

Test beam and irradiation facilities in Japan

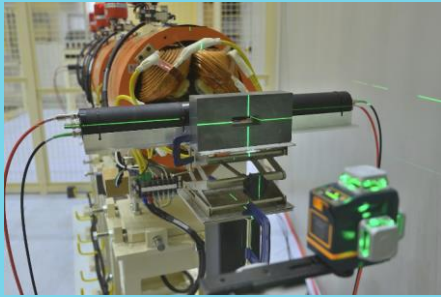
Yuji Enari, IPNS-KEK



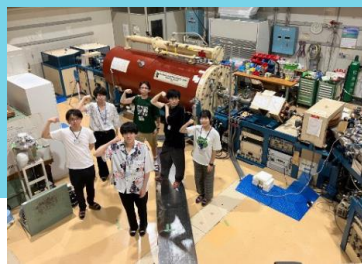
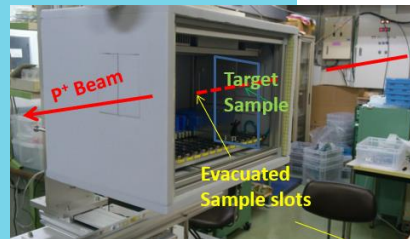
測定器開発センター
Instrumentation Technology Development Center

Test beam facilities in Japan for detector R&D

KEK PF-AR TBL



Tohoku CYRIC

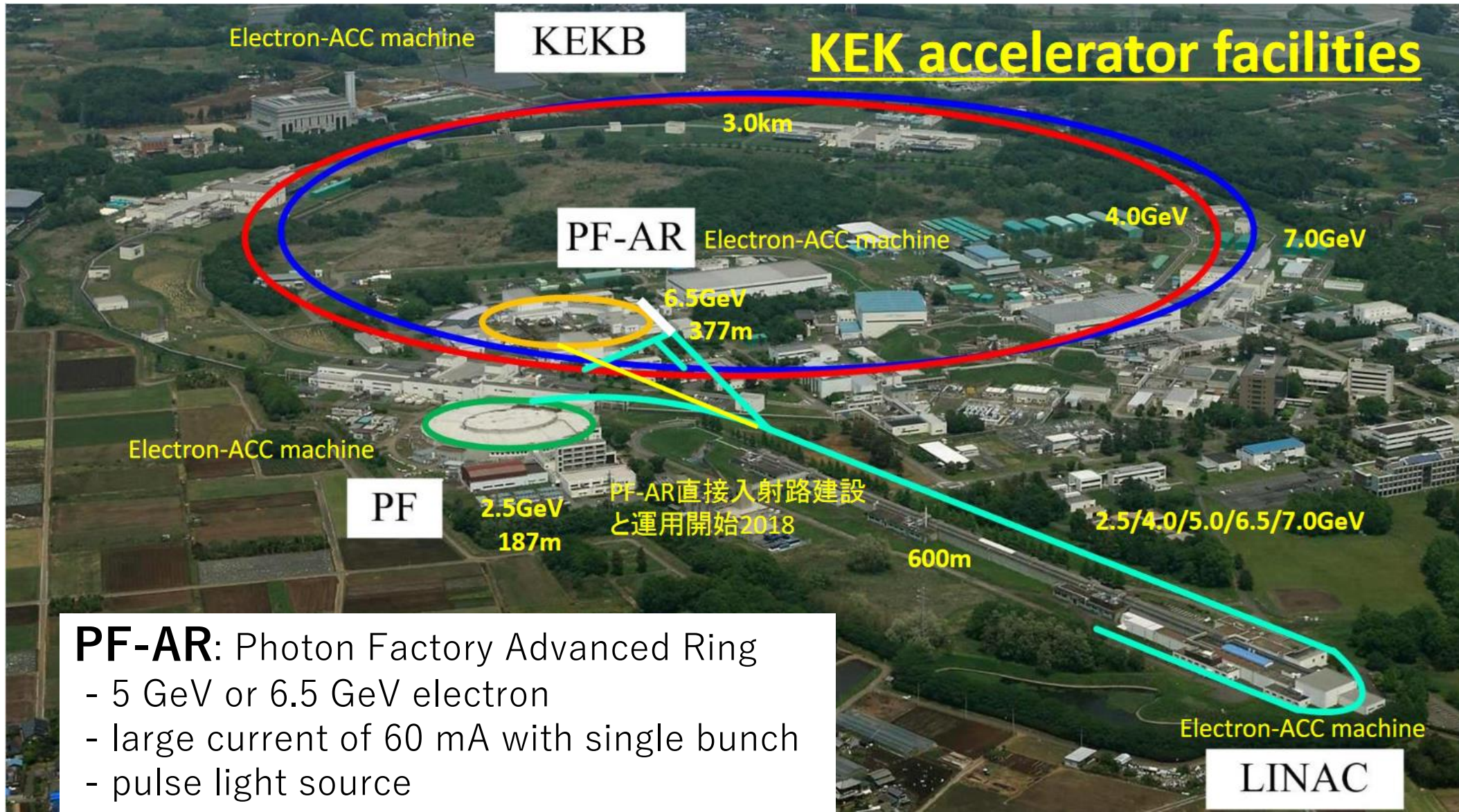


Kobe Tandem

