New vacuum furnace for N-doping / N-infusion in KEK

2018/May/30

ALCW2018@Fukuoka

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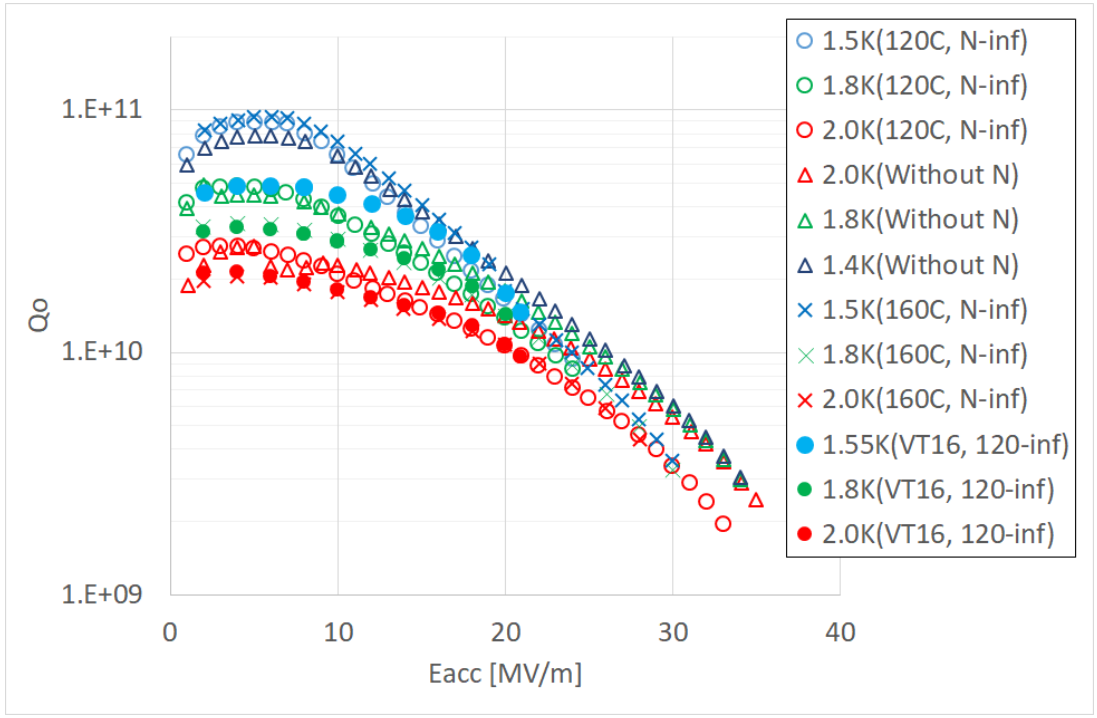
Outline

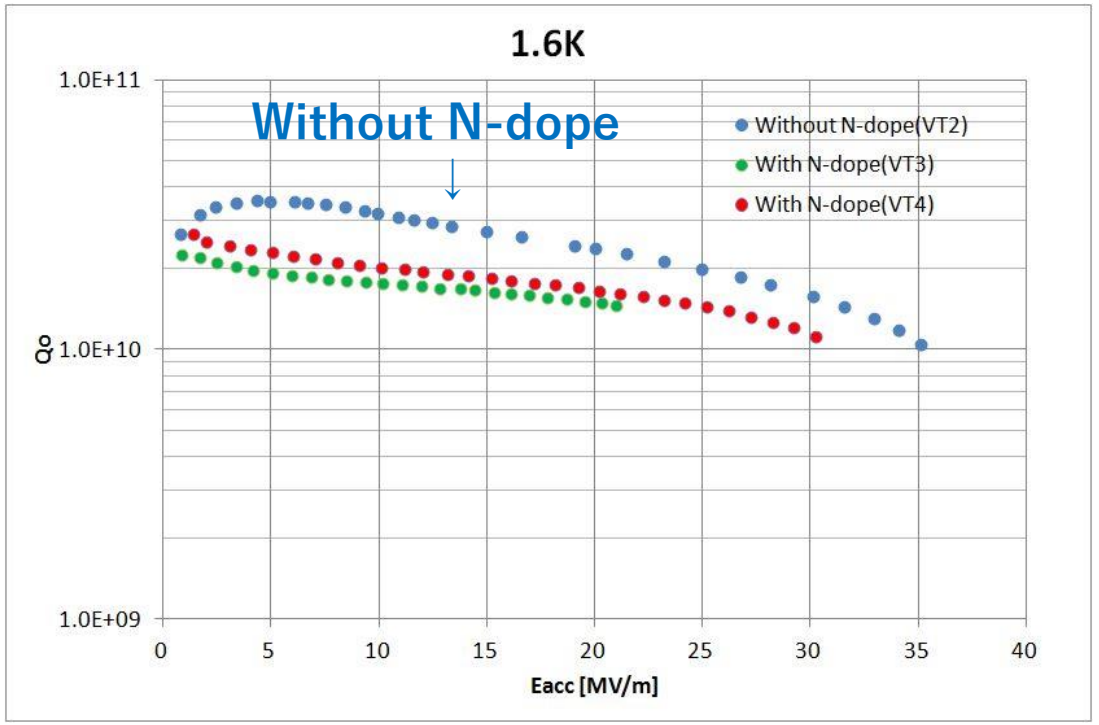
- Requirement for furnace
- Construction of furnace
- First commissioning of 800C heat treatment
- Summary and future

