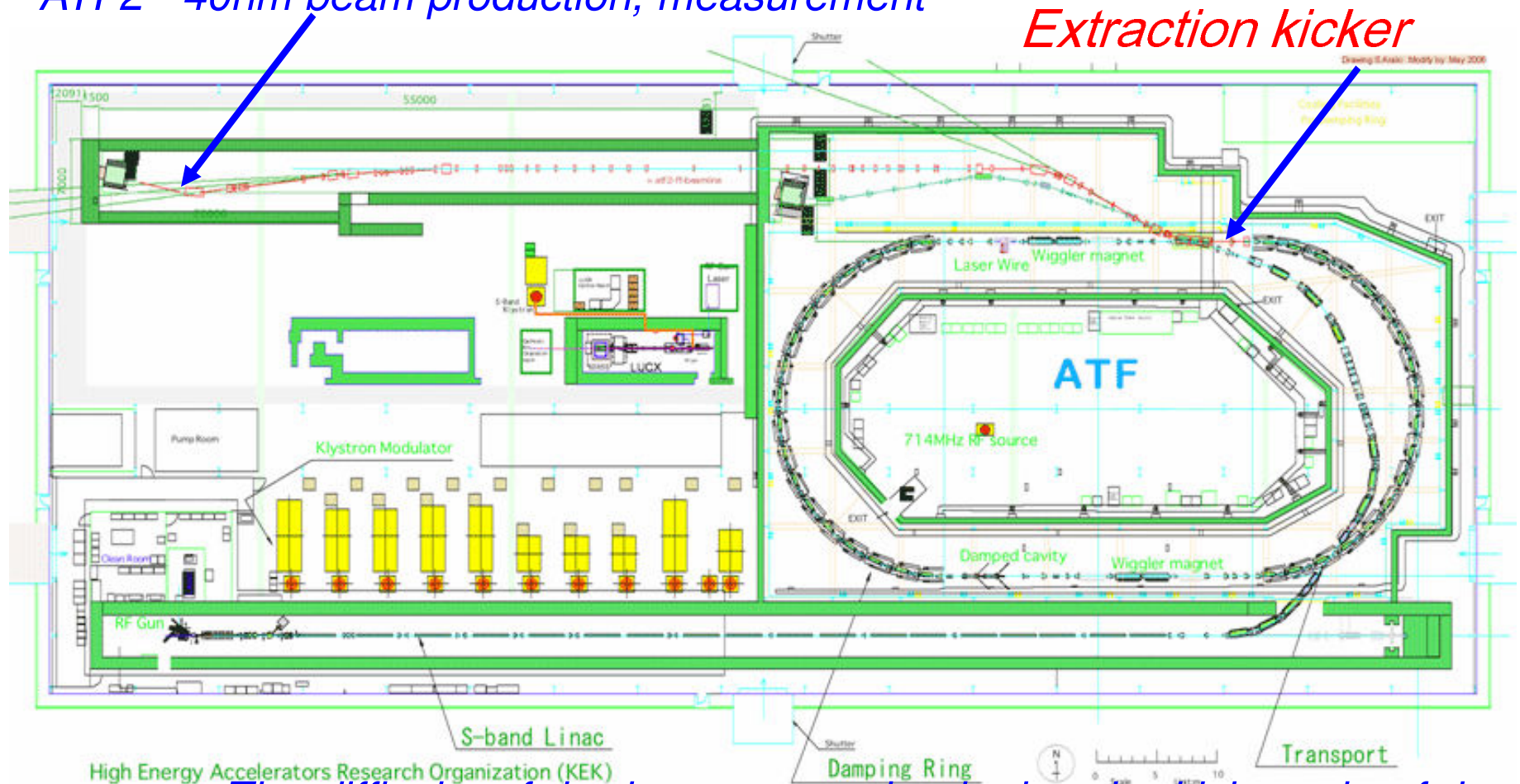


# Fast kicker Experiment at ATF



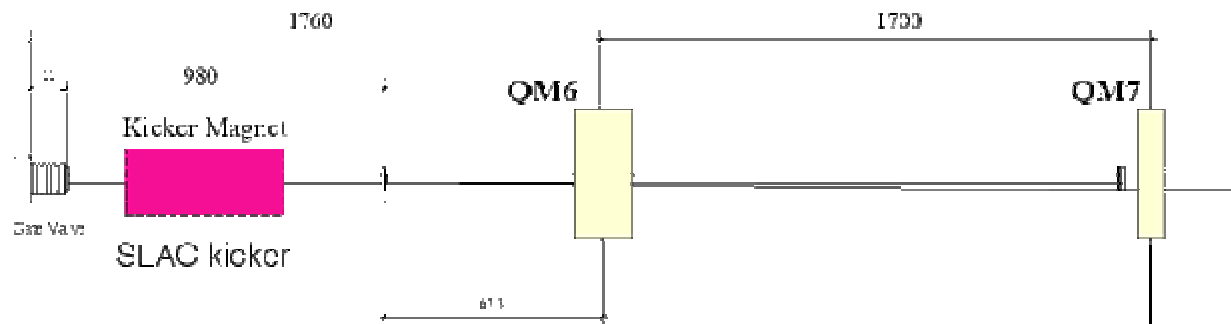
ATF2 - 40nm beam production, measurement



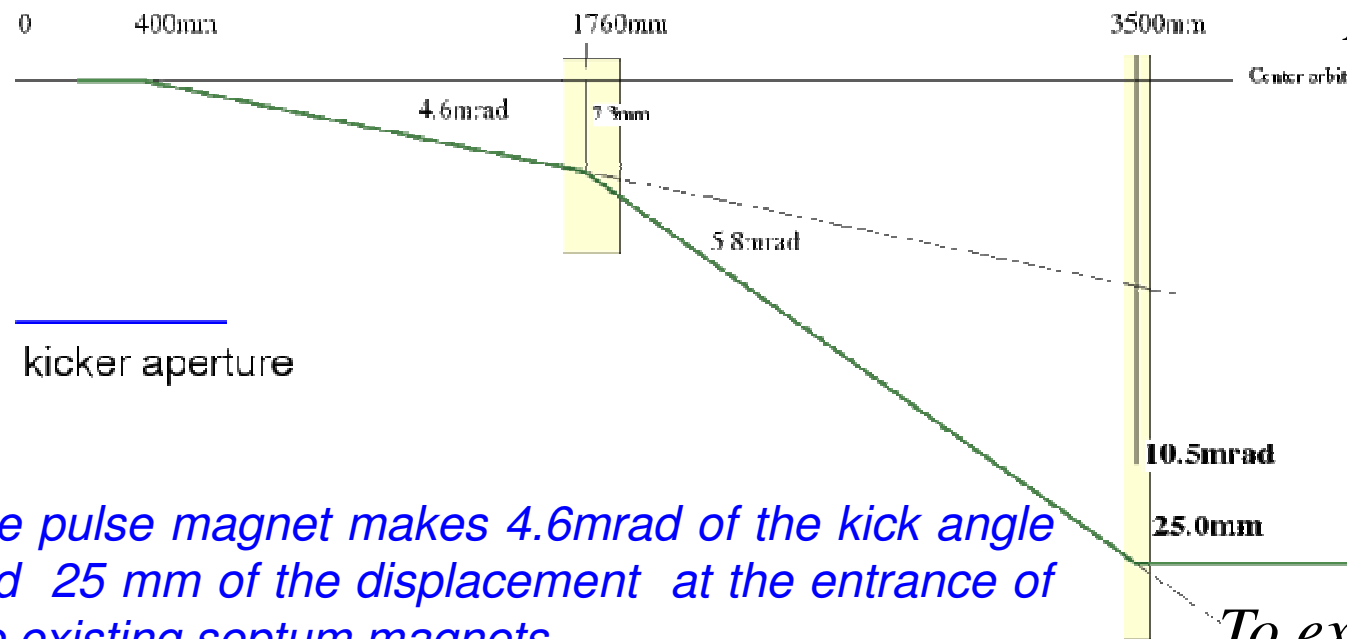
*The difficulty of the beam extraction is that the kick angle of the strip-line kicker is not enough compared to the kick angle of the existing pulse magnet.*

