

INTC Technical Report

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ISOLDE Technical Coordinator

59th INTC meeting 27th June 2018

Outline

- Recent developments
 - Start up
 - Tape station
 - HT upgrade
 - Target Development
 - RILIS
- Long Shutdown 2
 - Activities postponed
 - Target area
 - Frontend replacement
 - ISOLDE Hall
 - Scanner and FC upgrade
 - HT upgrade
 - Slits
 - REX
 - HIE-ISOLDE
 - Building 179
 - Nanolab construction
 - Overall Planning

Start-Up 2018

- Water back on 26th February
- Cold check out from 26th February till 26th March
- SEM Grid tests done in week before and during Easter
- HT tests on new modulator done in week after Easter
- First experiment as from 9th April
- Lots of initial beam diagnostics and controls issues during cold check out
- Too many co-activities...
 - RFQ Cooler tests
 - Cold check out
 - RILIS developments

Fast Tape Station check out

- Two days of beam time allocated in week 20 but not very conclusive
 - The local control screen has been removed. Managed to operate it through FESA navigator
 - Triggering had to be repaired.
 - Beamgate wired up and working but timing still needs to be tested.
 - The collimator was not working and had to be moved in manually
 - Numerous issues with the beamline including inversion of quadrupole polarities and scanners not working. Equally the HT was unstable at 60kV. The detector counters are incorrectly configured.
 - A new NIM module caught fire and damaged the crate power supply, causing one of the rails to over-voltage. The supply was replaced, but it looks as though the discriminators were damaged.
- Further testing will be done in August.
- The tape station has to be successfully tested before being installed in the CA0 beam line during LS2

New HT modulator

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 (μ s) of HT (+/-0.6V) with protons on convertor

Specification < 2ms

Compares to ~8ms on the previous Astec supply

TE-ABT-EC request to install a new modulator and power supply on the GPS in Q1 2019.

Benefit from the existing FESA controls and not put resources into making a new FESA class for the very old Astec supply

Drawback – no negative ion run in 2021. Bi-polar power supply needs further testing before being installed.

Target Overview APR-JUN 2018

12 targets retrieved from ISR

Cibles	Matériau	Operation 2018
#513	MWCNT-VD5	Tested in April
#534	Sn	used in April
#619	Pb-VD5	#577 backup
#620	LaC-Ta	#640 backup
#629M		Used at MEDICIS
#621M		Used at MEDICIS
#541	UC-VD7	#659 backup
#565	Ta-W	#655 backup
#577	Pb-VD5	#619 backup
#599	Ti-Foils	used in May
#618	Uc-n	used in May
#596	CaO-VD	Not scheduled

21 targets used / tested at offline

6 Units for development

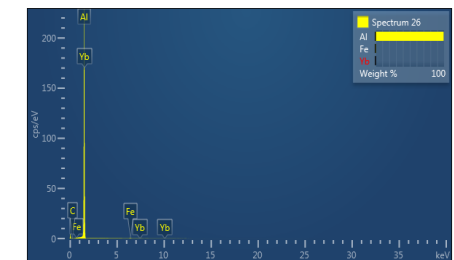
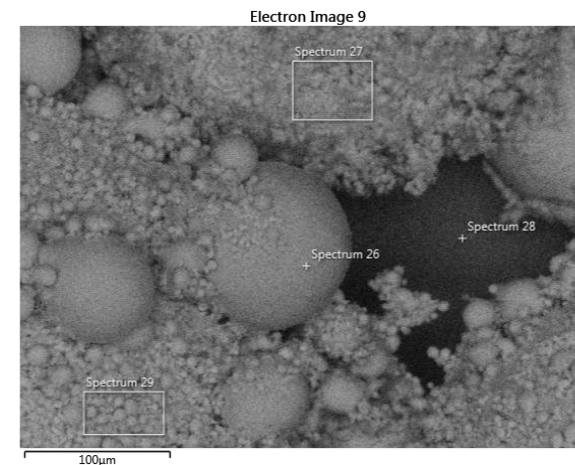
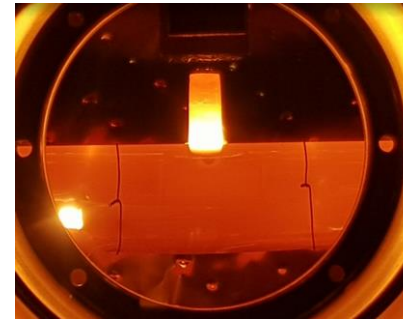
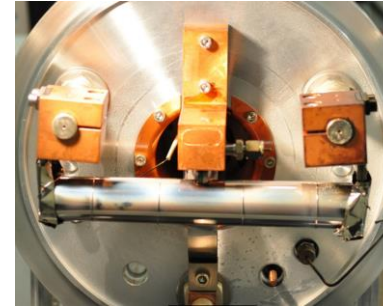
11 Units irradiated at ISOLDE

#614	empty	VD5	Mn tests PSI , Se tests ILL
#633	Nb foil	MK4 negative LaB6	Development, GANDALPH
#640	LaC	RILIS	In -> CRIS
#650	MWCNT	VD7	8B -> IDS
#627	Ta	RILIS	Sc
#567	Sn molten	VD7	backup for #534
#657	No target	VD7	LIEBE test
#651	ZrO	VD5	GeS /Ge -> COLLAPS
#652	ZrO	VD5	70Br
#653	UC (UC-2018-01)	MK1-Ta	Cu
#654	UC (UC-2018-02)	MK1-W	K
#626	Ta	RILIS	Sc
#660	SiC	LIST - 90mm	22Mg
#661	Empty	VD5	MD ISCOOL
#655	Ta	RILIS	Tb /Dy
#570	n.a.	GANDIS	Gandalph offline source
#656	empty	VD5	Mn tests PSI
#658	UC (UC-2018-04)	RILIS	Bi
#502	empty	n.a.	n-Converter dev
#628	empty	n.a.	nConverter / MEDICIS dev
#634	empty	LIST - 34 mm	LIST development

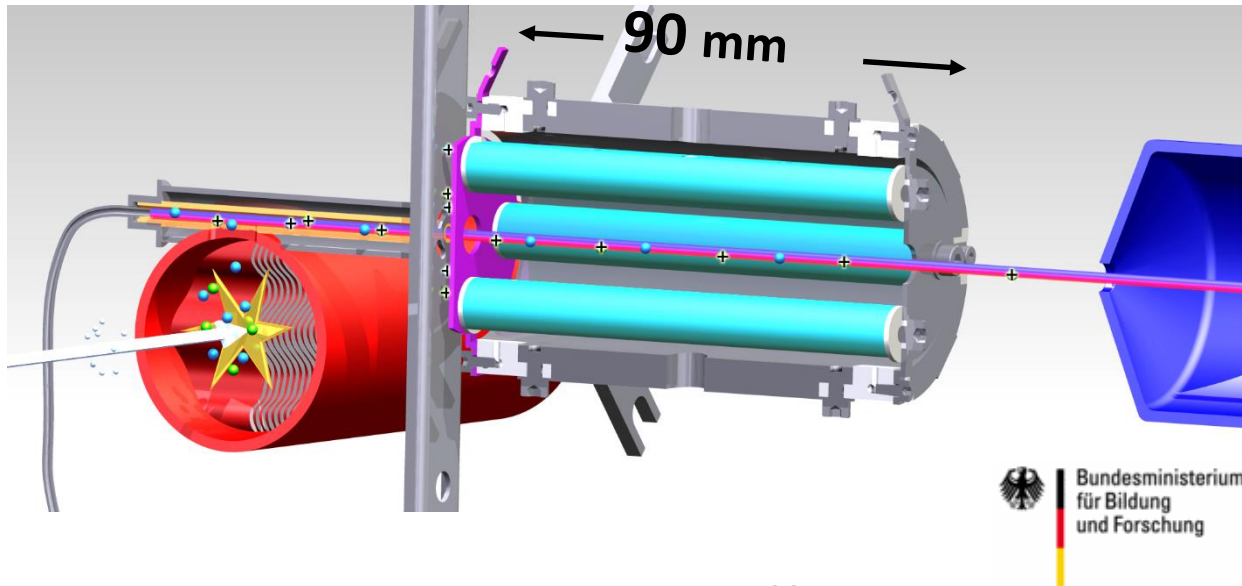
Target #606 -> #650

MWCNT for 8BF2 beams at IDS

- 2017: #606 Target could not be delivered, #513 was used
 - No infrastructure available to handle C nano tubes
 - Decided to recuperate charge from #606 for #650
 - Disassembly: transfer line found clogged with AlF
 - Target outgassed to remove contaminants
 - Found macroscopic amount of Aluminum in transfer line
 - Successfully used #650 for IDS run
 - Factor 10 yield increase compared to #513
- > **#650 rescheduled for HIE ISOLDE**



