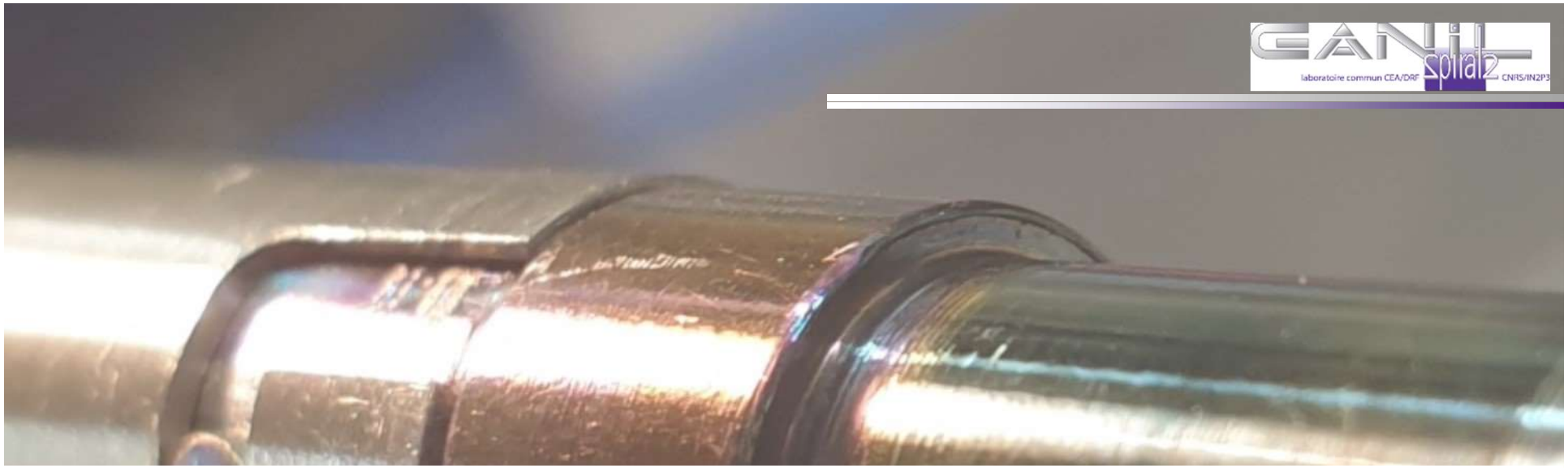
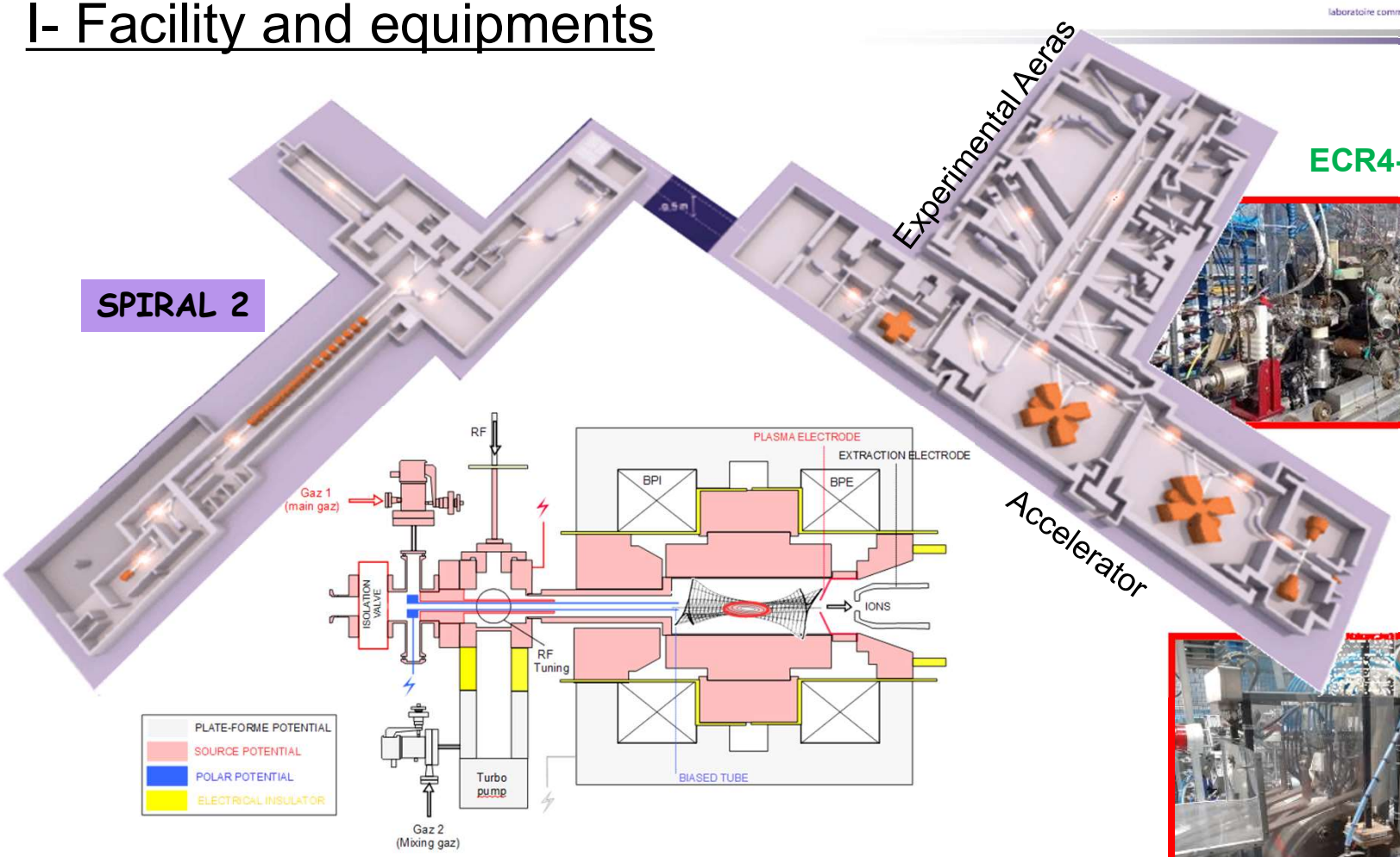


