



OSAKA UNIVERSITY

Beam Profile Measurements of Decelerated Multicharged Xe Ions from ECRIS for Estimating Low Energy Damage on Satellites Components

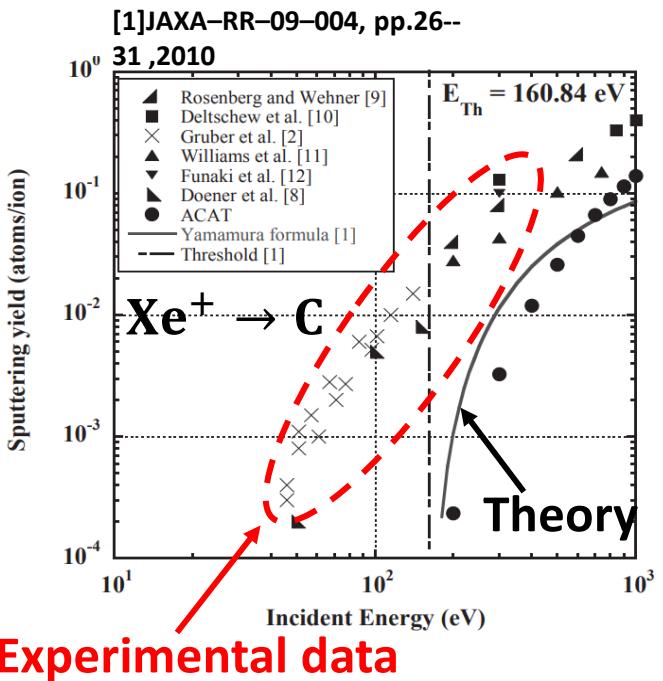
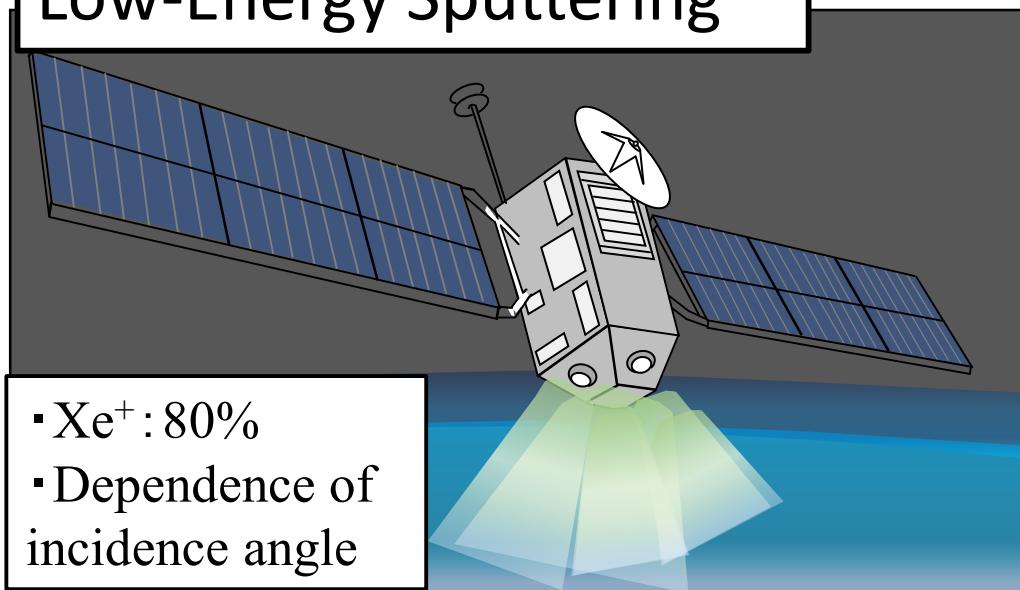
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24th International Workshop on ECR Ion Sources

