

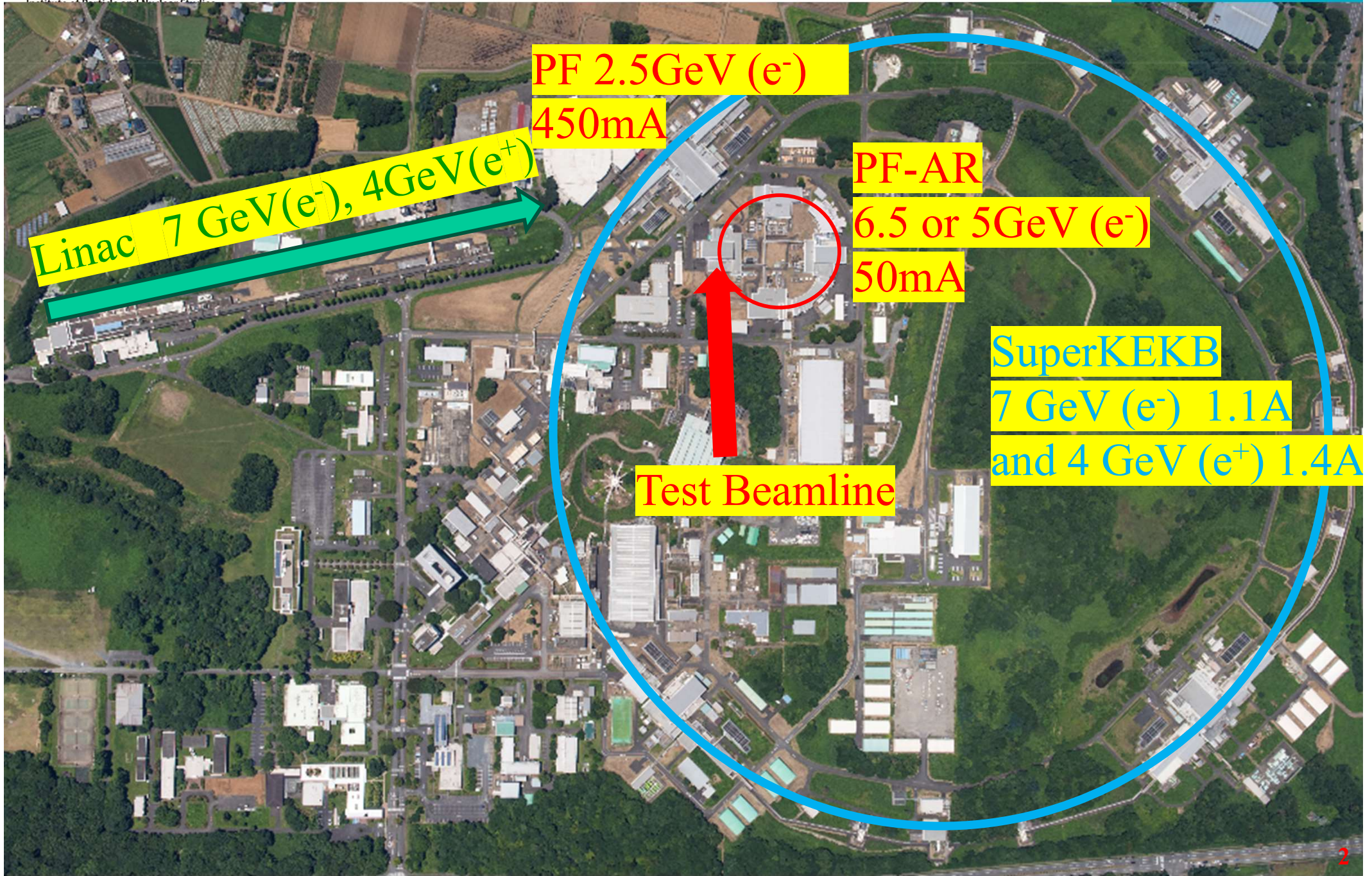
# A New Test Beamline at Photon Factory Advanced Ring (PF-AR) in KEK

**Shoji Uno (KEK)**  
on behalf of test beamline group  
April-18<sup>th</sup> , 2024

- Introduction of the beamline
- Feature of the beamline
- Users so far
- Summary

