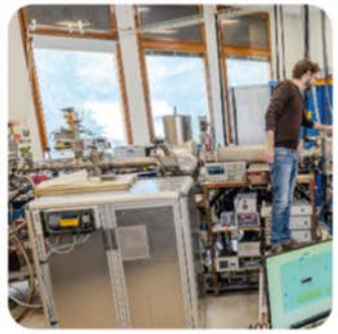
Journées des utilisateurs de la plateforme mosaic

IJCLab Irène Joliot-Curie
Laboratoire de Physique des 2 Infinis

mosaic

cnrs NUCLÉAIRE & PARTICULES

université PARIS-SACLAY



emir&a
Réseau national d'accélérateurs pour l'irradiation et l'analyse des molécules et matériaux

Un grand merci aux sponsors de ces journées :

université PARIS-SACLAY GRADUATE SCHOOL Physique | P2I Physique des deux Infinis

INSTITUT INTÉGRATIF DES MATÉRIAUX | université PARIS-SACLAY

https://indico.ijclab.in2p3.fr/event/12150

12 mars 2026 - 9h30
au 13 mars 2026 - 16h

Auditorium Joliot Curie (IJCLab)
Bâtiment 100

Irène Joliot-Curie
Laboratoire de Physique des 2 Infinis

cnrs université PARIS-SACLAY

MOSAIC, a multidisciplinary ion beam facility for research and training in Orsay

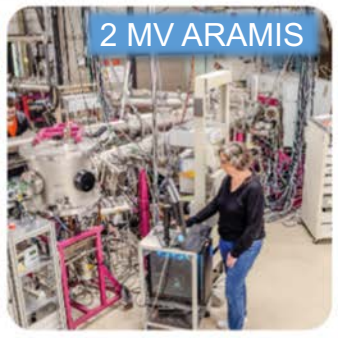
Operations manager: Cyril Bachelet
Operations deputy manager: Isabelle Ribaud
Scientific leader: Stéphanie Jublot-Leclerc

emir&a
Réseau national d'accélérateurs pour l'irradiation et l'analyse des molécules et matériaux

MOSAIC, a multidisciplinary platform with complementary equipment

mosaic

Ion beams for …



… synthesis, modification, and analysis of materials,

… and ion-matter interactions studies

MOSAIC, a multidisciplinary platform with complementary equipment

Facility open to

industrials
academics
students

Building 108

JANNuS-Orsay experimental hall

- 2 MV ARAMIS
- 190 kV IRMA
- 200 kV *in situ* TEM
- SEM-EDX AFM
- 40 kV Sidonie

Building 201

- 4 MV Andromède
- 30 kV Tancrède
- 400 kV Némée

mosaic

Scientific Interest Group GIS JANNuS (since 2005)

JANNuS-Saclay

JANNuS-Orsay hall

Joint **A**ccelerators for **N**ano-science and **Nu**clear **S**imulation

https://jannus.in2p3.fr

emir&a

Réseau national d'accélérateurs pour l'irradiation et l'analyse des molécules et matériaux

Member of the EMIR&A French accelerator federation Research Infrastructure

4 MV Andromède

EVE Mass Spectrometer
Ionic Imaging
Material modifications

Beam Line at 1°29
Primarily dedicated to beams from macromolecules to gold clusters

Beam line at 90 °
Atomic and molecular beams from hydrogen to ions with a mass to charge ratio below 70