# Present layout

20081221 U.S. Natio



Design Orbit



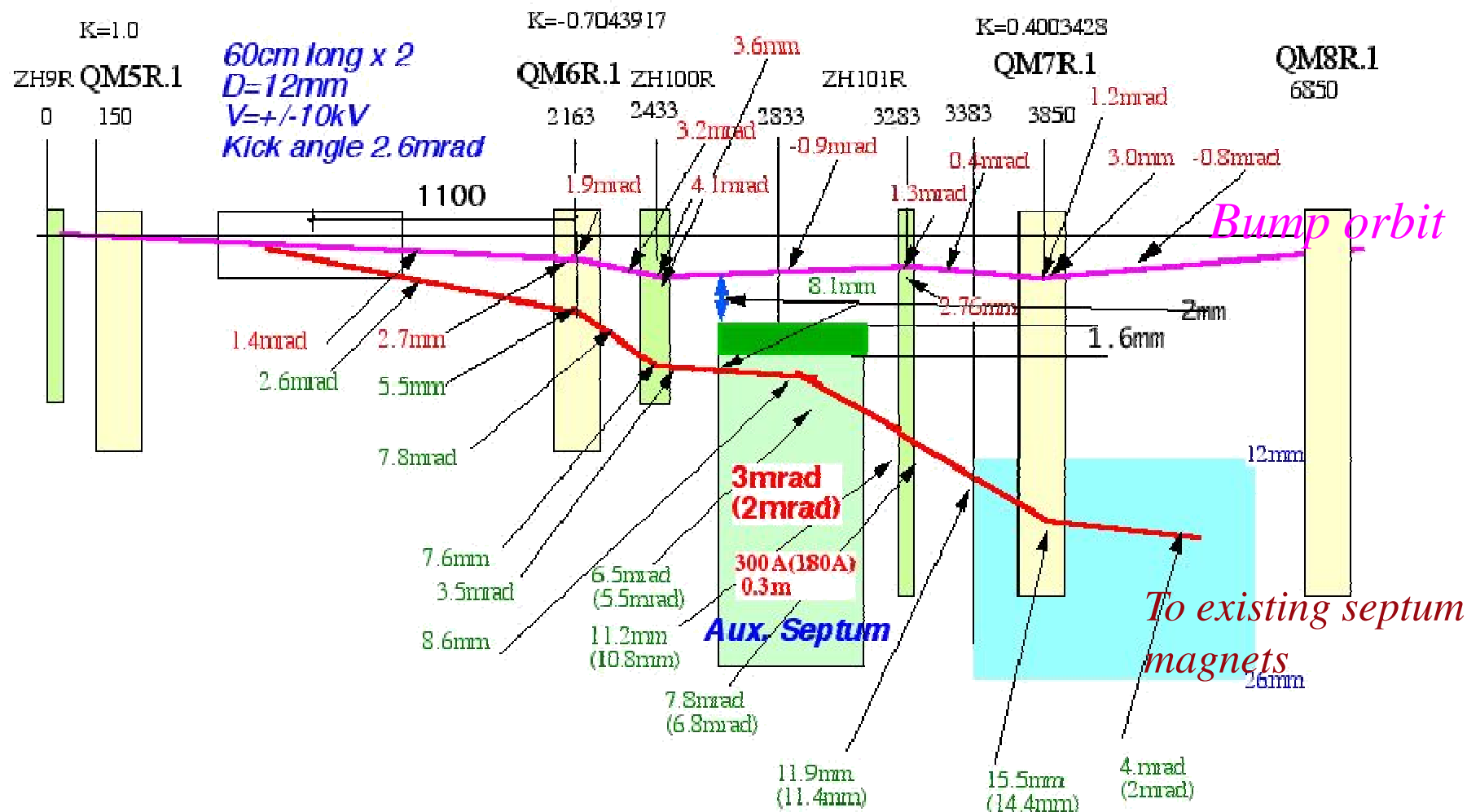
*DR orbit*

*The pulse magnet makes 4.6mrad of the kick angle and 25 mm of the displacement at the entrance of the existing septum magnets.*

*To existing septum magnets*

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

2.6mrad kick angle



# Timing chart of 30 bunches beam extraction



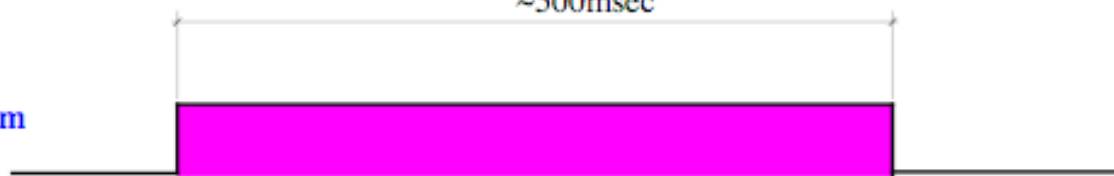
The bump orbit is gradually changed after all of the bunches have been damped. The strip-line kicker kicks out the beams at the timing of the flat-top of the bump orbit. The beams are extracted as one long bunch train, which is a 10micro-sec long with 154ns (or 308 ns) bunch spacing.

Injection beam  
1st Train    2nd Train    3rd Train



~500msec

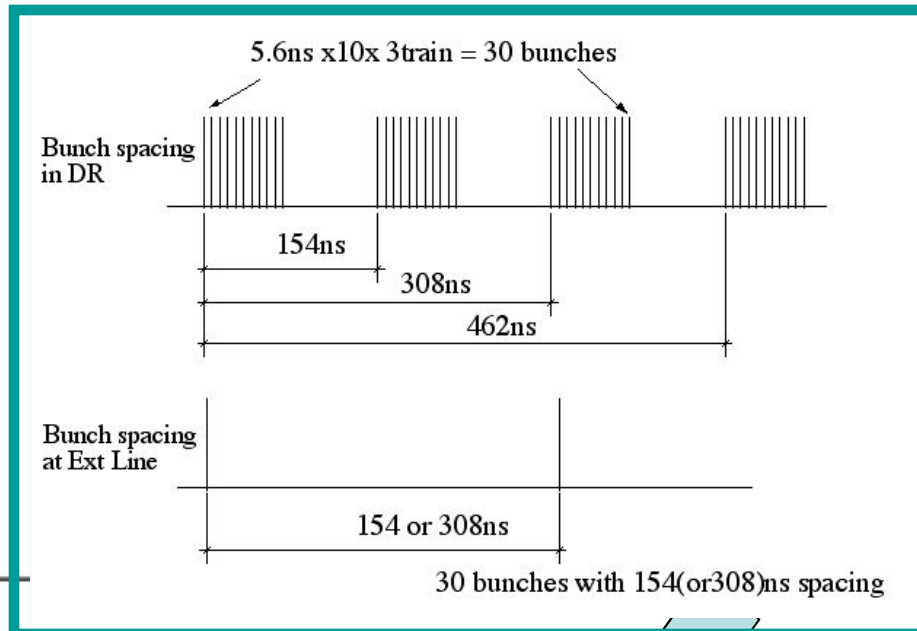
Stored beam



Local bump height



Extracted beam



## *Fast kicker Experiment 2009*

- 2009. Jan. (1 week)

Two pulsers were broken by the radiation damage during only a few hours.

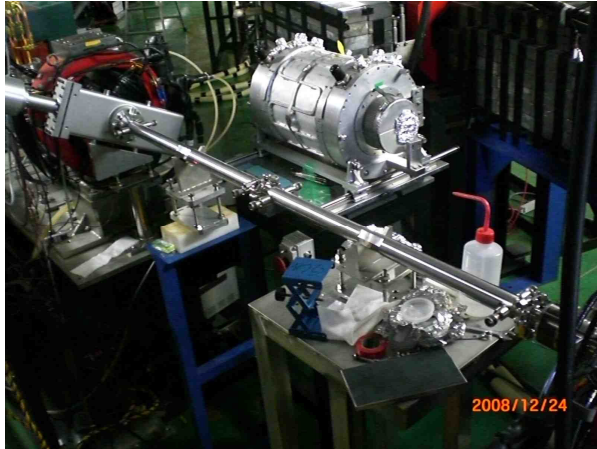
- 2009. June (1 week)

The beam did not come out to the extraction line for lack of the kick angle.

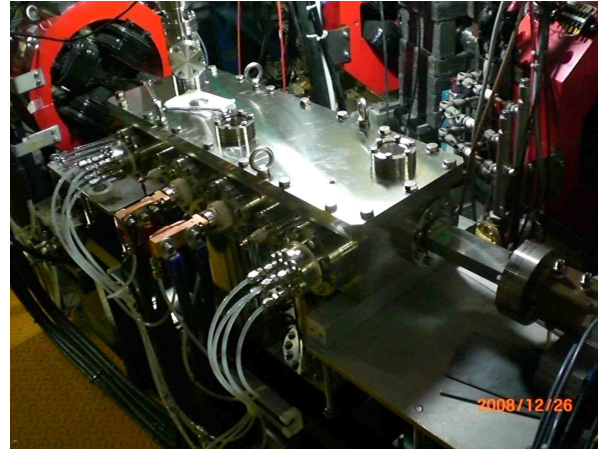
- 2009. Oct. (2 week)

The beam extraction have succeeded up to 17 bunches.

