

ATF Fast Kicker Progress



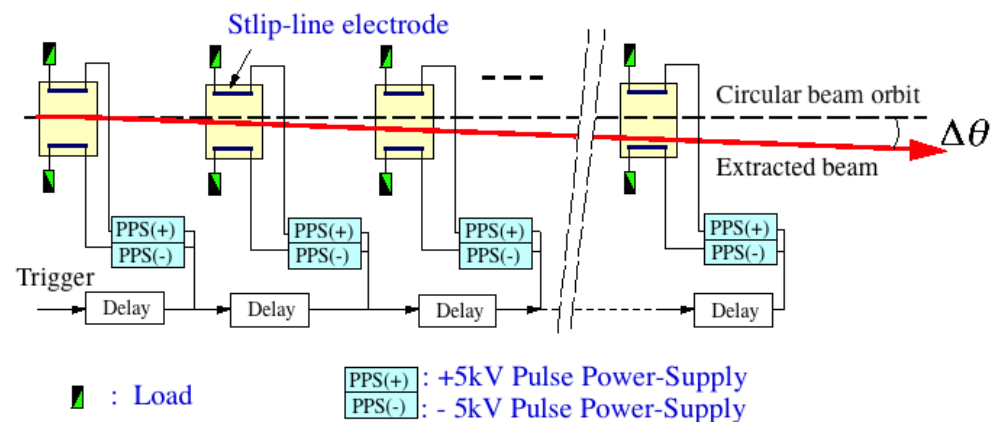
20101020 IWLC10

KEK T.Naito

- *Single unit test*
- *Beam extraction test from DR to ATF2 extraction line*
 1. *layout*
 2. *Single bunch extraction*
 3. *Multi-bunch extraction*
- *Summary and Future plan*

ILC kicker parameters

Kick angle	0.6 mrad
b_x at kicker	50 m
Repetition rate of the burst	6 - 2MHz
Number of macro-pulse	1320/2625/5120
Repetition rate of the macro-pulse	5 Hz
Rise and fall time	< 3 - 9 ns
Peak kick stability	0.07 %
Residual kick	< 0.42 mradian

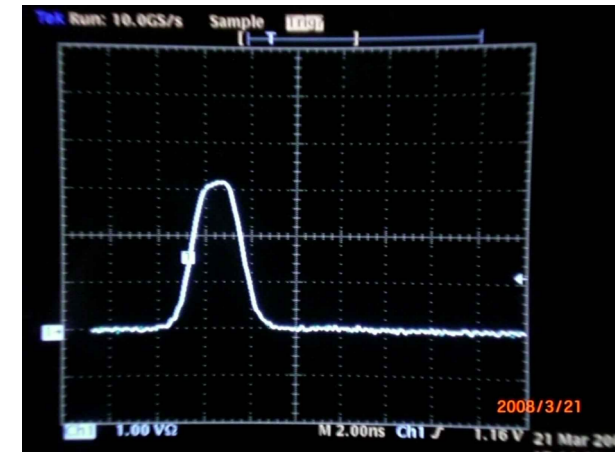


Single unit test

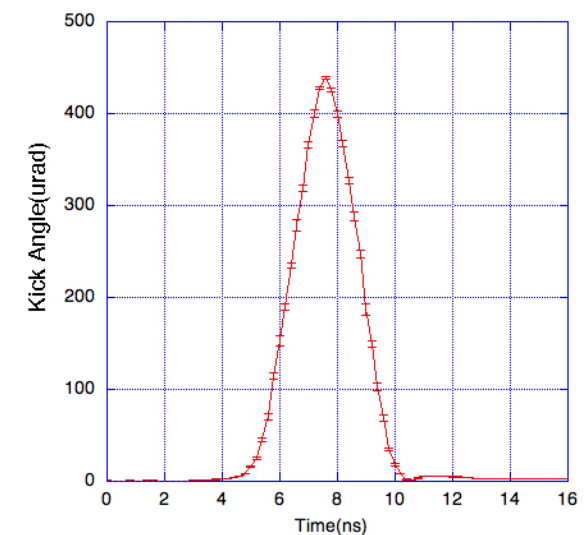
(To confirm 3ns of the rise time of the strip-line kicker)



- The time response of the kick field is strongly depends on the waveform of the drive pulse and the length of the strip-line electrode.
- FID pulser have 1.5ns rise time, 5kV peak voltage, 3MHz and 3000 burst pulse.
- The time response was tested when the drive pulse was applied to the 30 cm long strip-line electrode.
- The time response of the strip-line kicker was measured by measuring the betatron amplitude in ATF-DR. The measured rise time was 3ns, which meets the ILC requirement.

