Improvement of the Cryostat System performance of 28 GHz Electron Cyclotron Resonance Ion Source of the BIBA by a radiation shielding

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Status of BIBA (Busan Ion Beam Accelerator)

3 Future Plan

1 Ion implantation/surface modification

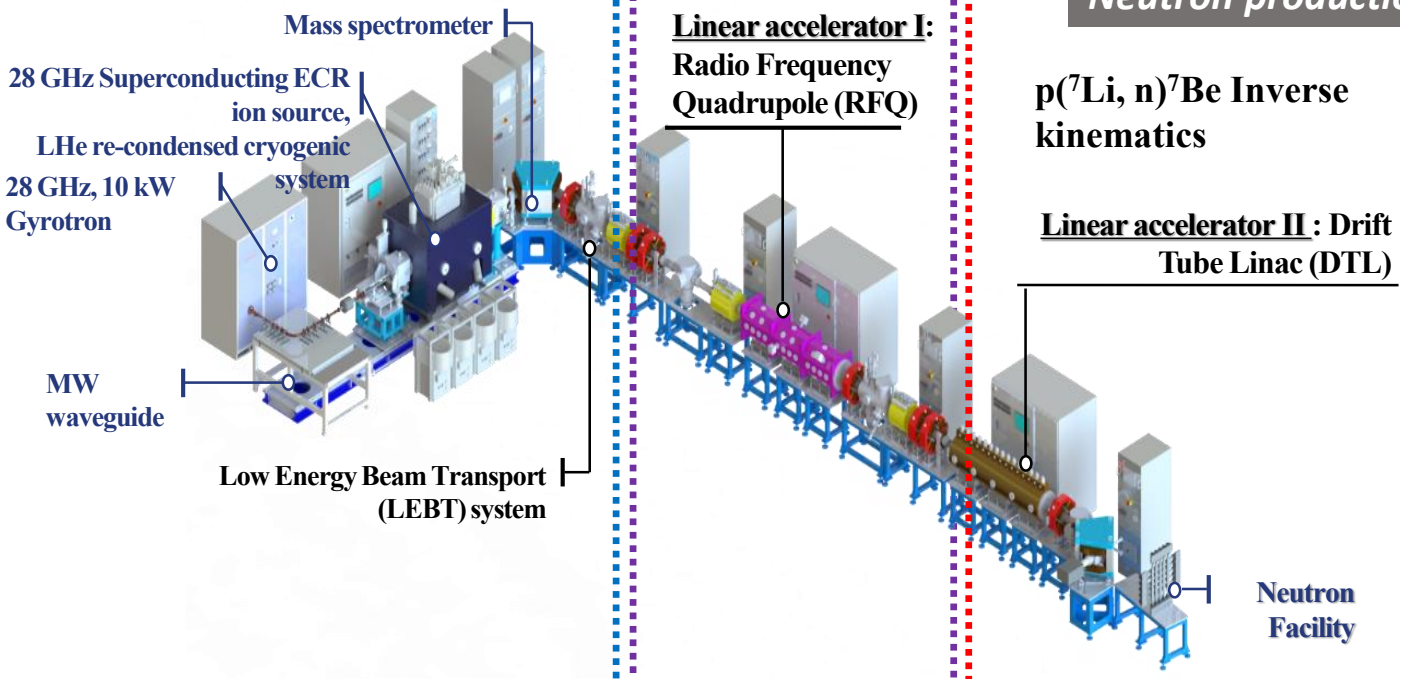
Extraction : ~ 12 keV/u

