

# Target Developments

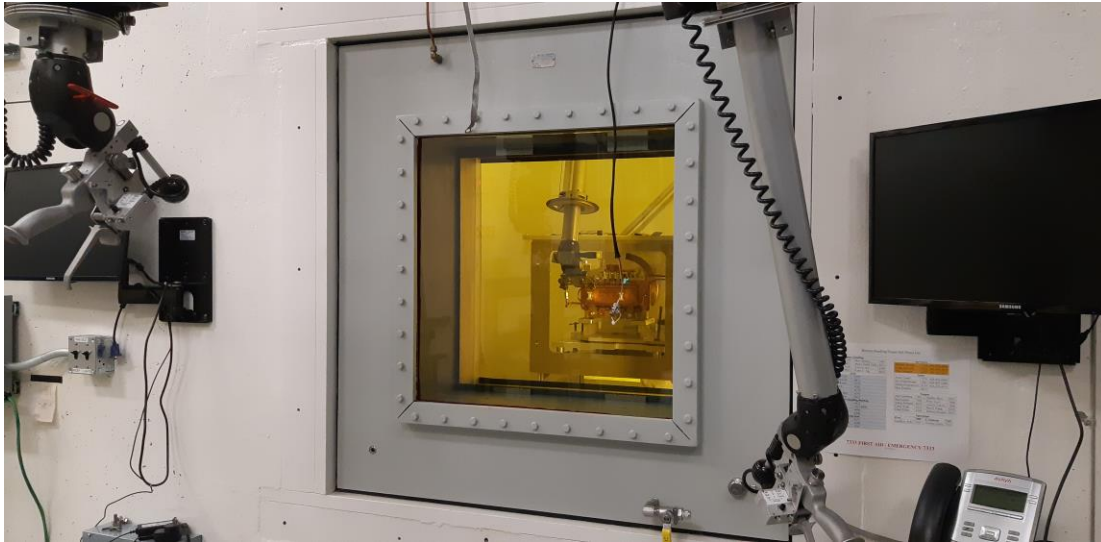
ISAC Strategy Workshop

Nov. 8 2019

# Outline

- Infrastructure developments
- Process developments
- Beam production developments
- Summary and priorities

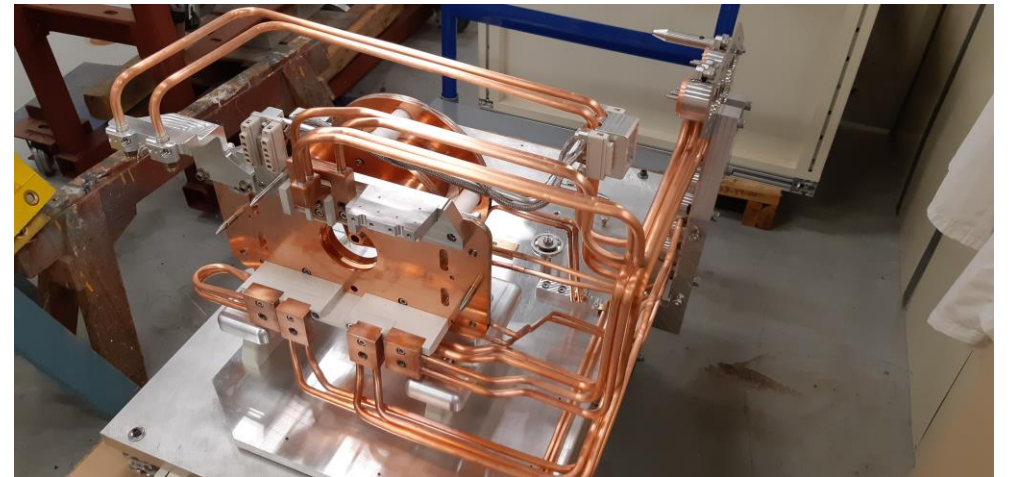
# Recent Infrastructure Developments



North Hot Cell

- NHC and SMP completed, making our refurbishment plans possible

- Upgrades to and replacement of TM2/4 source trays to increase HV performance and reliability



