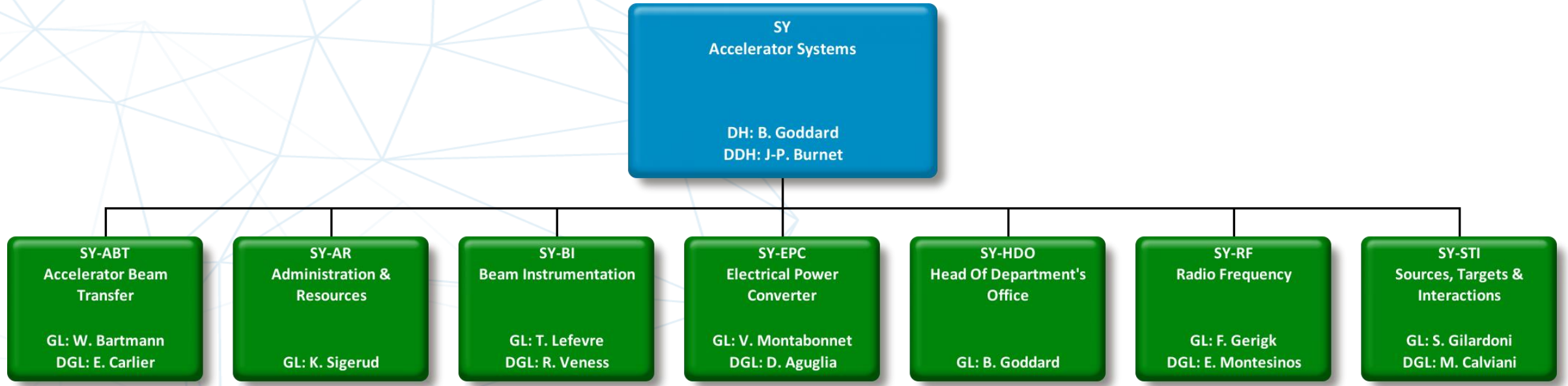


Update from TISD and Beam manipulation

S.Rothe for SY-STI-RBS



Accelerator Systems



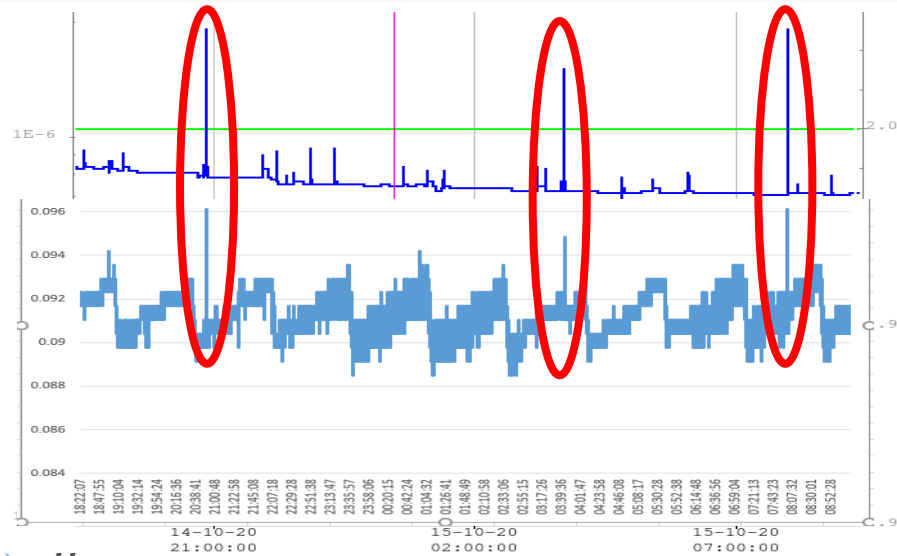
<https://organigram.web.cern.ch/SY>

Outline

- FE11 (3)
- Targets for 2021 (3)
- TISD : Molecular beams and Materials (8)
- Gas systems (new and old) (2)
- The Tapestation (1)
- Beam switching (1)

FE11 Extended High Voltage Tests

- FE11 commissioning in OL2 revealed occasional **dropout of the line heating**.
- With the addition of TIMBER to OL2 clear **evidence for discharging** was found.
- Systematic disassembly** of FE11 down to the main high-voltage insulator to rule out other components.
- Hand polishing of closest metal surfaces.
- *Discharges persist*



- *However*
 - Remounting of FE 8 at OL2 reveals rate of discharge is identical
 - Timber data demonstrates the **same behaviour from previous online frontends**
- *All evidence points to no worsening of this issue with the latest frontends.*
- Must consider amelioration strategies in the design of the next generation of frontends
- Budget allocated to install new FE in LS3

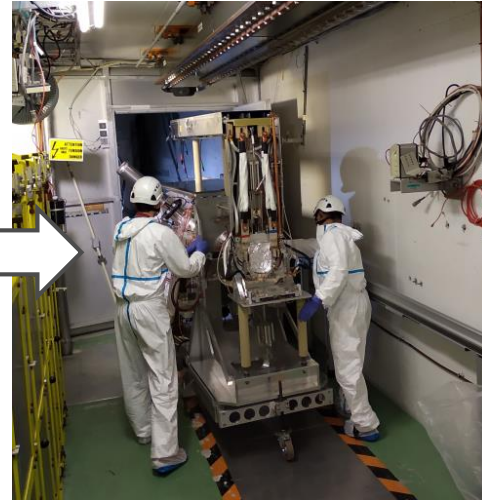


Slide: M.Bissell, (Y.Gracia, J.Cruikshank, S.Marzari)

FE11 (Frontend for HRS)



