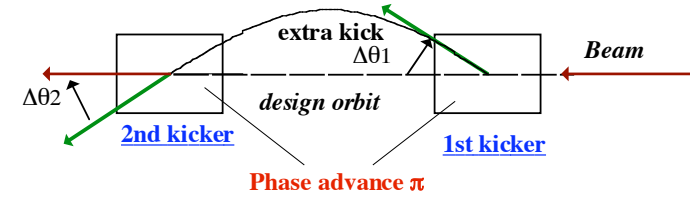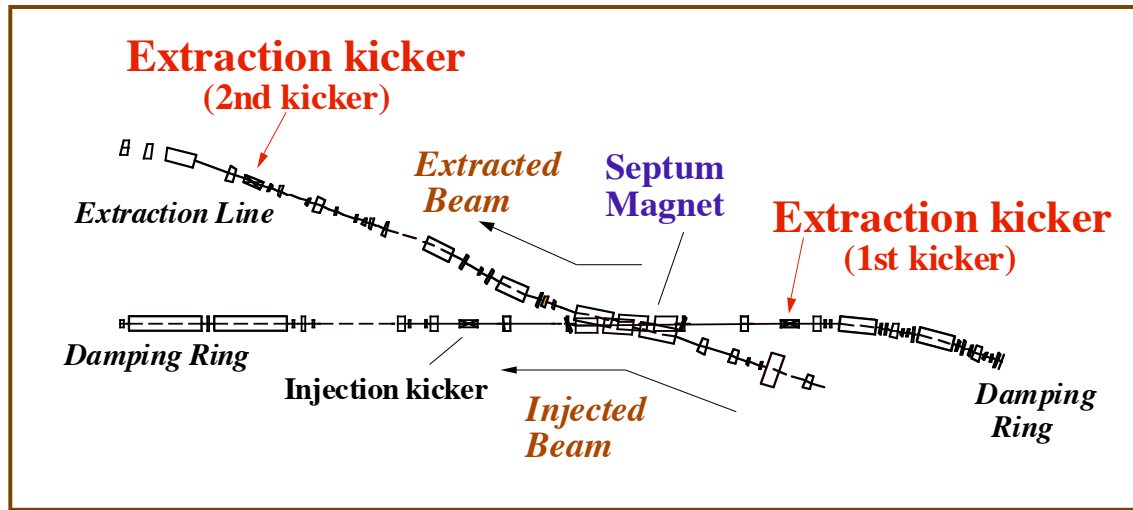# Beam Extract by using Strip-Line Kicker

at KEK-ATF
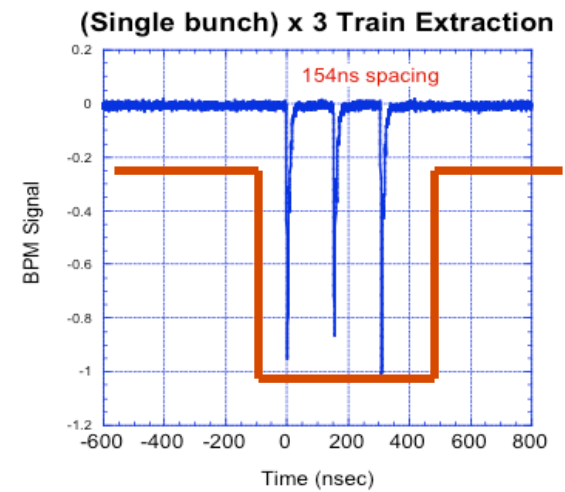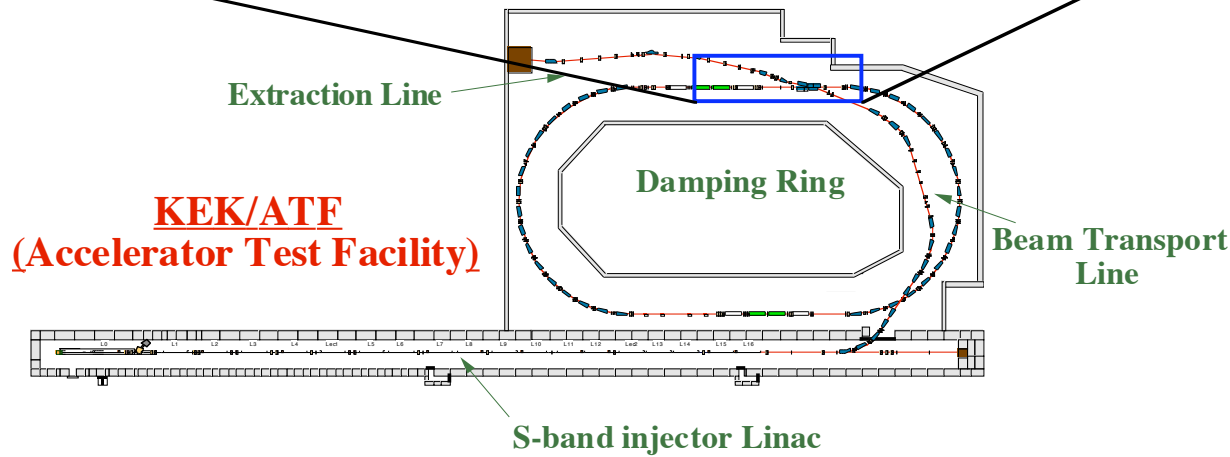
20060531 T.Naito

- Present kicker system

- Test result from the Beam Oscillation in the DR

- Experiment setup

Double kicker system

Extraction kicker
(2nd kicker)

Extraction Line

Extracted Beam

Septum Magnet

Extraction kicker
(1st kicker)

Damping Ring

Injection kicker

Injected Beam

Damping Ring

extra kick
$\Delta\theta1$

Beam

$\Delta\theta2$

2nd kicker

design orbit

1st kicker

Phase advance π

Kick angle Stability
$1\times10^{-3} \rightarrow 2.8\times10^{-4}$

Extraction Line

Damping Ring

KEK/ATF
(Accelerator Test Facility)

