

# 3.6cell rf-gun for LUCX

M. Fukuda<sup>A)</sup>,

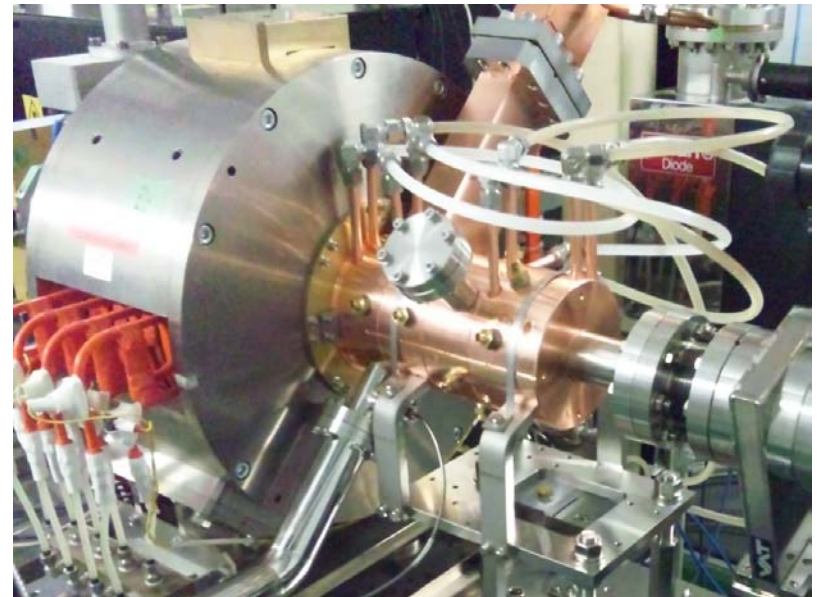
T. Aoki<sup>B)</sup>, K.Sakaue<sup>B)</sup>, T.Takatomi<sup>A)</sup>, J. Urakawa<sup>A)</sup>

<sup>A)</sup>High energy accelerator research organization:KEK

<sup>B)</sup>Research Institute for Science and Engineering,  
Waseda University

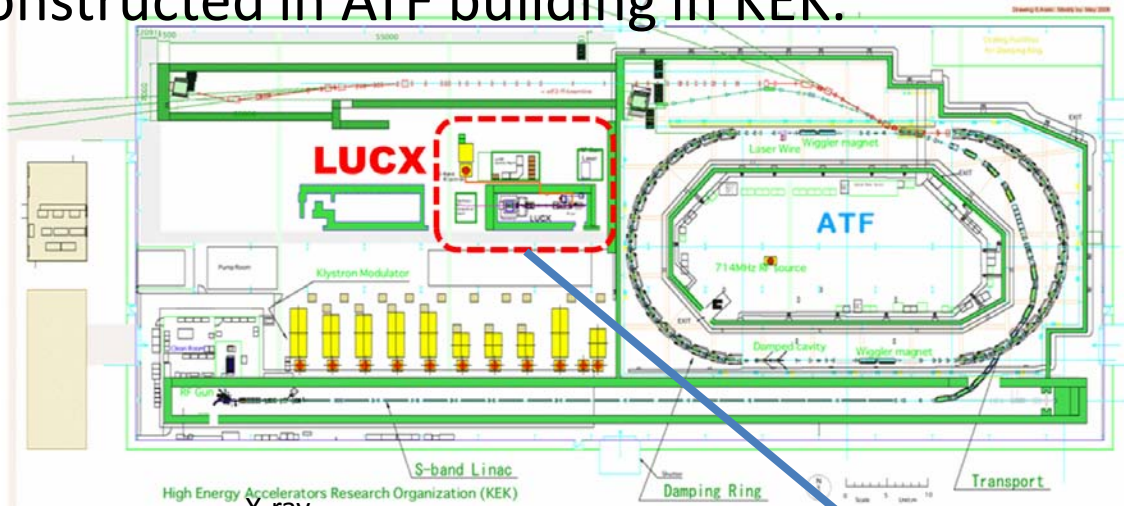
# Contents

- Introduction to LUCX
- 3.6cell photocathode rf-gun
- Machining & Brazing
- RF aging & Beam test
- Summary

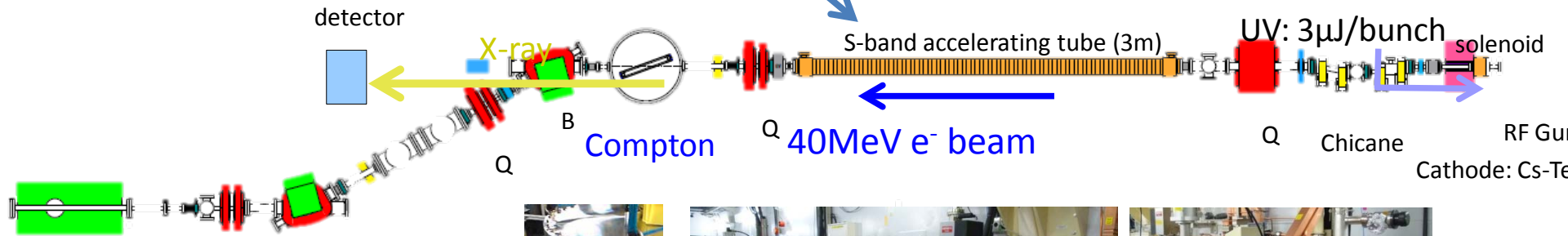


# Introduction to LUCX

The LUCX(Laser Undulator Compact X-ray source) accelerator is constructed in ATF building in KEK.