- **Electron test beam line**
 - Electron beam up to 5 GeV
 - KEK PF-AR
 - 50 km from Tokyo

- Irradiation site
 - **Tohoku Univ CYRIC**
 - 70 MeV proton beam ($\sim 1 \mu\text{A}$)
 - 350 km from Tokyo
 - **Kobe Univ Tandem**
 - Neutron irradiation
 - 500 km from Tokyo

KEK accelerators and PF-AR ring

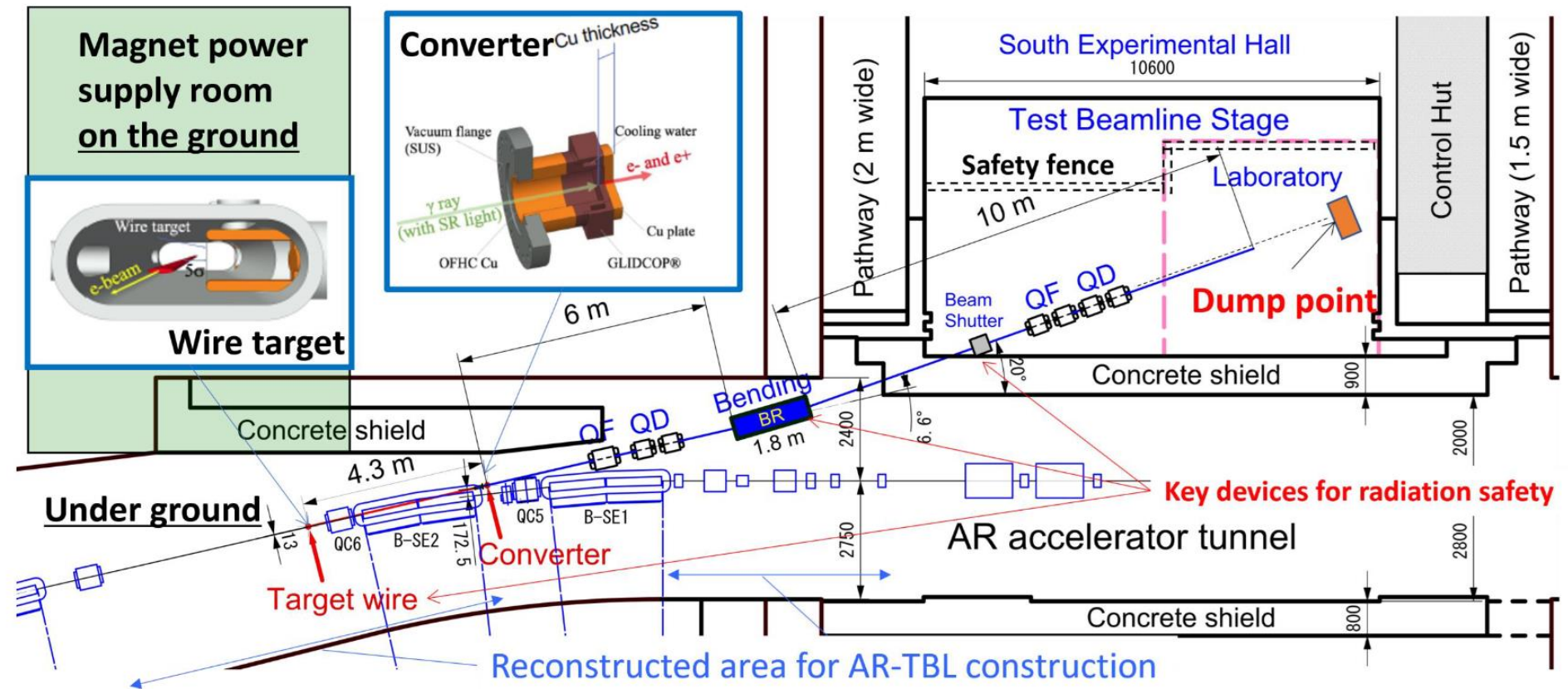
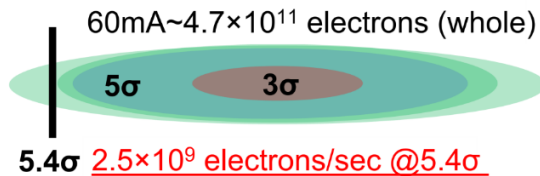