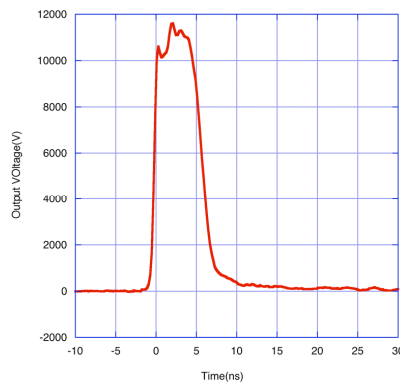
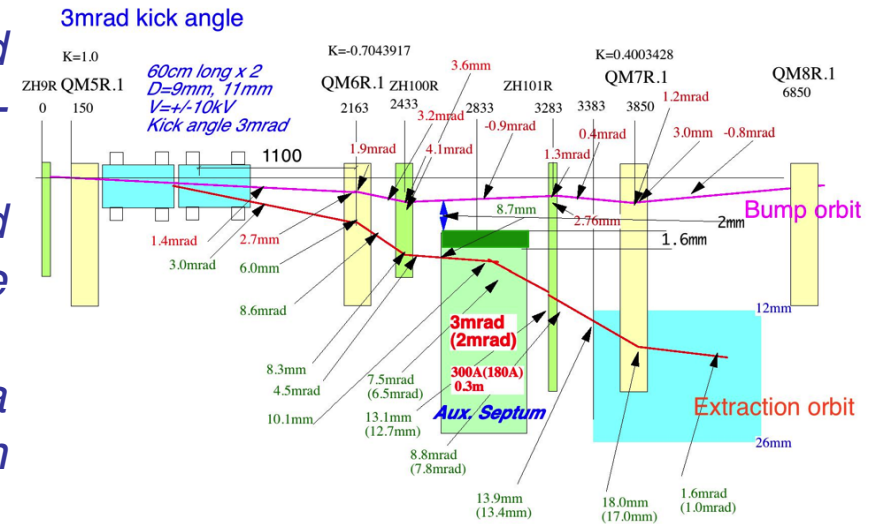


Waveform of FID pulser
5kv peak, 1.5ns rise time

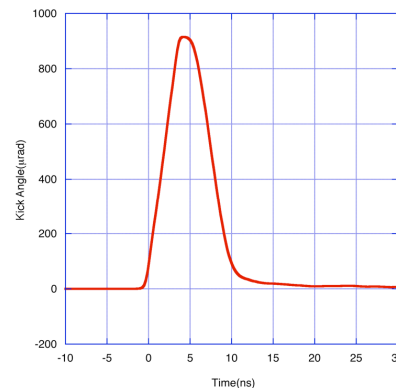


Beam extraction test(1)

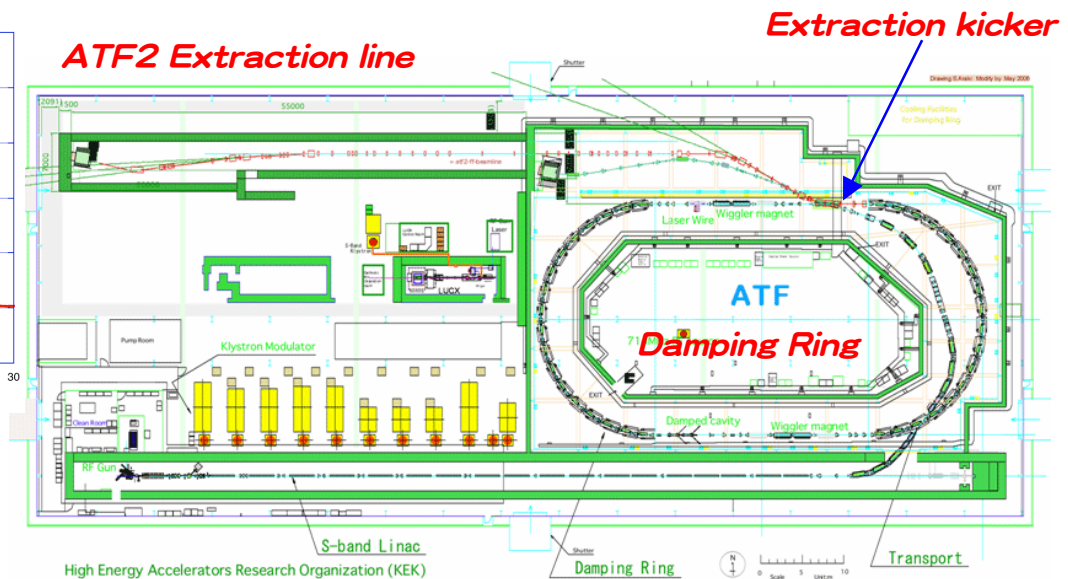
- The beam extraction test was proposed to confirm the performance of the strip-line kicker.
- The pulsed magnet kicker was replaced to two units of 60cm long strip-line kicker.
- To help the lack of the kick angle, a local bump orbit and an auxiliary septum is used.