Beam Transport Line

S-band injector Linac

(Single bunch) x 3 Train Extraction
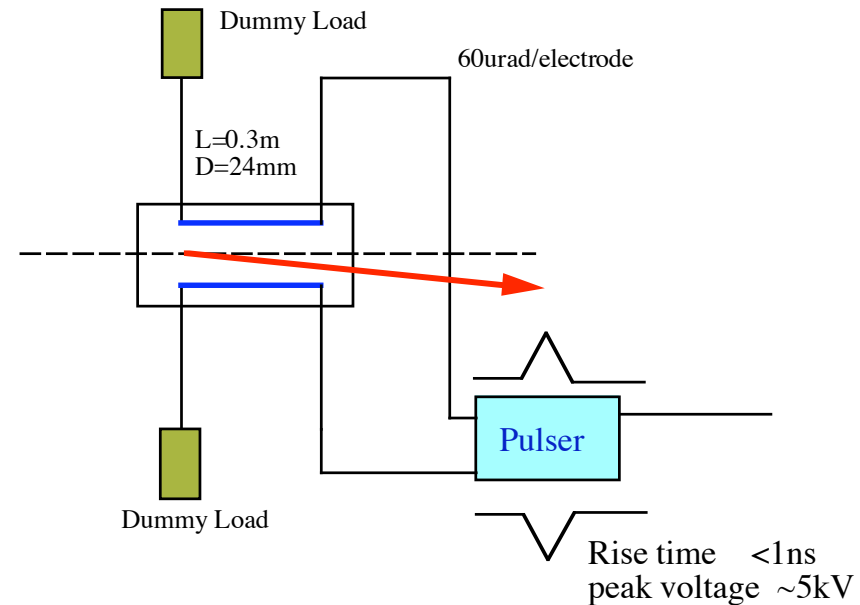
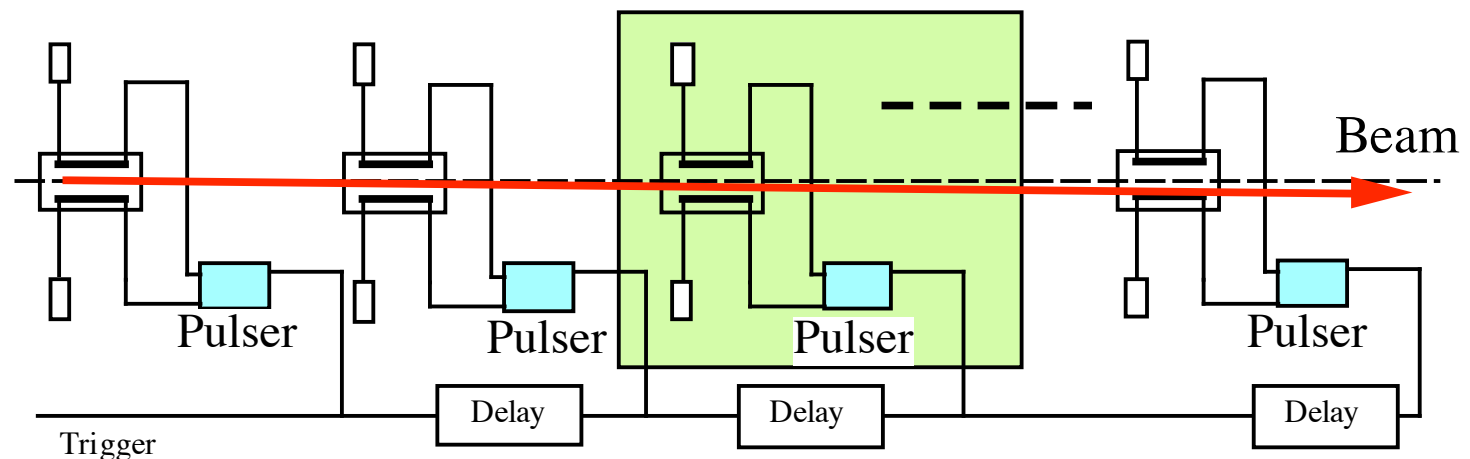154ns spacing

BPM Signal

Time (nsec)

300ns

kicker system

The kicker unit, which consist of the strip-line electrode and the fast high voltage pulse power supply, makes the very fast kick field, ~3ns rise/fall time.

20~40 units will be used to get the total kick angle(0.6mrad) at 5GeV, β=50m.

Dummy Load

60urad/electrode

L=0.3m
D=24mm

Pulser

Dummy Load

Rise time   <1ns
peak voltage ~5kV

Single Unit

Beam

Pulser   Pulser   Pulser   Pulser
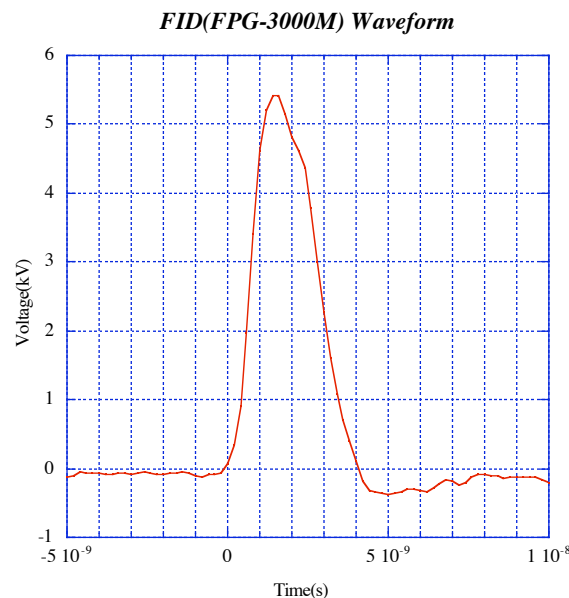
Delay   Delay   Delay

Trigger

Pulse generator

We tested some of pulse generators, FID, Behlke, LLNL.
FID Technology has very fast and high repetition rate pulse
generators. The specification meets our requirement for the high
voltage pulse source. We tested the kicker performance by using
the pulser.

