

ISOLDE Technical Report/ LS2 activities

Richard Catherall EN-STI-RBS

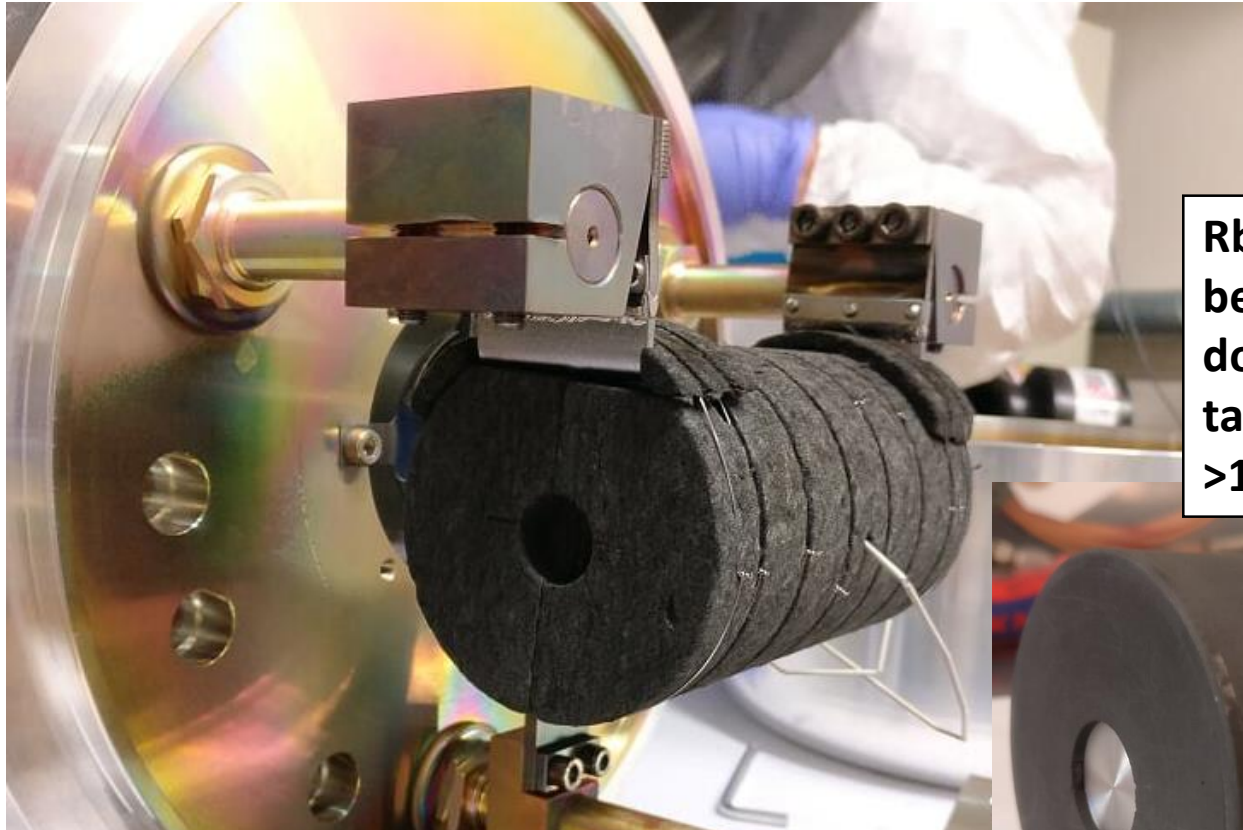
ISOLDE Technical Coordinator

60th INTC meeting 7th November 2018

Outline

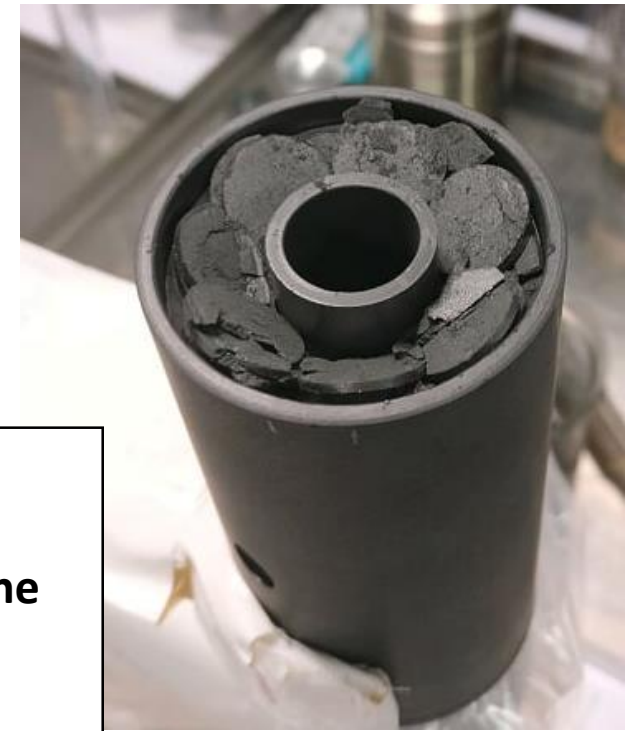
- Highlights
- LS2 activities
 - Target Area and Class A laboratories
 - Experimental Hall (low energy)
 - Services
 - REX and HIE-ISOLDE

p2nconverter - update



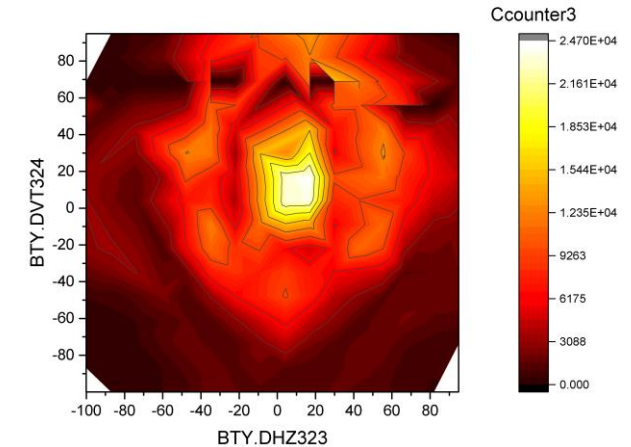
Being tested at
ISOLDE!

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



2nd half of beam time:

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



Proton scan with ^{145}Cs

The Electron Affinity of Astatine

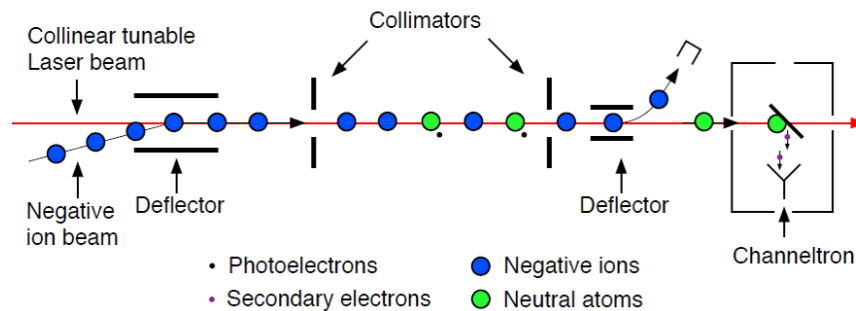
At is rarest naturally occurring element on Earth, ca. 70mg in crust, candidate for targeted alpha therapy

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

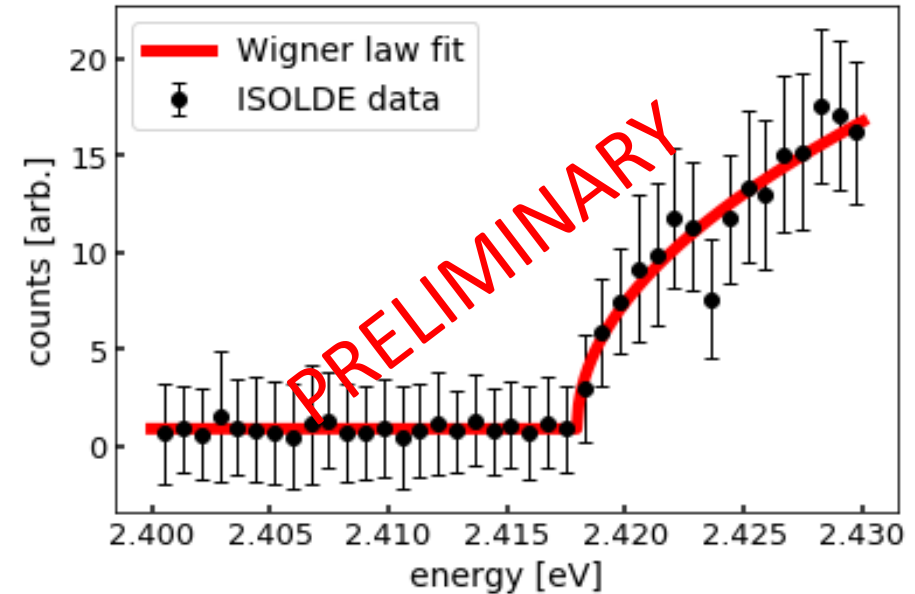
- EA required to describe the chemical properties of At
- Benchmark for quantum chemical models
- Predictions for chemistry of superheavy elements, e.g. tennessine (Ts)
- Can be measured by **laser photodetachment**