FE11 Transport



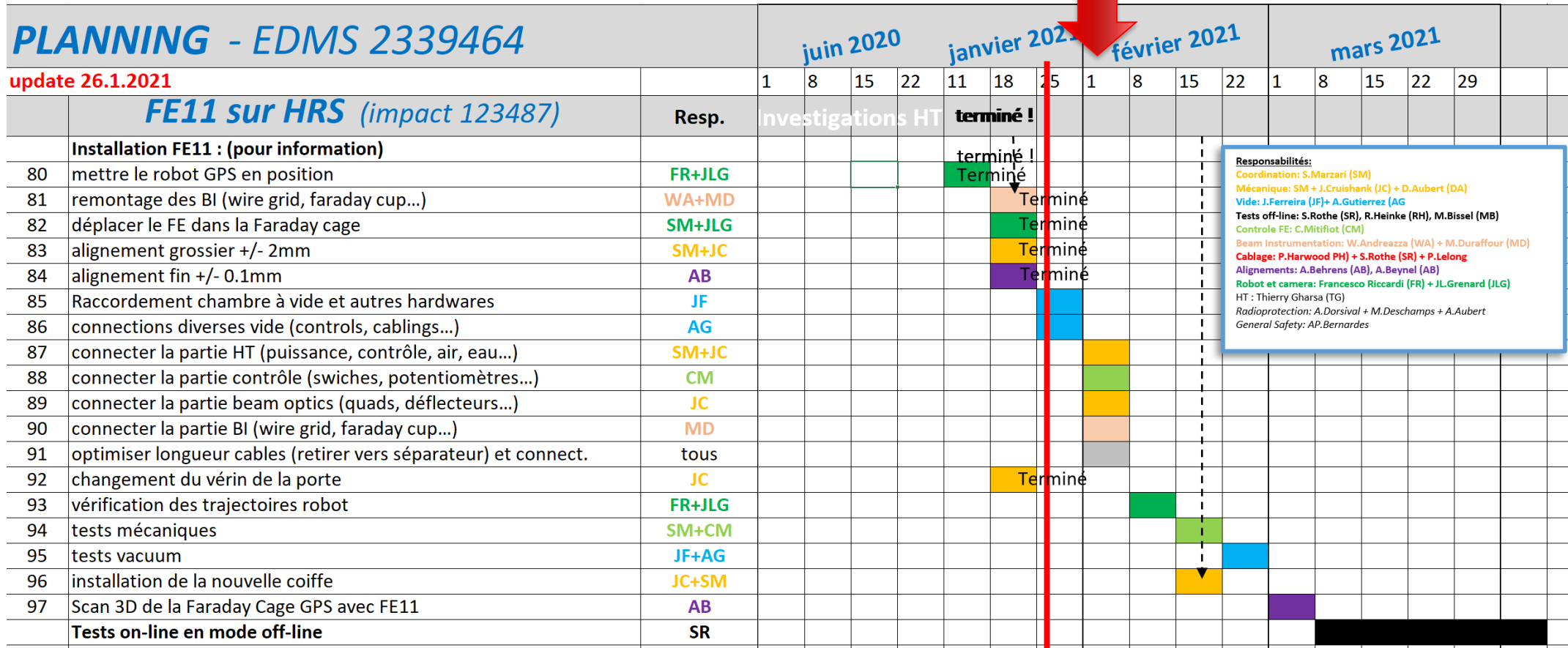
Pre-Alignment



- FE11 was transported to the ISOLDE Target Area on the **19 January 2021**
- Final installation and Commissioning for the FE11 HRS is ongoing:
 - **Alignment completed**
 - Vacuum connection and testing ongoing
 - Cabling HV/LV, controls and service connections to begin this week

Slide: J.Cruikshank

Frontend 11 installation at ISOLDE



Beam commissioning at HRS begin in early March

(S.Marzari)

Targets for 2021

5 UC target units produced 2020 and stored

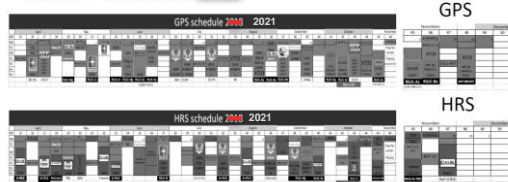
- Pre-production of all UC units due to upgrade of nuclear ventilation (till mid 2021)



#709-UC-Ta
#711-UC-Ta
#713-UC-VD5
#715-UC-Ta
#717-UC-Ta

~15 target units for production 2021

ISOLDE Schedule 2018-2021



- 5 UC charges ready to be used after ventilation stop
- Aim for 2 LIST units on HRS or GPS (R.Heinke)

See talk by B.Marsh

- (Eagerly Awaiting 2021 schedule 😊)

10 target units recuperated from Run 2

- For **online operation**:
 - #654 UC-W | n.conv. | K MM
 - #635 UC-Ta | Be MM
 - #534 Sn | VD
 - #619 Pb | VD
 - #653 UC-Ta | n.conv | In, Cu MM
 - #641 UC-Ta | Mn, In MM

- Molecular / Actinide beam dev.**
(M.Au, B.Reich, ISOLTRAP MR-ToF)

#637 UC-Ta | CF4, NF3
#638 UC-Re | Li, Sm MM
#659 UC-VD7
#668 UC-VD5



New Supplier Contract for vacuum vessels for the ISOLDE target



(Image credit ALCA, previous supplier)

