

Test Results and Current Status of the RISP 28GHz ECR ion source

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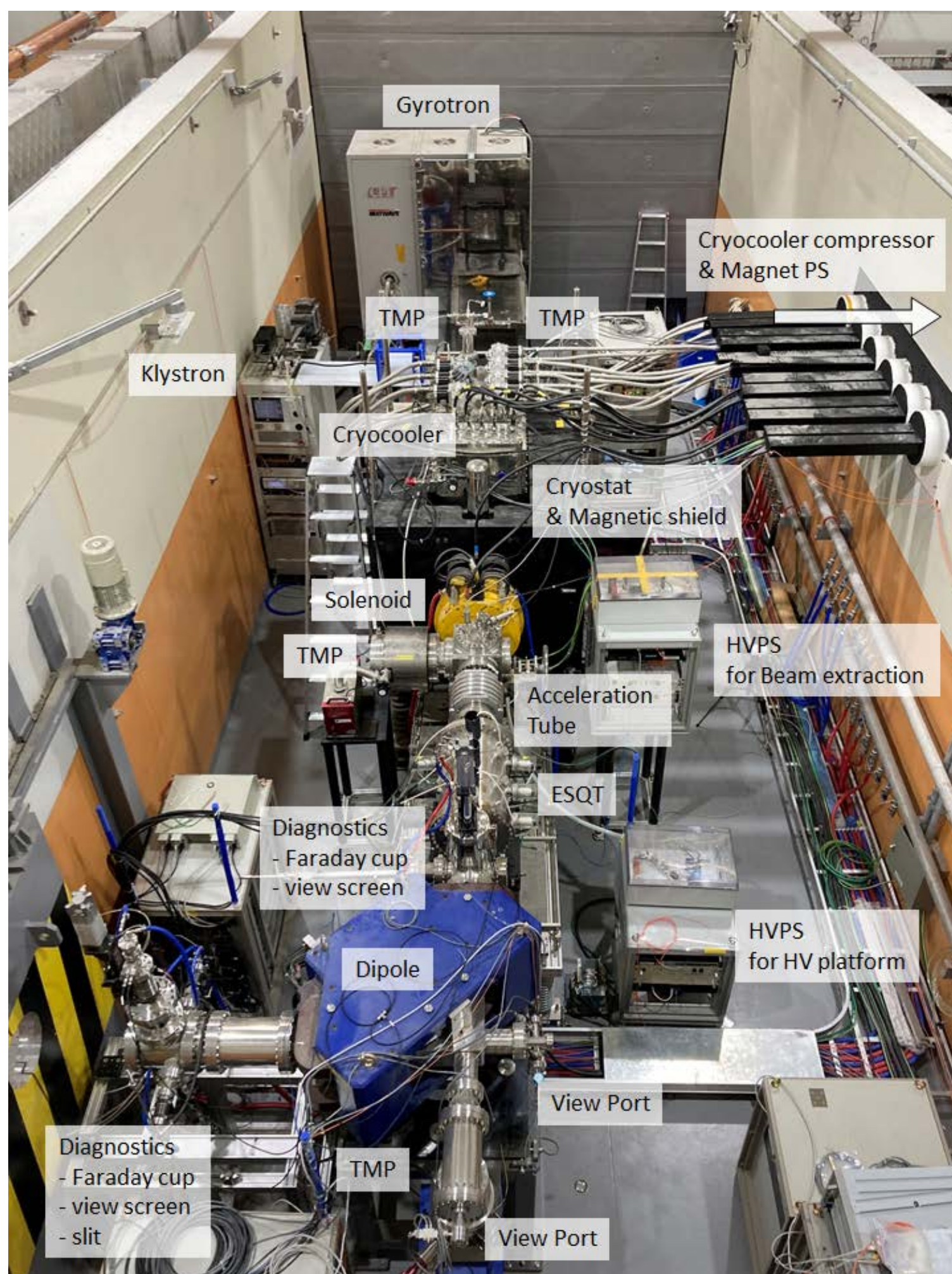
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Abstract

The RISP 28GHz ECR ion source was transferred from the temporary test site to the RISP main site in 4Q 2019. Installation and precision alignment were completed in 1Q 2020. Cryostat cool-down started in October 2021 due to site mechanical equipment condition. In the operation of the superconducting electromagnet, after several training procedures, Ba.max=3.0T was reached in June 2021. The beam extraction test was conducted under such magnetic field conditions. For the relative verification of the ion source performance, Ar13+ beam was selected as the target beam, and a test was conducted to maximize the beam current. As a result, a beam current of 100euA, which was less than the 1st stage target of Ar13+ 250euA, was drawn. For further improvement of the ion source, points to be improved are summarized in this paper.