Kicker pulse



Kicker field

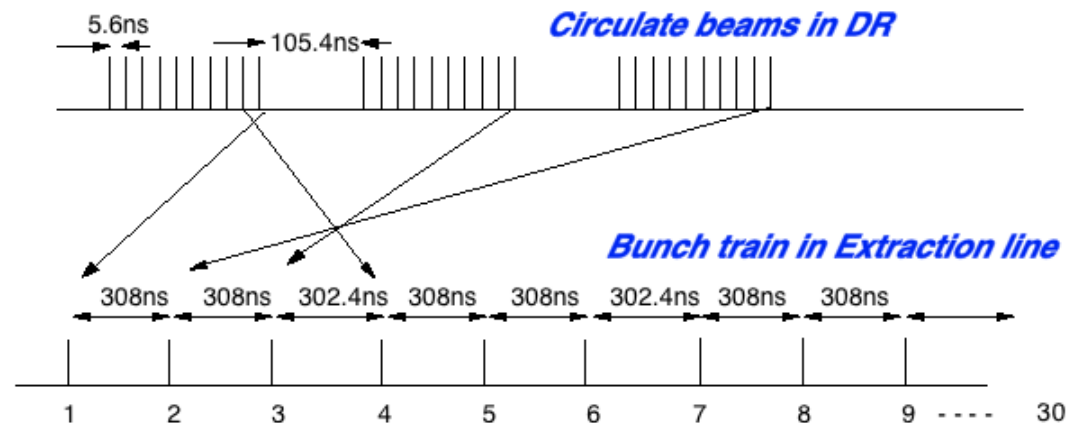
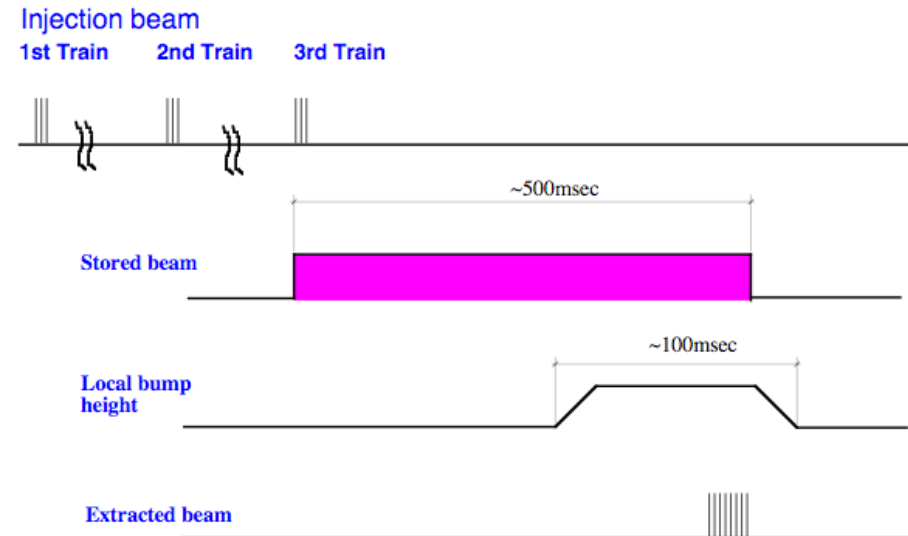




Beam extraction test(2)

