
GANIL

General presentation

Some numbers

• 240 permanent staff CNRS et CEA
(engineers, technicians, 29 researchers)
1 lecturer Univ. Caen

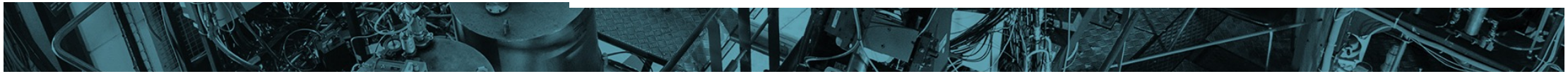
- 91 temporary staff

40 CDD engineers, technicians,
19 PhD
16 post-docs
16 apprenticies

- CIMAP = 24 permanent staff

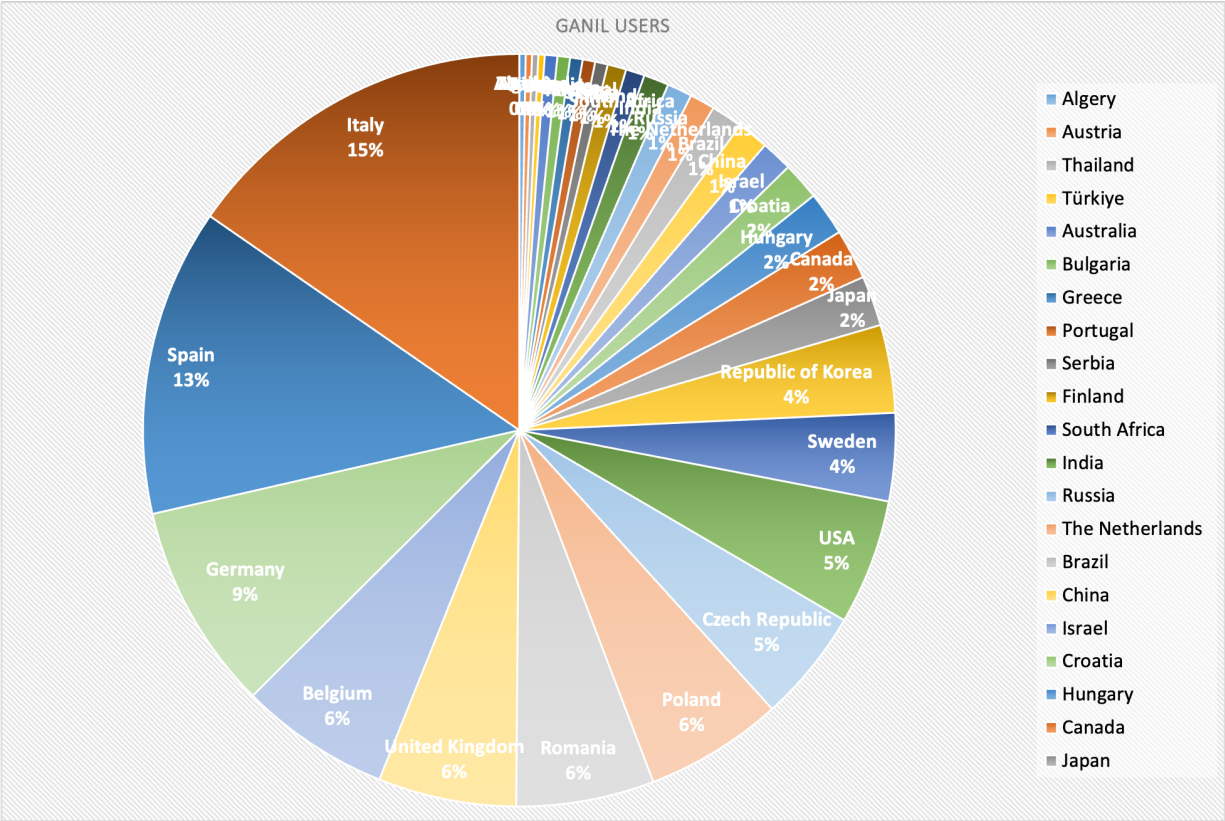
+ 15 PhD + 8 postdocs

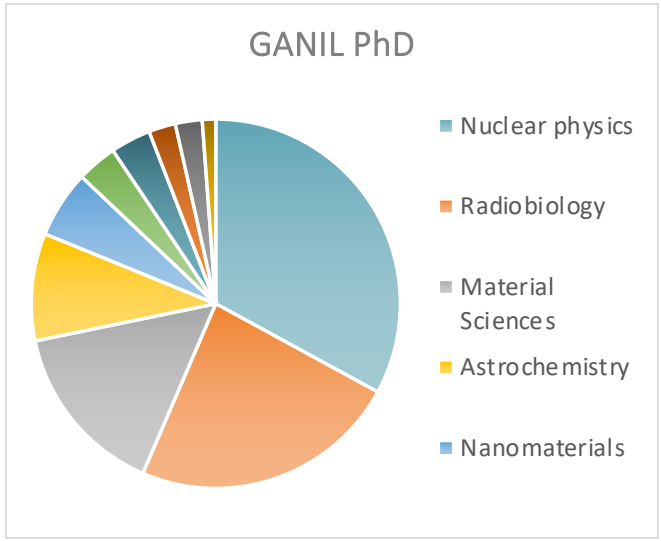
- More than 300 scientists yearly to perform experiments



Some numbers

- An international scientific community of almost 800 members (~half French)

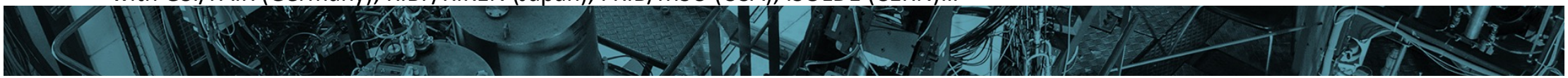




95 PhD students working on GANIL data

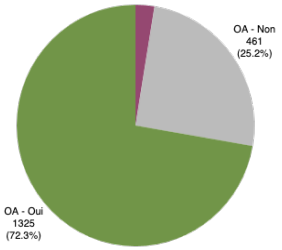
A major facility for heavy ions in the world