Photodetachment threshold spectroscopy:

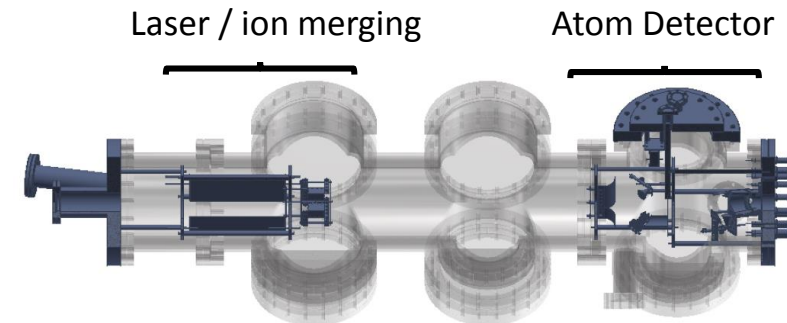
- Laser and negative ion beam are overlapped
- Detachment cross section is given by the Wigner law $\sigma(E) \propto (E_\gamma - E_{th})^{l+\frac{1}{2}}$



Photodetachment of astatine

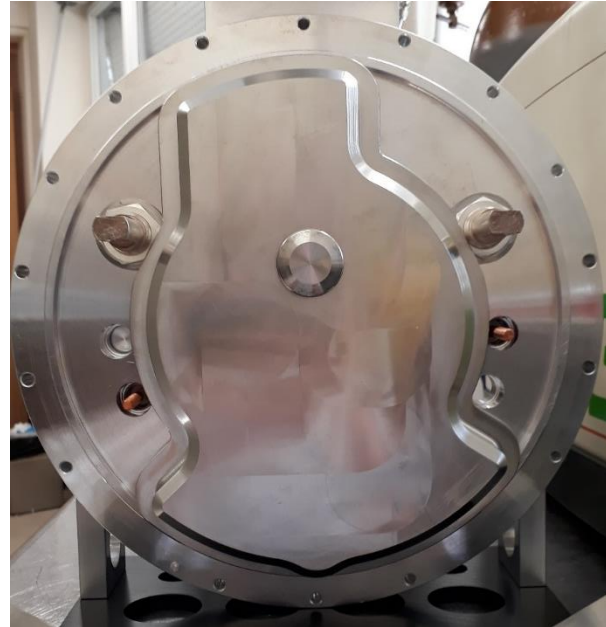


1st ever measurement of the EA of At achieved with the GANDALPH-beamline at ISOLDE

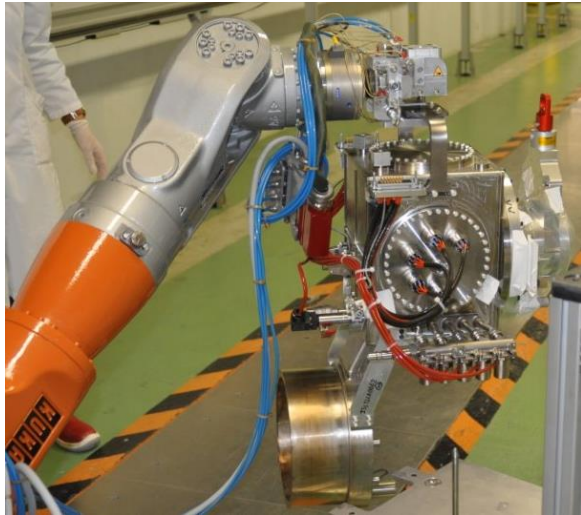


LIEBE: offline commissioning & prospects for ^{100}Sn @ HIE-ISOLDE

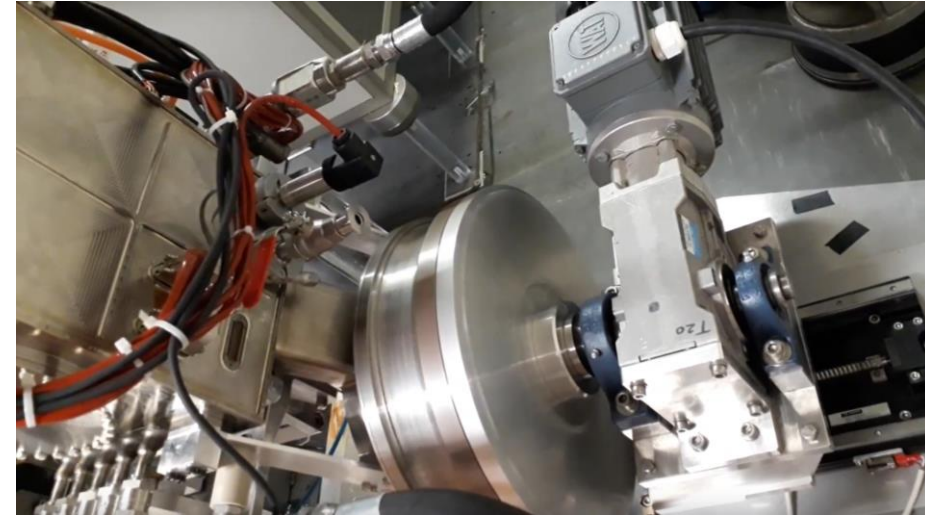
Successful replacement of the target base