The time sequence is that ,

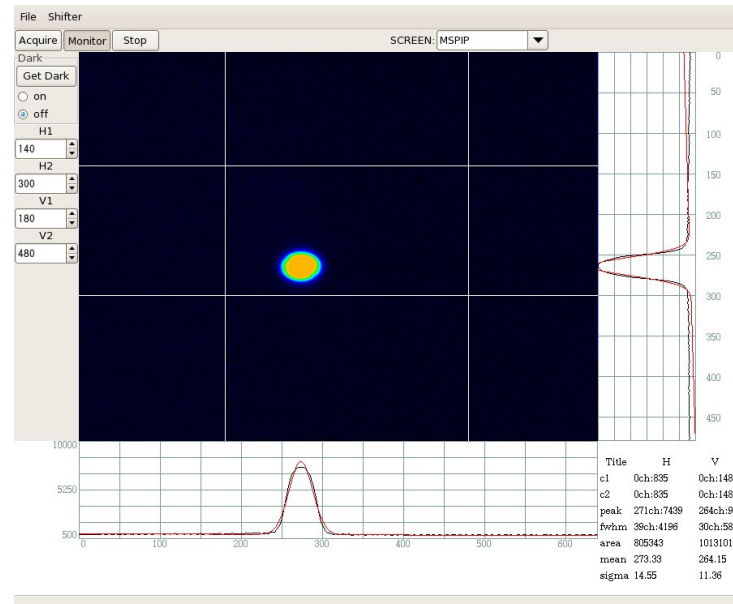
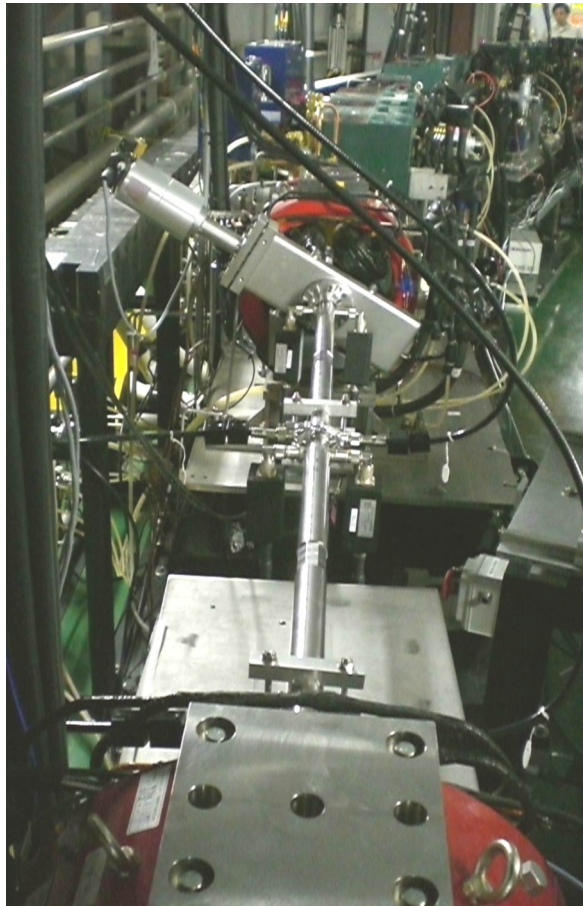
1. 10 bunches with 5.6ns bunch spacing beam is injected to the DR three times, 30 bunches total.
2. The local bump orbit is excited gradually after all of beam is damped.
3. The beam is kicked out bunch-by-bunch by the strip-line kicker.
4. The local bump orbit is return to zero.





Single bunch extraction

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



*Firs Beam extraction was confirmed
2009/Oct/22 by the screen monitor at 2m
downstream of the extraction septum.*