FID(FPG-3000M) Waveform

Specifications

Amplitude at 50 ohm : 5 kV
Rise time :   1-1,2 ns
Pulse width at 50% of amplitude : 2-3 ns
Maximum PRF in burst mode - 3 MHz

Beam kick test in ATF DR

We fabricated the single unit of the strip-line kicker.
The kicker pulse is applied to the strip-line electrode at just the time of the beam goes through the electrode.
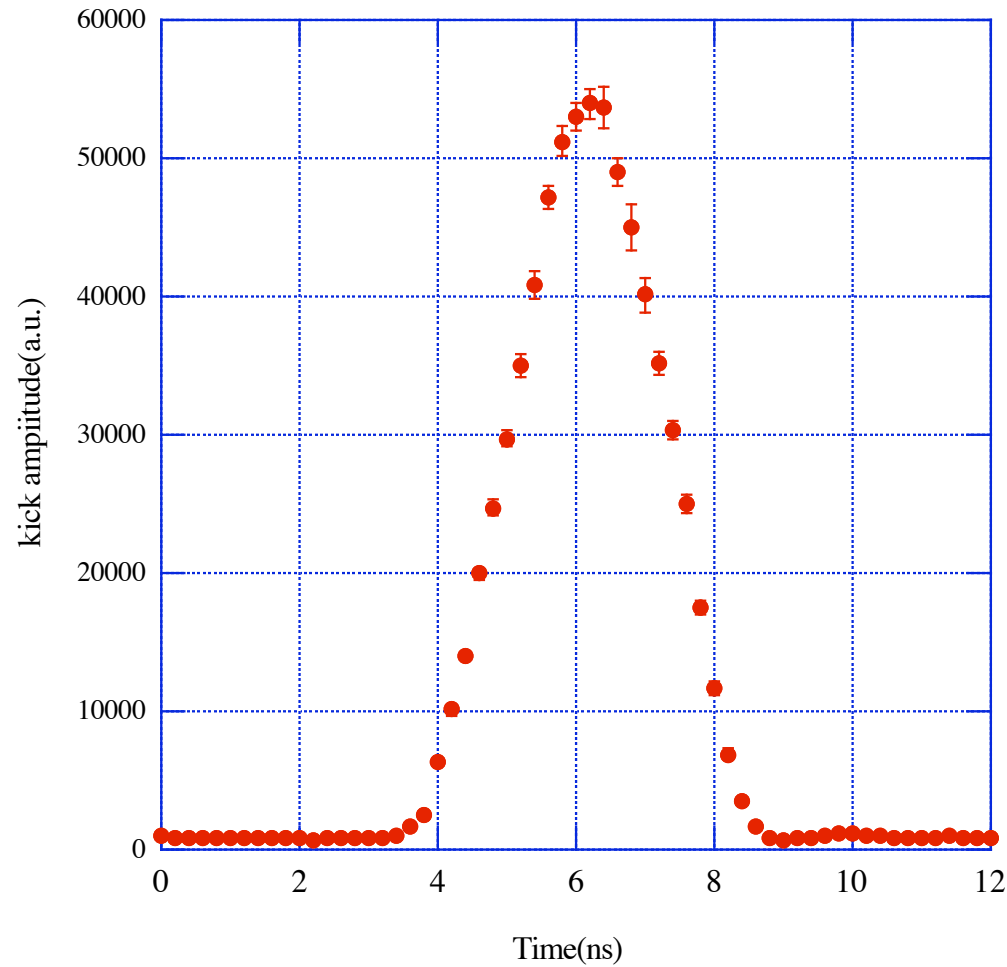*The beam kick is observed by a turn-by-turn BPM as the amplitude of the oscillation of the betatron frequency component.*
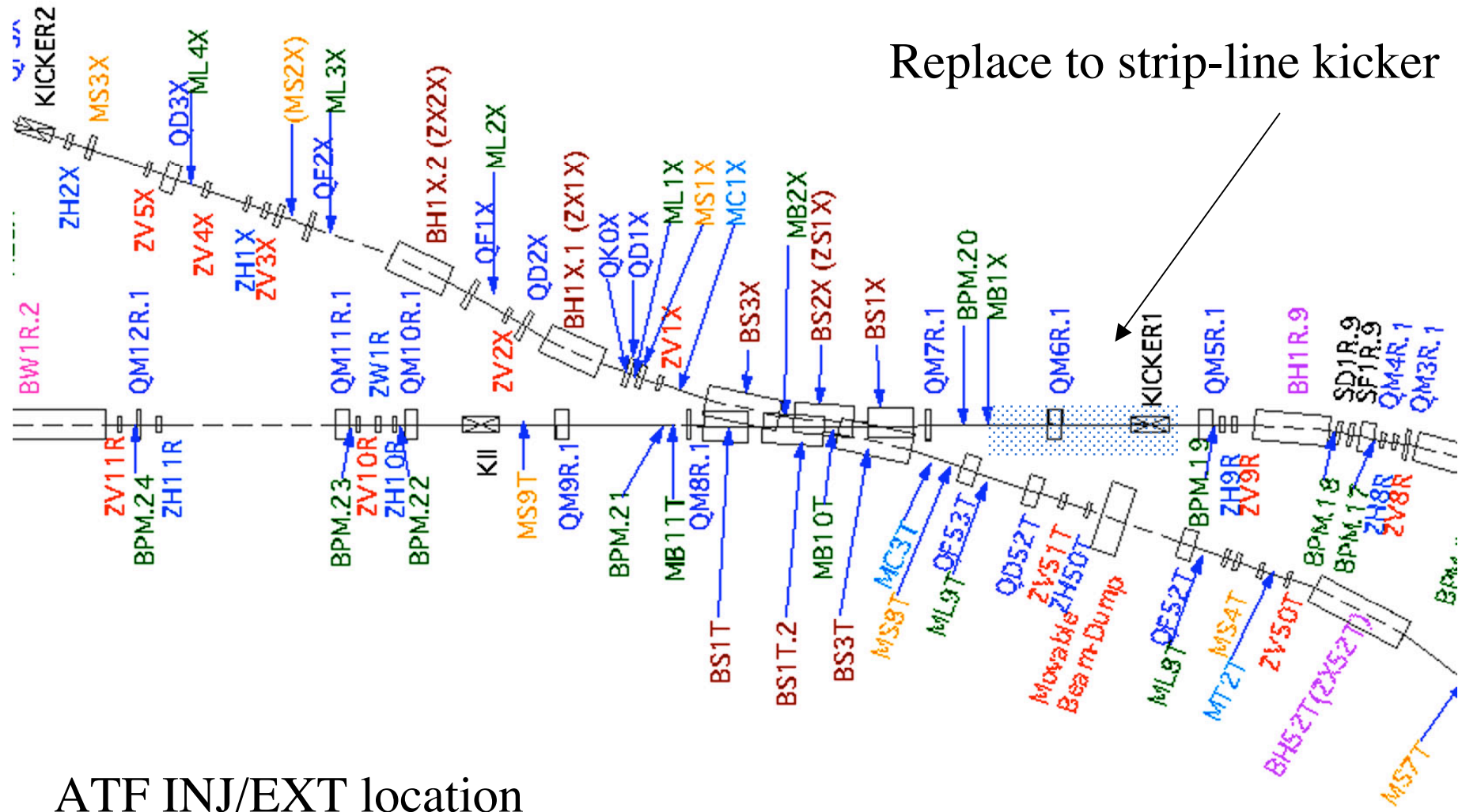*The kick effect is measured by scanning the pulse timing.*