2 Ion beam based analytic instruments

Acceleration : ~ 500 keV/u

Neutron application

Acceleration : ~ 2.7 MeV/u

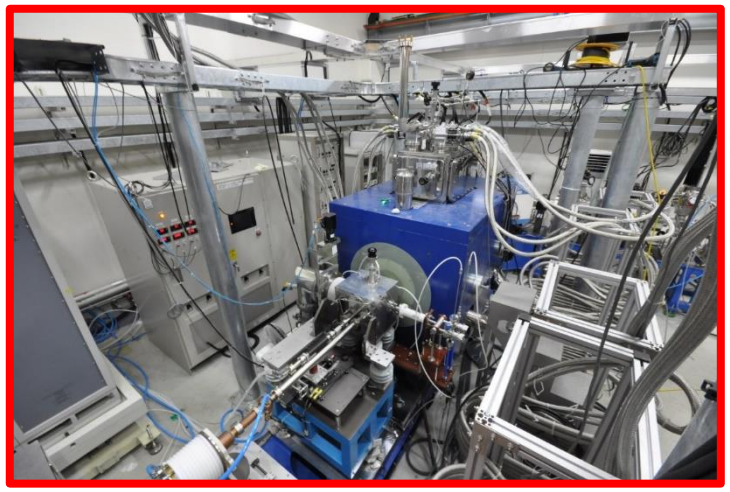


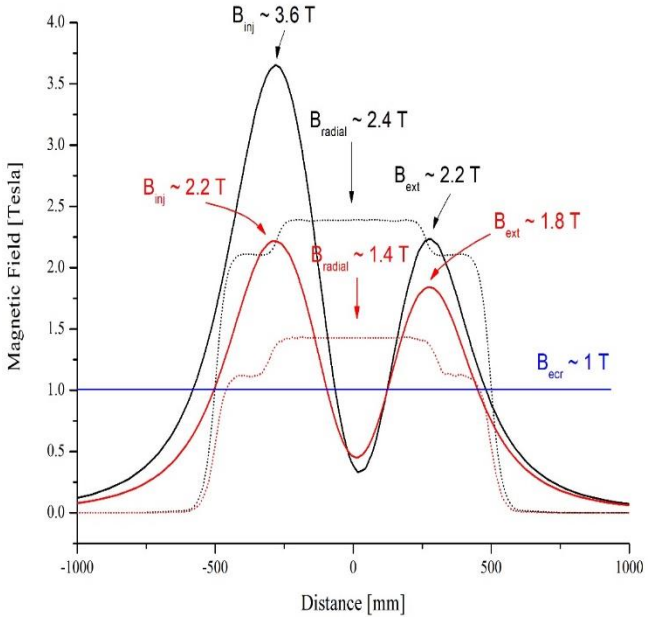
Neutron productio

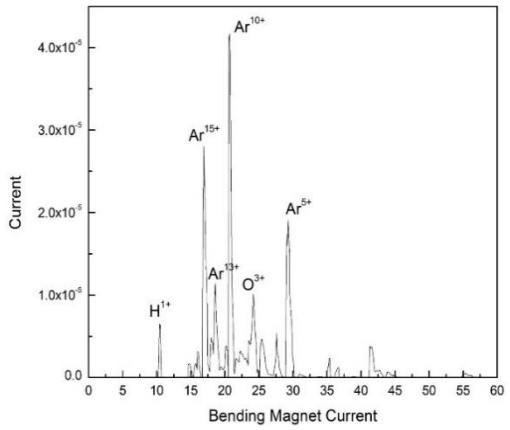
$p(^7Li, n)^7Be$ Inverse kinematics

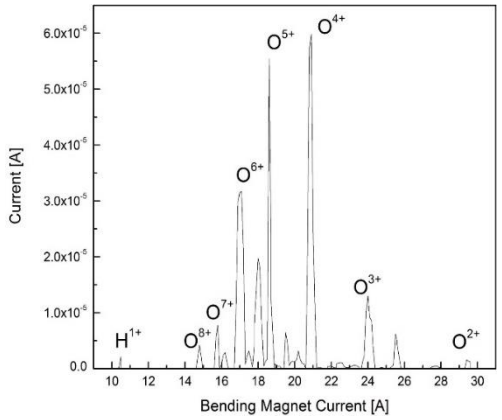
New high-tech research facility.