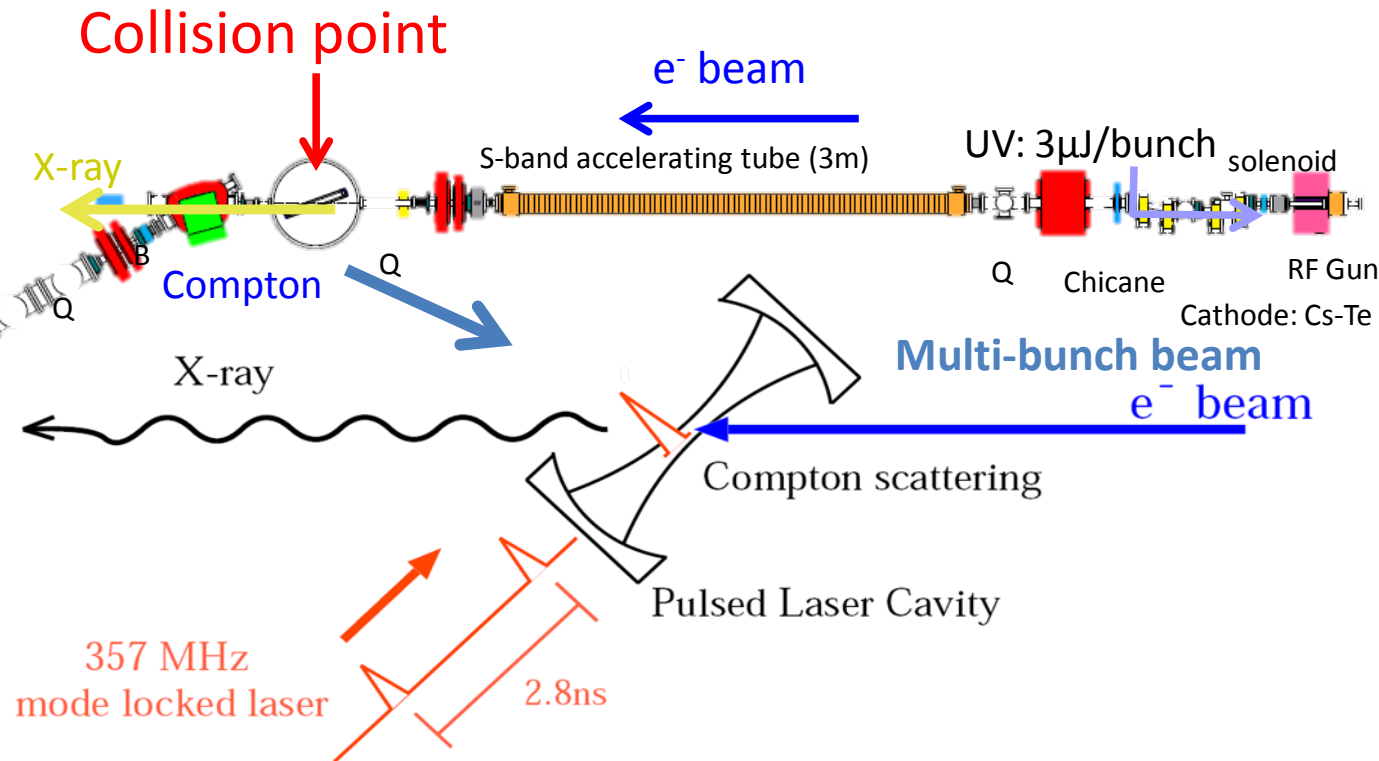
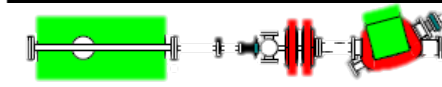
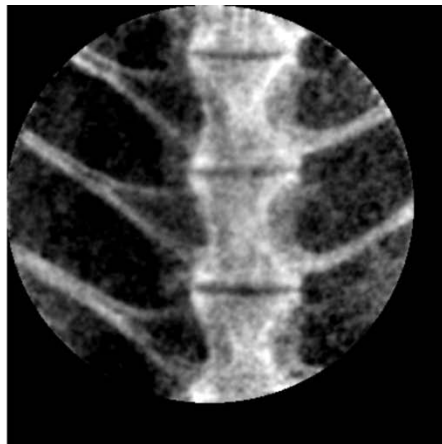


Frequency : 2856MHz  
 Beam Energy : 30~40 MeV  
 Bunch Number : 100  
 Rep Rate : 3.13~12.5Hz



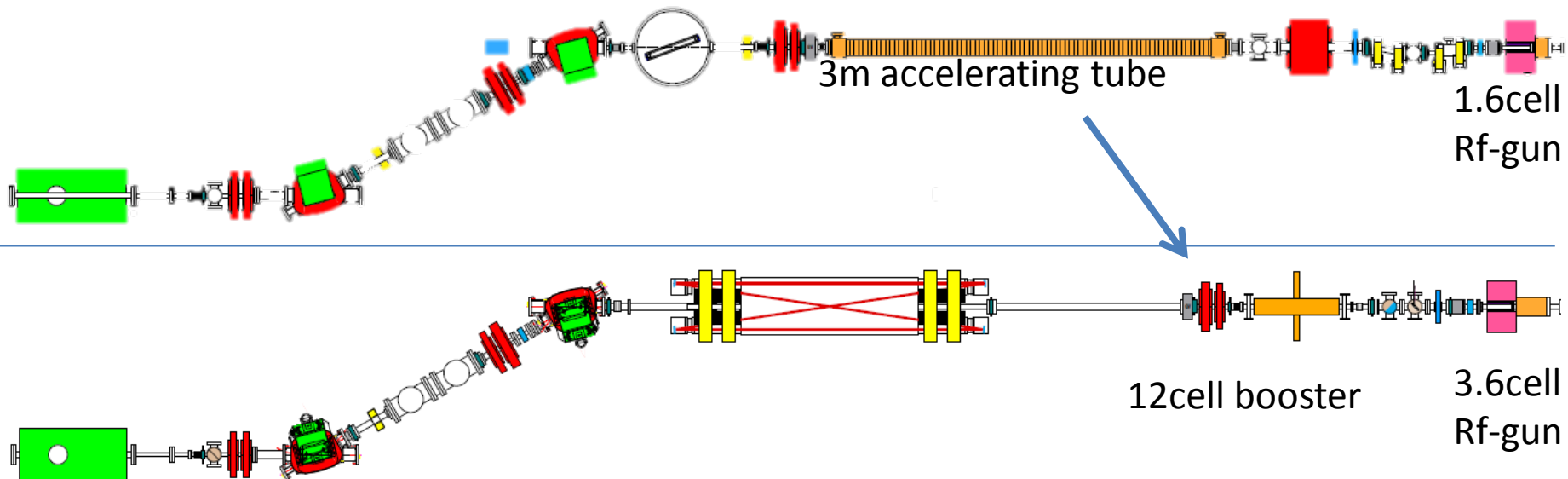
# Introduction to LUCX

We have developed the X-ray source based on inverse Compton scattering for X-ray Imaging.