BPM

Kicked Beam

Spectrum analysis

kicker pulses

Beam

Strip-line kicker
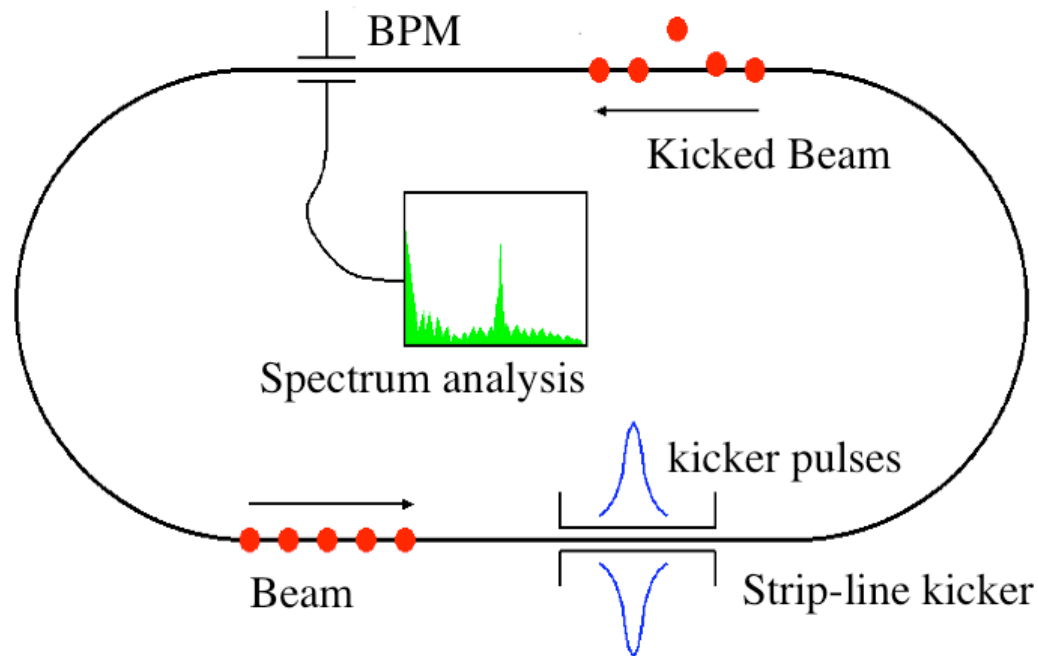
Measurement result of FPG5-3000M

Beam kick profile(30cm strip-line, 5kV FID pulser)

Rise time~3.2ns
Kick angle ~85μrad
(calc. 94.7μrad)
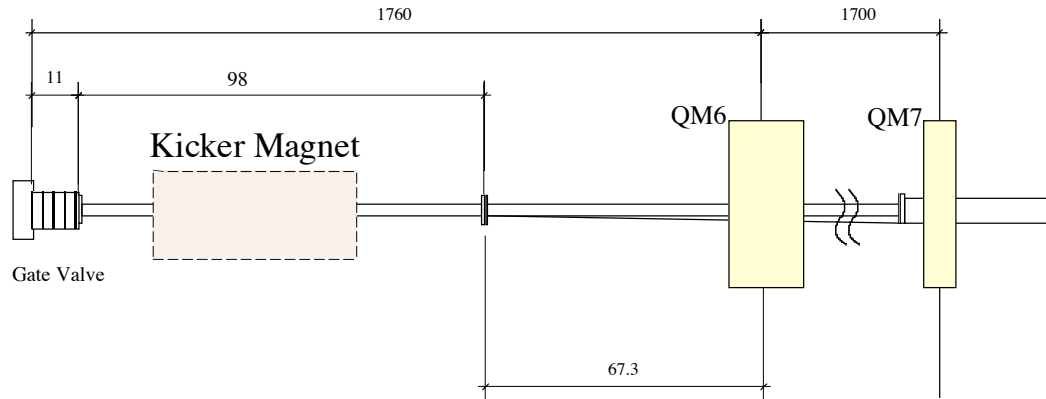
Beam Extraction Test