- PF-AR:** Photon Factory Advanced Ring
- 5 GeV or 6.5 GeV electron
 - large current of 60 mA with single bunch
 - pulse light source

Electron test beam from PF-AR

Electron in AR ring

$\beta_x = 20.6$ [m], $\epsilon_x = 290$ [nmrad]
beam size $1\sigma_x = 2.4$ [mm] $1\sigma_y = 0.1$ [mm]

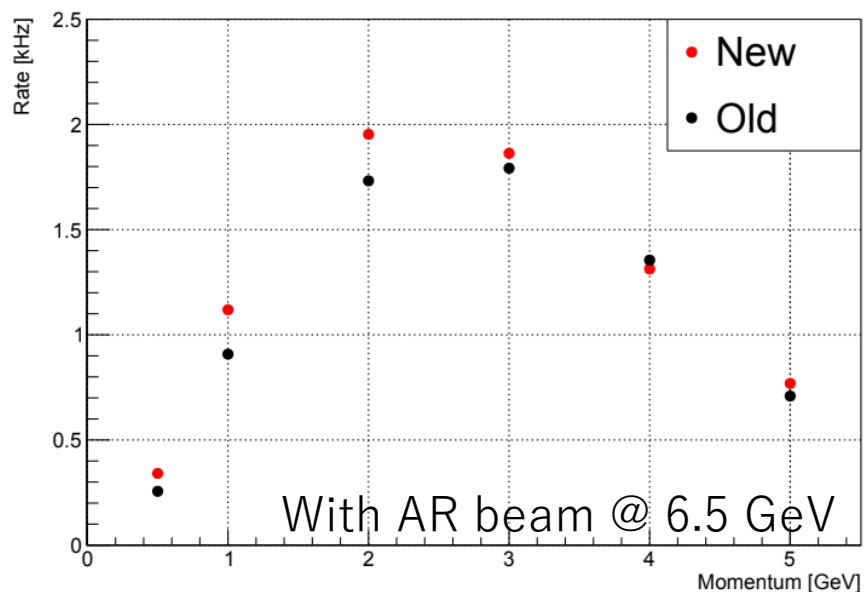


- Photon emission by wire target (Graphene)
- Inject photon to a converter (16 mm Copper plate) to make pair creation.
- Transfer electron with Di-pole and Quadra-pole magnets to the test stage.

Test beam rate and profile

Rate:

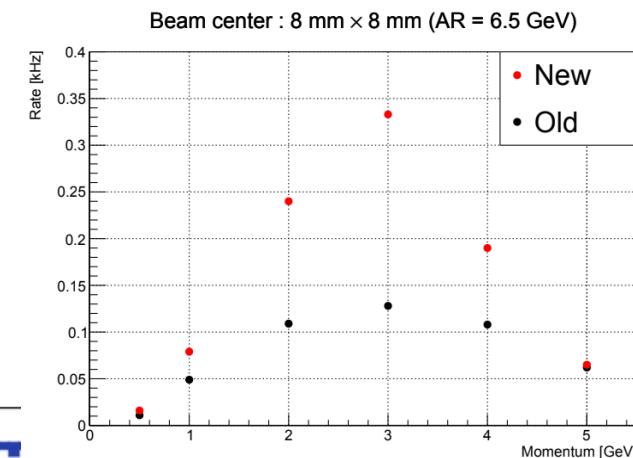
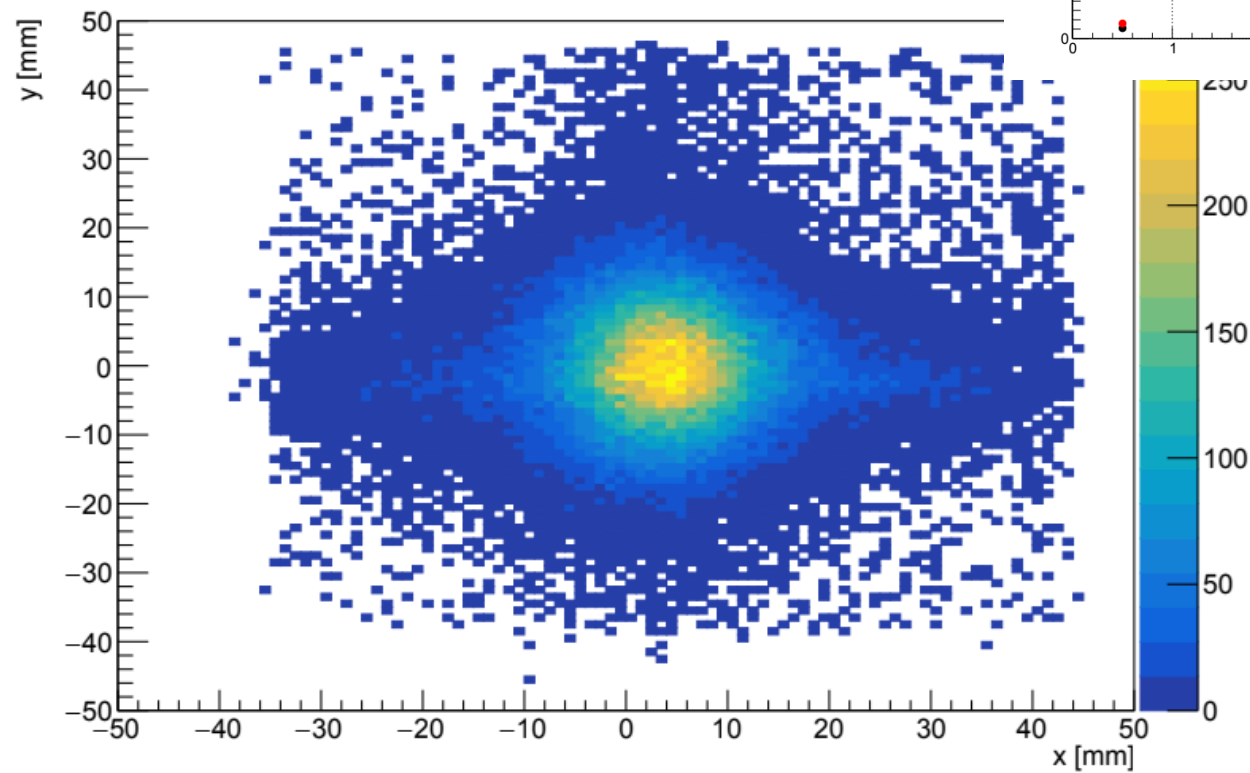
Overall rate is 2~2.5 kHz
Highest rate ~ 3 GeV.



Recently we optimize Q-magnet
New: after optimization.
 $\Delta p/p \sim 10\%$.

