Development of Pulsed Quadrupoles

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Contents

- Motivation (LER and HER)
  - The magnet will be installed only in LER in this summer.
- Pulsed Quadrupoles System
  - Pulsed magnet
  - Power supply
- Summary and schedule

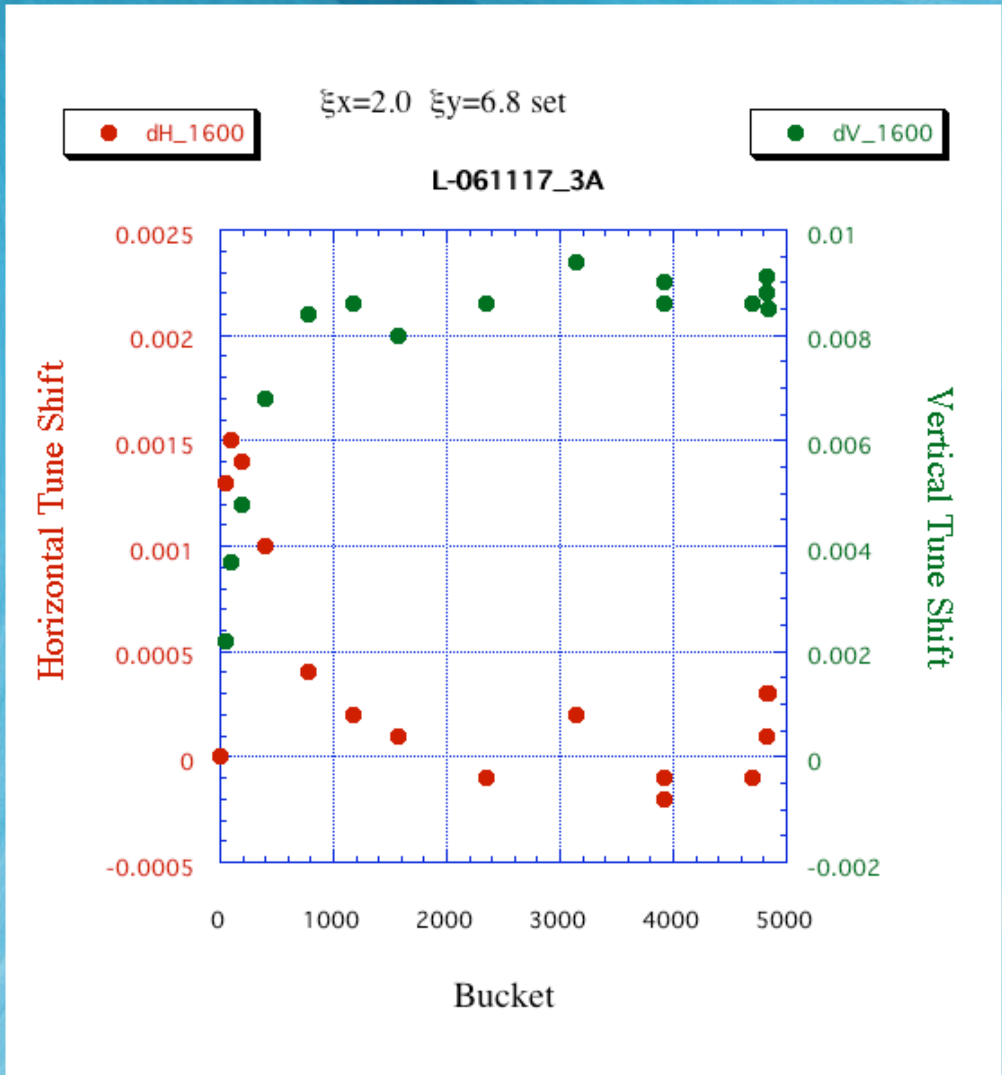
Motivation (LER)

- **Betatron tune changes along the position in the train.**

->Because of photoelectron cloud, vertical tune becomes higher. (relatively lower tune at the head of train.)

-> Only bunches at the head of train get into the resonance band and they are lost.

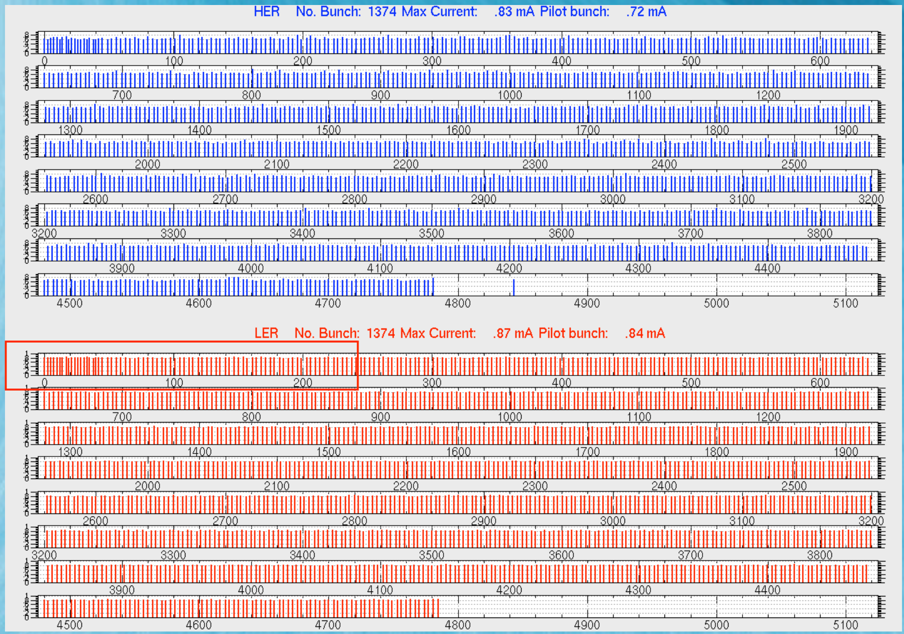
The position dependence of Betatron tune (LER)