New stable beam developments

F.Lemagnen and GCS team

Summary:

I- Facility and equipments



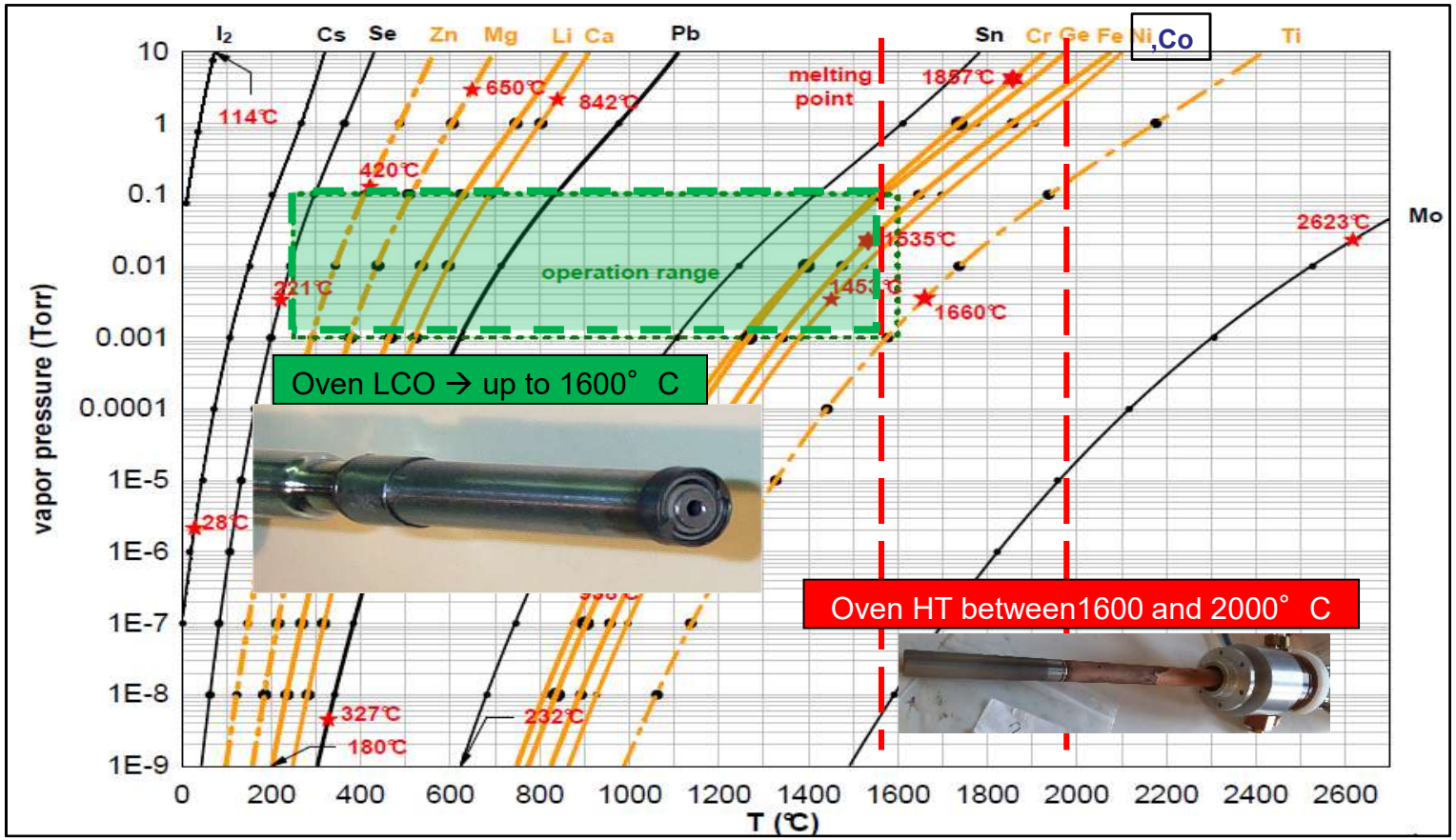
ECR4-M

ECR4

ECR4 ion source : platform 100kV
ECR4-M ion source : 25KV

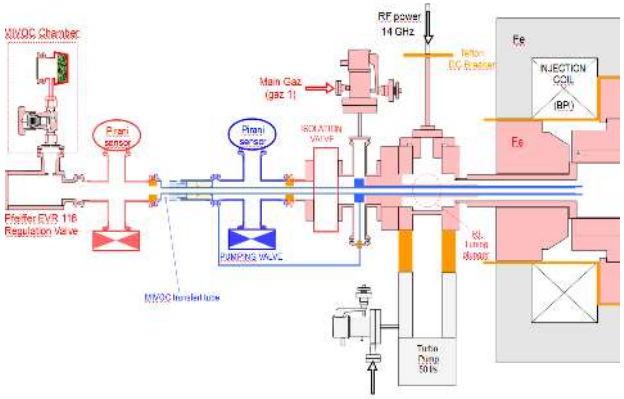
Tests beams production in parallele of experiments
→ tests 24/24H

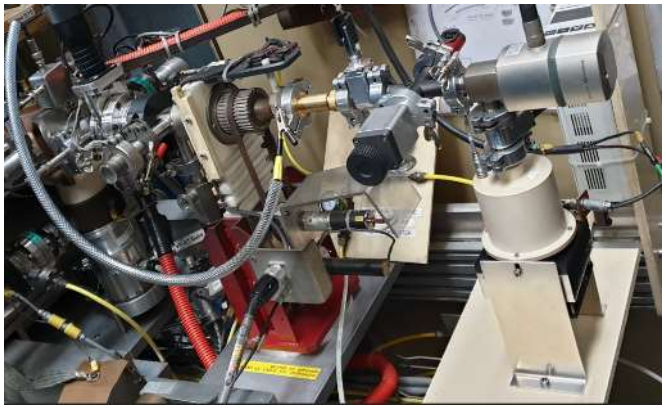
Oven method



- A lot of isotopically enriched elements are evaporated by oven (oxyde and metallic form)
- Control of evaporation
- High charges states can be optimized

MIVOC method





equipment to inject organometallic compound

Metallic beams with MIVOC:

Ni, Fe, Mg, Cr, Ti

For natural elements : Several Commercial compounds can be found.