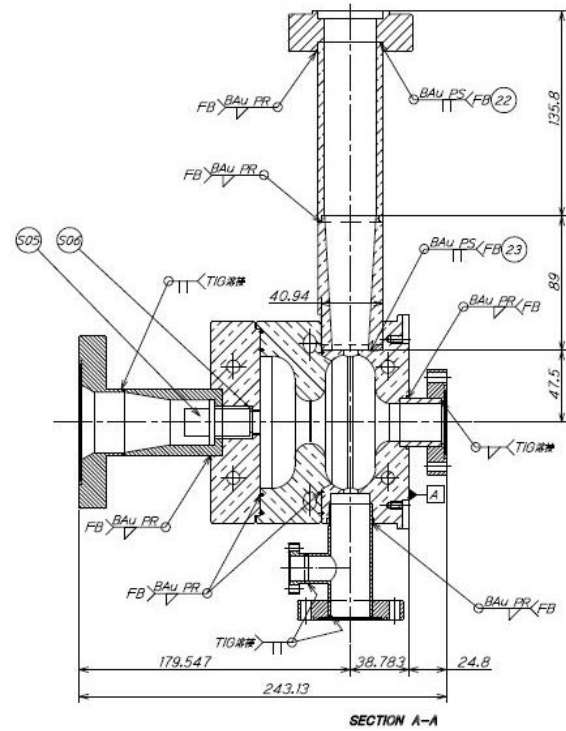


# Future plan for LUCX accelerator

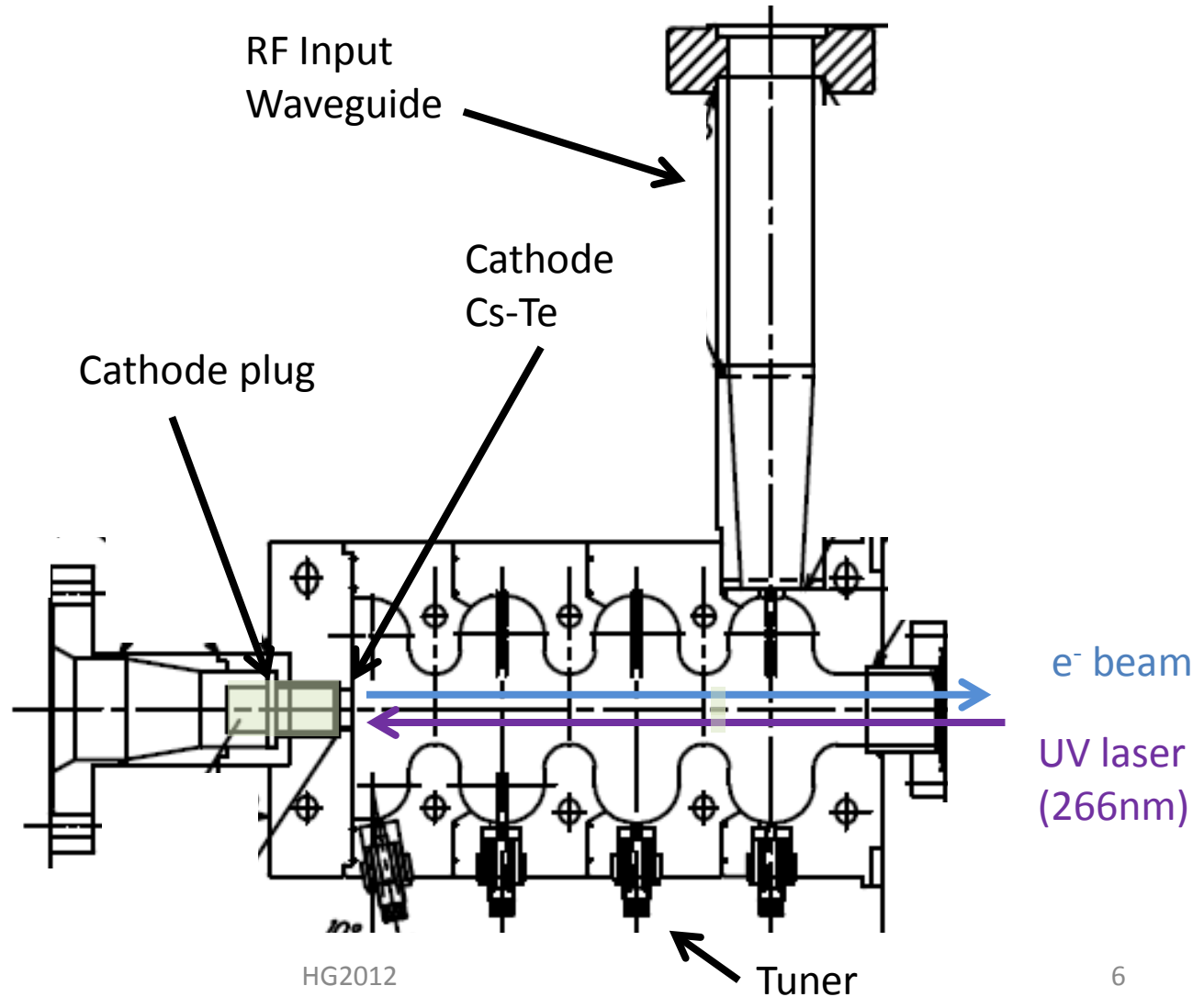
- To downsize the accelerator, we have planned to install a 3.6cell rf-gun and a 12cell booster.
  - 3.6cell rf-gun
    - Beam test has been started from Jan 2012.
  - 12cell booster
    - This booster is making now.