Background

Low-Energy Sputtering

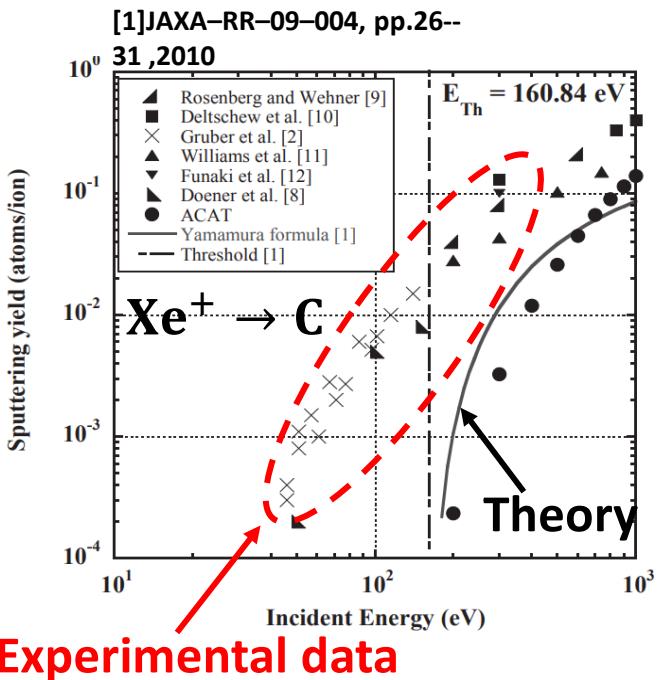
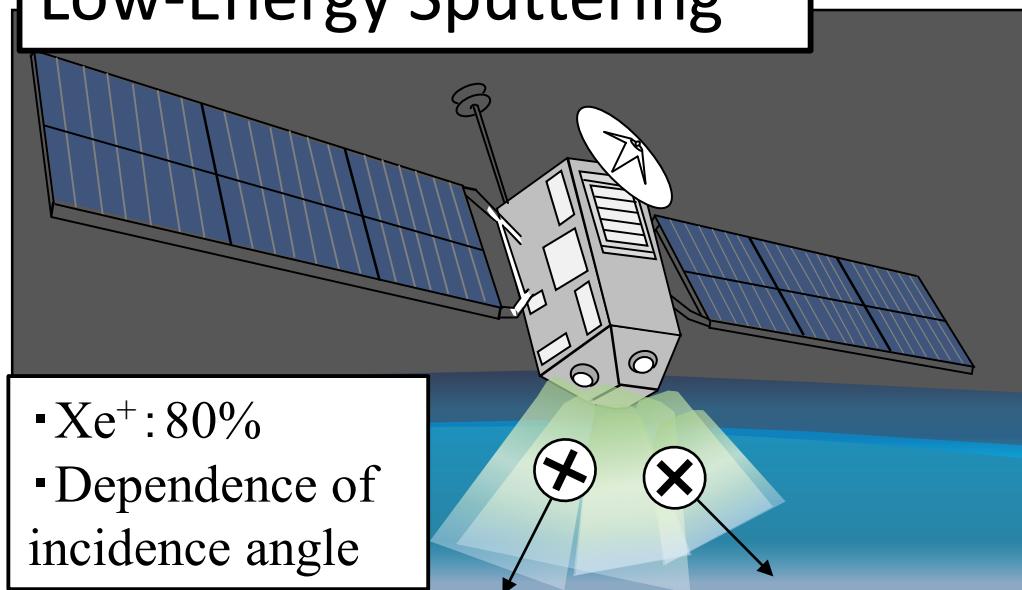


- ☞ In designing satellites for 10–15 years of operation, low energy sputtering cannot be ignored.
- ☞ Low energy sputtering yield has some different results in experimental data and theory.

The irradiation experiment is carried out using a device that simulates an ion engine.

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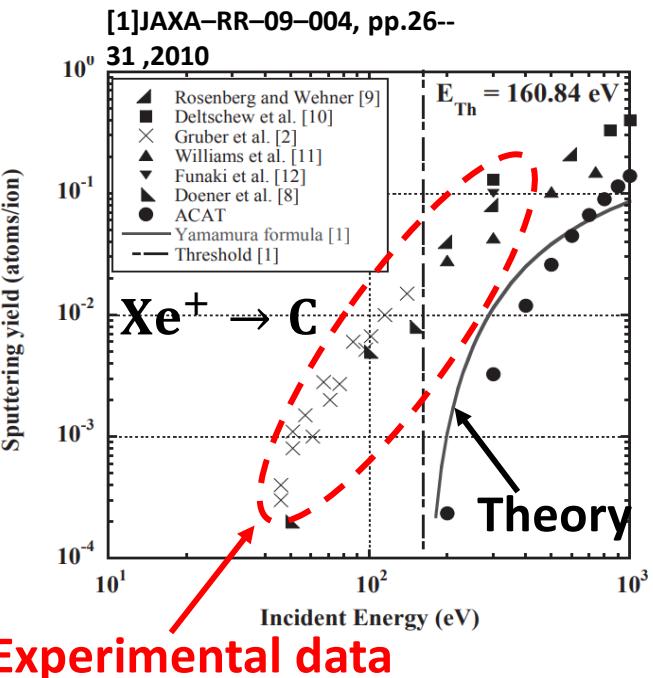
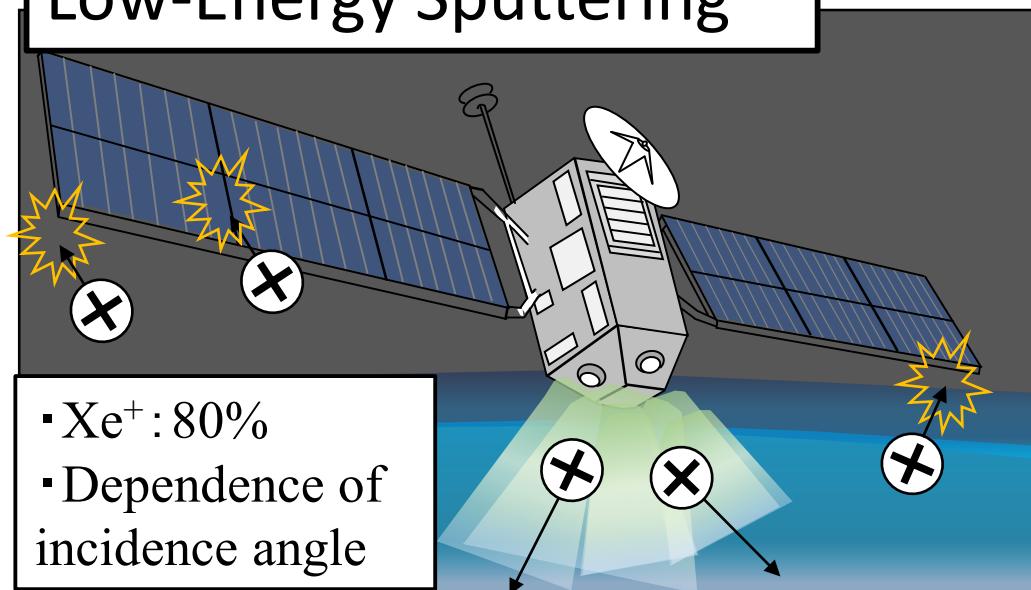
Low-Energy Sputtering



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Background

~ In our laboratory ~

Our goal is measurement of sputtering yield by irradiating satellite components with low energy Xe ion beam.