4 MV NEC Accelerator
ECR source & LMI source from protons to gold nanoparticles

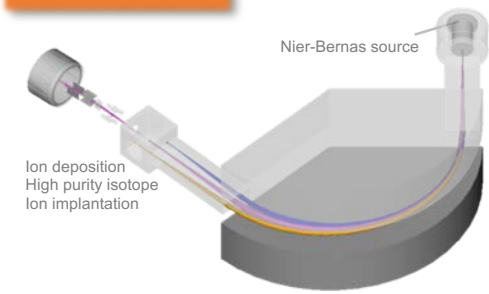
JANNuS-Orsay experimental hall

2 MV ARAMIS

190 kV IRMA

200 kV TEM

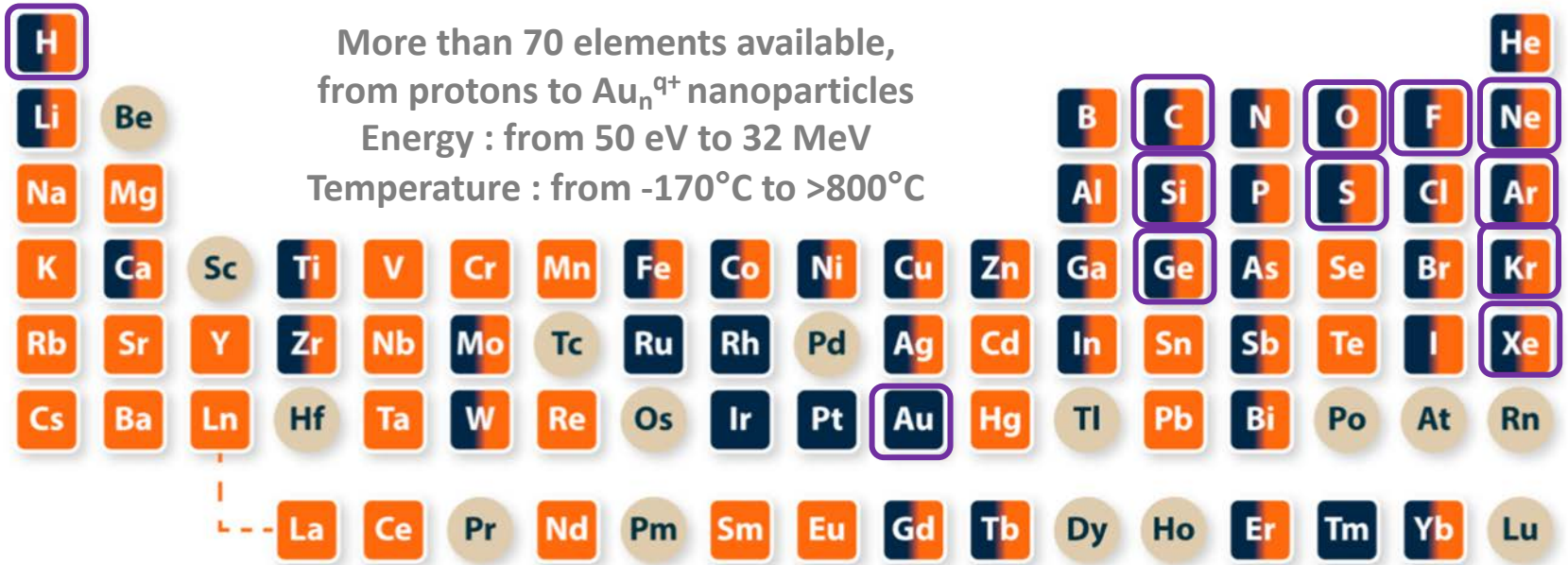
40 kV Sidonie



A large variety of elements

mosaic

More than 70 elements available,
from protons to Au_n^{q+} nanoparticles
Energy : from 50 eV to 32 MeV
Temperature : from -170°C to >800°C



ARAMIS | IRMA, Sidonie Némée | UNAVAILABLE | Andromède

Complementary ion sources

Multicharged atomic and molecular ions
H_2^+, CH_n^{q+}, $C_2H_5^+$, SFn^+, C_{60}^{q+} …
Au_n^{q+} *with n/q from 1 to 1600*

4 MV Andromède

2 MV ARAMIS

400 kV Némée

40 kV Sidonie

190 kV IRMA

30 kV Tancrède

50 eV | 1 keV | 10 keV | 100 keV | 1 MeV | 10 MeV | 32 MeV

MOSAIC: ion beams for pluridisciplinary science

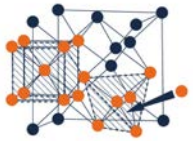
Deposition
High purity isotope deposition (eV)

Doping
Stable elements
Ion beam synthesis

Solid

Irradiation
Low energy ions (KeV)
'High' energy ions (MeV)

Ion-matter interactions
Nuclear reactions



Elemental and molecular composition, evolution of the microstructural modifications at the nanoscale

Characterization (*ex* & *in situ*)