TM4 Source Tray

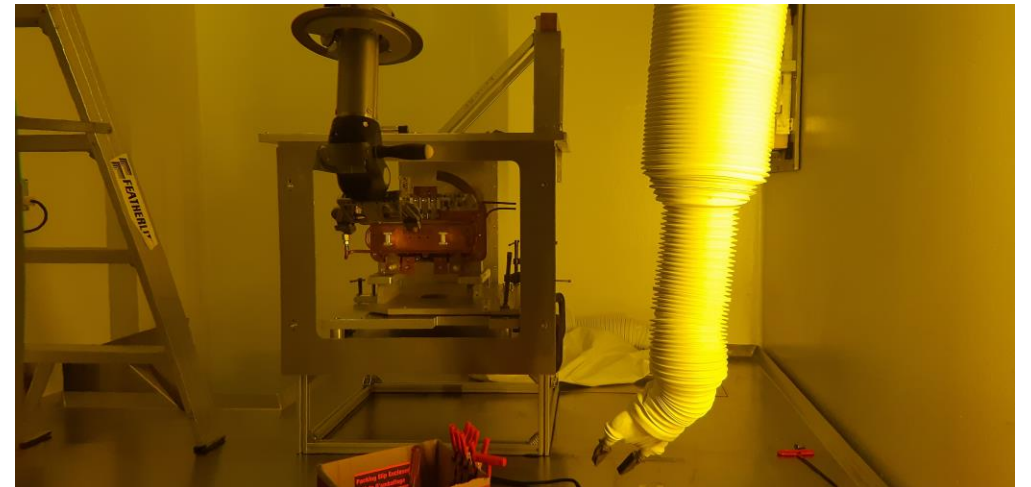
# Recent Infrastructure Developments



CHI stand

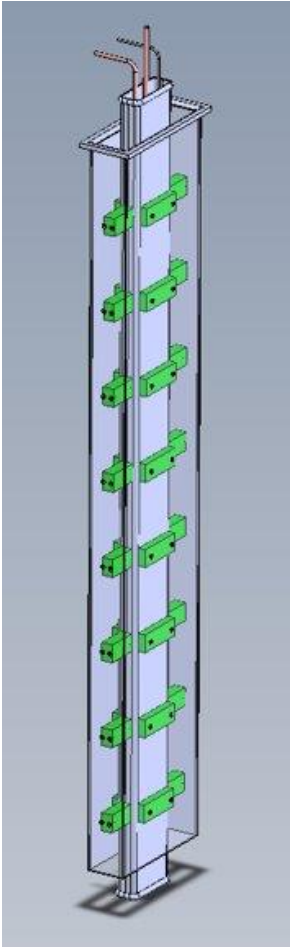
- CHI stand being built to test thermal conductivity and diffusion of elements in UCx material

- Source tray mockup built to test hot cell procedures, reducing uncertainty in new processes



Source Tray Mockup in NHC

# Ongoing Infrastructure Developments

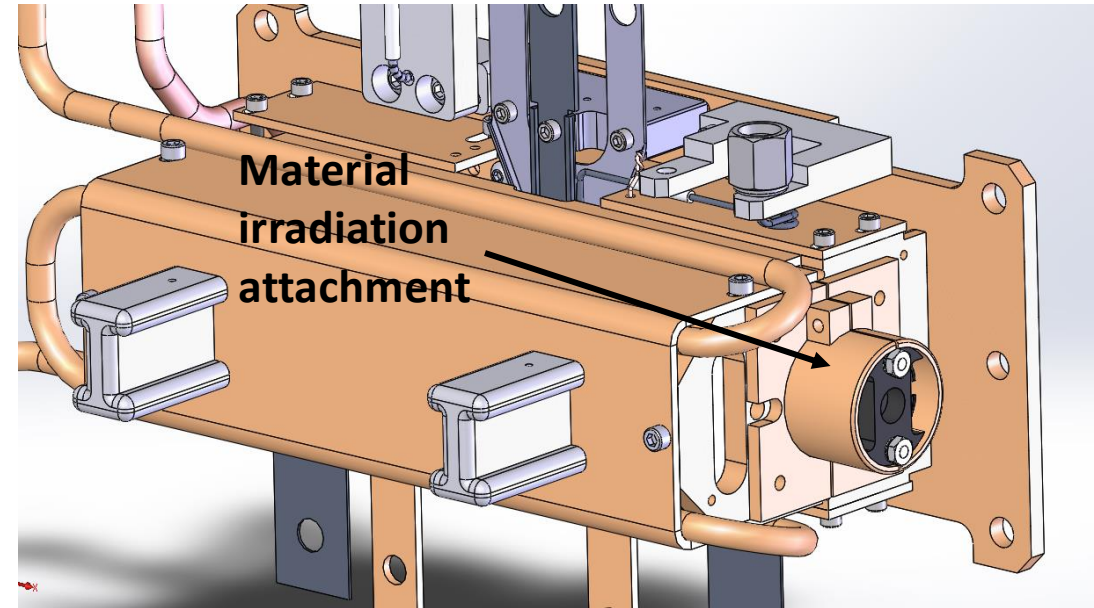


TM3 service  
tray concept

- TM3 refurbishment project to fix HV issues and water leaks
- Factory model for pieces that fail frequently has begun, meaning they are replaced regularly and there are always spares
- Extension of rotating beam to both target stations
- Waste disposal plans need to be developed for large components