R&D to obtain synthesis with the isotopically enriched element.
=> B.GALL's team IPHC- Strasbourg

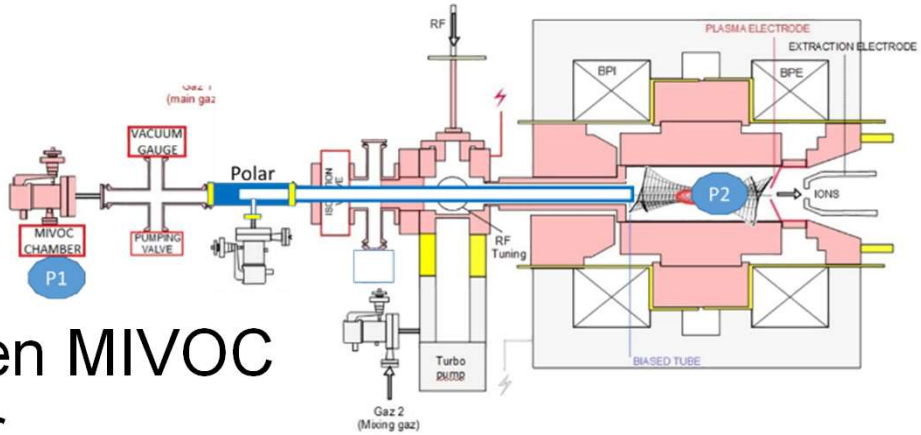
Several syntheses could be developped to replace the evaporation of element with high vapor pressure (difficulties of evaporation control with oven)

In progress: synthesis of Uranocene
First test in March 2022 without success
Second test in 2023

Upgrade of MIVOC system (2021-2022)

Goal:

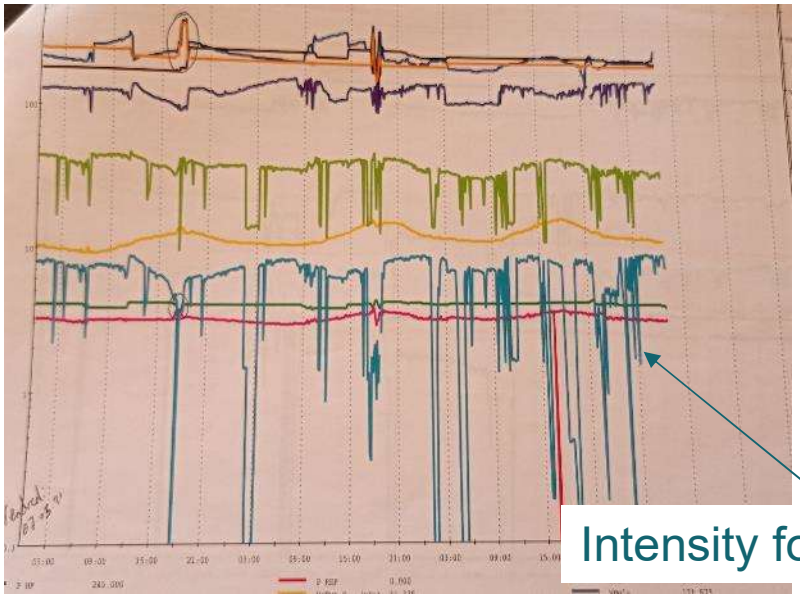
⇒ Optimization of regulation
⇒ Increase conductance between MIVOC chamber and plasma chamber
⇒ Design to stop the insulator metalization

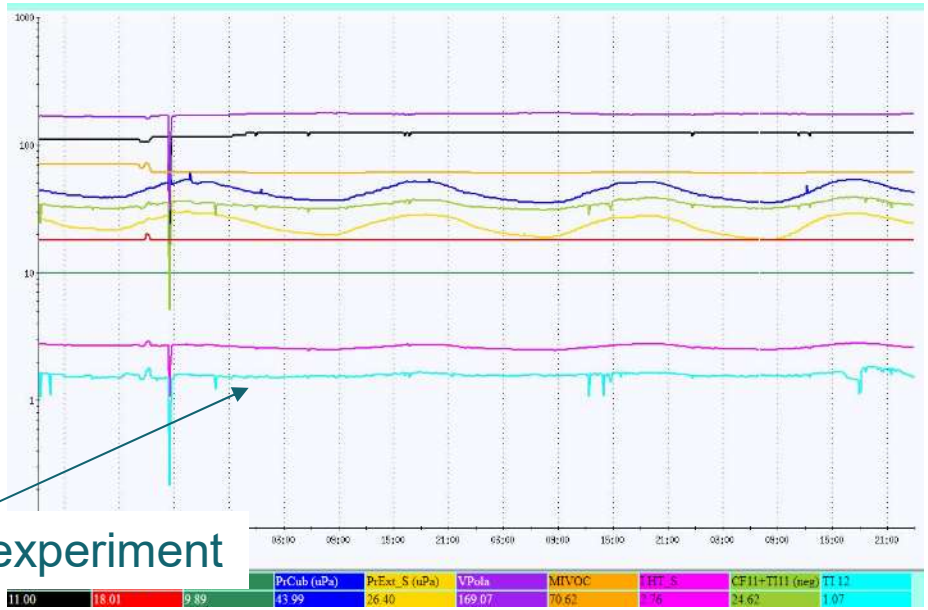


RUN with $^{58}Ni^{11+}$:
20 e.µA for 31UT with better stability

Upgrade of MIVOC system (2021-2022)