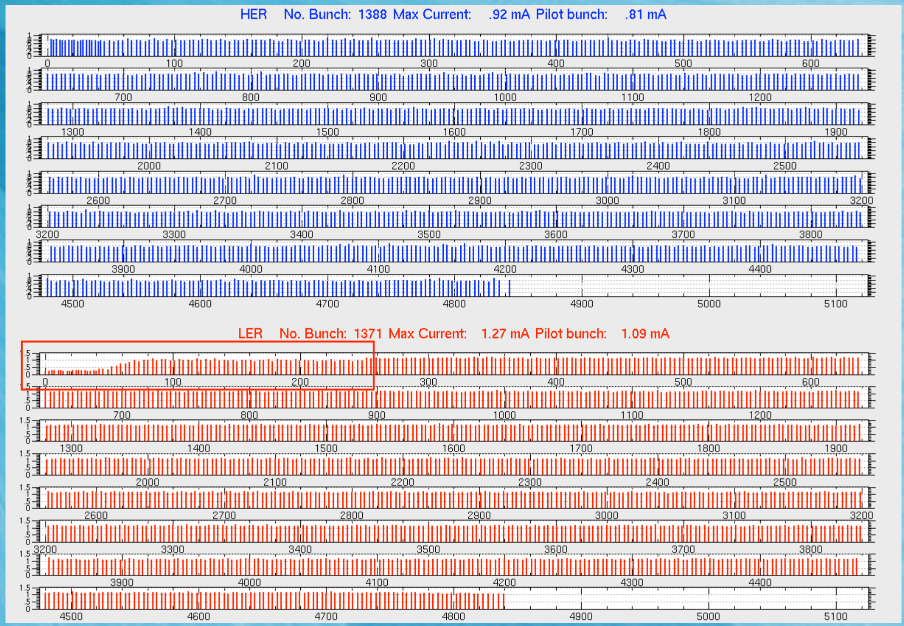


Solenoid ON

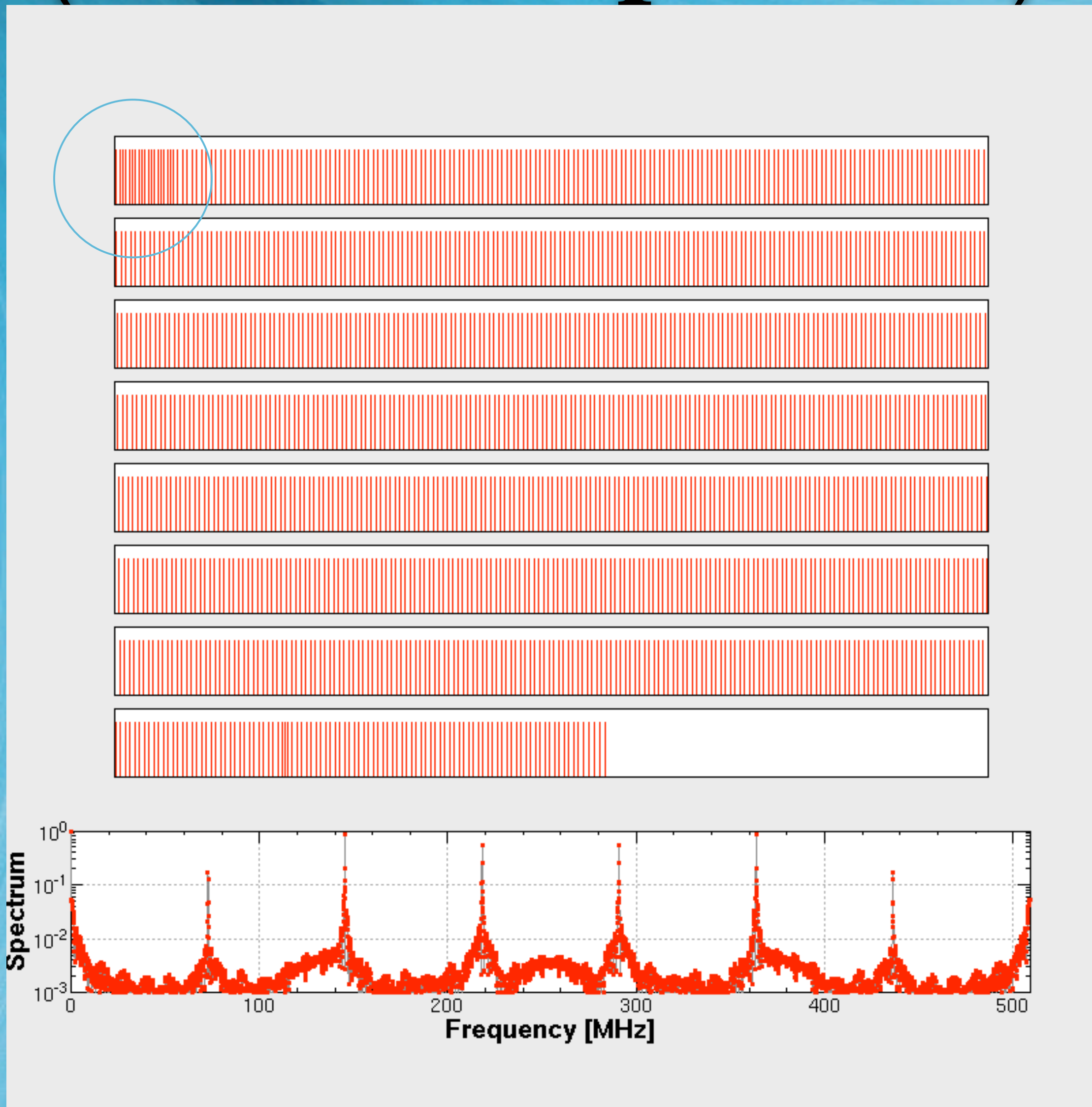
Measured by Dr.Ieiri

Lose some bunches at the head of bunch train

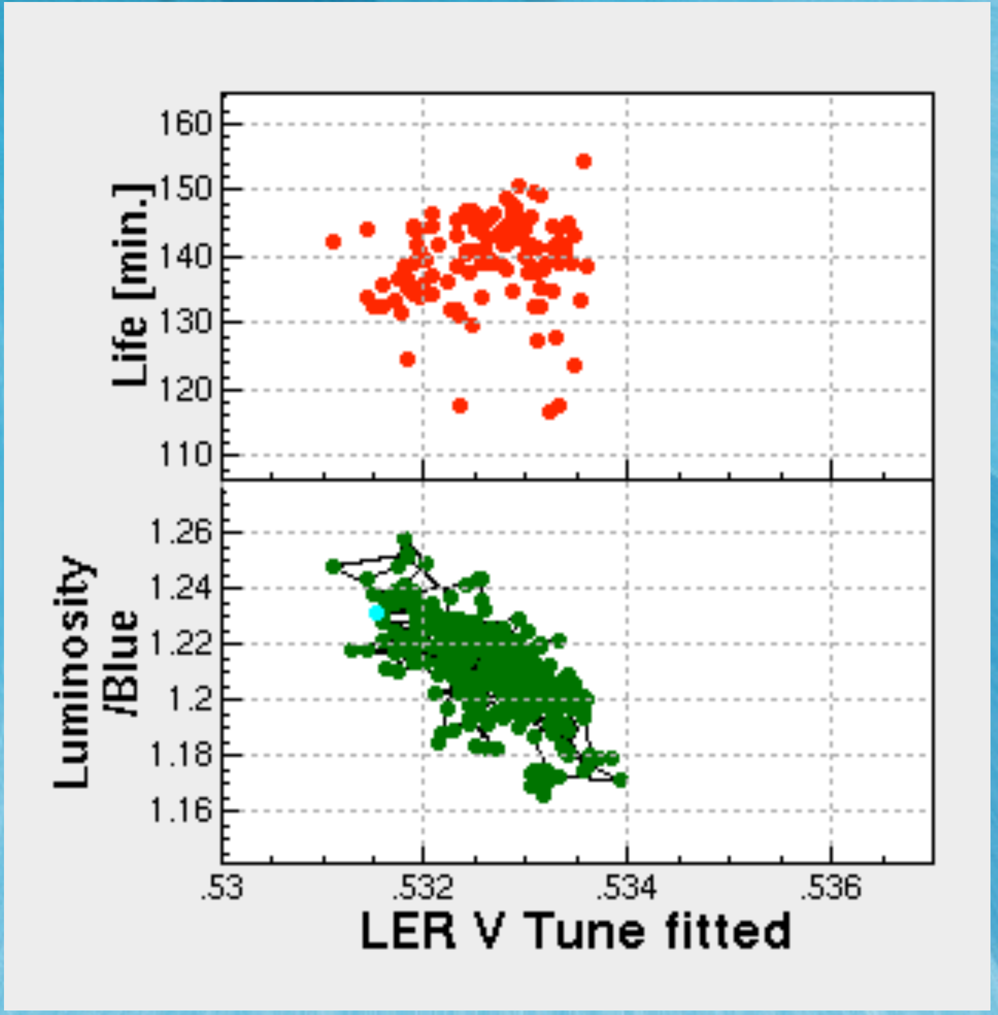