with GSI/FAIR (Germany), RIBF/RIKEN (Japan), FRIB/MSU (USA), ISOLDE (CERN)…

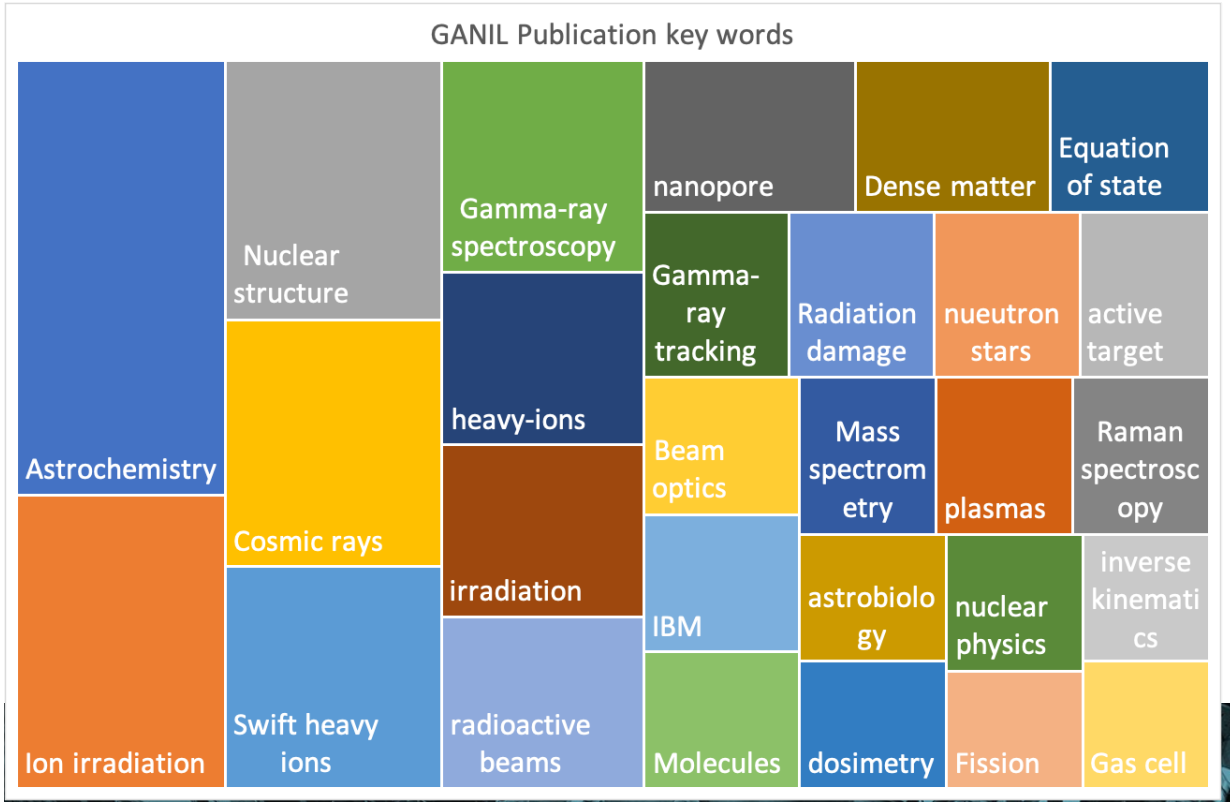


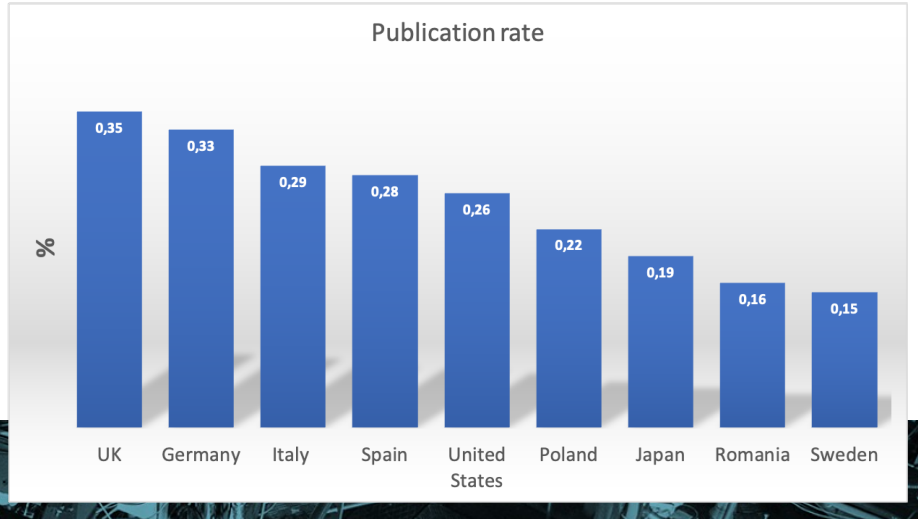
Scientific production

OPEN ACCESS 73%



Between 100 and 150 publications/year
85% in international collaboration



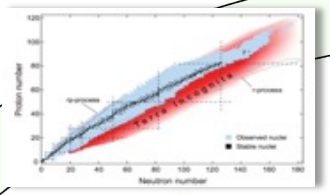



GANIL
Scientific programs at GANIL
© Ph. Stroppa/CEA

A multi-user pluridisciplinary laboratory

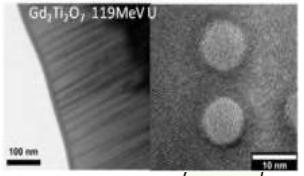
Nuclear Astrophysics

Nuclear Physics

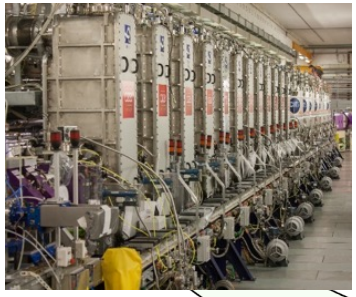


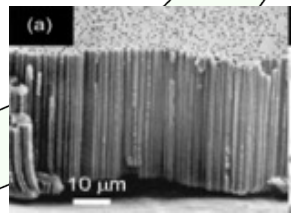
Astrochemistry

Materials under irradiation

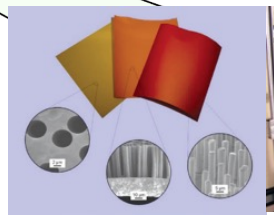


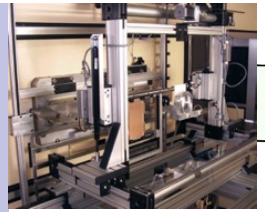
R&D on accelerators and detectors





Nanostructuration



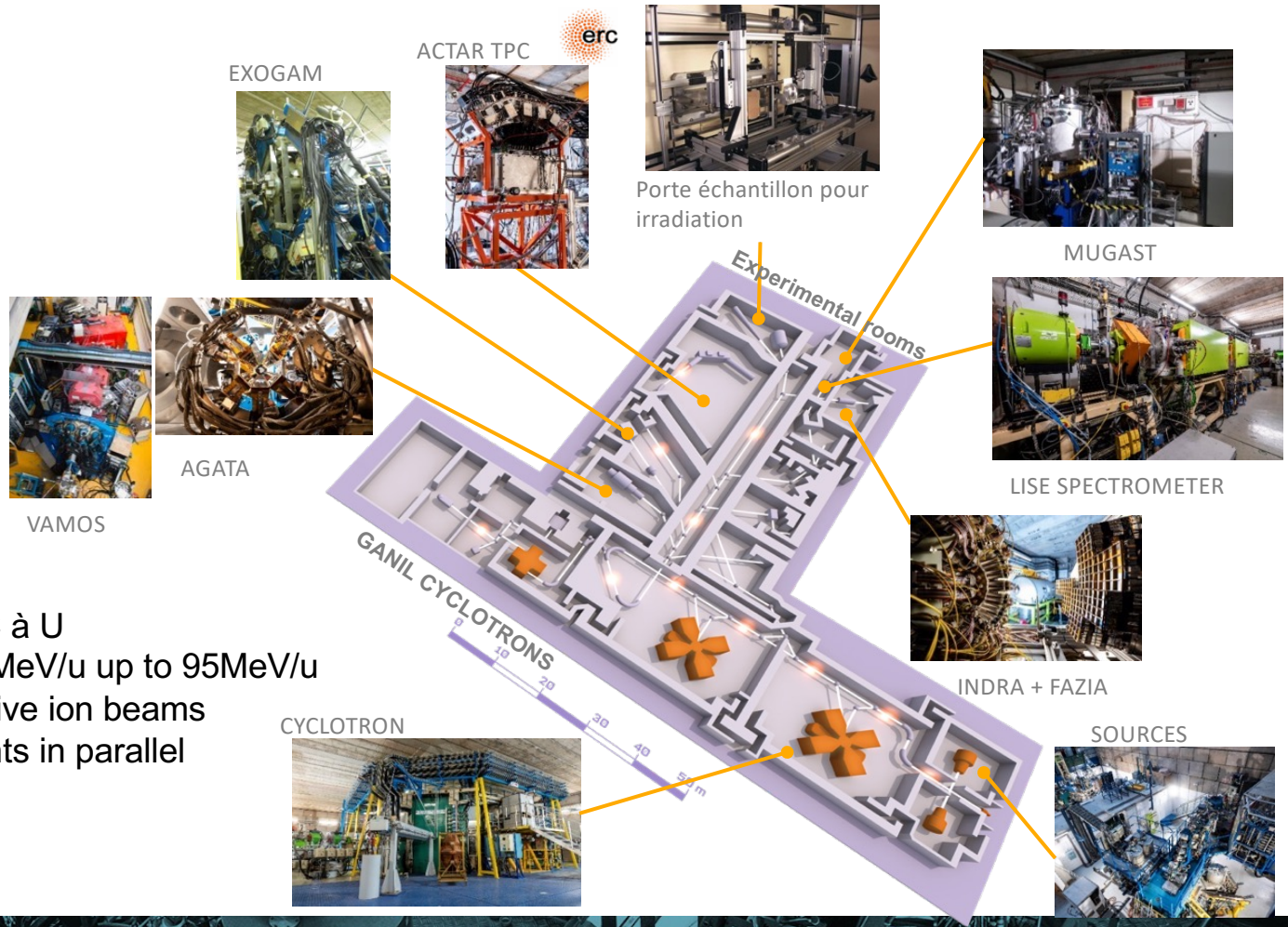


Industrial applications: microporous membranes, tests of electronic components

Radiobiology, new therapies

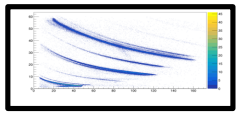
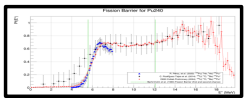
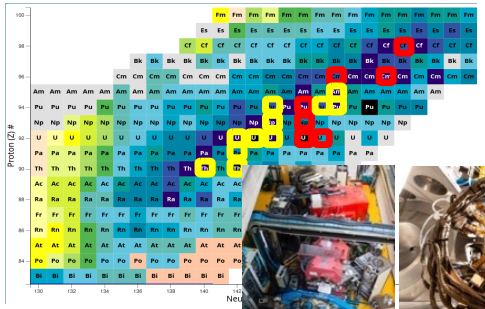
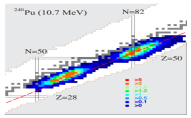

GANIL
GANIL installations and projects
© Ph. Stroppa/CEA

GANIL cyclotrons and experimental rooms



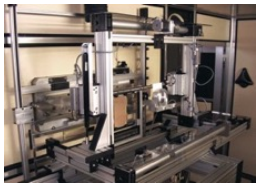
- 5 cyclotrons
- Stable beams: ^{12}C à U
- Energy : from <1 MeV/u up to 95MeV/u
- SPIRAL1 radioactive ion beams
- Up to 4 experiments in parallel