Experiments and Results

Experimental setup



- Cryo-system : 7 cryo-coolers. Cooling capacity margin is about 6 W
- Superconducting magnet
 - 4 solenoids and 1 hexapole.
 - The two solenoids in the middle were connected in series and operated in the same form as a total of three solenoids.
- Microwave system
 - 10 kW Gyrotron and 2kW Klystron
 - Maximum operating power of the Klystron is limited to 500W due to DC break power limitations.
- HV system
 - 2 stage HV system (50kV + 20kV).
 - At this point, the second stage of 50kV high voltage platform was grounded and just the first stage of 20kV system was operated
- Vacuum system
 - Vacuum pumping was performed with a total of 4 TMPs : 2EA in the injection chamber, 1EA in the extraction chamber, and 1EA in the dipole chamber.
 - Base pressure reaches about 1x10E-8.
- Beam transport system
 - 1 solenoid and 1 ESQT on the upstream side of dipole magnet
 - On the downstream side of the dipole magnet, there is no optical component other than the beam slit, and the beam diagnostic system is configured at the focal point of the dipole.
- Beam diagnostic system
 - A Faraday cup and a view screen were installed on the upstream side and downstream side of the dipole magnet, respectively.

Experimental goal

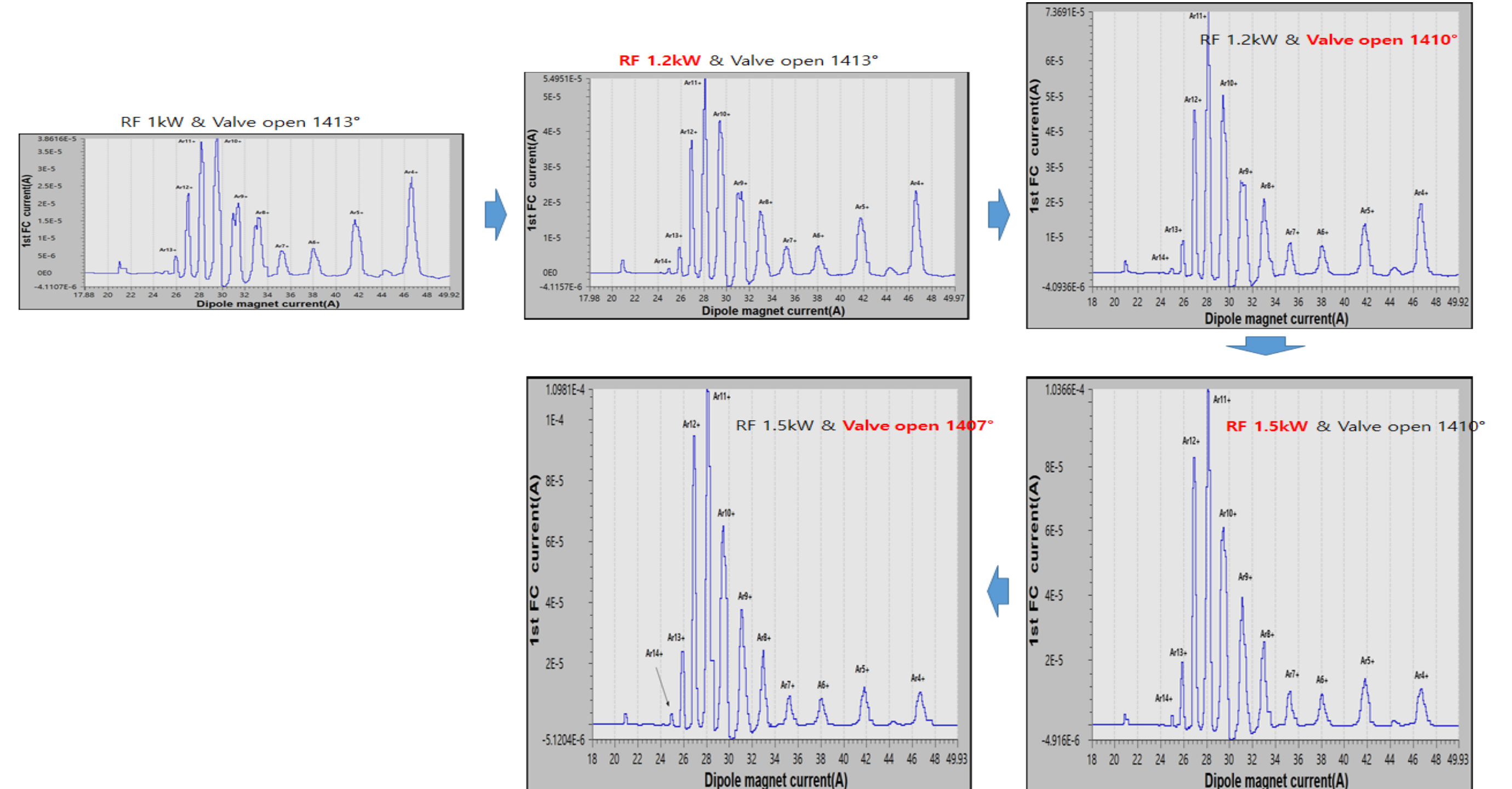
- Extracting Ar13+ 250euA : 50% of Ar13+ beam current drawn during initial operation after setup of another 28GHz ECR ion source
- Maximization of beam current through RF power, vacuum pressure, gas mixing, dual frequency heating and optimization of beam transmission system