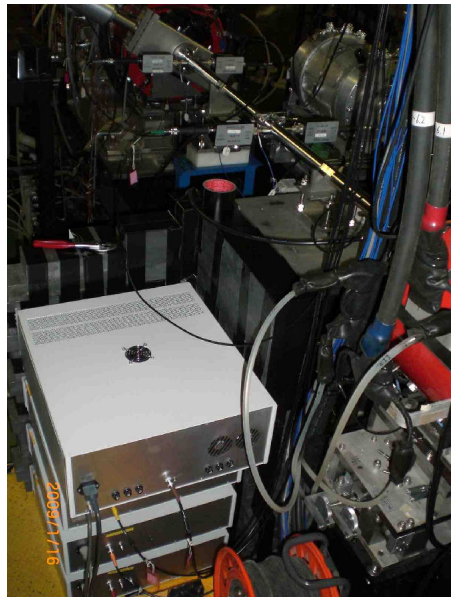
# Pictures of the installed components(2009Jan)



*Strip-line electrodes*



*Aux. Septum*



2009/12/15 *FDI pulser*

The radiation level at the location was  
>10msv/h(gamma) and  
100u sv/h(neutron).

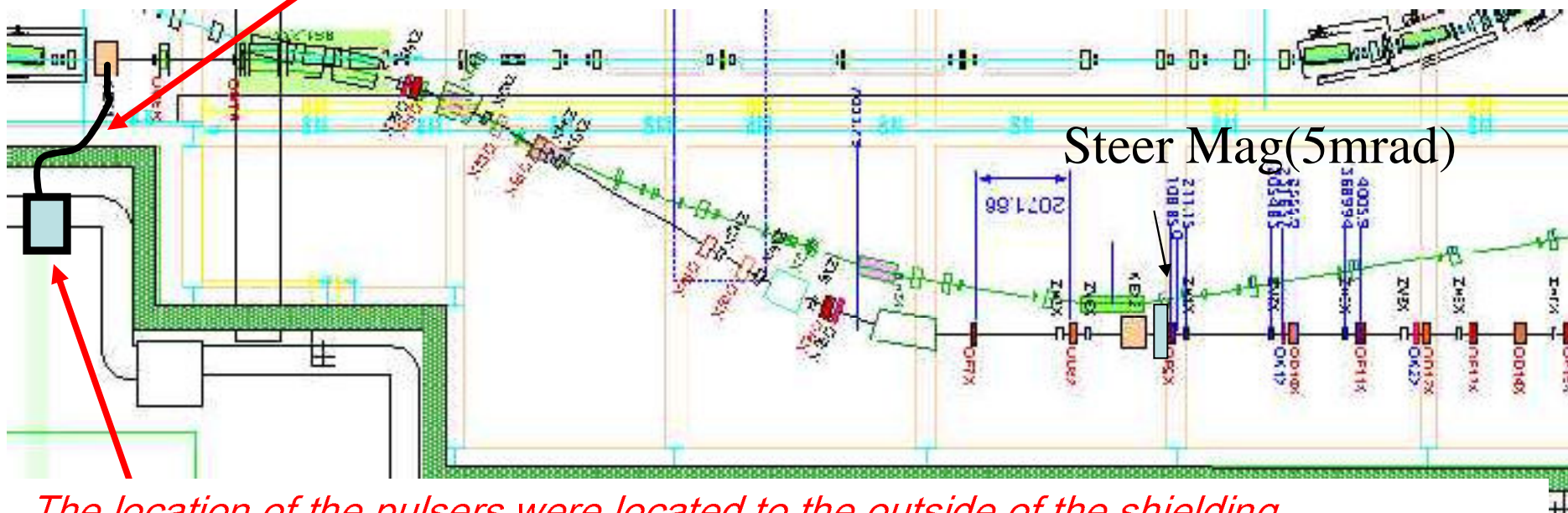


*Bump PS and Septum PS*

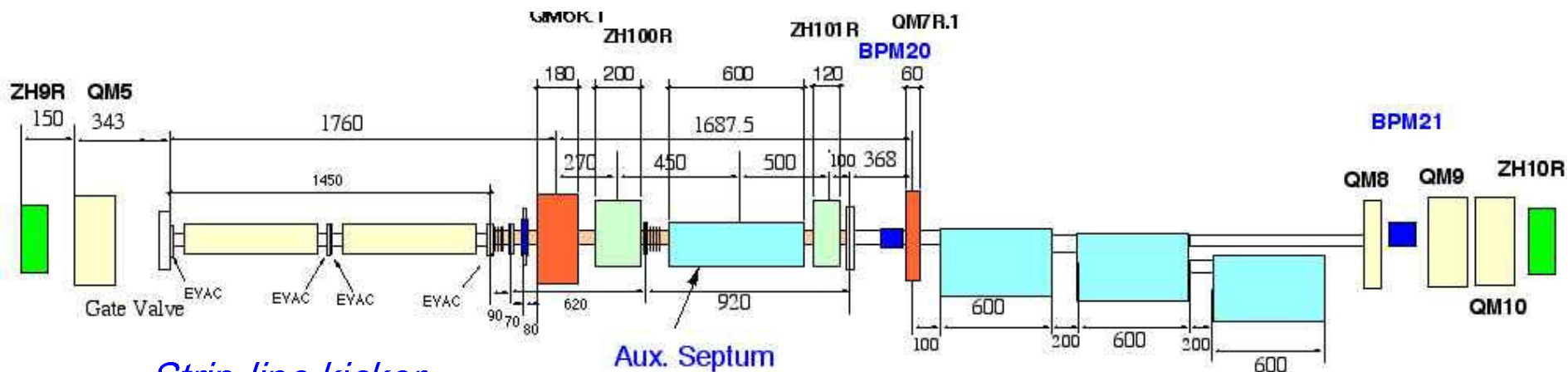


## *New location of the pulsers*

*6m cables*

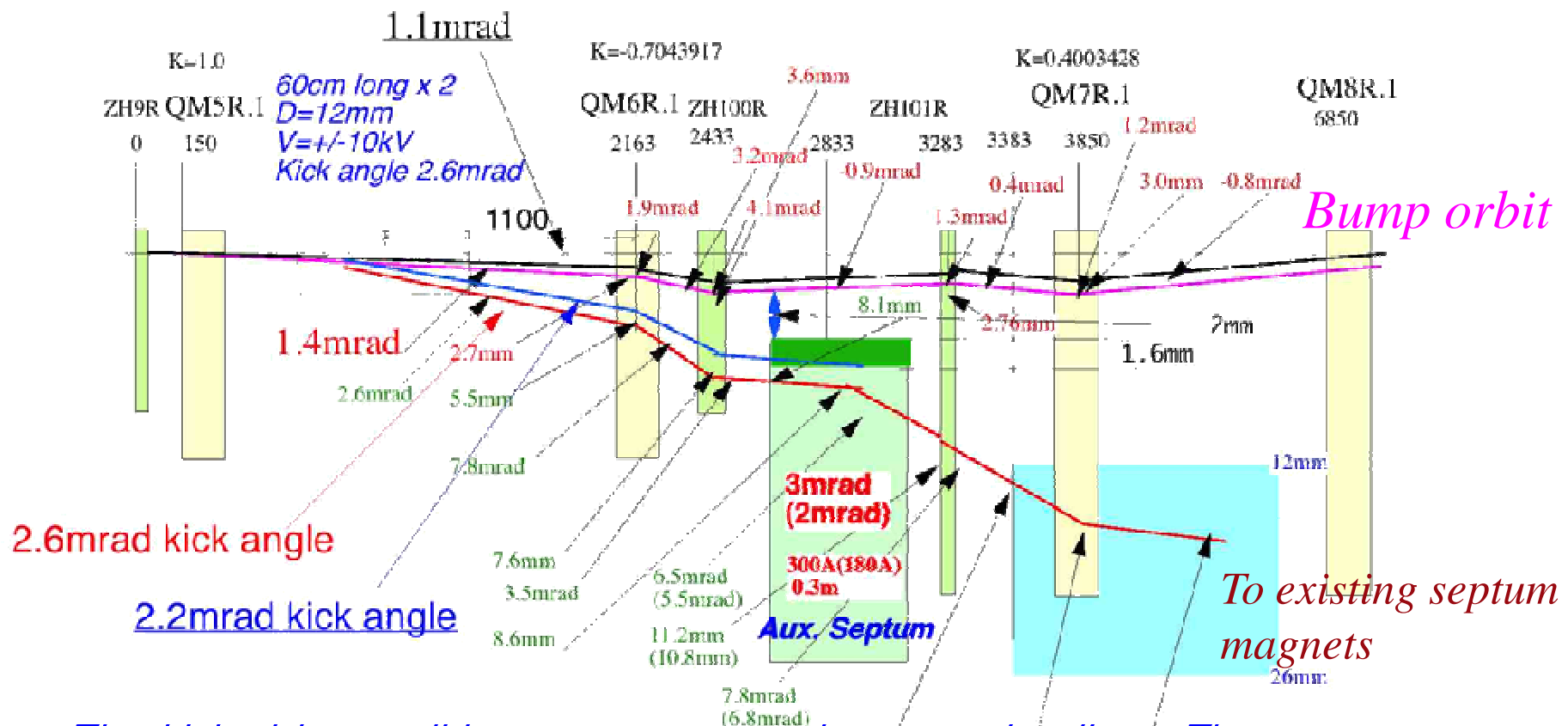


*The location of the pulsers were located to the outside of the shielding.*



### Strip-line kicker

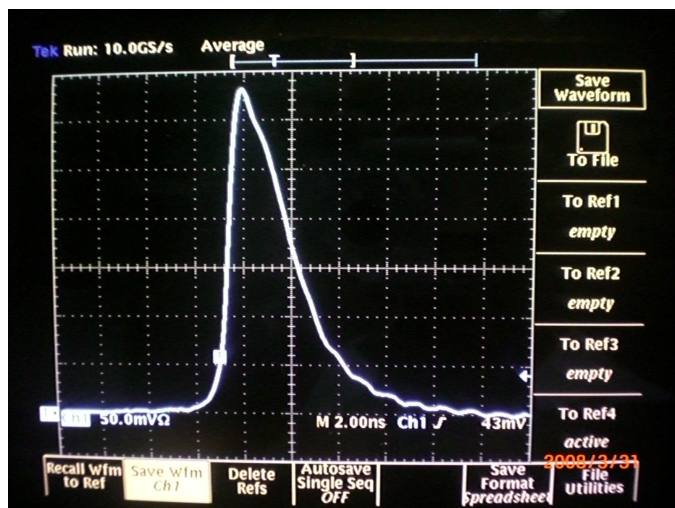