GANIL cyclotrons and experimental rooms

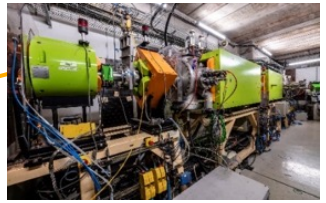
EXOGAM

ACTAR TPC



Porte échantillon pour irradiation

MUGAST



LISE SPECTROMETER

INDRA + FAZIA

AGATA

VAMOS

Fission and fission fragment properties

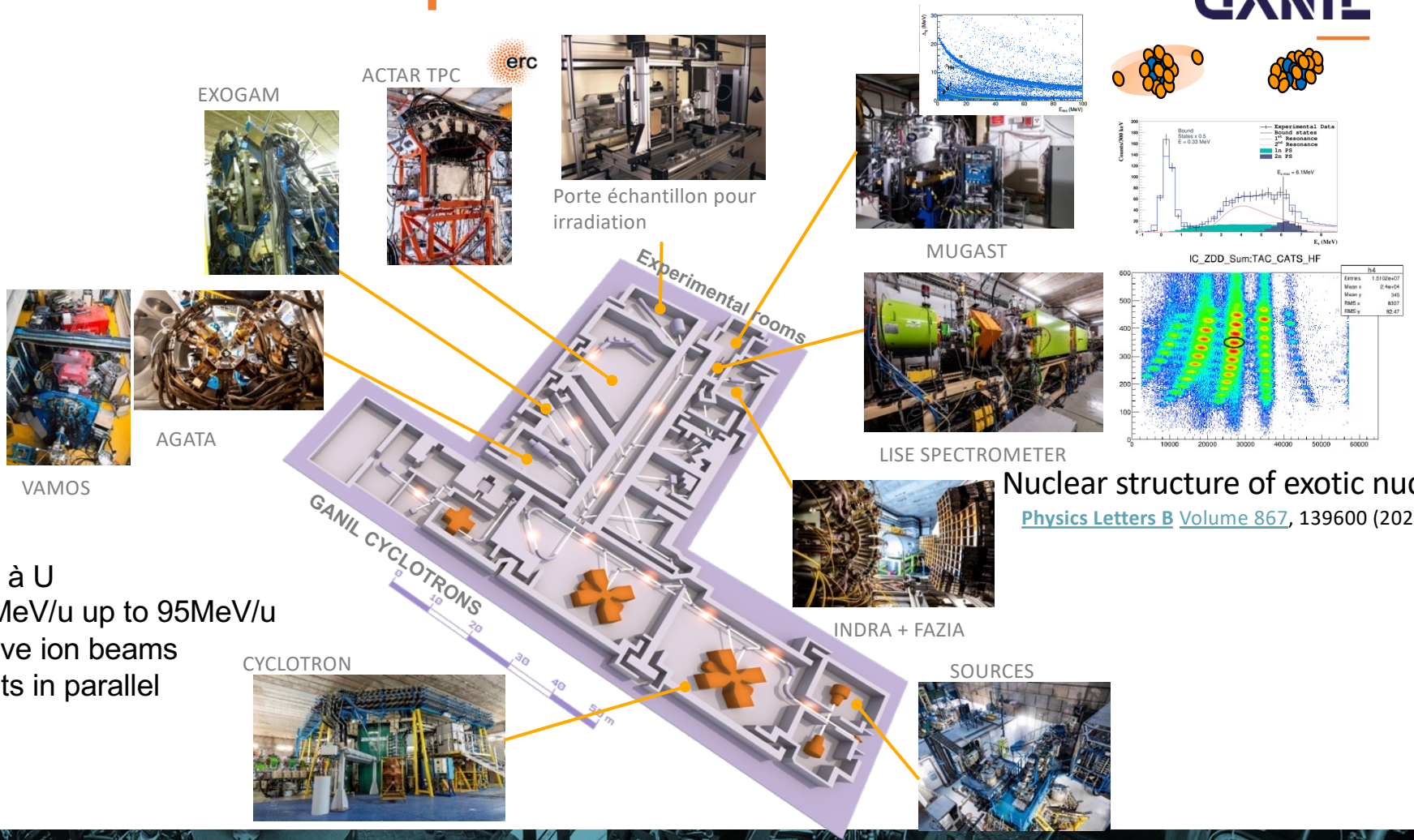
- 5 cyclotrons
- Stable beams: ^{12}C à U
- Energy : from <1 MeV/u up to 95MeV/u
- SPIRAL1 radioactive ion beams
- Up to 4 experiments in parallel

CYCLOTRON

SOURCES

GANIL cyclotrons and experimental rooms

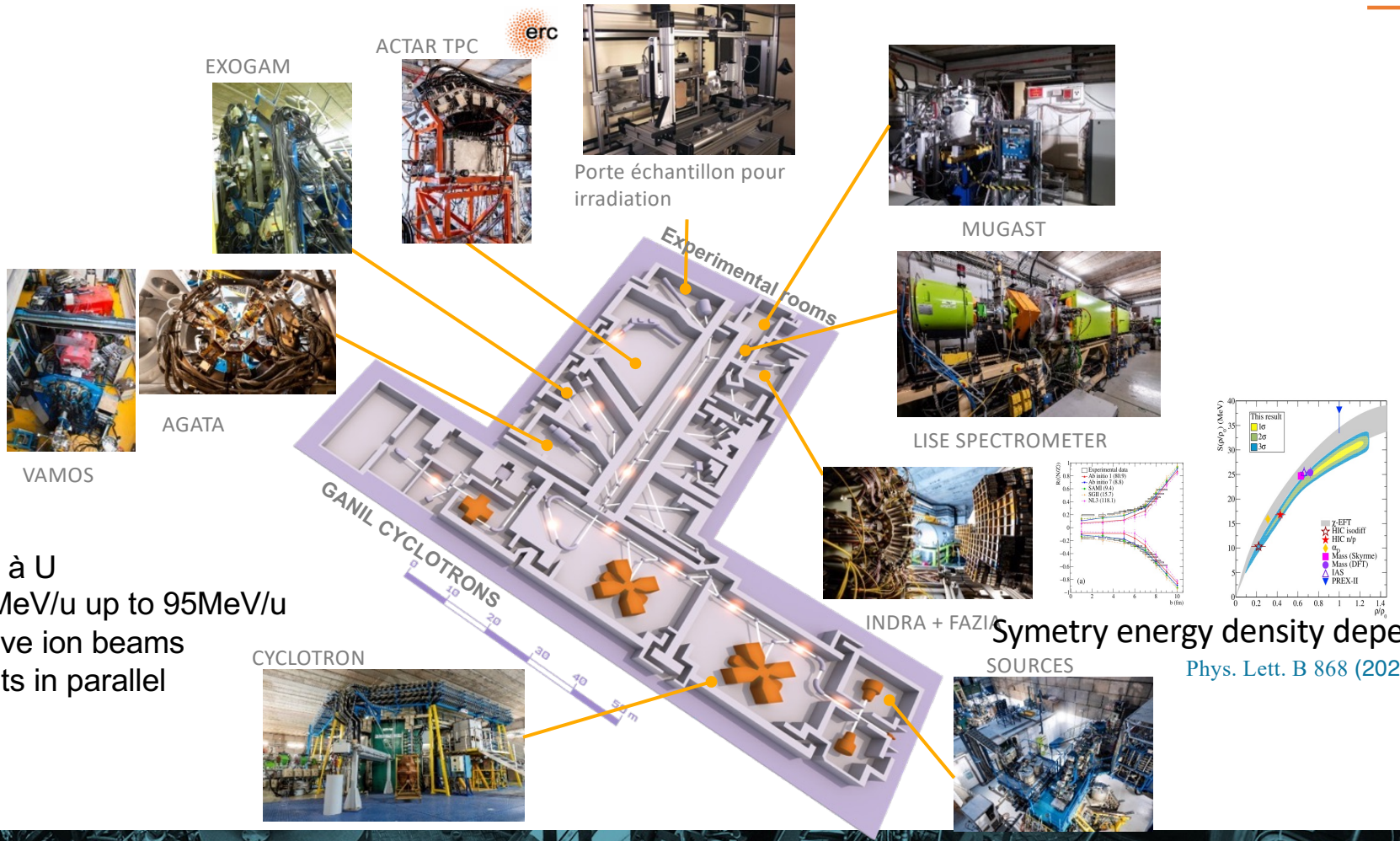
- 5 cyclotrons
- Stable beams: ^{12}C à U
- Energy : from <1 MeV/u up to 95MeV/u
- SPIRAL1 radioactive ion beams
- Up to 4 experiments in parallel



Nuclear structure of exotic nuclei

Physics Letters B Volume 867, 139600 (2025)

GANIL cyclotrons and experimental rooms



- 5 cyclotrons
- Stable beams: ^{12}C à U
- Energy : from <1 MeV/u up to 95MeV/u
- SPIRAL1 radioactive ion beams
- Up to 4 experiments in parallel

Symetry energy density dependence

Phys. Lett. B 868 (2025) 139815

And much more …

- On LISE (D4-D6):
  - A **radiobiology** experiment to compare the effect of ^{8}Li and ^{12}C for hadrontherapy (E847, E. Traykov)
  - Tests of target **materials under high intensity beams** (E872, D. Renish)
- On IRRSUD + SME + D1 HE : 58 experiments - 227,5 UT

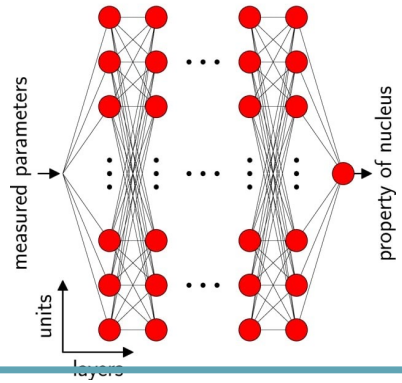
IRRSUD	+	SME	+	HE
112 UT		***86 UT***		***29,5 UT***