# 3.6cell photocathode rf-gun



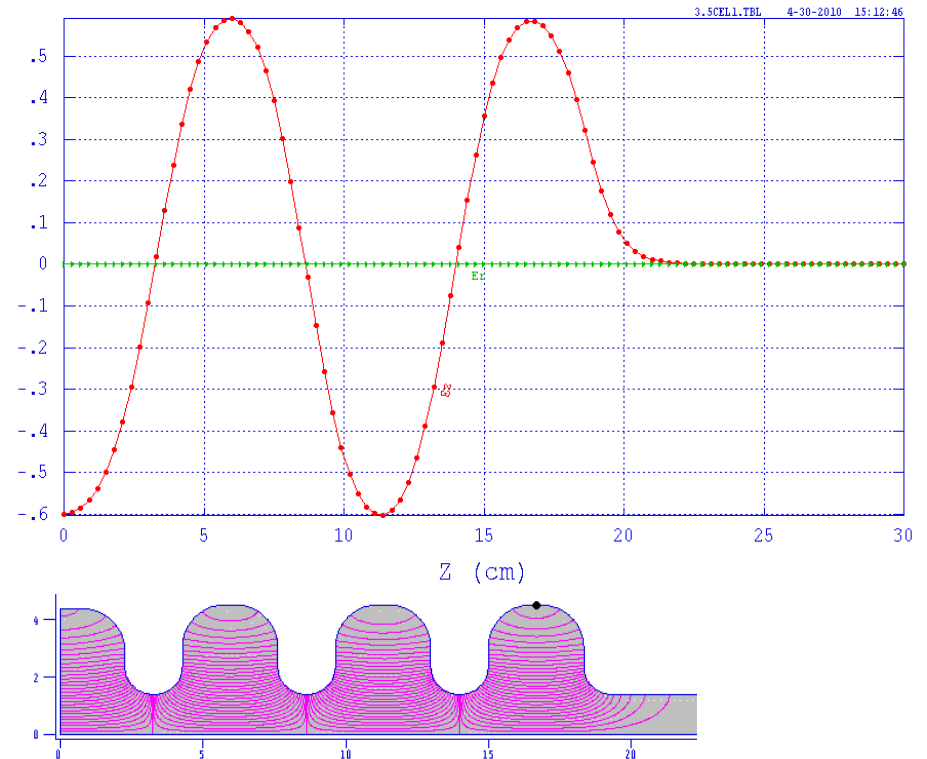
1.6cell rf-gun



# 3.6cell rf-gun parameter

Parameter	
Frequency@ $\pi$ mode	2856 MHz
Qvalue	17500
$\beta$	1.0
Shunt Impedance	50 M $\Omega$ /m
Mode separation ( $\pi$ - $2\pi/3$ )	2.8 MHz

Electromagnetic field data from file 3.5CELLRF-GUN(PI-MODE).TXT  
Problem title line 1: Case 3 Modified

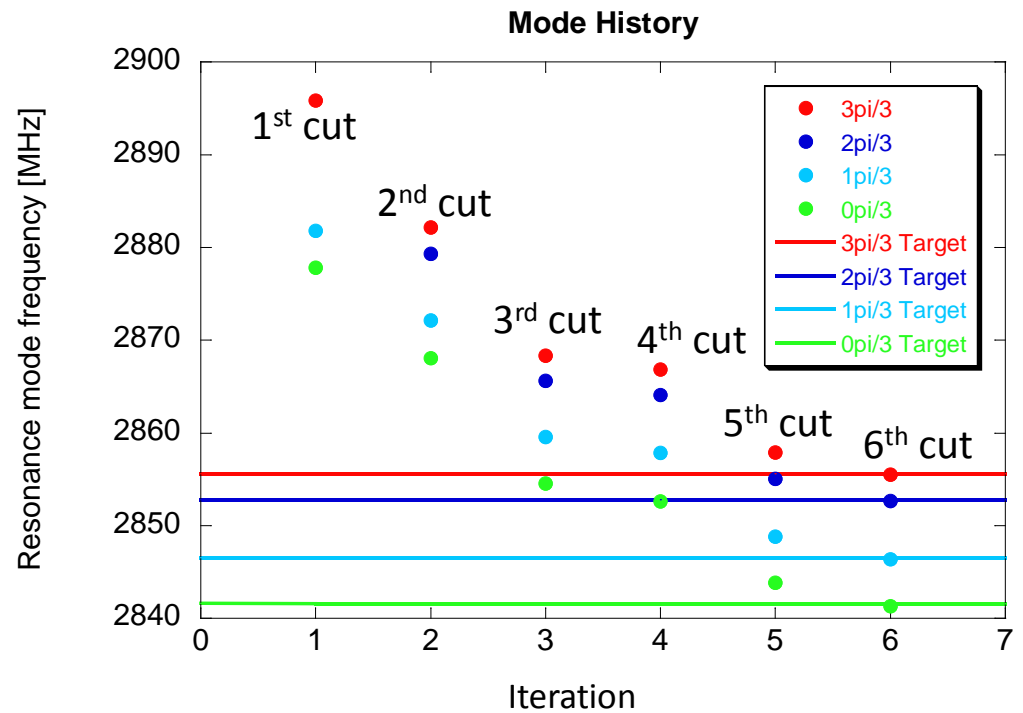
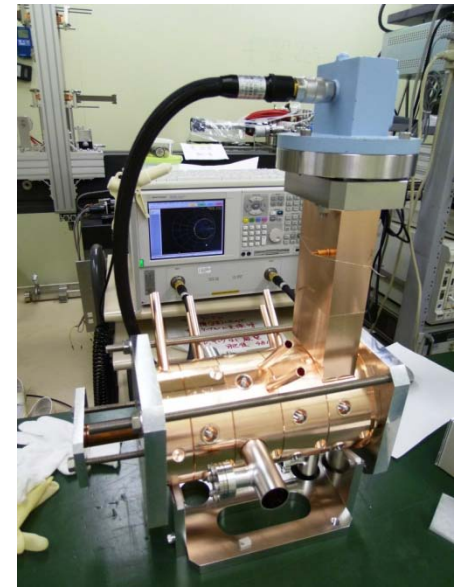