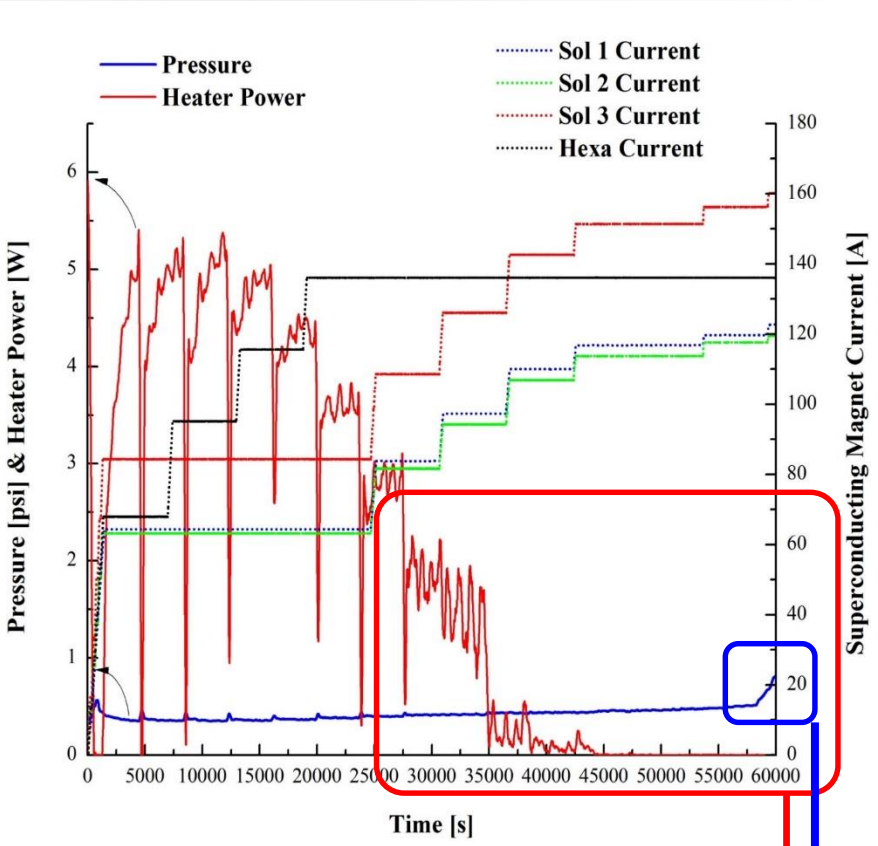
28GHz ECR ion source of BIBA











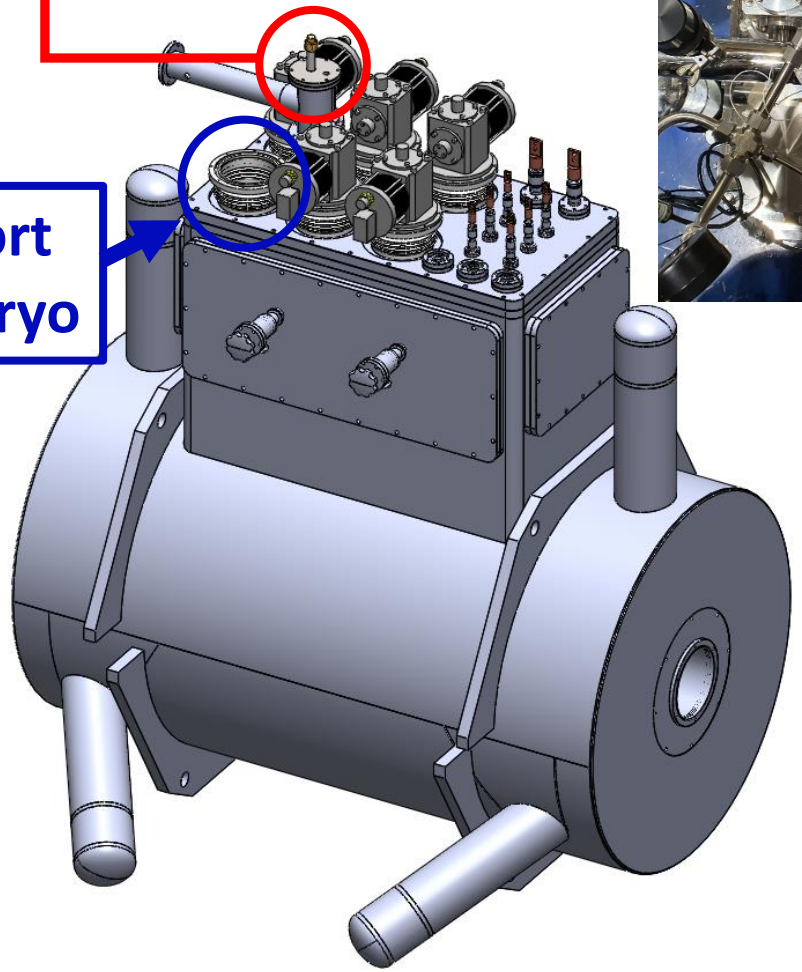
The effect of exiting current
: As the current increases, the cooling margin unexpectedly decreased.