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.*

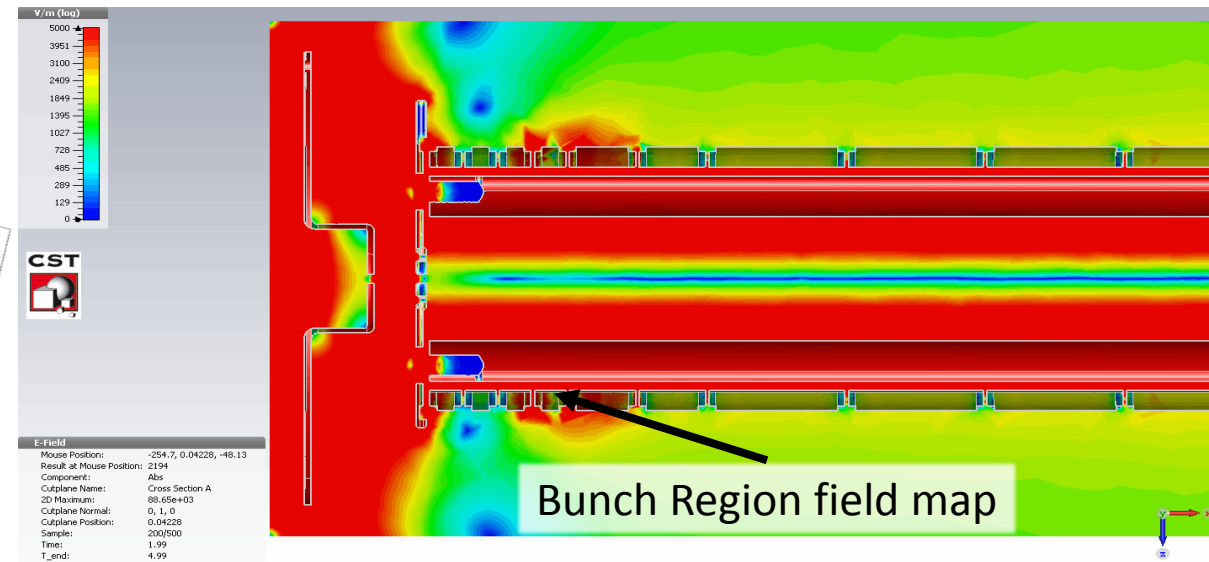
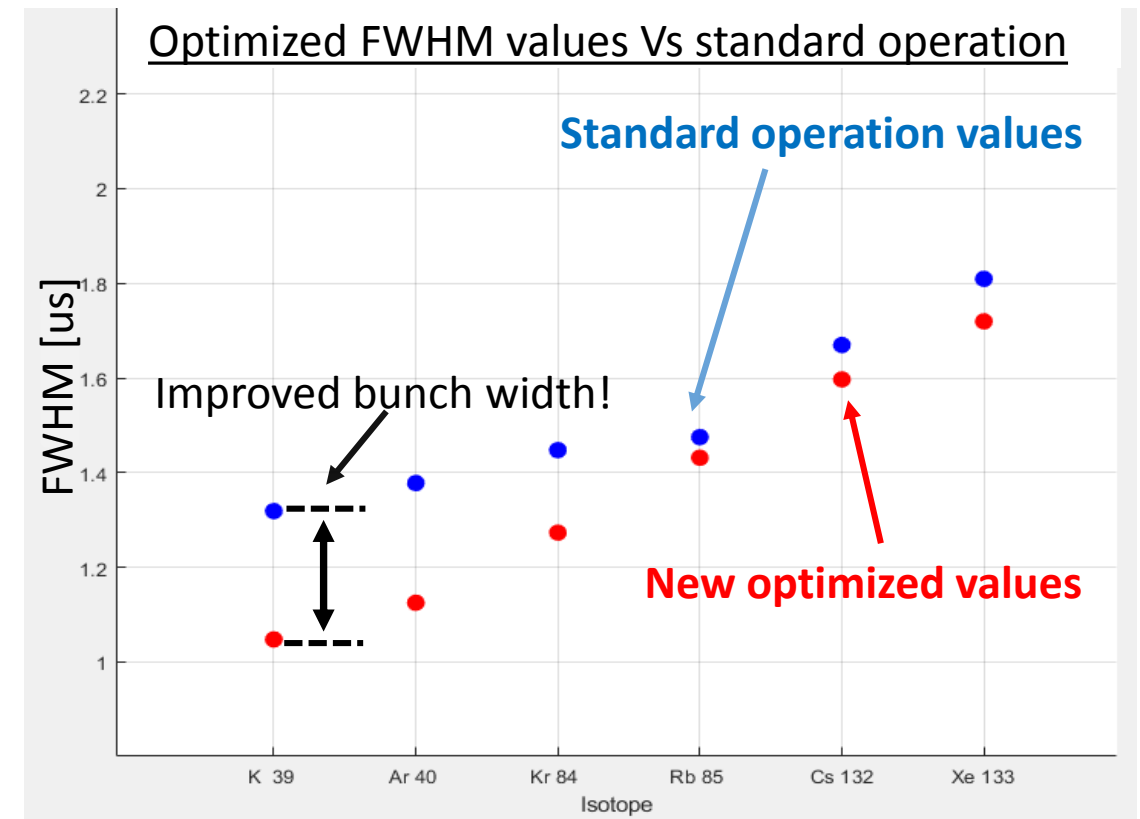
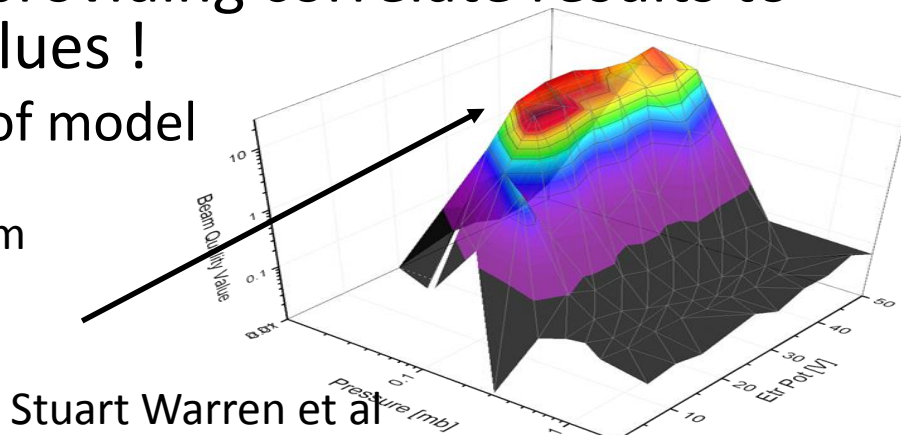
Shower formation in a liquid LBE target – An experimental and numerical study of the jetting and dripping regimes, *M. Delonca et al, in prep.*

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

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



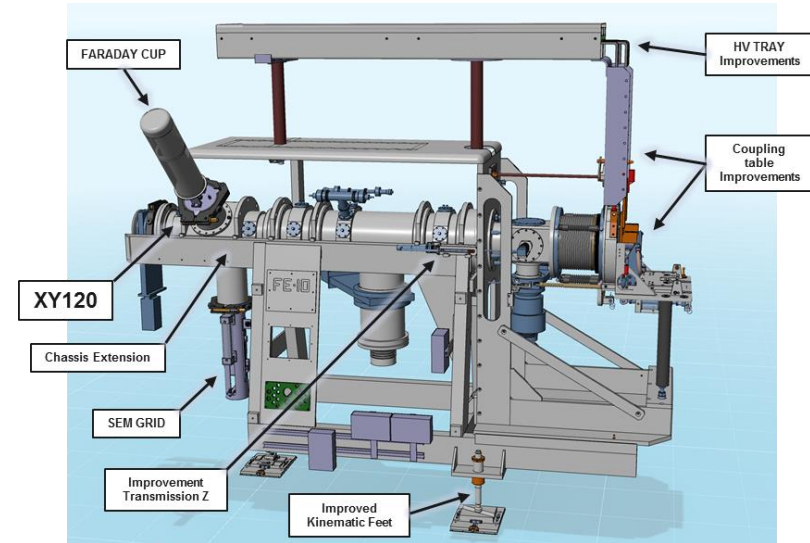
LS2 Activities

- Target area and Class A labs

FRONTEND 10 & 11

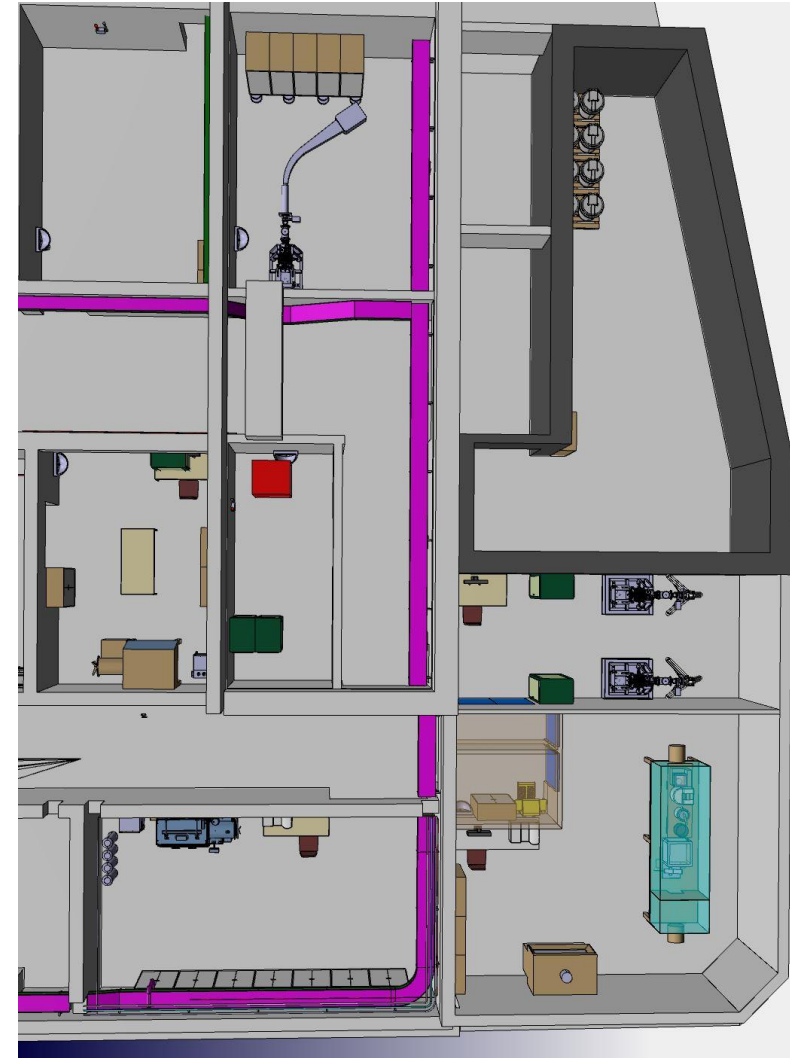
FRONTEND 10&11 Status November 2018

- **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.