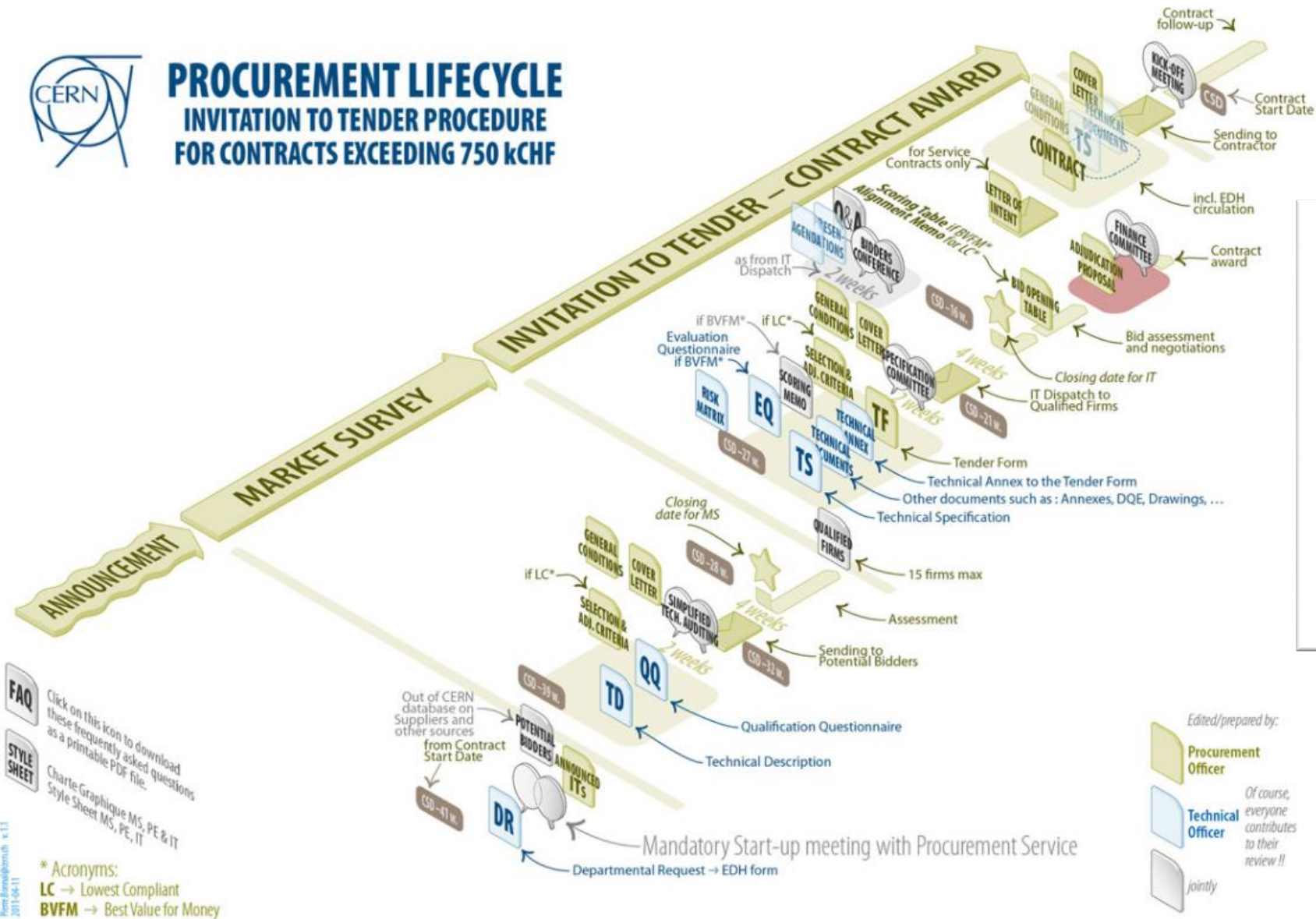
CERN Rules

- Contracts over **750K CHF** follow full invitation to tender process;
 - Market Survey
 - Invitation to Tender
 - Contract award
- Contract put out to tender **every 5 years**

M.Owen




PROCUREMENT LIFECYCLE INVITATION TO TENDER PROCEDURE FOR CONTRACTS EXCEEDING 750 kCHF



FAQ Click on this icon to download these frequently asked questions as a printable PDF file.
STYLE SHEET Chartre Graphique MS, PE & IT Style Sheet MS, PE, IT

* Acronyms:
LC → Lowest Compliant
BVFM → Best Value for Money



European Organization for Nuclear Research
Organisation européenne pour la recherche nucléaire

EDMS No. 2376261 Group Code: EN-STI
IT-4602/EN/ISOLDE

Invitation to Tender

Technical Specification Supply of Vacuum Vessels for the ISOLDE Target

Abstract

This Technical Specification concerns the manufacturing, assembly and testing of 200 vacuum vessels for ISOLDE targets.

CERN intends to place a five year contract, which is expected to be awarded in June 2021. First series delivery is foreseen in December 2021.

- First delivery of new batch expected for Q1 2022

M.Owen

The Development Team:

Pre-pandemic picture



T. Stora D. Leimbach J. Ballof **S. Rothe**

STAF DOCT Phd, FELL **STAF**



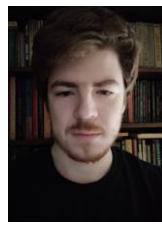
R. Heinke

FELL in STI/LP
From Q2.2021



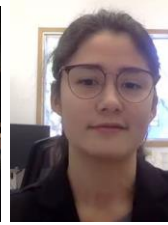
Y. Gracia

FTEC



E. Reis

FTEC



M. Au

Phd, FELL



M. Bissell

PJAS (50%)



S. Stegemann

FELL

Q3.21



M. Rapps

DOCT

- Negative ion sources and physics with negative beams

★ Molecular refractory beams

- LIST ion source (jointly with RILIS)

★ Gas systems and Carburization process

★ UC nano process development

★ Molecular actinide beams (LISA network)

★ ISCOOL, Tape station

★ General target material development

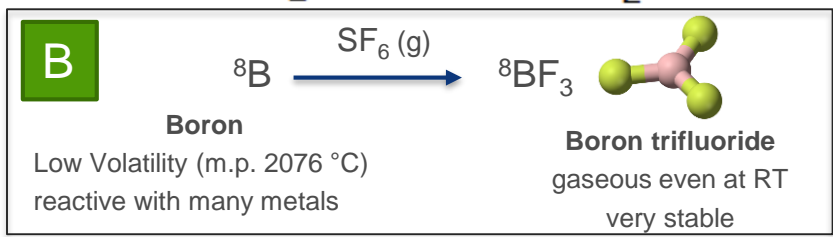
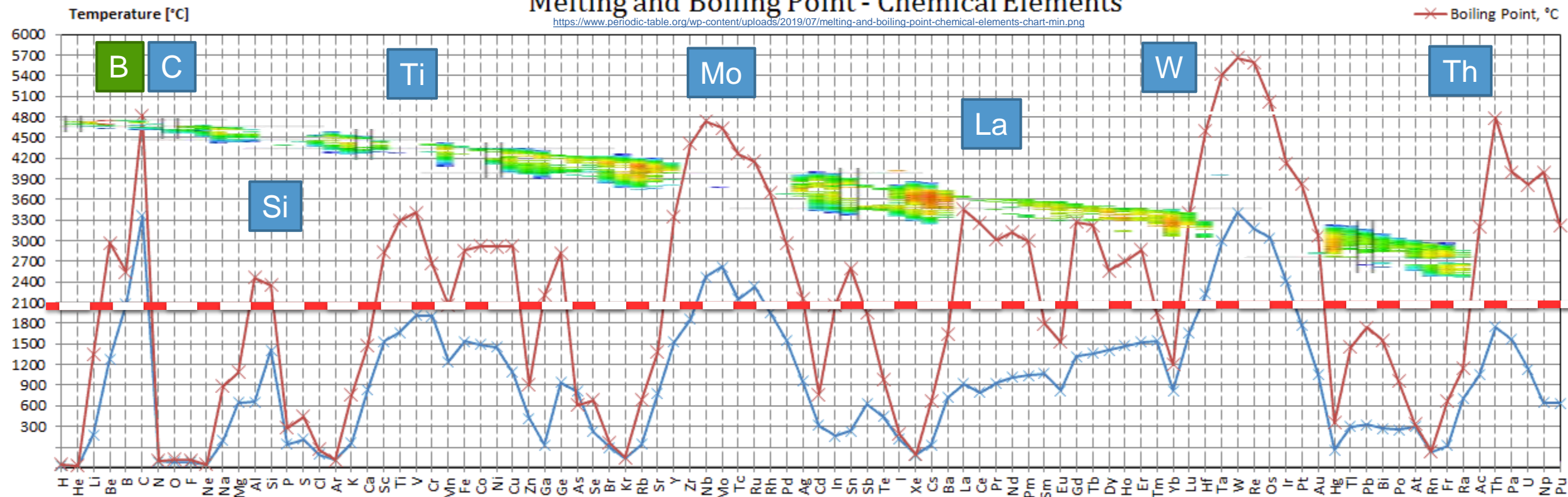
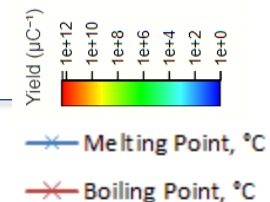
- Bottom-up nanomaterials