HFS studies of polonium / suppression of francium (IS456, September 2012)



Final on-line characteristics with SiC target:

- Suppression factor 1E6 measured for ^{21}Na
- Laser ion loss factor of 27 on ^{22}Mg
- No ^{22}Na seen in IS614 detectors
- Factor ~ 20 less yield on ^{22}Mg compared to database

Isobaric suppression > 1000 , efficiency loss ≈ 50

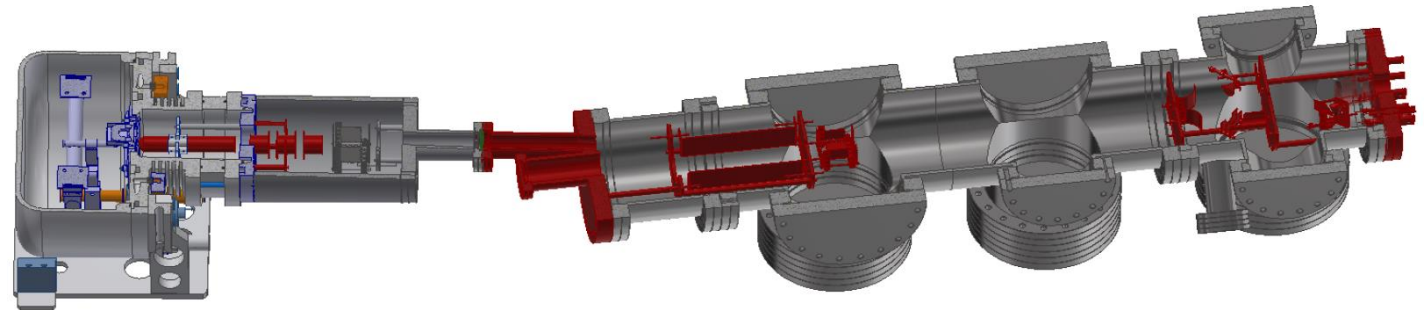
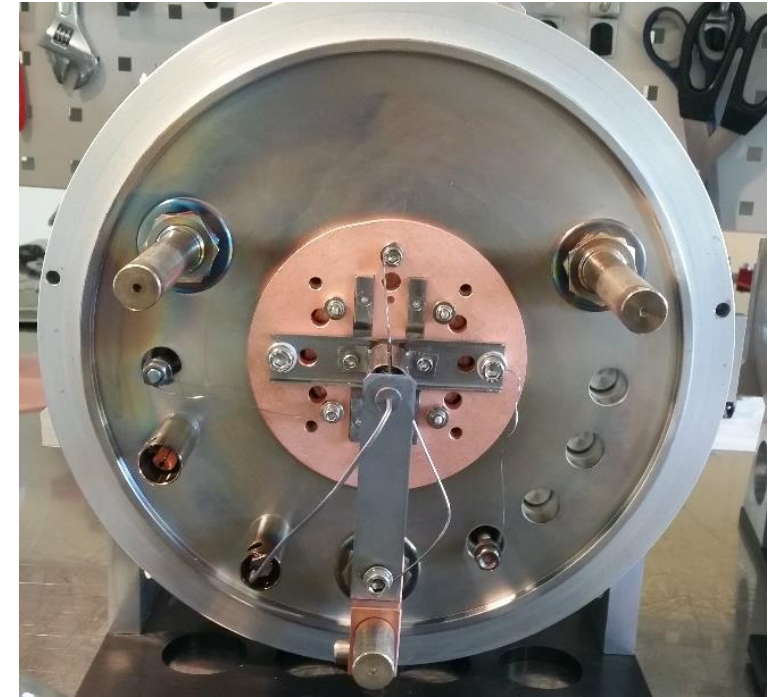
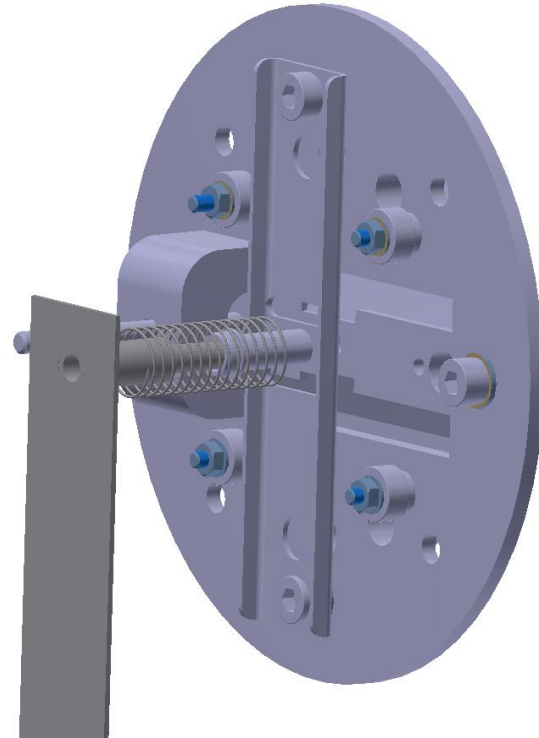
On-line implementation and first operation of the Laser Ion Source and Trap at ISOLDE/CERN, D. Fink et al., NIMB 344, 83-95 (2015)

In-Source Laser Spectroscopy with the Laser Ion Source and Trap: First Direct Study of the Ground-State Properties $^{217,219}\text{Po}$, D. Fink et al., PRX 5, 011018 (2015)



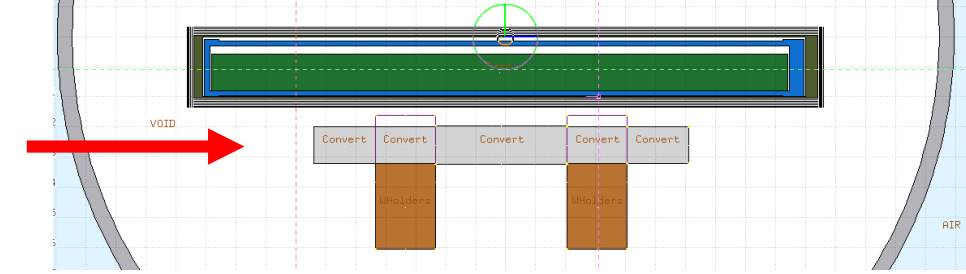
#570 GANDALPH negative Ion source (GANDIS)

- Goal: off-line testing of photodetachment setup
- Ion extraction via negative source potential
 - Electrical Isolation of the source from the base avoids faraday cage
 - external heating required



P2n Converter

Converter very close to uranium carbide – high neutron flux!