Results for 4 days before and after upgrade with $^{58}Ni^{11+}$





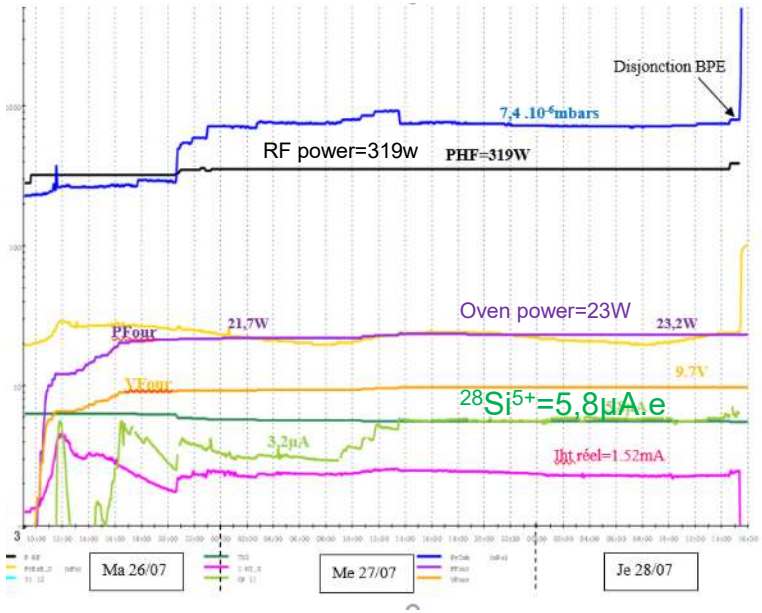
Intensity for experiment

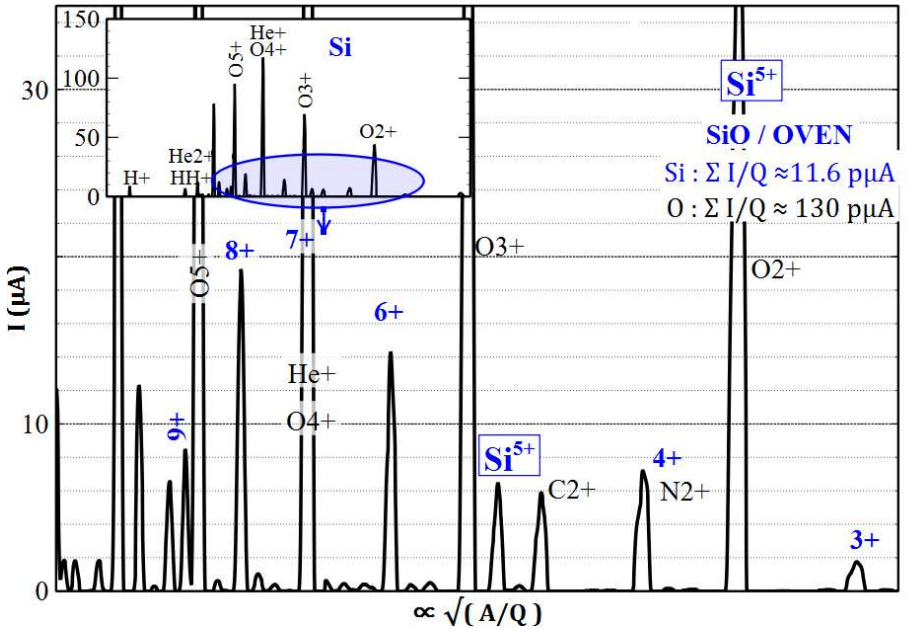
2021

2022

⇒ Intensity a little bit higher (20e.µA compare to 15e.µA)
⇒ More stable beam
⇒ Reduce tuning interventions along the experiment

II- Silicon beam production





Compound: SiO natural
Vapor pressure : 10^{-2} mbars for 1080° C
Interest of using: Several isotopicaly enriched samples with this compound (^{30}SiO, ^{29}SiO)

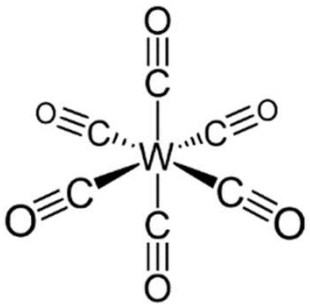
Consumption: 0,59mg/h of Si (0,89mg/h of SiO)
Efficiency: 6%

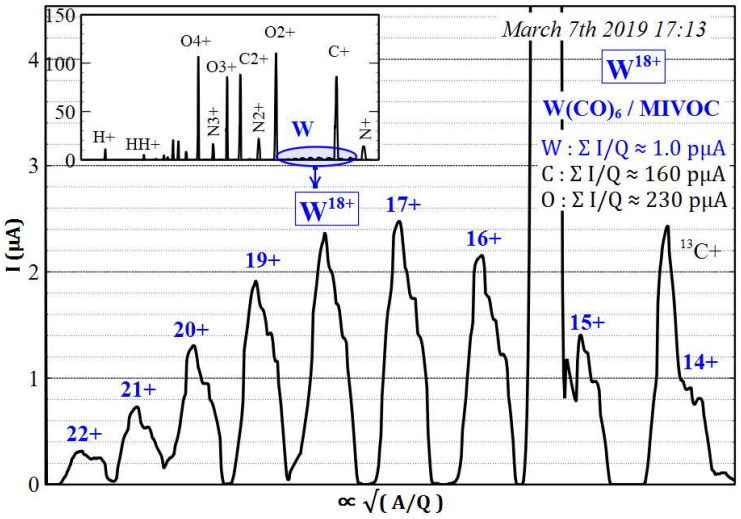
Example of beams available for physics

^{28}Si $^{7/14+}$ at 95 MeV/A→ 0,4 p.µA on the target
^{30}Si $^{7/14+}$ at 85 MeV/A→ 0,4 p.µA on the target