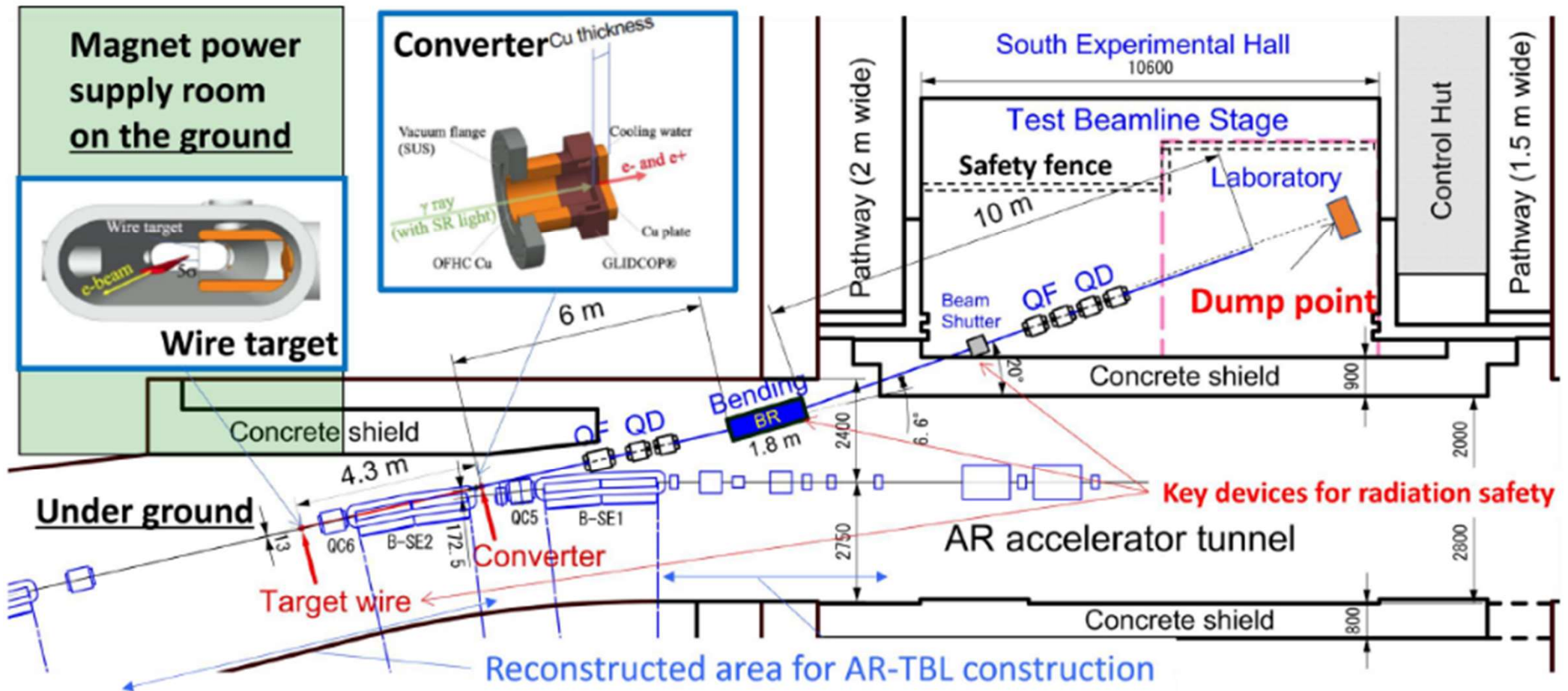


# Location of test beamline



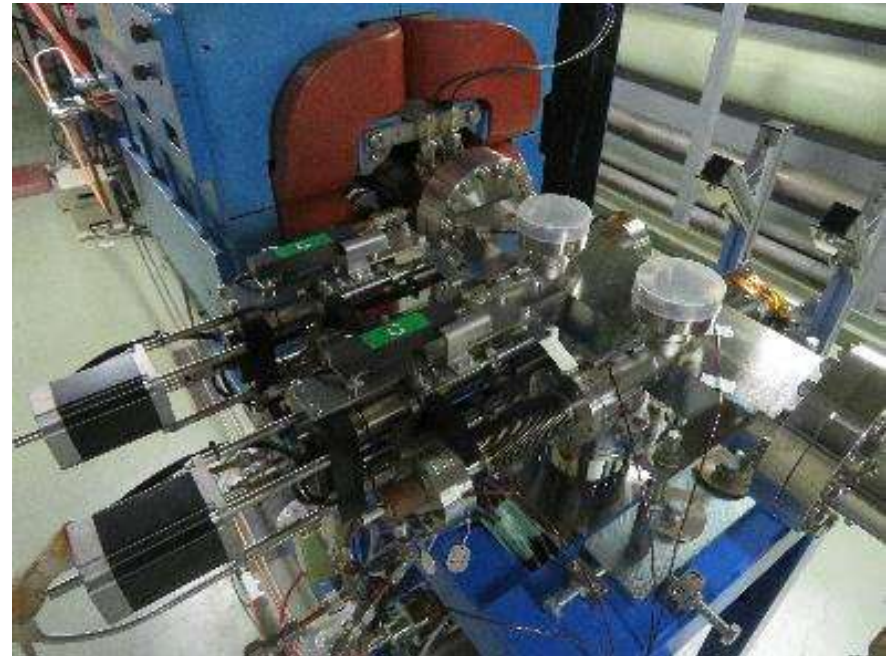
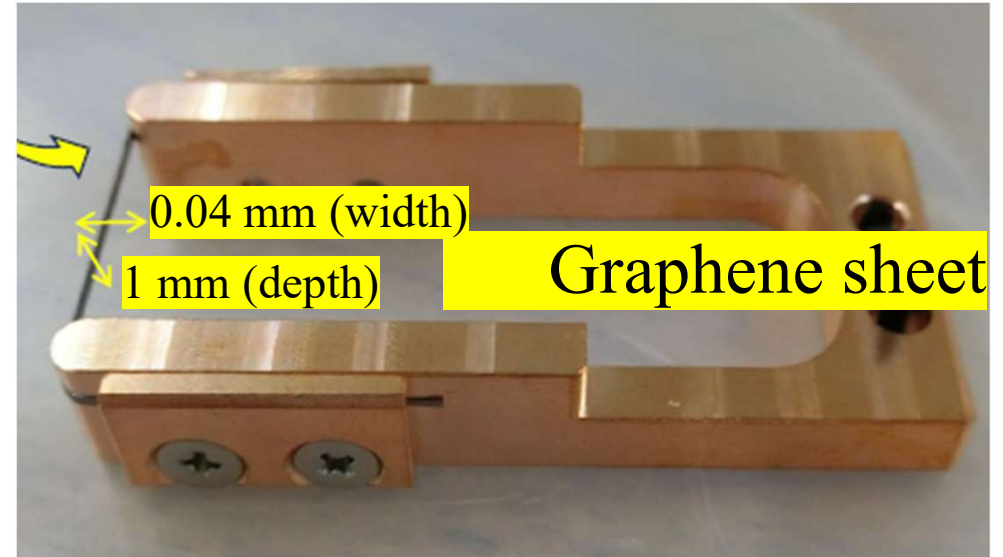


- The beamline was constructed in 2020 and 2021.
- Test trial was done in 2022.
- User run just started from 2023.