See talk by B. Marsh

Molecular beams : Why ?

Melting and Boiling Point - Chemical Elements

<https://www.periodic-table.org/wp-content/uploads/2019/07/melting-and-boiling-point-chemical-elements-chart-min.png>



Chemical Element

Target materials operated at < 2200 C

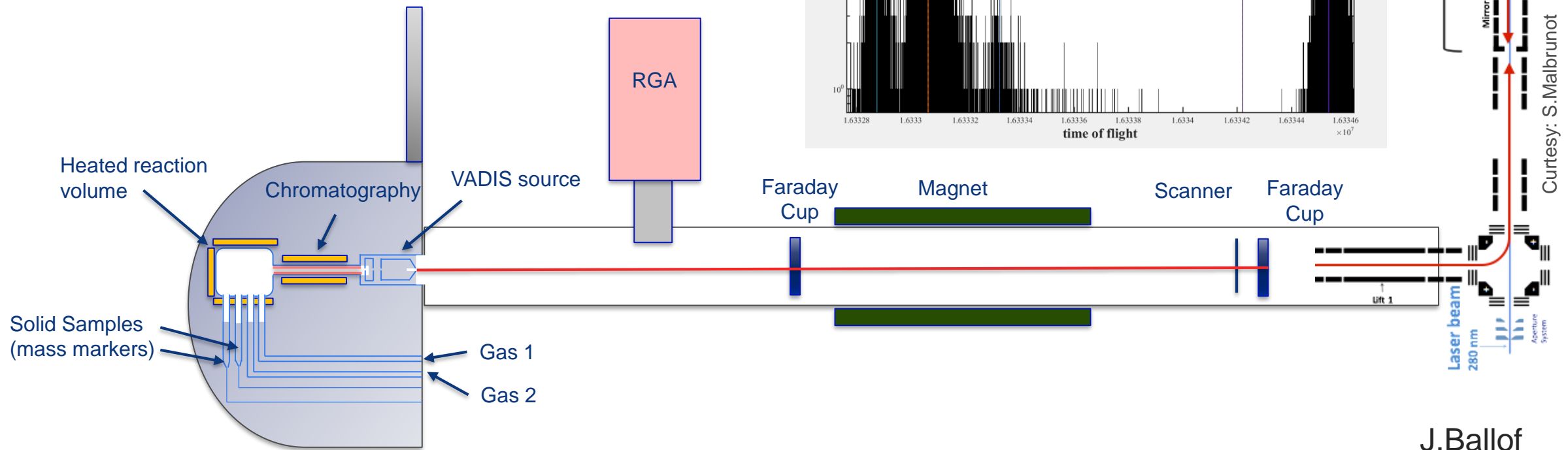
Molecules are more volatile

actinides

Studying molecular beam formation

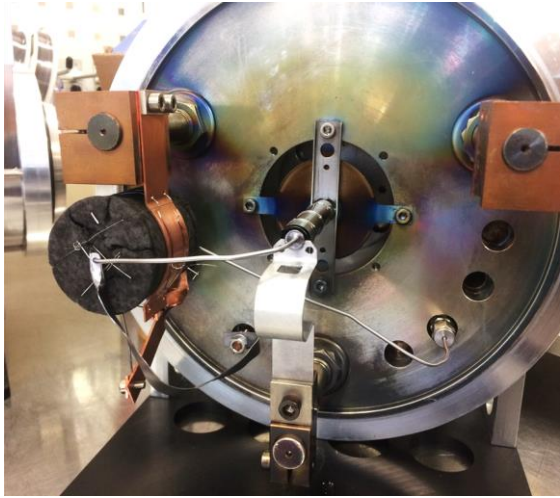
Concept for a dedicated development unit for molecular beams (pre LS2)

- Add **Multi Reflection Time of Flight (MR-ToF)** mass spectrometer: allows ISOBAR separation.
- Collaboration with MIRACLS experiment launched



