titled `VNC: Tek Run` showing a signal trace. The settings at the bottom are:

500mV Ω	400ns	250MS/s	16 Jun 2010
10.0mV ∇	128.000ns	1000 points	19:16:11
- xsr (atf-xsr) Window:** A window titled `xsr (atf-xsr)` showing a 2D histogram and a line graph. The histogram has a peak at approximately (430, 250). The line graph shows a peak at 430.0ch with a count of 4391. The settings at the bottom are:

PEAK=429.0ch : 4391	ROI1=103.0ch	AREA=921159	Sigma=23.85
FWHM=88.00ch : 2195.0	ROI2=495.0ch	Mean=435.20	



Next Beam Test

*Fast kicker beam test,
2010 Oct(Sep) 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.*

Fast kicker until 2013



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

Single bunch : same quality of the double kicker

-> can use for the other study

-> need to check long term stability

Multi bunch : 30 bunches extracted

-> need to cure the problem of FID pulser timing

-> need to cure the instability in DR

-> check to the quality of each bunch