



Current Status of Refurbished Target Irradiation System for Radioactive Isotope Production Using an Electron Linear Accelerator at Research Center for Electron Photon Science, Tohoku University

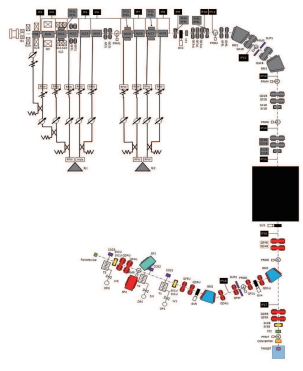
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Presentation ID : PO28

1. About 60 MeV electron linac



60 MeV electron linac. The Great East Japan Earthquake caused serious damage on the accelerator facility in ELPH. Only low energy part of 300 MeV linac was salvaged refining high voltage pulse unit for Gun and the components of the transport section.



Accelerator components of 60 MeV Linac

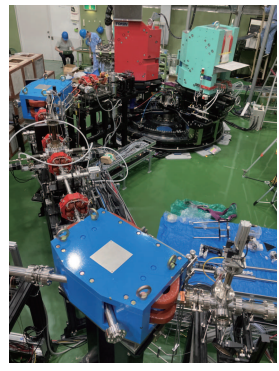
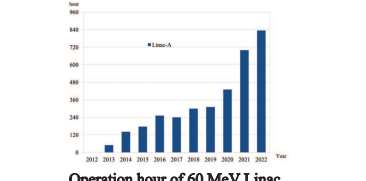


Photo of new beam line for electron scattering experiments.



Operation hour of 60 MeV Linac

Month	Jan 2023			Feb 2023			Mar 2023		
	Mon	Tue	Wed	Mon	Tue	Wed	Mon	Tue	Wed
1	Green	Green	Green	Green	Green	Green	Green	Green	Green
2	Green	Green	Green	Green	Green	Green	Green	Green	Green
3	Green	Green	Green	Green	Green	Green	Green	Green	Green
4	Green	Green	Green	Green	Green	Green	Green	Green	Green
5	Green	Green	Green	Green	Green	Green	Green	Green	Green
6	Green	Green	Green	Green	Green	Green	Green	Green	Green
7	Green	Green	Green	Green	Green	Green	Green	Green	Green
8	Green	Green	Green	Green	Green	Green	Green	Green	Green
9	Green	Green	Green	Green	Green	Green	Green	Green	Green
10	Green	Green	Green	Green	Green	Green	Green	Green	Green
11	Green	Green	Green	Green	Green	Green	Green	Green	Green
12	Green	Green	Green	Green	Green	Green	Green	Green	Green

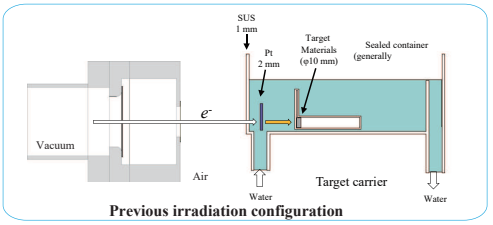
Operation schedule of accelerators from January to March in 2023

Operation timeline of 60 MeV Linac:

- 8:30 ~ Turn on the power supply, refill SF6 Gas, start up Klystron system, load saved operation parameter, and adjust phase shifter manually.
- 9:00 ~ Klystron RF-power on, Check beam energy, beam transport, beam position
- 10:30 ~ Preparation for an experiment by user, set irradiation target by user
- Irradiation starts. Irradiation time depends on experiments.
- 11:00 ~ Repeat 5 min irradiation for several times and change beam energy, keep irradiation for rest of the day.

2. About the irradiation system

Few people involved in development of the linac before



Previous irradiation configuration



The photo of target carrier

Development of Beam diagnostics. Accelerator Researcher: "Want to employ digital camera for diagnostic purpose!"

Maintenance of cooling system. Radiochemistry Researcher: "Need help to change pipes ..."

Engineer: "OK! How about this afternoon?"