# Beam Extraction Orbit (2009June)



The kicked beam did not come out to the extraction line. There were two reasons. One is the lack of the kick angle due to the fabrication error of the strip line. The other is the lower local bump height at the auxiliary septum. The beam loss was happen before reach the design. The beam was disappear at the aux. septum.



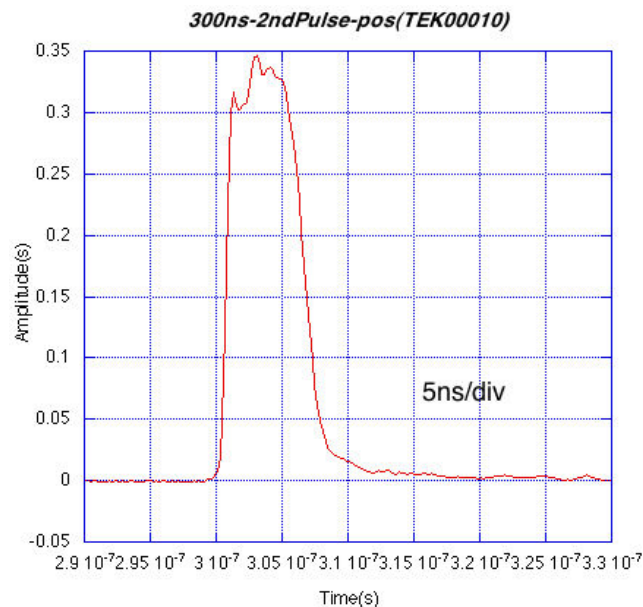
# Pulse source(FID)



**FPG10-6000KN(FID)**

**10kV, 2ns(FWHM) pulse width**

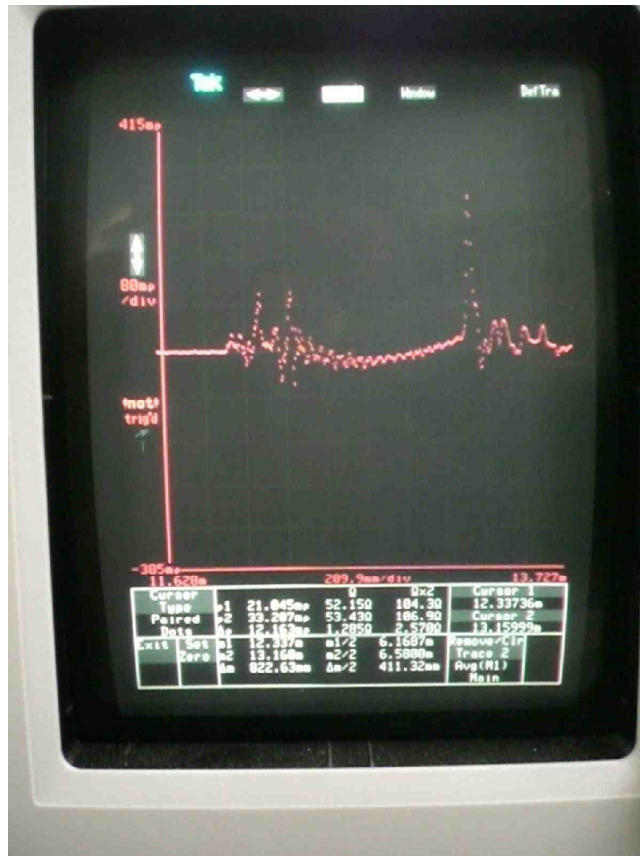
**Designed for 30cm strip-line(3ns rise time)**



