

Status of DESIR

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CSI of IN2P3, Strasbourg, June 24, 2024



DESIR scientific objectives

DE SIR

« Decay, Excitation and Storage of Radioactive Ions »

Exotic decay modes
High-precision β -decay studies

BESTIOL

Magnetic and quadrupole moments
Mean-square charge radii
Spins

LUMIERE

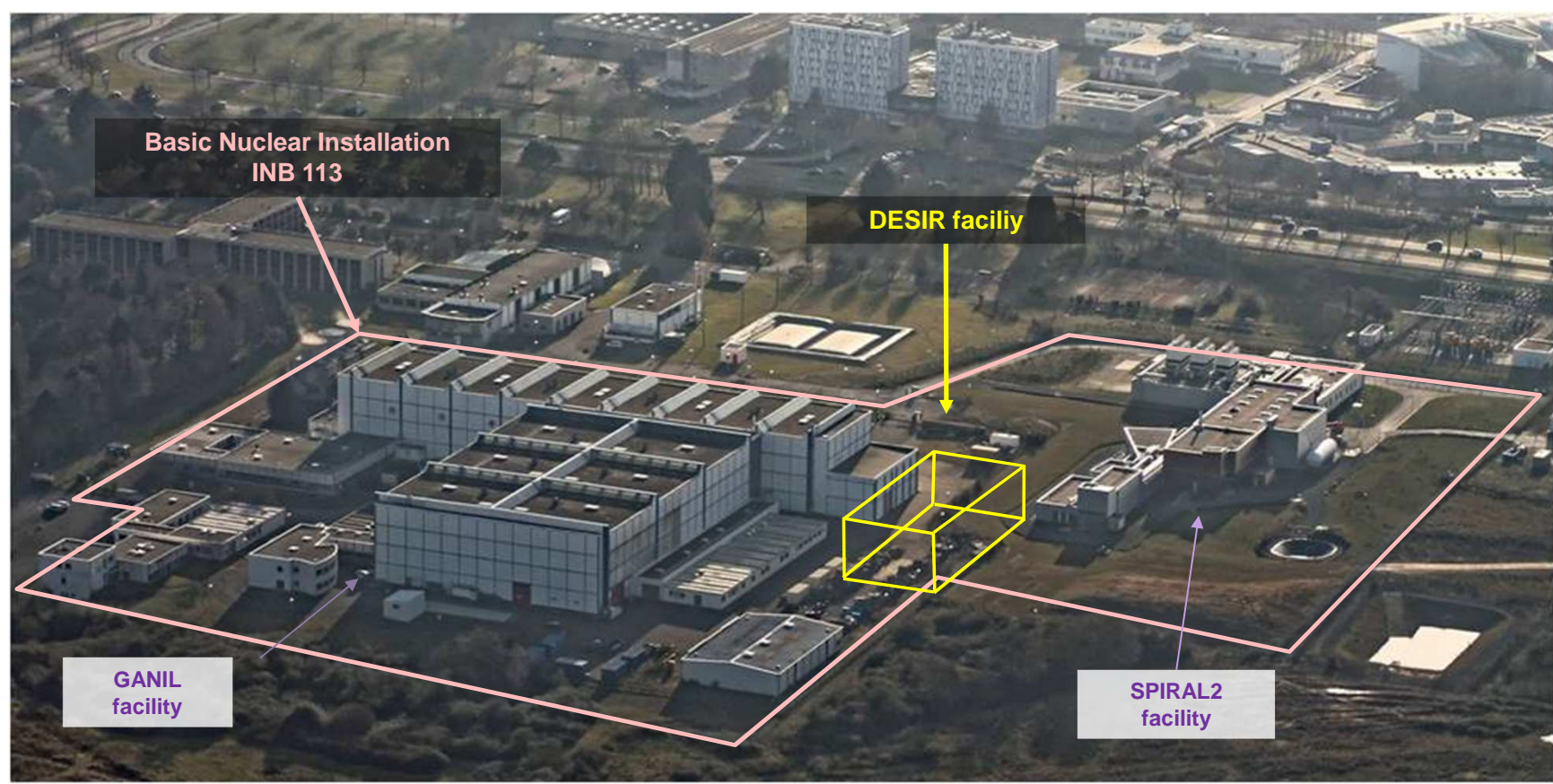
Masses
Trap-assisted spectroscopy
Correlation measurements