Replace to strip-line kicker

ATF INJ/EXT location

Present layout and design orbit
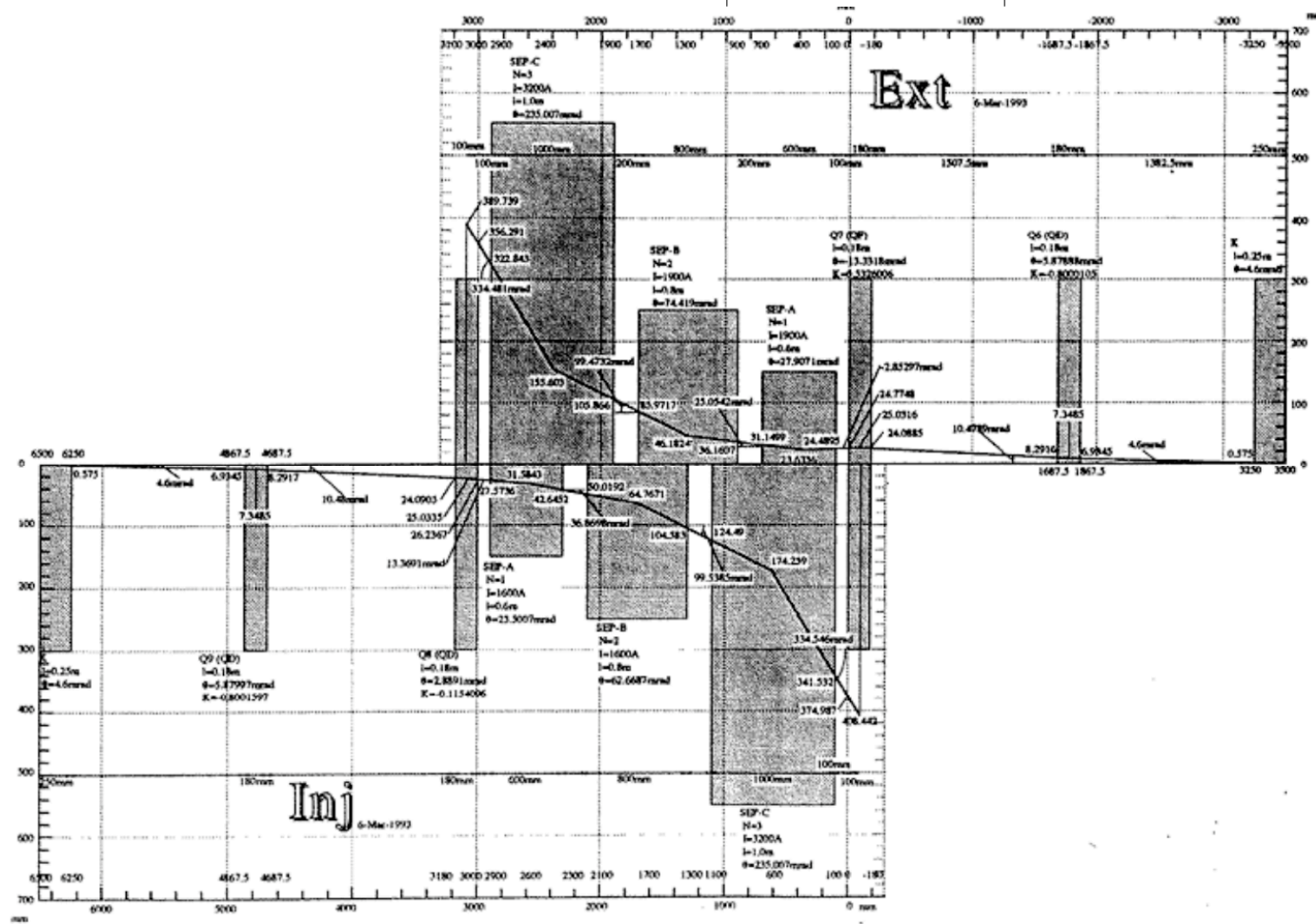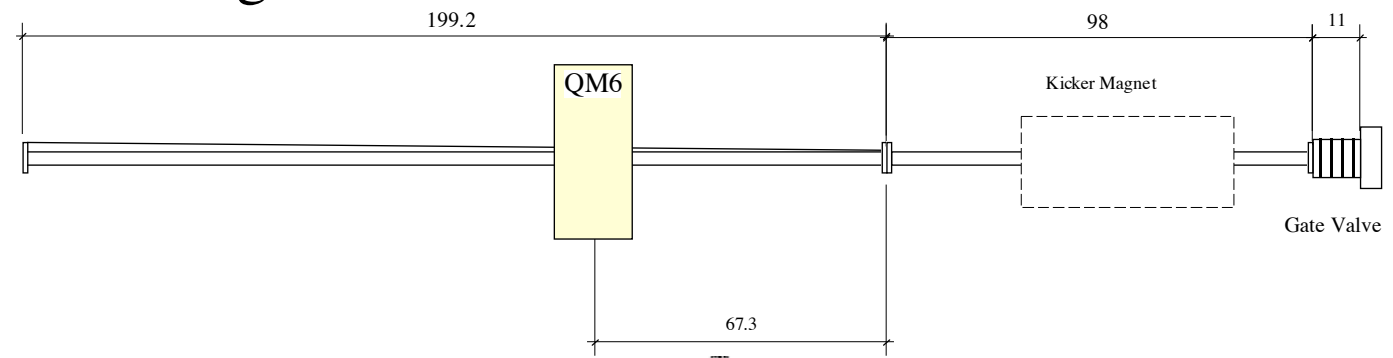
Orbit Design

