ISOLDE Technical Report/ LS2 activities

Richard Catherall EN-STI-RBS

ISOLDE Technical Coordinator

83rd ISCC meeting 6th November 2018

Outline

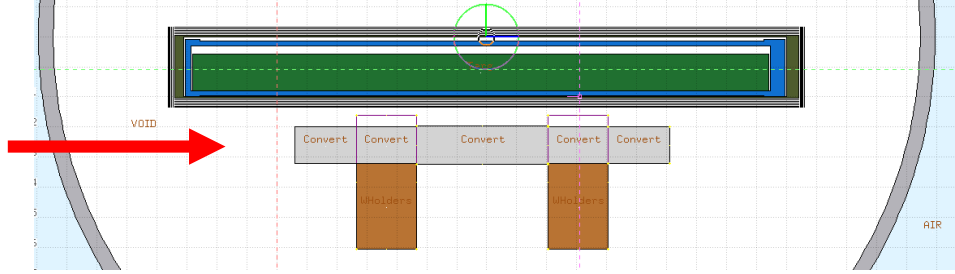
- Highlights
- LS2 activities
  - Frontends
  - Nanolab
  - Medicis
  - HT modulator installation
  - Scanner/faraday cup units
  - Tape station
- Off-line laboratories
- Available services
  - Water, electricity, compressed air, ventilation, vacuum
- Planning

Target area and Class A labs

Experimental Hall (excl. HIE)

P2n Converter

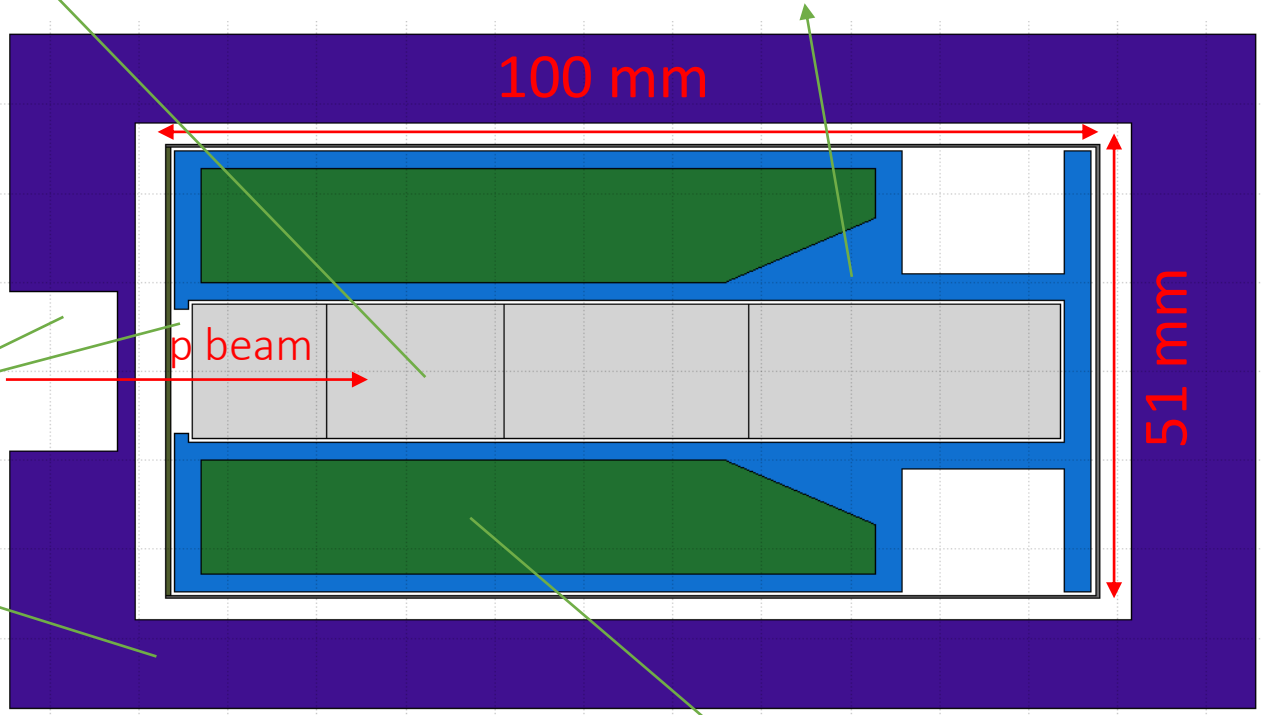
Converter very close to uranium carbide – high neutron flux!

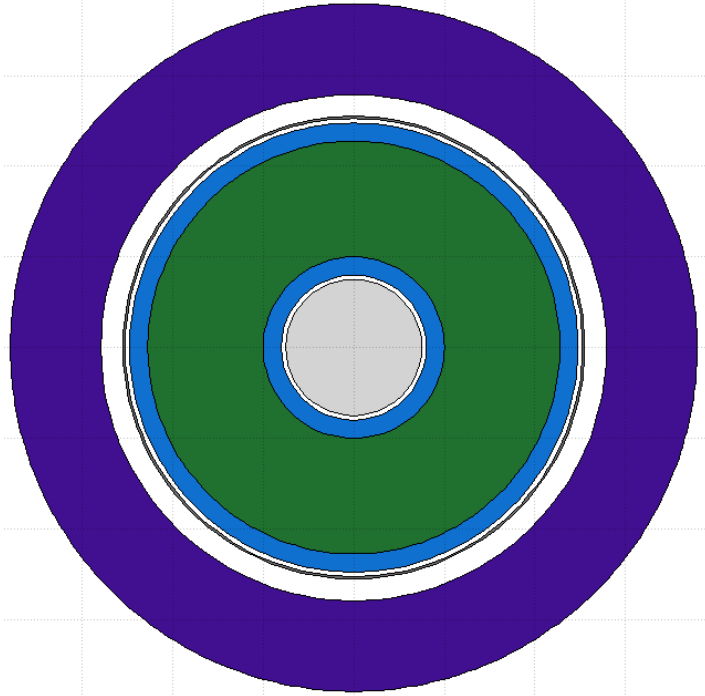


W converter

- Ø15 mm (12 mm - standard)
- Sliced to mitigate thermal shocks
- Operated at 2000 °C