Example of bad performance of N treatment

N-infusion @J-PARC furnace



N-dope @KEK (old) furnace



Degradation of Q-values above 5 MV/m.
Because of contamination from furnace??

Q-value become worse.
EP or magnetic field cancelling can not help.

Oil-free clean furnace is essential!!!

KEK just built a new furnace for N-infusion/N-dope.

Requirement for furnace

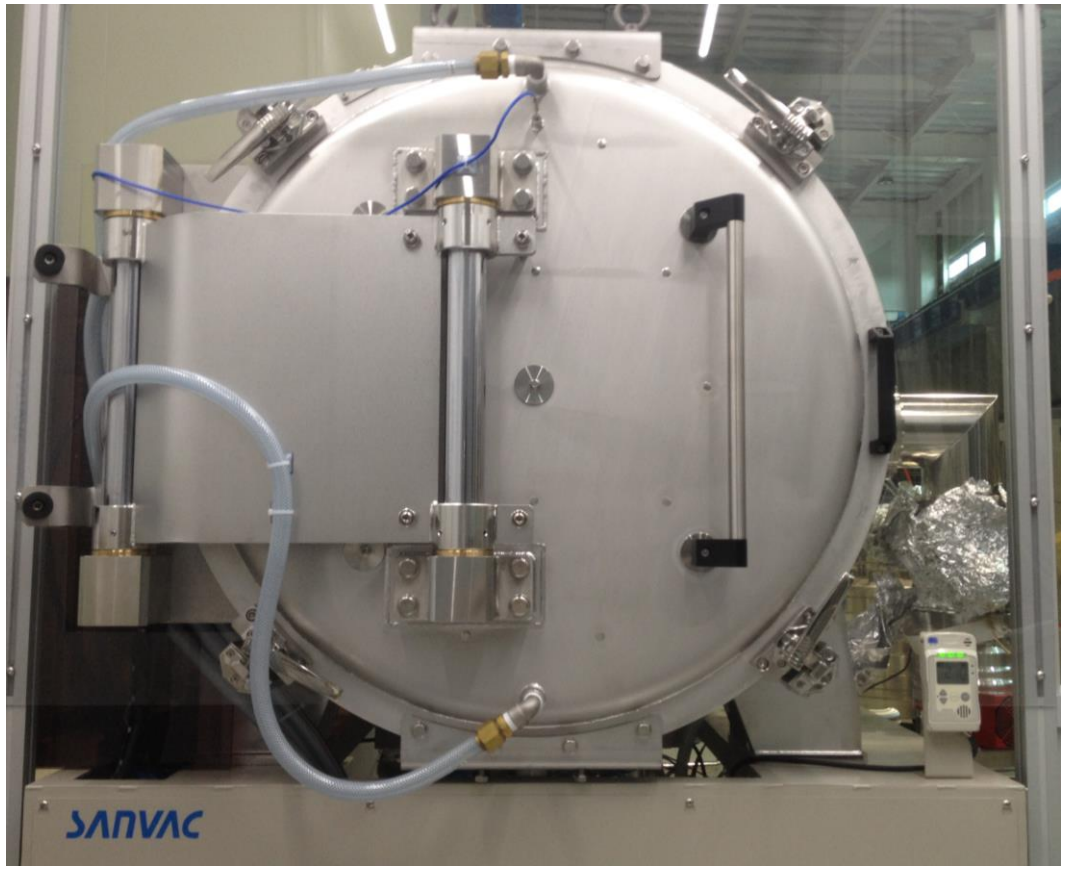
What is “clean furnace”?