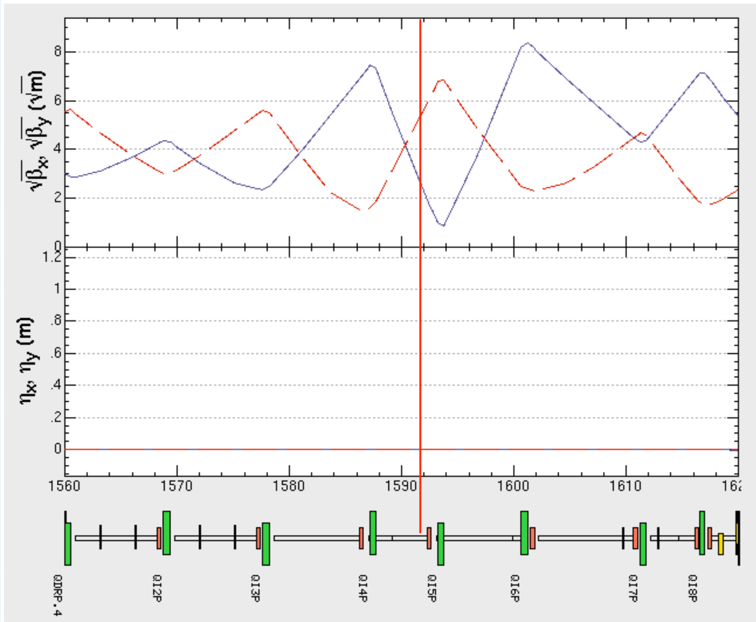
Fill pattern (A seawall pattern)



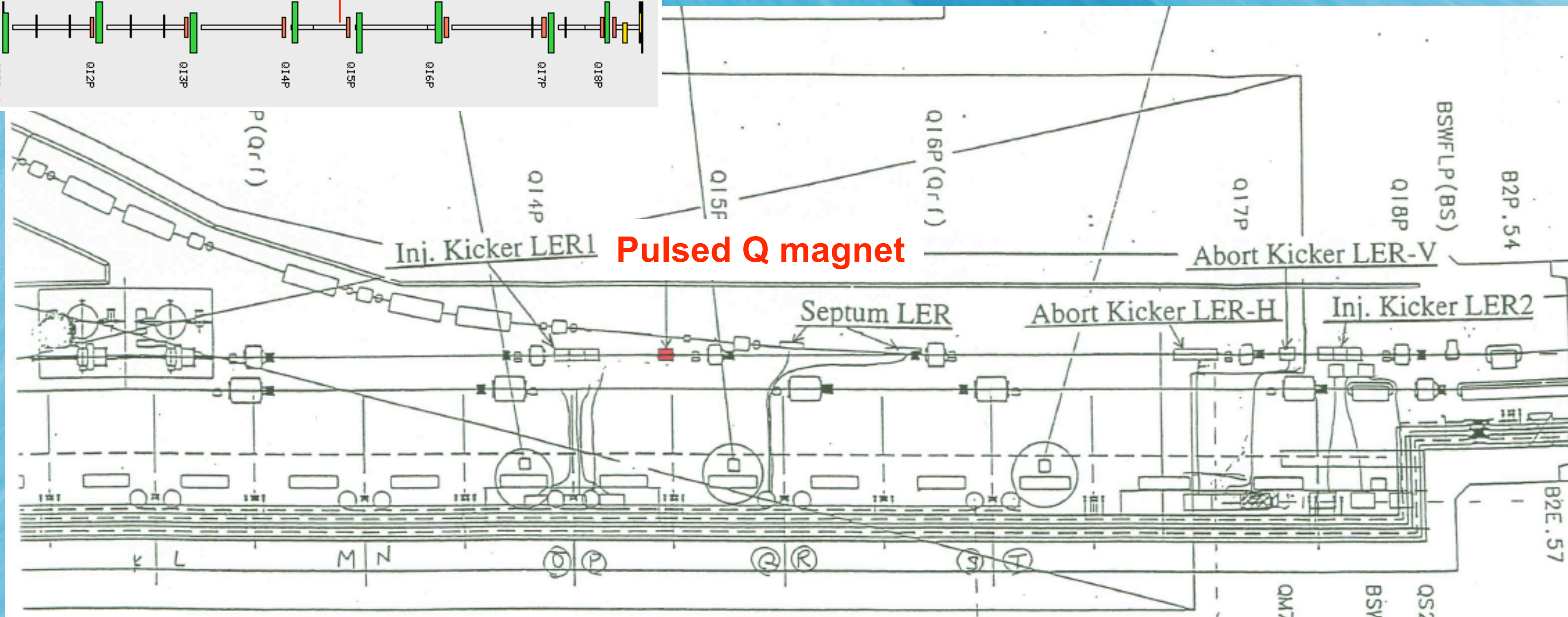
LER Vertical tune VS Blue Ratio (Luminosity ratio against reference)