Graphite container



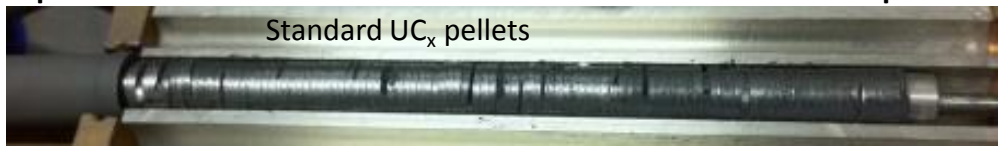


Avoid proton scattering

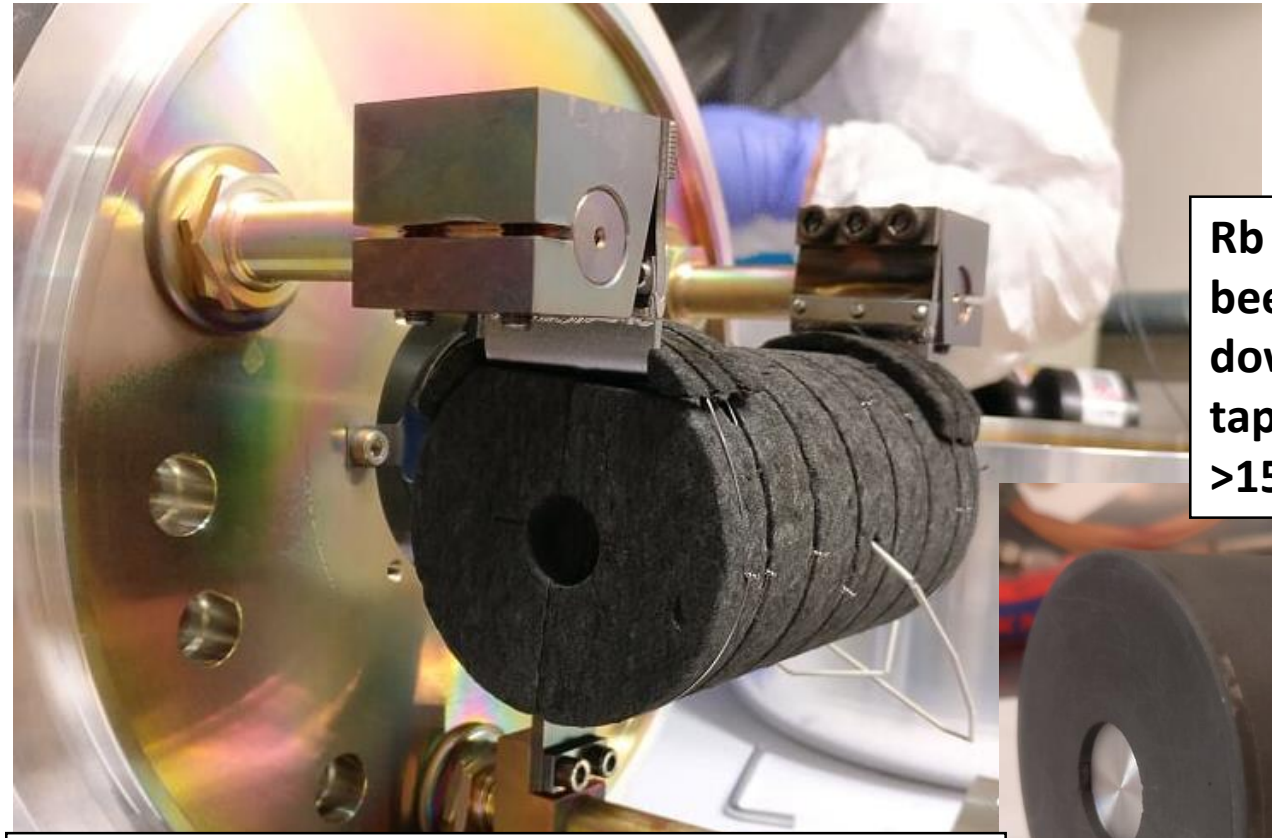
Thermal Shielding

- Sigratherm® - "graphite foam"
- 0.2 g/cm^3
- Low thermal conductivity

UC_x: new procedure has to be made for annular shape

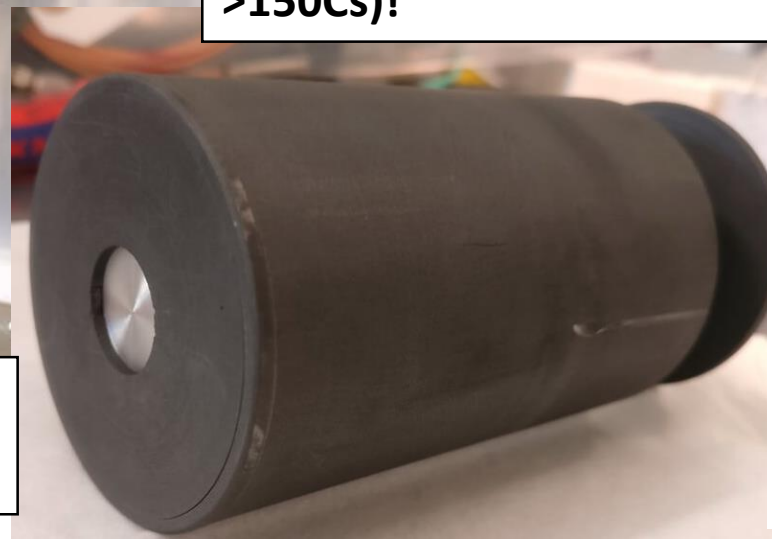


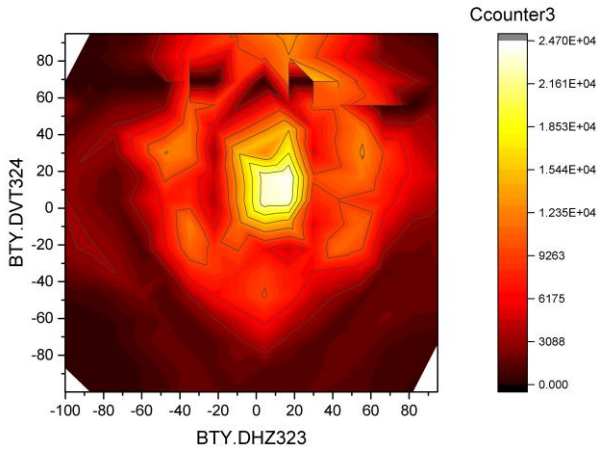
p2nconverter - update



Being tested at ISOLDE!

Rb and Cs isotopes have been measured – T1/2 down to 30 ms seen at the tapestation (>101Rb, >150Cs)!





Proton scan with 145Cs

2nd half of beam time:

- **Laser beams (Ga, Zn, Ni, In, Te)**

J.P. Ramos, et al.

The Electron Affinity of Astatine

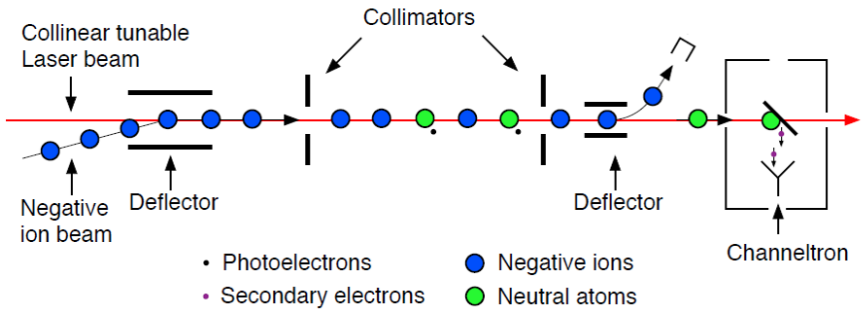
At is rarest naturally occurring element on Earth, ca. 70mg in crust, candidate for targeted alpha therapy

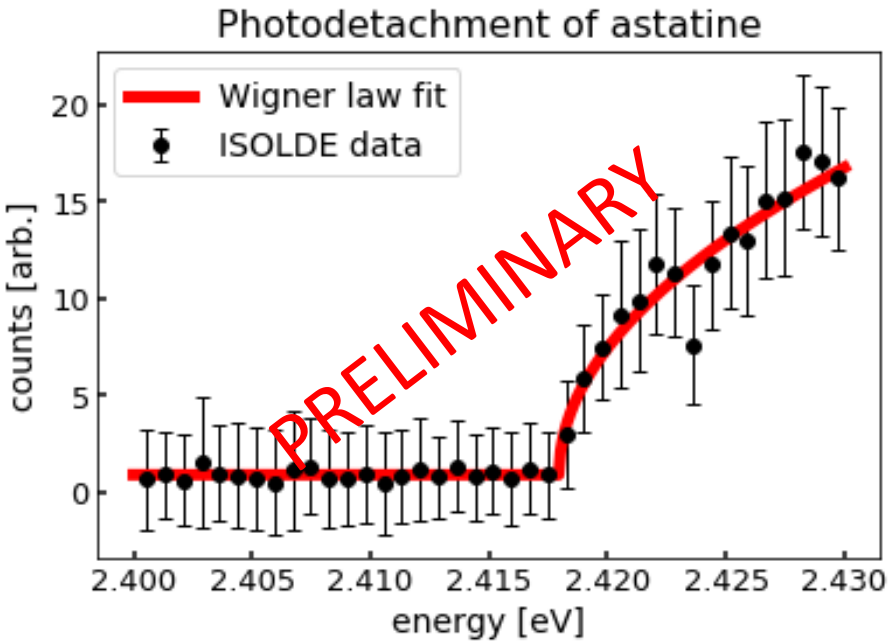
Electron Affinity (EA) is the binding energy of the additional electron in a negative ion