# Machining



Cutting by Diamond turning

Measurement of resonant frequency

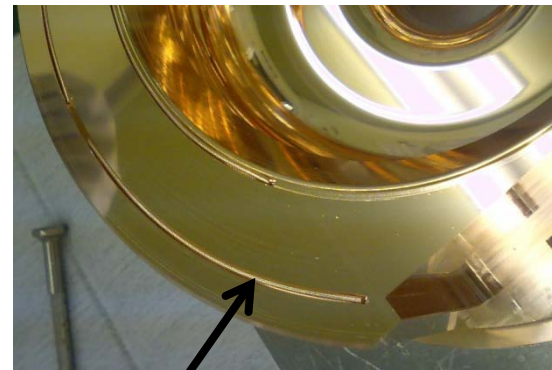




# Brazing

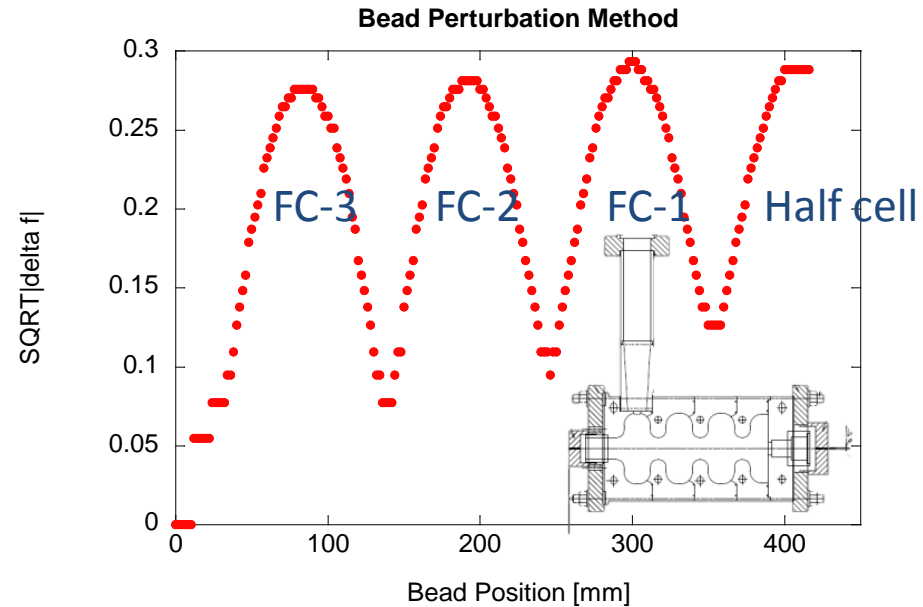
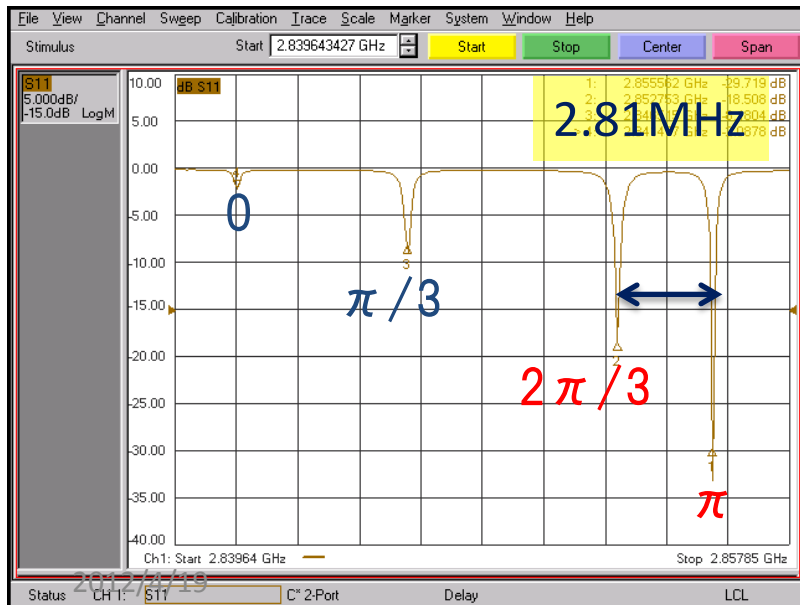


An rf-gun cavity and pipes were brazed in Hydrogen furnace.



# 3.6cell rf-gun parameter

RF Frequency: 2856MHz ( $\pi$ -mode)  
 Mode separation ( $2/3\pi - \pi$ ) : 2.8MHz  
 Q value: 15000  
 Coupling  $\beta$ : 1.0  
 Filling time: 0.84 $\mu$ s  
 R/Q: 395 $\Omega$

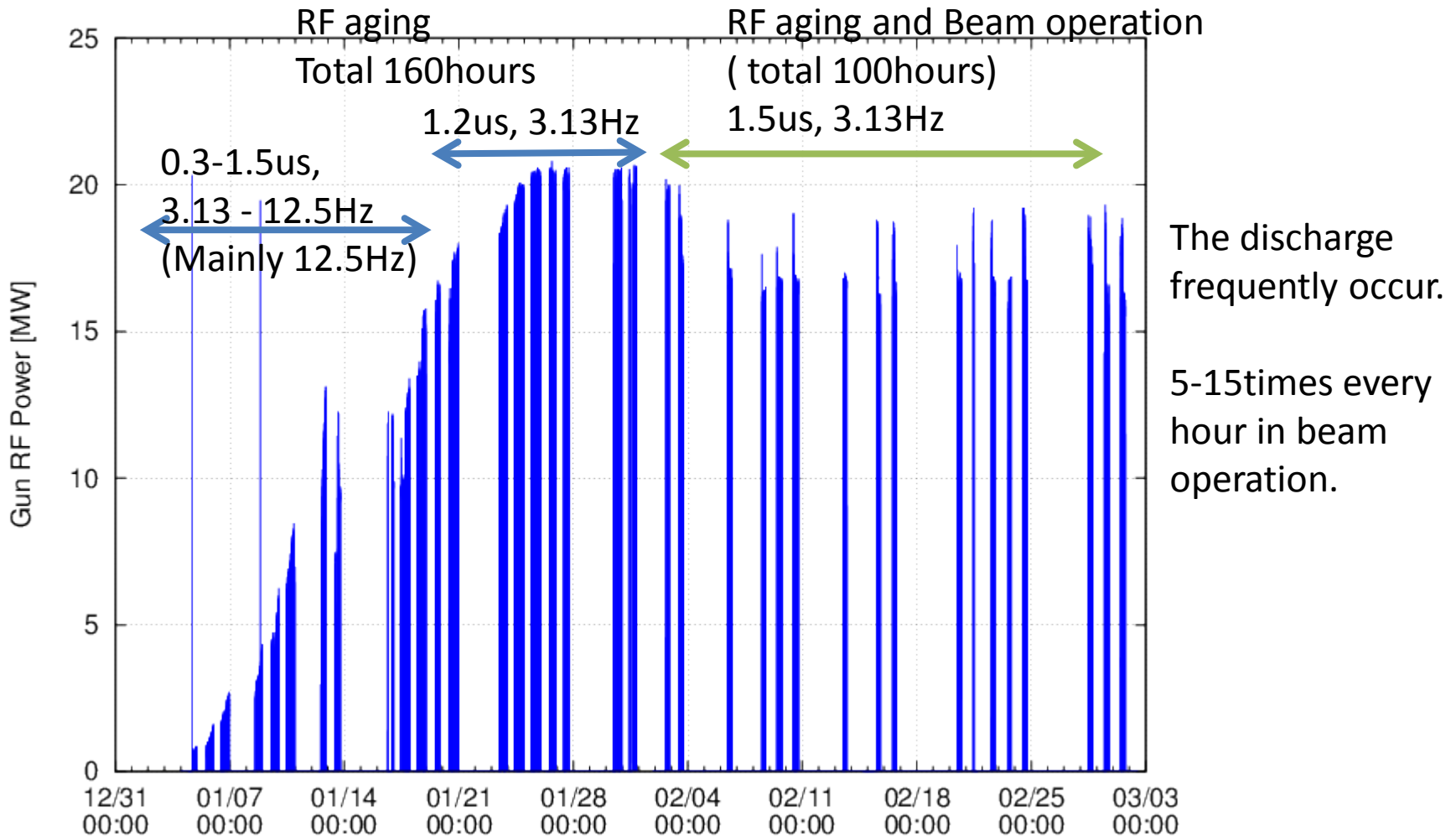


mode	3 $\pi$ /3	2 $\pi$ /3	1 $\pi$ /3	0 $\pi$ /3
Meas. [MHz]	2855.63	2852.82	2846.59	2841.55
Target [MHz]	2855.65	2852.82	2846.57	2841.65