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Single pulser + 1mx2 strip-lines

Present layout

1760   1700

11   98

QM6   QM7

Kicker Magnet

Gate Valve

67.3

Location of Strip-lines

85   65

QM6   QM7

Gate Valve

Design Orbit

0   850mm   1530mm   1760mm   3500mm

Center orbit

2.7mrad

2.2

4.0mm

2.2

2.7

0.6

0.8

5.6mm   4.4mrad

8.1mrad   -10.2mrad

19.6mm   -2.1mrad

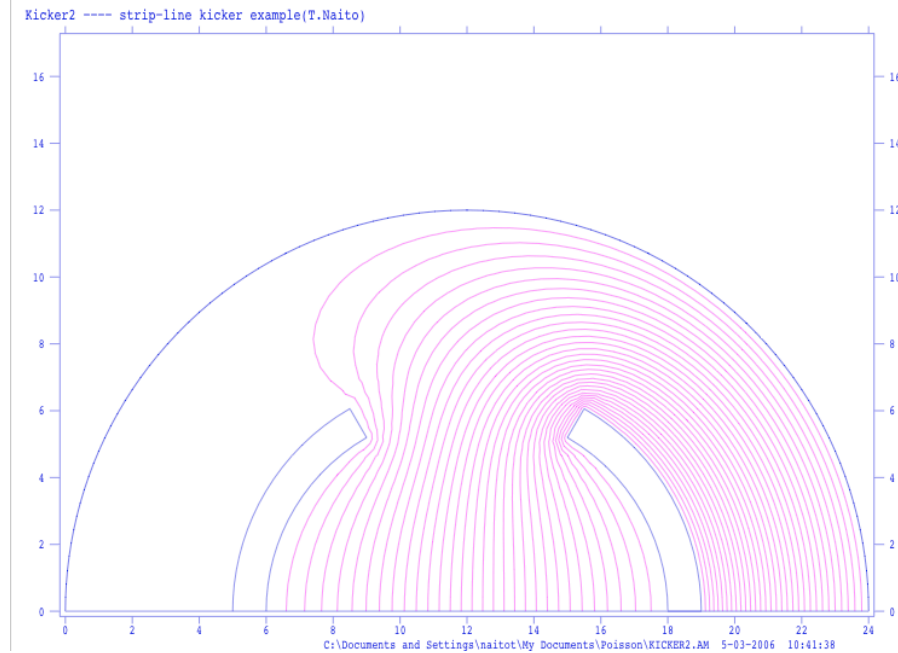## Electrode distance

6

12
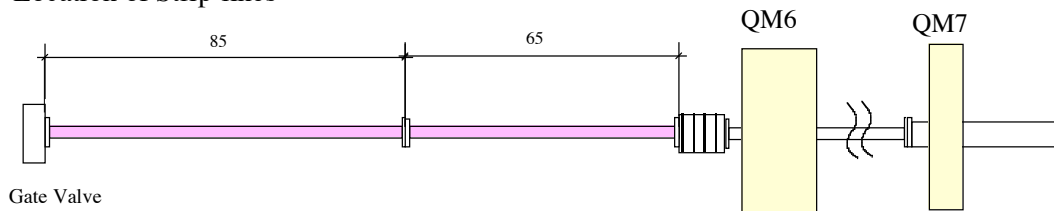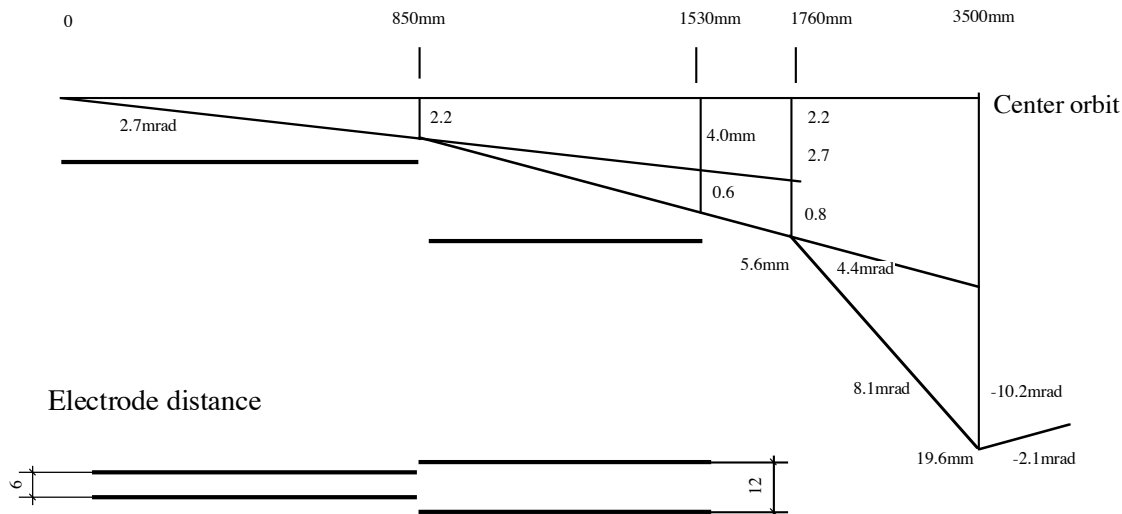
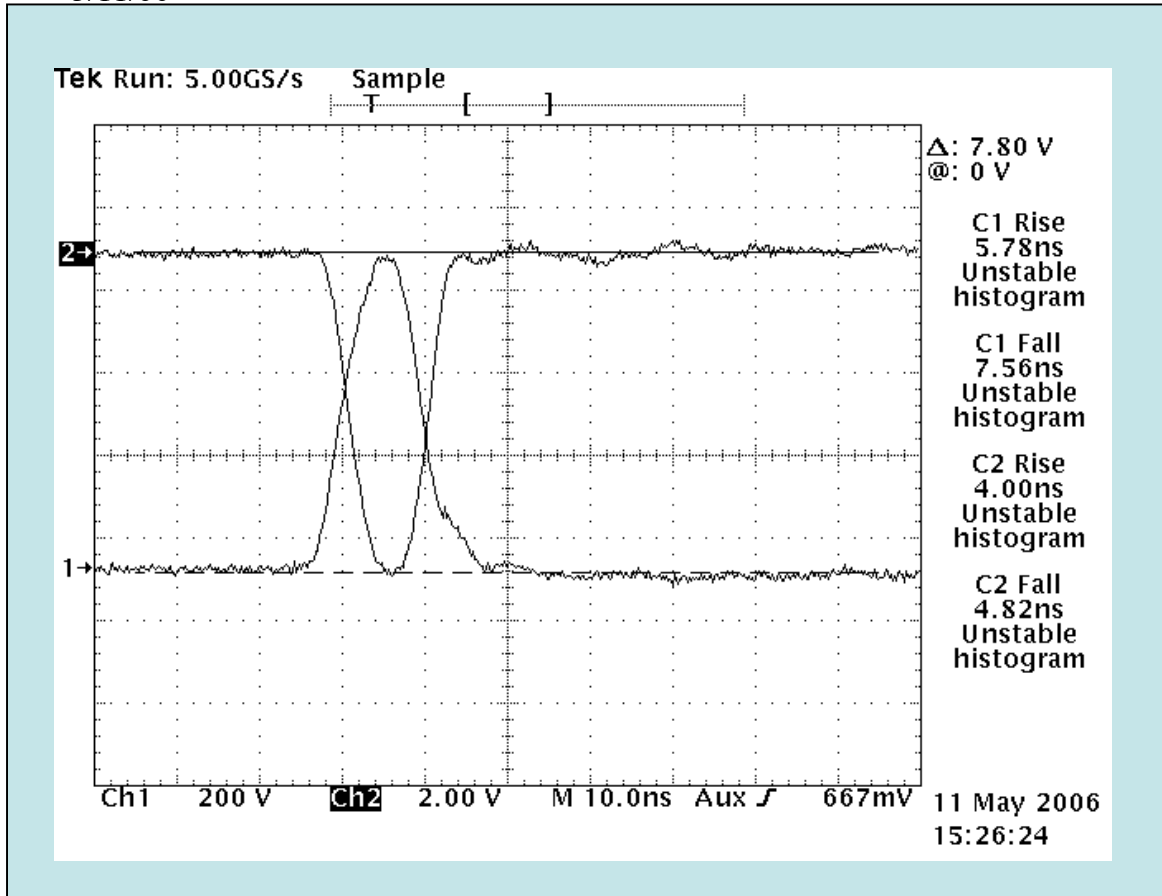Strip-line Electrode design