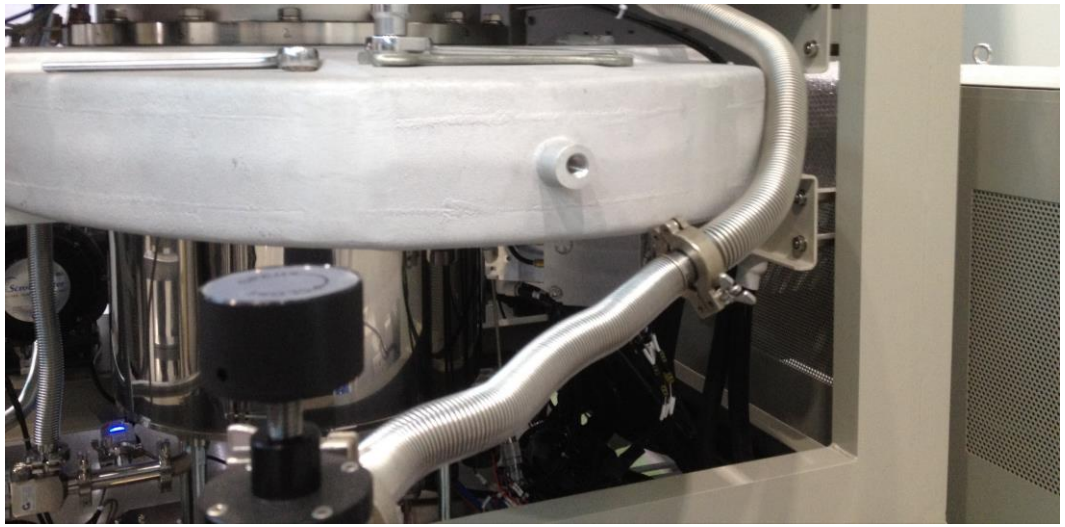
⇒ **Excellent reachable vacuum pressure**

⇒ **Less contamination, especially from Carbon**

- **All heaters and reflectors(6 layers) are made of Mo.**
- **Clean and less material inside furnace.**
- **Main pump is cryo-pump.**
- **TMP can be used during N-injection.**
- **Target vacuum pressure**
  - **RT:1e-6 Pa, 600C: 1e-5 Pa, 1000C: 1e-4 Pa**
- **Furnace is built in clean-booth.**