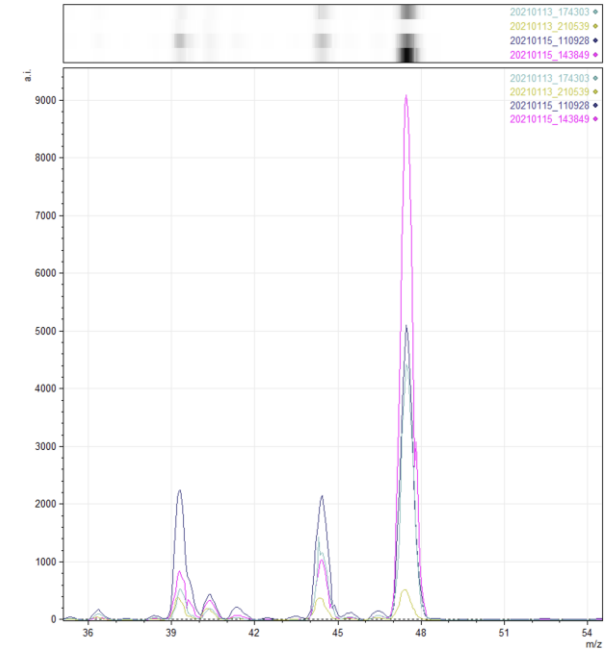
J. Ballof

Molecular beam development @ Offline 1



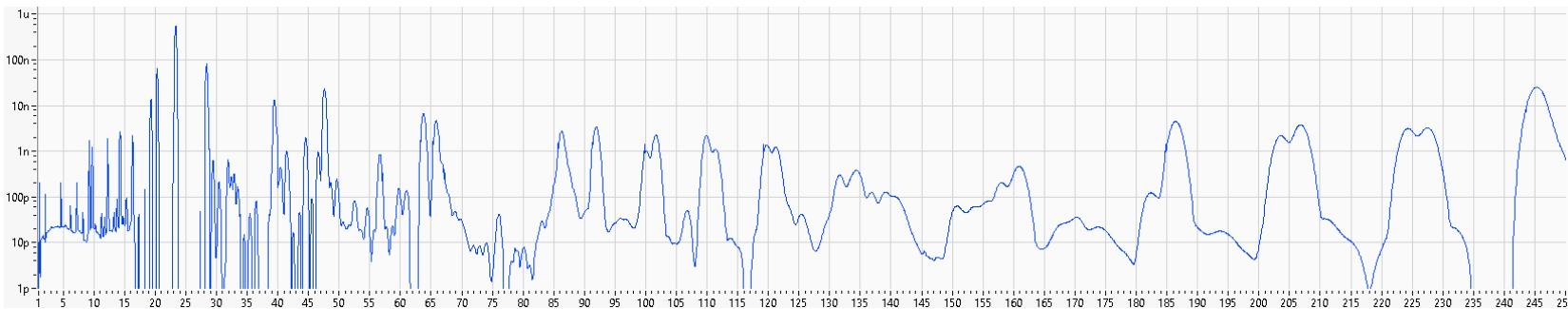
- Dedicated target/ion source for molecular beams

- Offline gas injection and reaction studies



Comparison of four mass scans in the same region of interest

-> showing changing peak intensities in response to changing target and ion source conditions

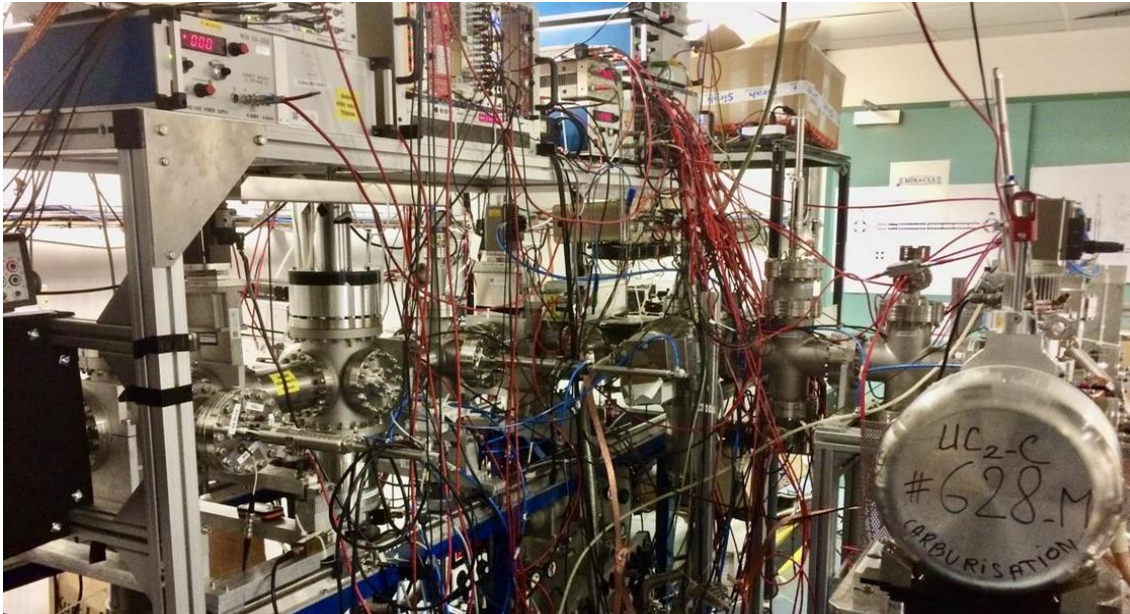


Sample mass scan in logarithmic scale. **Low intensity peaks can be difficult to identify**

M.Au

High resolution mass spectrometry for TISD

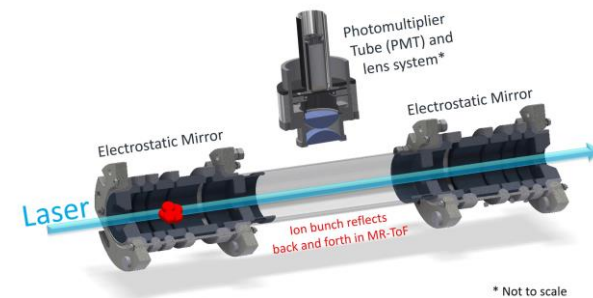
- Offline developments at **MIRACLS PoP MR-ToF** (Bat.508)
 - Negative ion beams for electron affinity study
 - From mid 2021: **Molecular beams**



The MIRACLS proof-of-principle setup, featuring an ISOLDE target and ion source coupled to a Paul trap before an MR-ToF.