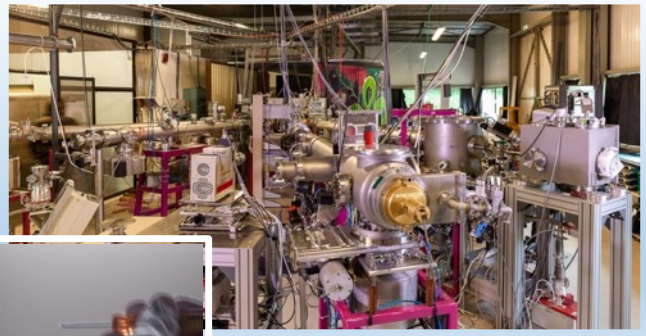
Ion Beam Analysis (RBS, channelling, ERDA, PIXE)
In situ RBS-C (with implantation)
Transmission Electron Microscopy (TEM)
In situ TEM (single/dual ion beam)
Mass spectrometry analysis (ToF-SIMS with MeV gold nanoparticles)
Surface analysis (SEM, AFM) & sample preparation

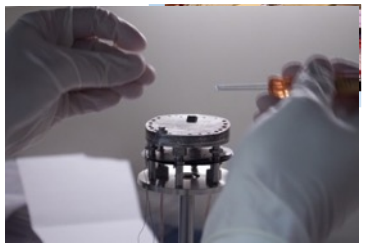
Ion beams for ....

… synthesis, modification of materials, and ion-matter interactions

4 MV Andromède | 2 MV ARAMIS | 400 kV Némée | 190 kV IRMA | 40 kV Sidonie | 30 kV Tancrède

Ion irradiations and implantations

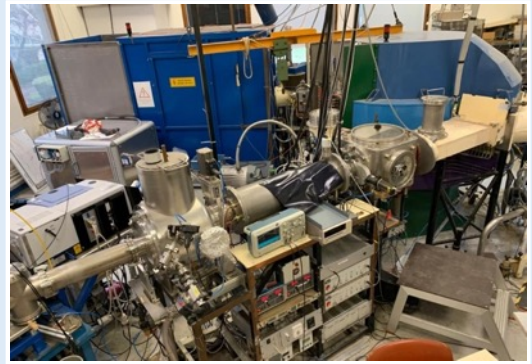




Oihan Allegret
Today, 12h20
+ Many others …

71 available elements,
from protons to Au_n^{q+} nanoparticles
Energy : from 50 eV to 32 MeV
Temperature : from -170°C to 1000°C

High purity isotopic deposition

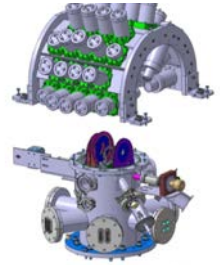


In situ nuclear reactions studies

NewJedi experiment

Beyhan Bastin
Today, 16h40

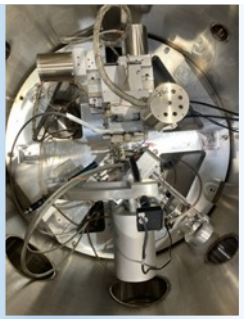
Stella experiment

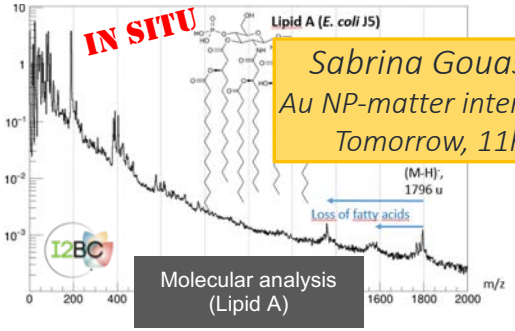


… analysis of materials and biological specimens

Mass spectrometry analysis

EVE : MeV Nanoparticles ToF SIMS @ Andromede



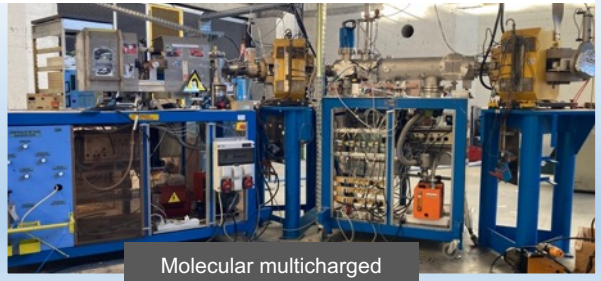


Sabrina Gouasmia
Au NP-matter interactions
Tomorrow, 11h25

Molecular analysis (Lipid A)