Beam Deceleration

The amount of beam currents is not enough for irradiation when the extraction voltage is 1kV and Xe is extracted.



We extract the ion beams from high voltage 10 kV and transported
into the ion beam irradiation system (IBIS) where we constructed.
And we decelerate and irradiate ion beams to the materials.

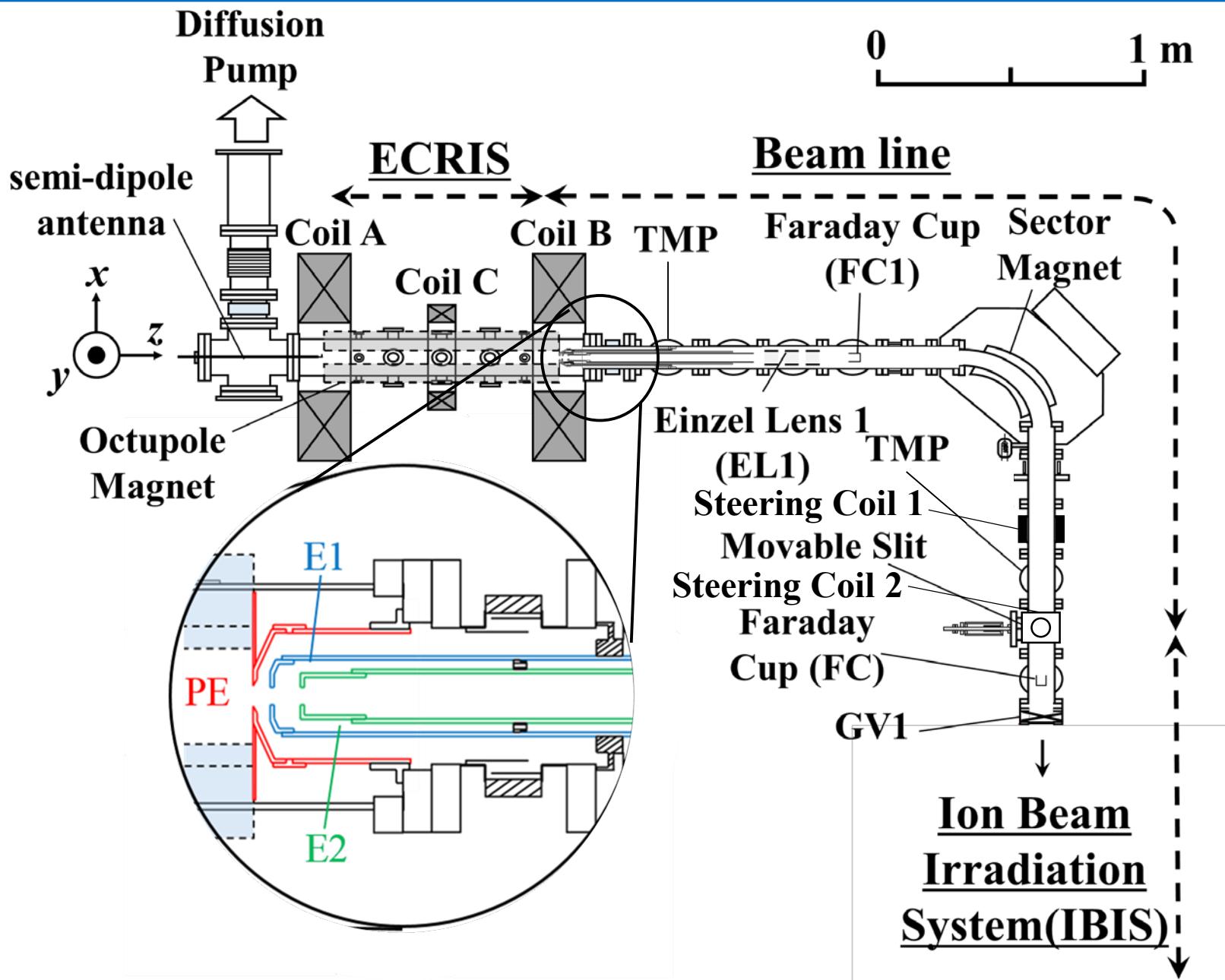
Previous studies

- Experimental setup using an existing ECRIS for decelerated ion beams
- Improvement of beam line to increase current