- EA required to describe the chemical properties of At
- Benchmark for quantum chemical models
- Predictions for chemistry of superheavy elements, e.g. tennessine (Ts)
- Can be measured by **laser photodetachment**

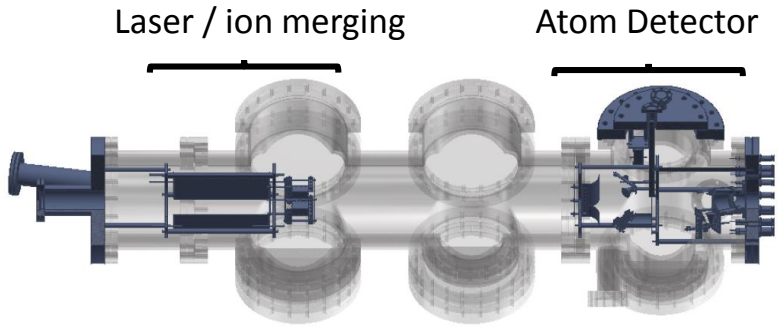
<u>Photodetachment threshold spectroscopy</u>:

- Laser and negative ion beam are overlapped
- Detachment cross section is given by the Wigner law $\sigma(E) \propto (E_\gamma - E_{th})^{l+\frac{1}{2}}$





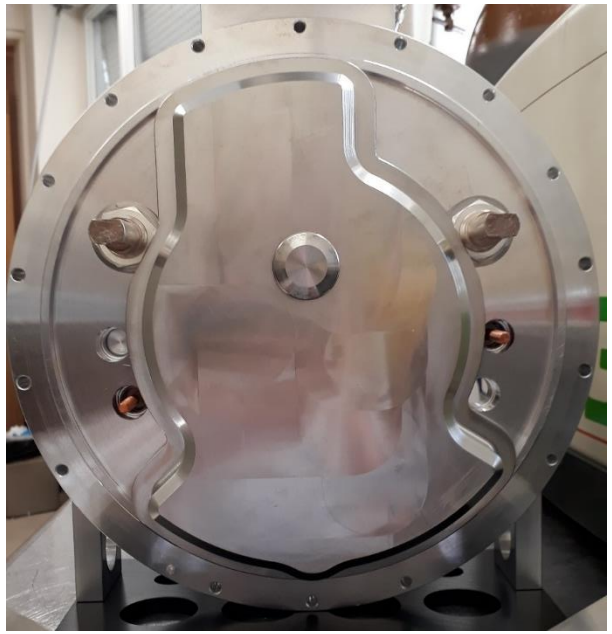
<u>1st ever measurement of the EA of At achieved with the GANDALPH-beamline at ISOLDE</u>

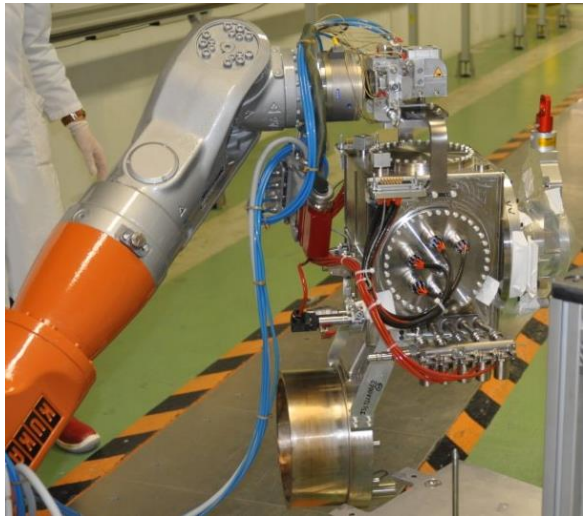


D.Leimbach, **S.Rothe** and the IS615 Collaboration

LIEBE: offline commissioning & prospects for ^{100}Sn @ HIE-ISOLDE

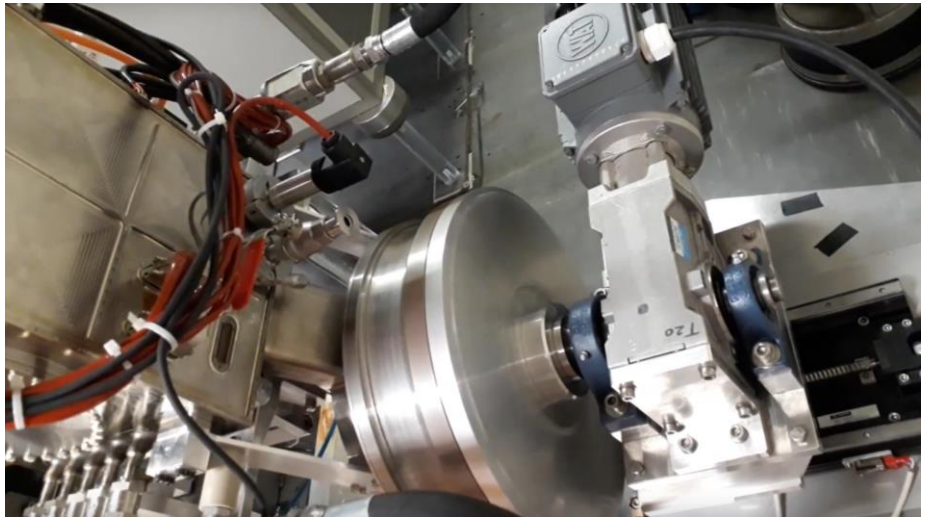
Successful replacement of the target base





Successful installation tests on GPS front-end

Offline tests with liquid LBE



Unsatisfactory results:

- Insufficient heating power
- LBE leak → not ready before LS2
  → review & next steps

Article & conferences:

The LIEBE high-power target: Offline commissioning results, *F. Boix Pamies et al., HPTW 2018 & EMIS 2018.*

Analytical model for release calculations in dynamic liquid ISOL targets, *D. Hounbo et al, subm.*