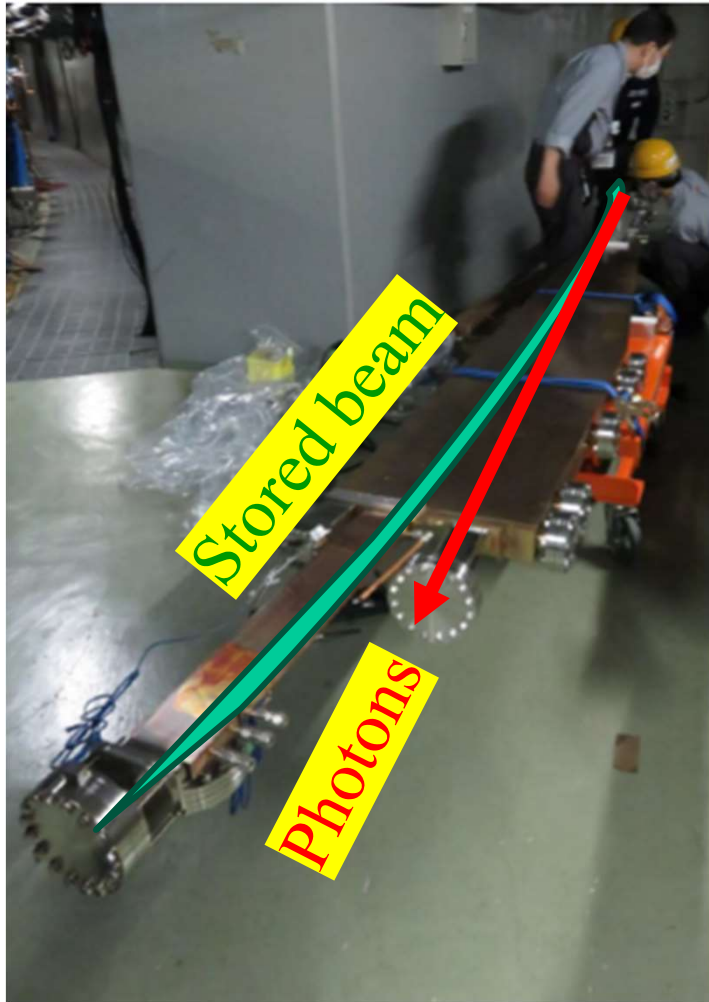
# Carbon target

- A carbon target (Graphene) is inserted at the tail ( $\sim 6$  sigma) of the stored electron beam to produce Bremsstrahlung photons.
- The target position can be adjusted precisely by a stepping motor and is fixed in one position at the beginning of the operation period. Unfortunately, we can not move it freely during the user run.
- Two same targets are prepared.
  - One is being used.
  - Another one is backup.



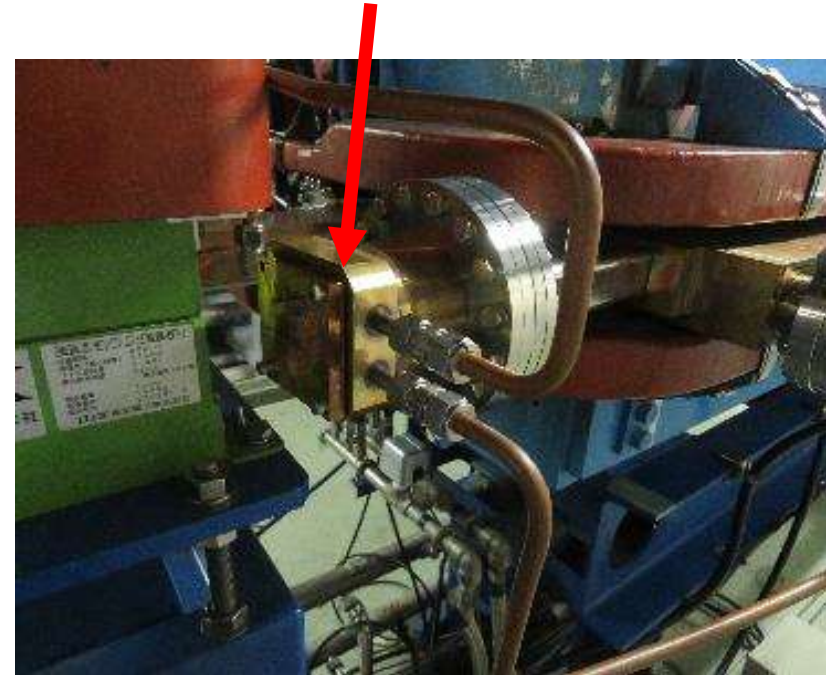


A special vacuum pipe was newly built for the test beamline.



Just before installation

Photon converter



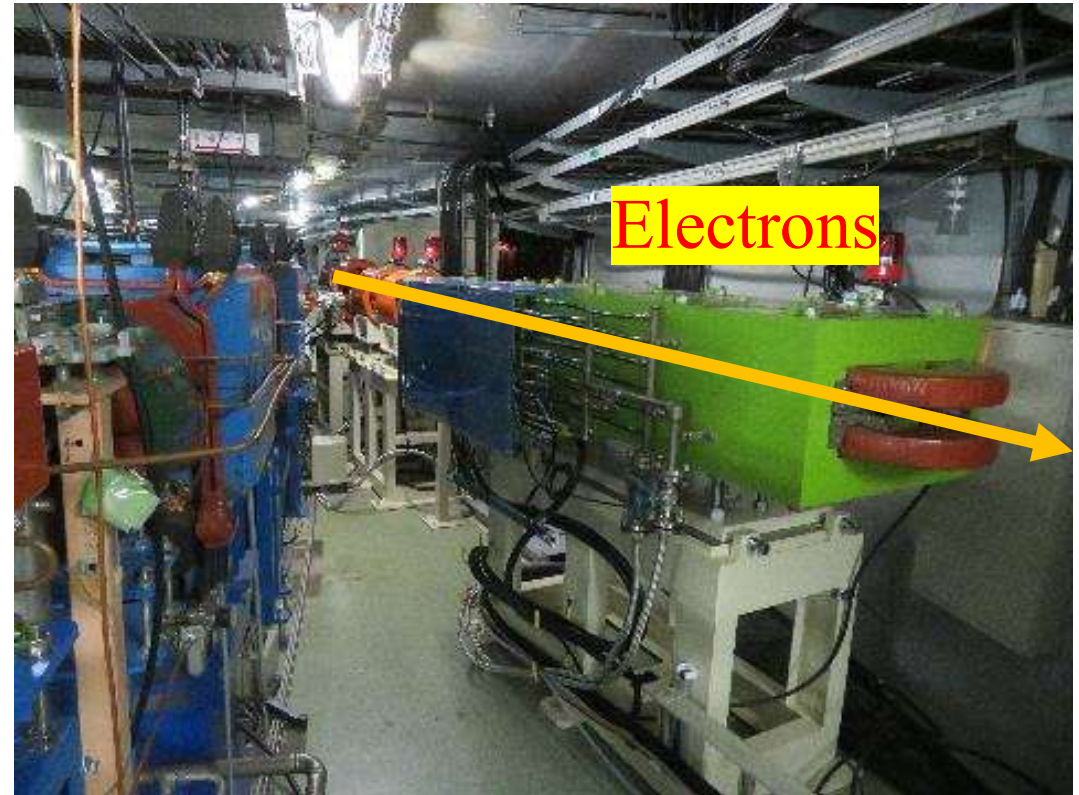
Photons are converted to  $e^+e^-$  pairs at the copper converter.