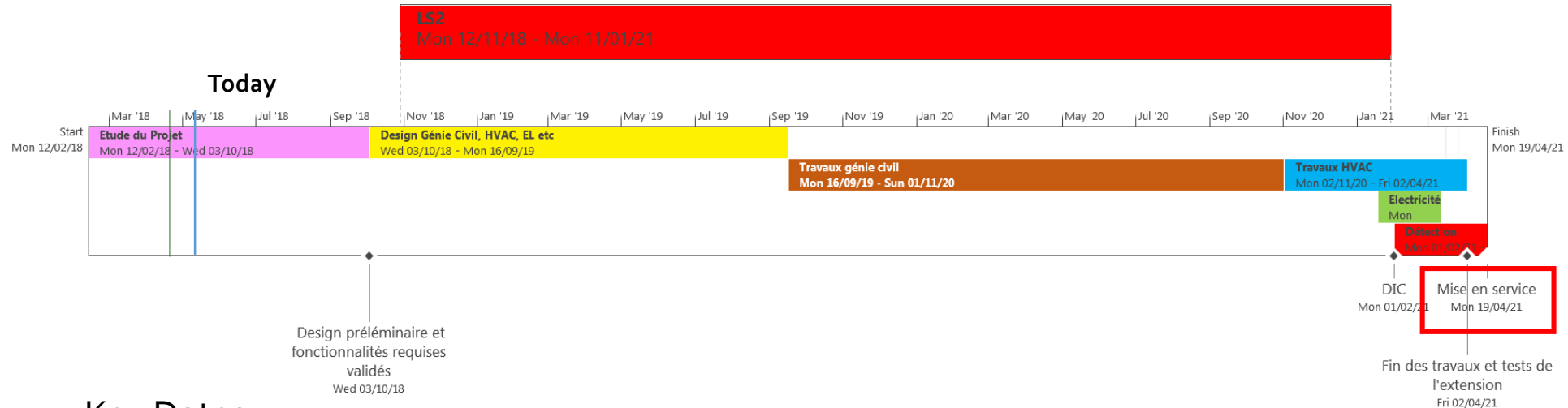


Layout of the Class A Extension (nano-lab)

- 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**

MEDICIS

Newly appointed MEDICIS run coordinator : J. P. Ramos

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



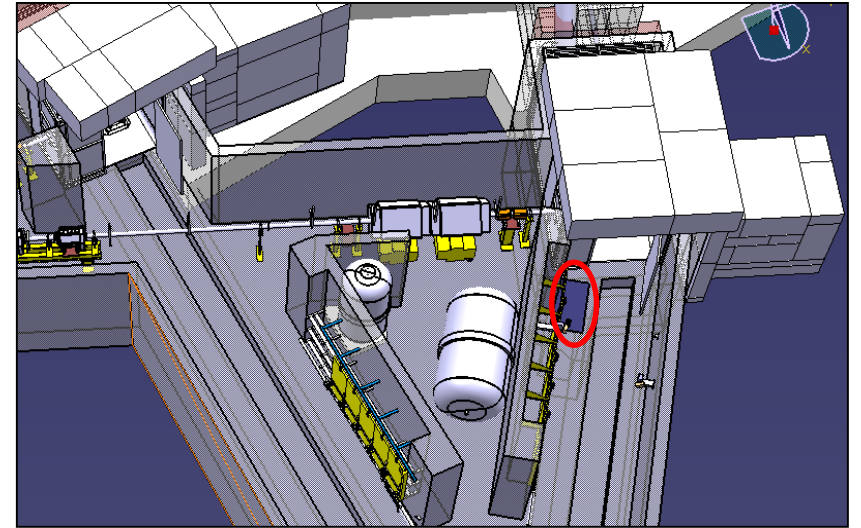
2nd MEDICIS Board took place 3rd October - 3rd Board planned Feb/March 2019

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



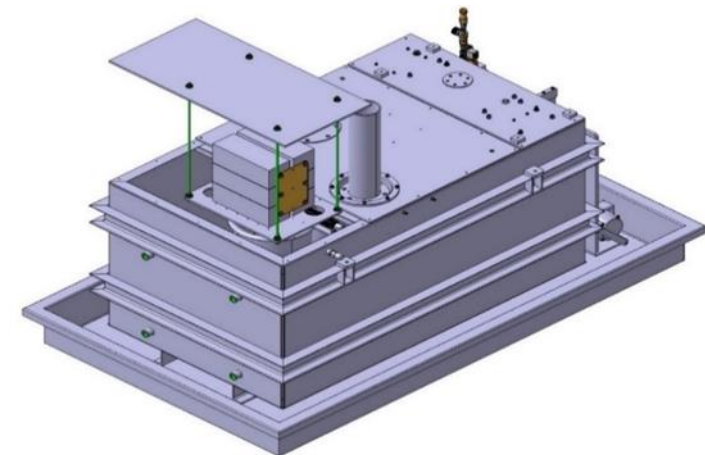
LS2 Activities

- Experimental Hall (low energy beamlines)

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



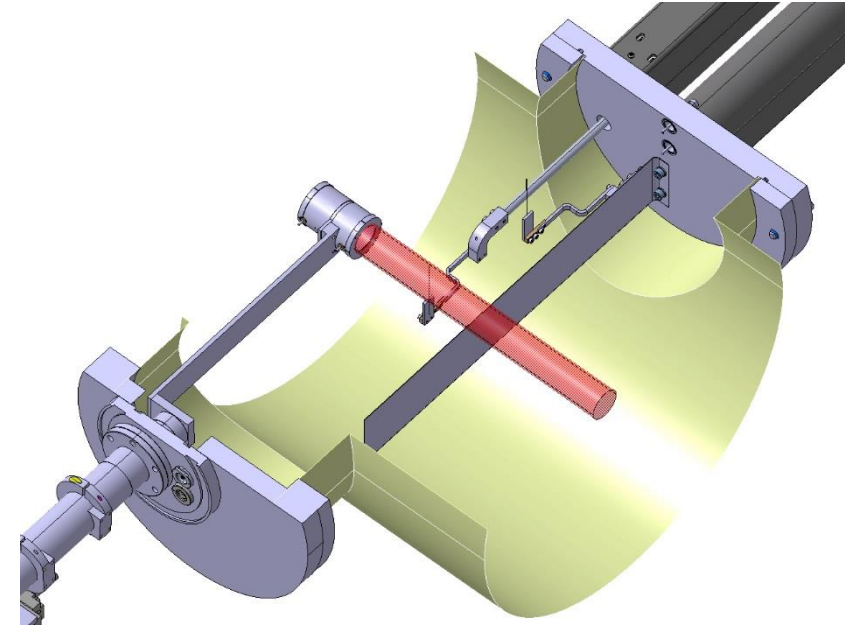
Recovery time (μs) of HT (+/-0.6V) with protons on convertor

Beam diagnostics

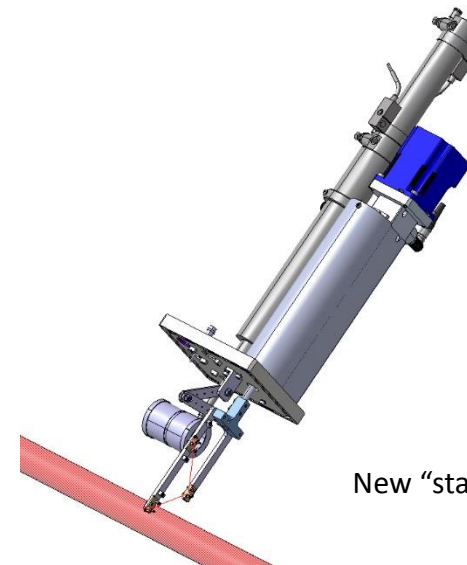
- BE-BI group to procure 20 FC/scanner units for low energy beam lines by Q1 2019
 - Need to prioritize which scanners are to be exchanged