DETRAP

- Fundamental properties of nuclei in their ground and long-lived isomeric states
- Ultra-pure samples for high-precision measurements
- Ion manipulation using traps and laser manipulation
- Complementarity with S³-LEB and other GANIL/SPIRAL2 facilities

DESIR infrastructure

Operation: Construction of the DESIR facility within INB 113



Projected investment cost: €33M (2/3 building and infrastructure - 1/3 scientific process)

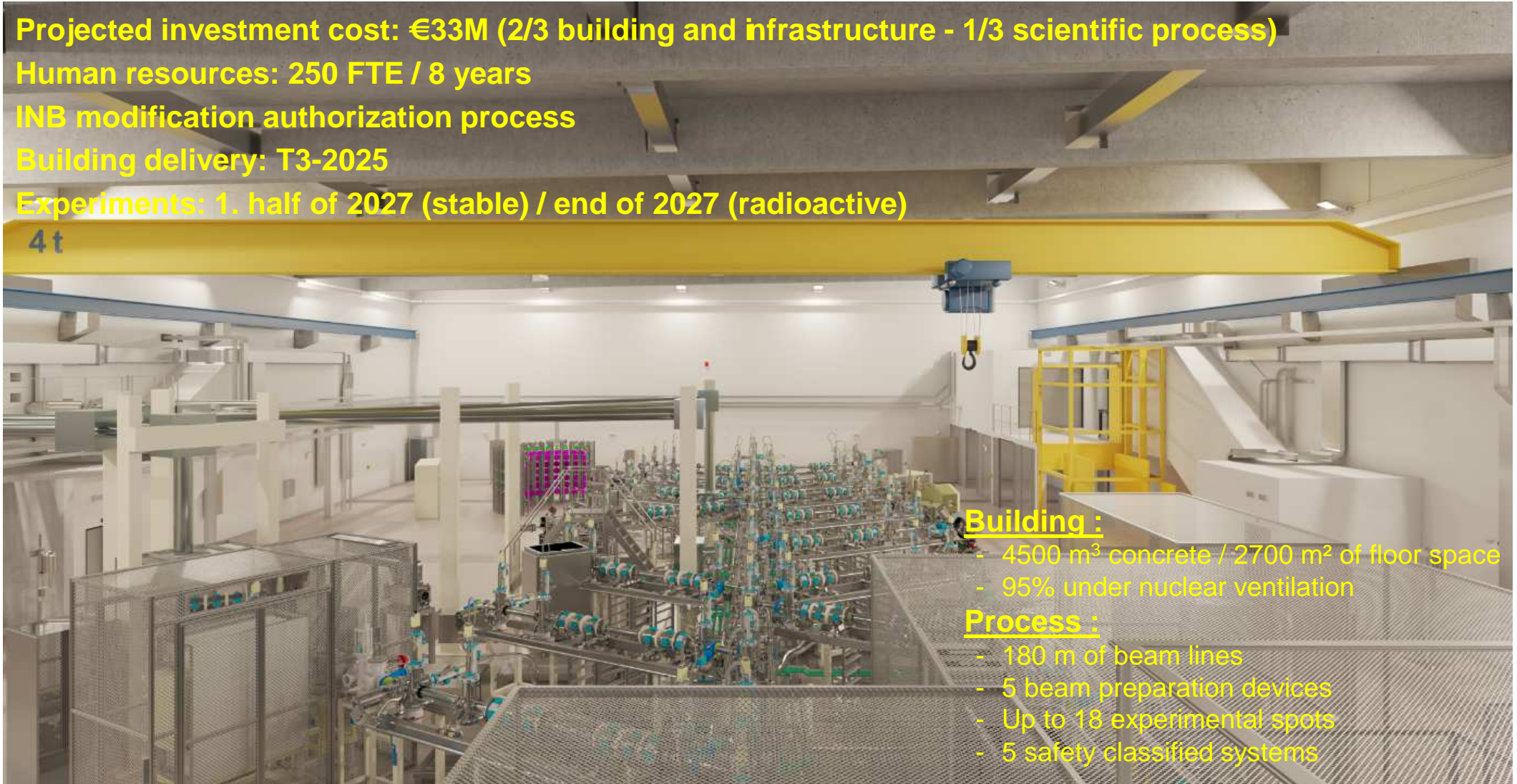
Human resources: 250 FTE / 8 years

INB modification authorization process

Building delivery: T3-2025

Experiments: 1. half of 2027 (stable) / end of 2027 (radioactive)

4 t



Building :

- 4500 m³ concrete / 2700 m² of floor space
- 95% under nuclear ventilation

Process :

- 180 m of beam lines
- 5 beam preparation devices
- Up to 18 experimental spots
- 5 safety classified systems

March 2022: construction licence submission to the Ministry of Ecological Transition



- 2022-03-23-demandes IRSN Questionnaire RP BERIN (avant le 16 mai)
- 2022-04-11-demandes IRSN Questionnaire Confinement SCA BAC (avant le 30 mai)
- 2022-04-29-demandes IRSN Inventaire radiologique (avant le 31 mai)