The vacuum wall with 7mm thickness is cooled down by water.

Additional copper plate with 9mm thickness is attached to obtain electrons more.

# Beamline magnets

- Electrons are kicked out by one bending magnet into outside of the radiation shield through a hole.
- The magnet is also used for the momentum selection.
- The vertical aperture is not wide enough to transfer the produced electrons.
  - One doublet of quadrupole magnets is located before the bending magnet.

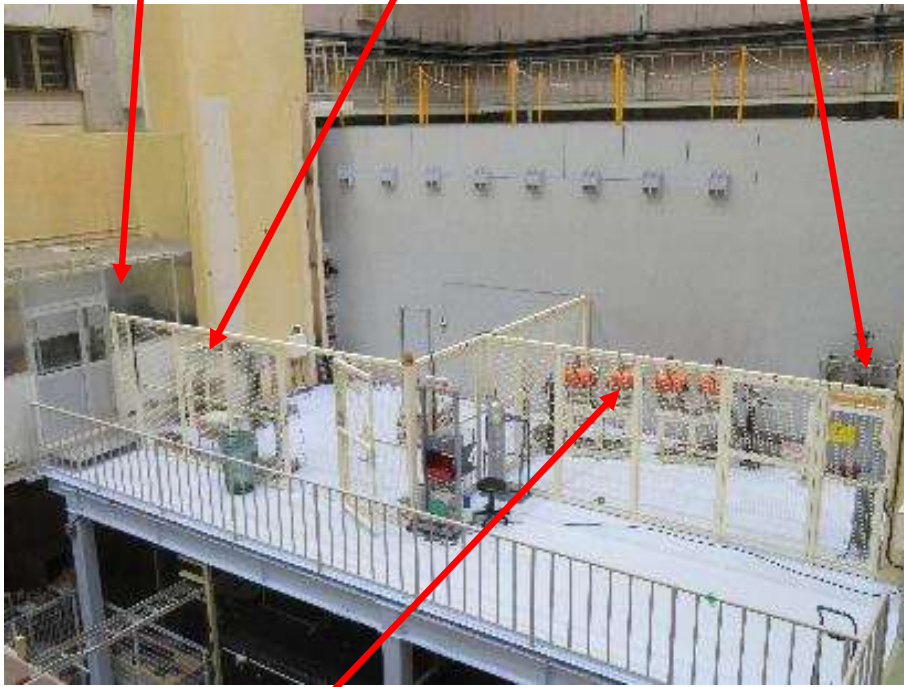




Counting room

Beam shutter

Beam dump



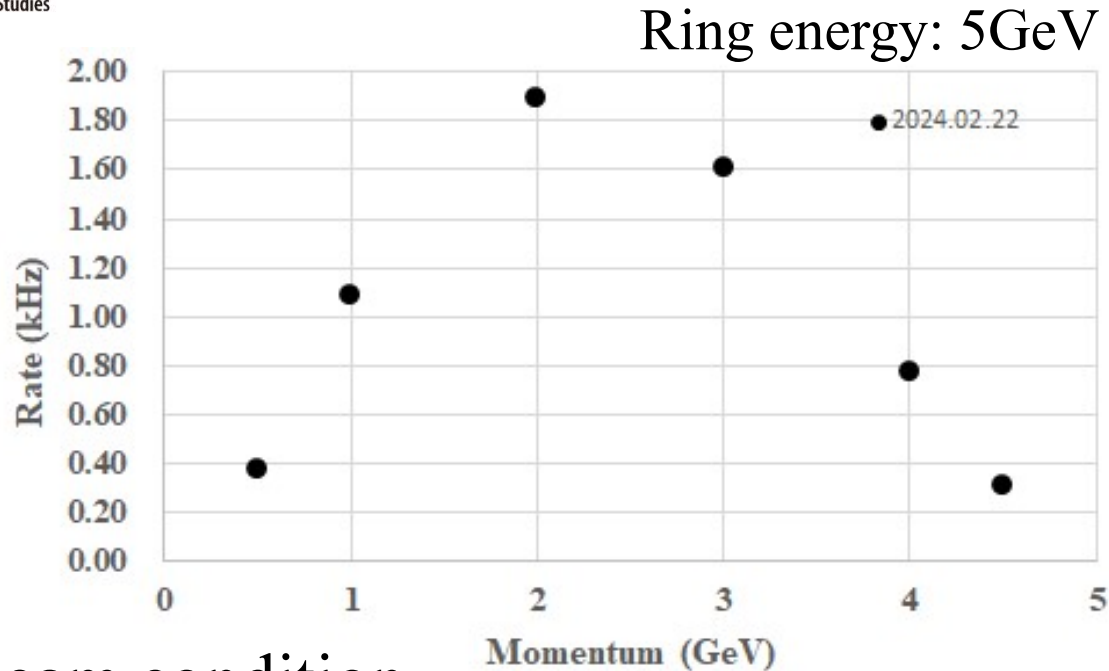
Q-magnets  
for adjusting the beam shape

Experimental area



Not so big.  
However, it is wide enough  
for most of test experiments.