**FPG10-3000N2G(FID)**

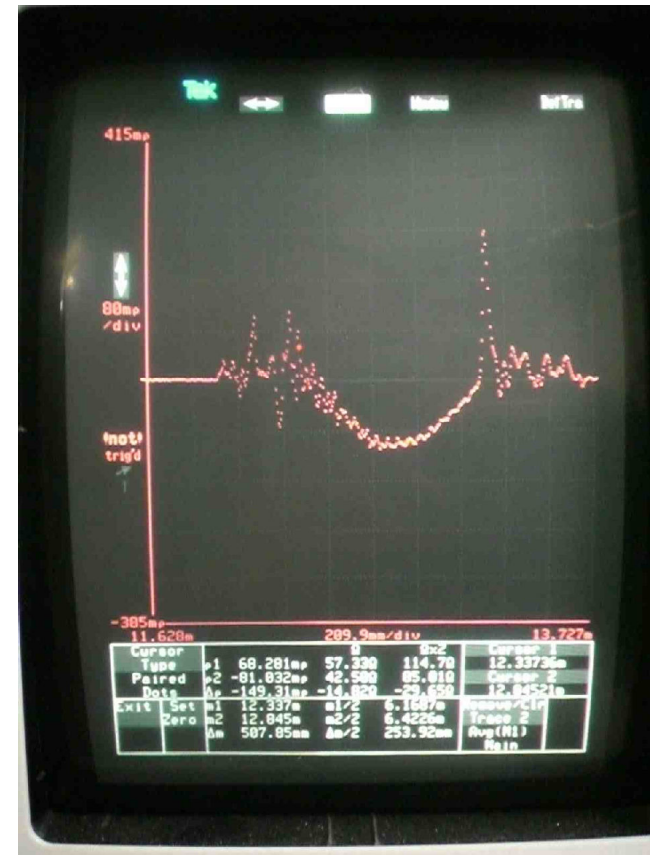
**10kV, 4ns(FWHM) pulse width**

## 60cm Left side electrode

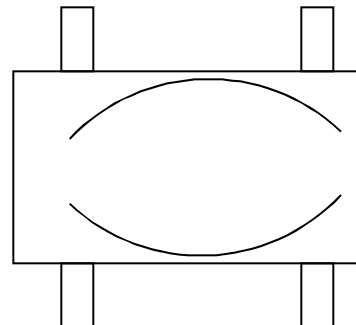


In 52.95Ω  
Out 52.95Ω  
Middle 48.9Ω

## 60cm Right side electrode

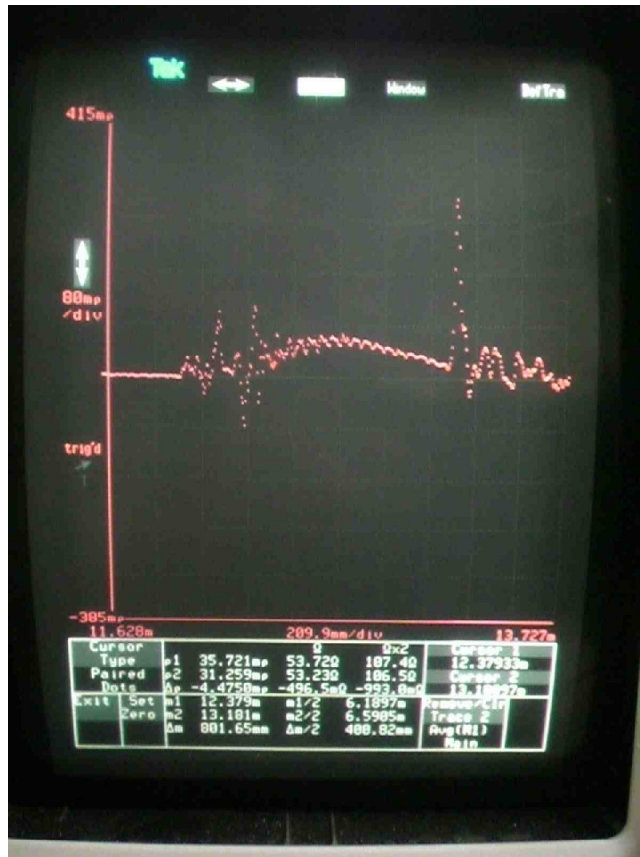


In 57.3Ω  
Out 50.16Ω  
Middle 41.9Ω

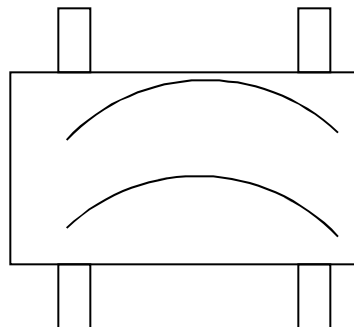


(Beam Test)

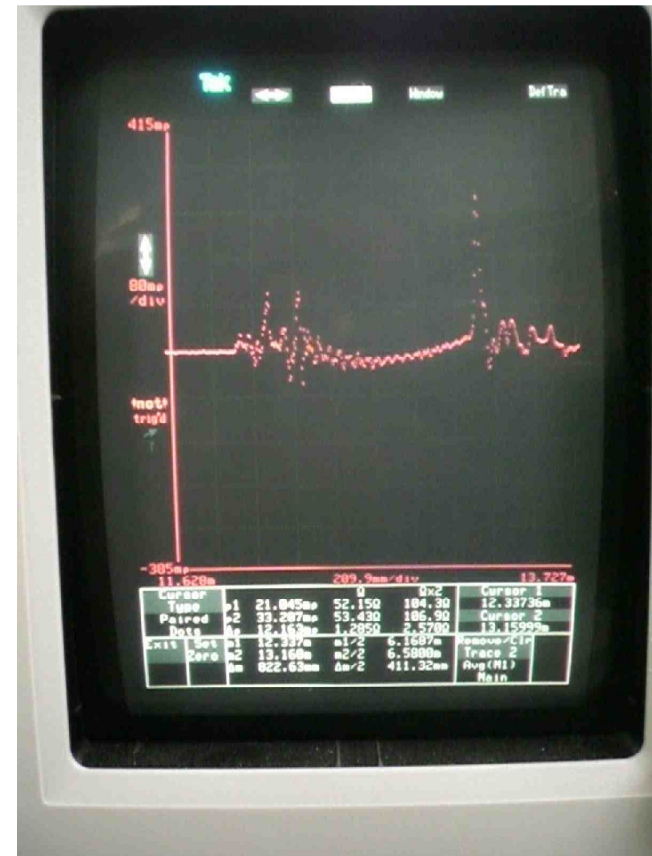
## 60 cm Left side electrode



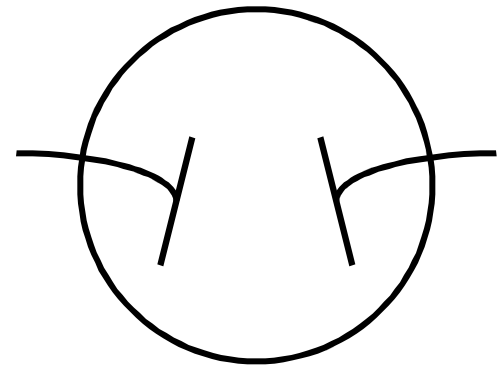
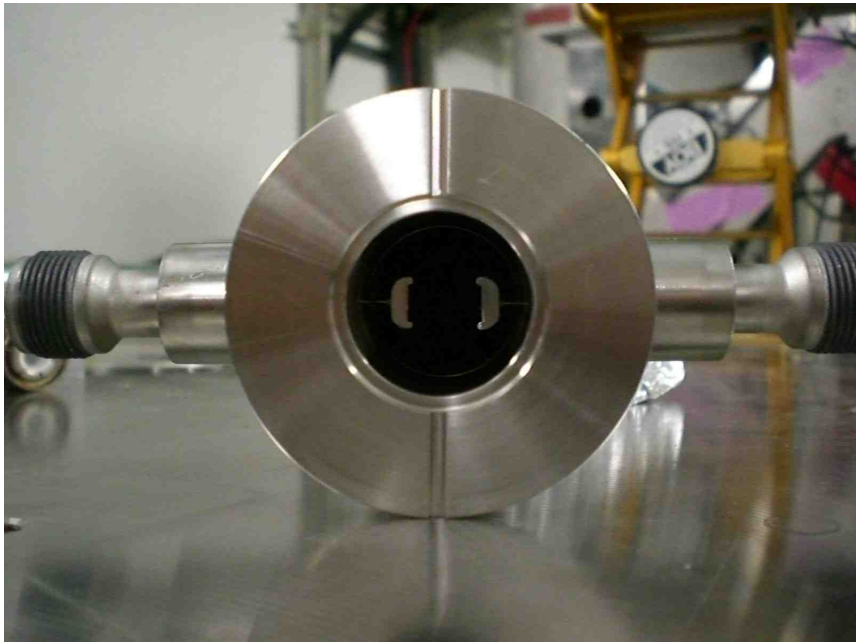
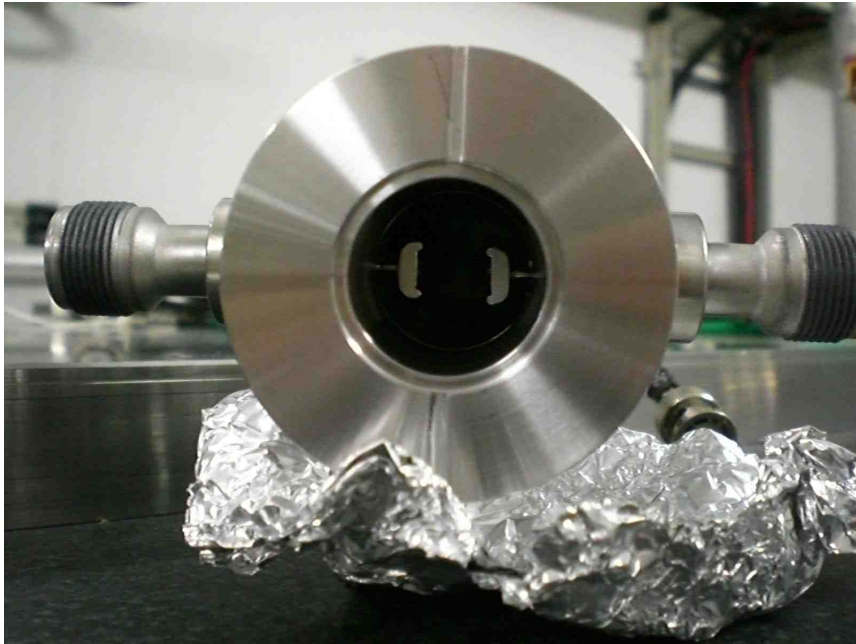
In 53.5Ω  
Out 53.2Ω  
Middle 58.5Ω