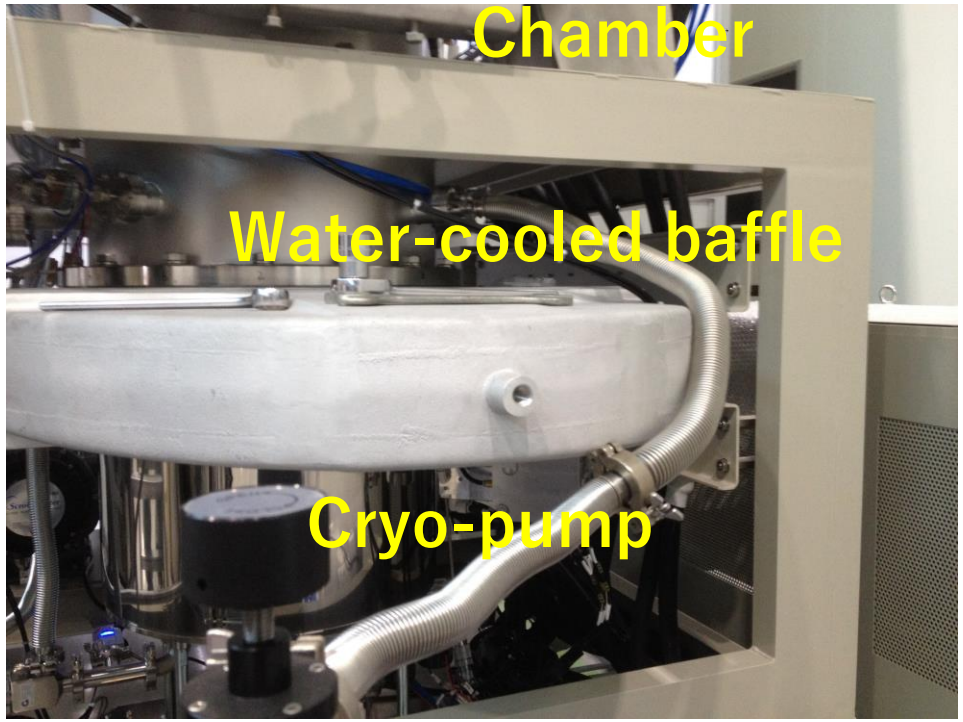
Construction of new furnace

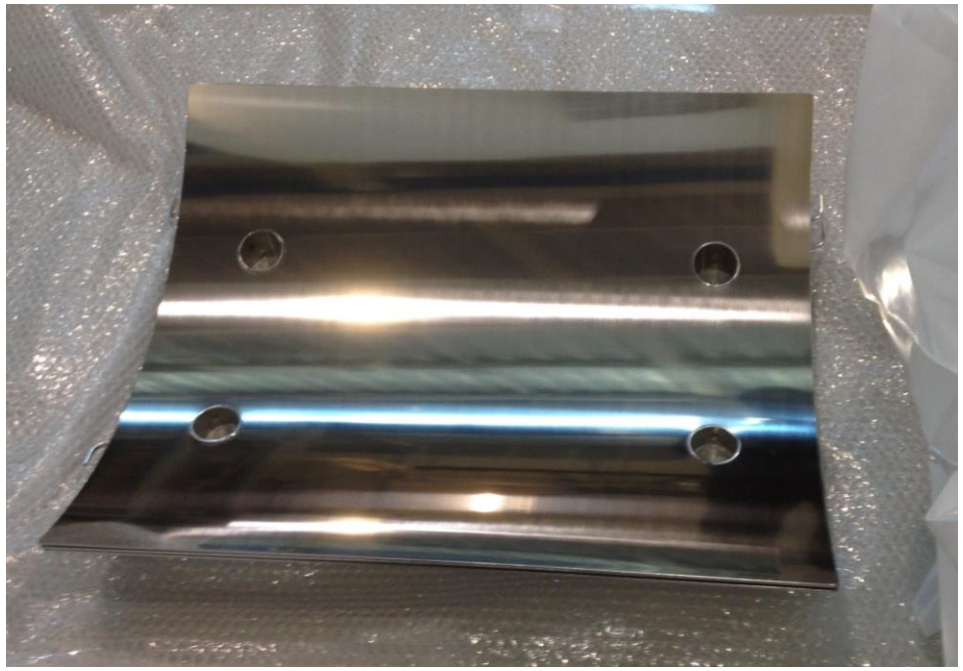


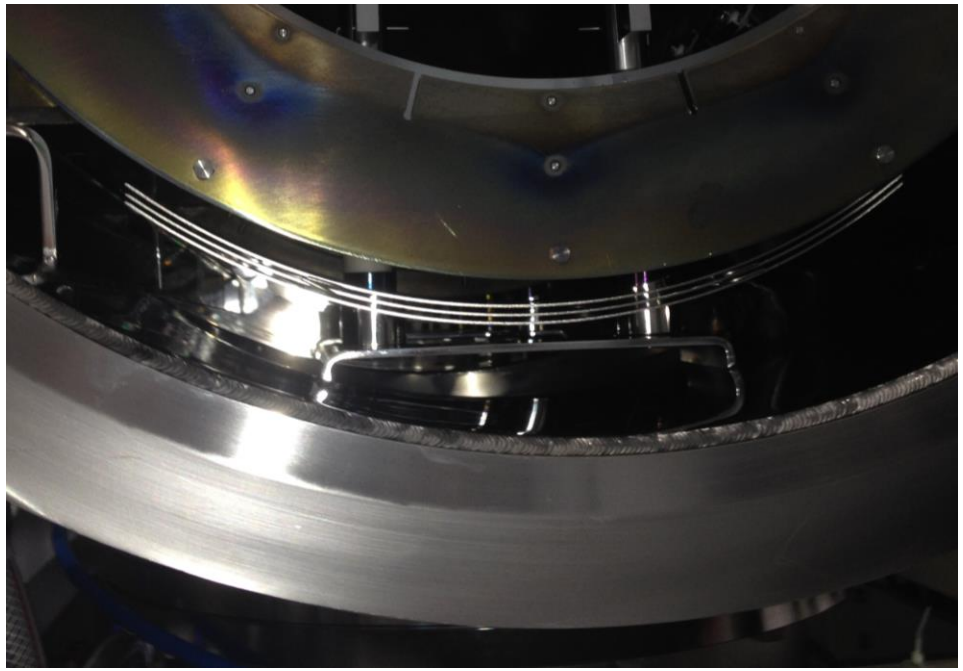


Completed at the end of last fiscal year