# Beam rate



No bunch structure  
Good for beam test

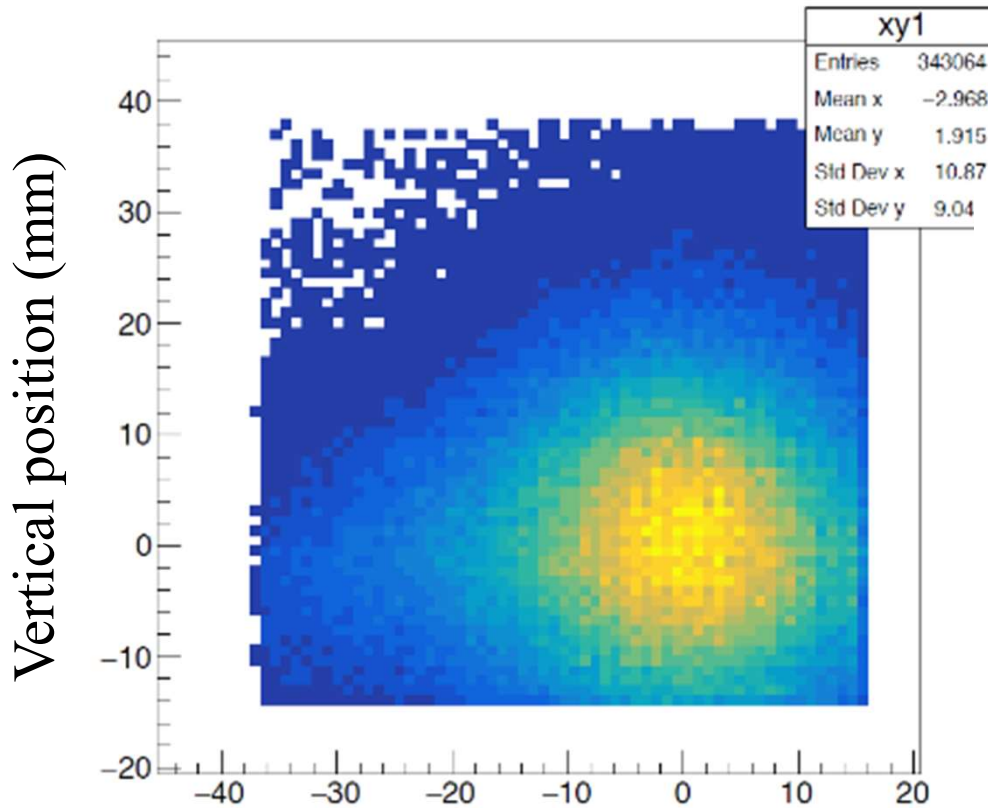
- AR beam condition
  - Beam energy : 6.5 GeV or 5 GeV
    - 5 GeV is selected in half period to save the electricity cost.
  - Beam current : 50 mA (single bunch)
    - Top up injection → constant beam rate for 24 hours
  - Target position : ~11 mm from the beam center (~6 sigma)
    - Beam lifetime : ~10 hours
  - Circumference : 377m → 795 kHz