Ionic emissions

Tancrède + UHV analysis chamber or EDEN

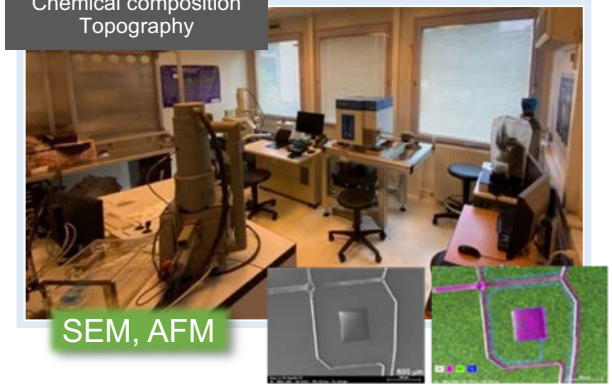


Molecular multicharged ions impact

Surface analysis

Scanning Electron Microscopy
Atomic Force Microscopy

Chemical composition
Topography



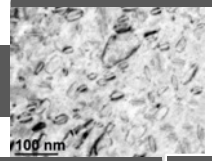
SEM, AFM

Observation and analysis of microstructure evolution of a material at the nanoscale

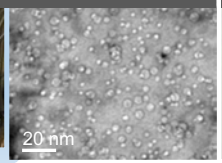
In situ dual ion beam Transmission Electron Microscopy

Cristallographic structure

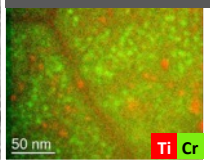
Loops, dislocations



Cavities and bubbles



Elemental analysis



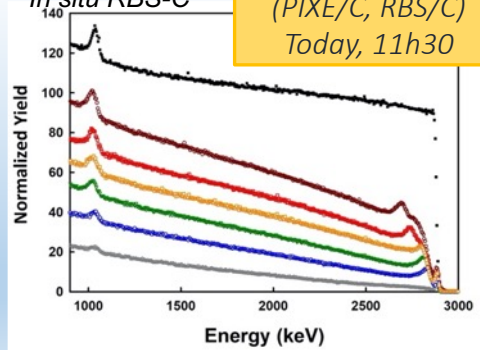
- *Karen Pacho Dominguez*
  Today, 14h15
- *Marie-Laure David (EELS)*
- *Camilo A.F. Salvador (DL)*
  Tomorrow