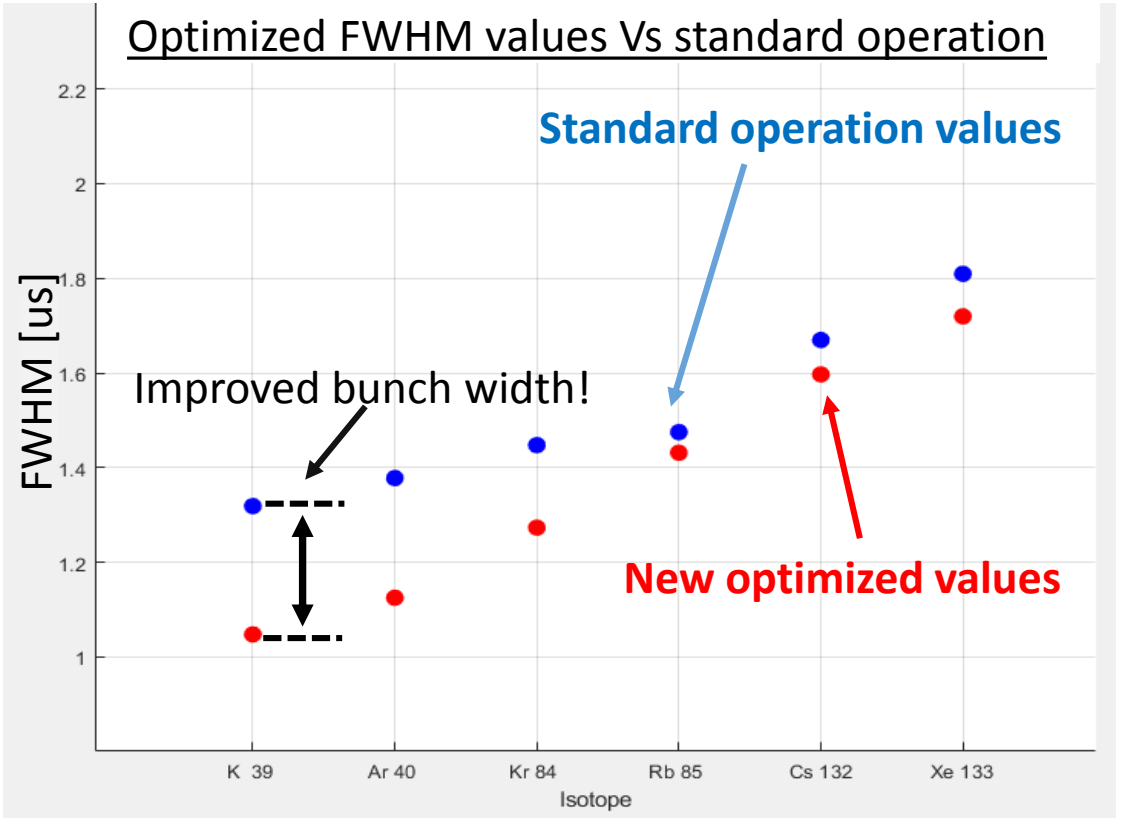
Shower formation in a liquid LBE target – An experimental and numerical study of the jetting and dripping regimes, *M. Delonca et al, in prep.*

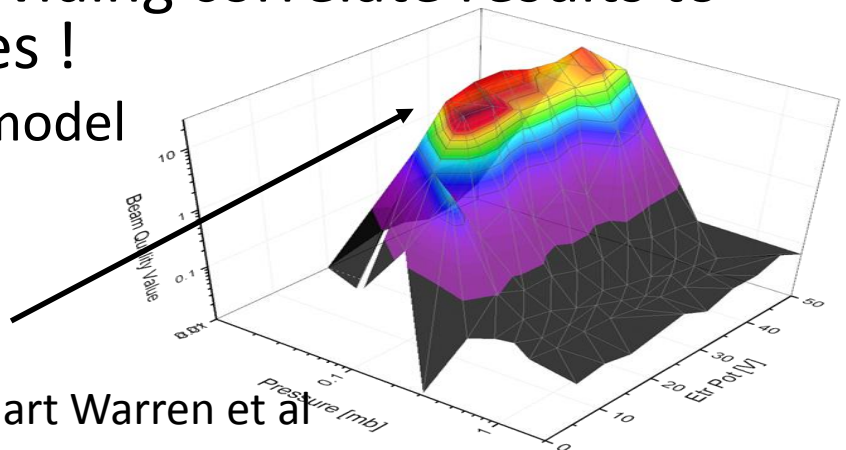
Prospects for the production of ^{100}Sn ISOL beams at HIE-ISOLDE, *F. Boix Pamies et al., EMIS 2018*.

Ferran Boix Pamies, et al.

RFQcb ISCOOL

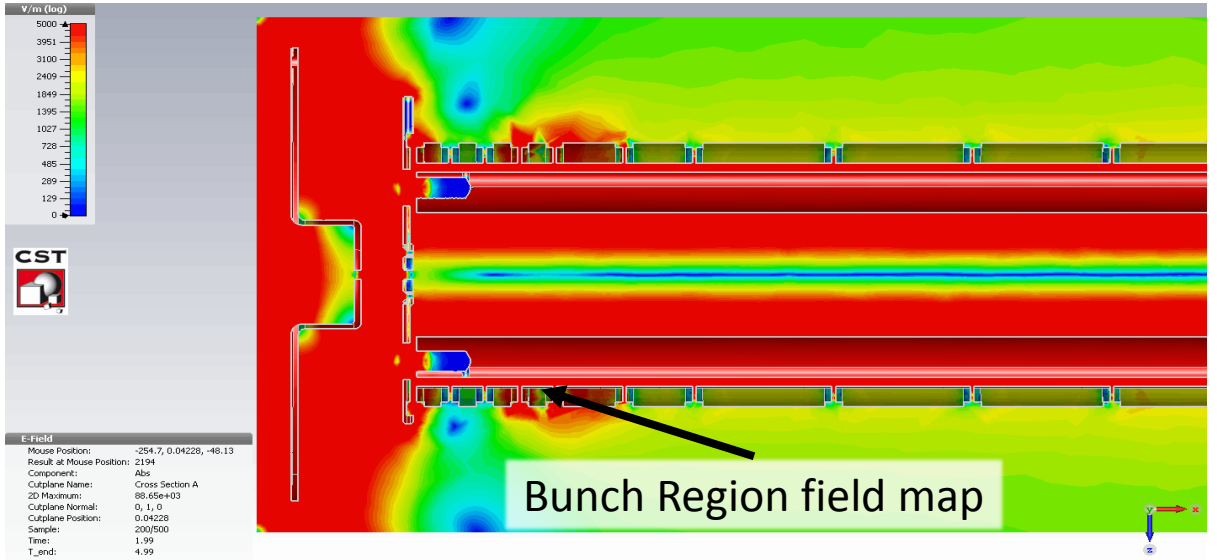
- Testing campaign :
  - New gas injection system – accurate internal buffer gas pressure control
  - New bunching techniques – injection chopping
  - New TOF detector- accurate 100% efficient in beam detector 10 m downstream of RFQcb
- Results have shown:
  - Minimum FWHM mass dependent
  - Cooling time minimum
  - Max Ions per bunch
  - Correct operational parameters per isotope
- Simulations providing correlate results to measured values !
  - Validation of model





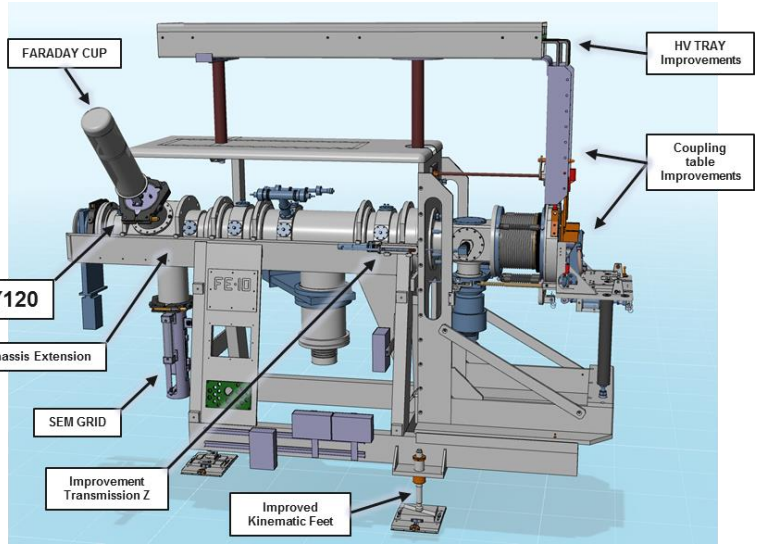
Simulated Optimum conditions saddle point matches real data