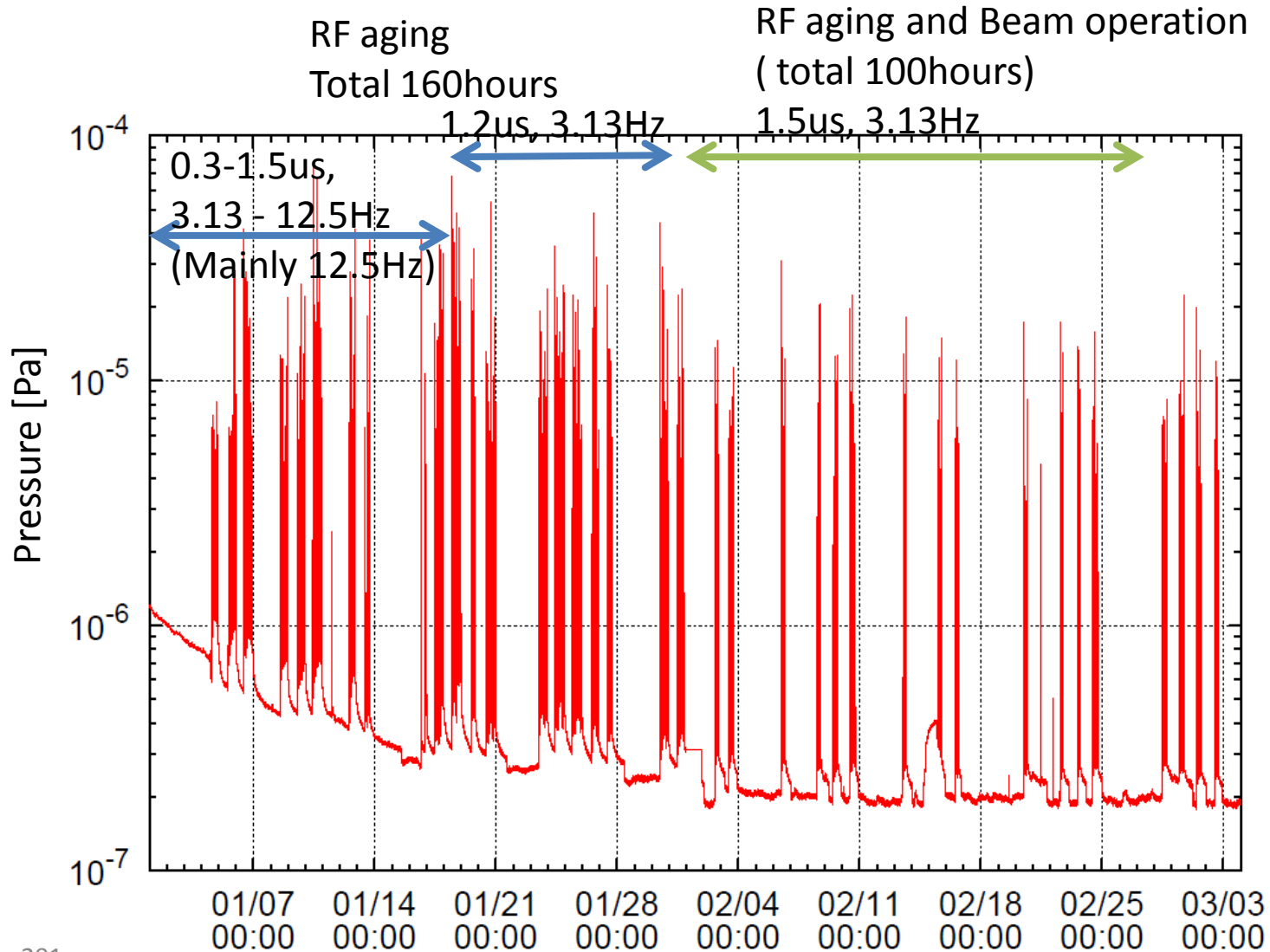
Cell	Half cell	FC1	FC2	FC3
Meas.[MHz]	2848.97	2848.06	2847.64	2851.82
Target [MHz]	2848.85	2848.10	2847.45	2851.70