III-Tungsten beam production

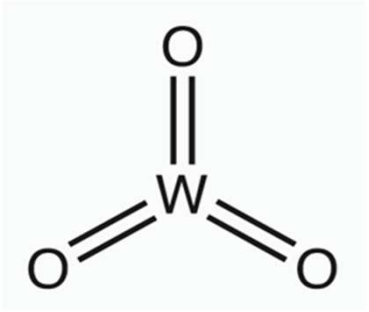
Compound: tungsten hexacarbonyl $W(CO)_6$

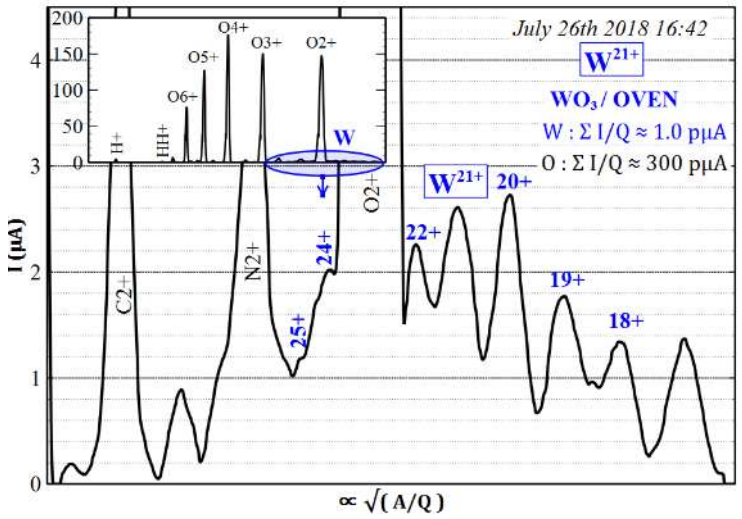




Consumption: 0,49mg/h of W (0,97mg/h of $W(CO)_6$)
Efficiency: 4,9%
$^{186}W^{20+}$ =1.4e.μA (in the faraday cup after source)

Compound: tungsten trioxide- WO_3 natural
Vapor pressure : 10^{-2} mbars for 1176° C

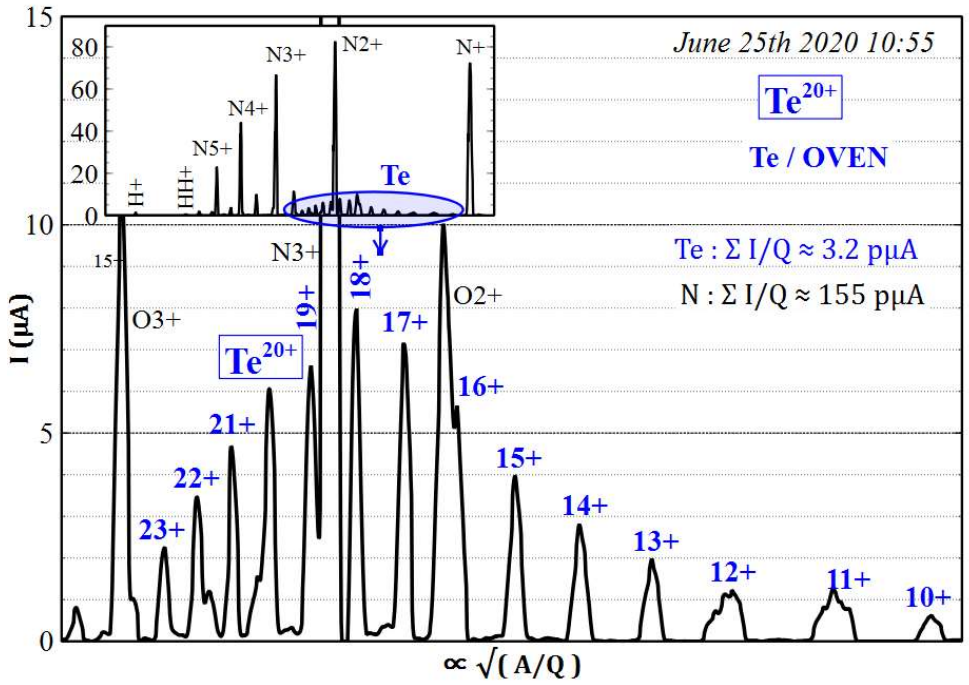


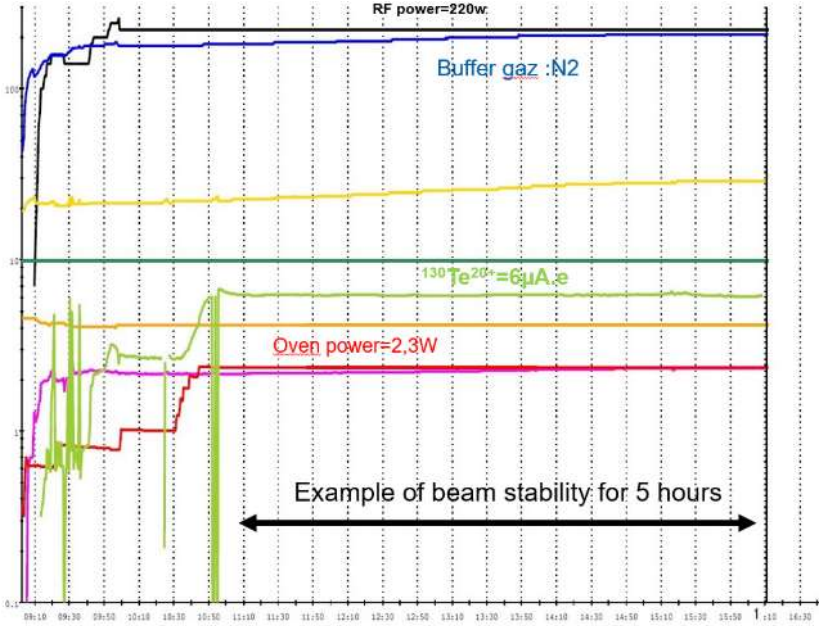


Consumption: 3,5 mg/h of W (4,5mg/h of WO_3
Efficiency: 1,4%
$^{186}W^{20+}$ =2.8e.μA (in the faraday cup after source)