Stuart Warren et al



LS2 Activities

FRONTEND 10 & 11



FRONTEND 10&11 Status November 2018

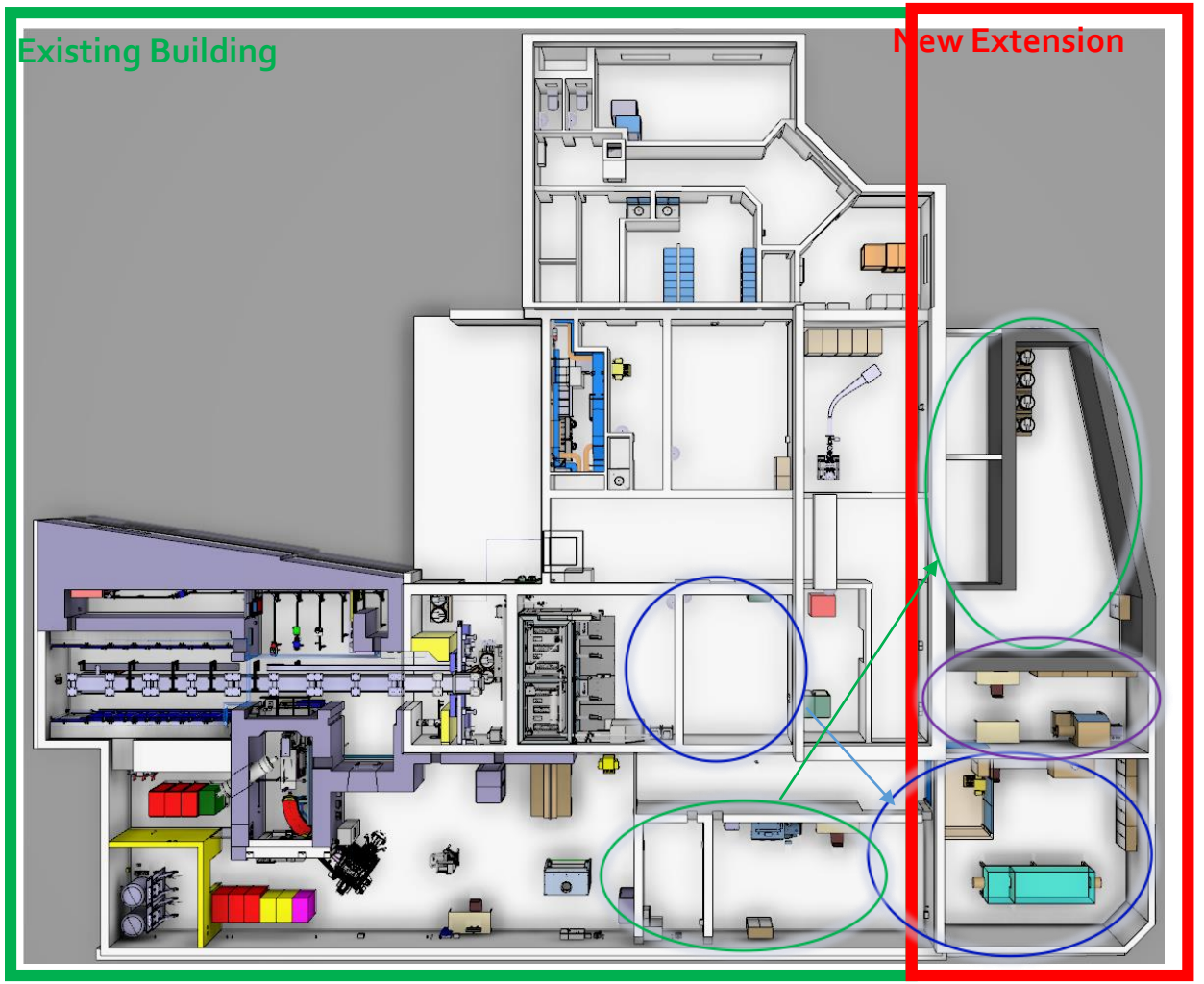
- **Manufacturing**
  - 90% of the FRONTEND 10&11 Pieces Received
- **FE 10&11 Assembly**
  - **Finalization of Assembly preparation**
    - Surface Treatment
    - Cleaning
    - Welding
  - **Assembly to begin the 7th November 2018 in 3/R-035**

- **FRONTEND 10&11 Testing**
  - FRONTEND testing to begin in January 2019 on OFFLINE 2
- **Installation in the Target Area May 2019**
  - Preliminary transport tests beginning on the 9th November 2018 with EN/HE to improve the ease of installation.

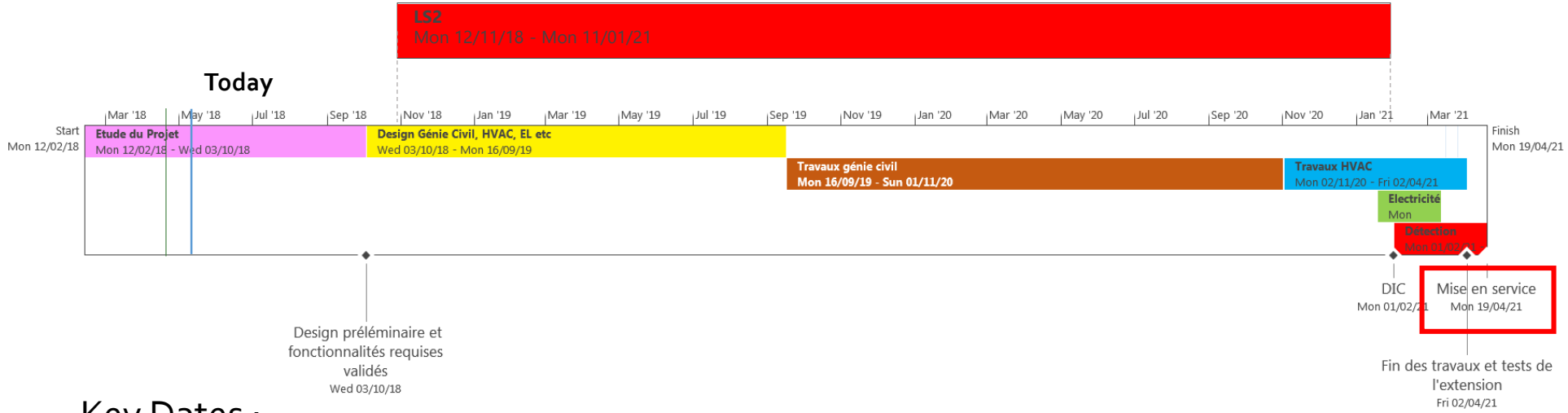
James Cruikshank

Layout of the Class A Extension (nano-lab)

- Produce actinide nano materials targets by having a laboratory equipped for Uranium Nano target production
- Provide a safe working environment for the manipulation of actinide nano-materials - confinement
- Having a specific laboratory equipped for the validation of the oxidation process (target dismantling)
- Move the buffer area and increase its capacity



Nano-lab Preliminary Schedule



Key Dates :

- Launch of the design in October 2018
- Beginning of LS2 in November 2018 until January 2021
- Beginning of civil engineering works in September 2019
- Installation of the remaining infrastructure from November 2020 to the end of March 2021
- **Commissioning of the extension April 2021**

E.Fontaine & R.Catherall
27/04/2018

MEDICIS

Newly appointed MEDICIS run coordinator : J. P. Ramos

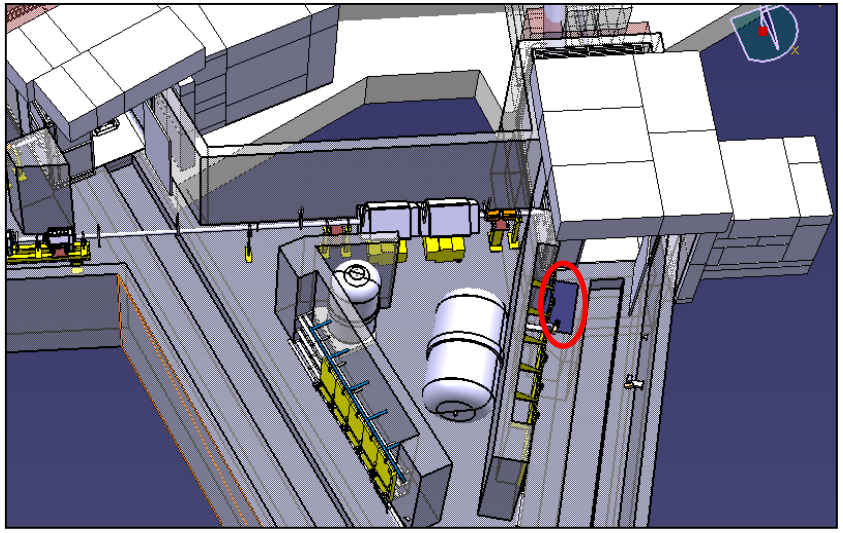
Final conference MEDICIS Promed 30st April-4th May 2019, Erice
(1st Flyer to be dispatched in November)

2nd MEDICIS Board took place 3rd October - 3rd Board planned Feb/March 2019

MEDICIS is planned to operate at a 1-2 weeks/months level throughout LS2, with some interruptions (YETS, services upgrades, etc).