## 60cm Right side electrode



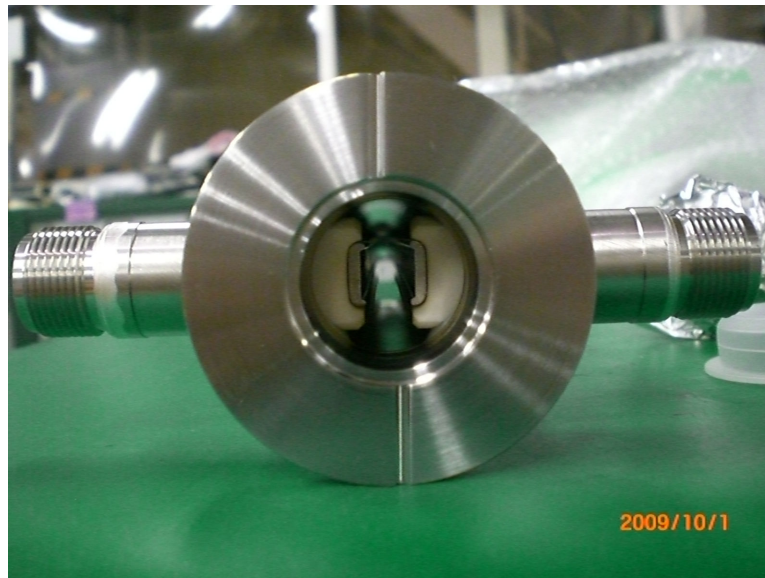
In 52.2Ω  
Out 53.1Ω  
Middle 45.4Ω





## Improvements

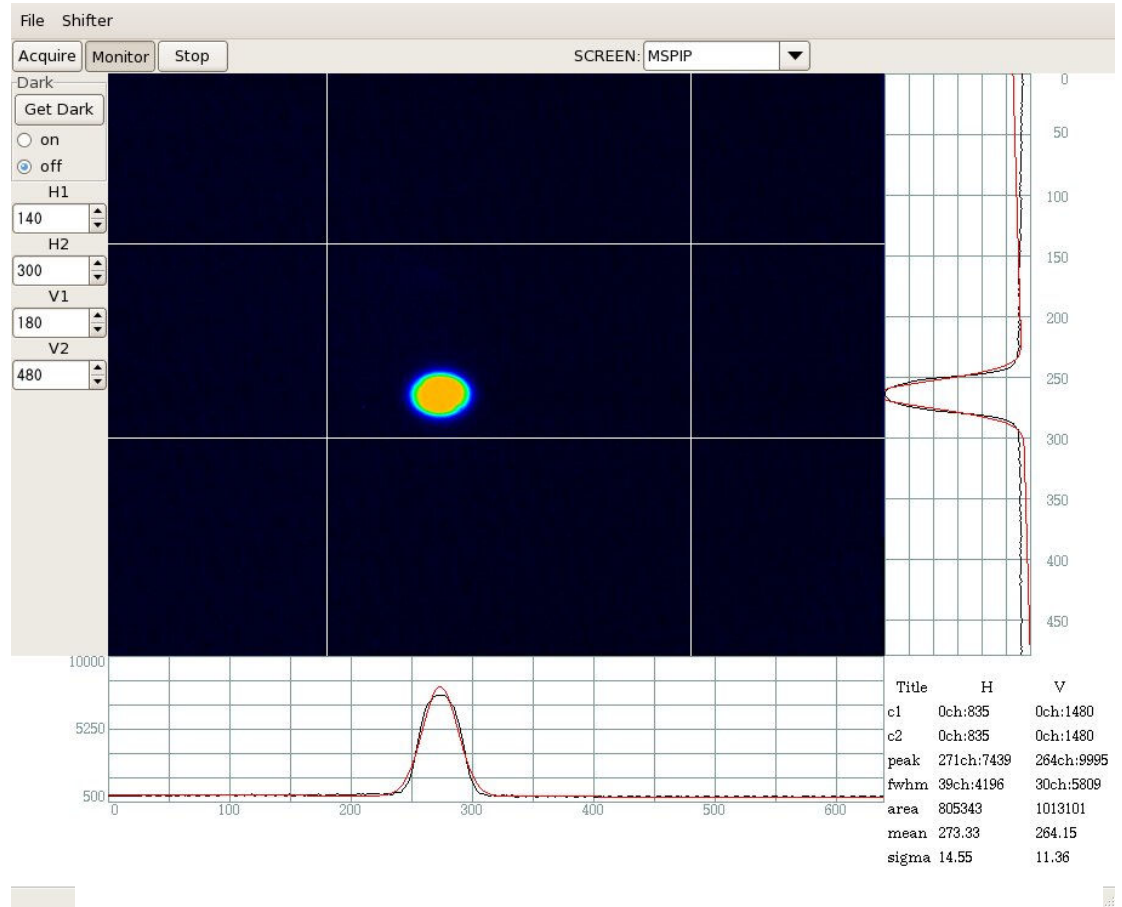
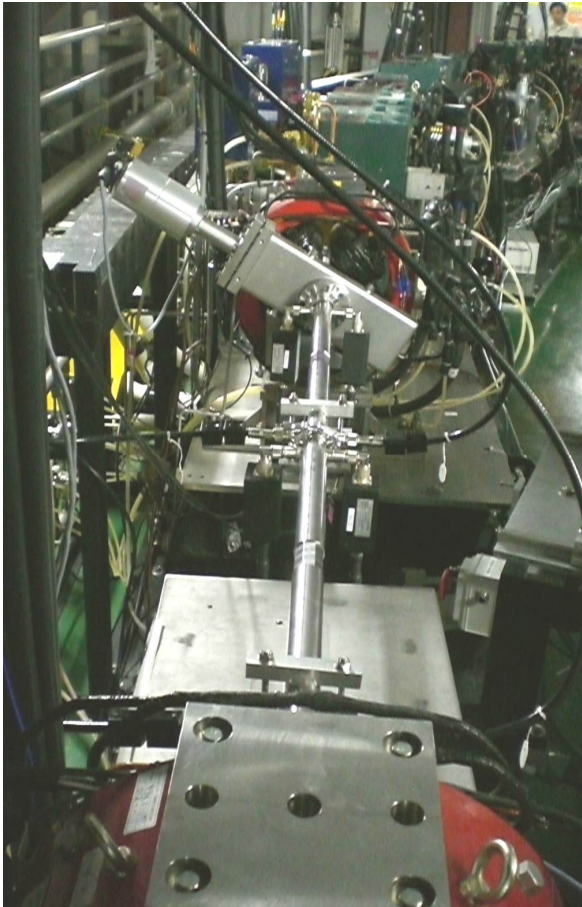
- Re-fabricate the strip-line electrode with new design
- Using 4ns pulser x 4 (20%)
- Strip-line gap 12mm  $\rightarrow$  9mm(30%)