# Ongoing Infrastructure Developments




- Use ISAC modules to investigate effects of radiation on materials as part of a collaboration and for use in our modules (ISAC & ARIEL)
- Upgrades to allow all ion sources to run on all target modules are ongoing





Material irradiation assembly on current ISAC target

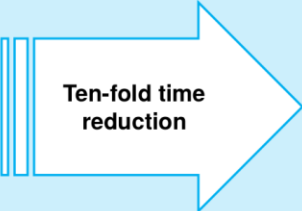
# Recent Process Developments

- 1-step UC<sub>x</sub> process developed and successfully established online, making it possible to meet ARIEL demands and increasing the UC<sub>x</sub> targets available at ISAC

| Previous UC <sub>x</sub> method | Synthesis of UC <sub>2</sub>  |  | Target conditioning   |  |  | 10 weeks |
|---------------------------------|---|--|---|--|--|----------|
|                                 | Casting UO <sub>2</sub> /C<br><br>4 days | Carbothermal reduction<br>5x10 <sup>-5</sup> Torr<br>30 days | Casting UC <sub>2</sub> /C<br><br>6 days | Loading target container<br><br>1 day | Conditioning<br>5x10 <sup>-5</sup> Torr<br>15 days |          |

| New UC <sub>x</sub> method | Synthesis & conditioning of target material   |  |   | 1 week |
|----------------------------|---|--|---|--------|
|                            | Casting UO <sub>2</sub> /C<br><br>4 days | Loading target container<br><br>1 day | Carbothermal reduction & conditioning<br>5x10 <sup>-1</sup> Torr<br>1 day |        |

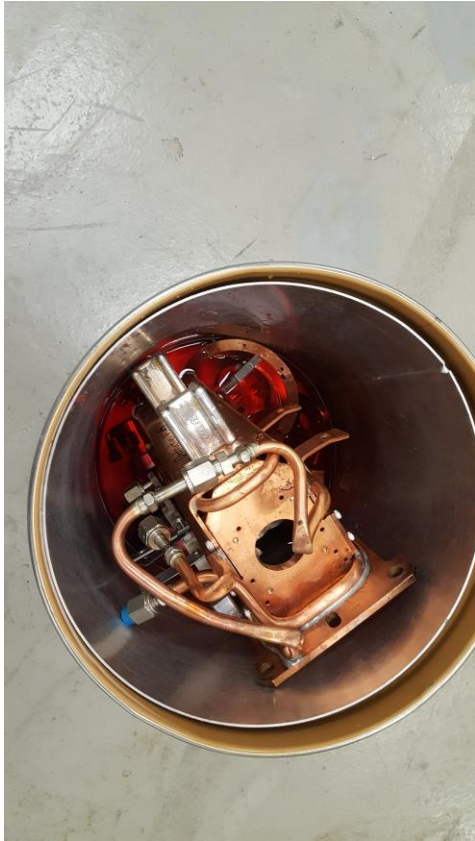

**Ten-fold time reduction**



- Quick connectors installed in target pit to speed up connection and disconnection processes

# Recent Process Developments

- Recertification of our shipping procedures using new pail design with thicker walls and an insert



New pail with insert and target assembly



New pail after drop test



# Ongoing Process Developments

- Ongoing investigations into the effects of the new graphite inserts now used on the UCx targets
- Waste disposal issue for UCx if we irradiate them at higher p+ currents



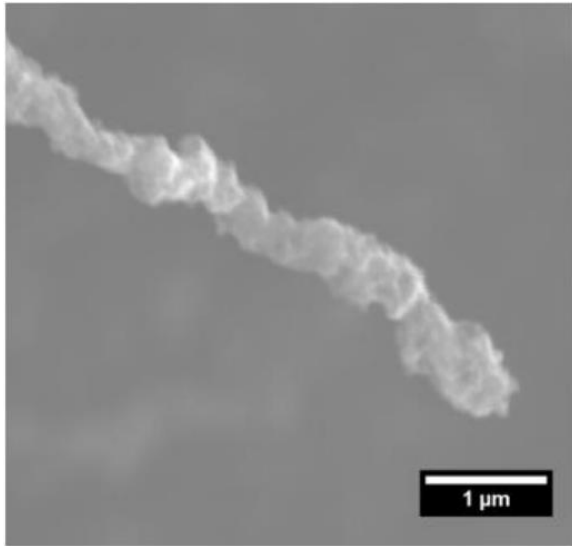
Post-irradiation inspection of a UCx target in the hot cell