Pulsed Quadrupoles in LER



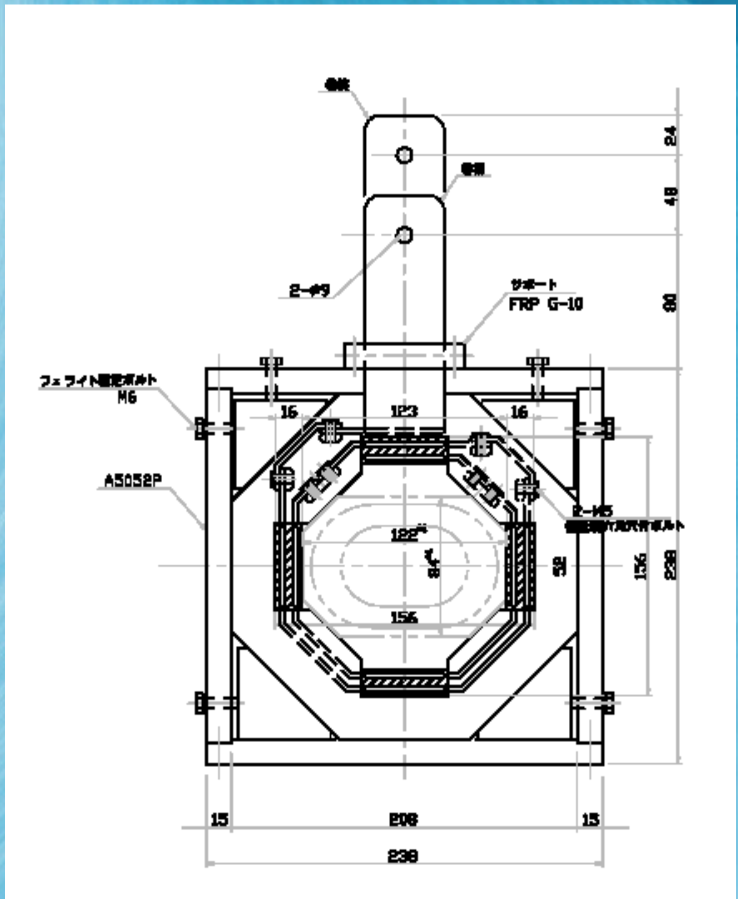
- The pulse Quadrupoles magnet will be installed in LER.