- Offline/Online developments at ISOLDE
 - Study of beam composition from pre-irradiated targets using **ISOLTRAP MR-ToF** planned for spring 2021
 - High mass resolution required for identification
 - Development of **actinide beams**
 - LISA (Laser Ionization and Spectroscopy of Actinides)*

**This Marie Skłodowska-Curie Action (MSCA) Innovative Training Network (ITN) receives funding from the European Union's H2020 Framework Programme under grant agreement no. 861198*



<https://miracls.web.cern.ch/experiment.html>

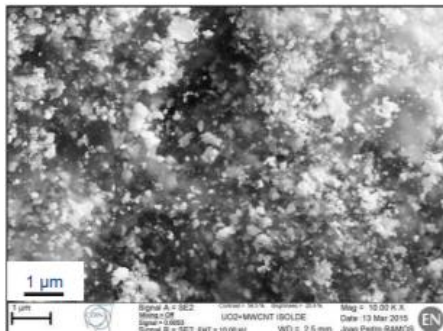


M.Au

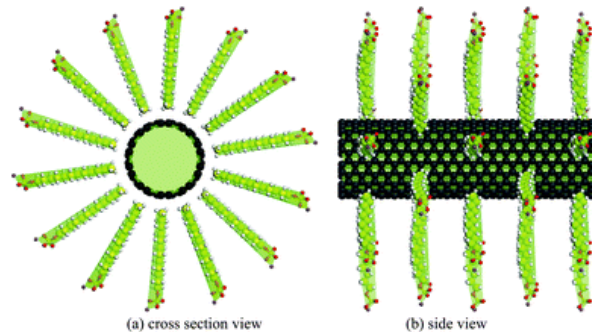
Target material development (nano)

Nano-UC_x target

- Process development focused on nanometric UO₂ mixed with Multi-walled Carbon NanoTubes (MWCNTs)
 - **Transfer of existing procedures** to glove box confinement
 - **Optimization of reaction conditions** (solvents, temperature, surfactants, mixing, grinding, pressing, etc)
- **Development** of alternative processes (bottom up)
- Production will be carried out in the new Nanolab



SEM of MWCNT-based UC_x

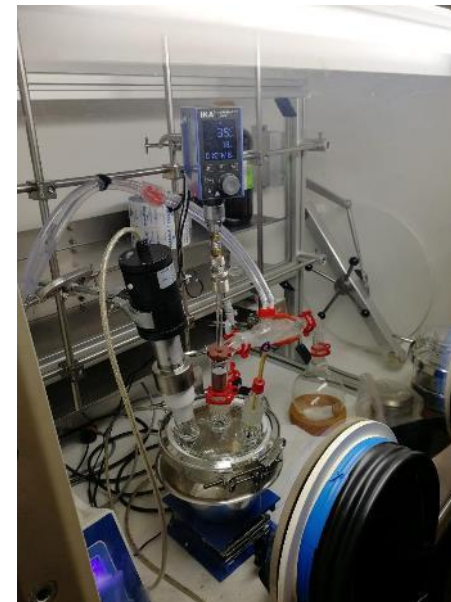


Surfactant micelles around MWCNTs

SEM imaging required for successful development

Nano-LaC_x target

- Development of a LaOH + MWCNT based target material
- Acts as a **surrogate for nano-Uc_x**
- Development phase already ongoing in the chemical lab
- Outcome will be directly translatable to nano-UC_x!



Prototype chemical reactor in (to be) refurbished glove box to optimize reaction conditions



Planetary ball for powder particle size reduction.

S.Stegemann, E.Reis

Target material development

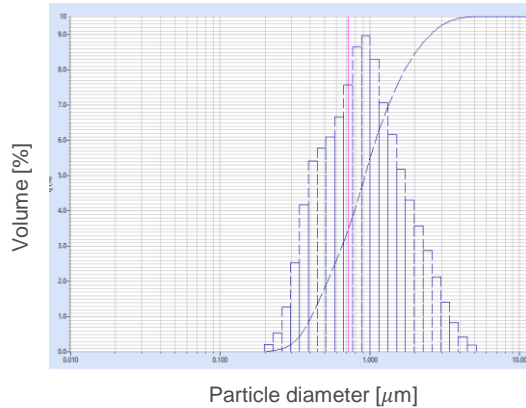
SiC target

- Previous supplier sold their SiC business
- Procurement or development of an equivalent raw material to produce targets that meet previous performances



Require av. particle size ~ 0.6 μm

Check purity conformity



Milling



		Eurofins Materials Science		GDMS Analytical Report		14, Avenue du Docteur Maurice Grynfogel ZAC Basso Cambô II, 31100 Toulouse, France T +33 (0)5 61 73 15 29 F +33 (0)5 61 73 15 67 info.fr@eurofins.com www.eurofins.com	
Customer: Fiven Norge AS		P.O.# 50146773		Job # F0KK6701		Sample ID: F201118109 - SR	
Date of Analysis: 26-nov-20		Customer ID: SiC		Issued on: 30/11/2020			
E-SiC 16.11.20-106							
Element	Concentration [ppm wt.]	Element	Concentration [ppm wt.]				

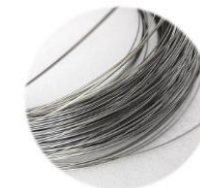
Ta-foil target

- Supplier stopped offering 6 μm thick foils
- Looking for new supplier
- Alternatives considered:
 - Postprocessing of thicker foils



Foil rolling mill

- Micrometric Ta-wires



S.Stegemann, E.Reis

(New) development and characterization equipment

Planetary ball mill – Powder particle size reduction



Laser diffraction particle size analyzer

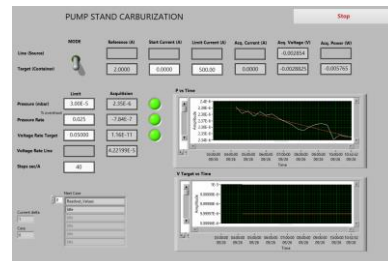


Gas sorption – Pore size distribution



Carburization pumpstand w. new control software

Target development, target sintering studies,...