The effect of X-ray
: Pressure is increased

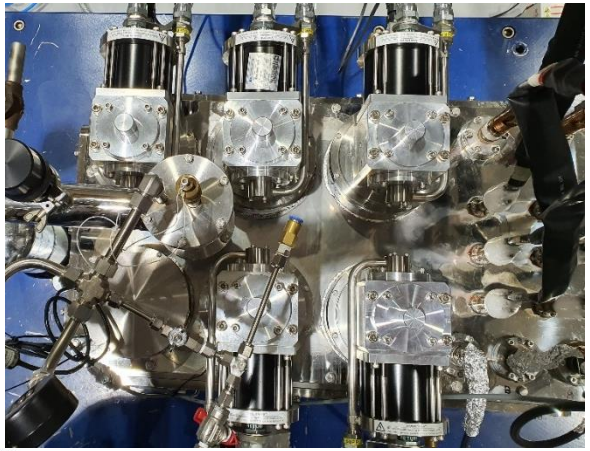
Upgrade of Cryostat

Add one Cryocooler

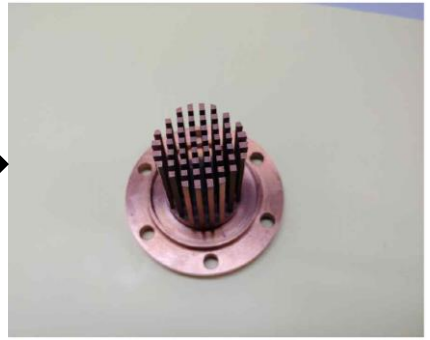
Spare port upto 6 Cryo



Adding the one cryocooler



Increasing the surface area of a pin-type heat exchanger



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A Study on the Performance of the Cryostat System for the 28-GHz Electron Cyclotron Resonance Ion Source at the Korea Basic Science Institute

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The BIBA (Busan Ion Beam Accelerator) is a compact linear accelerator facility using the 28 GHz ECRIS (Electron Cyclotron Resonance Ion Source) at the KBSI (Korea Basic Science Institute). The superconducting magnets of the 28 GHz ECRIS produce high magnetic fields for strong confinement of plasmas in an ion source chamber. For stable operation of the superconducting magnets, performance of cryostat system is very essential. However, the cryostat system produces significant quantities of the heating due to conduction from room temperature. In addition, part of the X-ray radiation produced by the collisions of the electrons within the ion source chamber is absorbed by the cold mass of the superconducting magnet, leading to an additional heat load in the [illegible] ECRIS is performed to improve the cooling efficiency of the cryostat system.

Ke[illegible] Cryocooler, HTS current lead
DOI: [illegible]