Ion Beam Analysis

ARAMIS, IRMA
RBS, channelling, ERDA, PIXE

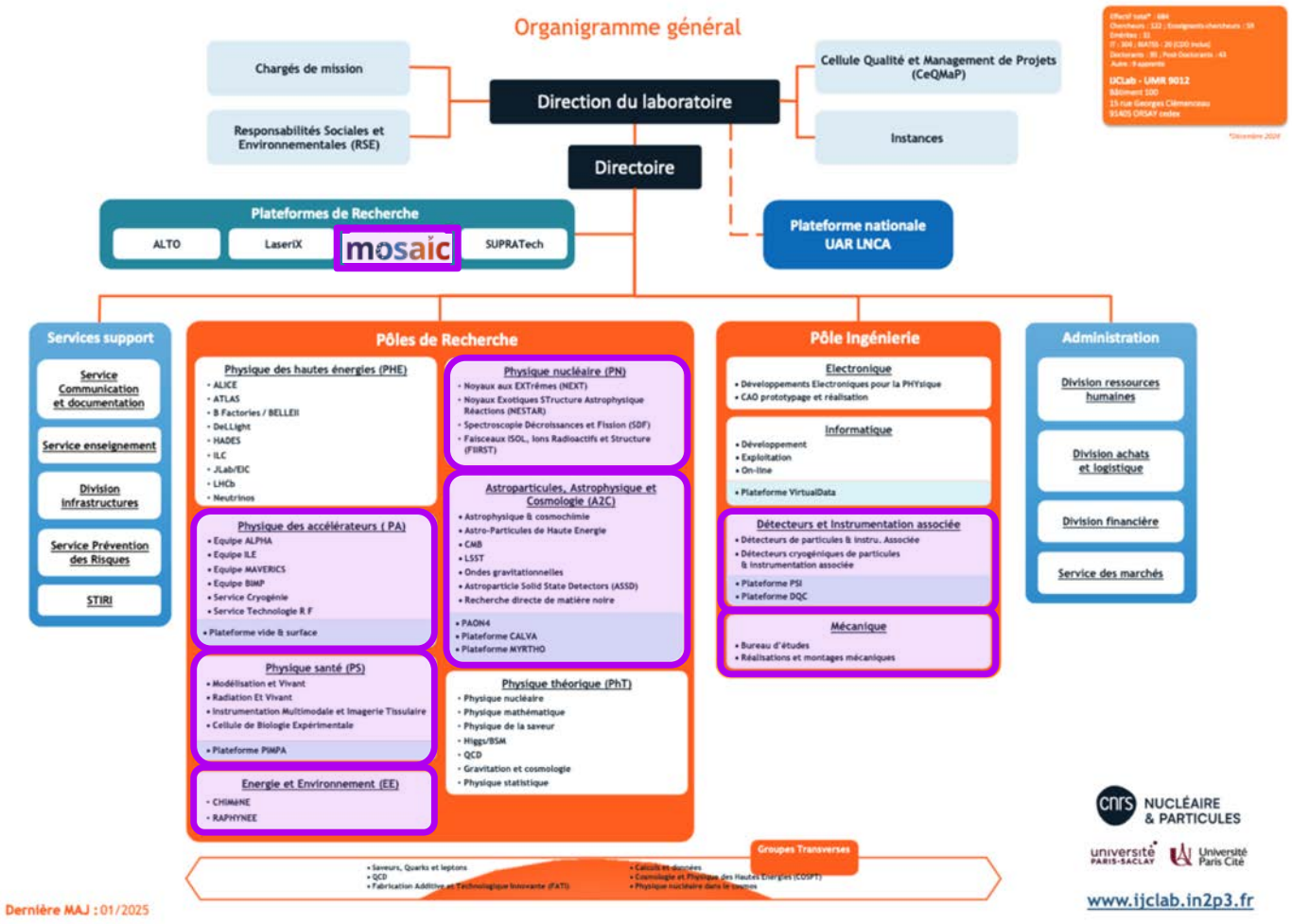
Elemental analysis, damage (displaced atoms), depth profiles…