Problem and modification

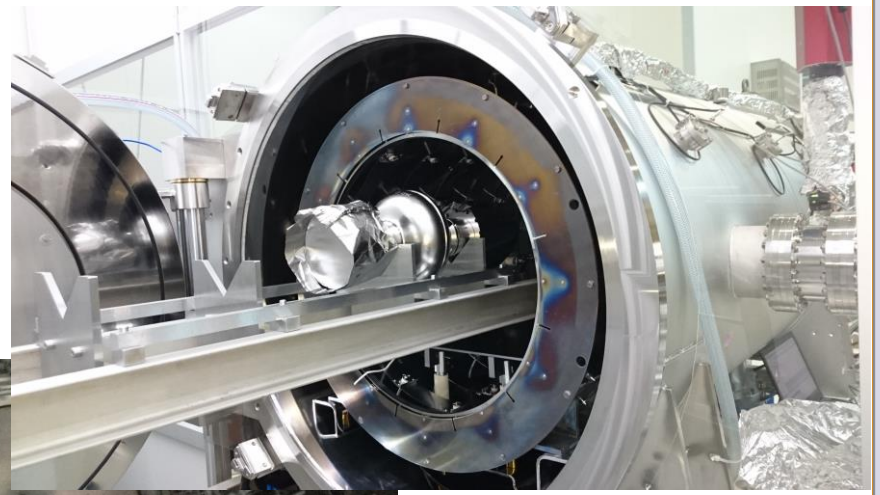


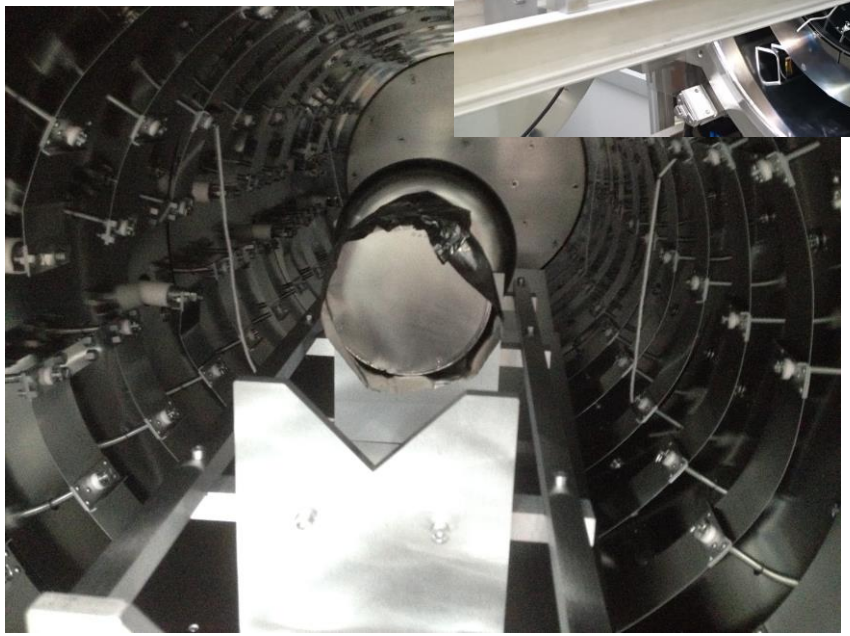


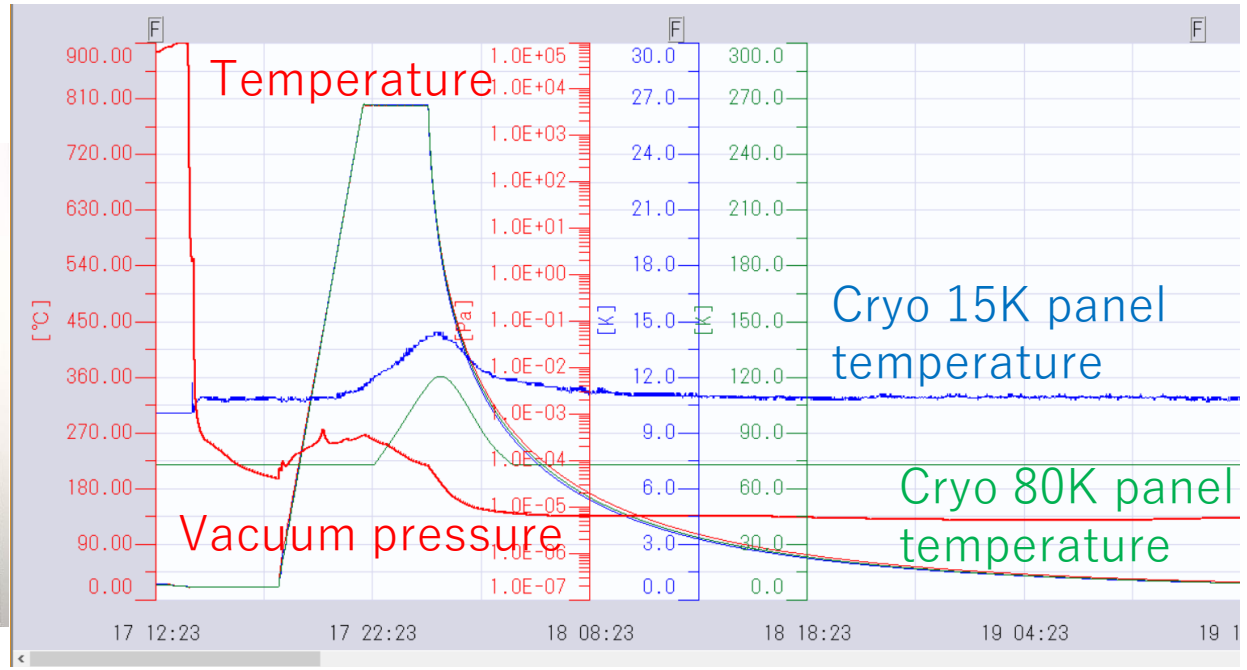


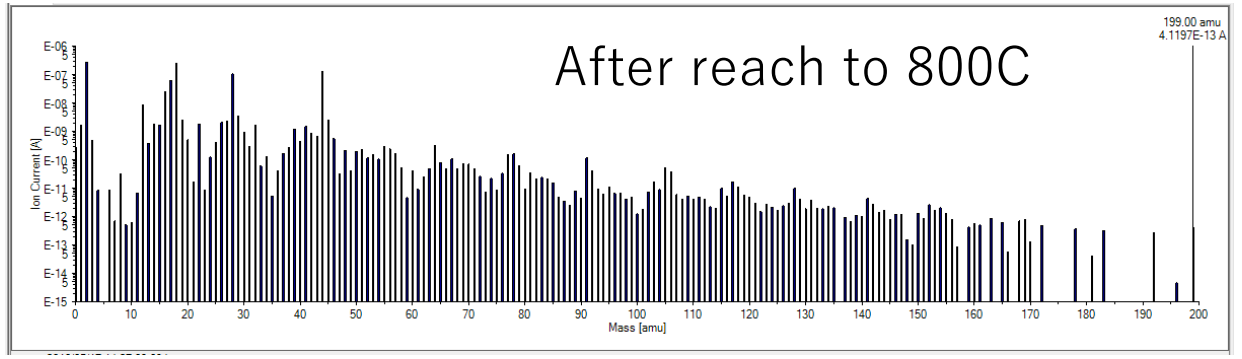
- Cryo-pump sits just bottom of vacuum chamber.
  ⇒ save space, material, cost…
- Temperature rise of cryo-pump during heat treatment.
- Added 3 layers of additional local reflector.
  ⇒ Now 800C operation is possible.