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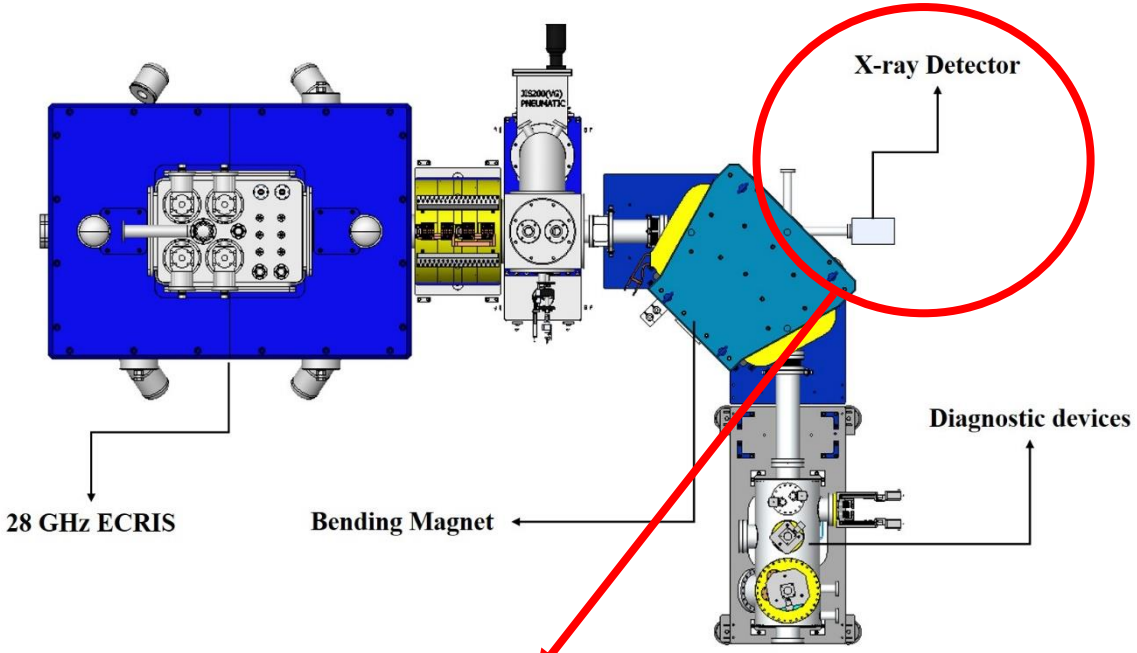
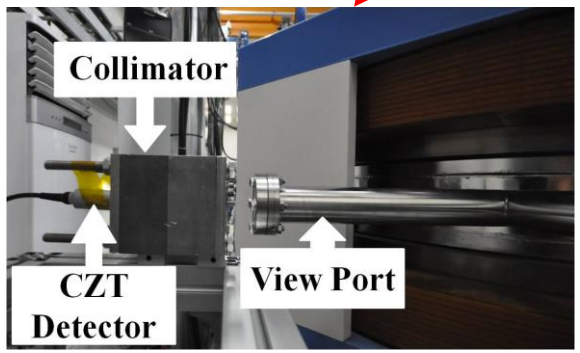
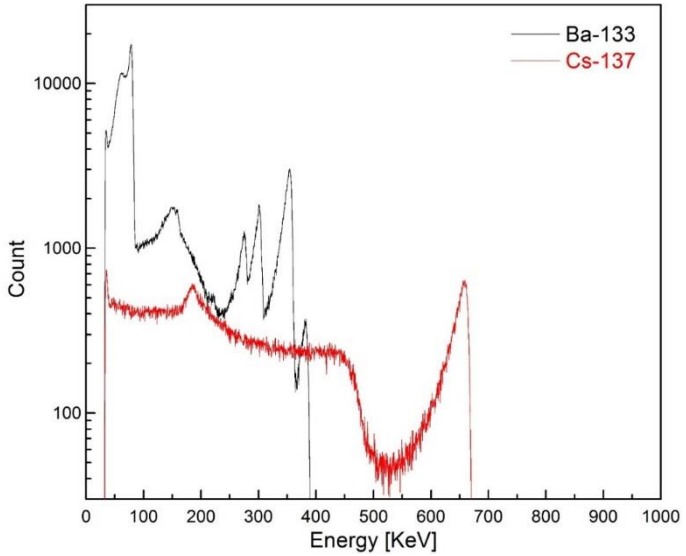
X-ray measurement on 28GHz ECR ion source