W converter

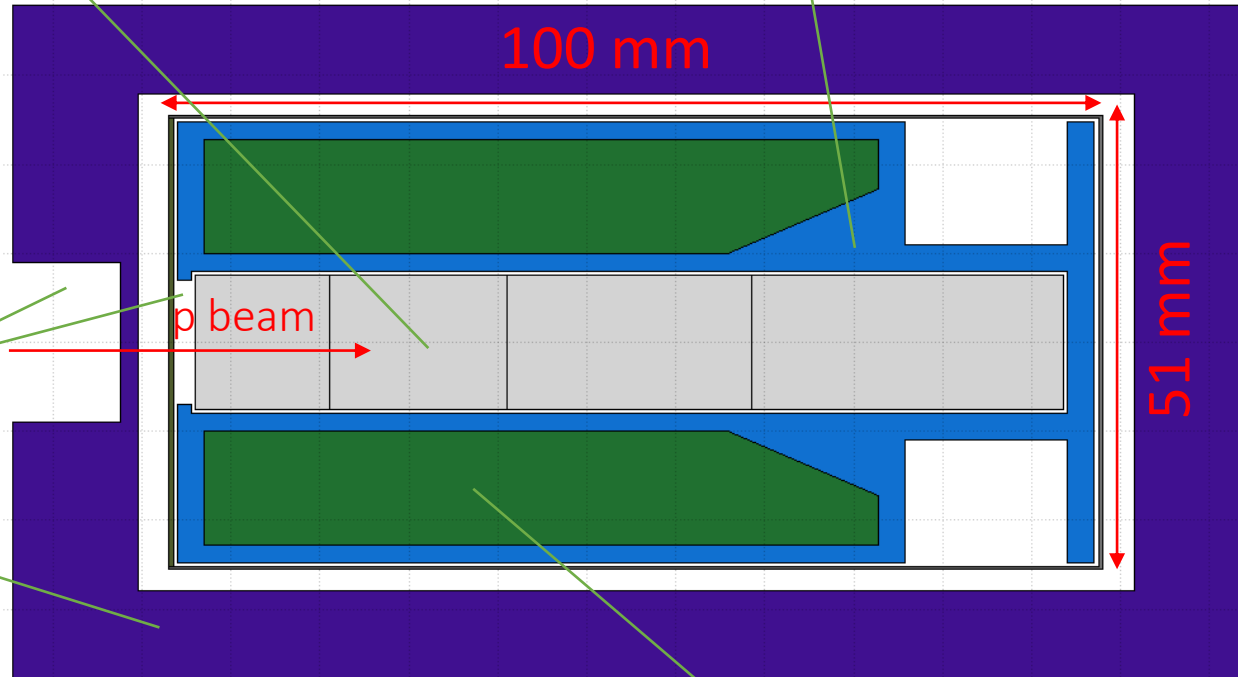
- $\varnothing 15$ mm (12 mm - standard)
- Sliced to mitigate thermal shocks
- Operated at 2000 °C

Avoid proton scattering

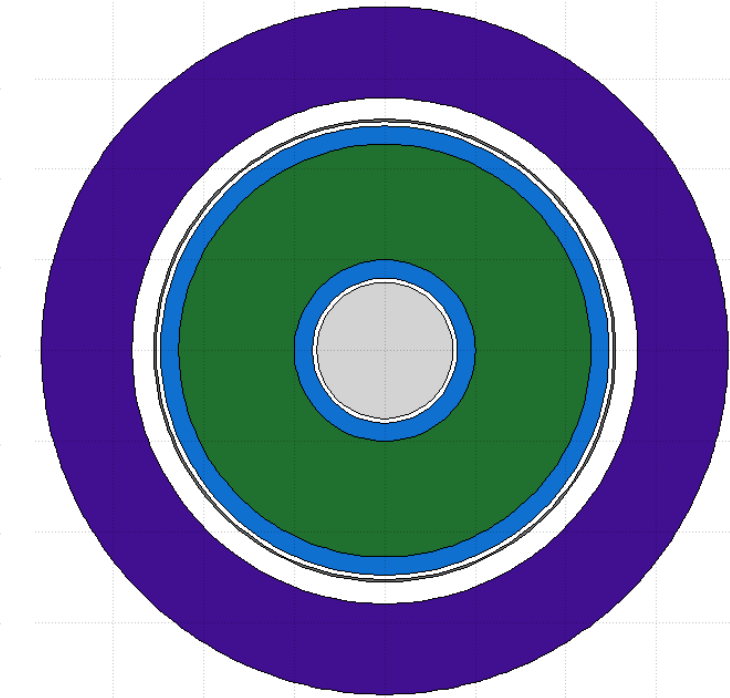
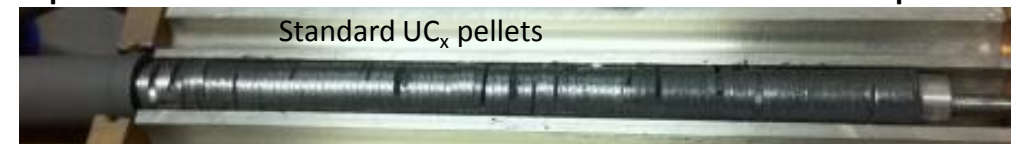
Thermal Shielding