- 2022-05-04-demandes IRSN voies de communication (avant le 03 juin)
- 2022-05-06-demandes IRSN acces (avant le 07 juin)
- 2022-05-06-demandes IRSN incendie (avant le 03 juin)
- 2022-06-28-demandes IRSN Radioprotection (avant le 18 juillet)
- 2022-07-05-demandes IRSN inventaire bis (avant le 25 juillet)
- 2022-07-06-demandes IRSN chutes d'avion (avant le 25 juillet)
- 2022-09-01-demande IRSN Note GC (avant le 15 septembre)

Instruction (many Q/A with the safety authority)

Sept. / Nov. 2022: green light from the safety authority -> Ministry of Ecological Transition



Discussion with local government representatives



... with the Environmental authority



Next: same procedure for the operation licencing

June 2023: Construction permit



April-May 2023: Public Enquiry



March 2023: Green light -> Ministry of Ecological Transition



Public Enquiry preparation



... numerous comments



October 2022:
Clearing/releasing of
construction areas



April 2023 : surface levelling



June 2023 : reorganization
of site utilities



July 2023 : general earthworks



September 2023 : site preparation



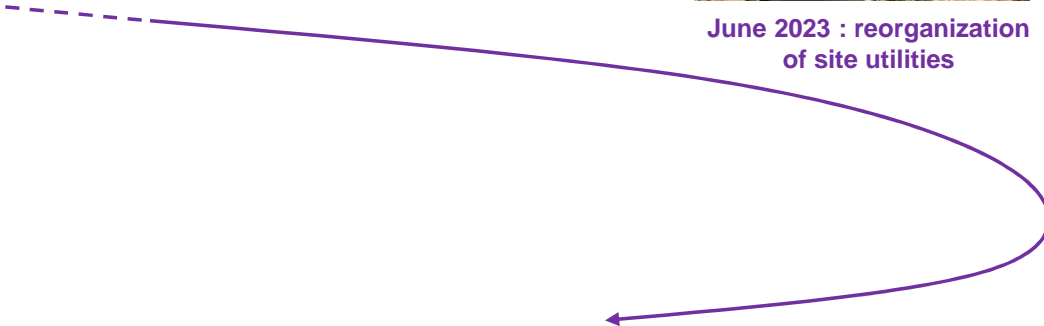
31 October 2023 : first concrete!