Graphite insert

- Ramping up of our ability to do post-irradiation analysis and extraction of irradiated materials

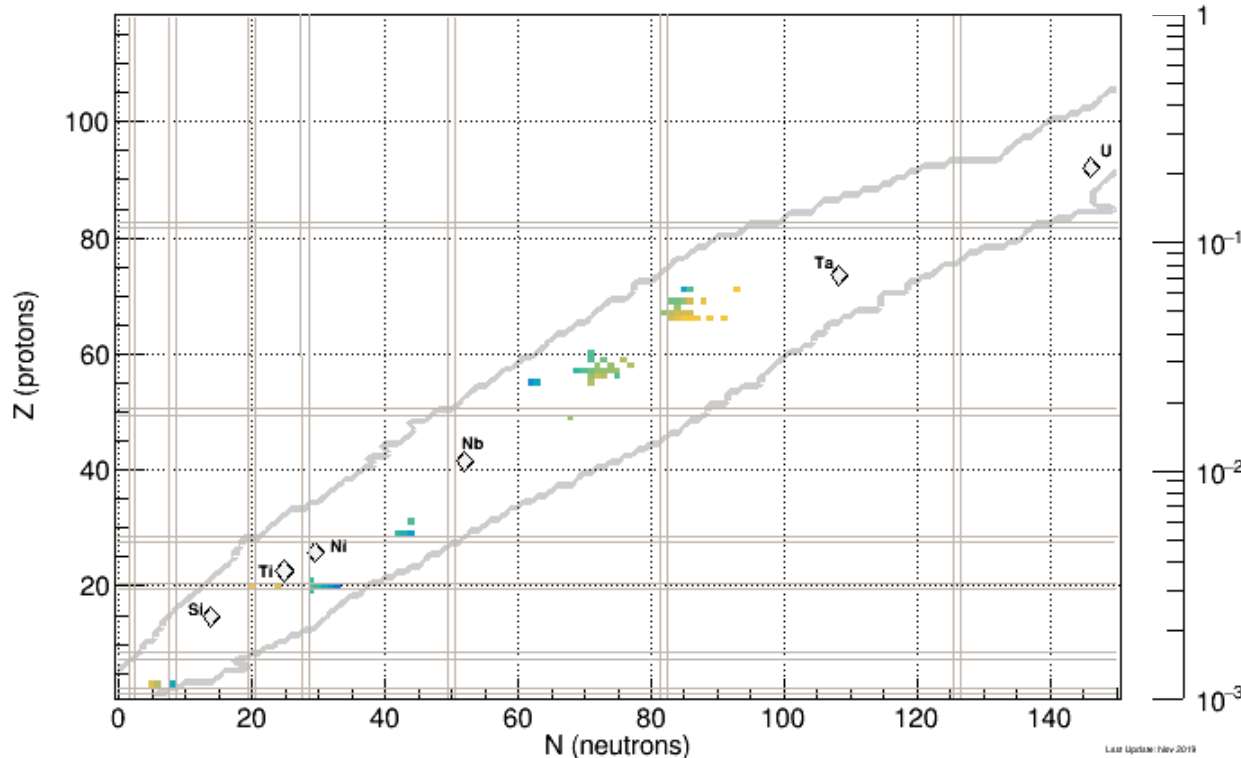
# Recent Beam Production Developments



Single SiC nanofibre under SEM

- Nano materials developed and tested online (nano-SiC)
- Cr and La beams delivered using new laser schemes
- Use of the implantation station for medical isotopes ( $^{165}\text{Er}$ ,  $^7\text{Be}$ ,  $^{155}\text{Tb}$ )