* This work was supported by the Rare Isotope Science Project of the Institute for Basic Science funded by Ministry of Science and ICT and NRF of Republic of Korea (2013M7A1A1075764)

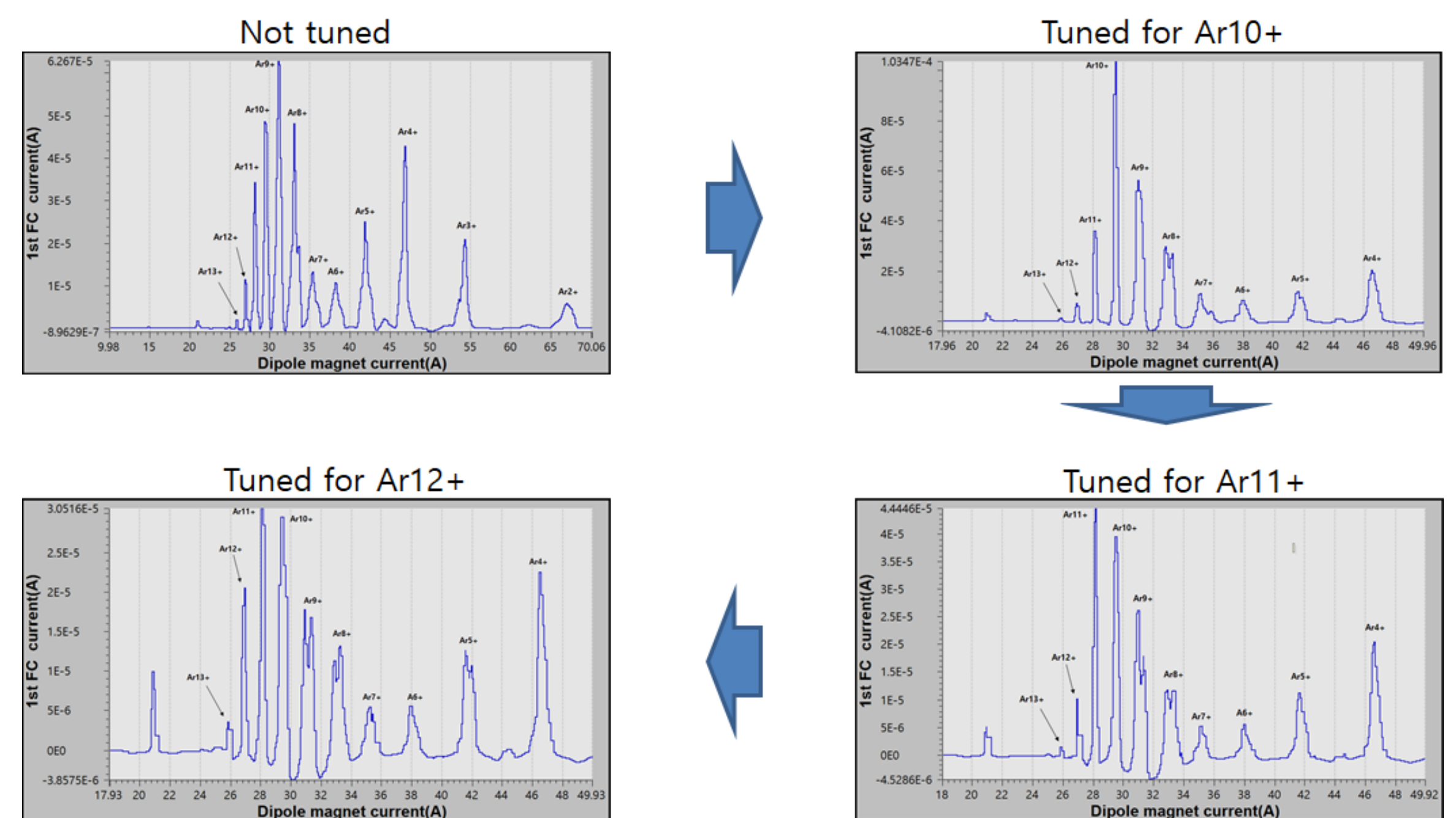
Experiments and Results

Experimental result

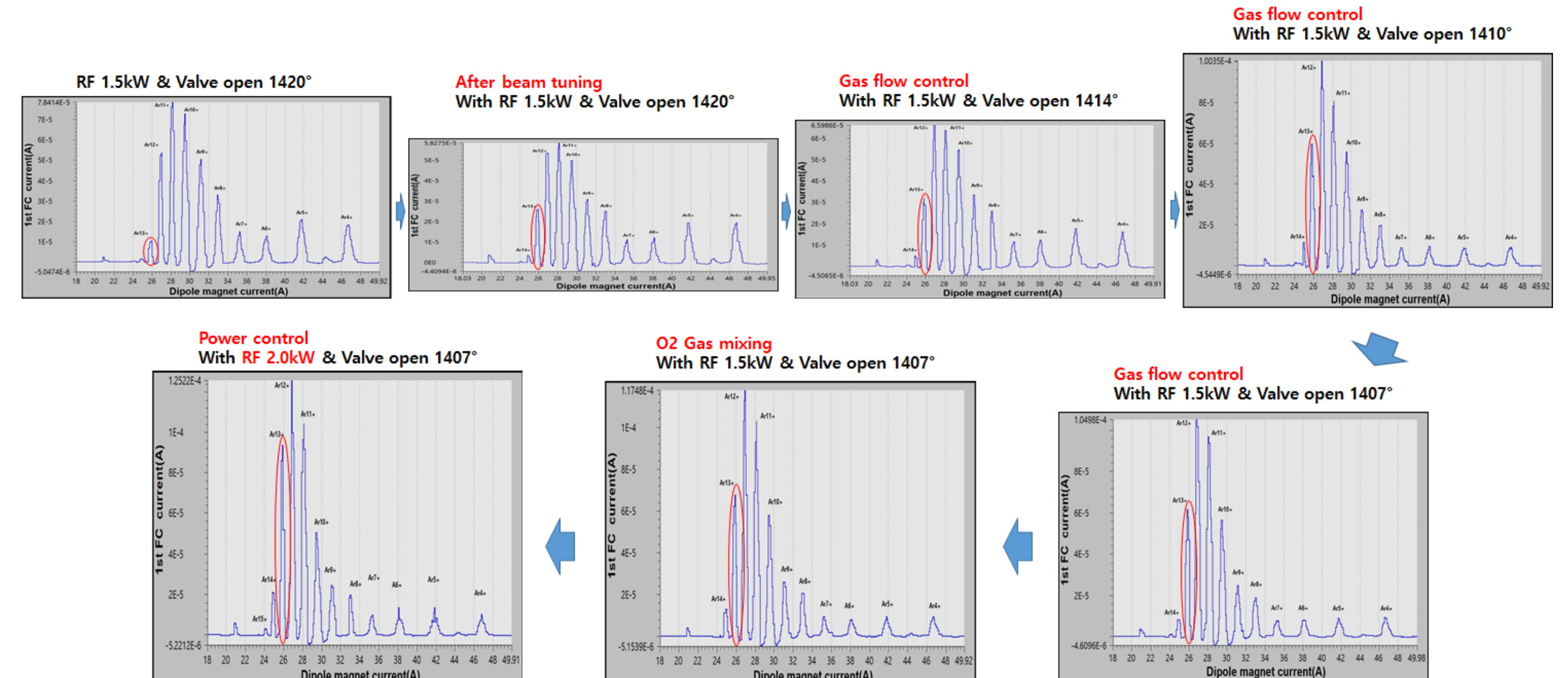
1) MW power & gas flow control effects



2) Beam Transmission System Optimization Effect : with MW power 1kW