	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

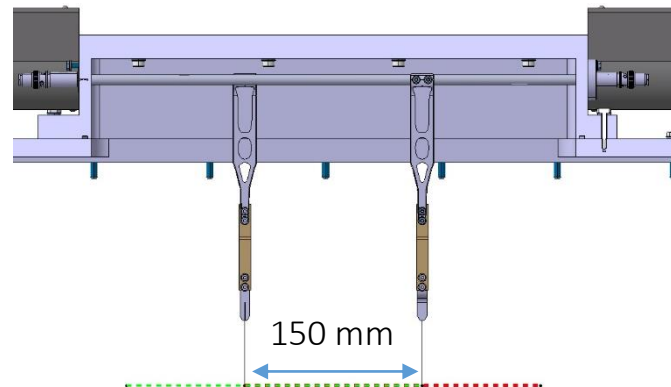
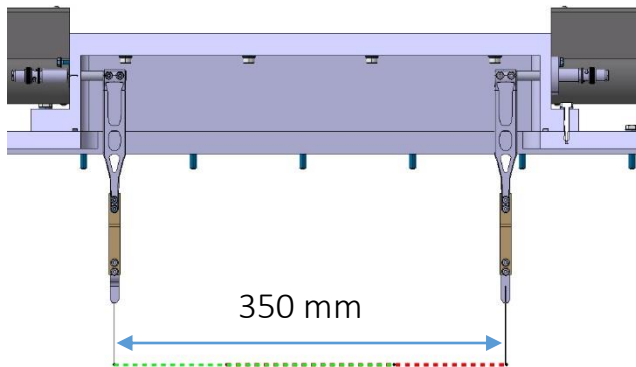
Magnetically coupled push-pulls: 250 mm stroke
 + 70 mm/needle: **Extra 140 mm to be allocated**

More **combined distance**

More **overlap** between two needles

+ Covers different mass ranges

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



Ana Miarnau Marin BE-BI

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

Max. useful range of combined scanners
 300 mm (mass range $\pm 10\%$)

No need for beam instrumentation at extreme
 edges when using mass ranges $\pm 15\%$

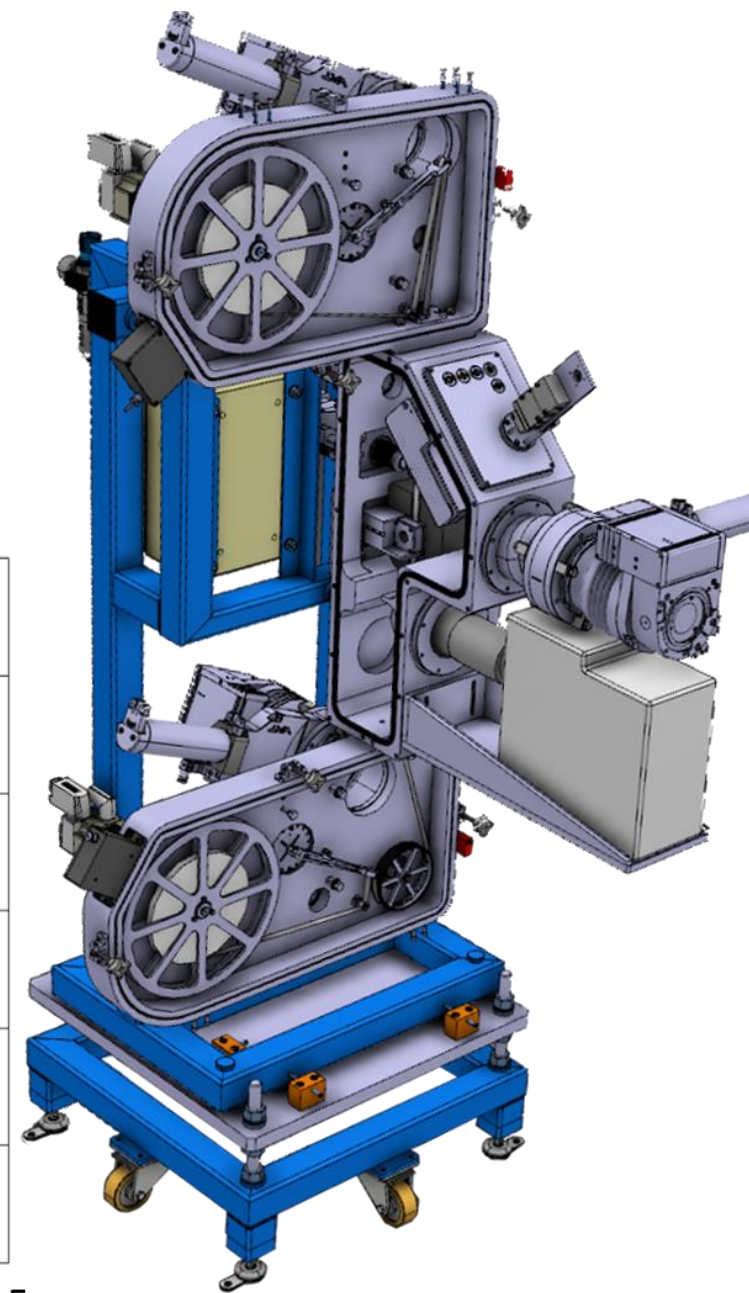
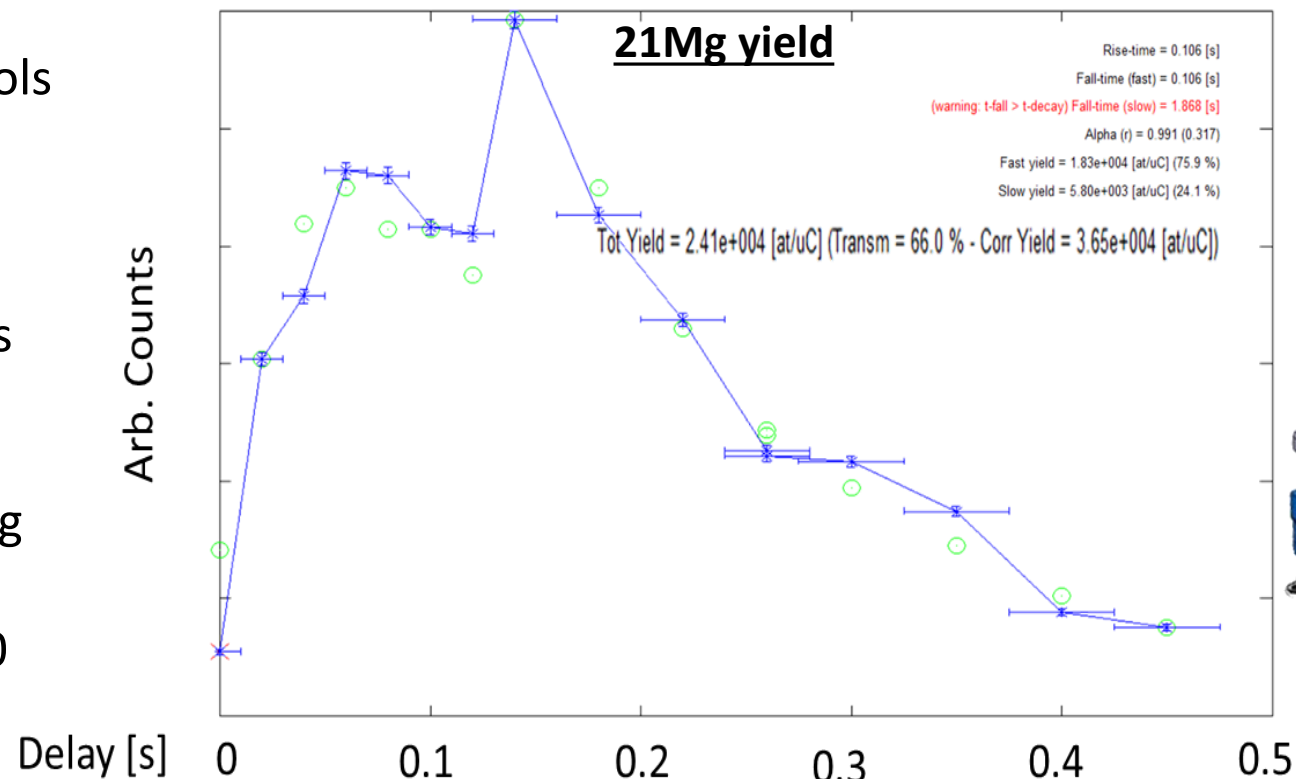
T. Giles