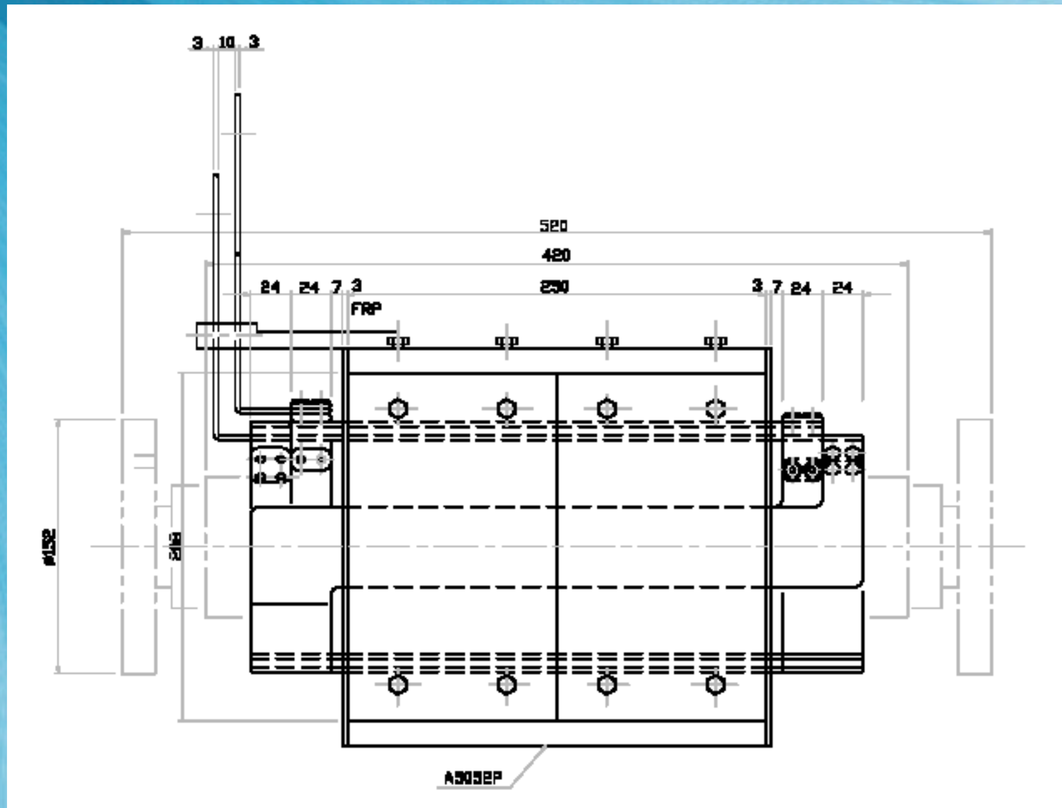


The parameters of LER Pulsed quadrupoles

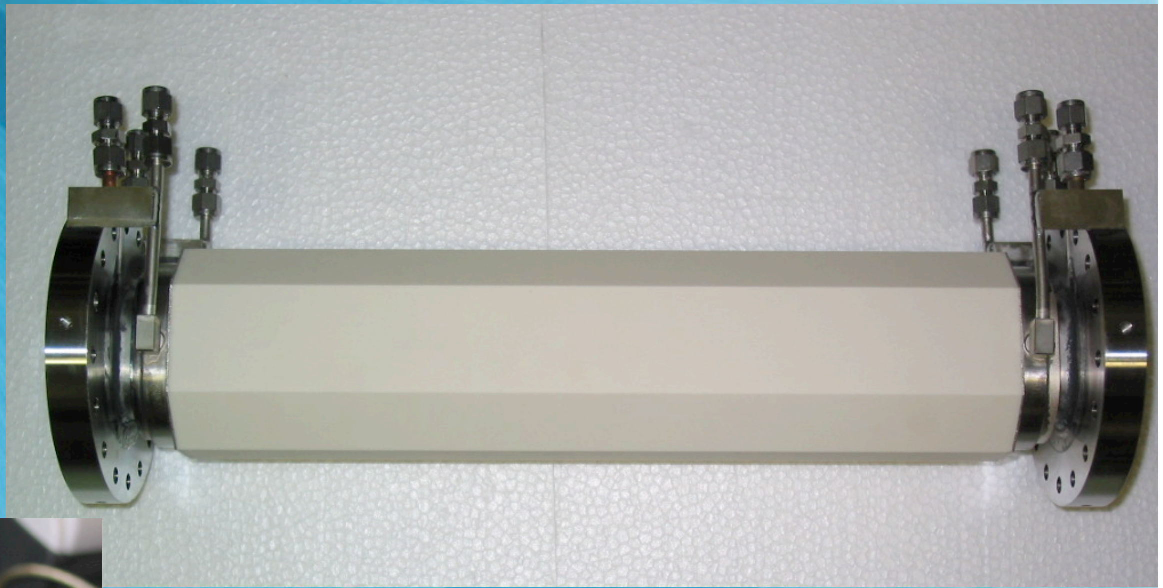
$\Delta\nu$	0.005
dBx/dy (T/m)	0.075
βy@magnet (m)	40
Pulse shape	Half Sine
Pulse Width (μsec)	1
Repetition Rate (KHz)	100
Peak Current (A)	100
Magnet Length (m)	0.25
Inductance of the coil (μH)	4-5

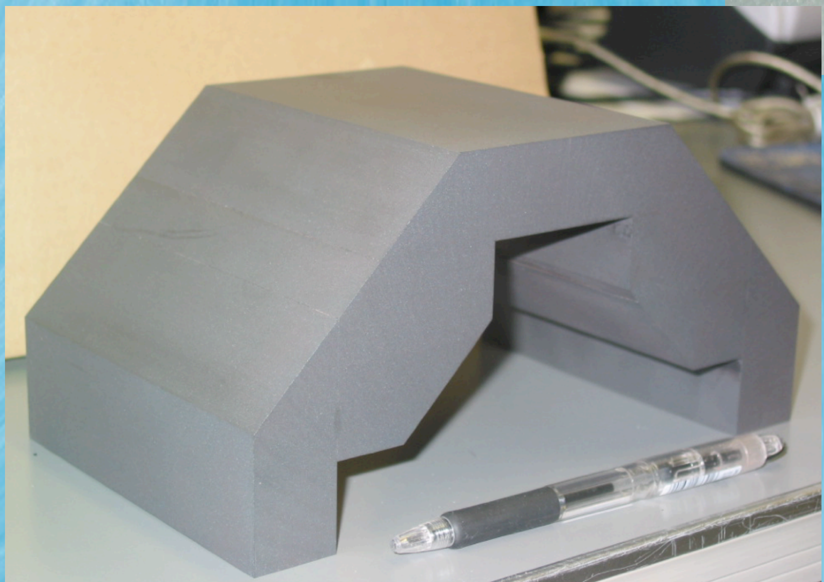
Pulsed Quadrupoles made of Ferrite Core





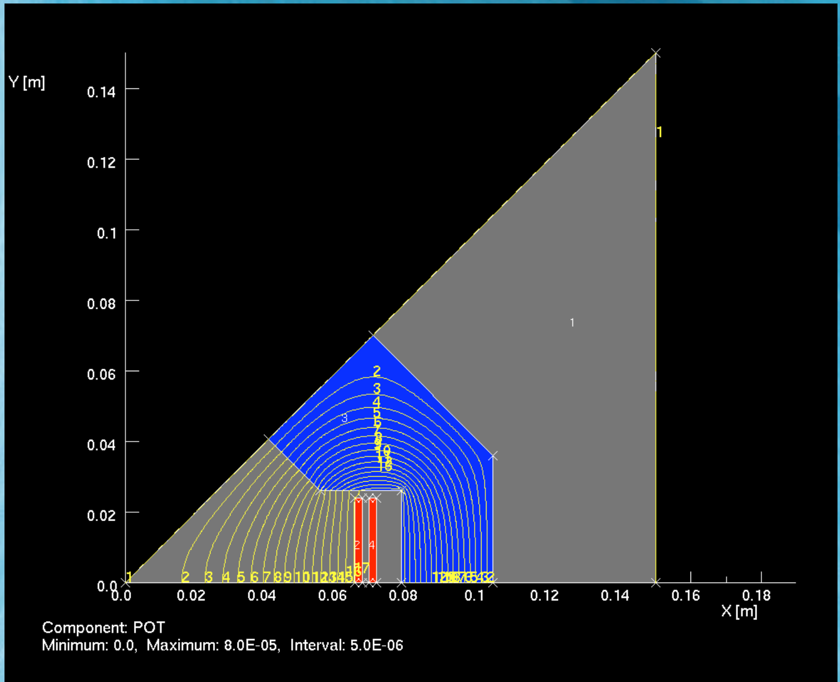
Ferrite core and the water cooling ceramic chamber