In situ RBS-C



Ewelina Kucal
(PIXE/C, RBS/C)
Today, 11h30

Positioning within the lab



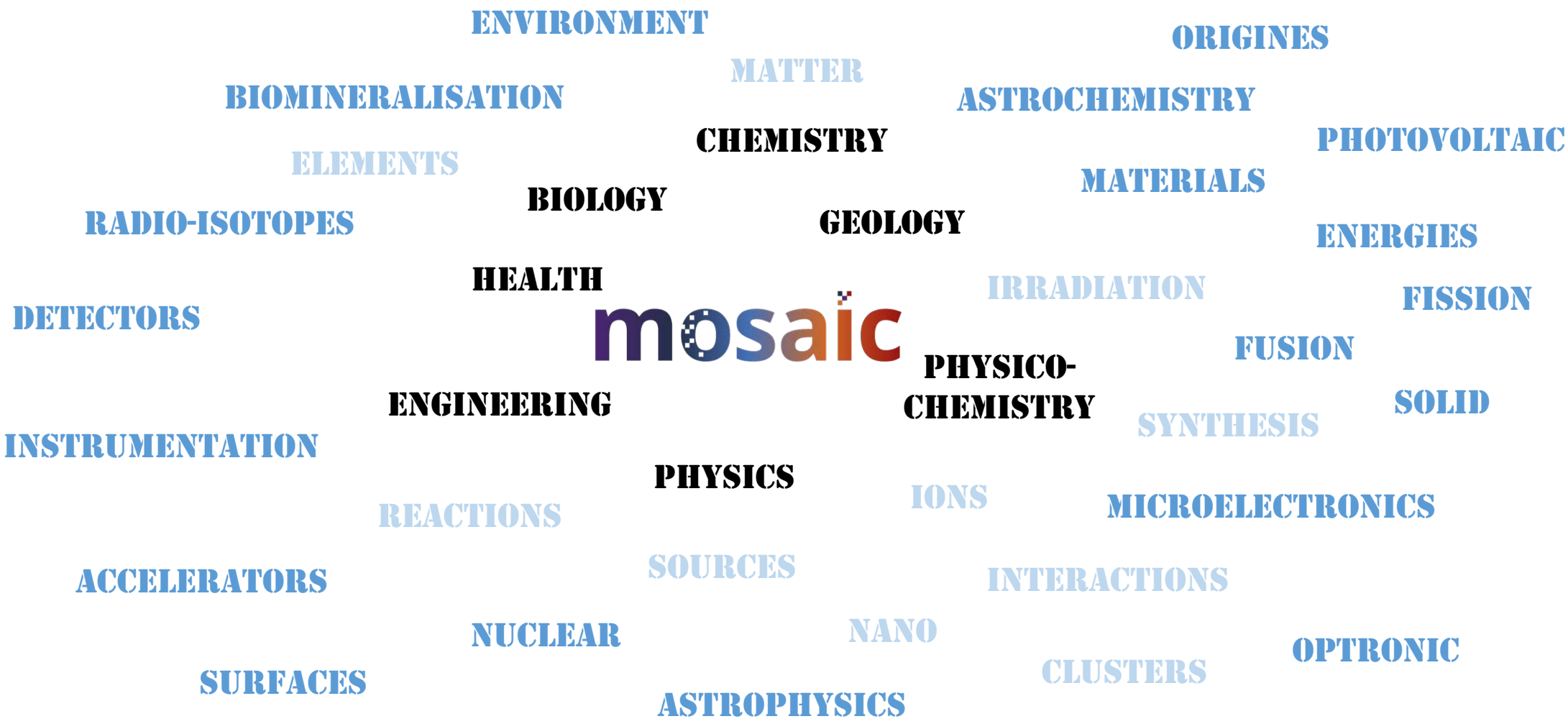
Strong implication of

- ✓ E&E pole (CHIMENE)
- ✓ Nuclear Physics pole (FIIRST)

Internal users :

- ✓ Energy & Environment pole (CHIMENE)
- ✓ Nuclear Physics pole (FIIRST)
- ✓ Physics for Health pole (REV)
- ✓ A2C pole (ASSD, Astrophys. and Cosmochemistry)
- ✓ Accelerators pole (MAVERICS)
- ✓ Engineering pole (detectors, mechanics/additive manufacturing,…)
- ✓ …

Scientific themes



Beam time attribution : call for proposals and paid services

Internal IJCLab users

Request beam time form

External academic users

E-mail + request beam time form

https://mosaic.ijclab.in2p3.fr

External users
(***in situ*** **TEM** or **Andromède/EVE**)

Online submission (EMIR&A web site)

Internal scientific committee
each 3 months / annual for Andromède

Internal Scientific Committee (CSI), composed of:

- Operation managers (Cyril Bachelet, Isabelle Ribaud)
- Scientific leader (Stéphanie Jublot-Leclerc)
- Direction or a representative of the lab direction (Fadi Ibrahim / Aurélie Gentils)
- Representatives of internal users (E&E, Nucl. Phys., Health poles) Frederico Garrido, Faïrouz Hammache, Charles-Olivier Bacri
- Persons in charge of Microscopies and Accelerators (Jérôme Bourçois, Cédric Baumier)
- A representative of the Risk Prevention department (Fabien Razafimamonjy)

Referees + EMIR&A international scientific council + internal technical review *(each year, approx. sept.-oct.)*