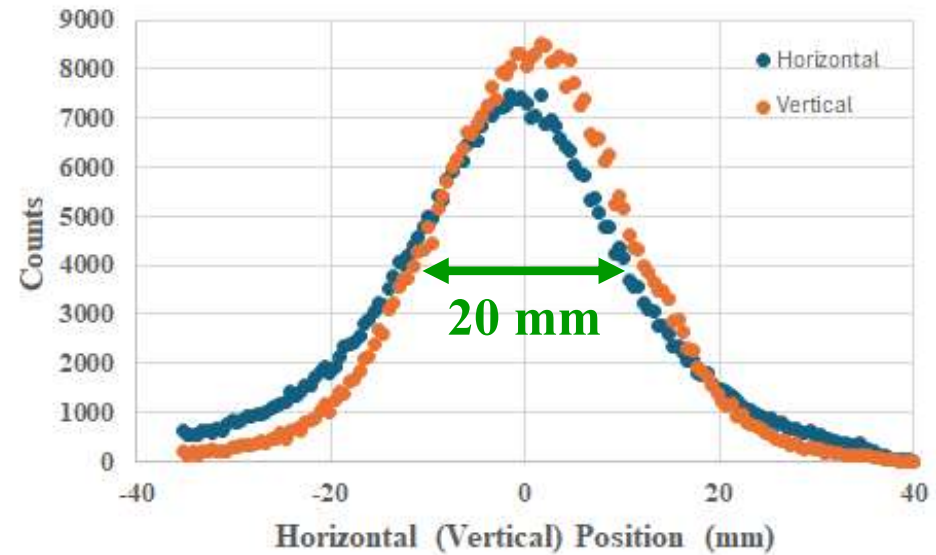
# Beam profile

$P=3.0\text{GeV}$

$Z=1.5\text{m}$  from the last Q-magnet



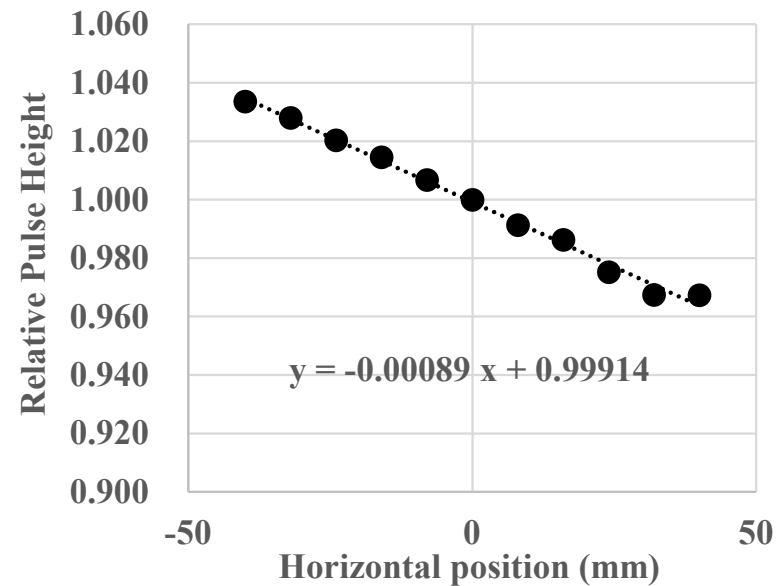
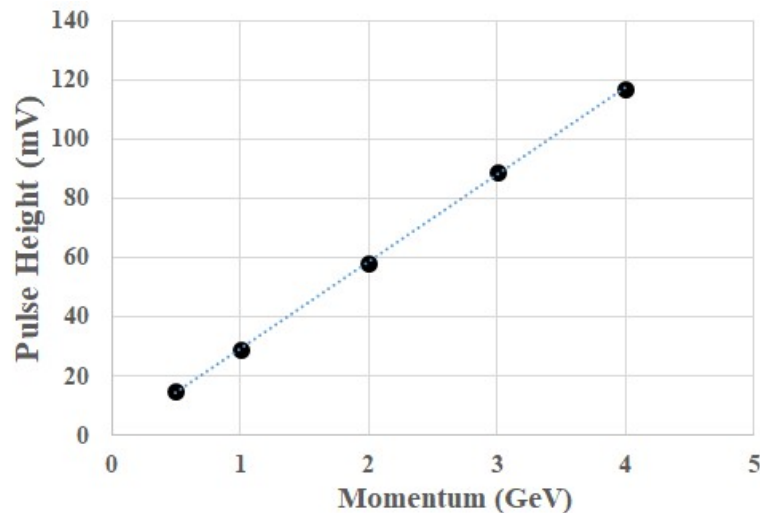
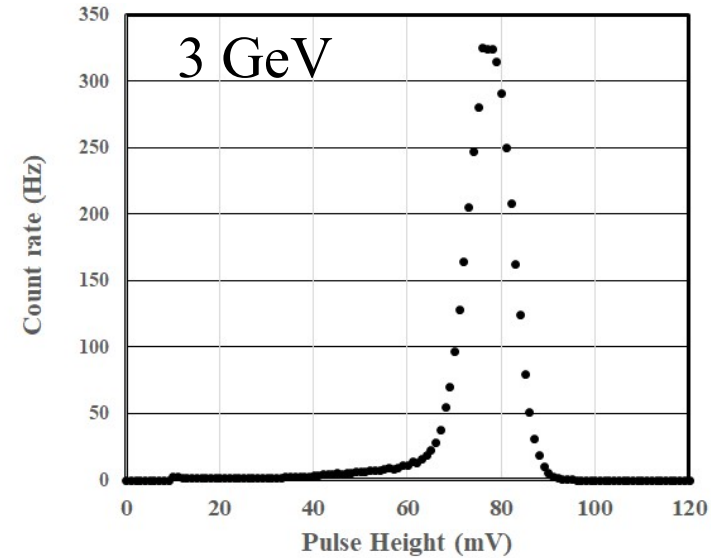
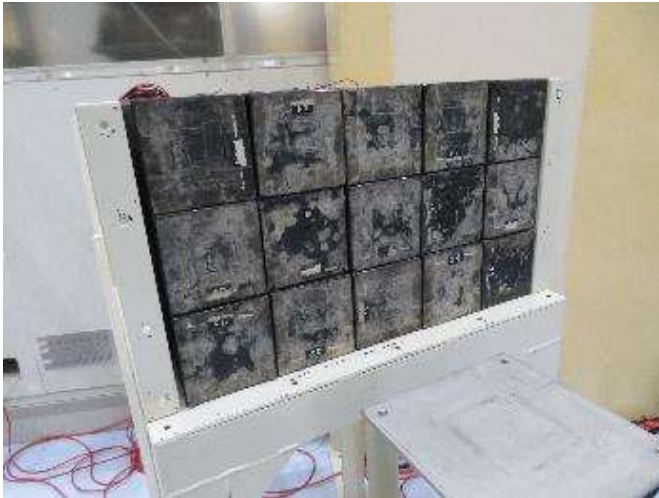
Horizontal position(mm)



Measured by the jet chamber,  
which is available in the beamline.

# Lead glass

- Lead glass array is available just before the beam dump.

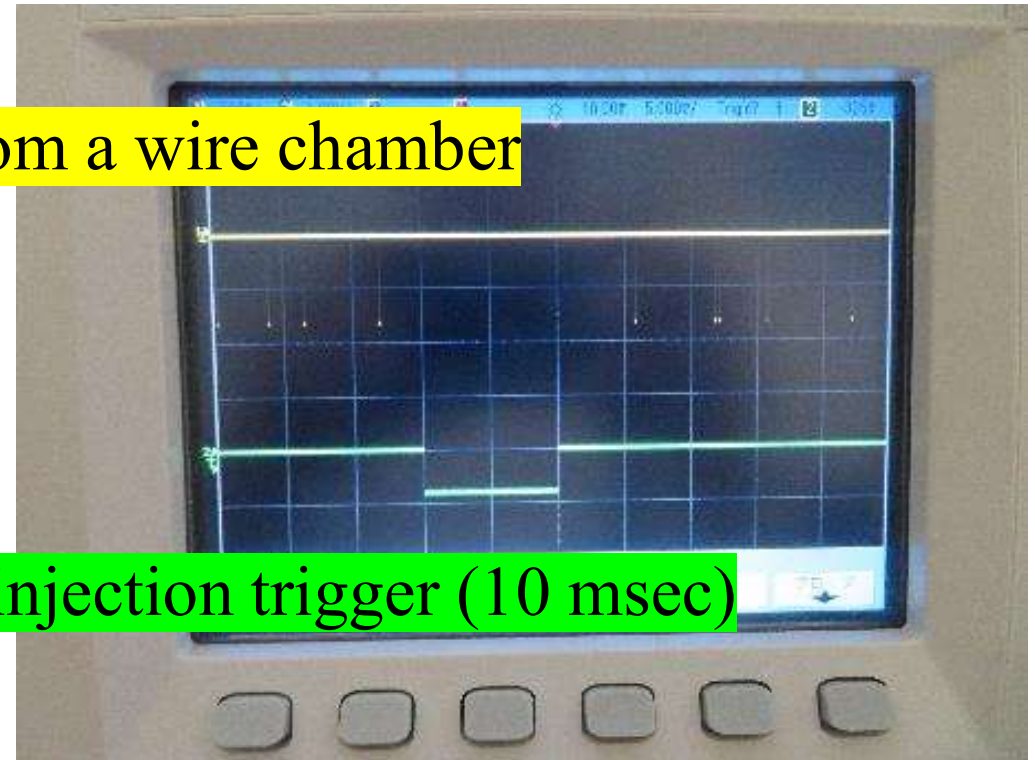




# Injection veto

Without veto

With veto



Many electrons come just after the injection.