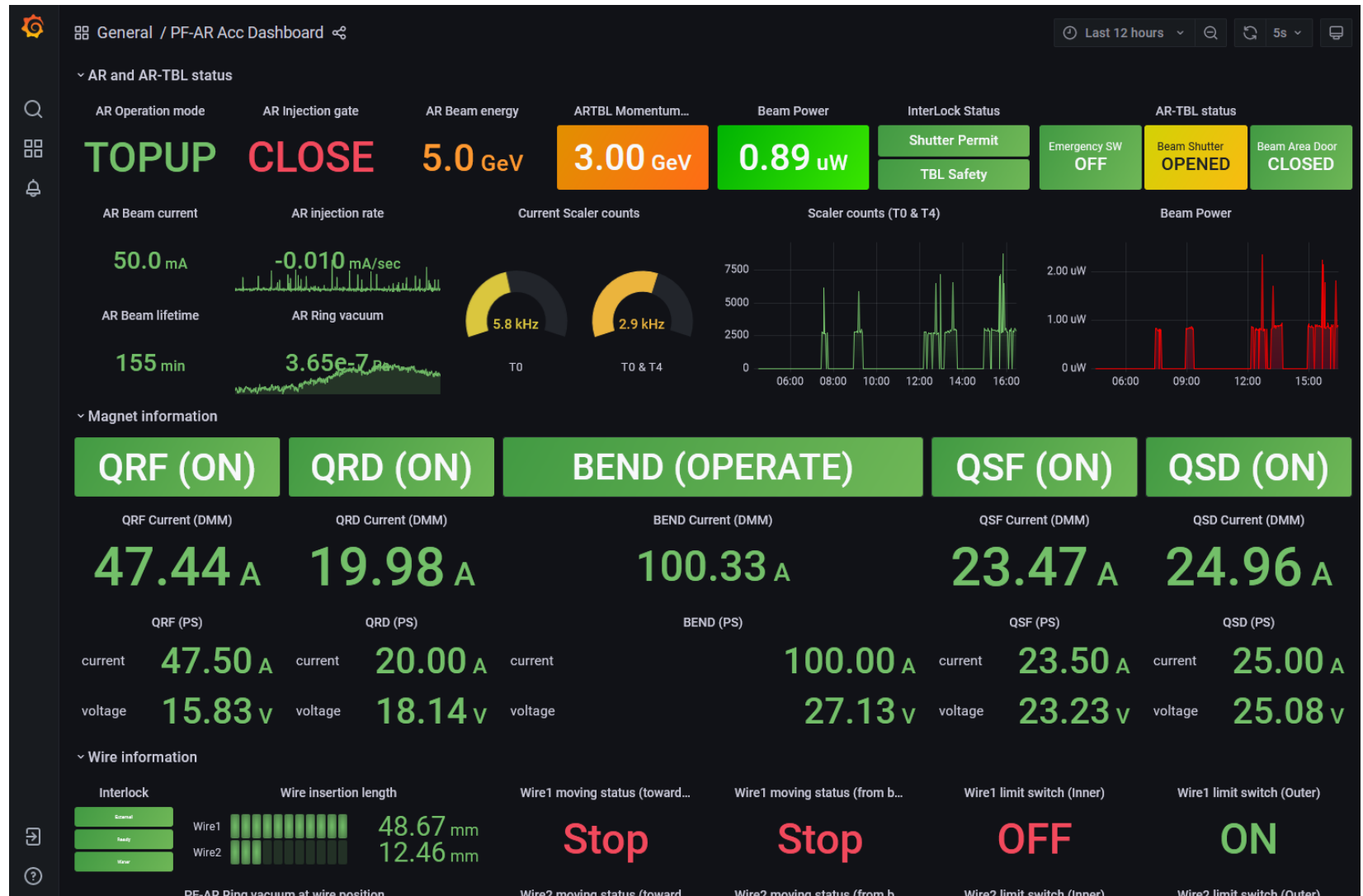
• Beam profile at 3 GeV

- ~ 4 mm in sigma
- Wide in x direction.
- Beam rate 8mm x 8mm:
350 ~ 600 Hz.



TBL control and monitoring

- Magnets currents can be changed with script.
 - User can change.
- Shutter is hard switch with inter-rock.
- Graphana is set up for monitoring



How does it look like?