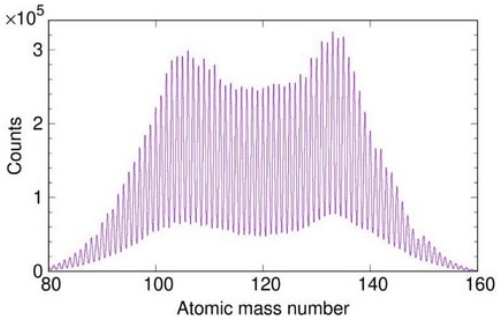
Solid state physics, **nanostructuration** and applications	46 %
Chemistry under irradiation and applications	22 %
Astrophysics / **Astrochemistry**	16 %
Radiobiology	11 %
Atomic and **Molecular physics**	5 %

- On ARIBE : 8 experiments – 232 UT
  - Molecular physics, laboratory astrophysics
  - First MIVOC beam (5+Mg)
  - Measurement of the GTS ion source radiation to define new radiological protection

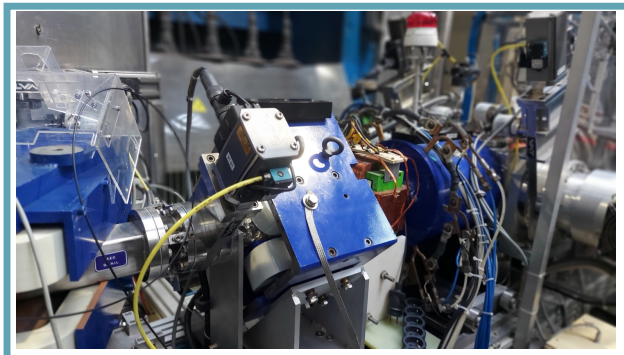
A constant upgrade to meet users needs

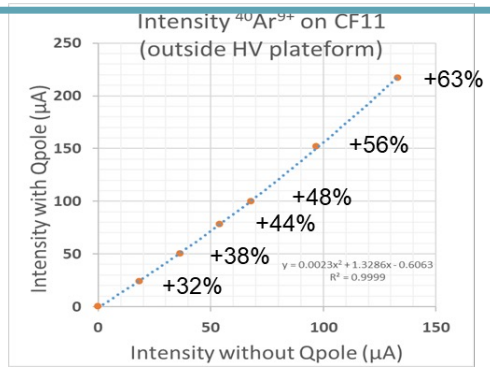
Neural network for VAMOS trajectory reconstruction



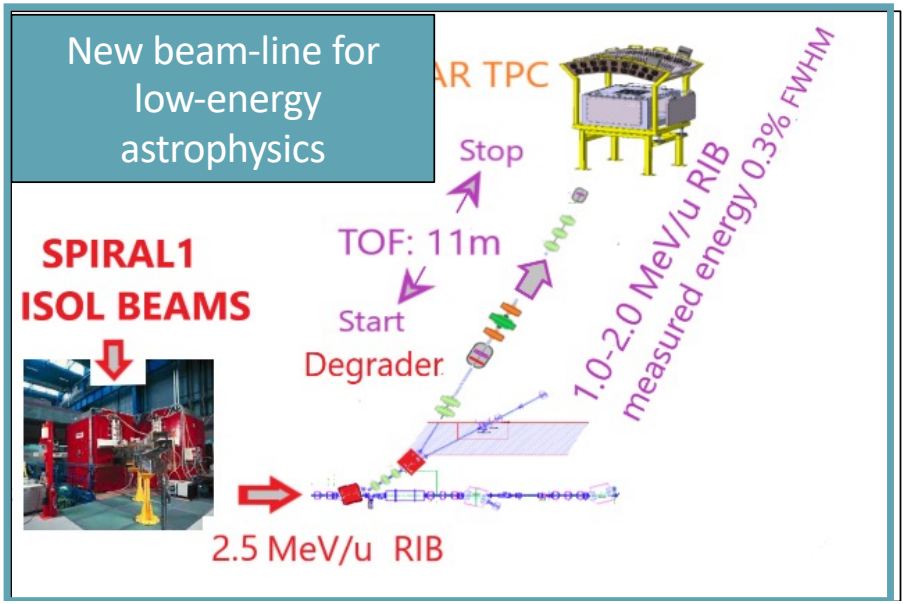


Improvement of beam stability and intensities : up to 50%

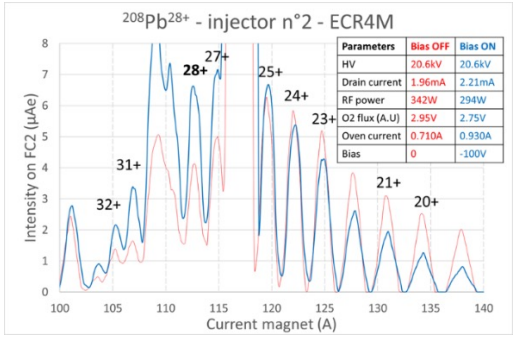




New beam-line for low-energy astrophysics



Improvement of metallic beams production and new RIBs



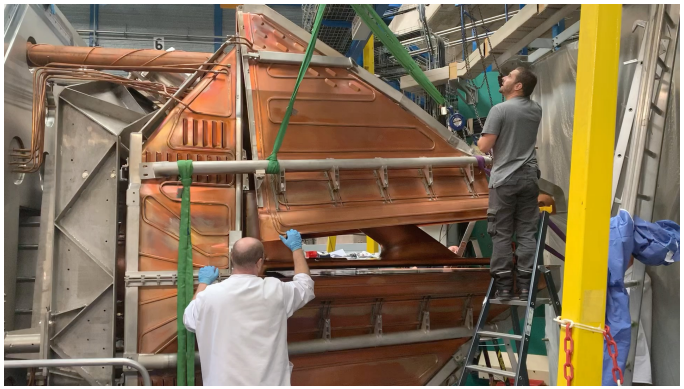
Primary beam ^{58}Ni@74A.MeV, 600W		Primary beam ^{129}Xe@50A.MeV, 200W	
Isotope	Measured Yields	Isotope	Measured Yields
58Co	9.40E+07	79Rb	1.58E+04
57Co	2.21E+08	79Kr	7.48E+04
57Ni	2.52E+07	80Rb	4.29E+04
56Co	1.11E+08	81mRb	5.34E+04
56Ni	1.99E+06	81Rb	3.62E+04
56Mn	1.09E+06	109Sn	4.30E+04
55Co	2.33E+07	109mIn	3.33E+04
53Fe	7.80E+06	109In	7.00E+05
53mFe	2.39E+06	117I	3.41E+05
52Fe	4.80E+06	117Te	1.64E+05
52Mn	1.19E+06	117Sb	7.42E+05
52mMn	3.10E+07	117In	1.05E+04
51Mn	3.90E+07		

CYREN : a deep renovation ambition for GANIL to maintain scientific objectives at the best level

2024-2033 renovation programme

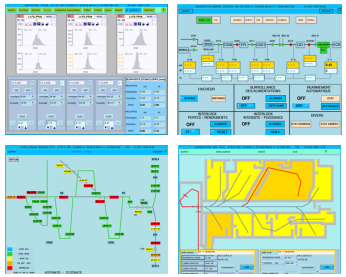
GANIL

- cyclotrons



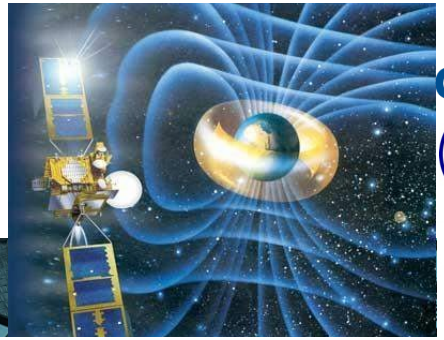
- Infrastructure

- Safety supervision



Minister for Research confirmed an endowment of ***40 M€ for GANIL projects: DESIR, NEWGAIN, CYREN (11,2 ; 7,4 ; 21,4)***

- Keep the installation in good operational conditions for the next 20 years
- Optimise human resources for operation



cnes

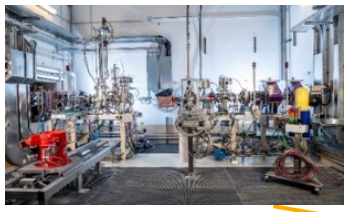
FRANCE 2030

RÉGION NORMANDIE

SAGA
19 M€
Beam quality improvement
Beam-time operation increase

SPIRAL2 LINAC and the new experimental rooms

EXPERIMENTAL ROOM NFS
(NEUTRONS FOR SCIENCE)

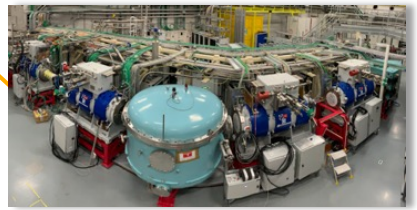


Convertor room

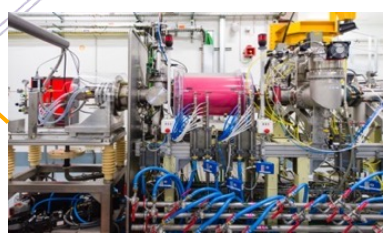
Time of Flight room

EXPERIMENTAL ROOM
DESIR
(Desintegration,
Excitation and Storage
of Radioactive Ions)

LINEAR accelerator (LINAC)



EXPERIMENTAL ROOM S3
(SUPER SEPARATOR
SPECTROMETER)