6mm φ

12mm φ
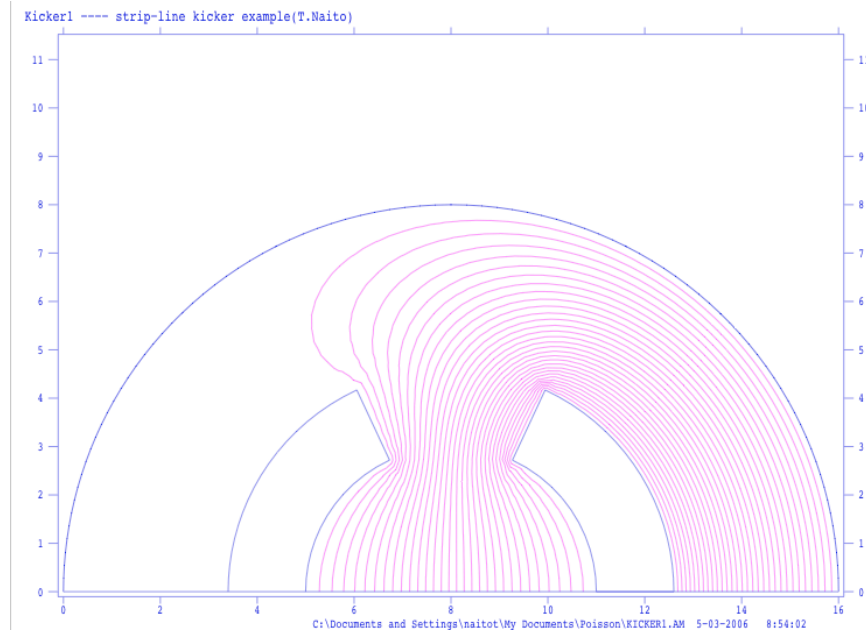
Data Taken By:
Ed Cook
5/11/06

LLNL pulser

Inductive Adder pulser

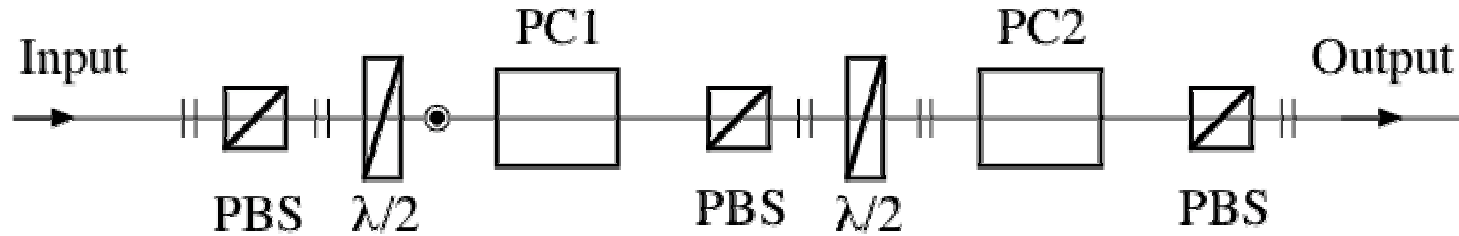The stacked FET boards makes the high speed and high voltage pulse.