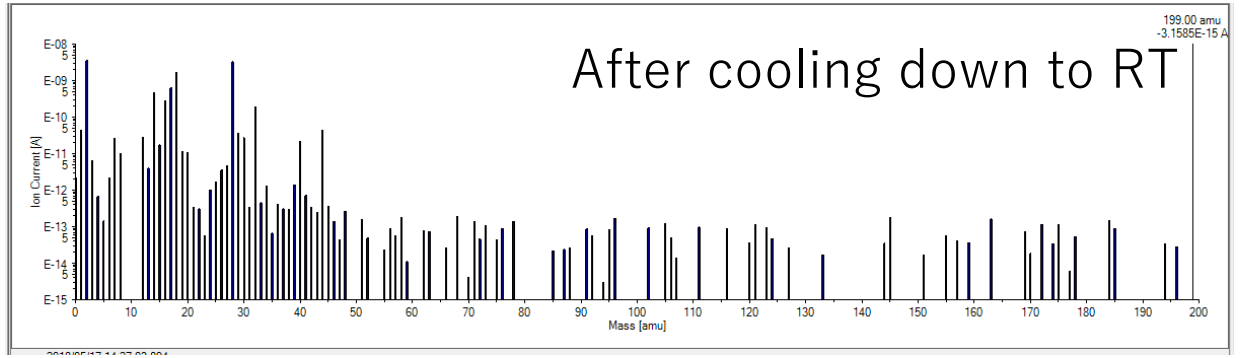
800C heat treatment test with cavity







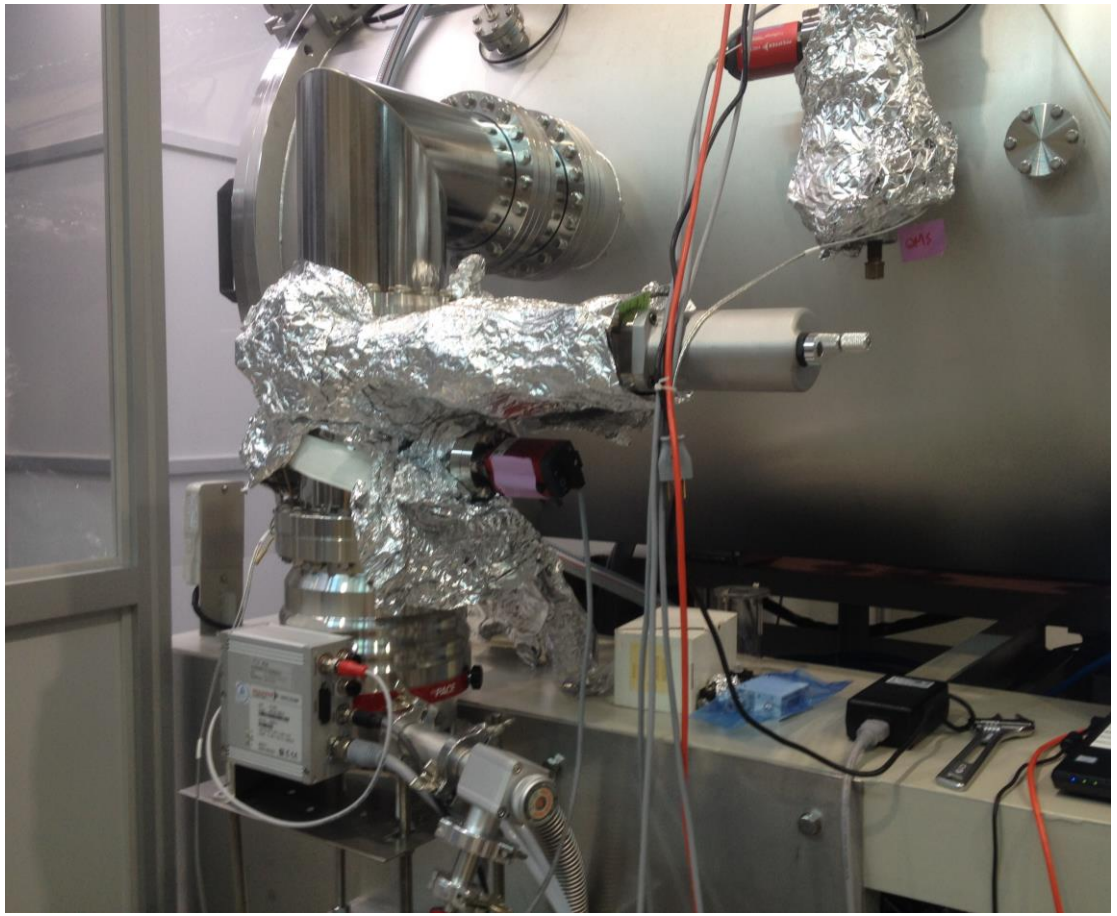


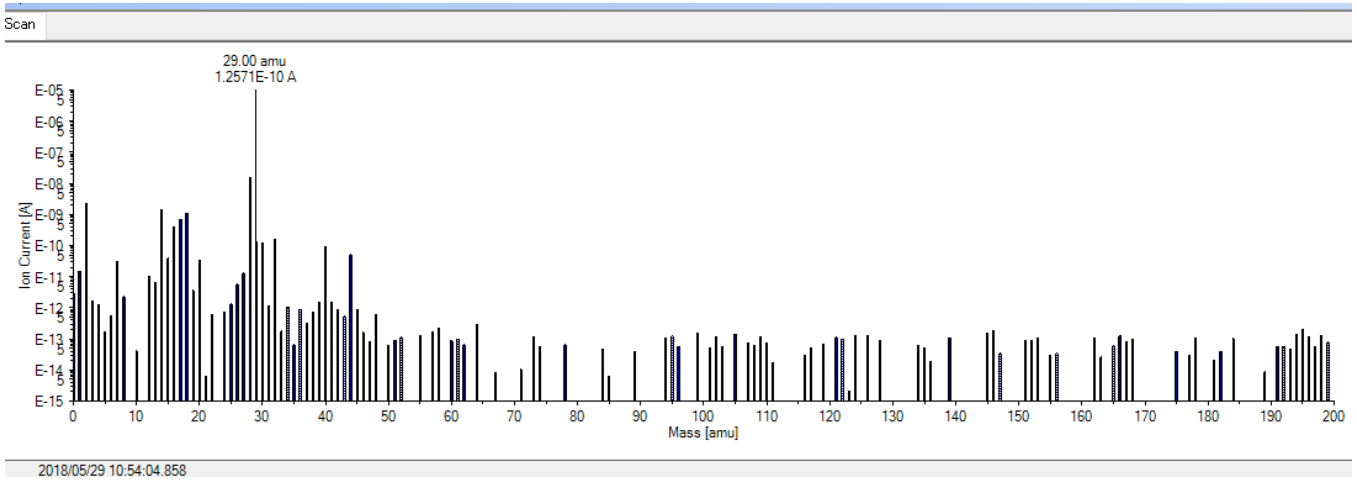


First test was just carried out.

After HPR &assembly, cavity performance will be tested tomorrow, to check cleanness of the furnace.

Condition for N-injection





- TMP(700 litter/sec) can be used during N-injection.
- 2~3e-5 Pa can be reached.

  ⇒Background during N-injection
- ~3Pa can be kept while pumping by this TMP.

Summary and future plan

- New furnace was designed and constructed at KEK.
- Its pumping system is oil-free and main pump is a cryo-pump.
- First heat treatment at 800C was just tested.

- Next week, we will carry out first N-infusion trial.

  ⇒ Strongly wish a success
- Then, we will perform systematic study to optimize parameters for N-infusion / N-dope.
- Optimize N-infusion procedure for 9-cell cavities.