Non-medical projects (as approved by INTC/Research Board could be scheduled in the facility (eg isotope collections), provided it does not collide with the medical program

Other target area activities



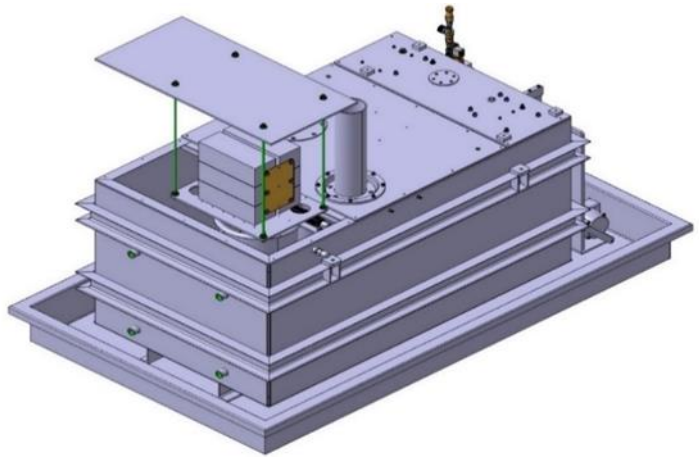
- Cameras
  - Revise and consolidate the current camera situation
    - Shield telescopic camera
- Safety requalification of gas storage tanks
  - Never been tested
  - Request by HSE to test or do visual inspection to continue to operate at > atm pressures
    - If not can only operate up to 1000 mbar Bar instead of 2800 mbar (absolute)
    - Volume of tanks 3m3 and 5 m3
- Robot/Montrac maintenance and testing

HT Modulator

- A second HT modulator (for the GPS) is planned to be installed during LS2
- However the negative power supply will only be installed during the 2021-2022 YETS
  - No negative beams available until 2022.

HT (kV)	1E13ppp	2E13ppp	3E13ppp
30	350	370	370
40	400	480	550
50	530	650	750
55	-	-	870
60	620	780	980

Recovery time (µs) of HT (+/-0.6V) with protons on convertor

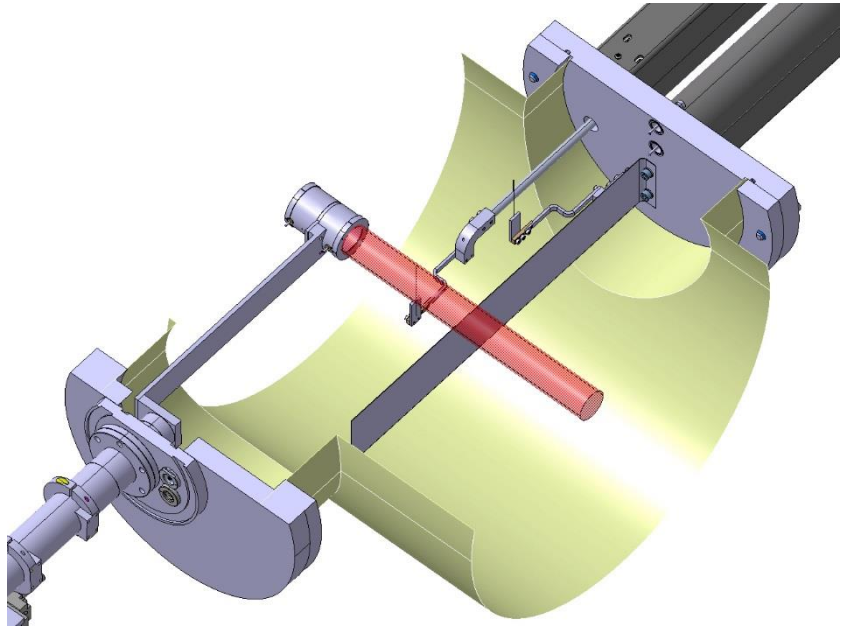


Beam diagnostics

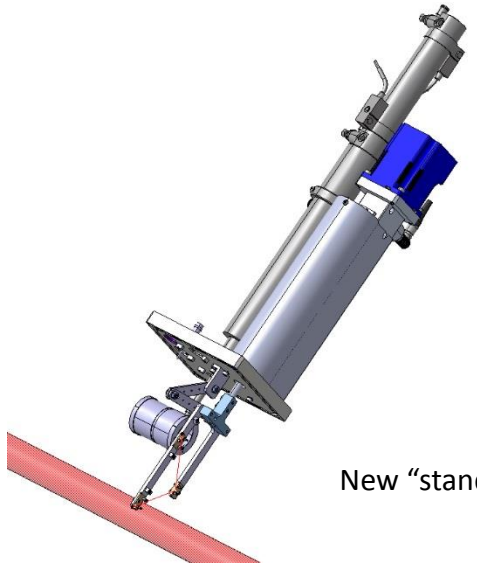
- BE-BI group to procure 20 FC/scanner units for low energy beam lines by Q1 2019
  - Need to prioritize which scanners are to be exchanged

	Total	REX	HIE	Low Energy
FC	64	8	23	32
Scanners	46	0	18	27

- Also new scanner units for the separators are under procurement
- To be installed in Q2 – Q4 in 2019



New HRS scanner/FC design



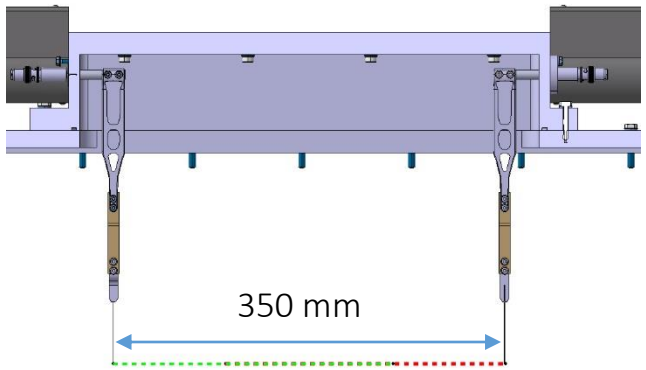
New “standard” scanner/FC design

GPS Scanner: Specification Changes

Magnetically coupled push-pulls: 250 mm stroke
+ 70 mm/needle: **Extra 140 mm to be allocated**

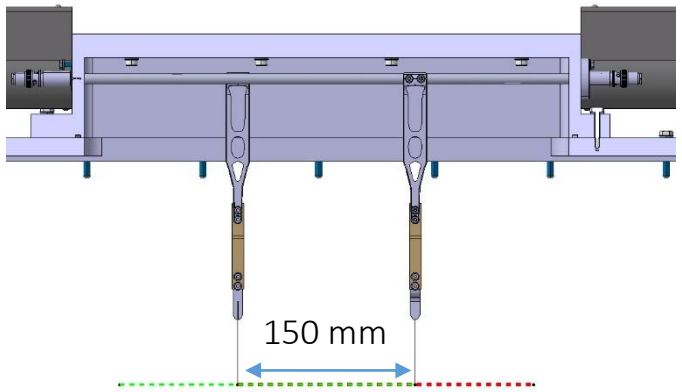
More **combined distance**

+ Covers different mass ranges



More overlap between two needles

+ Redundancy in case of failure of one needle, more versatile instrument



Maximum useful overlap is 147 mm
with central beam = 21Ne

Max. useful range of combined scanners
300 mm (mass range ± 10%)