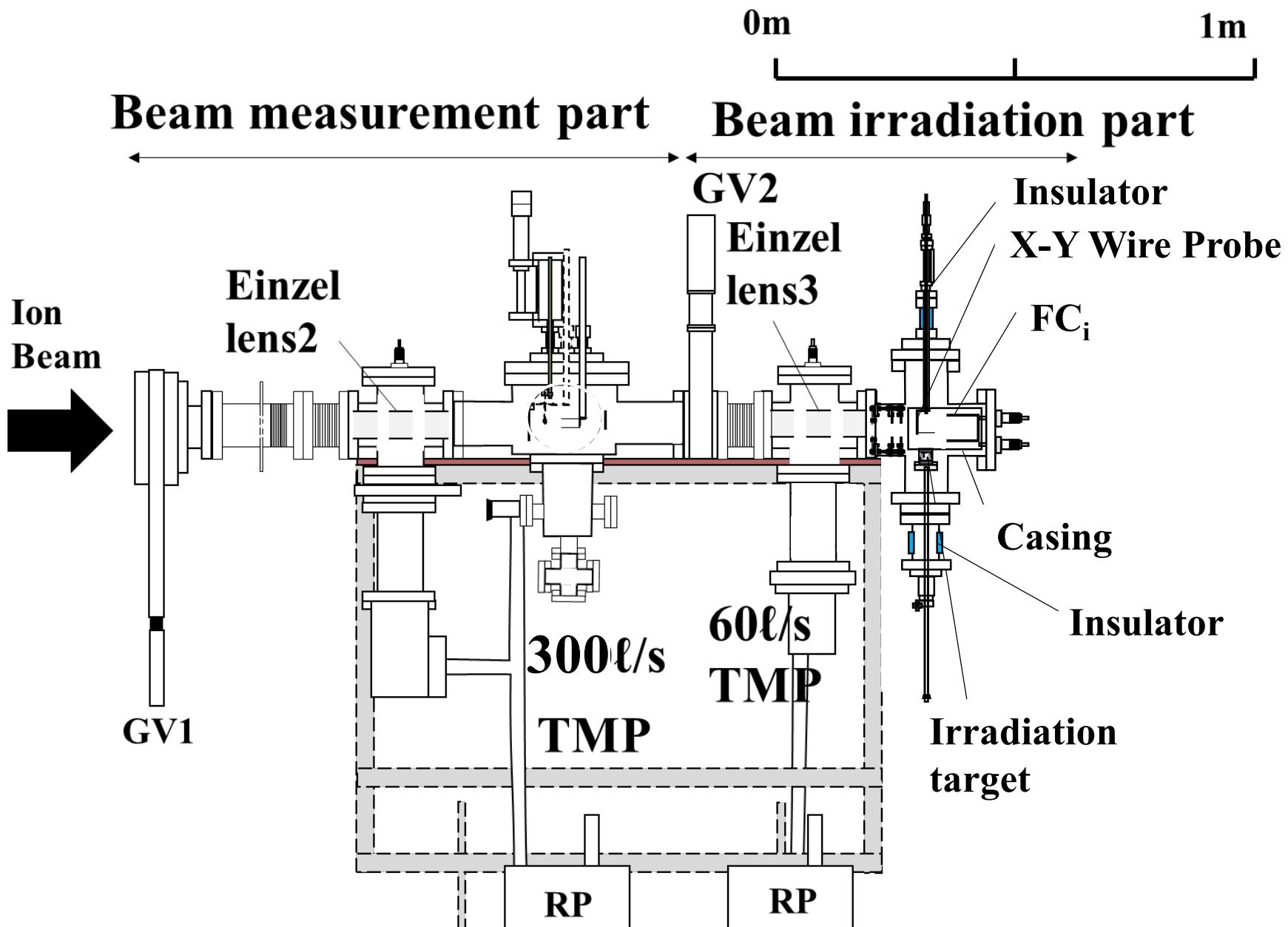
Construction of equipment for irradiation

- Problem: Uniformity of beam profile on the sample about 1cm^2
⇒ We measure the two dimensional profiles of the decelerated beam
- Xe, Ar Deceleration Experiments
→ Measurements of beam current in the low energy region
- Measurements of beam profiles in the low energy region
- Calculations of the current density & Evaluating of the dose amount
→ Estimation of irradiation time