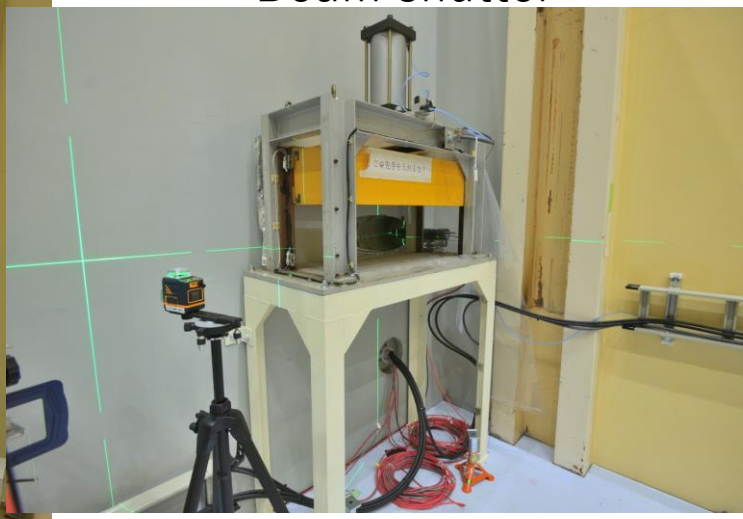
Counting room



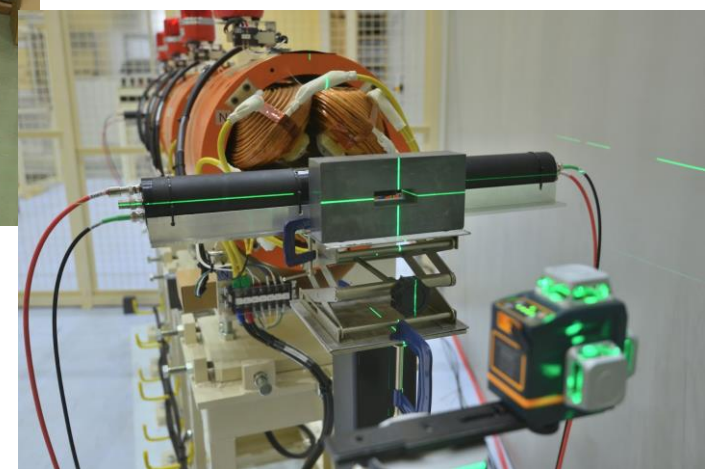
Sensor Stage



Beam shutter



Trigger counters



Tools at TBL

- Trigger, beam clock, veto signals
 - NIM level signals can be provided
 - Injection period may need to be vetoed.
 - NIM create, basic modules, oscilloscope are available.
- Tele-scope is not available
 - May be able to organize to set it up
- There is no common DAQ, no dedicated PCs.
 - User needs to prepare.
- Cooling / any specific infrastructure
 - Need to prepare by user.
- Room for preparation can be provided.
 - In another building (2 min on foot).



Period of availability and Paper work

- PF-AR operating period
 - May-June, Oct-Dec, Mar. No scheduled down years.
 - Wednesday is maintenance day.
 - Wed to Wed would be reasonable choice for beam time of a group.
 - Beam is stable over 24 hours as far as no problem.
- Call for proposal
 - https://www2.kek.jp/uskek/eng/apply/ar_tbl_eng.html
 - Is opening about 3.5 month before each period
 - Need to have a contact person who can speak Japanese.
 - YE will support for DRD3.
 - Application will be reviewed by TBL Program Advisory Committee
- Once your application approved
 - Need to become a user of KEK.
 - ITDC will support paper work
 - Prepare for test beam.
 - Shipping, etc..