# Recent Beam Production Developments

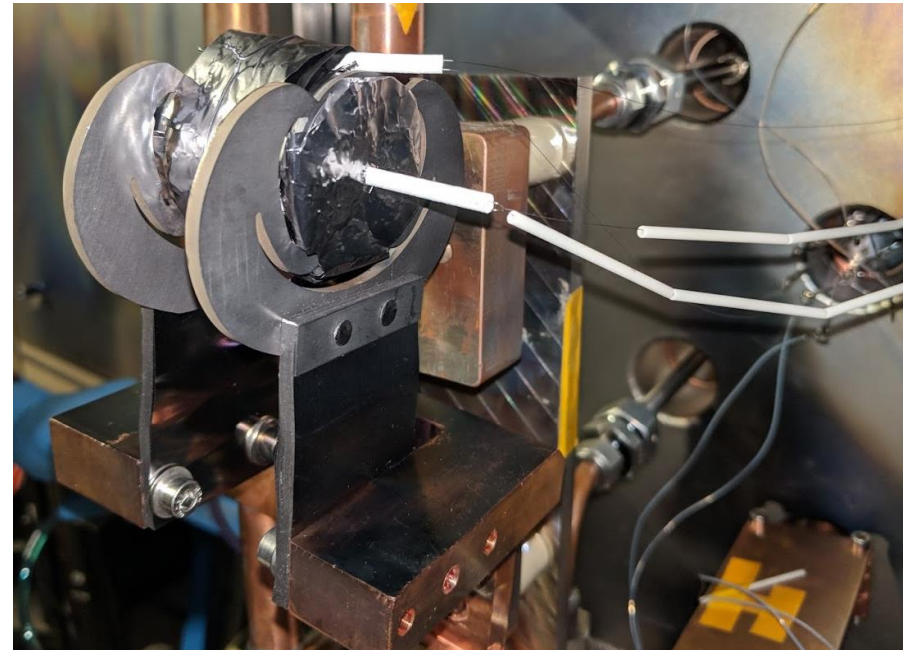


Improved yields with rotating beam

- New increased yield in lanthanide region from rotating beam
- Ongoing studies of release properties of UCx
- Additional information available on yield database (i.e. simulations with Geant4 and Fluka)

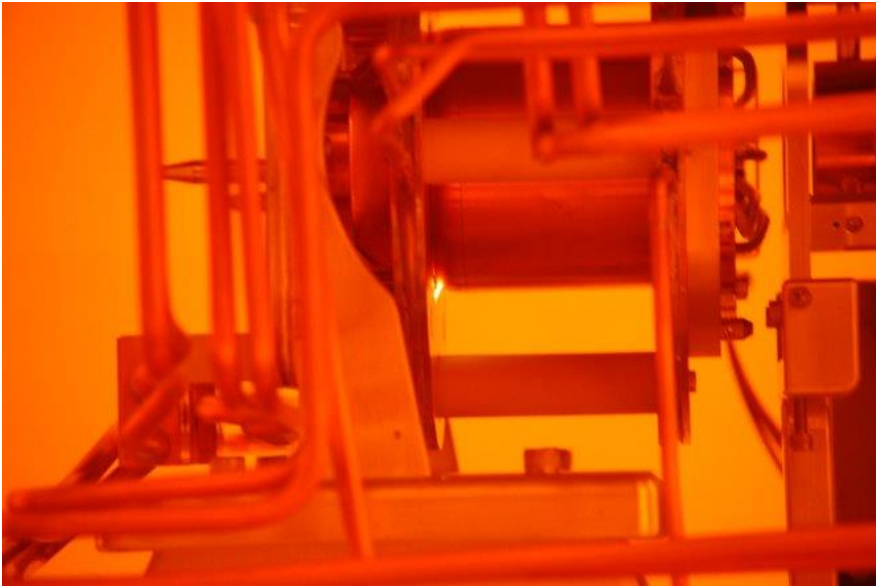
# Ongoing Beam Production Developments

- Fe, Co and Pd beams ready for yield measurements online with newly developed laser schemes, and on-going development for laser schemes of Te, Hg
- Investigations of higher temperatures and increased protons on the UCx targets underway
- Proton-to-neutron converter target fabricated and undergoing tests, to be run online spring 2020



Proton to neutron converter testing in the ATTS

# Ongoing Beam Production Developments



Discharge in the source tray.  
Photo by Aurelia Laxdal.

- Systematic studies of target/ion source properties for better performance
- Ongoing studies of HV behaviour of the modules in order to better understand limitations with protons on
- Extending rotating beam operation towards carbide targets
- Establishing low intensity yields with the help of TITAN-MR-TOF and GRIFFIN

# Summary

- Despite operational responsibilities, the targets and ion sources group has been making headway on development projects
- ARIEL will increase opportunities to do development – more test stands, more beams

# Priorities

- Manpower and other resources do not allow us to work on everything at once
- Much development work done as part of student projects
- What is the priority?
  - Reliability
  - Performance
  - New beam developments

Thank you!