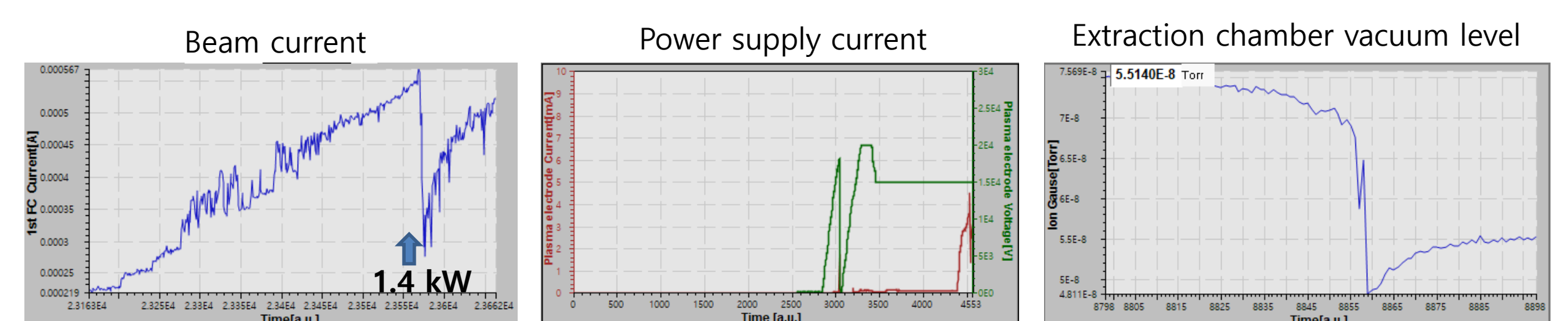


3) Optimization process for Ar13+

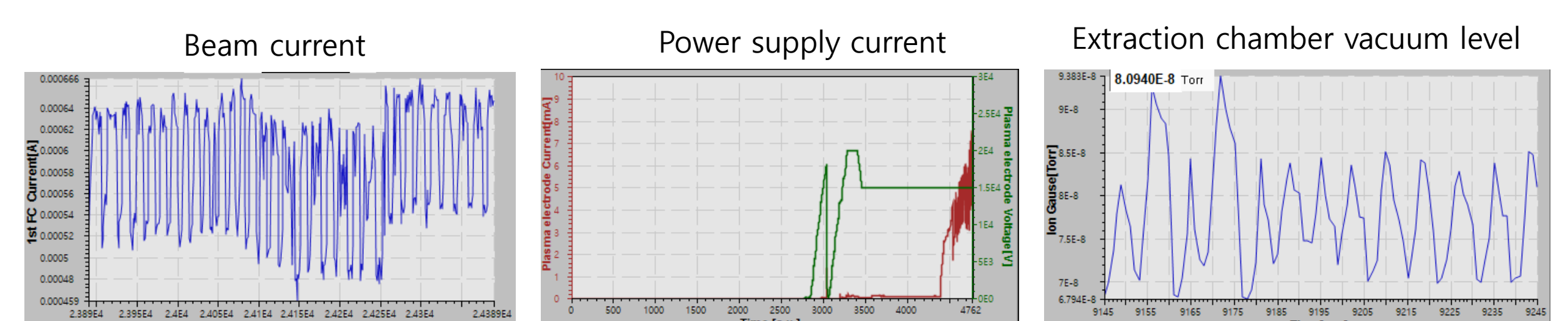


4) Limits due to deterioration of plasma stability

- When power was increased, beam instability was increased, vacuum changes rapidly, and outgoing beam current decreases rapidly.



- Power 계속 증가 시 beam oscillation & vacuum level oscillation 발생



summary and future work

- Beam experiment was performed under the max. axial B-field of 3T
- At a relatively low gas flow rate or high RF input power condition, plasma instability was increased and the beam current decreases
- The internal structure was changed to improve plasma stability, but it did not improve, but rather deteriorated.
- : it is necessary to fundamentally improve the internal structure of the plasma chamber.