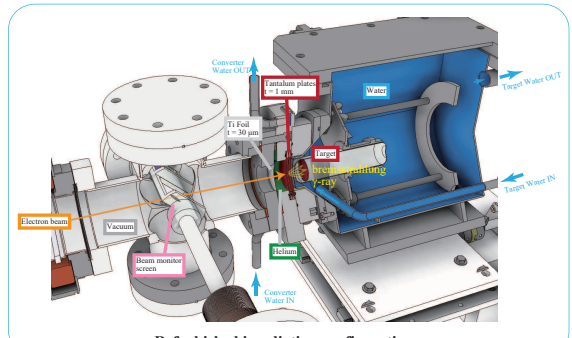
Engineer: "OK! How precise do you need to resolve beam on screen?"

Engineer: "New install devices are registered in system!"

Engineer: "OK! I will add new control buttons in console!"

Accelerator control console build by CR.

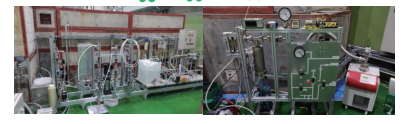
Many people are now involved after the refurbished irradiation system in 2018.



Refurbished irradiation configuration



The entire system has been refurbished: Control system, Interlock, display, irradiation history, video stream of irradiation beam position.

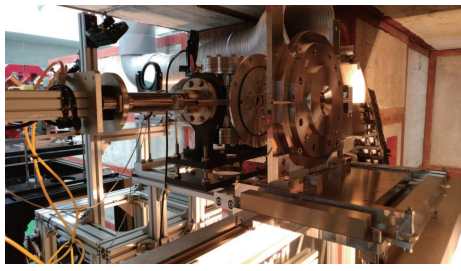


Water cooling system (3 lines: bremsstrahlung converter, irradiation target, beam dump) and Helium cooling system were newly built.

Minor Upgrade: detachable enclosure

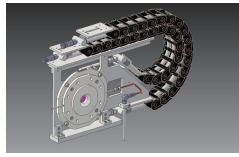
Radiochemistry Researcher: "Frequent changes to irradiation configuration are expected! Work flow must be convenient!"

Engineer: "OK! It will be removable! Quick connect in water cooling will be installed for detach."

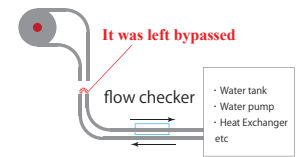


Enclosure of bremsstrahlung converter is now detachable and can be move over the rail.

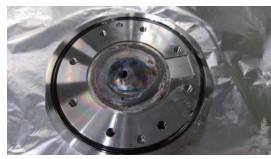
The beam stopped during irradiation. The interlock system has interrupted operation.



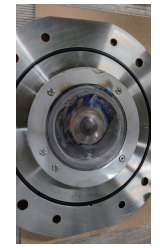
Movable enclosure of bremsstrahlung converter



Unfinished work. Water cooling pipe was left bypassed.



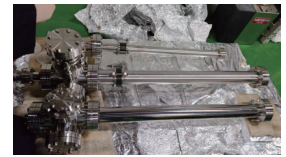
Brazed Ti foil of 30 μm thickness was pierced.



Ta plates of 1 mm thickness was inflated due to heat fatigue.



The inside of the vacuum chambers was wet with water and all chambers had to be disassembled.



Vacuum chambers were baked after reassembling the disassembled parts.

3. Summary

Accelerator beamline and the irradiation system are integrated after the refurbishment of the irradiation system. The trouble caused by lack of water flow in cooling system caused serious damage of Ta plates which seal cooling water. That water pierced Ti foil vacuum window and damaged the vacuum of the accelerator beamline.

Vacuum system is now recovered. Additional interlock hardware and logic are now installed. We confirm same beam quality as before in this beamline.

- All vacuum pipes and chamber were cleaned and assembled.
- Electron beam was confirm at the end of beamline.
- We set up new interlocks so that we would not repeat the same accident.