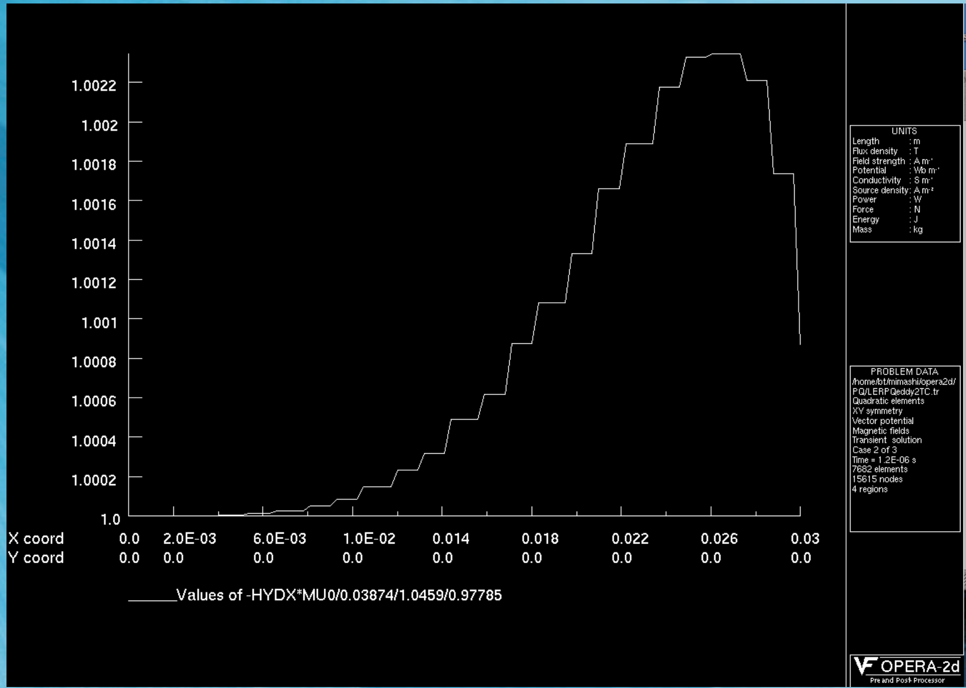


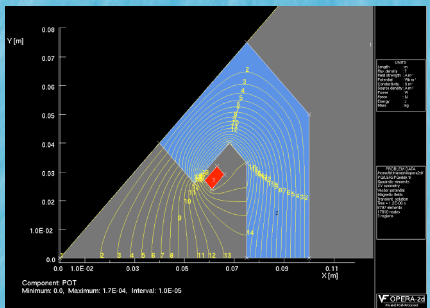


- Ferrite core (TDK PE14)
  Estimated loss in the core
  -> 2.3W (100kHz 5mT)

Simulation of magnetic field







Power supply

- Difficult points
  - Very High Repetition Rate (100kHz)
  - Large current (100A)

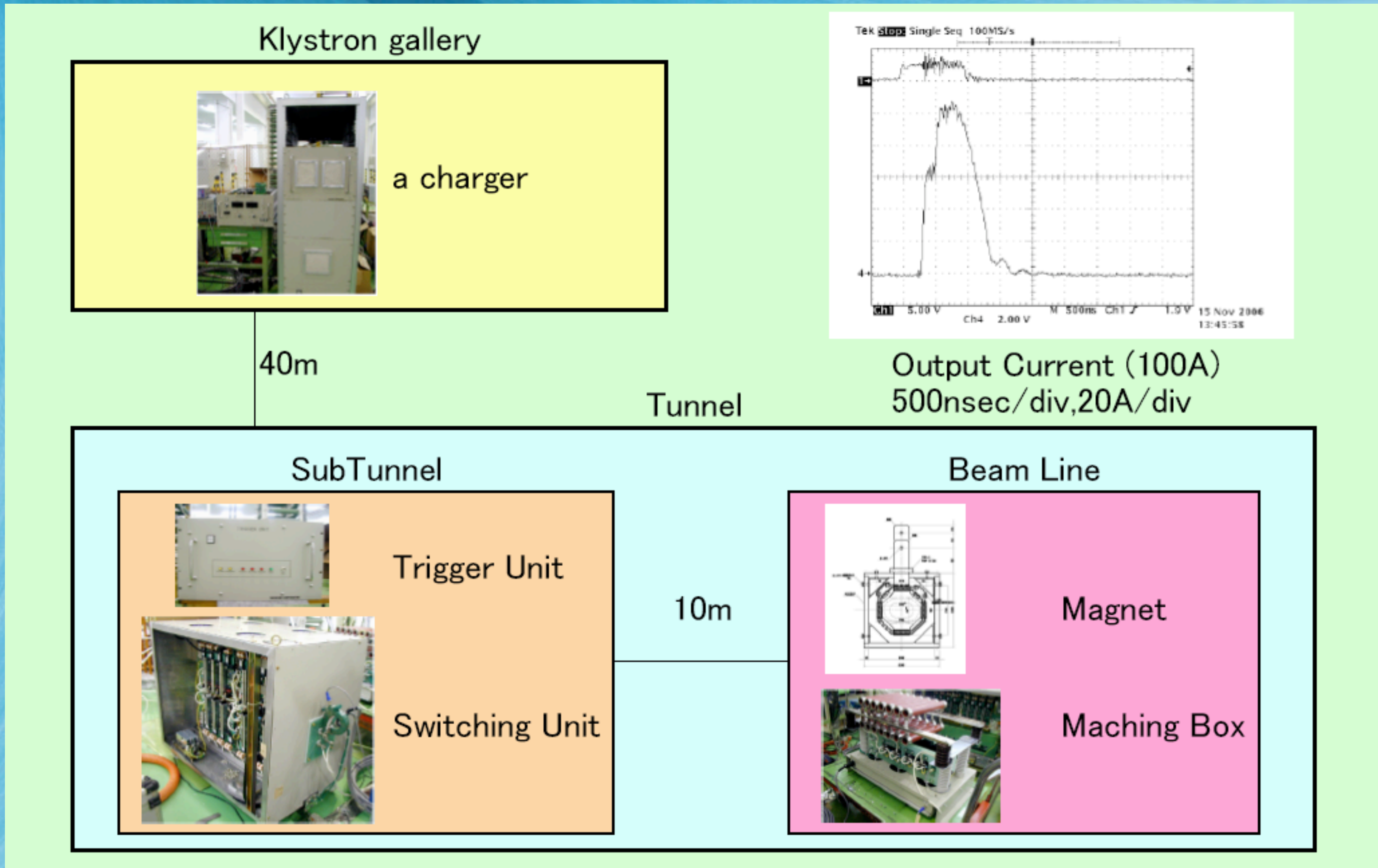
-> Switching device selection is the most important.