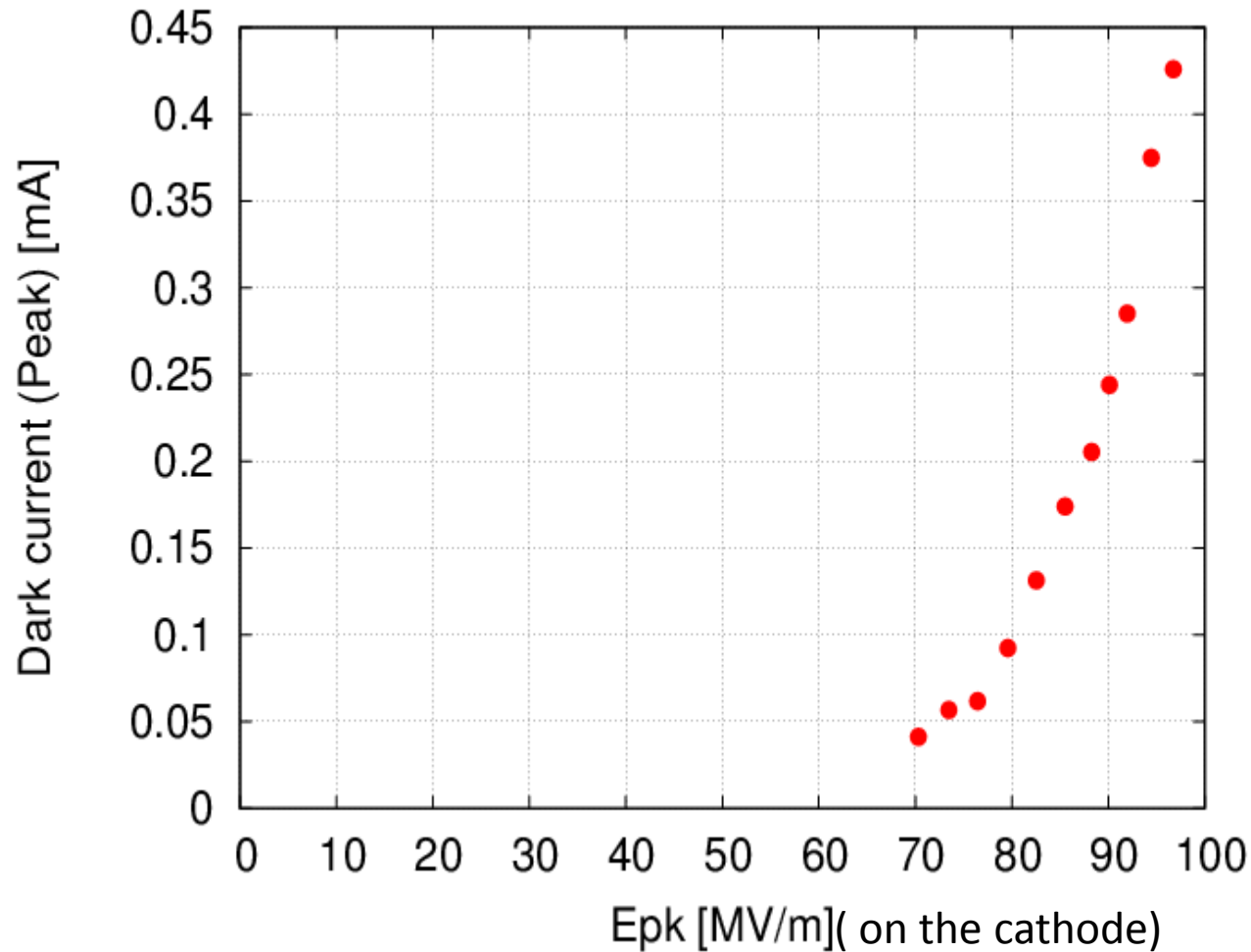
# RF aging



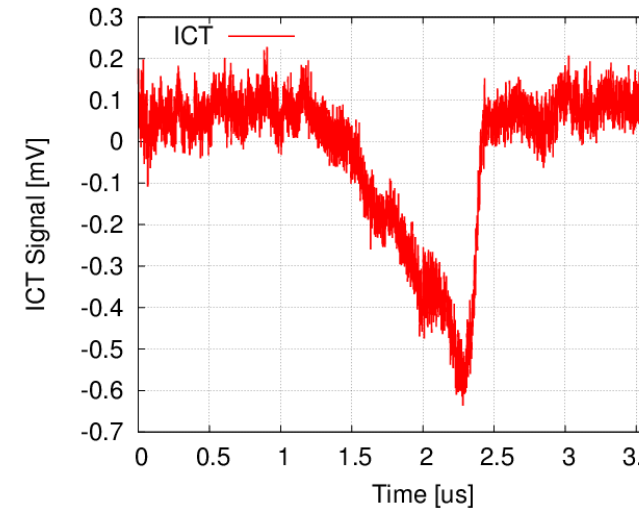
# RF aging



# Dark current



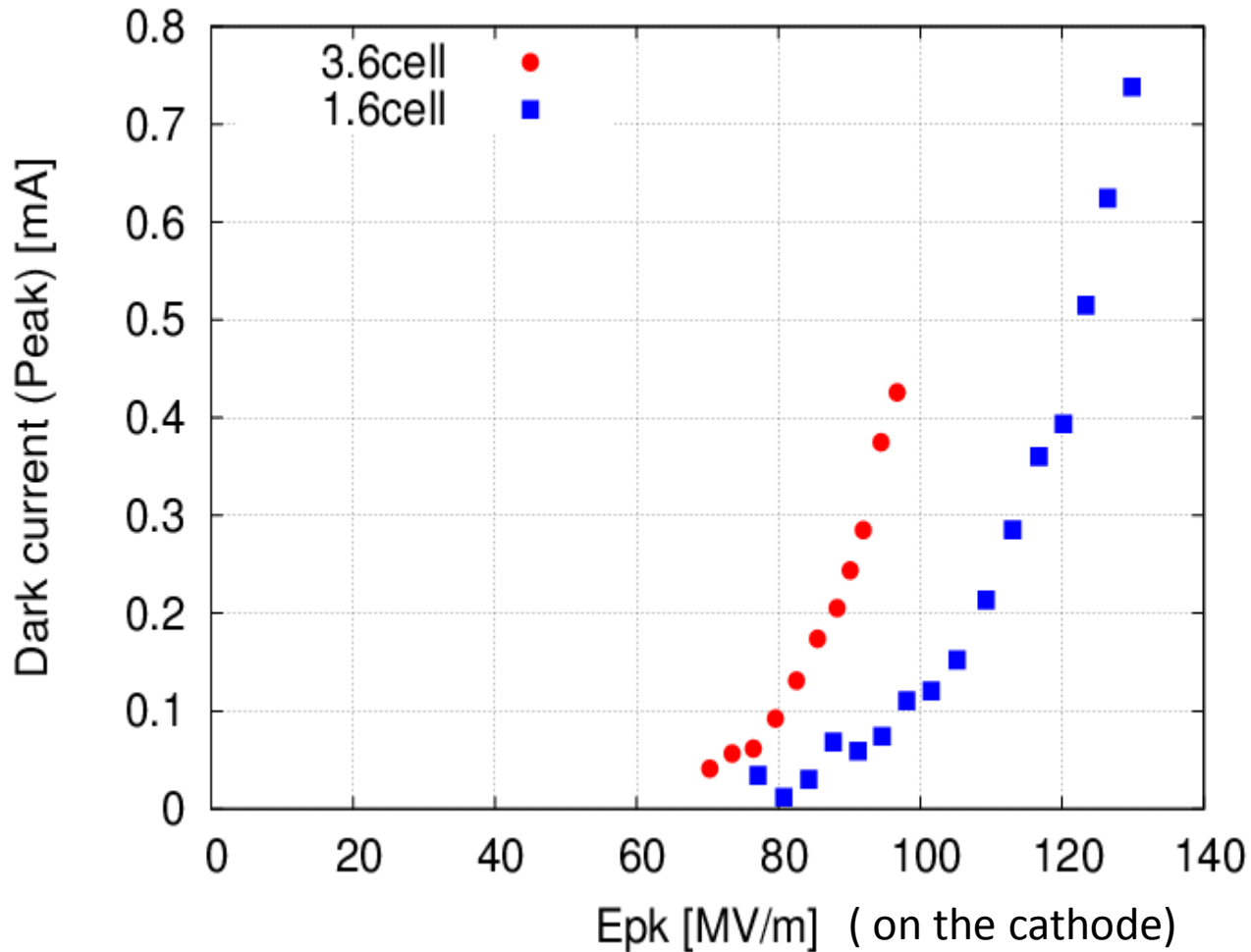
Dark current was measured by ICT at the exit of rf-gun.