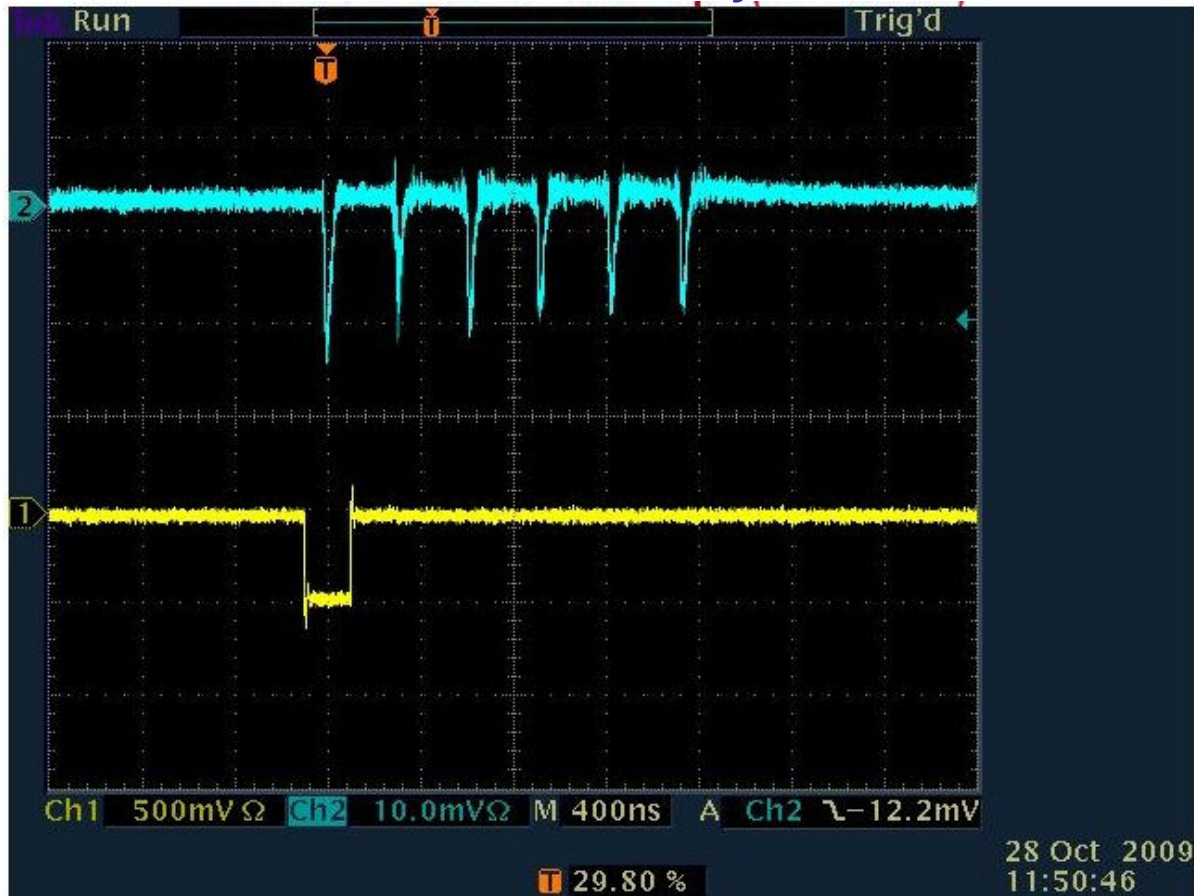
# Beam Extraction succeeded from DR to ATF2

## 2009.Oct. 22.



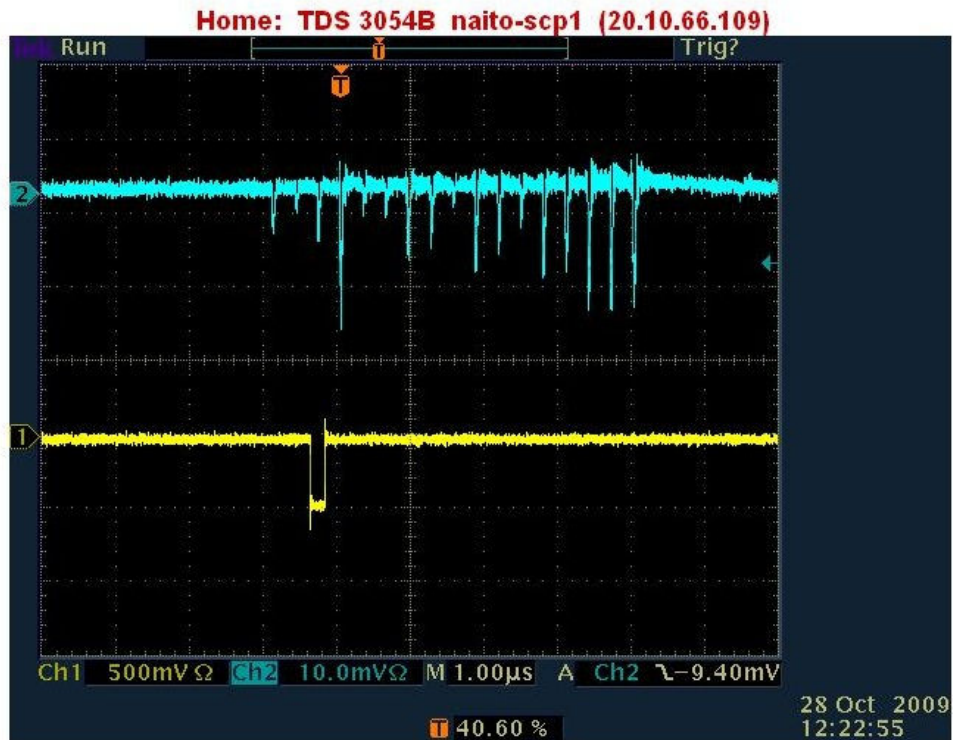
*Beam profile at MS1X screen monitor, which is located at the downstream of the septum magnets.*

## Multi-bunch beam extraction by the Fast kicker



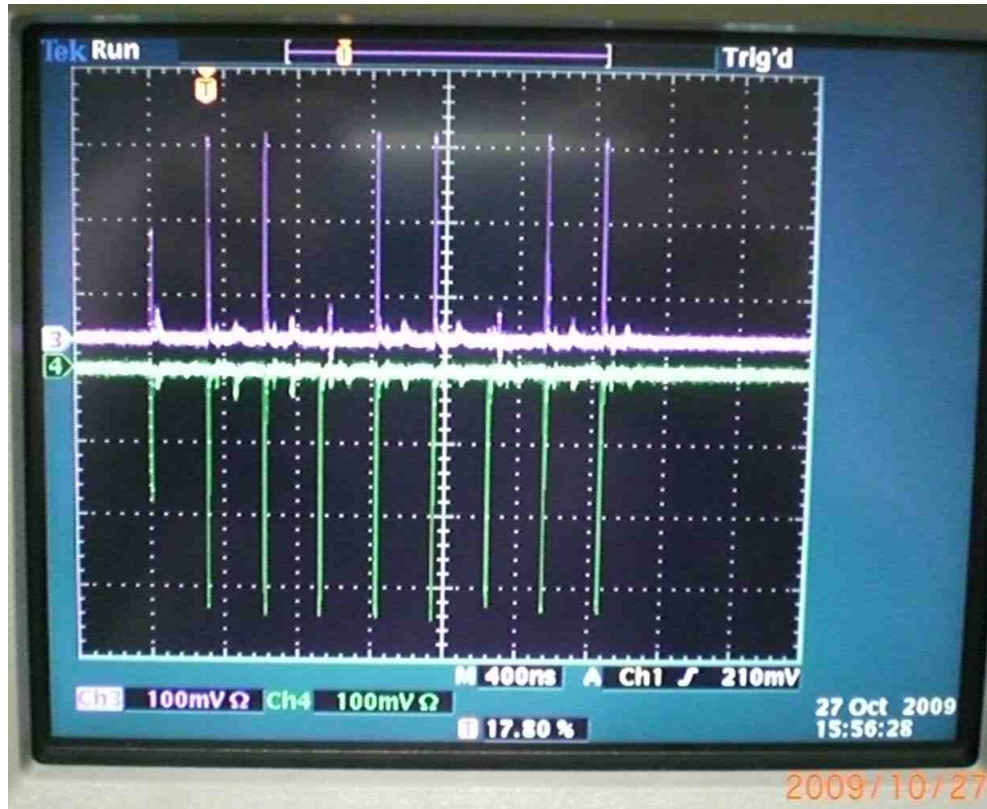
The stored multi-bunch beam, which has short bunch spacing(5.6ns), in the Damping Ring is kicked out bunch-by-bunch with 308ns interval by the fast kicker. The picture shows the case of the 6 bunches beam extraction. In the picture, the blue line shows the bunch charge monitored by the current transformer at the location of the middle of the extraction line. The horizontal scale is 400ns/div and the vertical scale is 0.2nC/div.

## Multi-bunch beam extraction by the Fast kicker(2)



Up to 17 bunches of the multi-bunch beam was extracted to the extraction line, however the bunch population of the extracted beam was not so flat. The timing system had a trouble at that time, which was caused by the unstable beam storage in the DR.