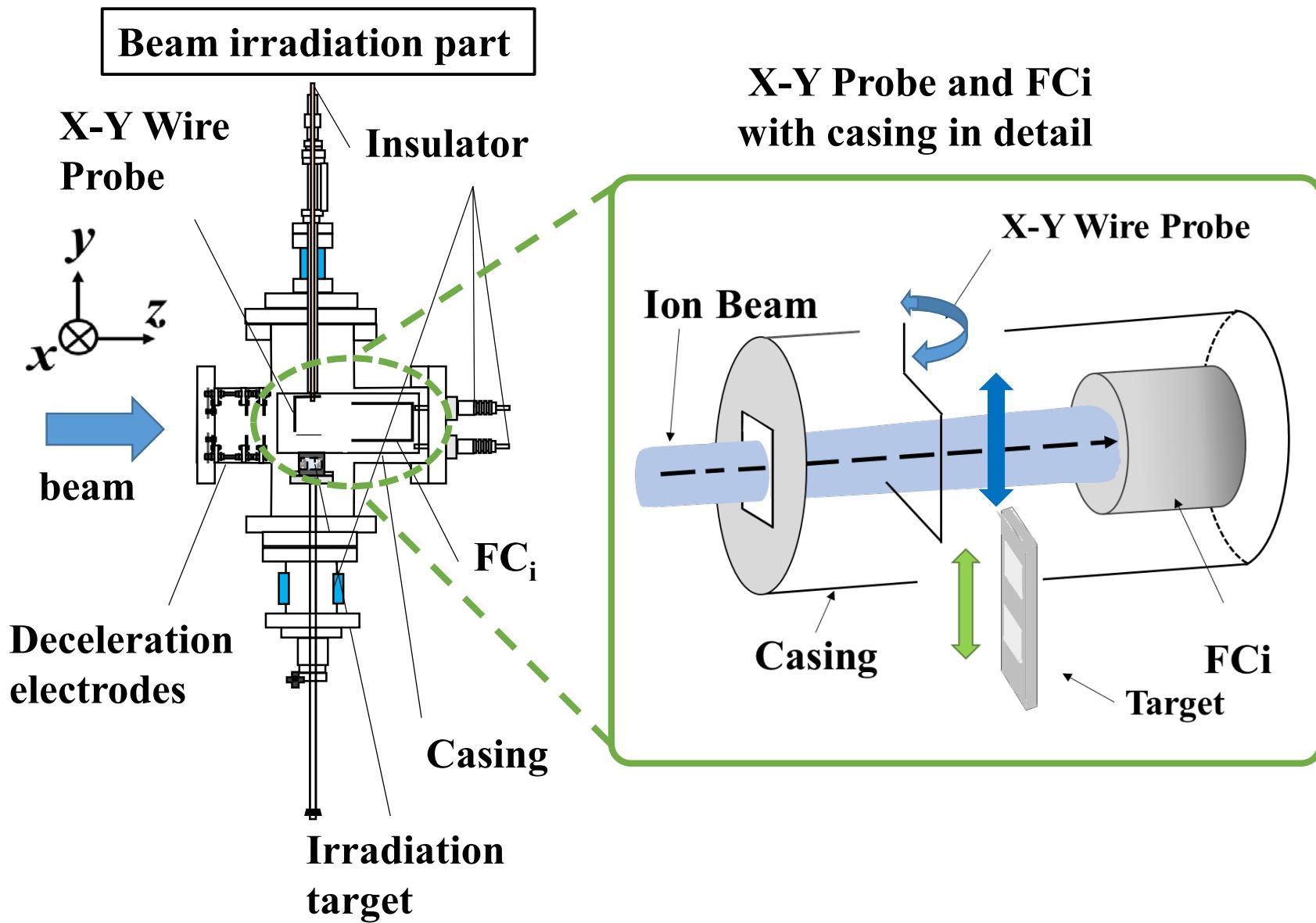
ECRIS & Beam line



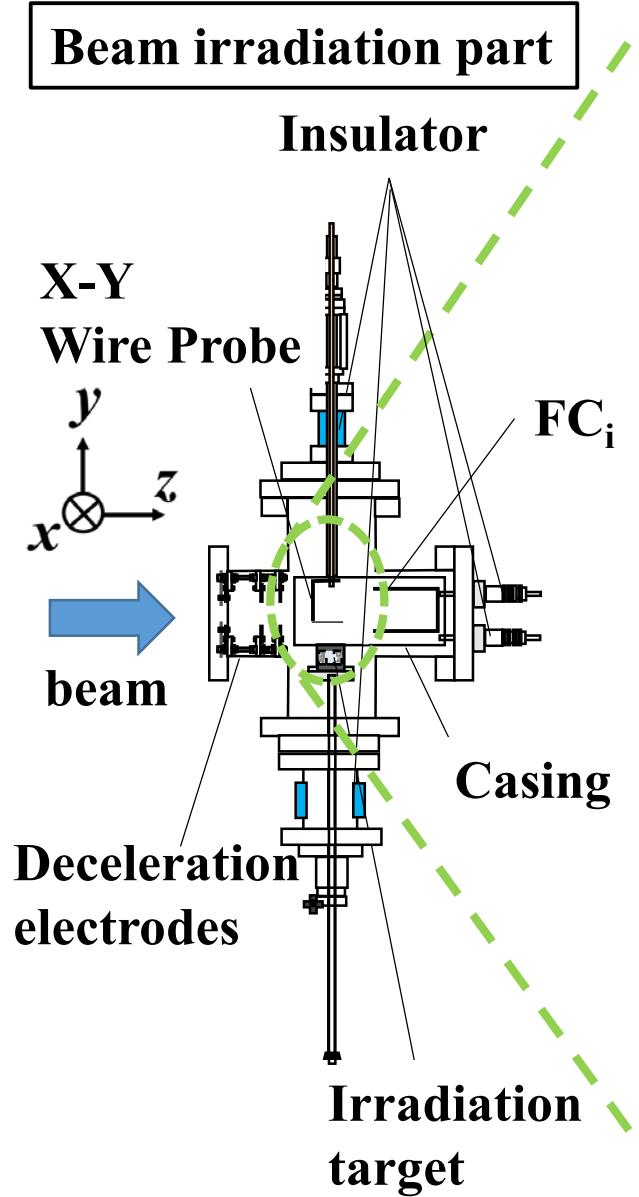
Ion Beam Irradiation System (IBIS)