$^{186}W^{24+}$ at 6 MeV/A→ 11p.nA on the target

IV-Tellurium beam production





Compound: ^{130}Te (99,8% enriched sample)

Vapor pressure : 10^{-2} mbar for 360° C

Melting point: 452° C

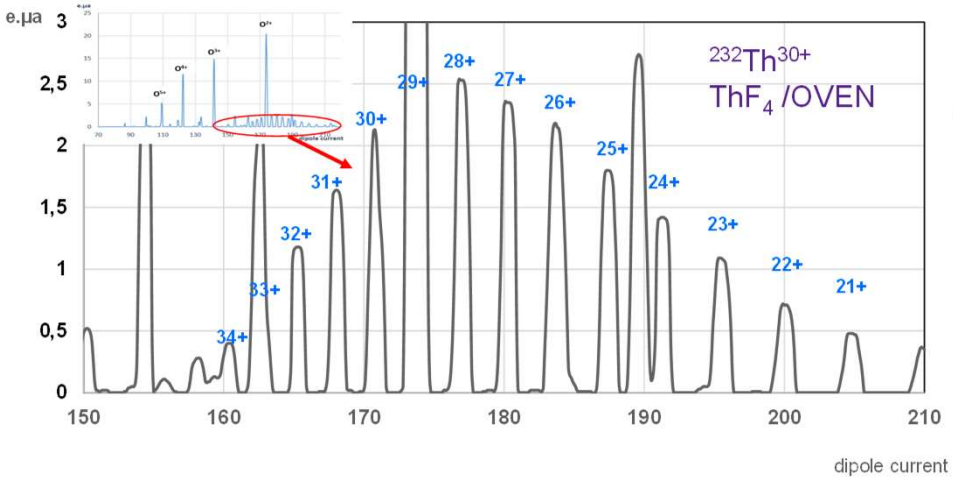
Consumption: 0,52mg/h of ^{130}Te

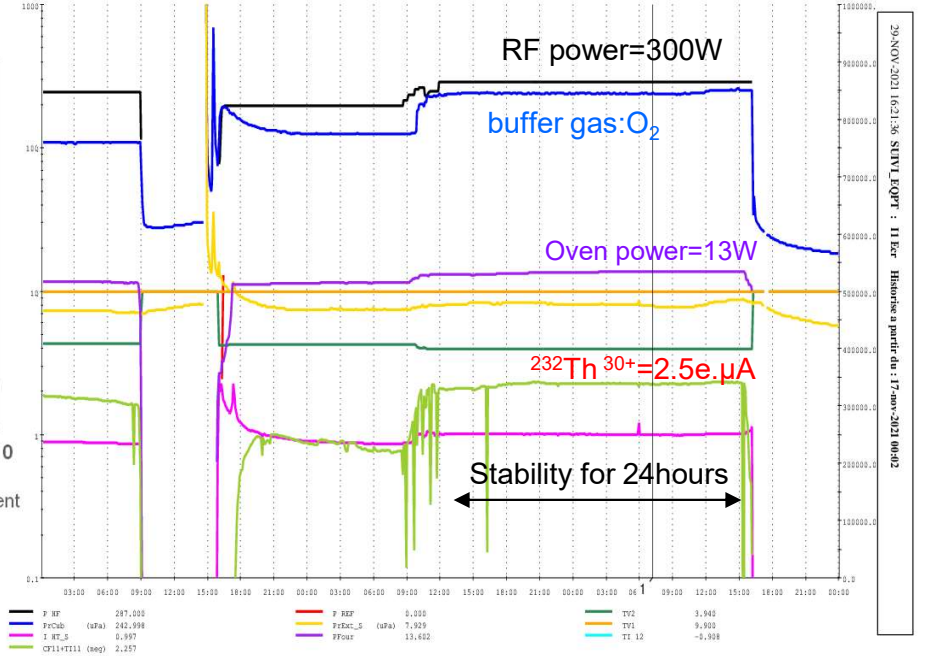
Efficiency: 7,5%

$^{130}Te^{20+}$=6e.μA (on the faraday cup after ion source)

$^{130}Te^{19+}$ at 8 MeV/A→ 50p.nA on the target

V-Thorium beam production





Compound: $^{232}ThF_4$
Vapor pressure : 10^{-2} mbar for 950° C
Melting point: 1100° C

Consumption: 0,1mg/h of ^{232}Th
Efficiency: 8%

- VAMOS experiment proposal:

$^{232}Th^{30+}$ at 6,1MeV/A→ 12p.nA on the target

- An other example of intensity

$^{232}Th^{34+}$ at 8MeV/A→ 2p.nA on the target

VI- The first beam tests with HT OVEN

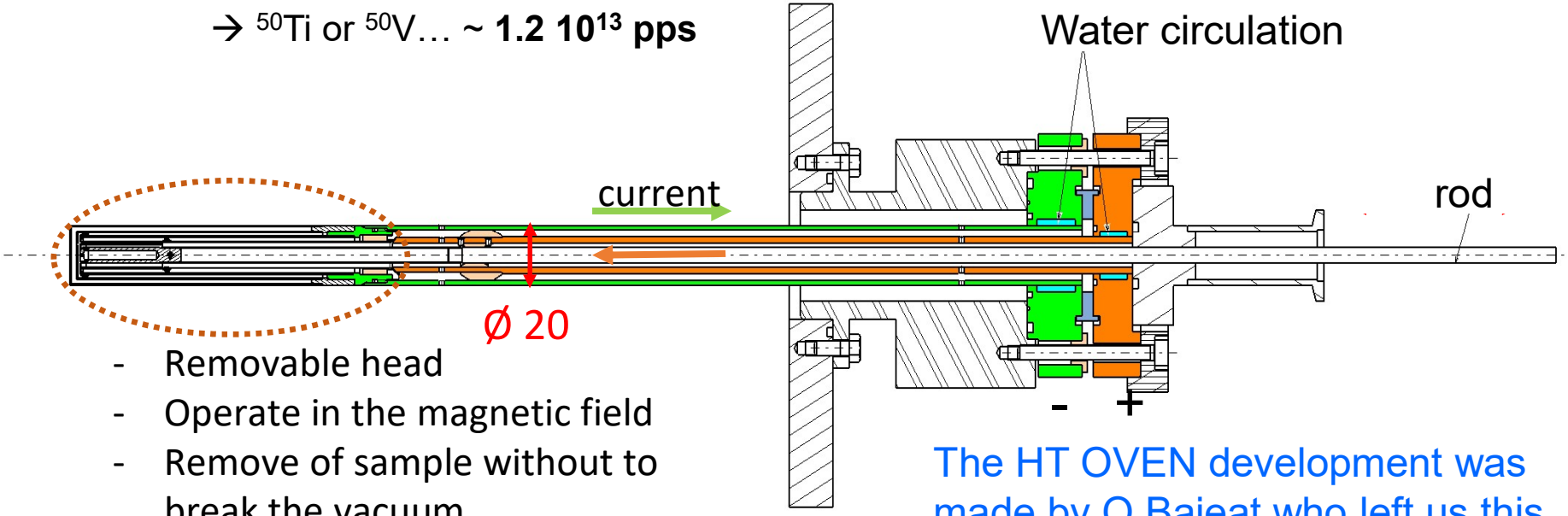
The goal of HT oven development

✓ For Ganil-Cyclotrons in ECR4 source:

→ increasing metallic beams intensities which are produced today by sputtering method (^{238}U, ^{181}Ta, ….)

✓ For Spiral 2 in ***Phoenix V3**** ECR IS:

→ ^{50}Ti or ^{50}V… ~ **$1.2\ 10^{13}$ pps**

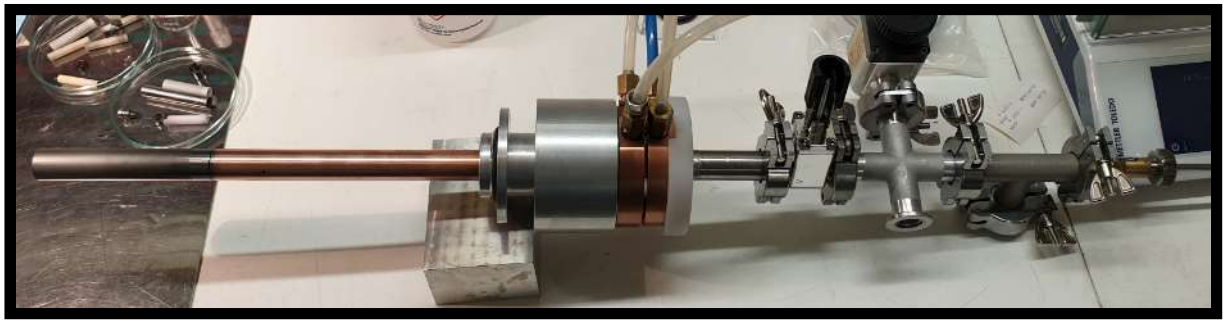


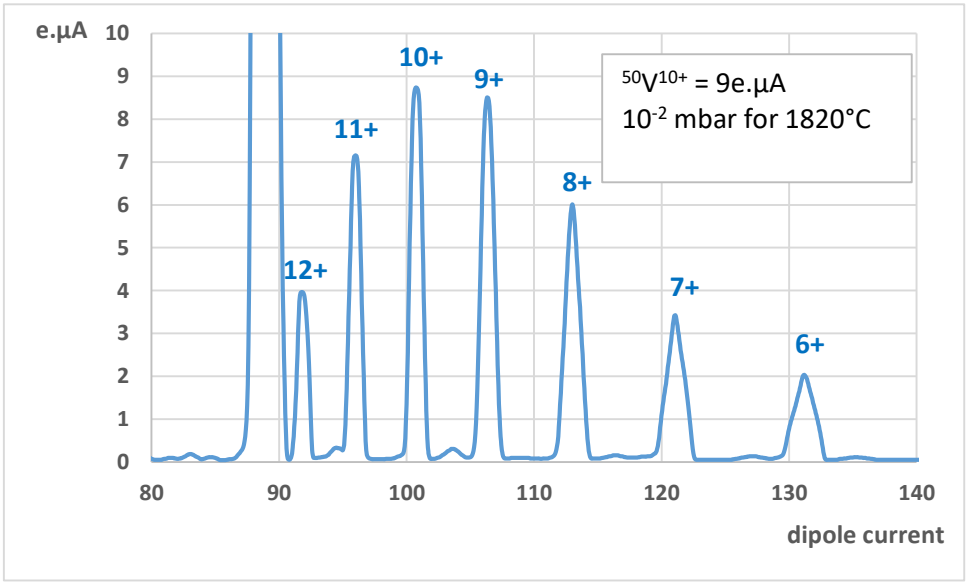
- Removable head
- Operate in the magnetic field
- Remove of sample without to break the vacuum