Duration is short less than 10 msec.

It happen every several minutes to keep the beam current constant (Top up injection).

The loss is little due to the veto.

# Available time

- There are 3 operational periods for every year in general.
  - Feb-Mar (1.5 m.), May-June (1.5 m.) and Oct-Dec(2.5 m.)
  - 5.5 months in a year
- The beam is available for 24 hours and a whole week.
  - Constant and stable beam rate in general
  - No beam times are one day a week for the linac study and some days for the PF-AR machine study, which are well scheduled.
  - Un-expected down time is rare.





# Users so far

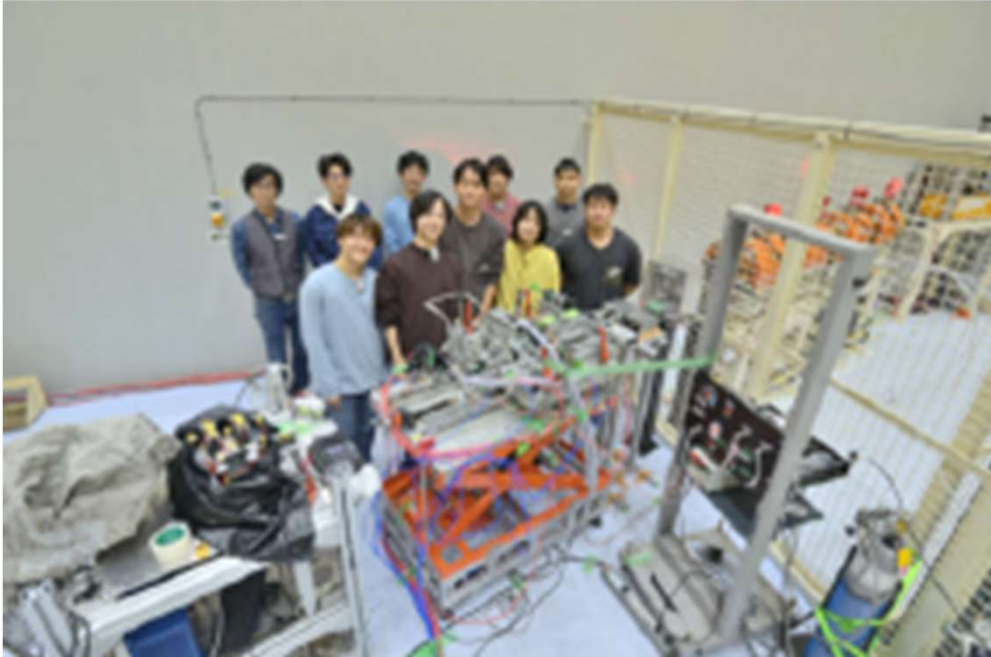
- 8 groups during the test trial period in JFY 2022.
- 18 groups during the user run in JFY 2023.
  - Semiconductor detector : 8
  - Calorimeter : 3
  - Particle identification device :2
  - Scintillation fiber : 1
  - Beam profile measurement : 2
  - Education : 2



- High school students jointed the experiment through the zoom.
- One workshop was done just two weeks ago.



# Many young people



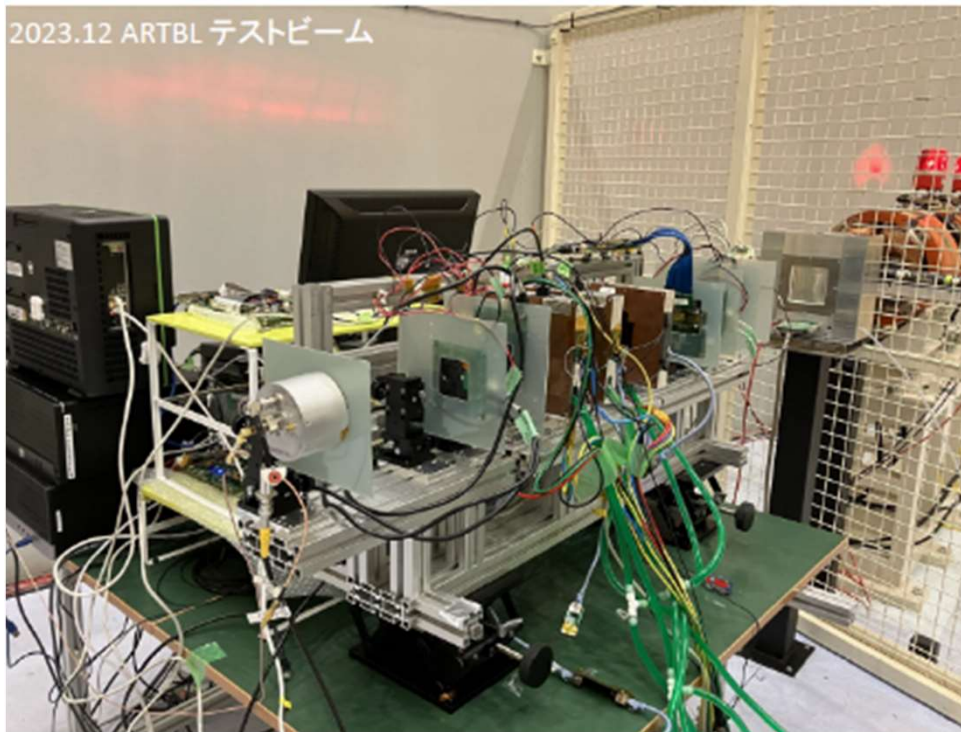
Many young people enjoyed the beam test.