Construction of equipment for irradiation experiment

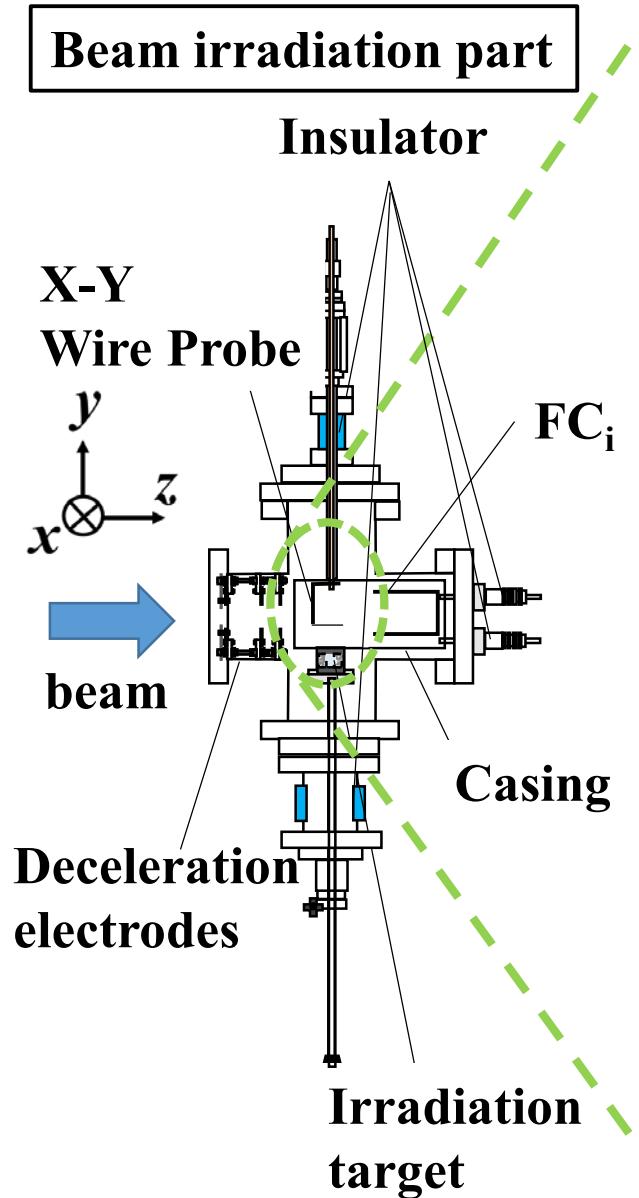


Construction of equipment for irradiation experiment

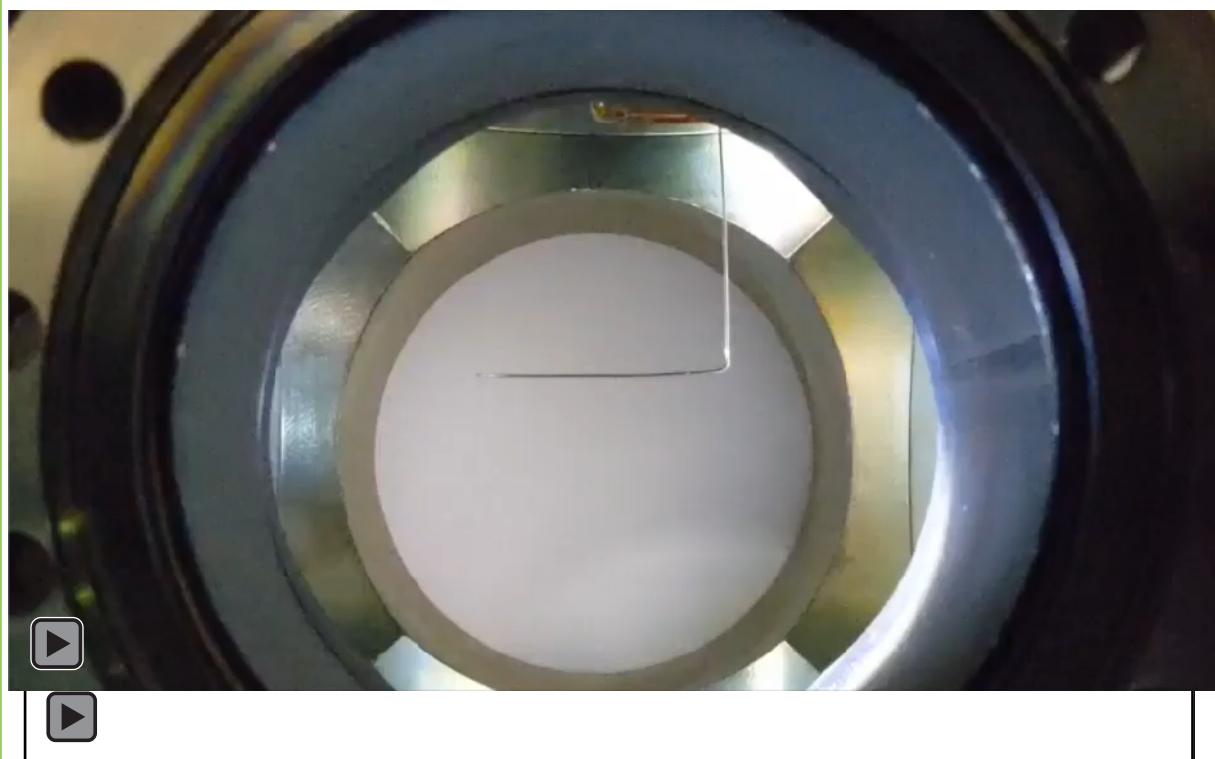


Movement of the X-Y wire probe during measurements of two dimensional profiles

Construction of equipment for irradiation experiment

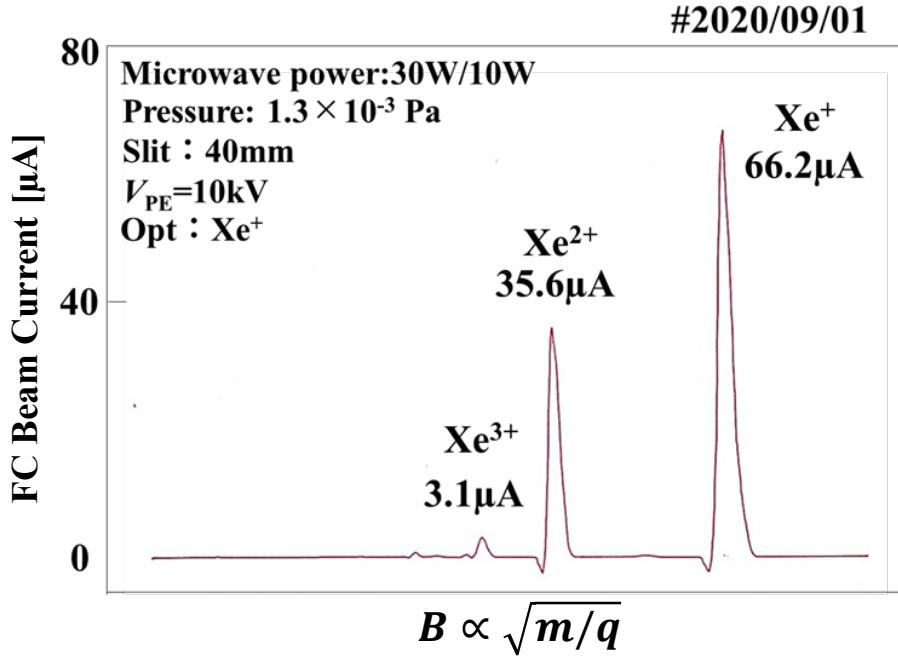


Movement of the X-Y wire probe during measurements of two dimensional profiles

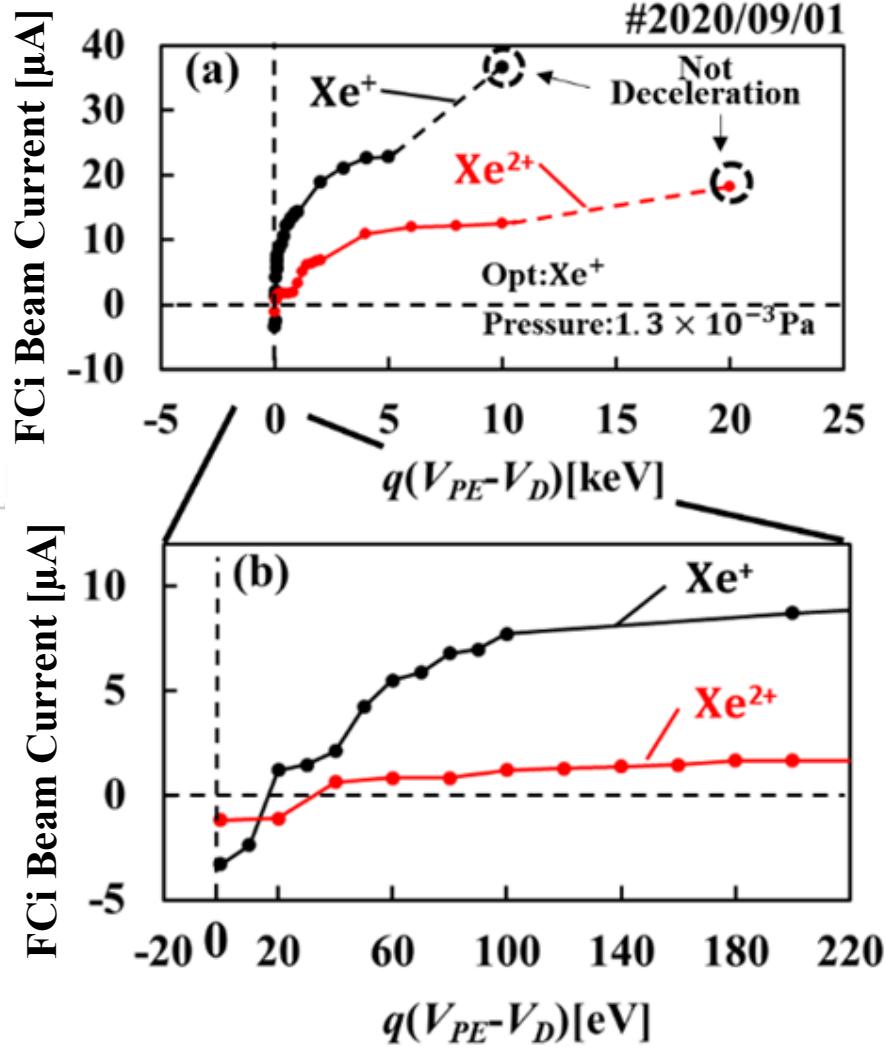


Experimental Results

Xe Deceleration Experiment

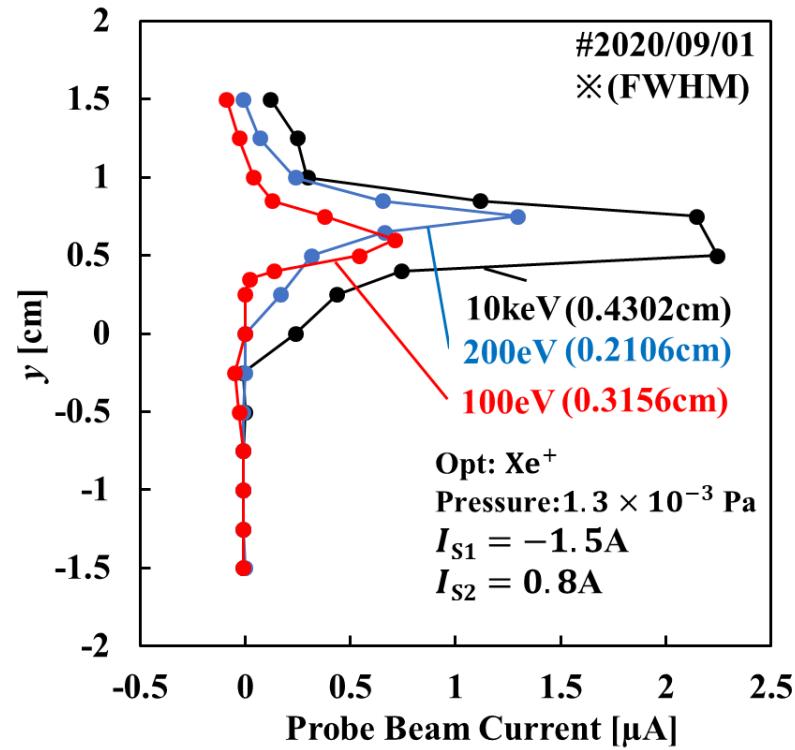