Rise time ~5.7ns

Vp ~ +/-8kV

Inj/Ext Beam

Bunch spacing in DR

2   1

8.4ns

Bunch spacing at Ext

1   2
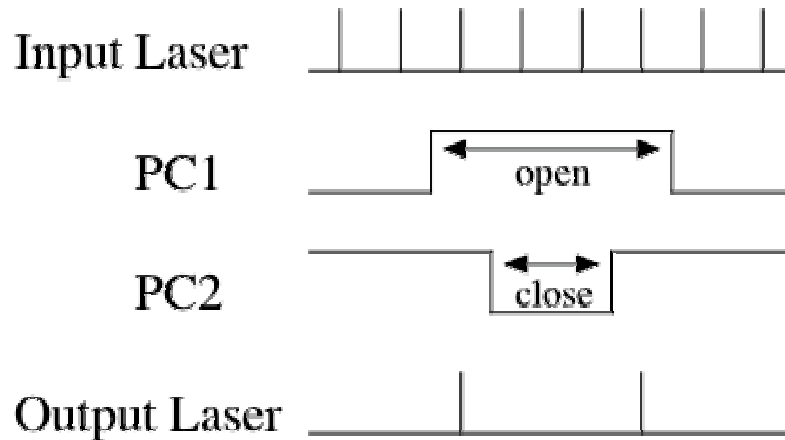
462ns - 8.4ns = 453.6ns
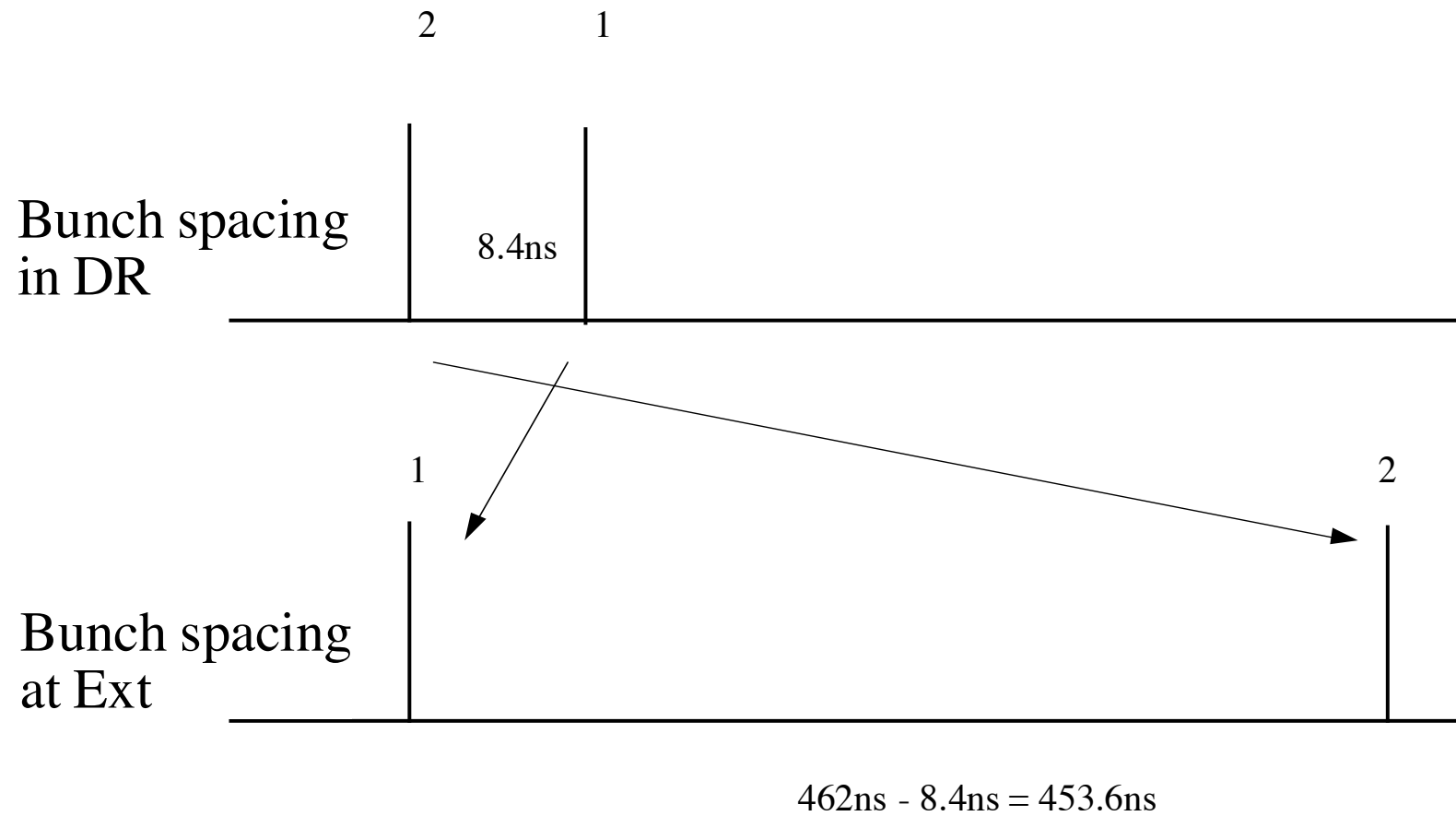
Laser modification for
Two bunches beam generation with arbitrary bunch spacing

PC: Pockels Cell
PBS: Polarizing beam splitter

Future Plan

5.6ns x 10

Bunch spacing
in DR

154ns

462ns

Bunch spacing
at Ext Line

154ns

30 bunches with 154ns spacing