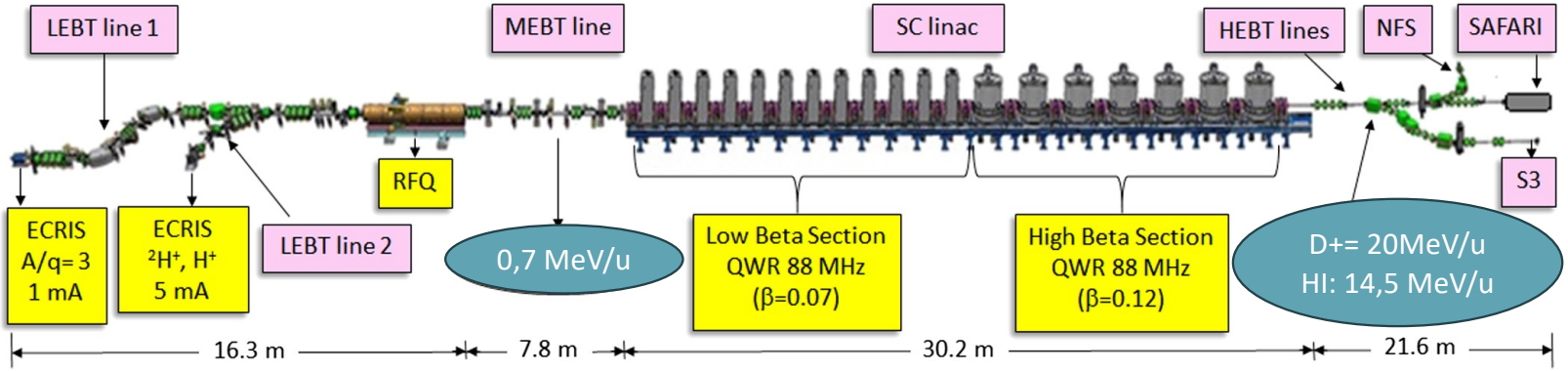


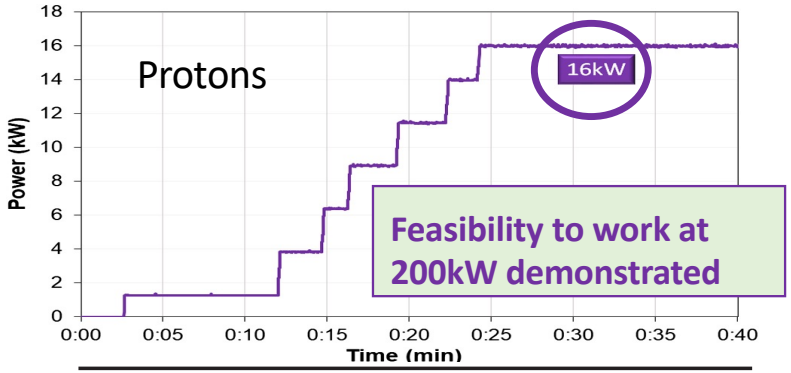
ION SOURCE

NEWGAIN
NEW GANIL INJECTOR

High intensity beams :
5 mA, 33 MeV protons
5 mA, 40 MeV deutons
1 mA, <14,5 MeV/u heavy ions

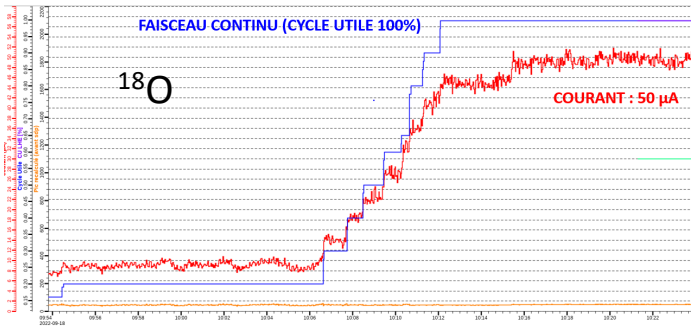
SPIRAL2 LINAC





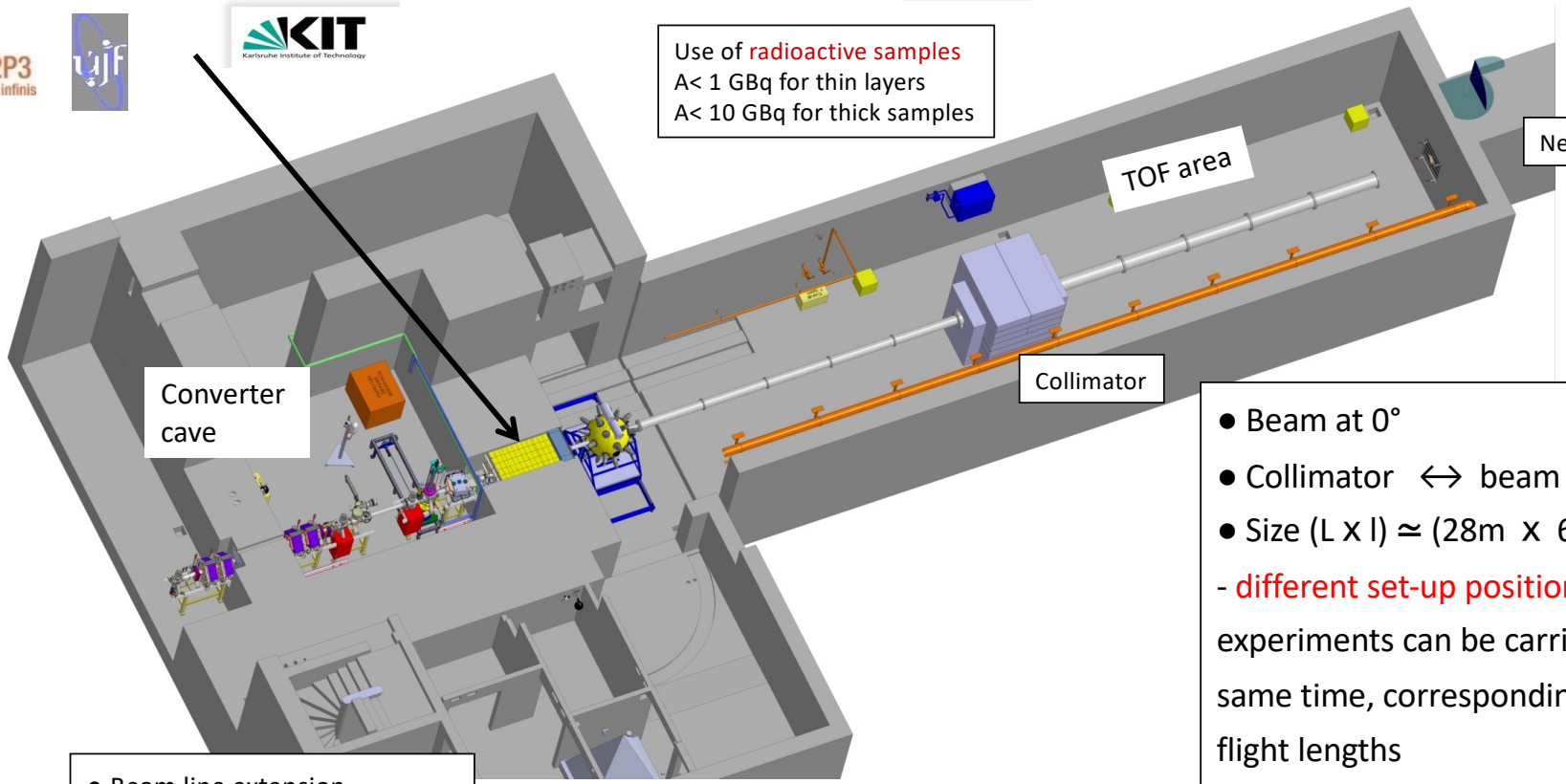
Beam power	2 kW	10 kW	16 kW
Energy (MeV)	31.90 ± 0.05	31.90 ± 0.05	31.90 ± 0.05
Intensity (mA)	4.35 ± 0.22	4.10 ± 0.21	4.00 ± 0.20
Pulse repetition (Hz)	1	10	10
Pulse length (ms)	14.5	7.7	12.6
Duty cycle (%)	1.5	7.7	12.6

A.K. Orduz et al, Phys. Rev. Acc. Beam 25, 060101 (2022)



First heavy ion beam : $^{18}O^{6+}$ 50µA, 7 MeV/u
LINAC transmission 98%
Other charge states accelerated by (quasi)automatic accelerator tuning
Also $^{40}Ar^{14+}$ 80µA, 7 MeV/u

NFS : Neutrons for Science facility



Use of radioactive samples
A< 1 GBq for thin layers
A< 10 GBq for thick samples

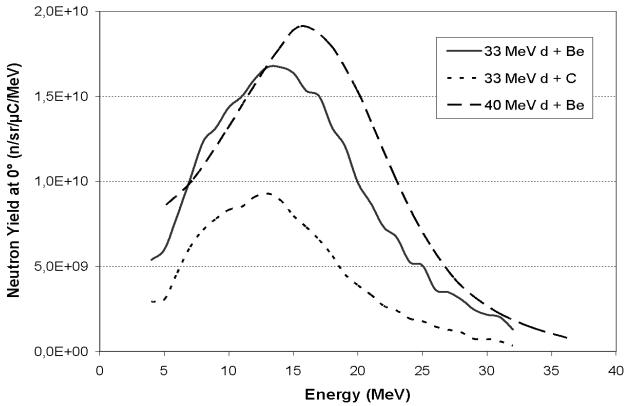
- Beam line extension
- Converter
- Magnet and beam dump
- Irradiation station (n, p, d)