October 2023 : steel reinforcement level -3



October 2023 : surface preparation

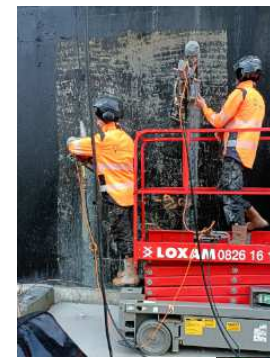




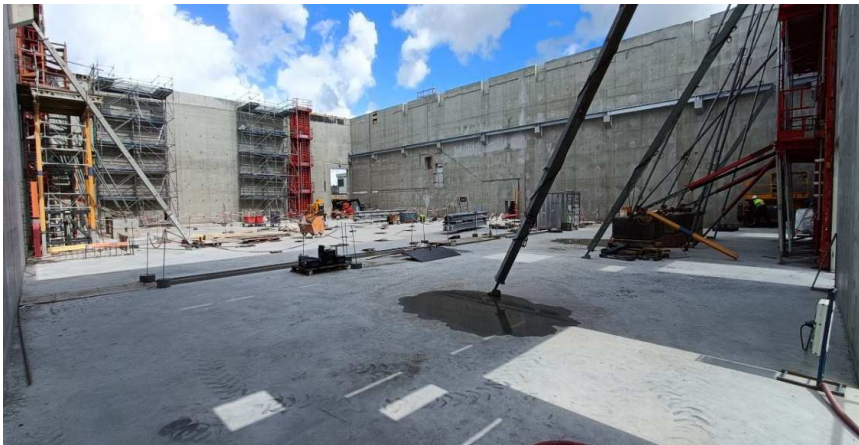
Dec. 2023... A number of questions!



Actually nothing to worry about



Drilling of existing walls, elevation of walls to level -3 and preparation of hall floor slab



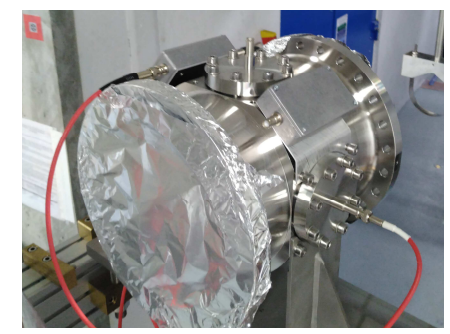
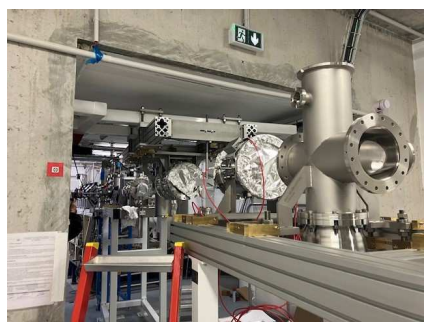
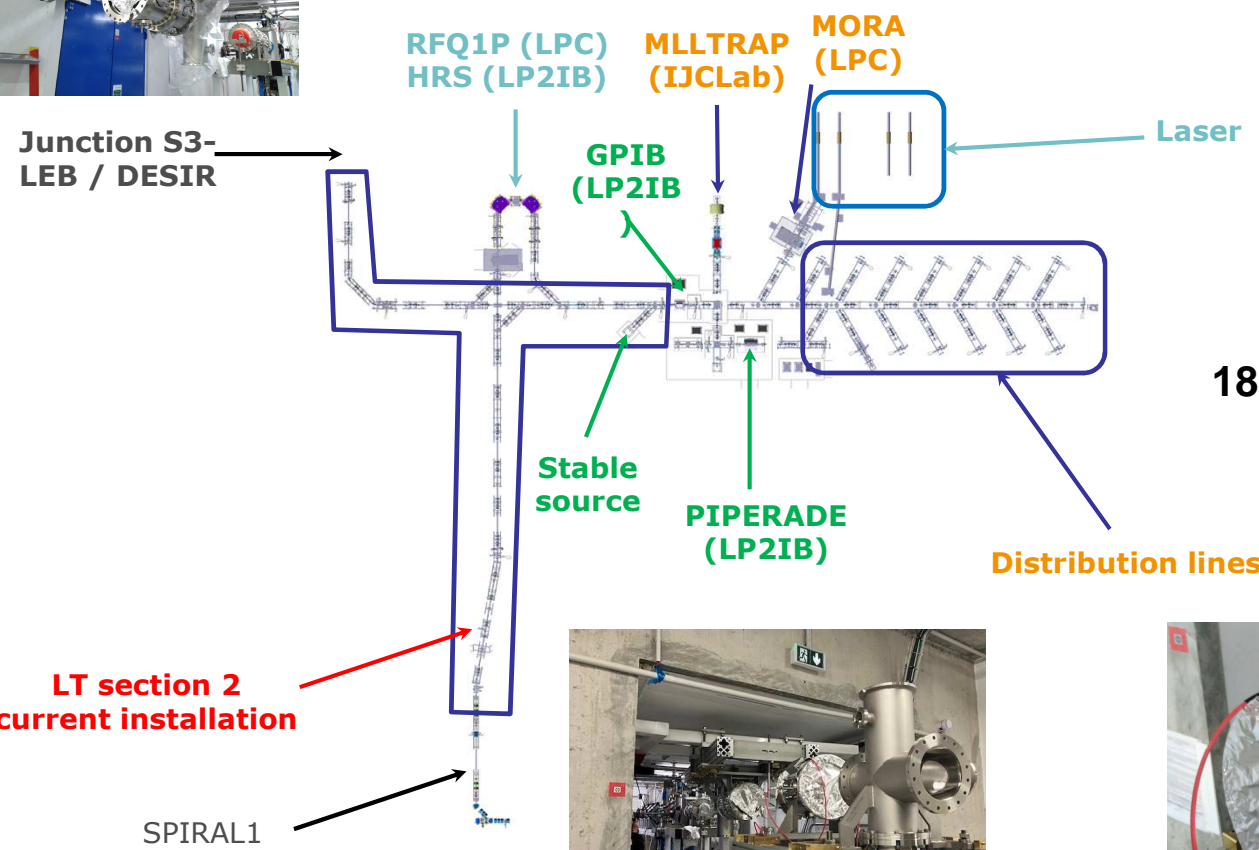
May 2024: DESIR has its four walls