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

New Fast Tape Station

Commissioning underway:

- Release curves ^{134}Cs - identical measured values old and new tape station.
- Beta detectors improved for 2×10^6 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



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 repairation
- Beam gate controls in ICR
- *Beam diagnostics*
- N2 supply line for experiments
- CRIS platform integration and installation?
- *Installation of second HT modulator*

LS2 Activities

- Services

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

Stops already announced:

19/12/2018 06:00 to 06:30

Weekend du 20/01/2019 AUG tests PS/Booster

- Punctual stops throughout 2019 with prior notice

Ventilation and compressed air

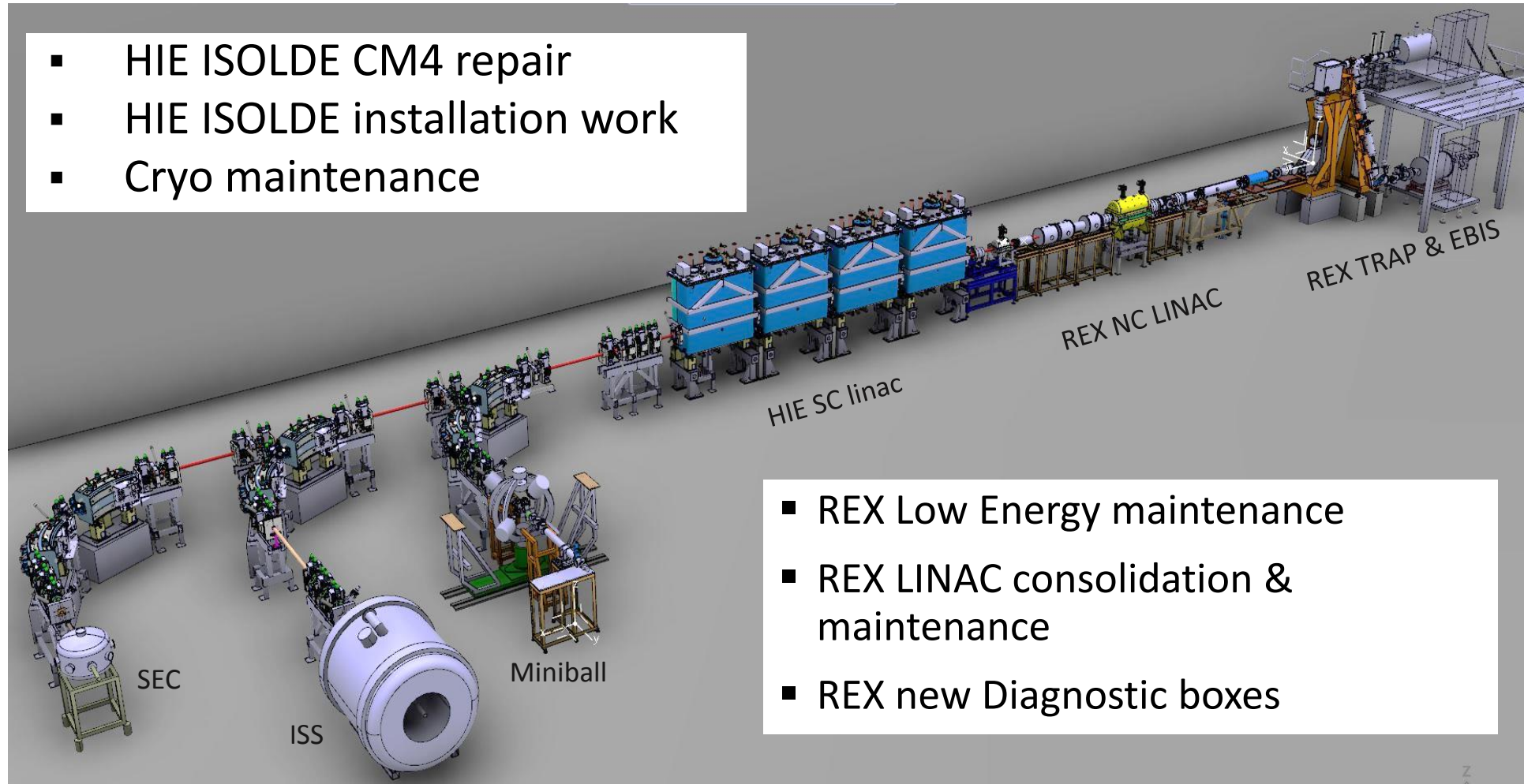
- Ventilation
 - 4 weeks stop of ventilation systems throughout ISOLDE
- Cooling maintenance
 - 4 weeks during the stop of the cryo-compressor
 - Proposed dates January and February 2019
- Compressed air will be operational throughout LS2

LS2 Activities

- REX and HIE-ISOLDE
 - Courtesy of Erwin Siesling

Outline:

- HIE ISOLDE CM4 repair
- HIE ISOLDE installation work
- Cryo maintenance



- REX Low Energy maintenance
- REX LINAC consolidation & maintenance
- REX new Diagnostic boxes

REX Low Energy maintenance

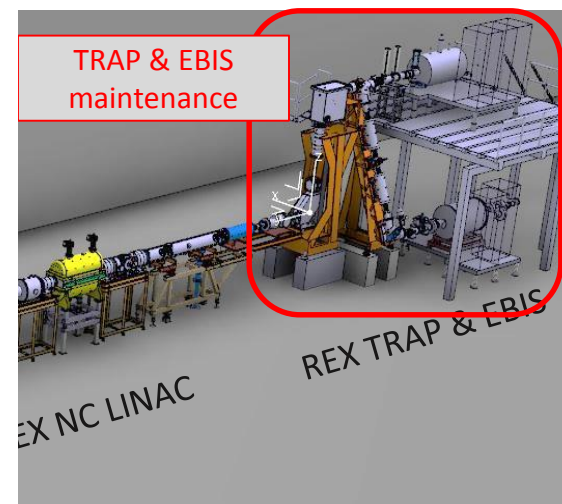


REXTRAP:

- 1a. Verify insulation of all internal electrodes, use HV tester
 - b. If faulty, open up REXTRAP, produce new insulators, exchange inside trapping structure
2. Instability of XTRAP.ST_EJC (and INJ)
 - open up REXTRAP, probably redo some of the Macor insulator rings
3. Measure RF amplitudes on the 8 central electrodes for different frequencies
4. Exchange the generation of the RF signal from CVORG for an 8-ch DDS card, not decided yet if during LS2
5. Revise power supplies for REXTRAP solenoid
6. Exchange zeolithe powder for the local ion source
7. Make sure all three Scope-in-the-box for the RF electrodes work correctly
8. Mark timing cables for REXTRAP
9. Clean REXTRAP HV platform and cage

REXEBS

10. Revision of motor-generator, complete over-haul
11. Rebuild electron gun (electron current losses, stability, vacuum, ion injection)
 - construct a more sturdy cathode assembly & gun with higher current compression
 - 12 months, A. Pikin, F. Wenander, EN/MME or outsourced design and construction before Dec 2019, tests during 2020
12. Exchange water cooling tubes EBIS
13. Clean water flow meters EBIS
14. Perform necessary bakeouts at each electron gun test
15. Clean HV platform and cage
16. Controls
 - 'standardize' application for slow extraction?
 - correct readback of EBIS HV, Lens1 and Lens2 voltages



BE-ABP F. Wenander,
C. Mastrostefano, J. Thiboud
BE-OP-ISO M. Lozano Benito,
BE-RF (M. Paoluzzi)
TE-EPC N. David
TE-VSC J. Ferreira Somoza

Common tasks

17. Vacuum work
 - Service all turbo pumps
 - Verify status of tubes for compressed air
18. TE/EPC work?
 - input from N. David
19. BE/BI?
 - Verify status of tubes for all compressed air

REX LINAC consolidation & maintenance



- Maintenance of the 90 kW 101 MHz amplifier resonators (full disassembly)
- Installation 5kW 101MHz solid-state Buncher amplifier (plus one purchased as spare)
- Replace the optical links in the power amplifiers
 - Consolidate the “Measurements Units”
 - Replace Grid1 and Grid2 variacs with solid state modules
- Consolidate the 202MHz Dressler solid-state amplifier used as tube amplifier pre-driver (obsolescence of some strategical components)
- Develop new FESA 3 classes for remote control of power amplifiers:
 - Implement an automatic ramp-up of the equipment after “reset”
 - Improve the monitoring/logging (e.g. critical interlocks, tube gain)
- REX RF validation tests can be carried out during LS2 (CV-OP: the 20 degree cooling water will be made available during Q2/3 2019)