- Beam at 0°
- Collimator ↔ beam quality
- Size (L x l) ≃ (28m x 6m)

- different set-up positions : several experiments can be carried out at the same time, corresponding to different flight lengths
- TOF measurements
- actinide targets (nuclear ventilation)

NFS: neutron production reactions

Deuteron beam
Continuous spectrum
E_{max} = 40 MeV , <E> = 14 MeV



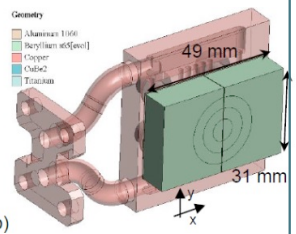
40 MeV d + Be at 50 µA → P=2 kW

Rotating converter

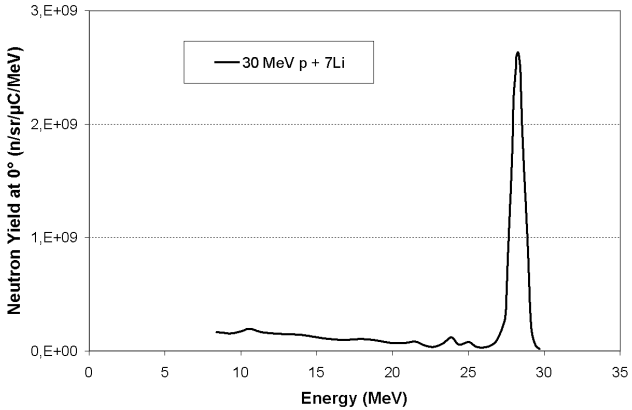
thick target Be (8 mm)

Static converter

thick target Be (11 mm) + Cu

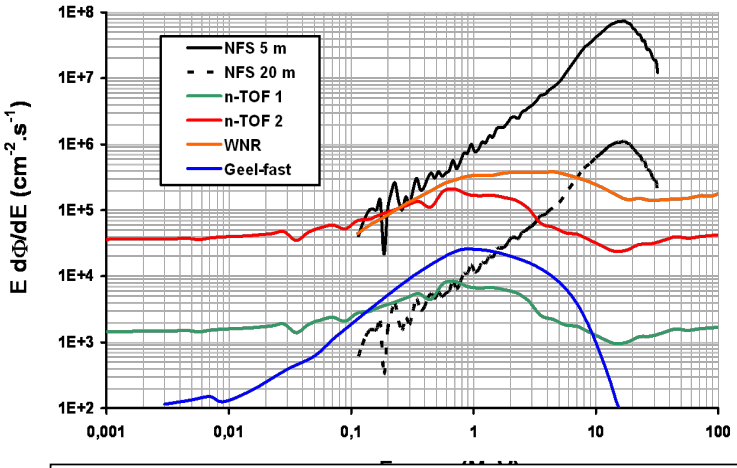


Proton beam
Quasi-monoenergetic spectrum
E_n = up to 31 MeV



p + Li (1.5 mm) at 20 µA

Beam characteristics

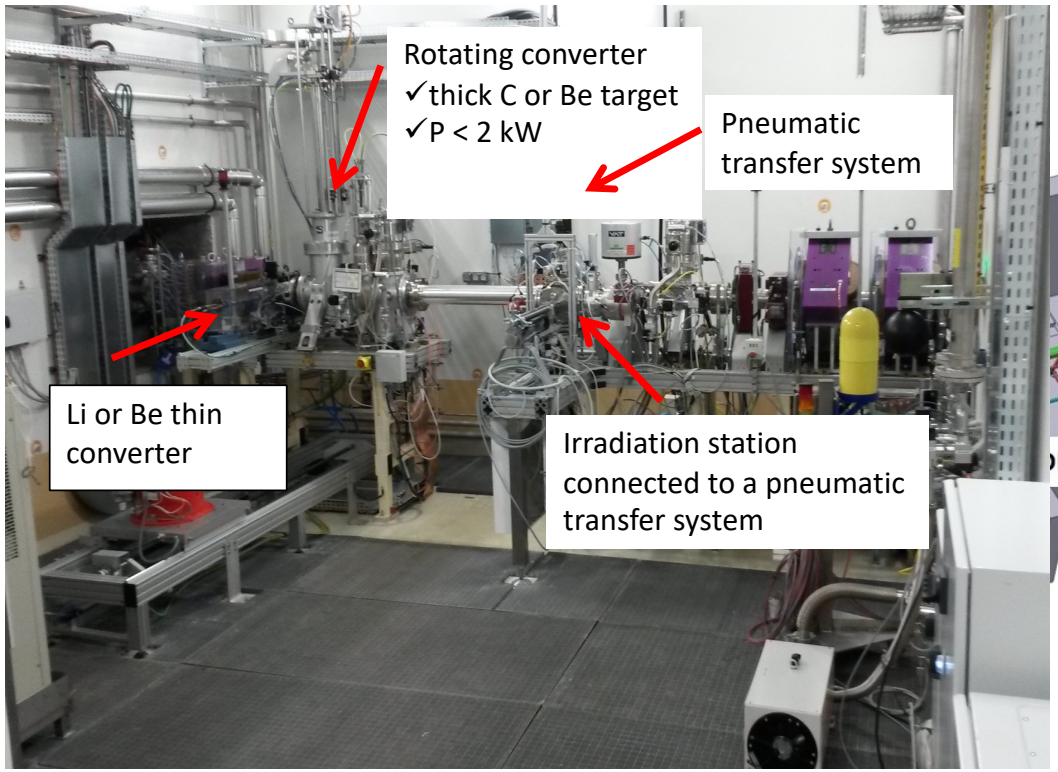


TOF hall

- Neutron Beam at 0°
- Collimator => beam quality
- Reduced gamma flash
-

Irfu
Institut de recherche sur les lois fondamentales de l'Univers

NFS : Neutrons for Science facility



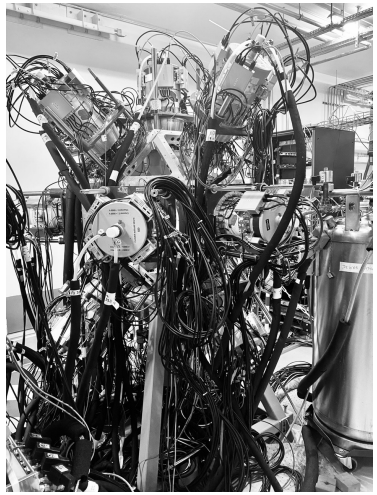
Converter room
- Ion and neutron induced reactions
- Irradiation station (n, p, d)

- different set-up positions : several experiments can be carried out at the same time, corresponding to different flight paths
- actinide targets (nuclear ventilation)

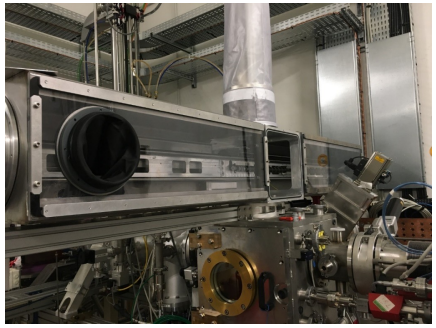
X. Ledoux et al, Eur. Phys.J. A (2021) 57:257

Some NFS Experiments

- Pygmy dipole resonance in ^{140}Ce using the (n,n'γ) reaction, Marine Vandebrouck et al
- Light ions production studies with MEDLEY at the NFS facility, Diego Tarrio et al
- (n,xn γ) reaction cross section measurements for nuclear energy, M. Kerveno et al
- REPARE project: production of ^{211}At for alphatherapy, Gilles de France et al

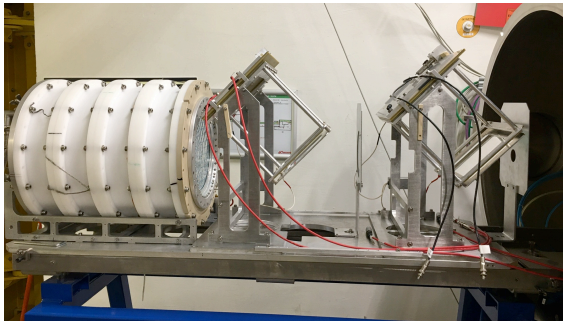


- Shedding new light on the structure of ^{56}Ni using (n,3n) reaction at NFS, E. Clement et al