❖ Setup of CZT detector

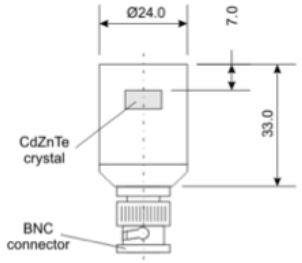




❖ Energy Calibration by check source



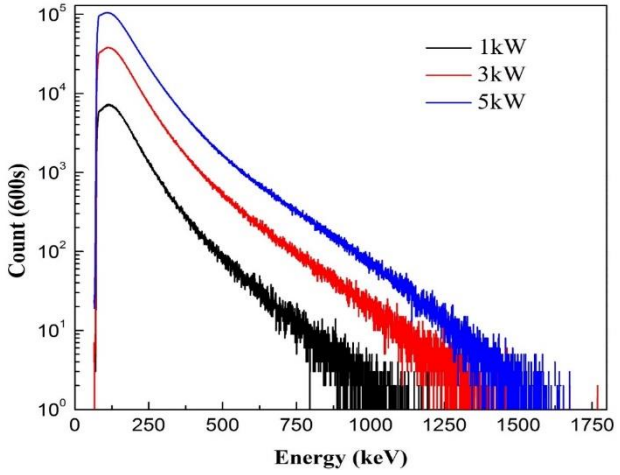
❖ Specification of the CZT detector



Specification	
Detector name	CZT/500S
Vendor	Ritec Ltd.
Year of fabrication	1998
Basic	
Detector type	CdZnTe
Detector geometry	Quasi-hemispherical
Detector sensitive volume	500 mm^3
Bias voltage requirements	
Detector high voltage	1000 V
Detector high-voltage polarity	Positive
Dimensions	
Diameter	23 mm
Length	33 mm
Distance between a top plane of the housing cover and sensitive surface of the detector	7 mm
Connector	
Detector bias voltage	BNC or SHV type

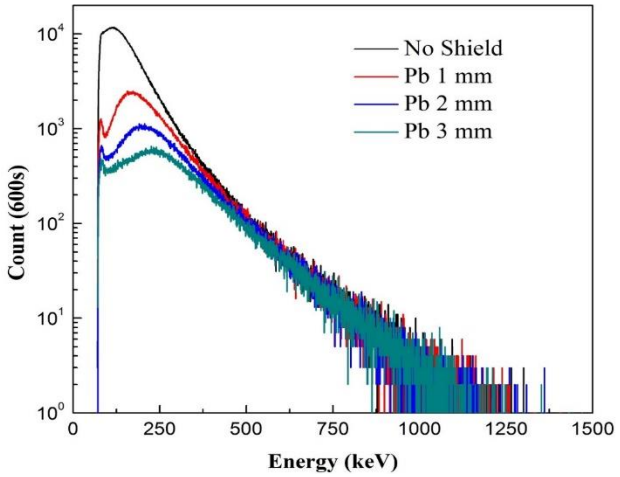
X-ray shielding on 28GHz ECR ion source

- **Measured x-ray spectra with respect to the RF power.**

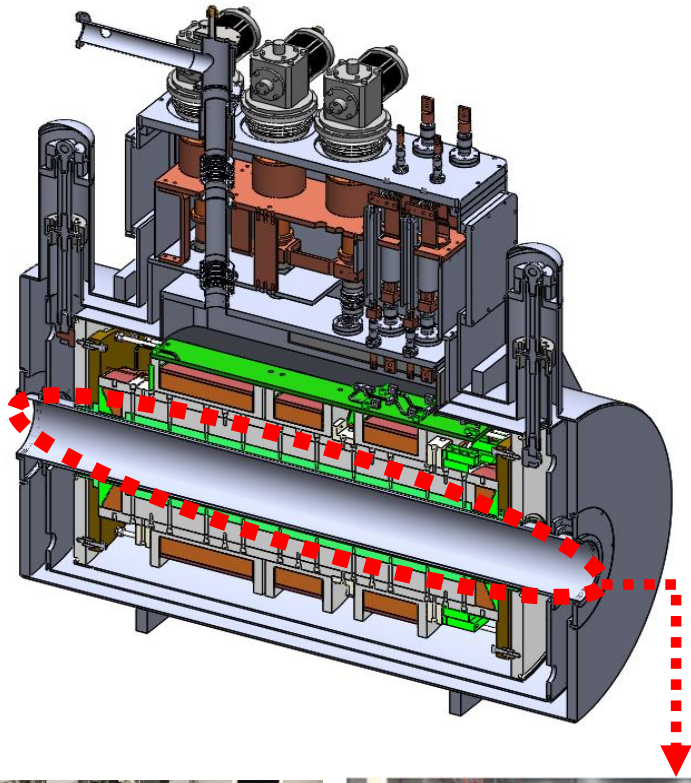


MW power	X-ray energy concentration below 600 keV
1 kW	97.5 %
3 kW	96.5 %
5 kW	95.9 %