-> 8 series 3 parallel (Total 24) FETs are used.

-> In order to increase the current new type of thyristors will be tested as the switching device.

(2 series 2 parallel : total 4 devices)

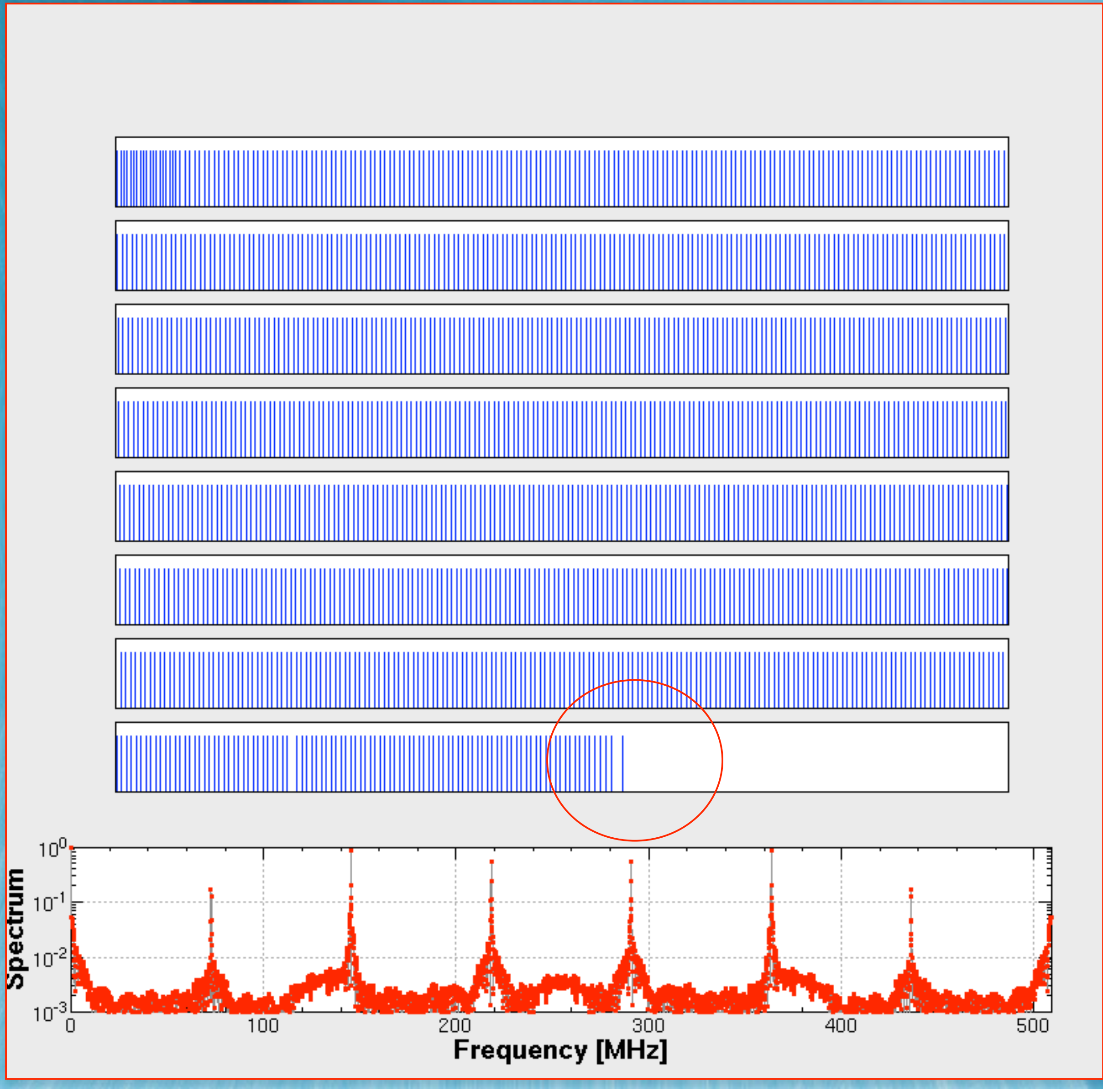
Power supply system



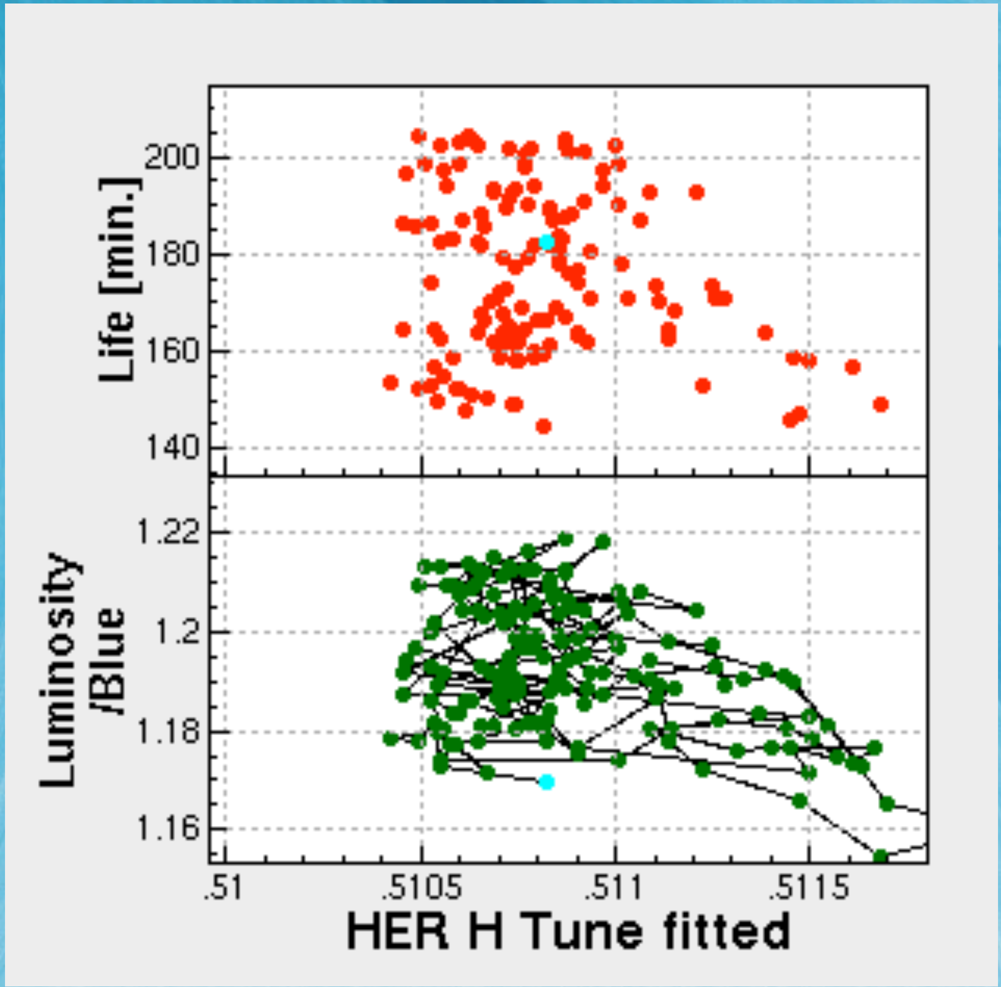
Motivation (HER)