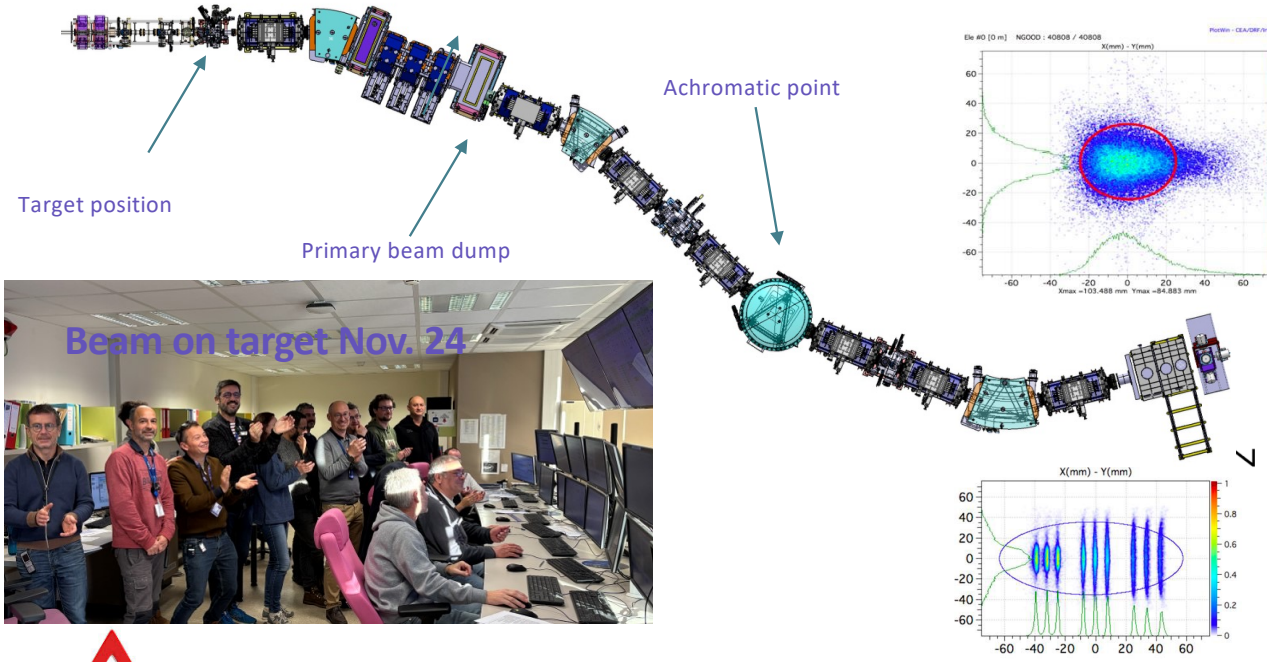
REPARE

MEDLEY



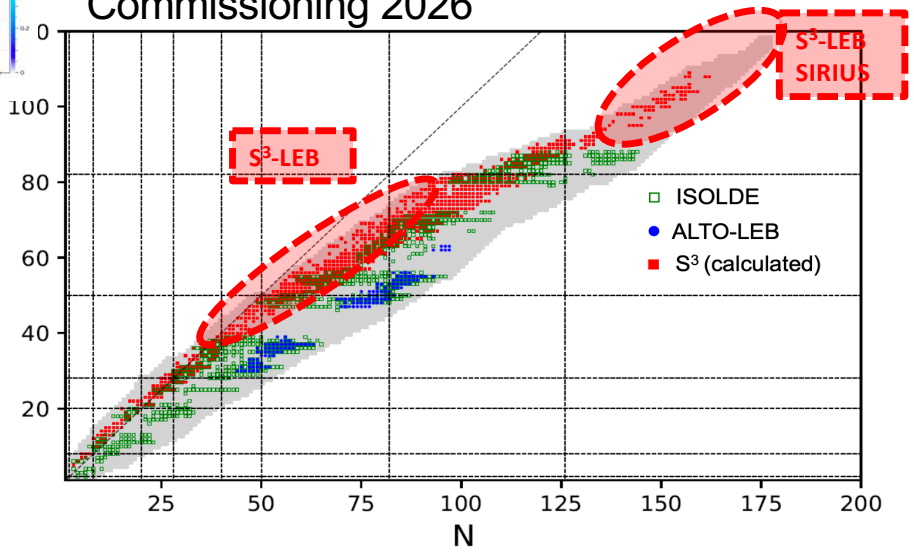
- ^{235}U fission fragment study with FALSTAFF at NFS, D. Doré et al.

S³ : Super Separator Spectrometer



A state-of-the-art spectrometer
Separator and Mass spectrometer
Convergent and High-resolution Mode

First beam on target 2024
Commissioning 2026



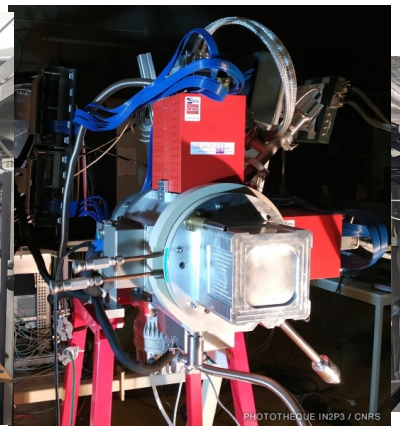
Commissioning is experiencing significant delays due to non-compliance of the soldered parts of the cryogenic system

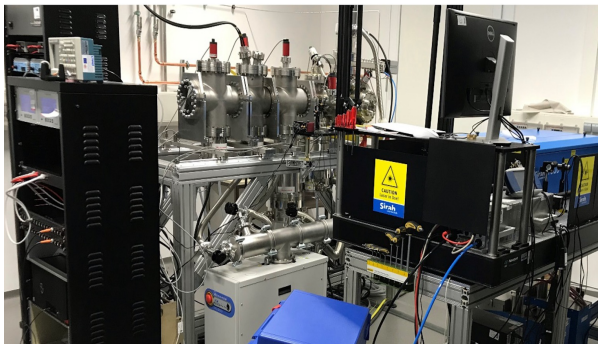
S3 collaborations get-ready

- S3_LEB laser spectroscopy, MR-TOF pursues its installation and commissioning off-line
- SIRIUS ready and upgrade approved for the X detection D-SHEXI
- SEASON commissioning in Jyvaskyla
- LRC H2020 ERC came to GANIL for a new scientific program on Super heavy elements

First experiments :

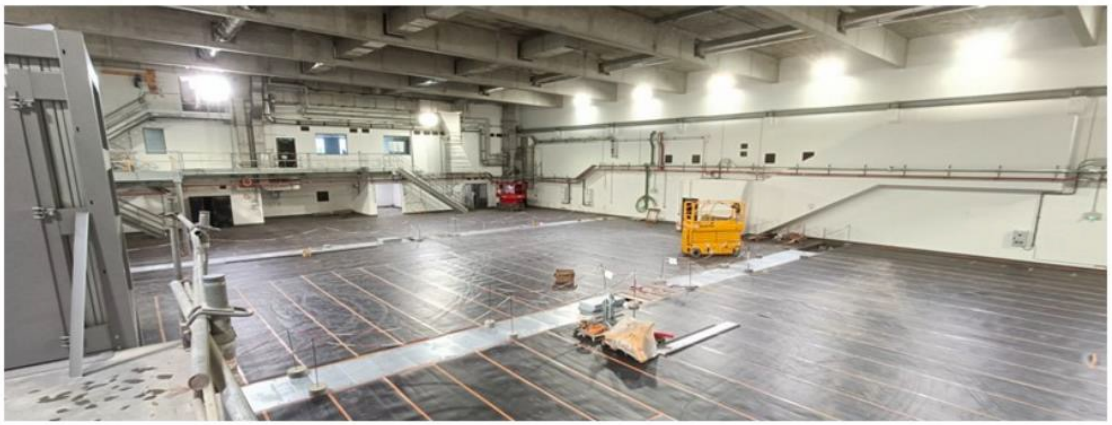
- $^{116}Sn(^{40}Ar, 4n)^{151}Er$: well-known cross section and alpha decay
- Production of Ac with assymetric fusion reactions : $^{40}Ar + ^{175}Lu$ and $^{20}Ne + ^{197}Au$
- Production of $N = Z$ nuclei($^{50}Cr + ^{58}Ni$) + study of direct ion extraction from gas cell





DESIR
Decay, Excitation, Storage of Radioactive Ions

- Site inauguration novembre 2023
- First stable beams 2027
- First experiments 2028



- Beams from SPIRAL1 and S3
- Important beam preparation and purification capabilities
- High resolution and high precision experiments
- Studies of fundamental properties of nuclei:

masses, lifetimes, decay modes, spin, quadrupolar moments…

- Nucleosynthesis
- Fundamental interactions, study of weak interaction

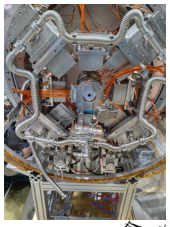
- Scientific aperture

Contribution to ESPPU

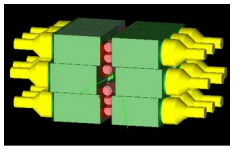
DESIR Collaborations

GANIL
DESIR

Evolution of Laser spectroscopy set-ups :