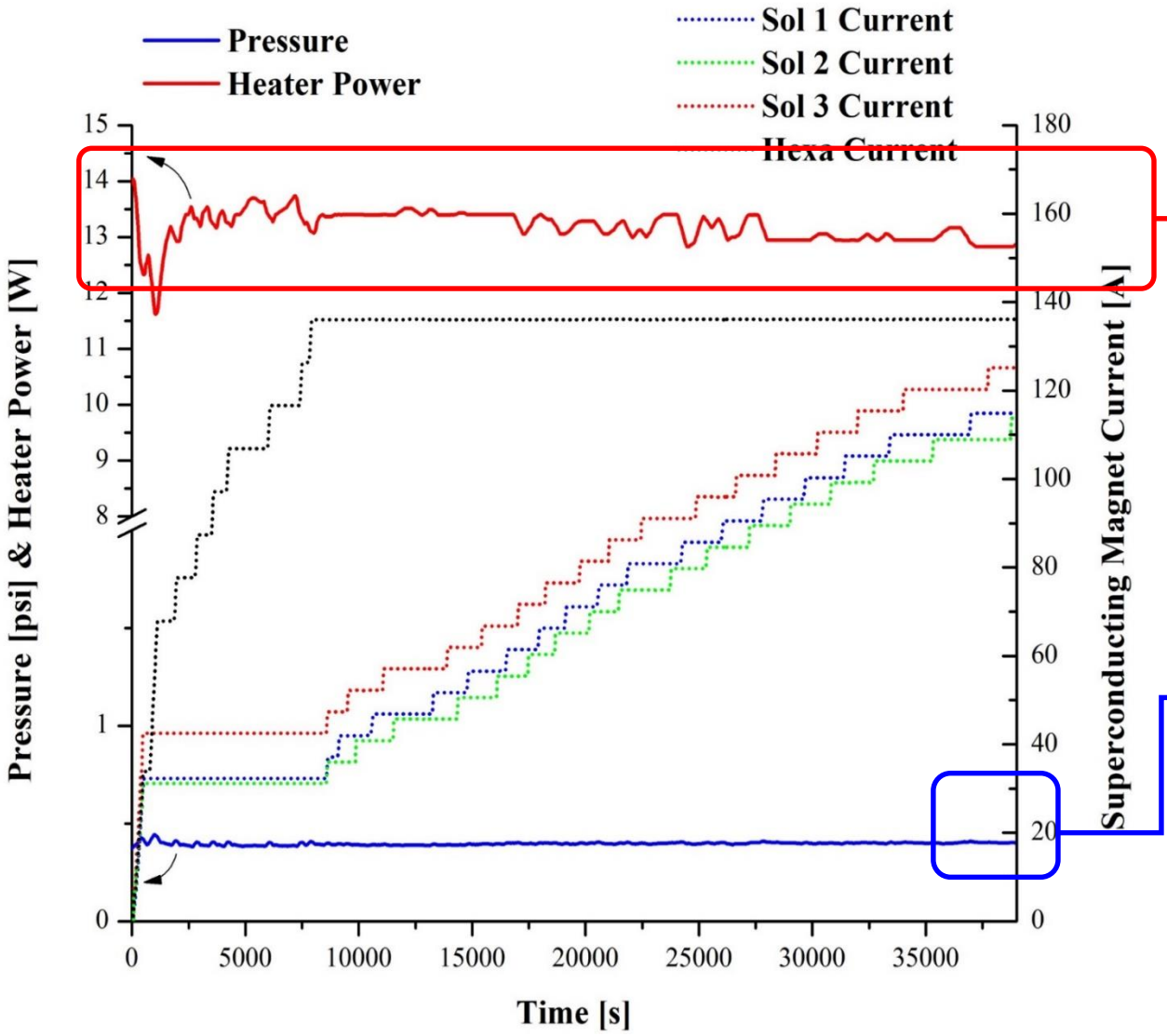
- **Measured x-ray spectra with respect to the thickness of Pb sheets**



Pb Sheet	Shielding rate(<600 keV)
1 mm	60 %
2 mm	75 %
3 mm	82 %



After modification of the Cryostat System



Improving the cooling efficiency

: As the current increases, the cooling margin was found to decrease 13 W and then saturated.

Installation of X-ray radiation shieling bore

: As the plasma ignition, the pressure was not increased.

Heat power and pressure according to excitation of the superconducting magnets.

Conclusion

- For stable operation of the superconducting 28 GHz ECRIS, we modified some components of the cryostat system.
- The cooling margin was sufficient to permit the magnet and cryostat system.
- Also, the test results of X-ray emission on cryostat system with radiation shield performance is satisfied for stable operation..