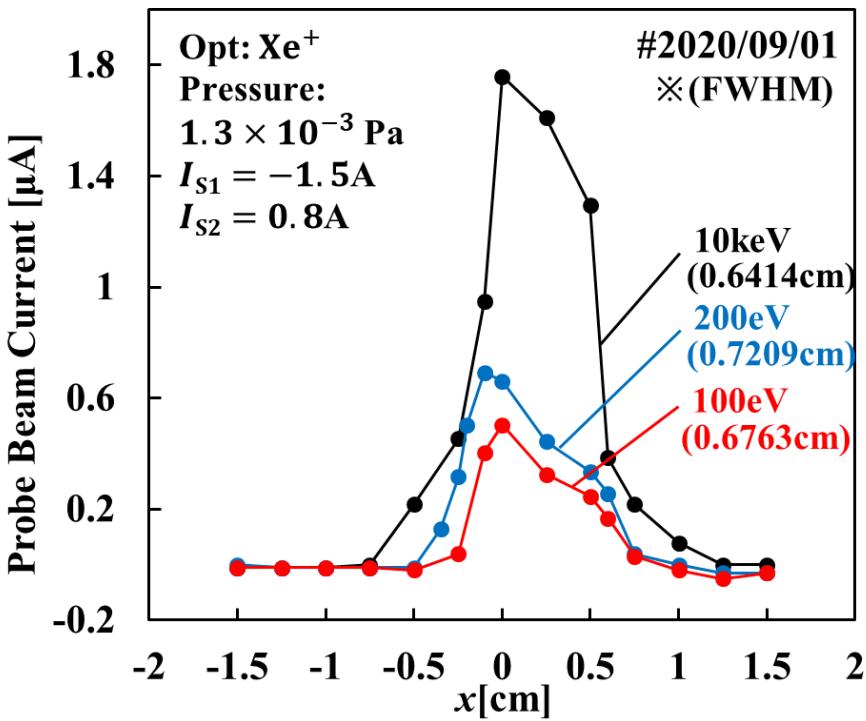


We found that there was sufficient current to conduct irradiation experiments in the low energy region (100~200eV).



Experimental Results

Measurements of Decelerated Xe^+ Ion Beam Profiles



| Irradiation condition of Xe^+ (200eV) | | |
|--|----------|----------------|
| | Si | SiO_2 |
| Irradiation Time [min] | 7 | 3 |
| erosion[nm] | 20 | 20 |
| Y[mm ³ /C] | 0.012 | 0.033 |
| Current Density[A/cm ²] | 4.33E-04 | 4.33E-04 |

| Irradiation condition of Xe^+ (100eV) | | |
|--|----------|----------------|
| | Si | SiO_2 |
| Irradiation Time [min] | 27 | 5 |
| erosion[nm] | 10 | 10 |
| Y[mm ³ /C] | 0.002 | 0.011 |
| Current Density[A/cm ²] | 3.20E-04 | 3.20E-04 |

Summary

- ☞ Sufficient beam current in the low energy region (about 100eV to 500eV) for irradiation experiments
- ☞ We succeeded in acquiring the profile of decelerated beam.
- ☞ Evaluation of high precision dose amount and irradiation time

Future Plan

- ☞ Further improvement of deceleration electrode and irradiation system to shorten irradiation time
- ☞ Irradiation experiments for various materials