Programming

mosaic@ijclab.in2p3.fr

Urgent requests
Internal users

E-mail

E-mail + form

Industrials

European programmes

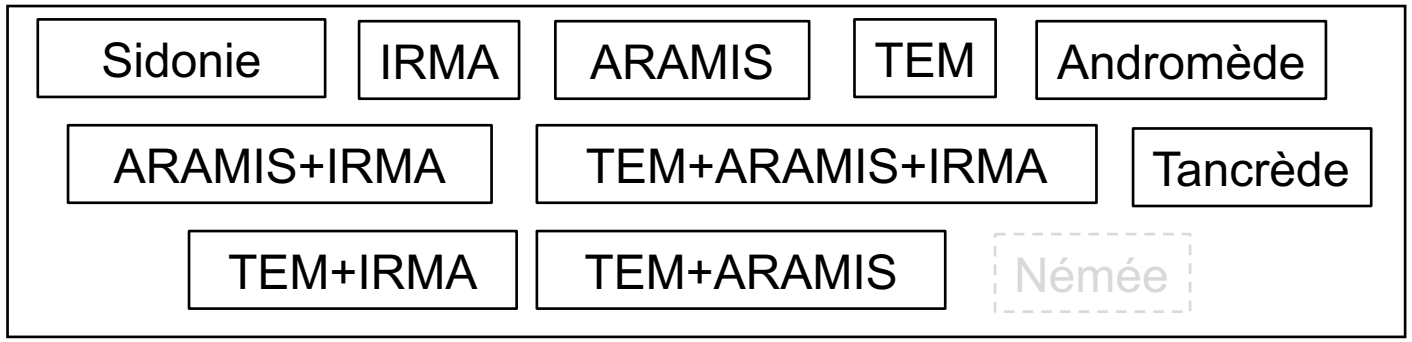
Time sheets

Beam time attribution- Programming

Programming

by the person in charge of the accelerators
and if needed, with help from facility managers
or/and committee

mosaic@ijclab.in2p3.fr



8h per day
from Monday to Friday

except some specific experiments 24/7 at Andromede

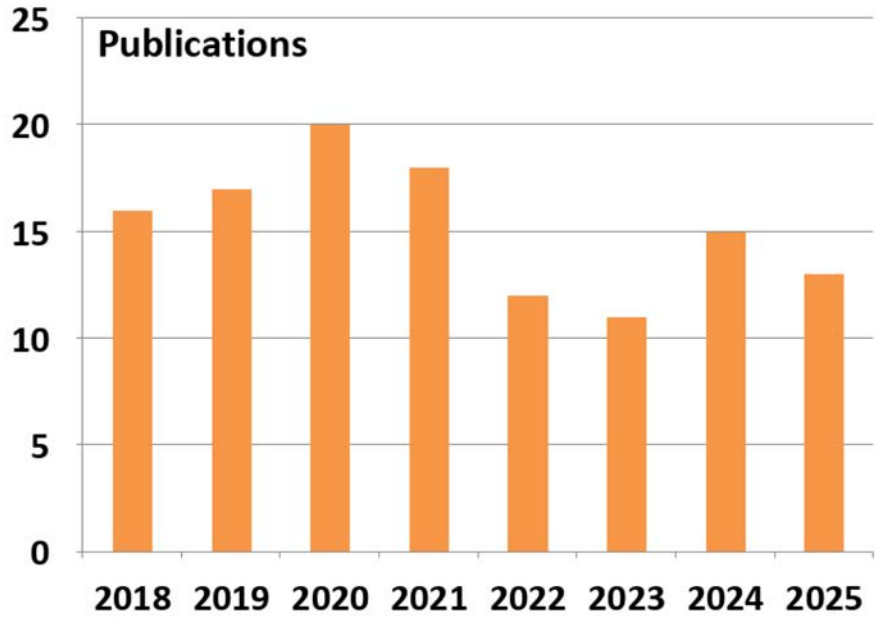
Publications and PhD thesis

- Yearly distribution of peer-reviewed publications related to experiments performed at MOSAIC