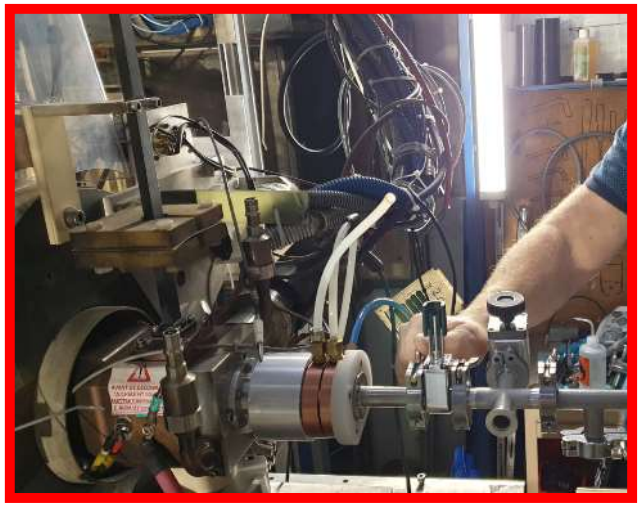
The HT OVEN development was made by O.Bajeat who left us this year.

developed by **LPSC (Grenoble)*

Test of vanadium in ECR4-M ion source

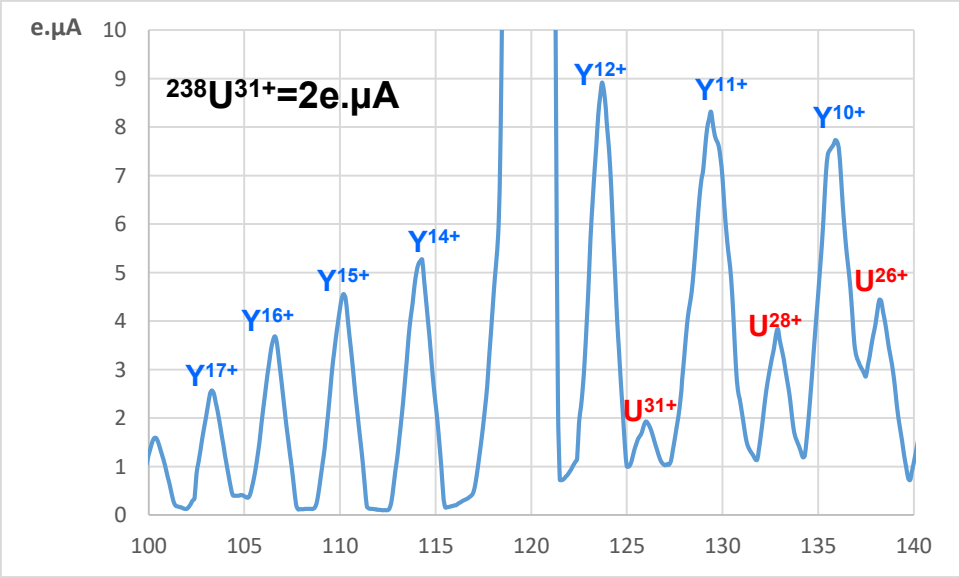


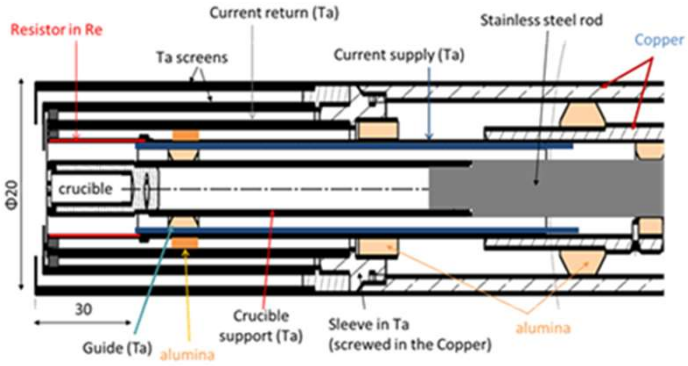




- 4 days of continue running with V and 25 days total operation in 2021
- Oven validated to evaporate Uranium

Test of uranium in ECR4-M ion source





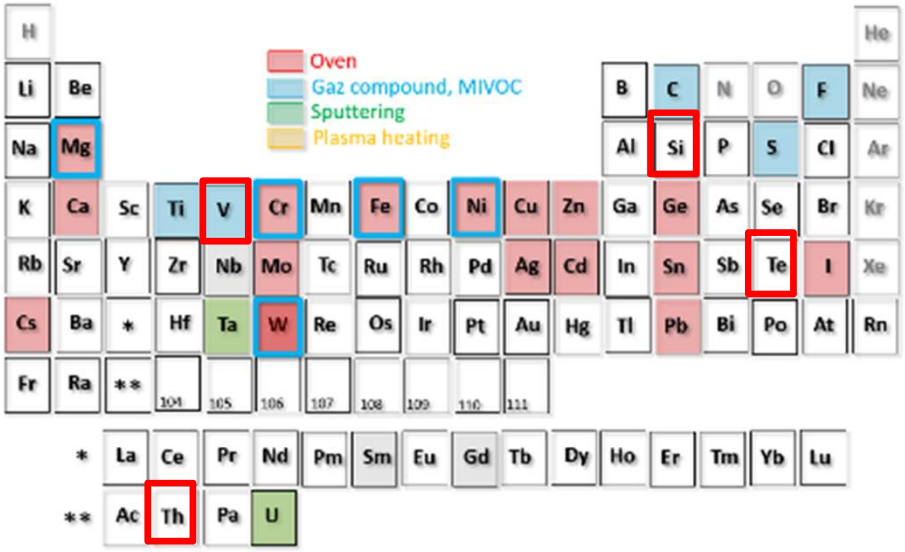
- Choice of crucible :Y_2O_3 for compatibility with ^{238}U

- Yttrium pollution due to evaporation of crucible
- Intensity of Uranium interesting despite the pollution and the lower of ion source ‘s perform (modification of RF injection with HT oven)
- Next test with UO_2

V-Conclusion

- Four new ions beams availables (Si, W, Te, Th)

- Carbonyl compounds: New way to produce other metallic elements.
- News organometallic syntheses could be developped depending of physics request.
- HT oven up to 2000° C is a successful and useable for operation



Thank you for you attention!