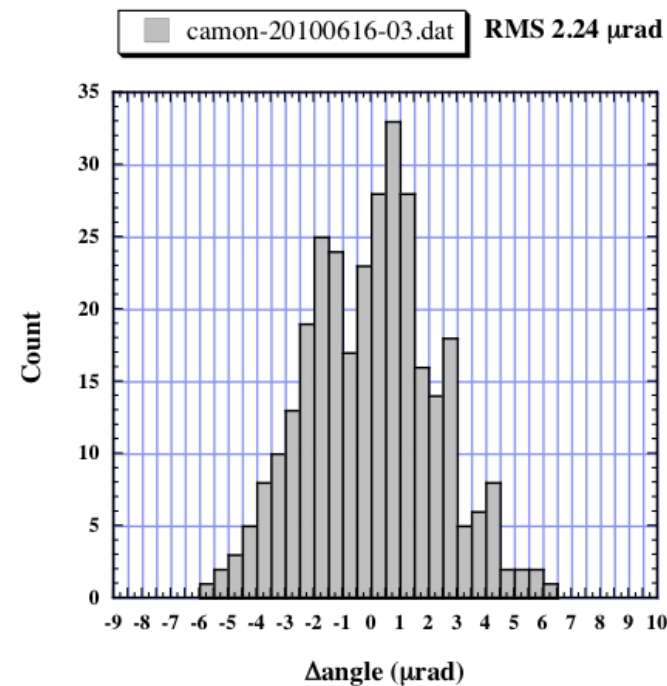
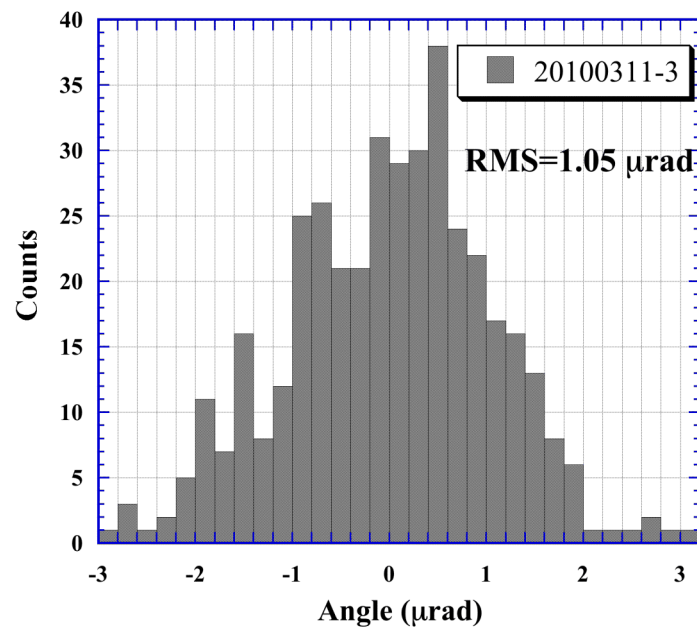
Kick angle measurement

Distribution of fitted angle at EXT entrance

(single bunch)

$$\text{Jitter } 1.05\text{e-}6/3\text{e-}3 = 3.5\text{e-}4$$

$$\text{Jitter } 2.24\text{e-}6/3\text{e-}3 = 7.4\text{e-}4$$



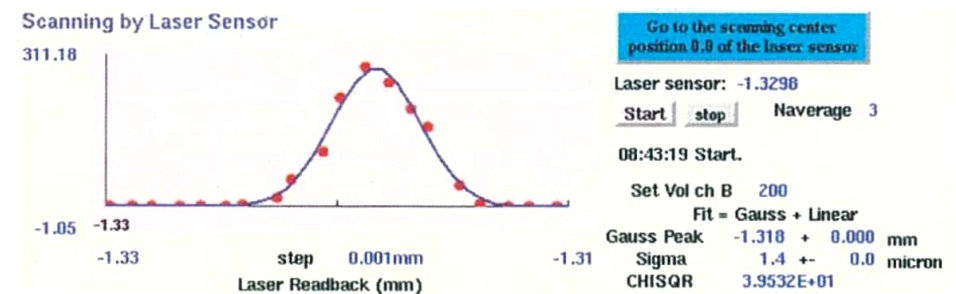
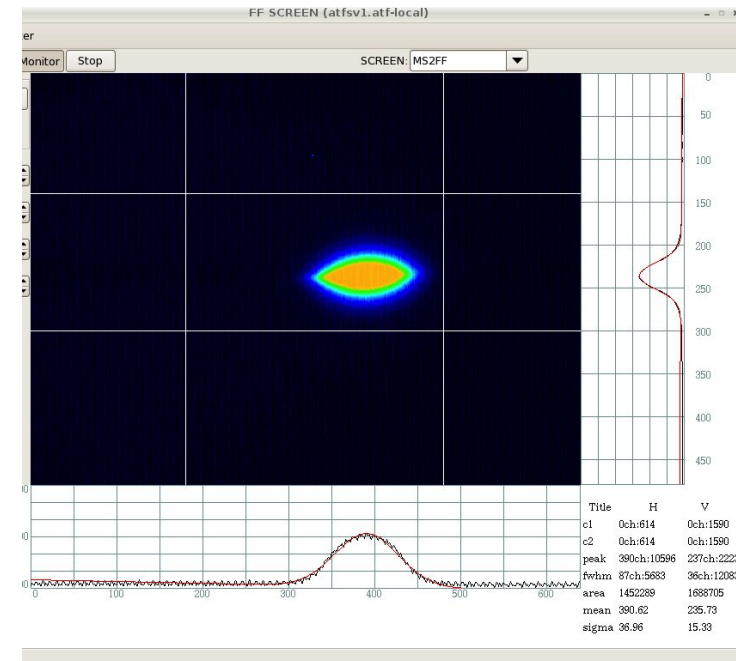
K.Kubo