- Sigratherm® - “graphite foam”
- 0.2 g/cm³
- Low thermal conductivity

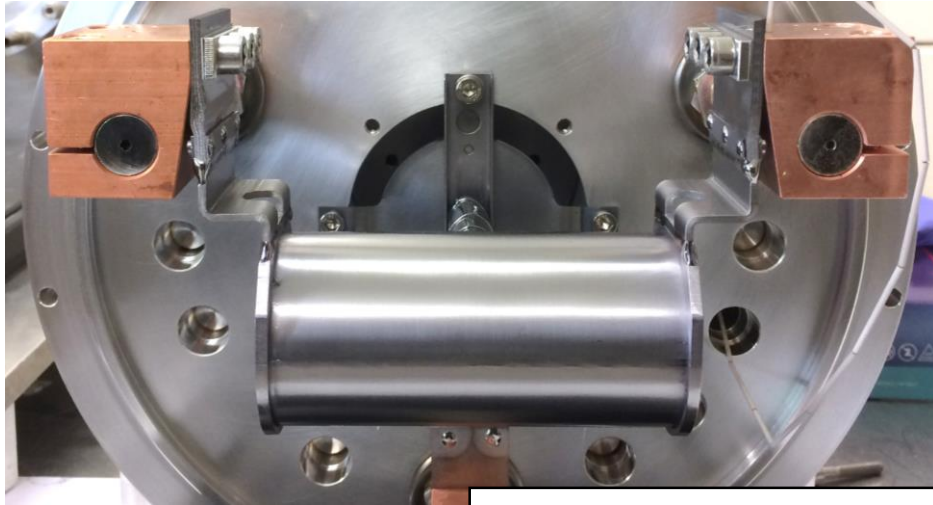
Graphite container



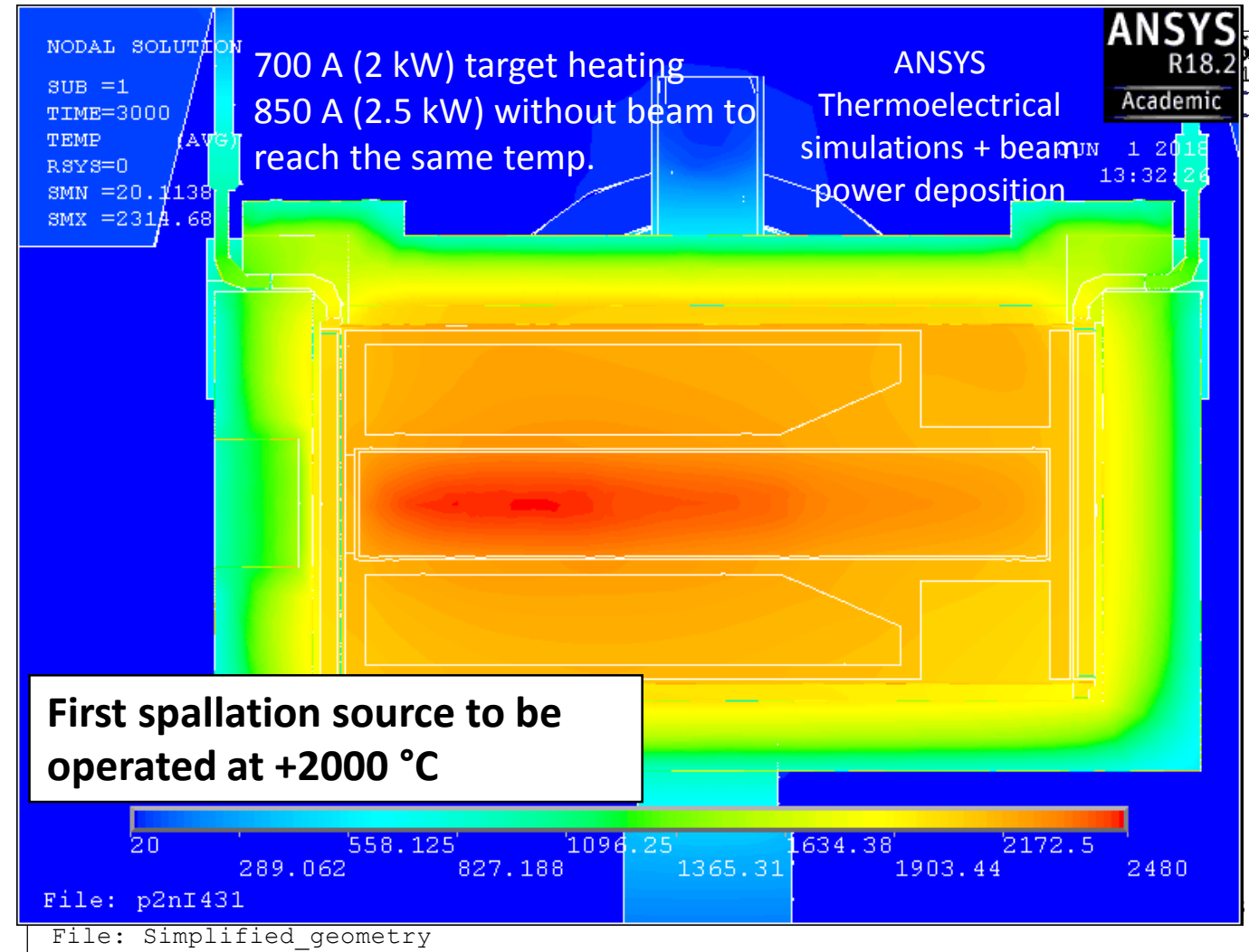
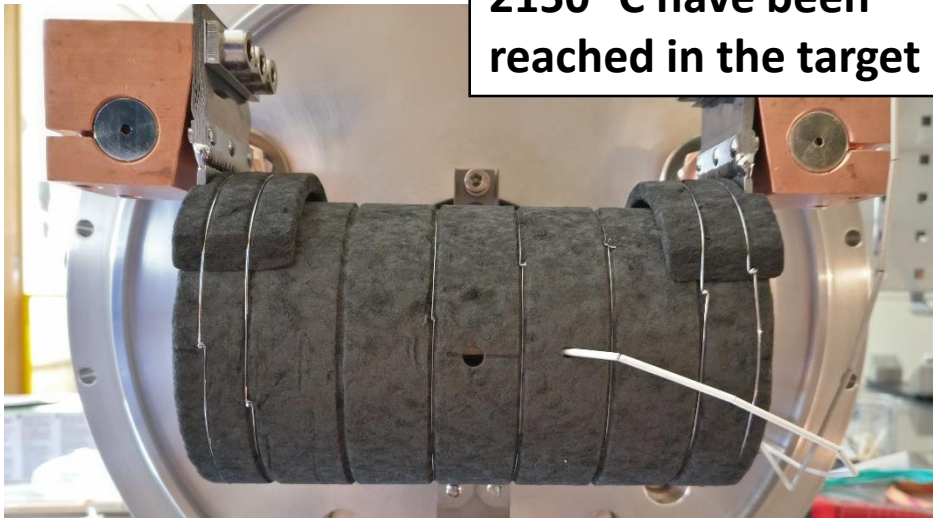
UC_x: new procedure has to be made for annular shape



p2n Challenges: beam heating



2150 °C have been reached in the target

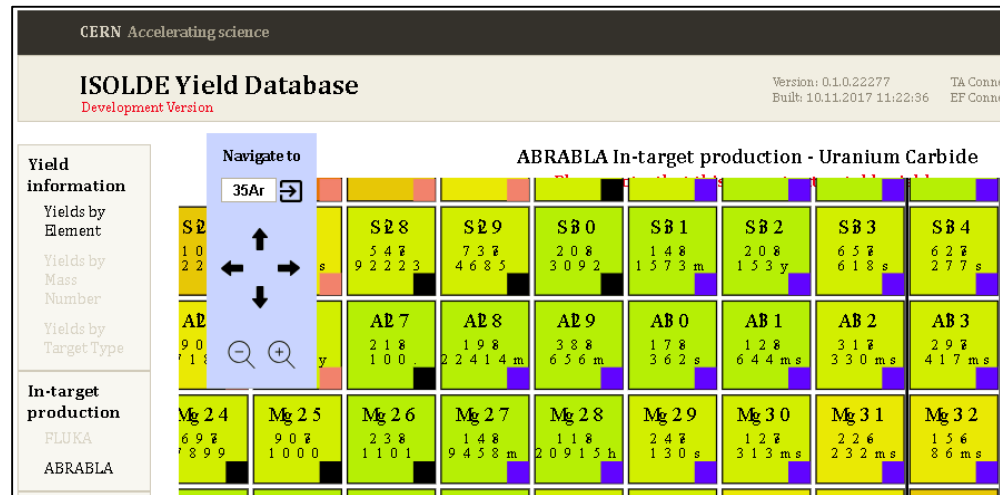


Yield Database

Status and new developments

Summer student (Andreas Molander) working on:

- Presentation of in-target yields for all ISOLDE target materials
- Extended search functions in the database
- Yield predictions / extrapolations
- Integration of Infor-Data
- ...

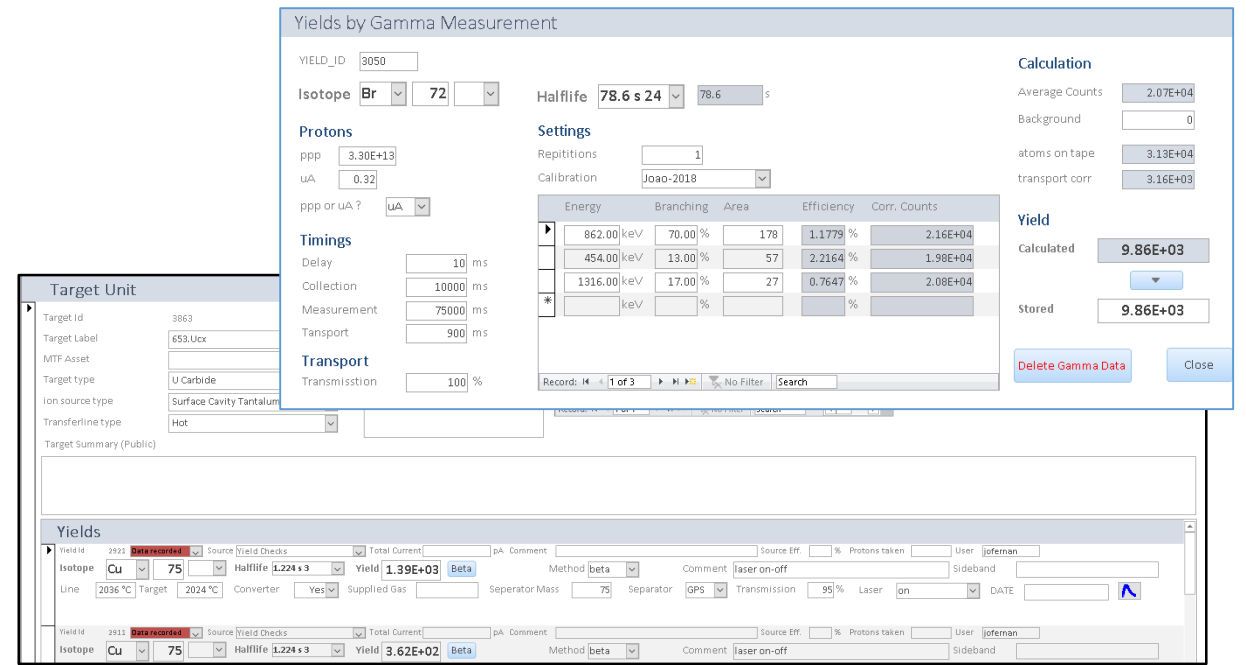


A new application for fast yield insertion

- Yields of this year all entered in database
- Web interface needs minor adjustments to avoid confusion