No need for beam instrumentation at extreme edges when using mass ranges ±15%

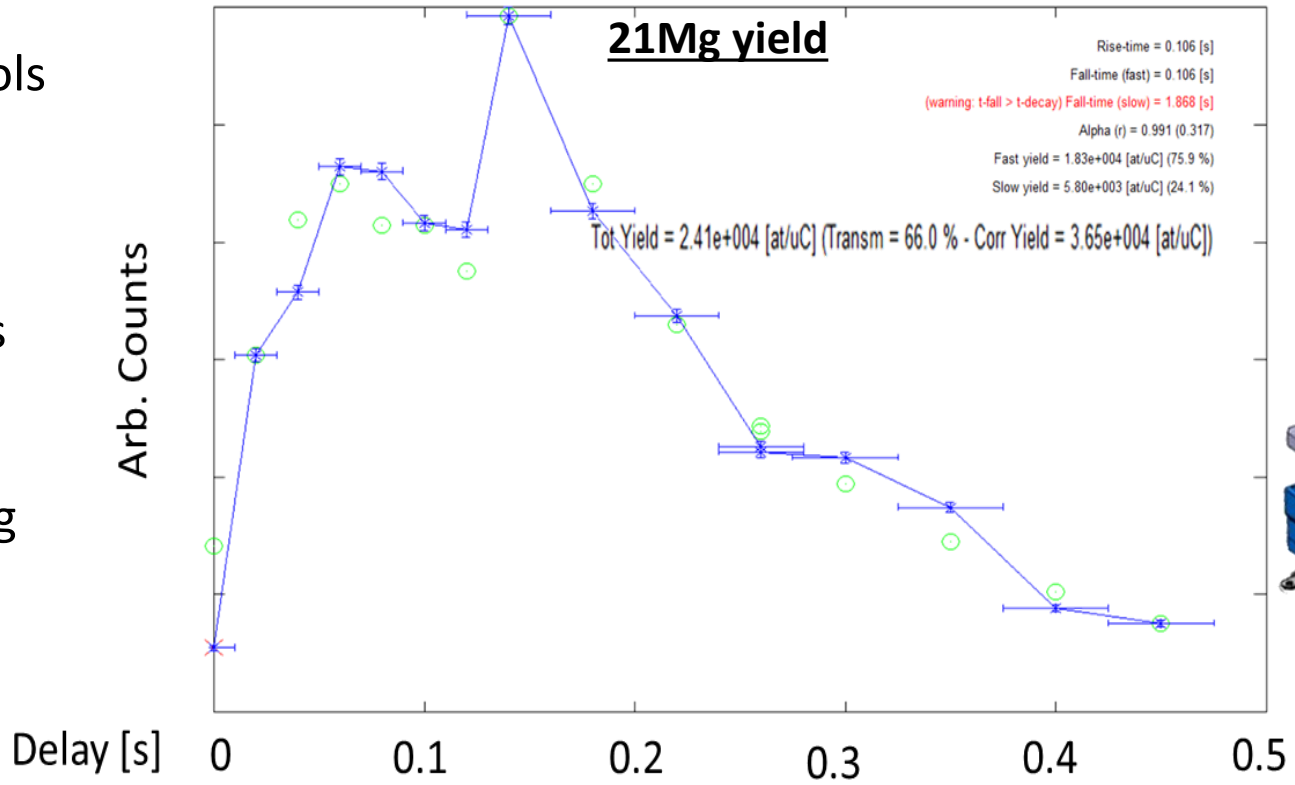
T. Giles

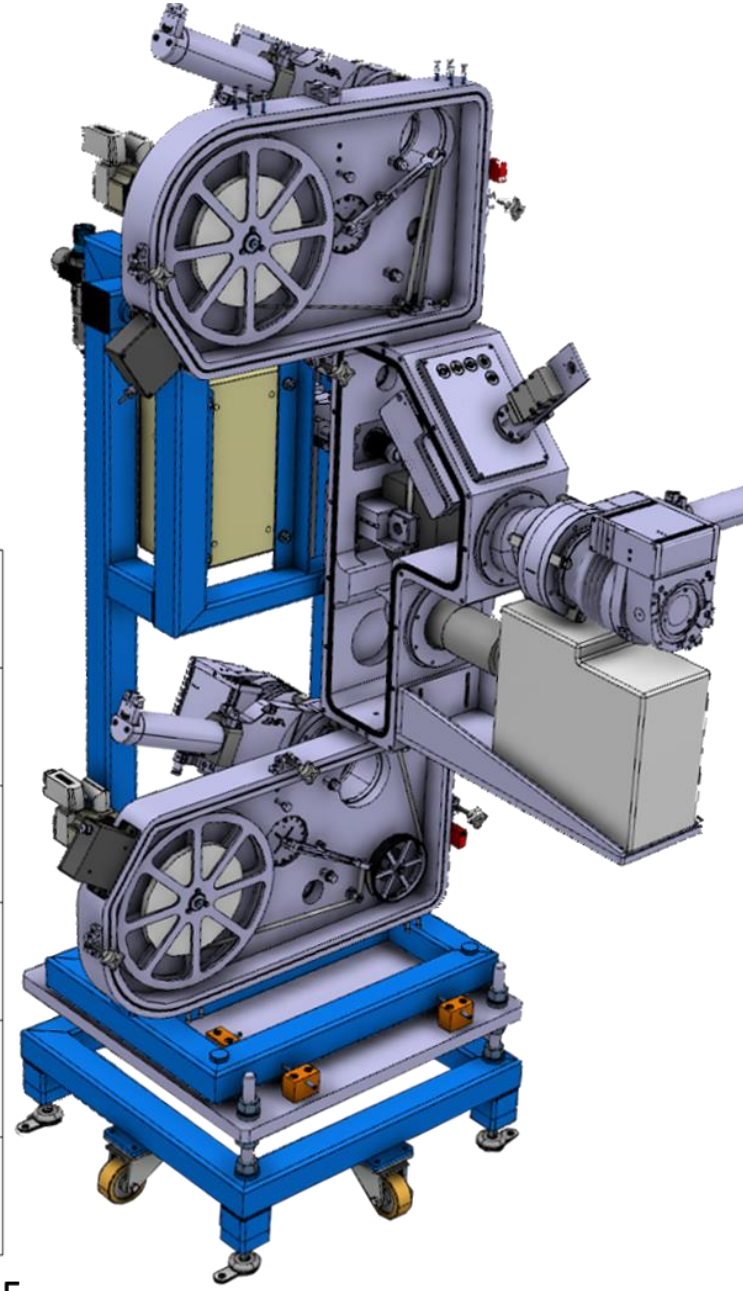
	Combined range	Overlap
Current	300 mm	60 mm
New	350 mm	**150 mm**

~~New~~ Fast Tapestation

Commissioning underway:

- Release curves 134 Cs - identical measured values old and new tape station.
- Beta detectors improved for $2x10^6$ counts/seconds rates
- Short lived isotope (^{21}Mg, $T_{1/2}$ =122 ms) yield measured for the **first time**!
- Mechanical controls tested
- Timing sequence tested
- Beam instruments installed and operational
- RIB commissioning continuing
- Installation in CA0 planned for 2019