Beam profile of the extracted beam

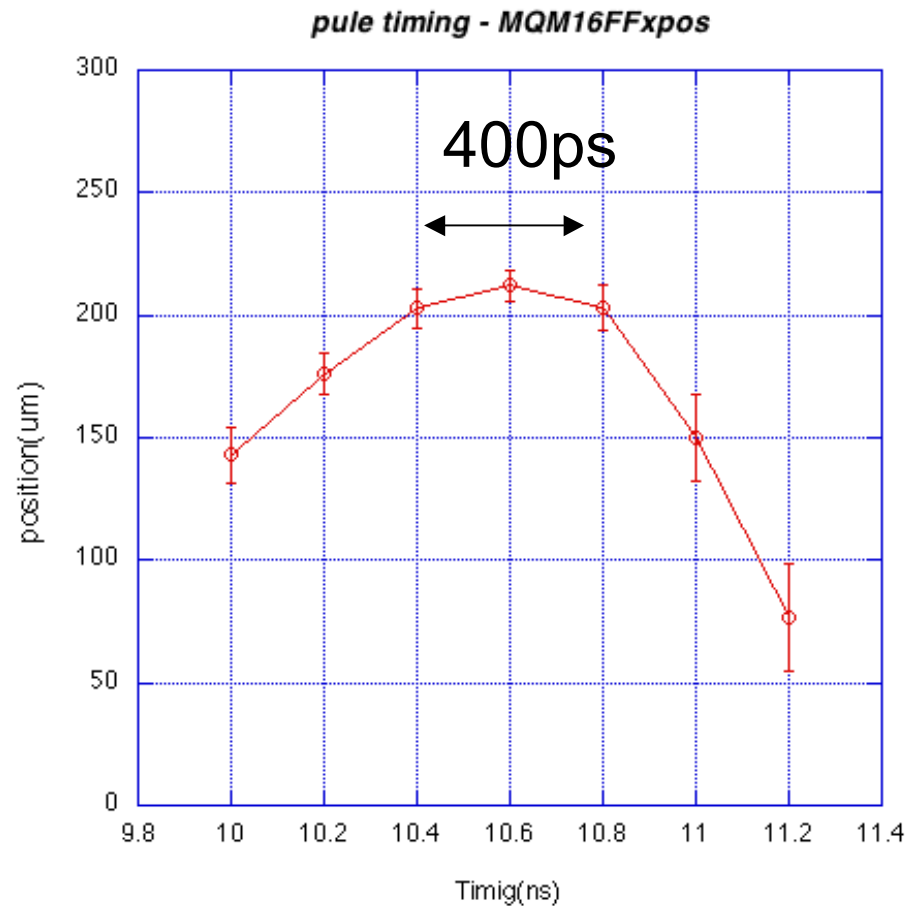
The observed beam profile at the extraction line was same as the extracted beam by the pulsed magnet.

The vertical beam profile of the extracted beam was measured by the MS1IP wire scanner, which is located just downstream of the focus point of the the ATF2 beam line. The measured vertical size was 1.4um, which is limited by the wire size. It means that the extracted beam has no deterioration for the vertical beam size.