- Betatron tune is monitored with noncollision bunch. (Pilot Bunch)
- When we set the HER horizontal Tune lower value, only pilot bunch is lost, while other collision bunches have enough beam life.

Pilot Bunch



HER Horizontal Tune VS Luminosity (Blue Ratio)



HER Pulse magnet(Design)

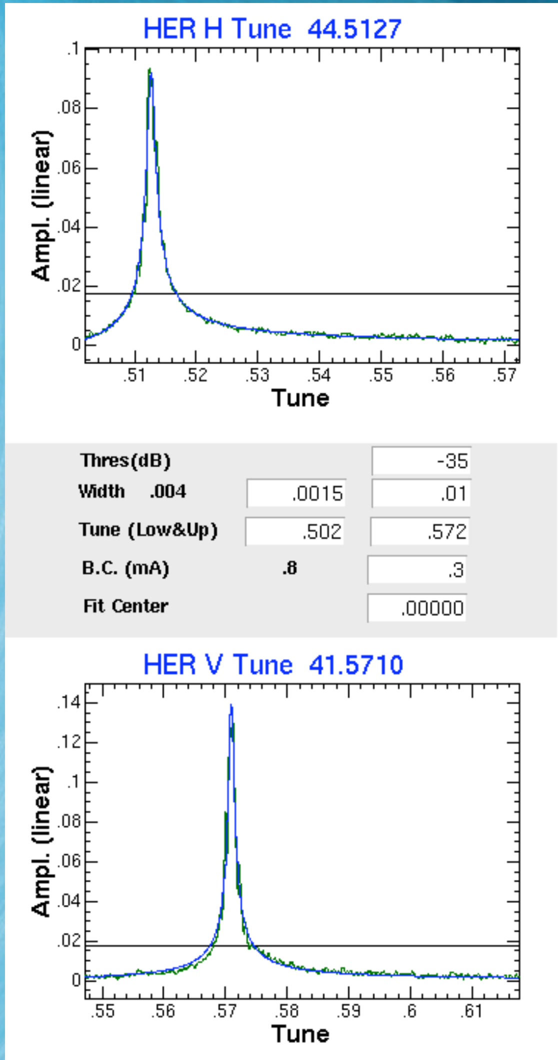
$\Delta\nu$	0.004
dBx/dy (T/m)	0.18
β_y@magnet (m)	30
Pulse shape	Half Sine
Pulse Width (μsec)	1
Repetition Rate (KHz)	100
Peak Current (A)	175
Magnet Length (m)	0.25
Inductance of the coil (μH)	4-5

Summary and schedule

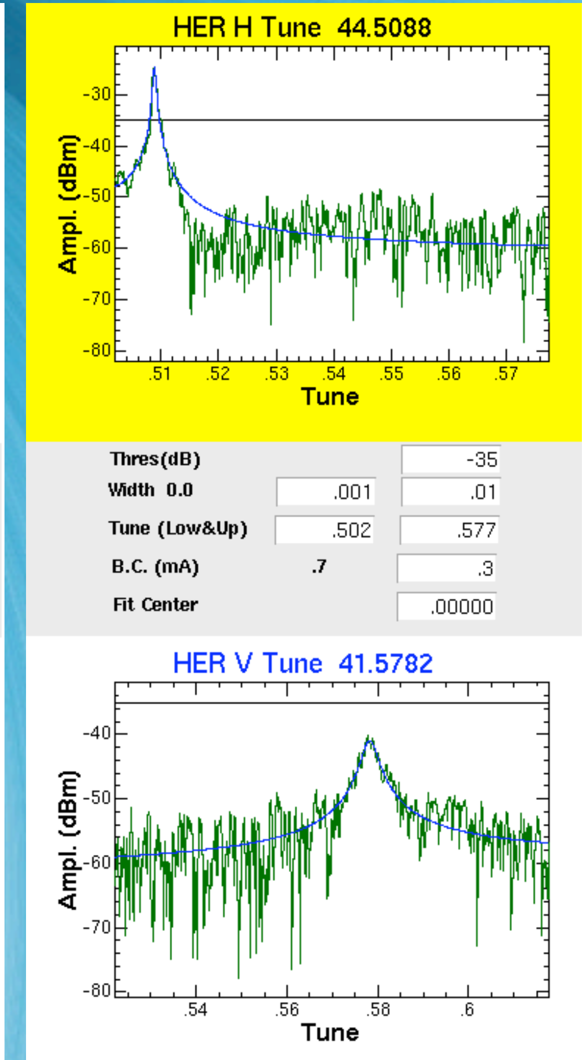
- The pulsed Quadrupoles has been designed and almost fabricated.
- The magnet will be tested and installed in LER in this summer.
- In order to increase the peak current of the power supply, new switching device will be tested.

END

Motivation (HER)



Pilot Bunch



Collision bunches

- Pilot Bunch
  ->Betatron tune is monitored with noncollision bunch.

The difference of Betatron tune between collision and noncollision bunches.

Tune	Col Bunch - Non Col Bunch
LER Horizontal	+.002
LER Vertical	+.014
HER Horizontal	-.004
HER Vertical	+.007

Pulsed Magnet (LER)

- Ferrite core (TDK PE14)
  - core loss 100kHz-5mT 2.3W
  - core loss 100kHz-50mT 1.3kW