RF pulse width: 1.5 $\mu$ s

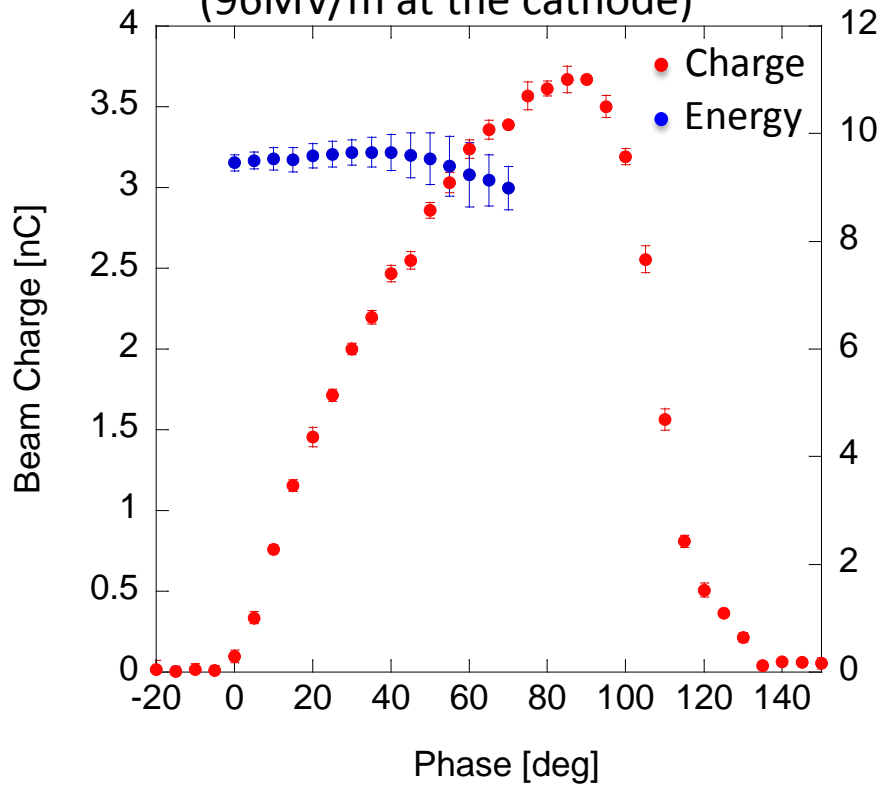
# Dark current

Dark current is 4 times that of 1.6cell rf-gun.

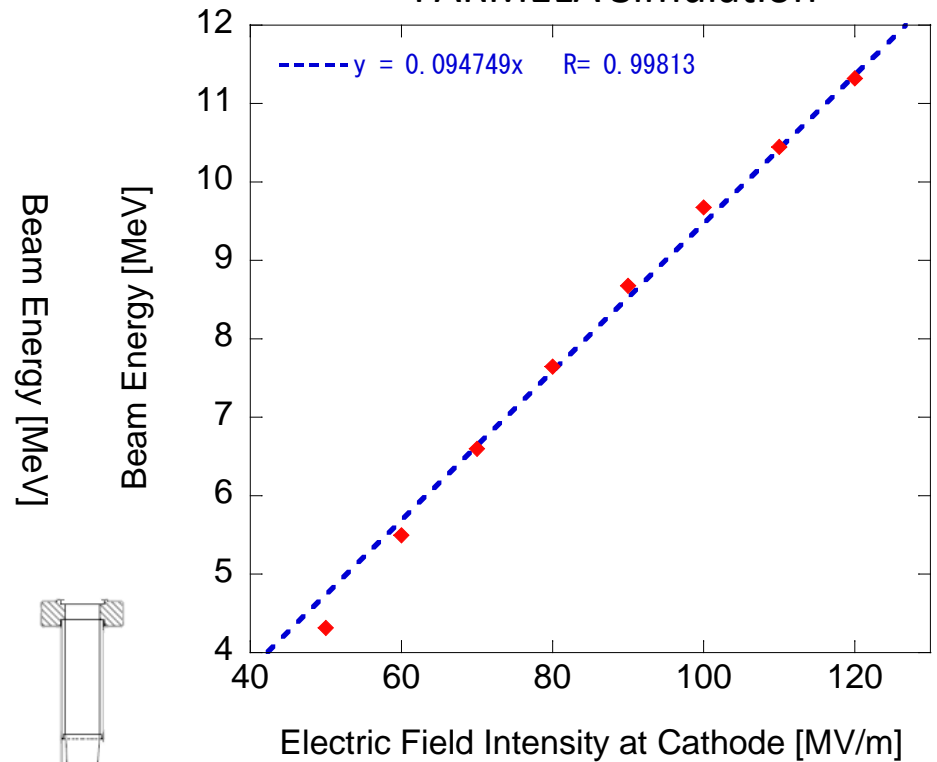


# Beam test

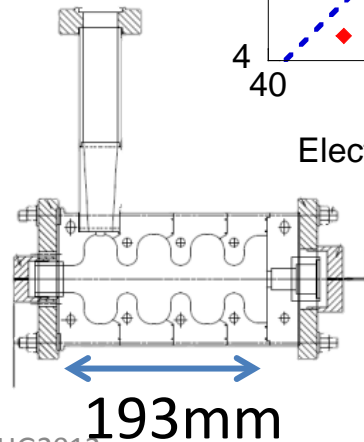
Input RF Power : 21MW  
(96MV/m at the cathode)



PARMELA Simulation



Beam Energy: 9.6MeV  
 $E_{acc} \sim 50MV/m$





# Summary

- We successfully made 3.6cell rf-gun.
- The beam with the energy of 9.6MeV can be generated from this gun. In this case, the electric field intensity on the cathode is 96MV/m.
- In the beam operation, the energy at the gun is 8.3MeV (83MV/m on the cathode). The discharge often occur . The frequency is in 5-15 times every hour.
- Dark current is 4 times that of 1.6cell rf-gun. We will continue the RF aging to reduce the dark current.
- We aim to get the beam with the energy of more than 10MeV.



# RF-guns for LUCX