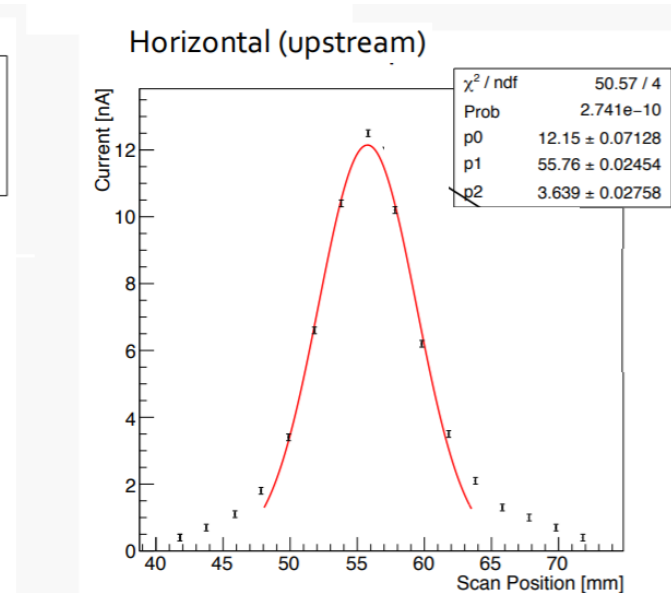
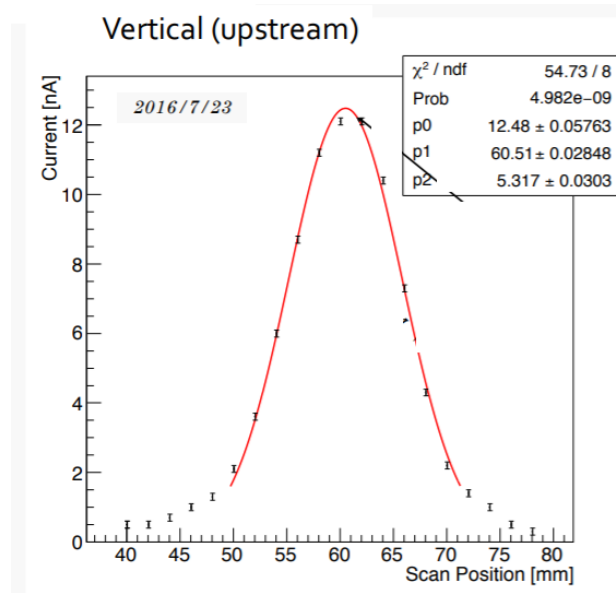
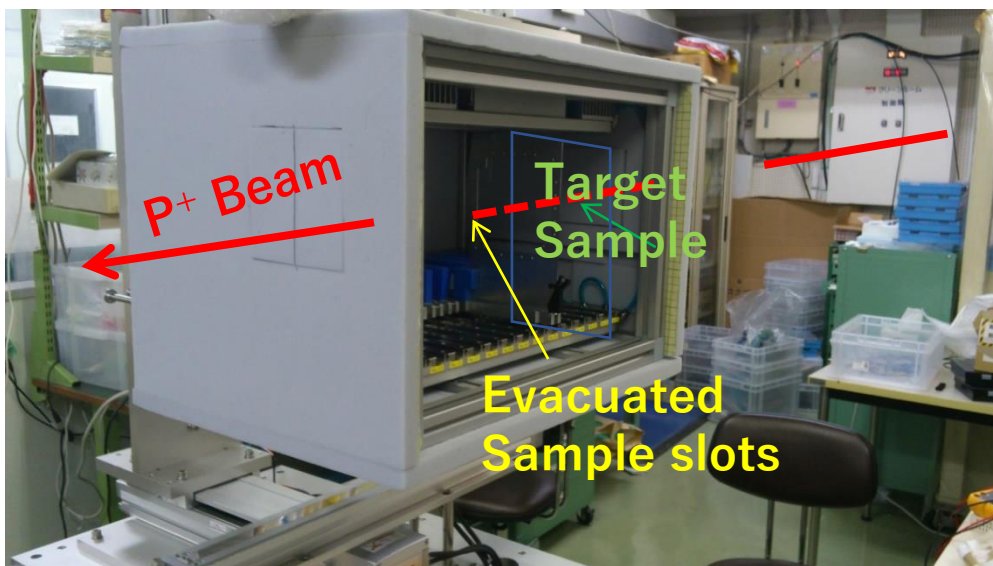
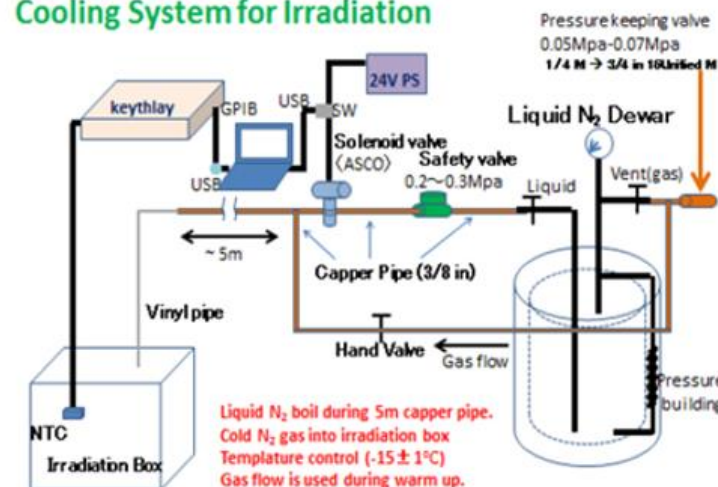
No fee is charged for user.