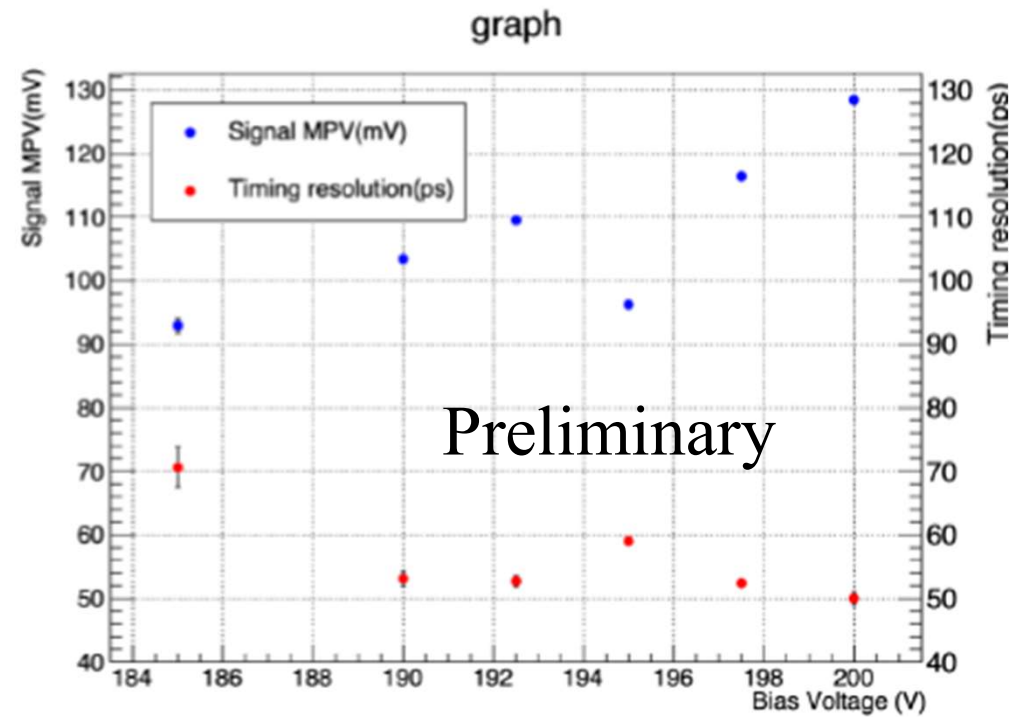
One user meeting room is available near the test beam in the same building just outside the radiation control area. Another bigger one is available and is located at other building.

# LGAD test

By Koji Nakamura (KEK)



Test setup in the beamline



Result is still preliminary and  
 is not good enough.  
 People are working hard  
 to understand possible reasons.

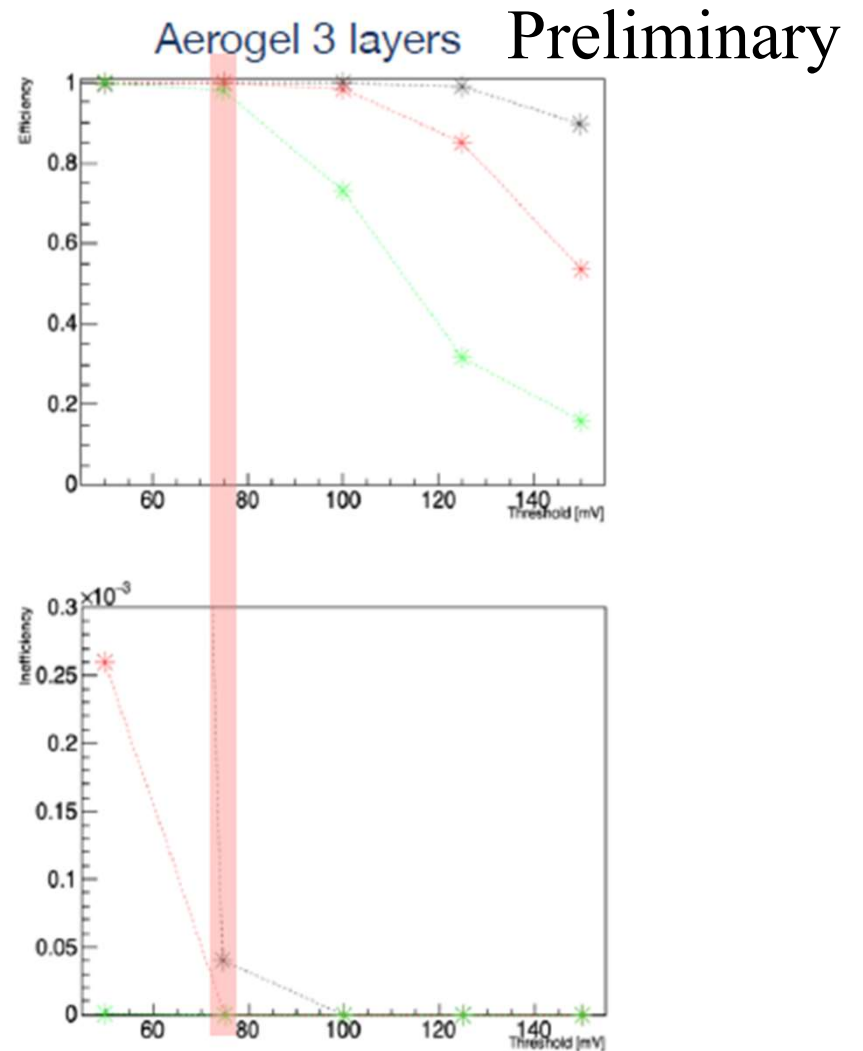


# Cherenkov detector

By S. Hayakawa (Tohoku U.)



Real Cherenkov detector for J-PARC experiment



# Summary

- A new test beamline is now available in KEK.
  - Just started.
  - There are 3 operation periods in every year.
  - Easy to use. Stable.
- Beam condition
  - Several GeV electrons
  - Rate :  $\sim 2$  kHz
  - Size :  $\sim 20$  mm (FWHM)  $\times$   $\sim 20$  mm (FWHM)
- The test beamline is open for the world.
  - If you want to use it, please contact me ([shoji.uno@kek.jp](mailto:shoji.uno@kek.jp)).
  - Now, we are preparing English web page.



素粒子原子核研究所  
Institute of Particle and Nuclear Studies



# BACKUP



ATTBLのTrigger Counter 配置