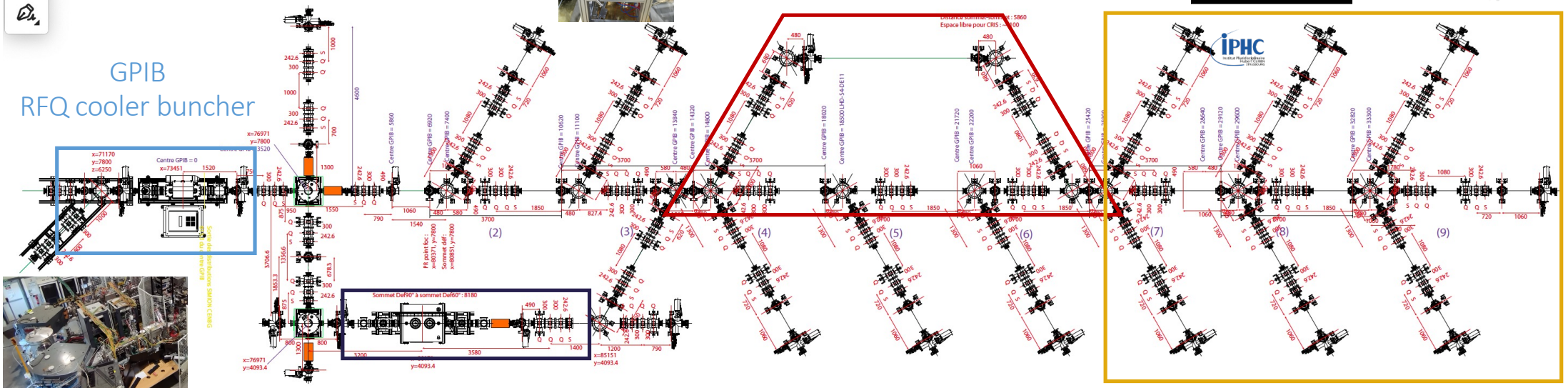


LASAGN

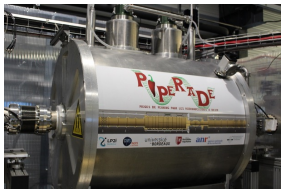


ASGARD

GPIB
RFQ cooler buncher



PIPERADE
double penning trap
for beam purification



Nuclear decay of
unstable heavy charged ions

Decays and Traps
- Laser spectroscopy with traps
- Laser purification for decay experiments

GANIL horizon 2030

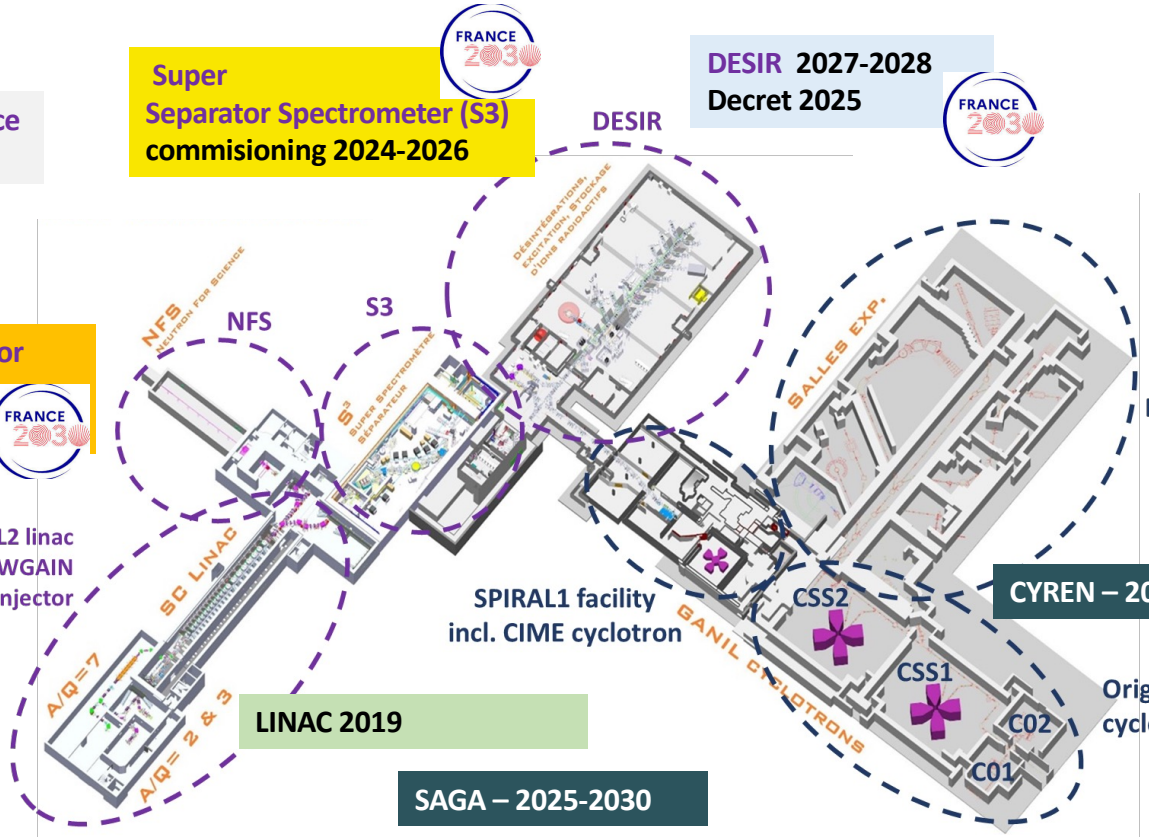
Neutrons for Science (NFS) 2021

GANIL Laboratory for Actinide Chemistry 2030

NEWGAIN, injector
2028 PHOENIX
2032 ASTERICS

Super Separator Spectrometer (S3) commisioning 2024-2026

DESIR 2027-2028
Decret 2025



AGATA 29-30

Experimental halls

CYREN – 2024-2030

Original cyclotrons chain

SPIRAL2 linac
incl. NEWGAIN
A/Q=7 injector

SPIRAL1 facility
incl. CIME cyclotron

LINAC 2019

SAGA – 2025-2030

Thank you for your attention

A brief history of GANIL

1976 Creation of GANIL GIE
(Grand Accélérateur national d'ions lourds)

1983 First experiment

2001 SPIRAL1 exotic beams

2006 SPIRAL2 Project signature of convention for construction
Inclusion on European Strategy Forum for
Research Infrastructures (ESFRI) roadmap

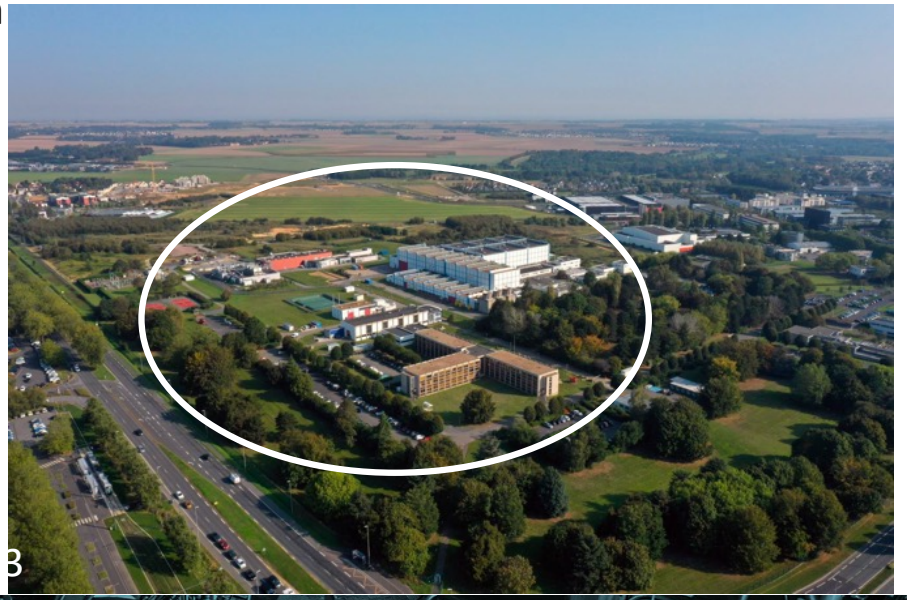
2011 Start of SPIRAL2 Construction

2019 Start of the SPIRAL2 commissioning

2020 First neutron beams at SPIRAL2

2022 First heavy ion beams at SPIRAL2


GANIL late 70s



GANIL in the European and national lanscape

Groupement d'intérêt économique

UAR 3266

Département de l'Irfu

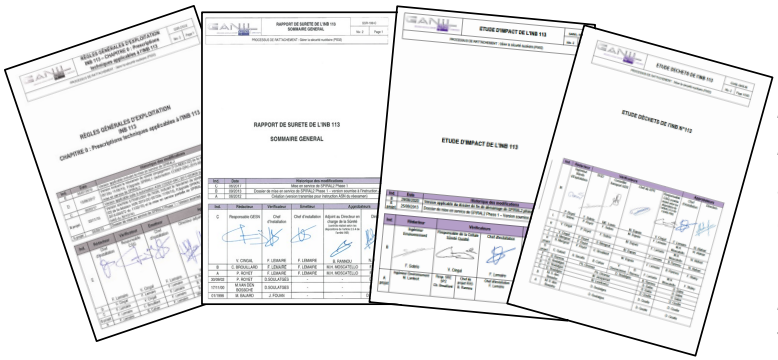
Research Infrastructure* in Ministry roadmap

MINISTÈRE DE L'ENSEIGNEMENT SUPÉRIEUR ET DE LA RECHERCHE
Liberté Égalité Fraternité

https://enseignementsup-recherche.gouv.fr/fr/la-feuille-de-route-nationale-des-infrastructures-de-recherche-2021-84056

5 IO, 23 RI*, 73 RI, 7 P

GANIL : nuclear installation INB 113



Regular inspections (≈3 every year) by National Safety Authority ASN
Annual meeting ASN
Second safety examination on-going
Modification Autorisation request file for DESIR under evaluation

SPIRAL2 ESFRI « landmark » since 2016, renewed after evaluation in 2023 for 5 years

ESFRI

Organization