Stuart Warren et al

ISOLDE Hall: Separator upgrades

- Mechanical slits on HRS
  - Revise the mechanics (EN-STI-RBS)
- Replacement of flexible compressed air lines
  - 5 yearly preventive maintenance
- *Installation of Fast Tape Station in CA0 beam line*
- Target and ion source gas system to be refurbished
  - Mechanical parts and leak reparation
- Beam gate controls in ICR
- *Beam diagnostics*
- N2 supply line for experiments
- CRIS platform integration and installation?
- *Installation of second HT modulator*

Vacuum

- Maintenance of turbopumps and replacement of oil of primary pumps
- Consolidation of turbopumps (replacement of 6 TMPs)
- Repair leak in tank 1 of exhaust system.
- Replace profibus full range gauges by compact full range gauges in experimental hall
- Replace REX roughing pump
- Consolidation of compressed air system and installation of reservoirs to better protect the vacuum system against power cuts.
- Support FE installation
- Interventions planned for May/June 2020

Water

Machine	Circuits	Stop	Start
ISOLDE	Cryo-primary	18/12/2018	01/04/20
	BTY magnet cooling	18/12/2018	28/02/21
	Hall (incl. Separators, REXEBIS and REXTRAP)	18/12/2018	28/02/19
	HIE-ISOLDE (HEBT lines + triplets REX + RF B. 199	18/12/2018	01/05/20
	Target cooling	10/12/18	…31/07/20
	Mixed water cooling (Ampli RF bldg. 170 + REX cavities	18/12/2018 30/09/19	31/07/19 01/05/20

Electricity

- Cut of 18kV power to ISOLDE
  - 3rd April 2019
  - UIAC-19701
  - Groupe Trane UHF1-0101
  - EWD15*80 (Armoire CV local 197/R-401
  - EBD12*80 : Hvac bâtiment 508/R-006
  - Tableaux machines : ERD11*80, EXD32*80, ERD5*80 ERD2*80, EXD12*80, EXD16*80
  - Armoire UIA0-00045 CLIM REX ISOLDE
  - Ventilation hall 170 local 170/3-401 (Passerelle sur bâtiment 197)
  - UIAC-00094 Bâtiment 179/1-023
- Punctual stops throughout 2019 with prior notice

Stops already announced:
19/12/2018 06:00 to 06:30
Weekend du 20/01/2019 AUG tests PS/Booster

Ventilation and compressed air

- Ventilation
  - 4 weeks stop of ventilation systems throughout ISOLDE
  - Dates
- Cooling maintenance
  - 4 weeks during the stop of the cryo-compressor
  - Proposed dates January and February 2019
- Compressed air will be operational throughout LS2

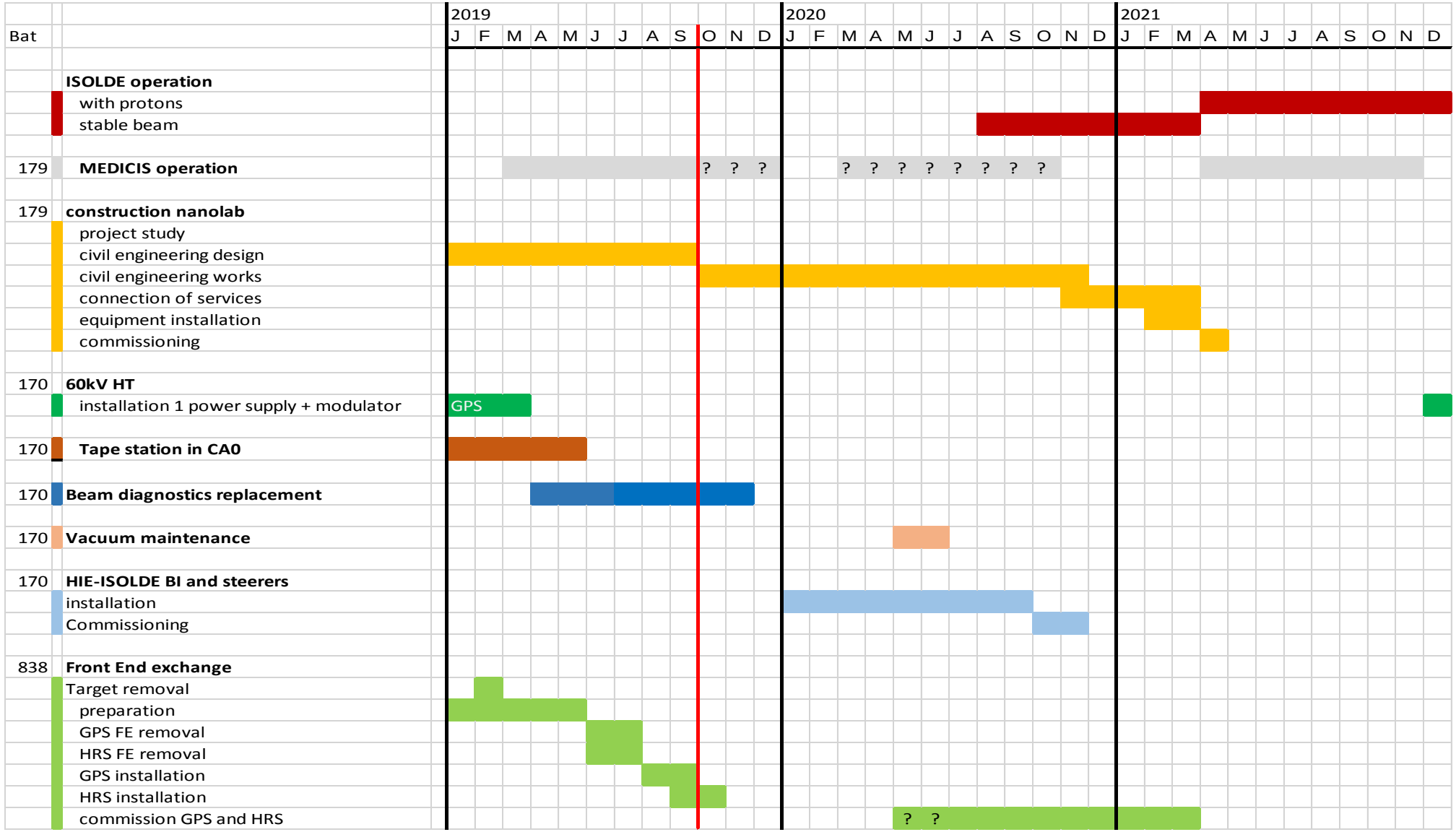
Off-line Facilities

- **Offline 1**
- Vacuum System
- Beam Instrumentation
- Purchase of residual gas analyser
- Control software: upgrade and development of new modules
- **Target production Labs**
- Additional leak detector
- Install second fume hood in chemical lab
- Add demineralized water supply
- Investigating options for save nanomaterial handling
- Optimization target production and documentation using INFOR EAM

- <u>Off-line beam development</u>
- Set up of the ion source test stand
- Long-term ion source performance measurement
- Benchmarking of ion source simulations
- Design of infrastructure to investigate molecular ion beams
- Preparations for in-LIST laser spectroscopy, general LIST development
- Continuation of the ToF-LIS project
- Negative ion source – new materials and geometries
- FEBIAD: Simulation driven optimization. Benchmark of codes at offline.

Sebastian Rothe

Planning


2019
2020
2021
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
Bat
ISOLDE operation
with protons
stable beam
179 MEDICIS operation
? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
179 construction nanolab
project study
civil engineering design
civil engineering works
connection of services
equipment installation
commissioning
170 60kV HT
installation 1 power supply + modulator
GPS
170 Tape station in CA0
170 Beam diagnostics replacement
170 Vacuum maintenance
170 HIE-ISOLDE BI and steerers
installation
Commissioning
838 Front End exchange
Target removal
preparation
GPS FE removal
HRS FE removal
GPS installation
HRS installation
commission GPS and HRS
? ?