Issues to tackle

- Reliability of CERN webserver not yet fully satisfactory



New RILIS pump laser

- New DPSS laser **Innolas Nanio** for Ti:Sa pumping and other applications

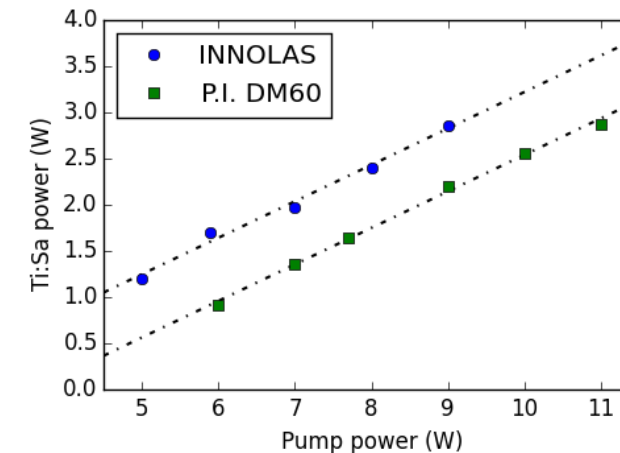
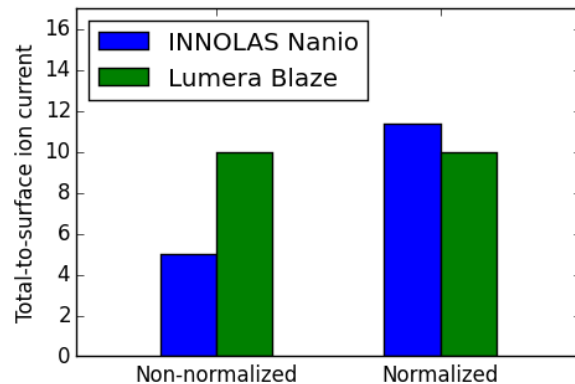
- TEM00 – mode
- 18W output @ 10kHz pulse rate, 30ns pulse length

- Simpler cooling mechanism → decreased risk for chiller failures
- Proposed laser for CERN-MEDICIS (Tender underway)

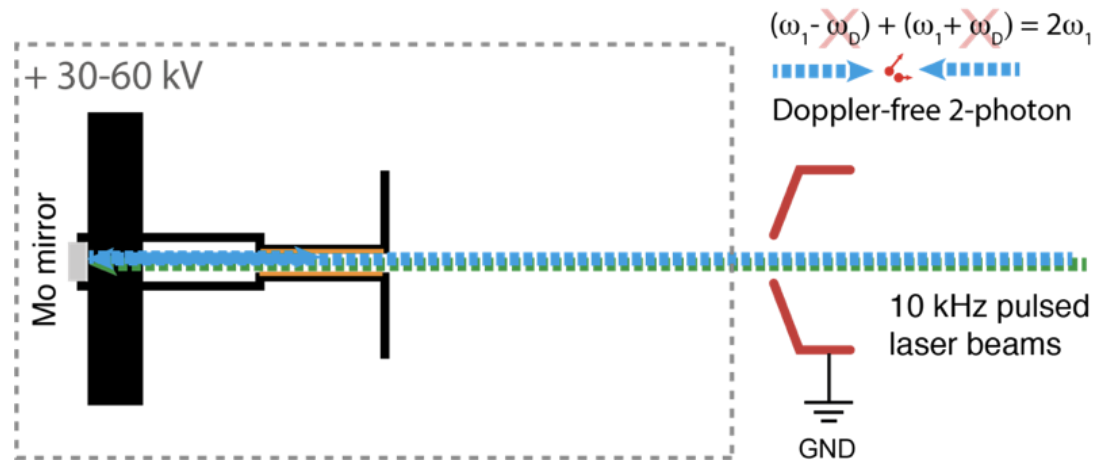


Ti:Sapphire pumping test:
Increased efficiency:
lasing at <5W pump power

Non-resonant ionization test: Demonstrated to be effective for non-resonant ionization



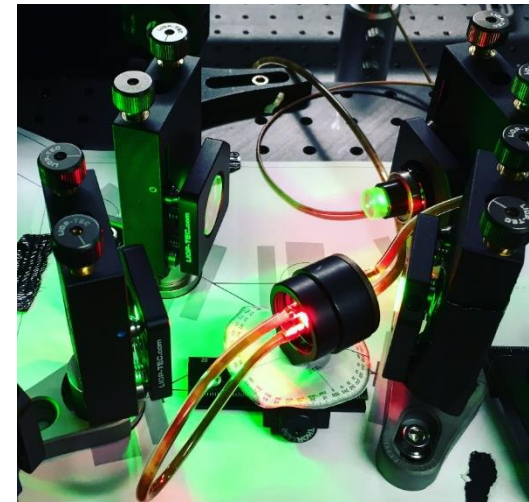
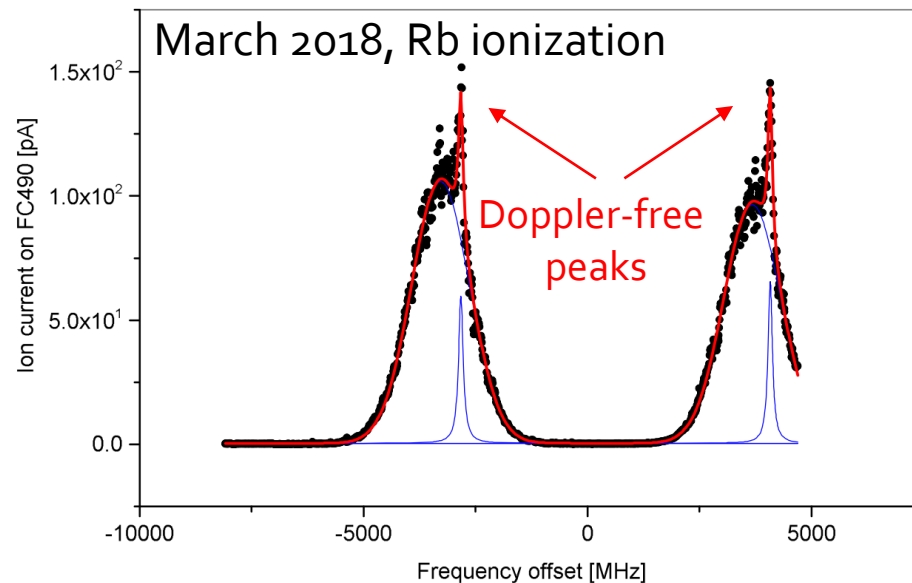
1st Demonstration of Doppler-free RILIS ionization at ISOLDE



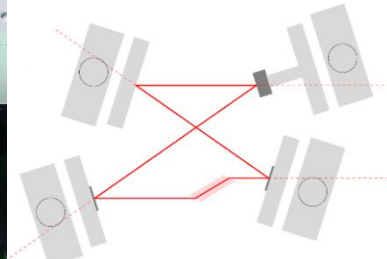
Main objective-

Use pulse-amplified single-mode narrow linewidth laser to make RILIS capable of:

- 1) High-resolution laser spectroscopy for nuclear physics studies
- 2) Enhanced selectivity – isomer selective ionization
- 3) Laser ionization of non-metals