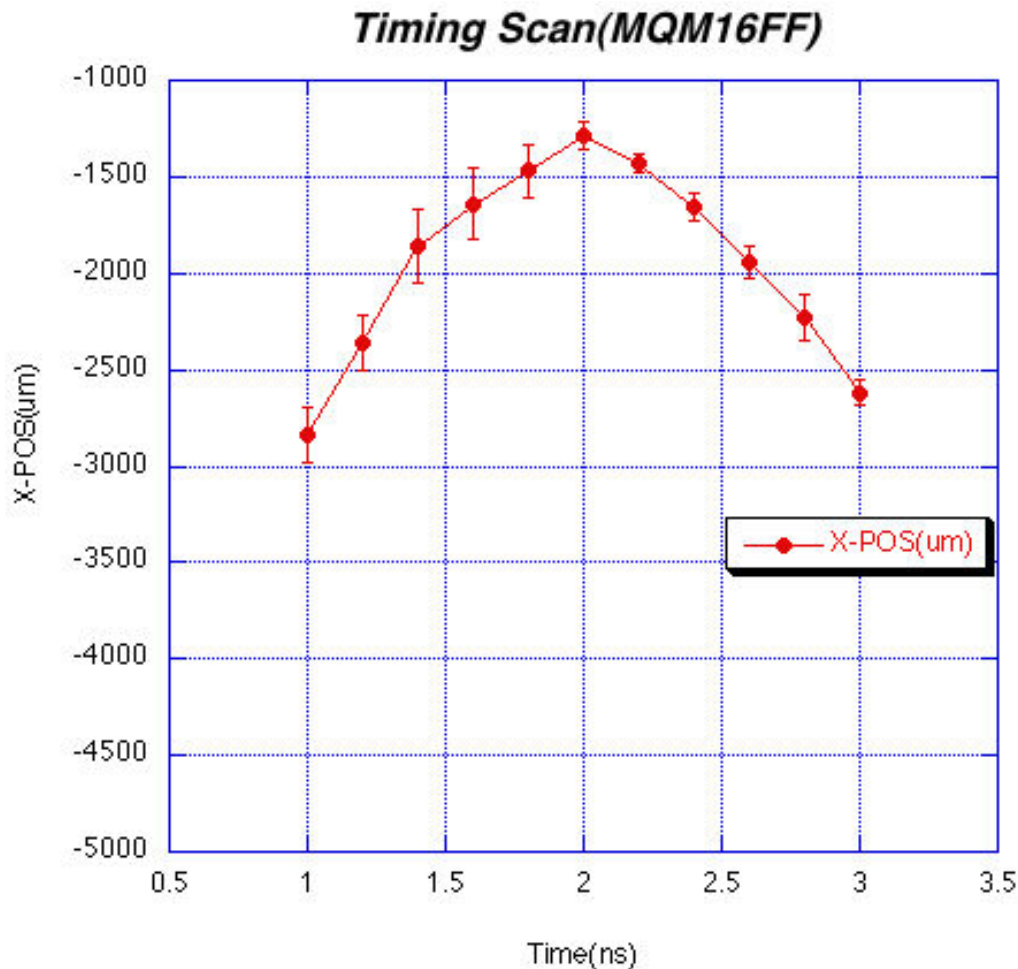
# Pulser trouble



*One of the pulsers did not output every third pulse. The every third pulse has different timing(302.4ns). The pulser was replaced to the 2ns pulser at the multi-bunch beam extraction.*



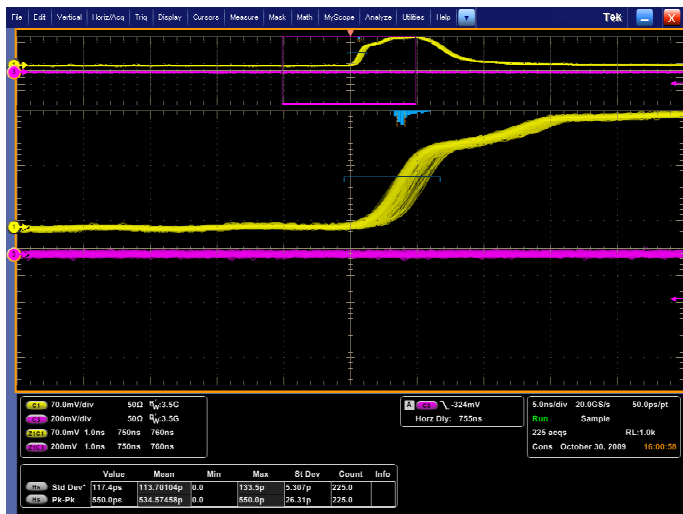
# Kick field profile and Timing jitter



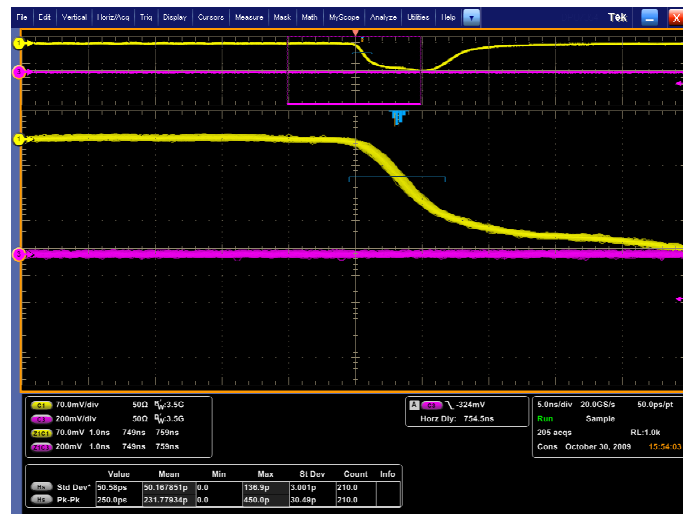
The graph shows the measured horizontal beam position when the kicker pulse timing was scanned. The position displacement corresponds to the kick field difference. A cavity BPM(MQM16FF) at the ATF2 beam line was used for the measurement.

There is no flat-top for the kick field of the strip-line kicker. The estimated kick angle jitter is about  $2 \times 10^{-3}$ , when the designed R12 is used. We already found that the kick angle jitter come from the pulser. One of four pulses has a large timing jitter( $\sim 500$ ps). The kick angle jitter will be improved after treated the pulse power supply.

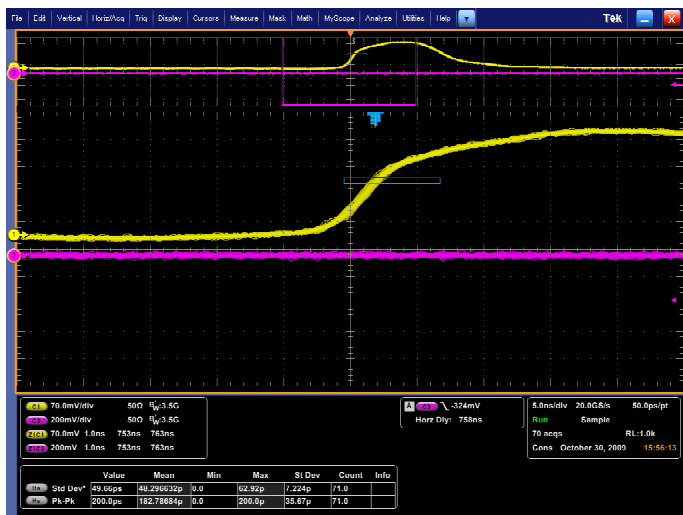




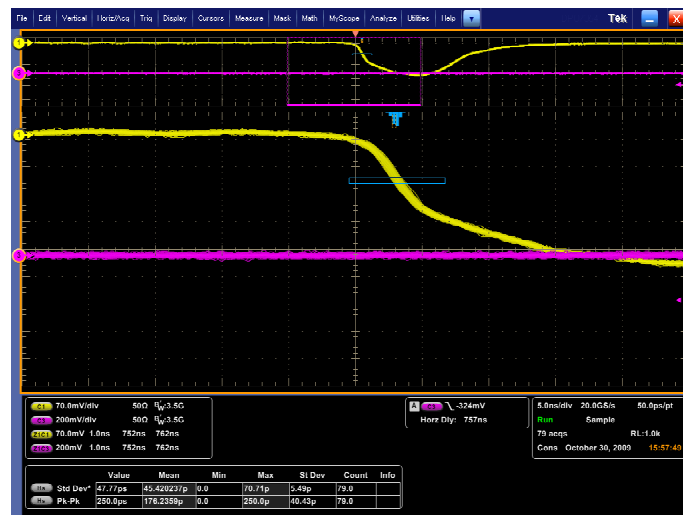
#1 pulser Jitter550ps(P-P)



#2 pulser Jitter250ps(P-P)



#3 pulser Jitter200ps(P-P)



#4 pulser Jitter250ps(P-P)

# *Next Beam Test*

*We hope to take Fast kicker beam test,*

*2010 March 2weeks*

*2010 June 1week*

*Goal of the next beam test,*

- 1. To confirm the stable beam extraction up to 30 bunches*
- 2. To realize the lower kick angle jitter*
- 3. To realize the stable beam extraction at the condition of the delta-F ramp*