Kick field profile

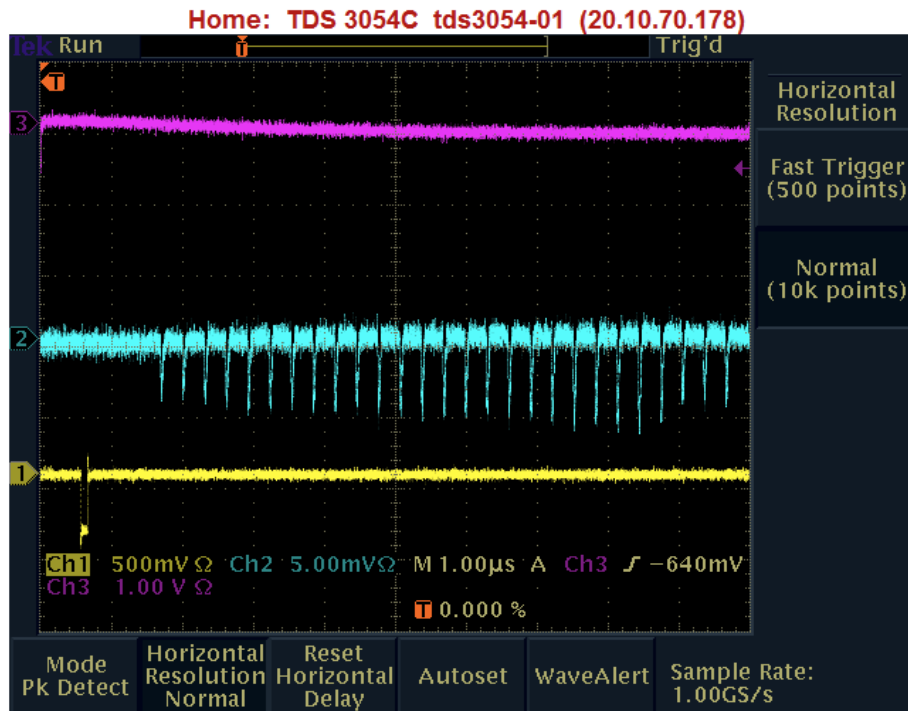


Plot shows the beam position at MQM16FF BPM. The flattop of the kick field is only 400ps and the jitter increased at the both side of the flat top.

The timing of the four pulses needs to careful adjustment.



Multi-bunch extraction



Picture shows the extracted multi-bunch beam signal. The blue line shows the waveform of the current monitor at the extraction line. The bunch spacing is 308ns(302.4ns). In spite of the very low intensity, we could confirm the basic function of the multi-bunch beam extraction. The observed number of the bunch at the extraction line was 27 due to the stored beam condition in the DR. The last bunch of each train was not stored in the DR at the time.



Summary and Future plan

- 1. 3ns rise time of the kick field was measured with 30 cm long strip-line electrode and FID pulser.*
- 2. The beam extraction from AF-DR to ATF2 extraction line was succeeded by using strip-line kicker.*
- 3. The angle jitter of the kicked beam was 3.5×10^{-4} . (single bunch)*
- 4. Multi-bunch beam extraction was demonstrated.*

Future plan

- 1. To stabilize the kicker pulse timing for multi-bunch beam*
- 2. To measure the kick angle and the angle jitter for each bunch of the multi-bunch*
- 3. To confirm the long term stability*

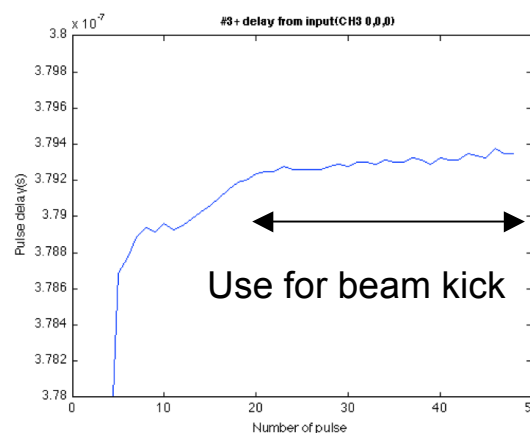
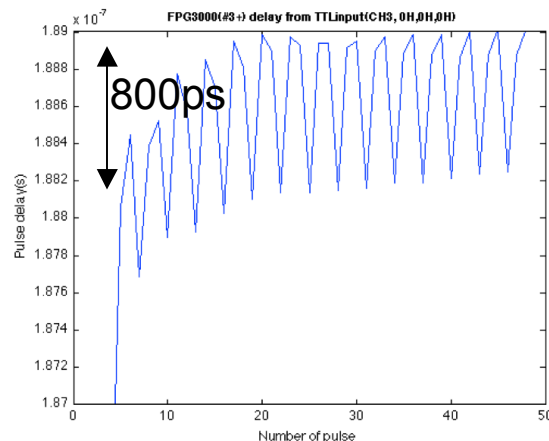
Future plan

Timing delay for each pulse

The timing control of the kicker pulse is not only the stabilization of the trigger signal, but also the characteristics of the pulser have to be stabilized. There are two problems of FID pulser.