Other facility in Japan

- Tohoku University CYRIC

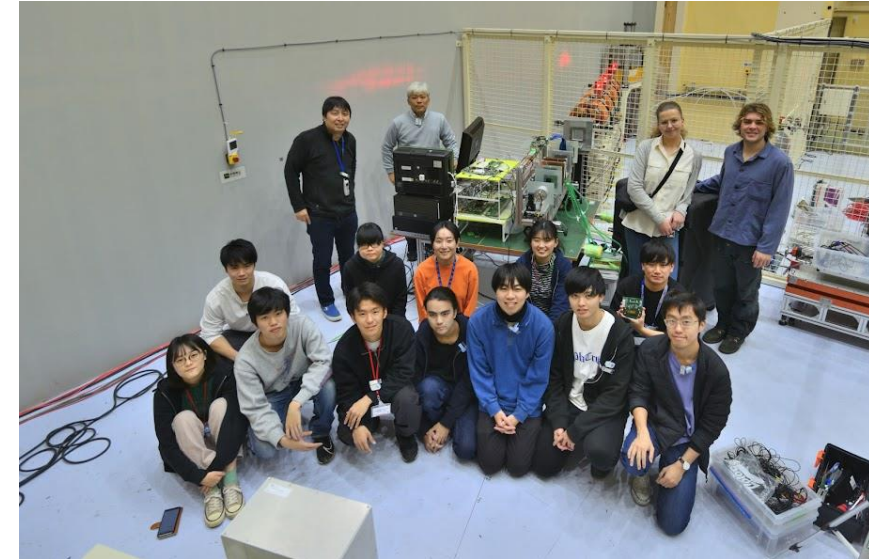
- 70 MeV proton beam with range of 0.5 nA to 1.5 μA
 - Irradiate 5 hours @ 700 nA can reach $5 \times 10^{15} \text{ n}_{\text{eq}}/\text{cm}^2$
- Stable temperature at -15 degree in C
- Can make readout without access.
- Need to have Japanese colleagues

Cooling System for Irradiation

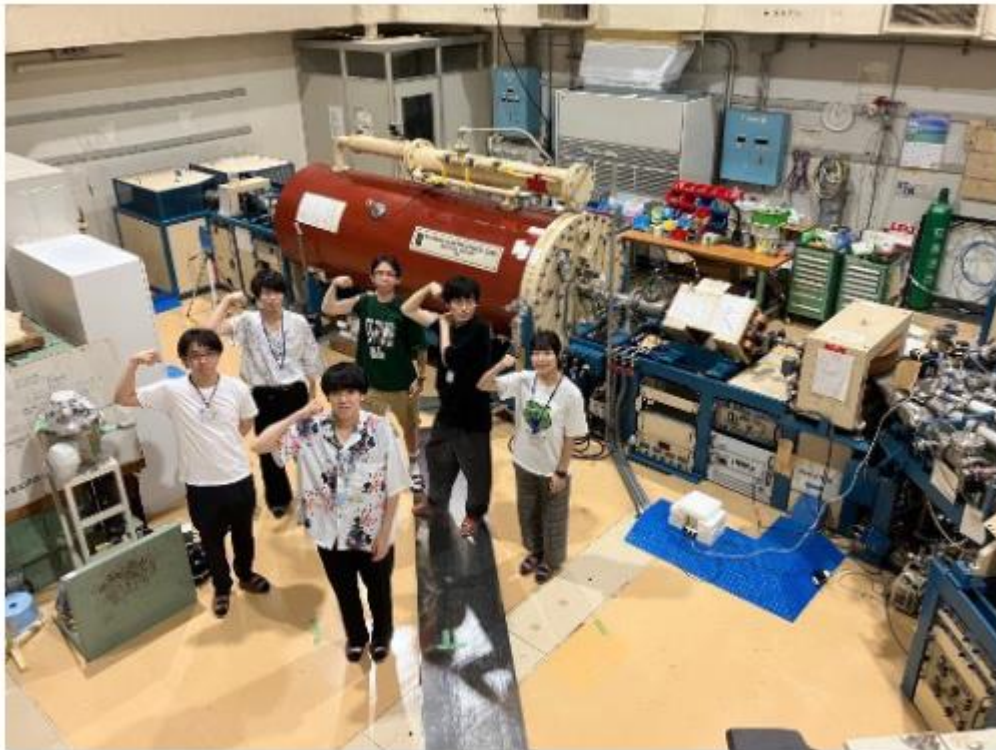


Summary

- Electron test beam is available in Japan
 - Momentum up to 5 GeV
 - Rate: ~ 3 kHz @ 3 GeV
 - 24 hours stable beam with top-up injection
- Availability: May-Jun, Oct-Dec, Mar
 - No scheduled down years
- 1 user beam time: typically, 7 days
 - Wednesday is machine study day.
- No fee is charged for a beam time.
 - Shipping, special cooling, gas needs to be covered by user.
- Irradiation facility is also available in Japan
 - CYRIC in Tohoku University
- YE will serve as DRD3 contact person for facilities in Japan



Neutron irradiation at Kobe University



- Tandem accelerator
- Neutron irradiation
 - $4.9 \times 10^6 \text{ n/cm}^2/\text{s}$ @ $1 \mu\text{A}$
 - $10^{12} \text{ n}_{\text{eq}}/\text{cm}^2$
 - Can be reached with 9 hours