Miniature
Ti:Sapphire ring
cavity amplifier
now operational



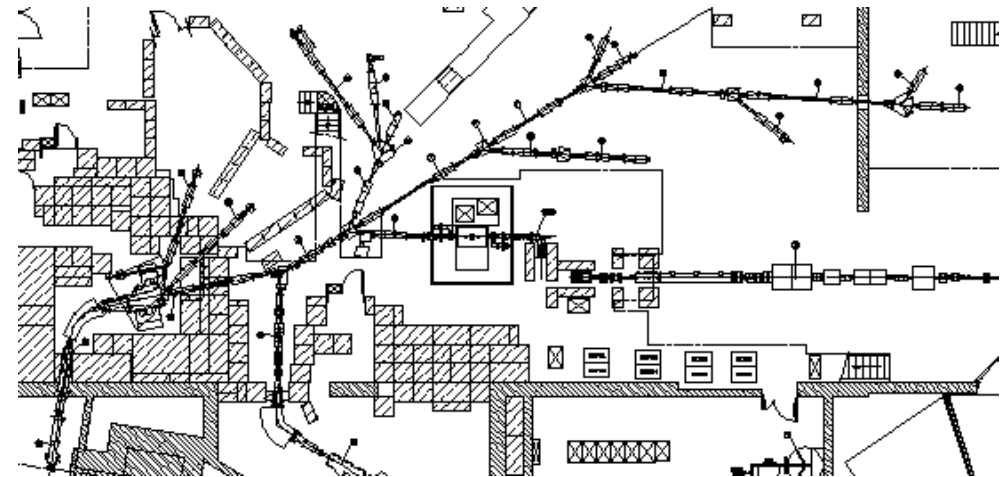
PhD study of Katerina Chrysalidis

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 - ISOLDE Hall
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Activities postponed

- ISOLDE hall beam line re-alignment
 - Decision by ISCC to postpone this activity. Risk analysis revealed that start-up in 2020 could be jeopardized.
 - Verification of alignment to be done.
- Replacement of beam line power supplies
 - Not foreseen during LS2
 - Cables and interlocks to be verified.
- Ventilation controls upgrade
 - Budget available only in 2023
 - Might be possible during 2022-2023 YETS



Target Area: Frontend replacement

- The two existing Frontends (GPS & HRS) will come to the end of their expected lifetime during the LS2 period.
- LS2 will provide a significant cool down period to minimise collective dose rates.
- The opportunity will be taken to improve on design features and upgrades
 - Beam instrumentation
 - Extraction electrode mechanics
 - Local cable replacement
 - Beam line modification

Main groups involved:

EN-STI-RBS/ECE

TE-VSC

EN-SU

TE-EPC

DGS-RP

Assembly and installation to be done mainly by

EN-STI-RBS

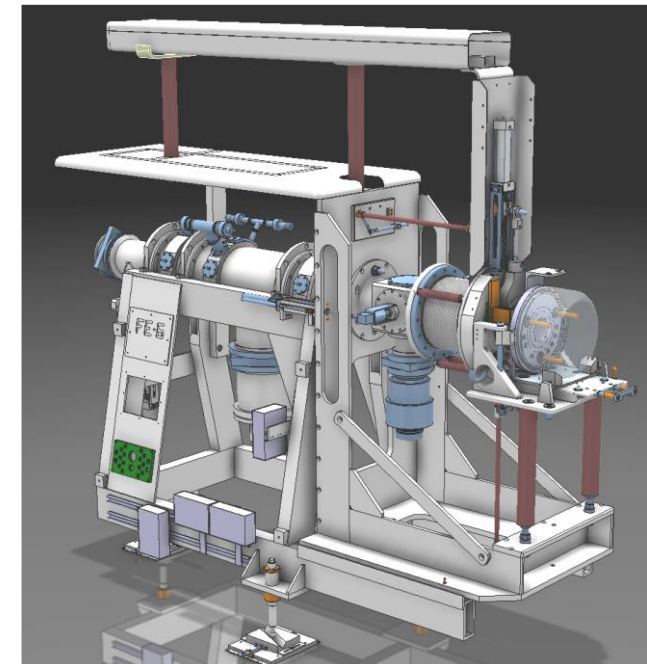
Projection

2018: procurement & assembly

Q4 2019: testing

Q2-Q3 2019: installation

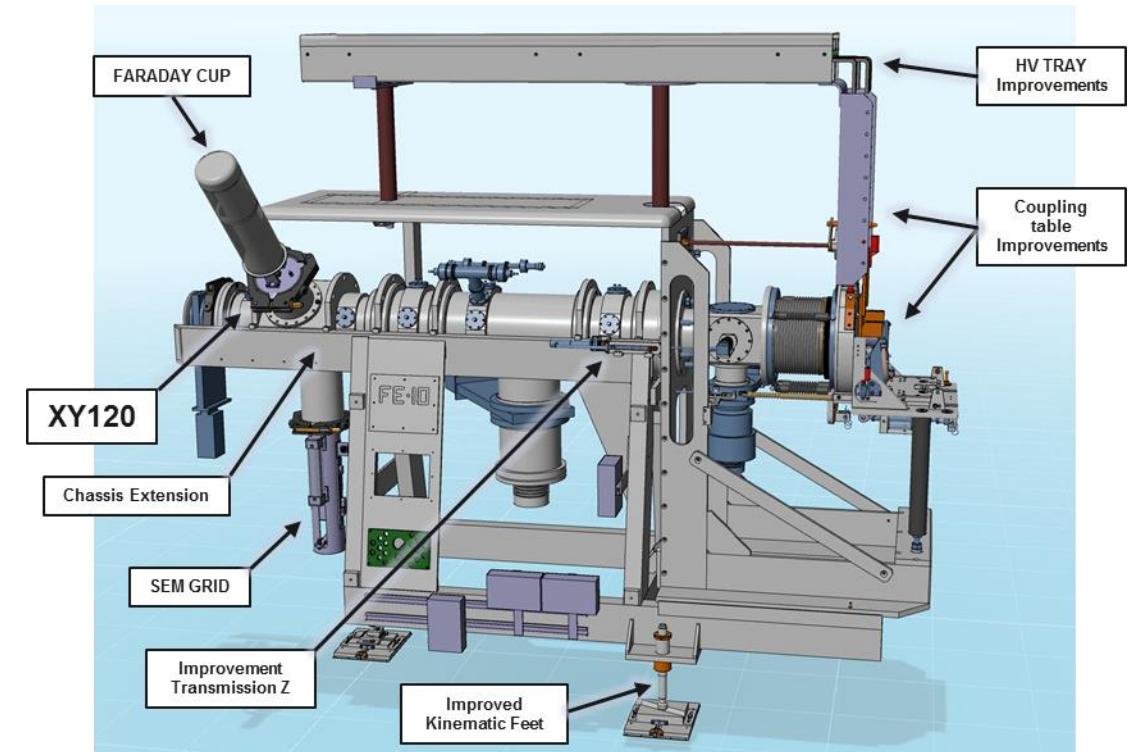
Q3 2020 - commissioning



FRONTEND 10 & 11

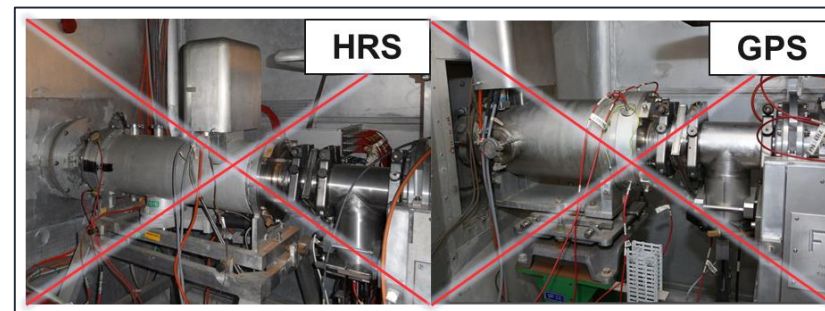
FRONTEND 10&11 modifications:

- **XY120 Vacuum vessel - Extension**
 - XY Deflectors
 - Faraday Cup
 - SEM Grid
- **Coupling table**
 - New metal seals piston
- **Cable Tray**
 - Aluminium Conductors
 - Improved layout
- **FRONTEND Chassis**
 - Extended chassis
 - Improved stability/Weight distribution
- **Faraday Cage**
 - Removal of XY120 Vacuum Vessel



Manufacturing/Assembly

- Complex pieces and vacuum components ordered
- Finalizing orders of small components (June 2018).
- Assembly to begin August 2018 in 3/R-035
- Testing in October/November 2018 on OFFLINE 2



In Development

- Aluminium flexible Conductors
- FRONTEND Removal System
- Metal Seal Piston

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ISOLDE Hall: Separator upgrades

- Mechanical slits on HRS
 - Revise the mechanics (EN-STI-RBS)
- Replacement of flexible compressed air lines
- Installation of Fast Tape Station in CA0 beam line
- Target and ion source gas system to be refurbished
- Beam gate controls in ICR
- Beam diagnostics
 - BE-BI group to procure 20 FC/scanner units by Q1 2019
 - Also new scanner units for the separators are under procurement
 - To be installed in Q2 – Q4 in 2019
- N2 supply line for experiments
- CRIS platform integration and installation?
- Installation of second HT modulator...?