- a large timing shift from the first to the 18th pulse, which changes like an exponential function.*
- the pulse timing changes every 3 pulses, in this case about 800 ps of the timing change was measured.*

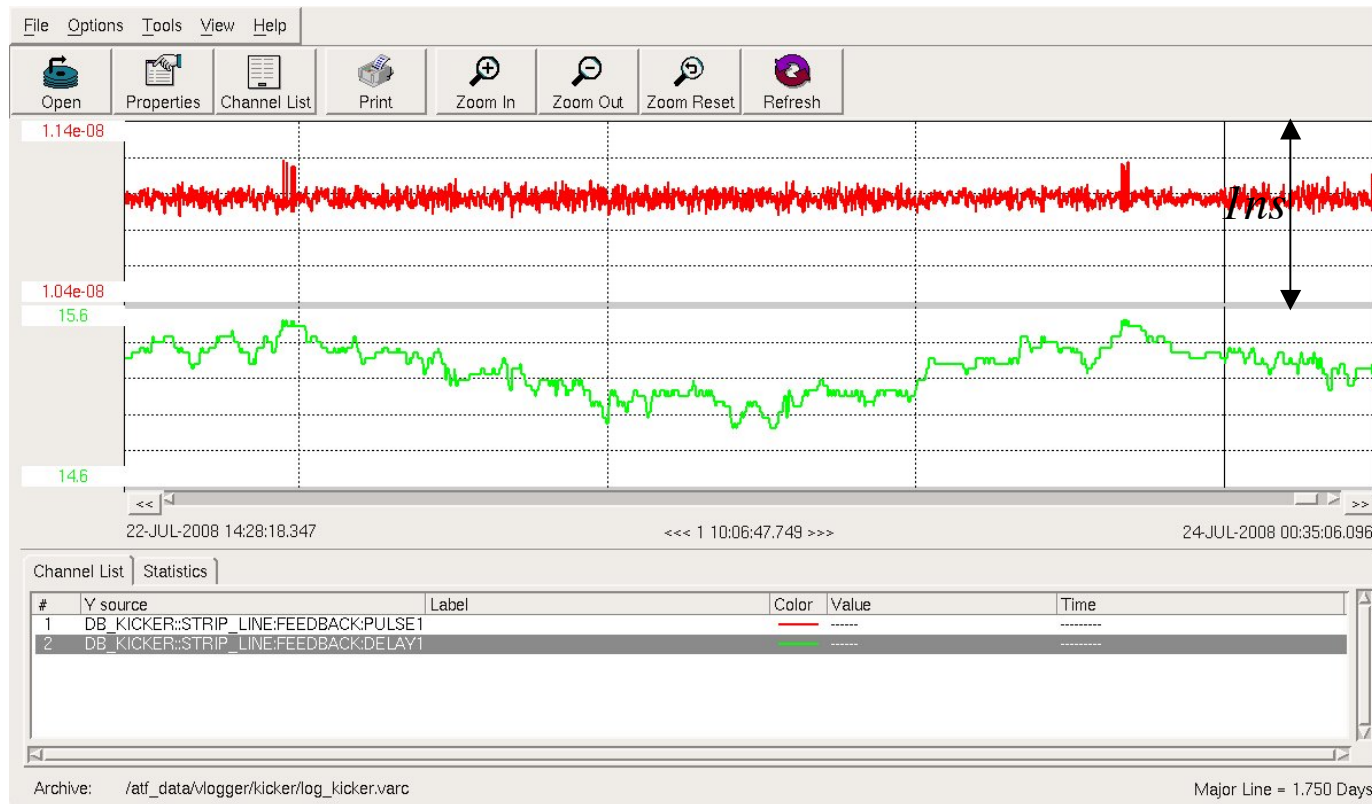
It seemed that the narrow band component inside of the pulser makes such a timing shift, the timing changes every 3 pulses coming from the interval change between 308ns and 302.4ns. We made the trigger timing circuit to cancel the timing changes every 3 pulses.



With compensation circuit, the timing shift is in the range of 200ps.



Future plan



Measurement

Delay Setting

Timing feedback to compensate the temperature drift

The graph shows the pulse timing measurement and the delay setting of the timing feedback system. The pulser output drifted about 600ps in a day, which is compensated less than 200ps except for a bit error of the delay module.