January 2024: Finishing of level -3 wall

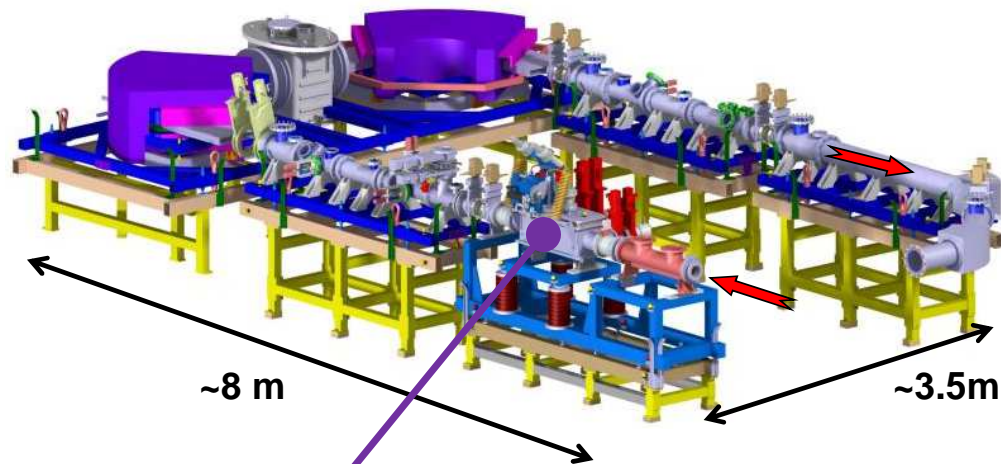


DESIR beam lines



DESIR beam purification and sampling

HRS



*J. Michaud et al., NIM B 541 (2023) 161
Commissioning of the DESIR high-resolution mass separator”*