Gas pycnometry - Apparent density determination



TGA-MS – Reaction kinetics



ISOLDE Gas Systems Update

PLANNING	Resp.	Jan. 2021			Feb. 2021			March 2021			April 2021					
		4	11	18	25	1	8	15	22	1	8	15	22	5	12	19
Arrival Hardware Test	YV	finished														
Device Electronics Test	CM	finished														
GPS FE																
Design	FJ + YV	finished														
Mark, Drill Pletine	FJ + YV			finished												
Build tubing + System	FJ + YV															
Leak Tests	YV															
Final Electronics Check	CM + YV															
Arrival New EVR116	YV															
Implementation FC	FJ + YV															
HRS FE																
Arrival Components	YV															
Mark, Drill Pletine	FJ + YV															
Build tubing + System	FJ + YV															
Leak Tests	YV															
Final Electronics Check	CM + YV															
Implementation FC	FJ + YV															

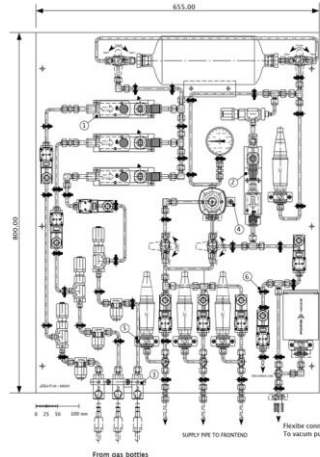
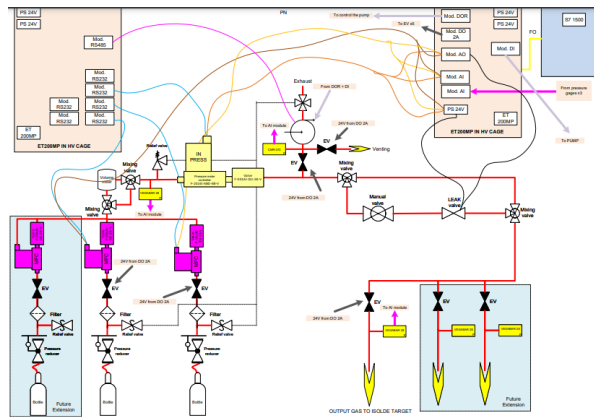
Specifications

Implementation modes:

- Calibrated leak.
- Leak valve.
- Loop.

Ready for 3 inlet lines and 3 output lines (to FE)

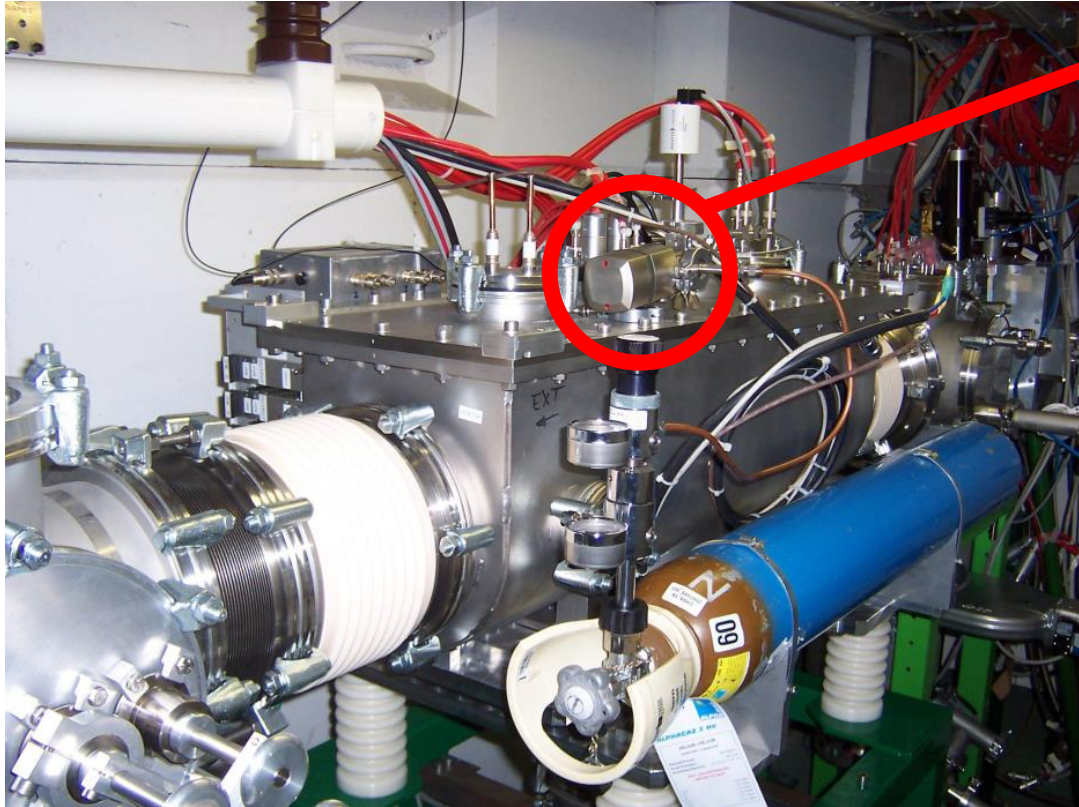
Gases: Ar, N₂, NF₃, O₂, SF₆, CF₄, Air, H₂ (2% in Ar), CO (after upgrade)



- Control system tested w. hardware (C.Mitifiot, BE/CEM)
- Assembly ongoing
- Installation foreseen end of FEB

Y.Gracia, F.Josa

ISCOOL He Gas Injection



Motorized needle valve installed in 2007 was removed in 2012 and replaced with a hand operated valve.

- Significant difficulty to set correct flow rate (2 people communicating via mobile).
- No possibility to tune He flow based on ion beam transmission.

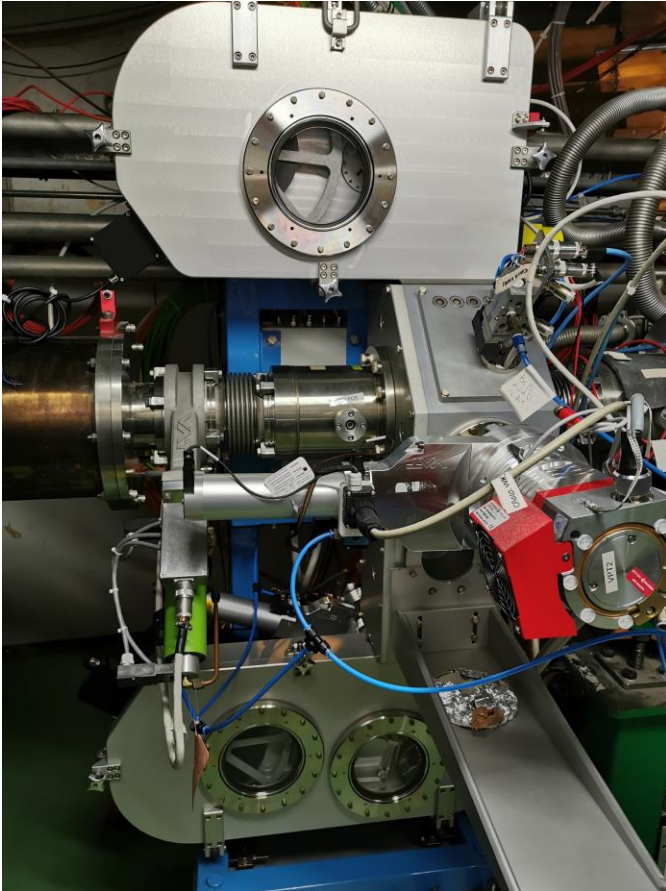
2 alternative systems investigated in 2012 and 2018 found to be unsuitable.