REX/HIE-ISOLDE: RF List of activities (I)

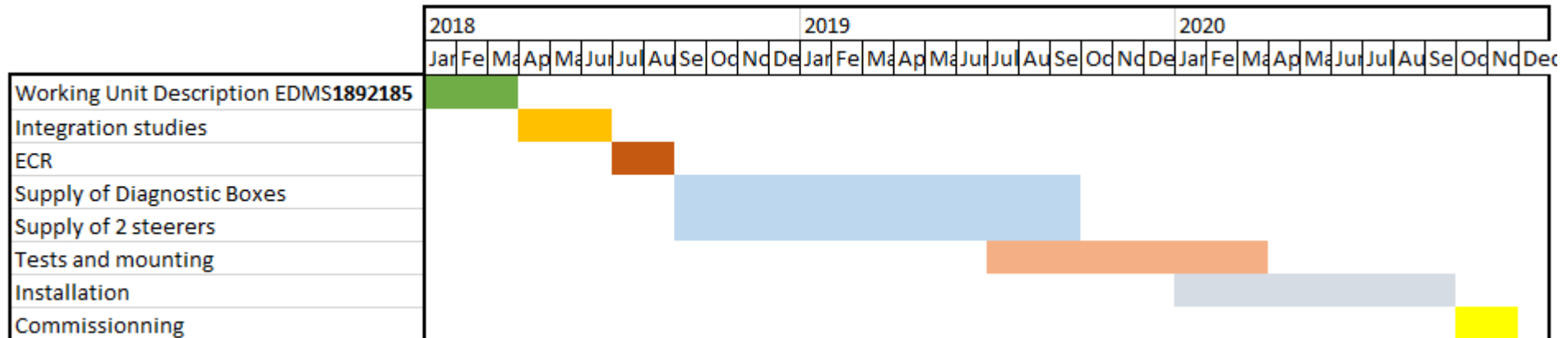
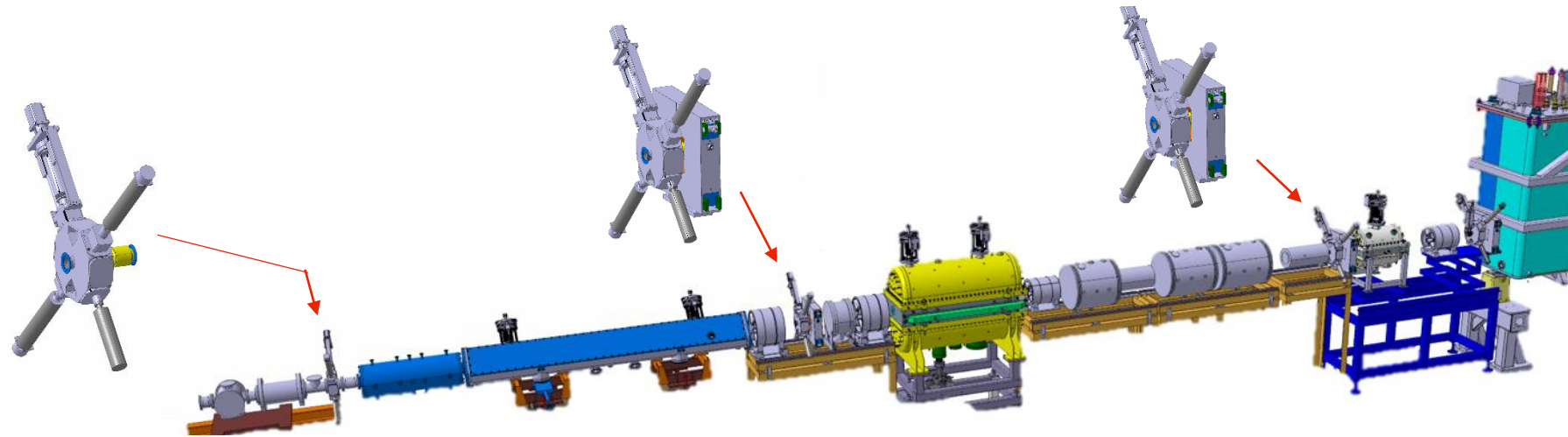
- Design and install a new cooling system for IH structure (beyond LRF team capacity: external resources are required)
- 90kW Bertronix amplifiers: profound status evaluation
 - Disassemble one amplifier
 - Define the strategy for the others and execute
- Purchase of two 101MHz 5kW solid-state amplifiers
 - One to be used to supply the Buncher
 - One spare

REX/HIE-ISOLDE: RF List of activities (II)

- 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 the automatic ramp-up of the equipment after “reset”
 - Improve the monitoring/logging (e.g., critical interlocks, tube gain)
- Replace the optical links in the power amplifiers
 - Consolidate the “Measurements Units”
- Replace Grid1 and Grid2 variacs with solid state modules

Request for 3 beam diagnostic boxes & 2 steerers between REX and HIE-ISOLDE

Around 20% of beam is lost between the REX separator and the HIE-ISOLDE LINAC



Meetings indico 9995 and Activity declared in PLAN ID 11617.

ECR will be written in July and circulated for comments and approvals at the end of summer

HIE- ISOLDE activities

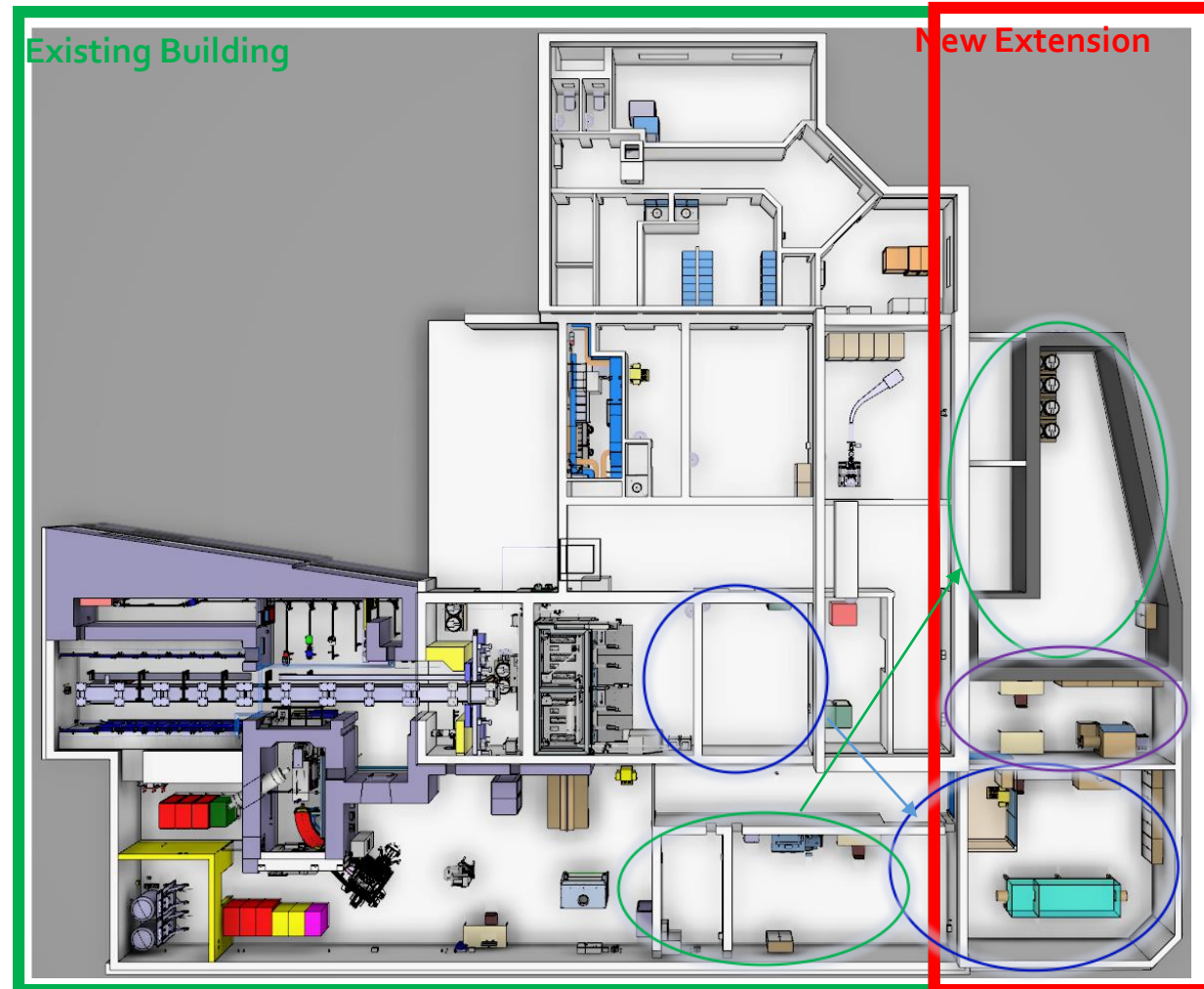
- Cryogenics
 - Preventive maintenance of the cryogenic system including major overhauling of rotating machinery
 - Cryo operation: Setup of the automatic controls for transient modes
- Installation of fixed radiation monitors for each CM (4x) in the HIE tunnel connected to the monitoring system in the ICR
- HIE-LINAC
 - Possible repair of CM 4
 - RF coupler issue on cavity 3 of CM4
 - W. Venturini investigating the possibility of repairs during LS2
 - E. Siesling has provided a planning for the removal of CM4 straight after the last physics run this year