HRS

Conception: QSQD-M-DQSQQ

Specification:

$M/\Delta M = 20,000 @ 3\pi \text{ mm.mrad @ } 60\text{keV}$

Achievement;

$M/\Delta M = 25,000 @ 1-2\pi \text{ mm.mrad @ } 25 \text{ keV}$

Commissioning at LP2iB

SHIRaC RFQ



SHIRaC

Emittance reduction of high intensity beams

Transmission $\sim 70 \% @ 1\mu\text{A}$

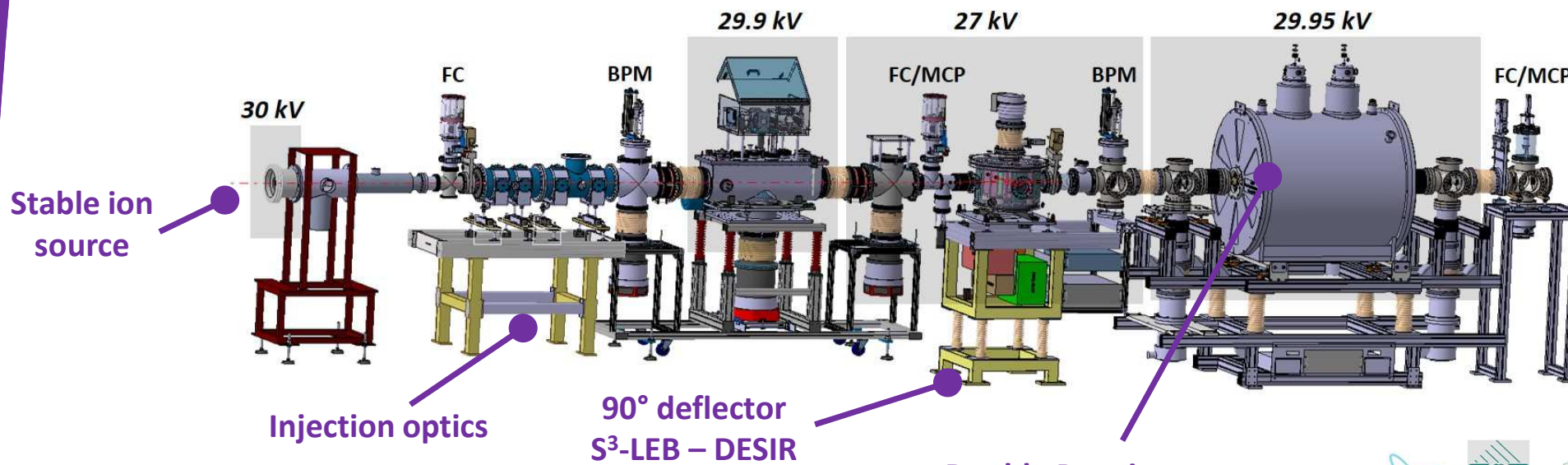
Refurbishing at LPC Caen

R. Boussaid et al., JINST 9 (2014) P07009

“Simulations of high intensity ion beam RFQ cooler for DESIR/SPIRAL 2: SHIRaC”

General Purpose Ion Buncher and cooler (GPIB)

- 10^6 - 10^7 ions/bunch, < 100 Hz
- emittance reduction



- Double Penning trap
- 10^5 ions/bunch, 2-20 Hz
 - $M/\Delta M = 10^5$



M. Gerbaux et al., NIM A 1046 (2023) 167631
 “The General Purpose Ion Buncher: A radiofrequency quadrupole cooler-buncher for DESIR at SPIRAL2”

P. Ascher et al., NIM A 1019 (2021) 165857
 “PIPERADE: A double Penning trap for mass separation and mass spectrometry at DESIR/SPIRAL2”

Commissioning at LP2iB

DESIR experimental equipment

The **DE_{sir}TRAP_{ping}** facility

MORA

P. Delahaye, GANIL, L. Hayen, LPC Caen

- RFQ-CB associated with a Paul trap
- > β -v angular correlation coefficient
- > D correlation with laser polarized beams