Meanwhile, the new ISOLDE target gas injection employs the same valves as previously used on ISCOOL.

- ***Move back to the original specification maintaining commonality of spare parts and universality of controls infrastructure.***

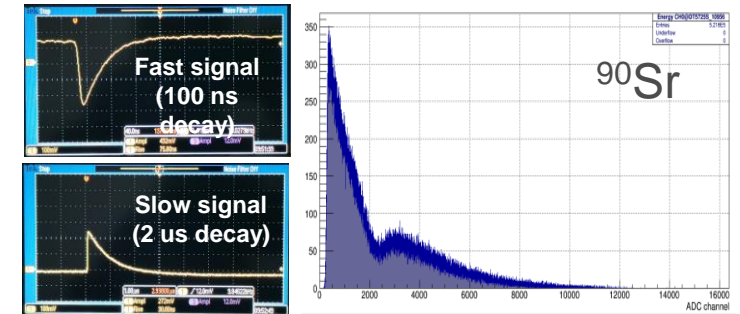
M.Bissell, Y.Gracia

The Tape Station (TS1)



- **Beam instrumentation and low level control:**
 - Beam scanner to be installed by SY-BI, design phase
- **Beta detectors:**
 - 2 prototypes (3x3 SiPM array) tested at CERN, noise at tapestation position is absent, **ready for production**.
 - Same design can be used for all the positions.
 - Updating drawings and producing new parts, collaboration with SY-STI-TCO.
- **HPGe detector:**
 - Preliminary tests at GSI show a **fully recovered resolution**
 - noise from cooling system was identified and currently addressed.
- **Data acquisition:**
 - CAEN DT5725 **purchased**, all-in-one solution
- **Top level Controls (GUI)**
 - Basic version by BE-OP (Java)
 - Expert interface via STI-RBS (LabVIEW)
- **Future**
 - Final tests to be performed by March with all detectors in place
 - **Once TS1 ready launching TS2 installation**

IFIN-HH 3x3 SiPM array



Old Tapestation HPGe detector



DT5725

8 Channel 14-bit 250 MS/s Digitizer

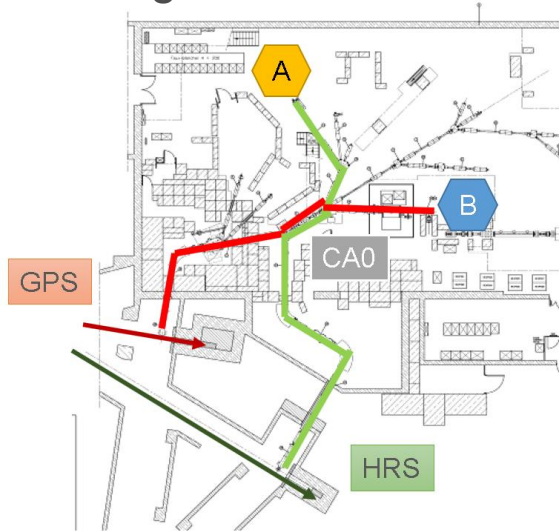
(R.Lica)



ISOLDE beamlines: Alternating and Switching operation

More details see presentation in [EPIC Workshop 2020](#)

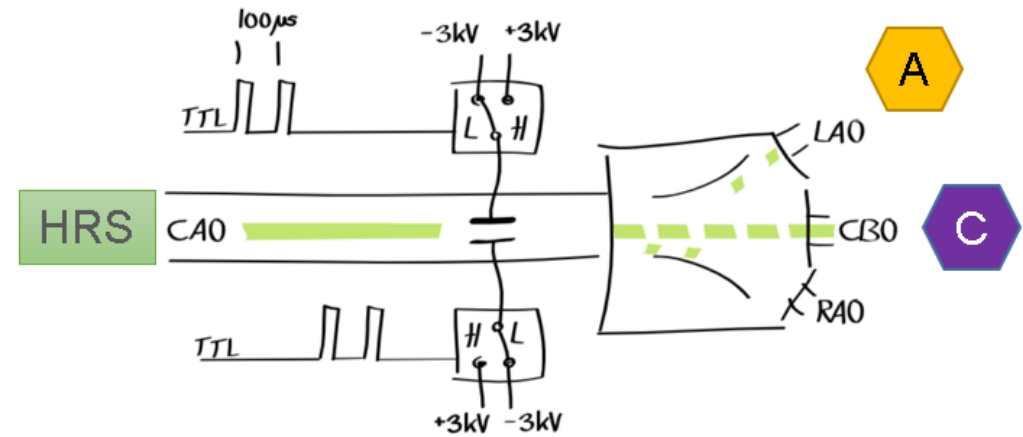
Alternating mode



[TG06] M. Lindroos and T. Nilsson, "HIE-ISOLDE: the technical options," CERN-2006-003, (2006). (Chapter 7 by T. Giles)

- Requires proof of concept + prototype (100kCHF, **looking for funding**)
- Final design can be installed during a winter shutdown

Sharing mode



[srr16a] S.Rothe, "Proposal - Introducing Fast Beam Multiplexing at ISOLDE", [EDMS1509964](#)

[srr16b] S.Rothe et al., "Advances in surface ion suppression from RILIS: Towards the Time-of-Flight Laser Ion Source (ToF-LIS)" [NIMB. 376 \(2016\) 86-90](#)

- Tested at ISOLDE, used already for experiments
- Can be set up on request
- to be integrated in ISOLDE timing system