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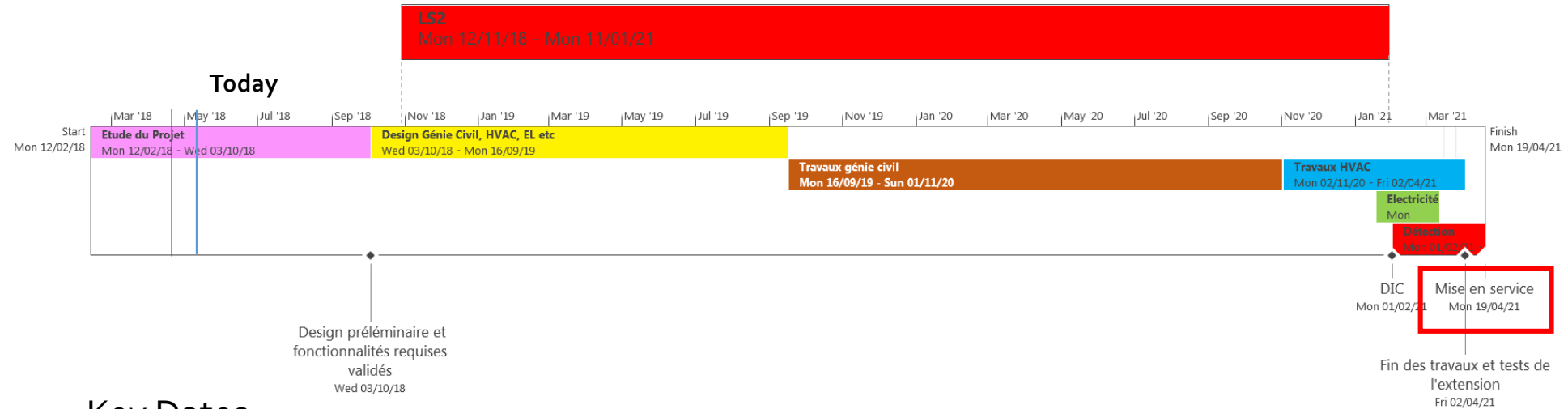
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Layout of the Class A Extension (nano-lab)

- 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

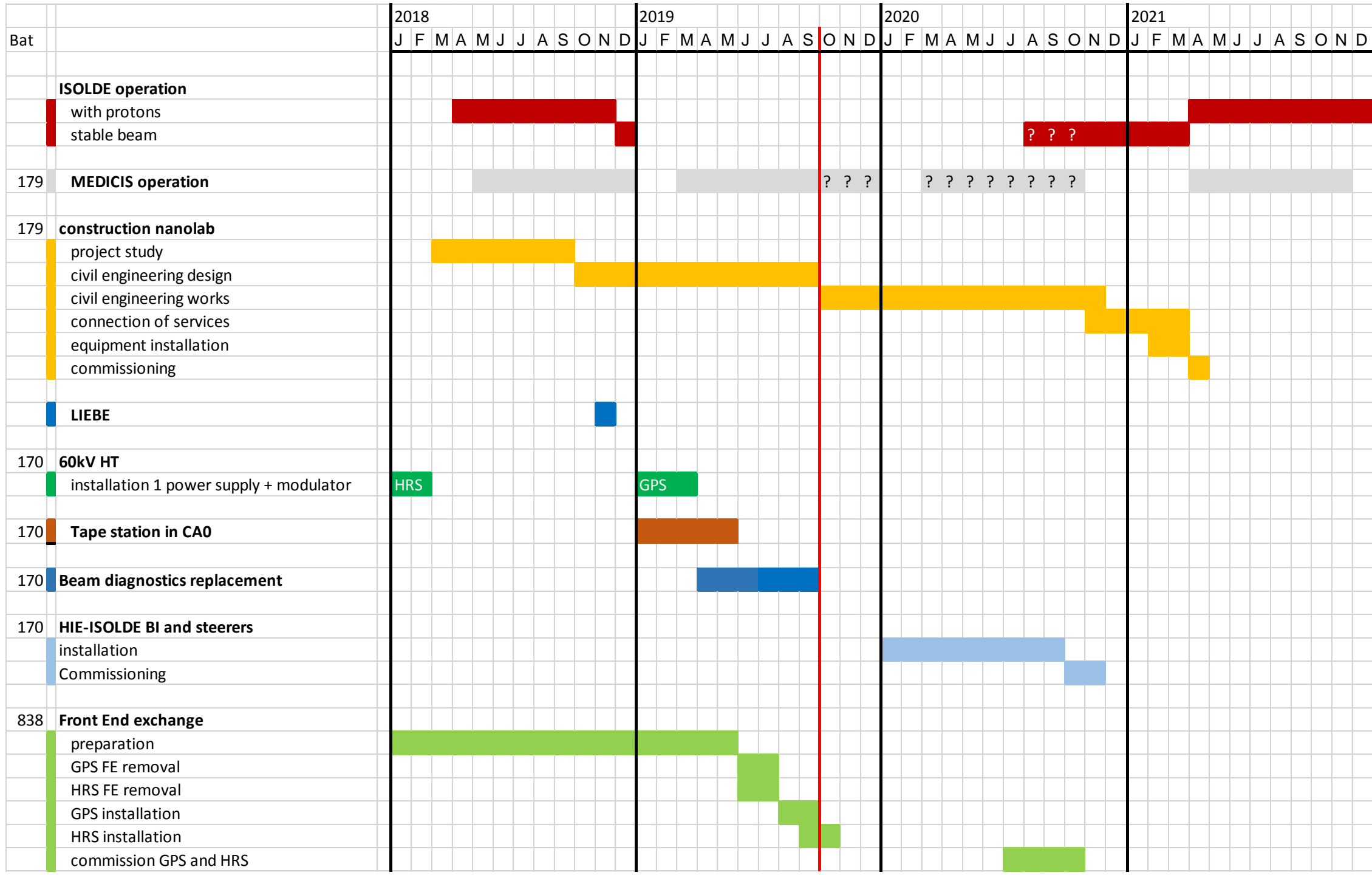


Key Dates :

- 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**

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- Thank you for your attention