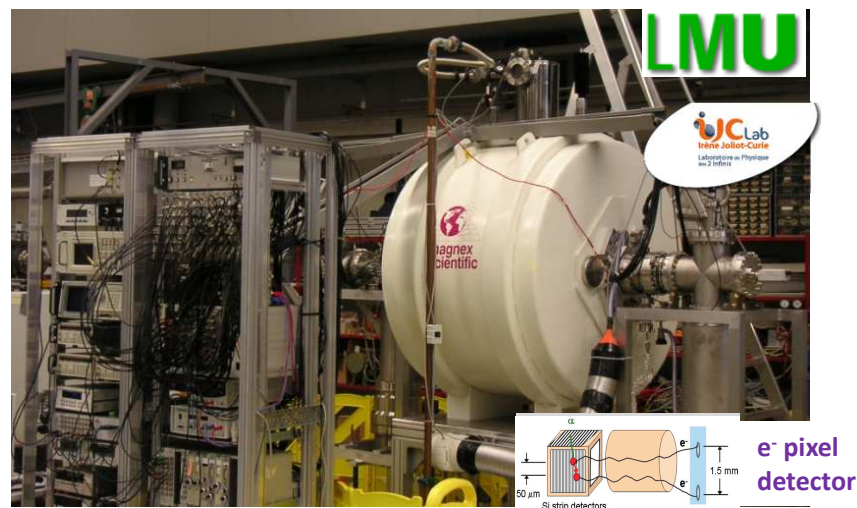
P. Delahaye et al., Hyperfine Interaction 240 (2019) 63

Commissioning at JYFL

MLLTrap

P. Thirolf, LMU Munich – E. Minaya Ramires, IJCLab

- 7T double Penning trap
- > mass measurements ($\Delta M/M \sim 10^{-8}$) of pure samples
- > in-trap e- and α spectroscopy



E. Minaya-Ramires et al., NIM B 463 (2020) 315

P. Chauveau et al., NIMB 463 (2020) 371

⇒ **Nuclear structure & decay properties**

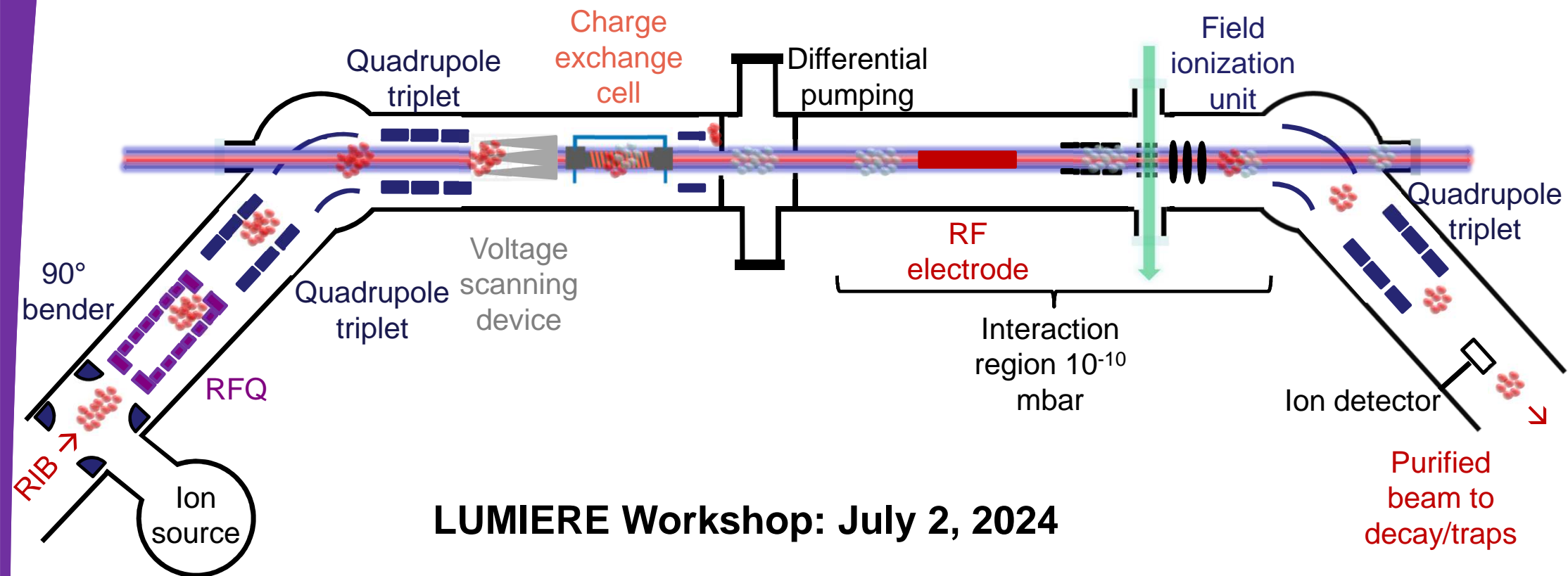
- shell evolution, deformation
- (super-) heavy nuclei decay spectroscopy