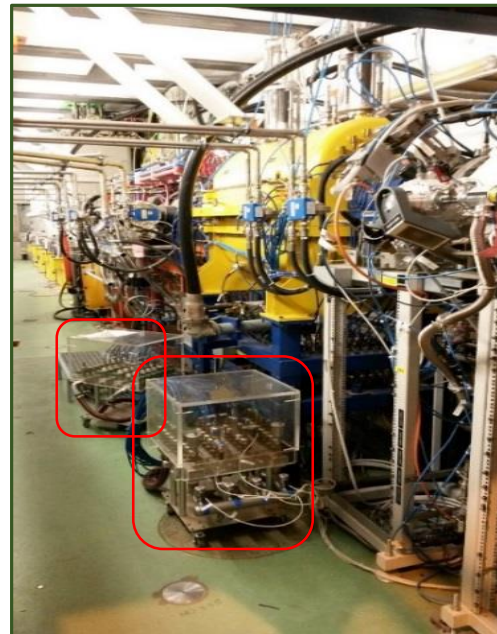
(Luca Timeo & RF team)



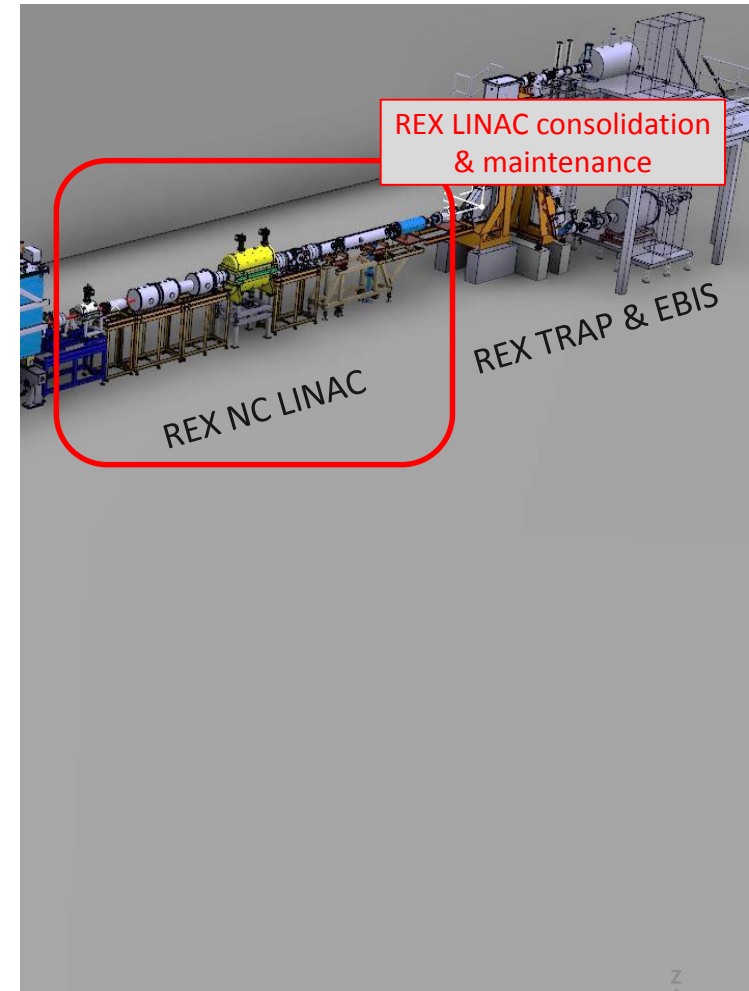
REX RF amplifiers in the REX RF room

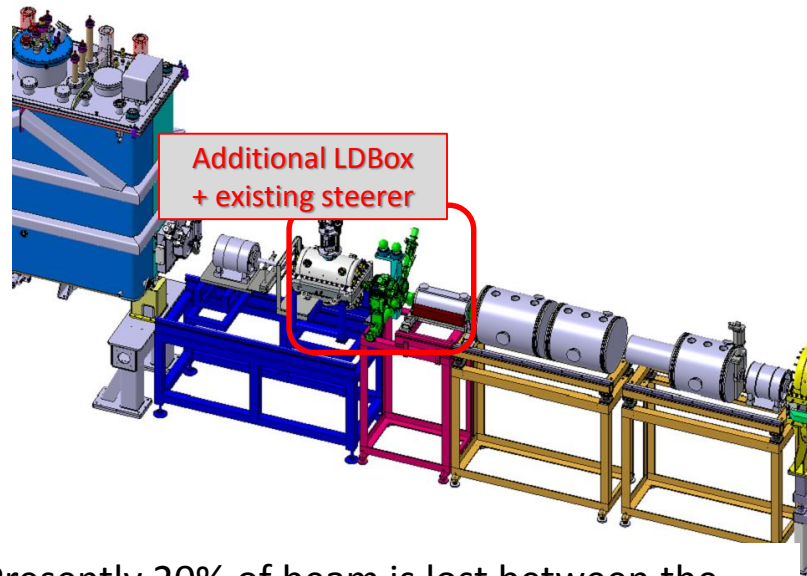
REX LINAC consolidation & maintenance

- Full vacuum system maintenance (Jose Ferreira Somoza & Vacuum team)
- new cooling system for IH structure (contractor)
- Water cooling hoses of some cavities need a complete overhaul
- Check of all flow and thermal interlock switches (magnets & NC cavities)



IH structure cooling water distribution





Presently 20% of beam is lost between the REX separator and the HIE-ISOLDE LINAC. To understand and improve the quality of the beam, and reduce losses beam diagnostics are required (+ an additional steerer REX-ISOLDE type).

3 new standard Long type HIE-ISOLDE diagnostic boxes with modified vacuum chambers will be installed keeping future consolidation of REX in mind.

3 new REX Dboxes + steerer:

- Project initiated by Jose Alberto Rodriguez (BE-OP) and ECR written by Simon Mataguez (BE-OP) covering costs & manpower, modifications and integration points
- Integration done (Nicolas Joannon EN-MME)
- Will require severe modifications of vacuum chambers and supports
- Budget has been allocated (Richard Catherall EN-STI)
- Manpower during LS2 has been allocated by the different groups (BI, Magnets, Vacuum, Transport)
- Installation foreseen Q2/3 2020

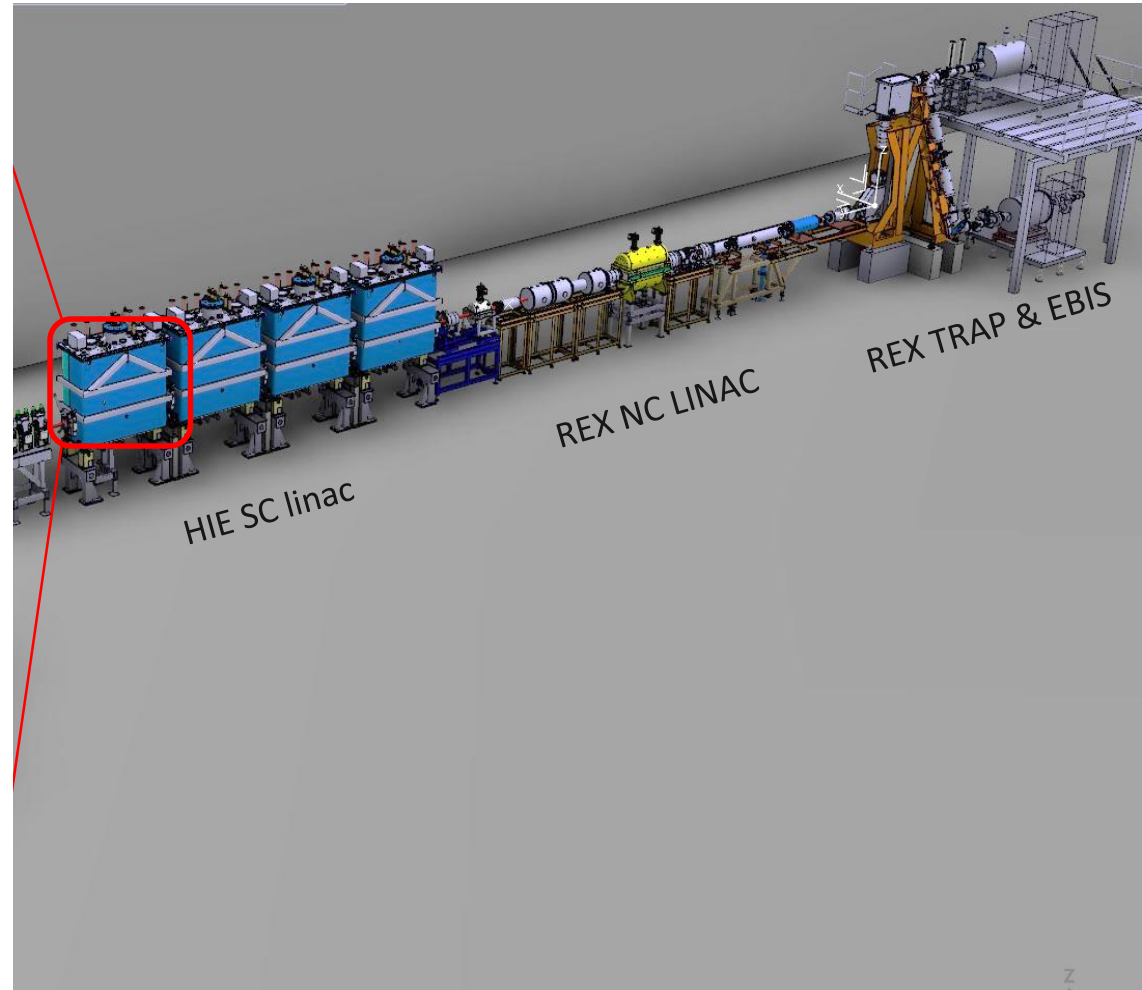
Slowdown but not showstopper:

- New tender to go out for manufacturing of the HIE ISOLDE Dboxes

HIE ISOLDE CM4 repair

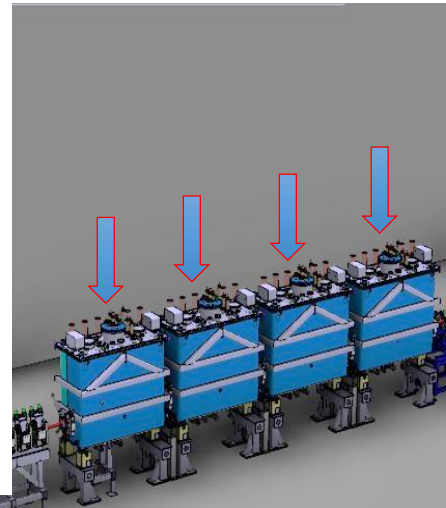
Dis- and re-mounting CM4:

- Warm-up of the HIE SC LINAC as of 7th December until max 18th December (cooling water stop)
- Gives enough time to finish all planned 'Winter-Physics' + TRAP, EBIS & REX tests (Niels Bidault)
- Preparations CM4 dismount as of January. It involves dismantling:
 - BCAM survey system (survey team)
 - Top-plate RF cabling, instrumentation and motors (RF team)
 - Vacuum pumps & chambers (Vacuum team)
 - Cryo flexibles, He release and Solenoid leads (Cryo team)
 - Steerer magnets (Magnet team)
 - Diagnostic Boxes (BI team)
 - Tunnel roof (Transport)
- A planning will be in place taking availability (LS2 workload) of the different groups in account. The transport of CM4 is foreseen mid-March 2019 to SM18 (cleanroom)
- CM4 expected to come back to the ISOLDE hall January 2020
- Aiming to finish installation and start re-commissioning by April 2020. Cooling water will be available and the Cryo plant will be able to start up. Tests with stable beam in parallel with ISOLDE Low Energy start-up.

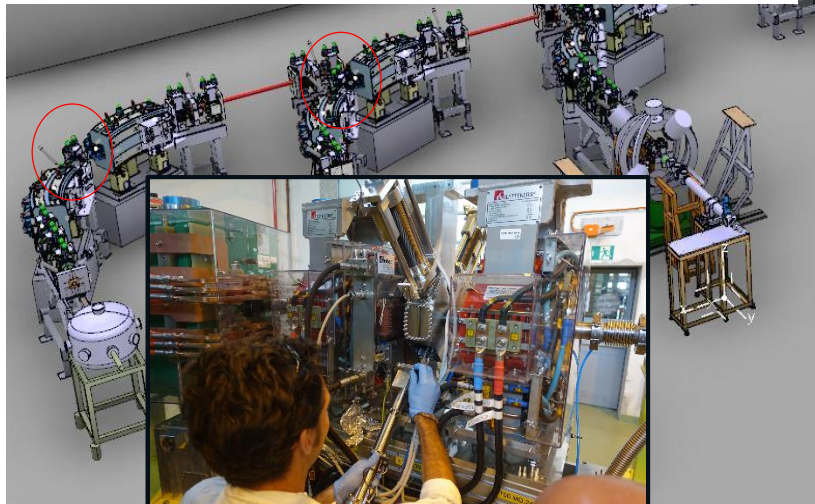


Other HIE ISOLDE installation work

- Installation of 4 RAMSES radiation monitors type IAM (Induced Activity Monitor), one for each CM (Alexandre Dorsival, RP team, Pawel Burdelski, Cabling team)
 - This will significantly improve the analysis of SRF cavities field emission issues during RF conditioning and during the run



Presently: Mobile radiation monitor



- Survey scan of the complete SC LINAC and REX (Antje Behrens, Survey team)
- Installation of Silicon detectors in the XT02 & XT03 Dboxes (between the dipoles) for energy measurements (William Andrezza, Sergey Sadovich, BI team)

Cryo maintenance

Cryogenics

- Preventive maintenance of the cryogenic system including major overhauling of rotating machinery
- Cryo operation: Setup of the automatic controls for transient modes
- Due to the adequate repair this year (YETS 2018) by CRIOTEC of the Cryo Distribution System, no CDS intervention will be needed
- All maintenance work will be carried out through 2019. The cryo plant will be operational and ready for re-start before April 2020 for cooldown and re-commissioning of the HIE LINAC



Acknowledgement



- EN/EA : FABIO FORMENTI
- GS/SE : DANIEL PARCHET
- EN/ACE : STEPHANE MARIDOR, JEAN-CHRISTOPHE GAYDE, ESTRELLA FERNANDEZ, ANTJE BEHRENS, ALEX BEYNEL
- BE/ABP / OP : SIMON MATAGUEZ, FREDERIK WENANDER, JOSE ALBERTO RODRIGUEZ, ELEFTHIS FADAKIS, MIGUEL LOZANO BENITO, ERWIN SIESLING
- PH/SME : MARIA BORGE, KARL JOHNSTON, GERDA NEYENS
- BE/RF : DANIEL VALUCH, WALTER VENTURINI DELSOLARO, MATHIEU THERRASSE, AKIRA MYAZAKI
- EN/CV : AZIZ AMAMOU, NICOLAS ROGET, HASSANE SABRI
- EN/EL,TE/EPC: RENE NECCA, GEORGI GEORGIEV, MICHELE MARTINO, PAWEL BURDELSKI, NICOLAS DAVID
- TE/CRG : JOS METSELAAR, OLIVIER PIROTTE, NICOLAS GUILLOTIN, REMI GUEYDAN
- EN/STI : RICHARD CATHERALL, ANA-PAULA BERNARDES
- GS/DI : CYRILLE BEDEL, YANNICK BERAUD
- TE/MSC : YANN LECLERCQ, LLOYD WILLIAMS, VITTORIO PARMA, JEREMIE BAUCHE, DAVID SMEKENS, GRAEME BARLOW, JEAN BAPTISTE DESCHAMPS
- DSG/RP : JOACHIM VOLLAIRE, ALEXANDRE DORSIVAL, ELODIE AUBERT
- TE/ABT/ MPE : MATTHEW FRASE, RICHARD MOMPO
- TE/VSC : JOSE FERREIRA SOMOZA, GUILLERMO FERNANDEZ, ABEL GUTIERREZ, PAUL DEMAREST
- BE/BI : WILLIAM ANDREAZZA, SERGEY SADOVICH
- EN/MME : ANTTI KOLEHMAINEN, MARC TIMMINS
- EN/HE : JEAN-LOUIS GRECARD, FRANCK SCHNEITER and the entire Transport Team