Commissioning at ALTO (IJCLab)

The LUMIERE facility

Laser Utilization for Measurement and Ionization of Exotic Radioactive Elements

- Collinear laser spectroscopy (CRIS like, ISOLDE)
 - > hyperfine structure (magnetic and quadrupole moments, mean square charge radii, spins)



LUMIERE Workshop: July 2, 2024

The BESTIOL facility

BETA decay STUDIES at the SPIRAL2 IsOL facility

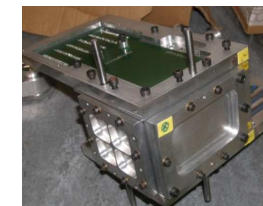
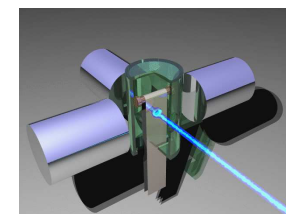
Beam cooling and purification using PIPERADE for (trap-assisted) decay spectroscopy

-> High-precision measurements with ultra-pure samples using:

- β - γ decay stations (BEDO, ...)
- full absorption spectrometers (DTAS)
- neutron detection arrays (BELEN, MONSTER, ...)

⇒ Fundamental interaction, nuclear structure, decay properties

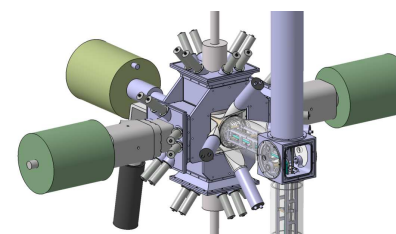
- CVC, V_{ud}
- lifetimes, $P_{(2)n}$
- exotic decays (β -2p, cluster emission)
- Gamow-Teller strength



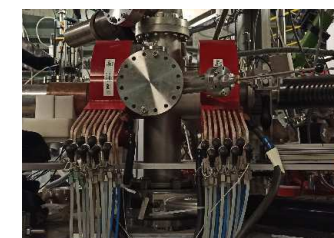
SiCube



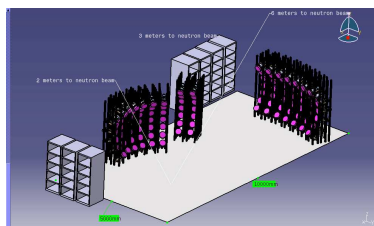
BELEN



BEDO



COeCO



MONSTER



DTAS

DESIR time line

- **Building delivery : September 2025**
- **October 2025 to September 2026 : Beam line & experiment installation**
- **October 2026 to June 2027 : Technical commissioning**
- **March to October 2027 : Stable beam commissioning**
- **November 2027 : Facility ready for radioactive beams**

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→→ but for all this we need wo/man power at GANIL...



Thank you for
your attention