✓ Users must send the **DOI** of each publication to mosaic@ijclab.in2p3.fr

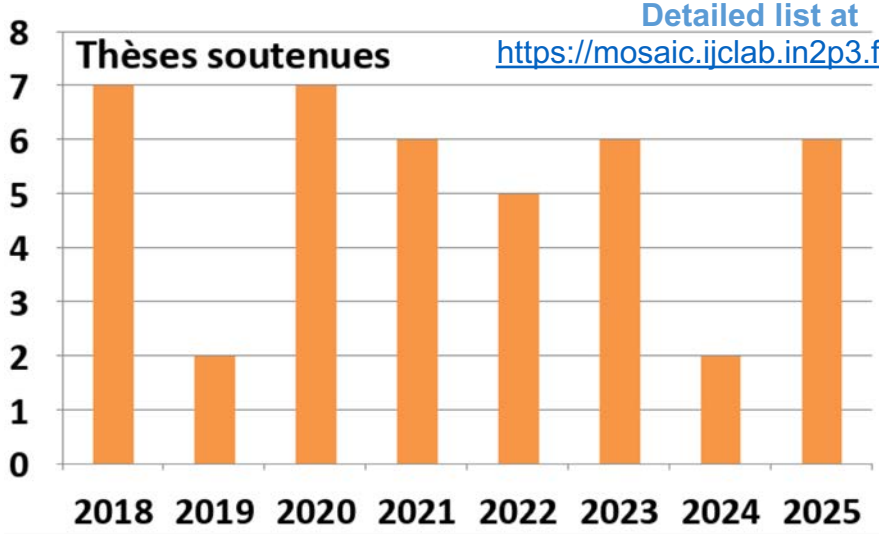
✓ MOSAIC collection created in HAL https://hal.science/IJCLAB-MOSAIC/

✓ This collection is automatically linked to the facility web site Publications page



- Number of PhD thesis defence per year, to our knowledge, during which MOSAIC beam time has been used

Detailed list at https://mosaic.ijclab.in2p3.fr/theses/



Please send PhD IdHAL to mosaic@ijclab.in2p3.fr

Mainly **Université Paris-Saclay**
But also Université Paris Sciences et Lettres, Université d'Orléans, Université de Caen, Université de Toulouse, Université de Lyon, Université de Poitiers, Université de Limoges, Université Grenoble Alpes, Université de Strasbourg, EPFL Switzerland, Queen's University Canada, Univ Wisconsin-Madison USA, North Carolina State University, NRNU MEPhI Russia, Université des Sciences et de la Technologie Houari-Boumédiène, Algeria

Ongoing projects and technical developments

Examples of SIXPAC, Tancrède, Némée, TEM liquid sample holder

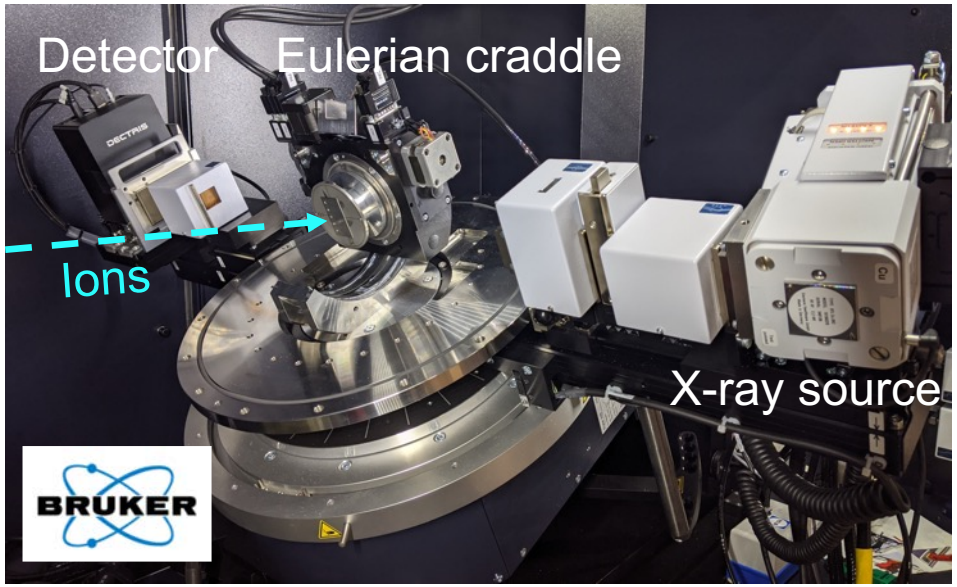
SIXPAC project: Setup for In situ X-ray diffraction coupled to an ion ACcelerator

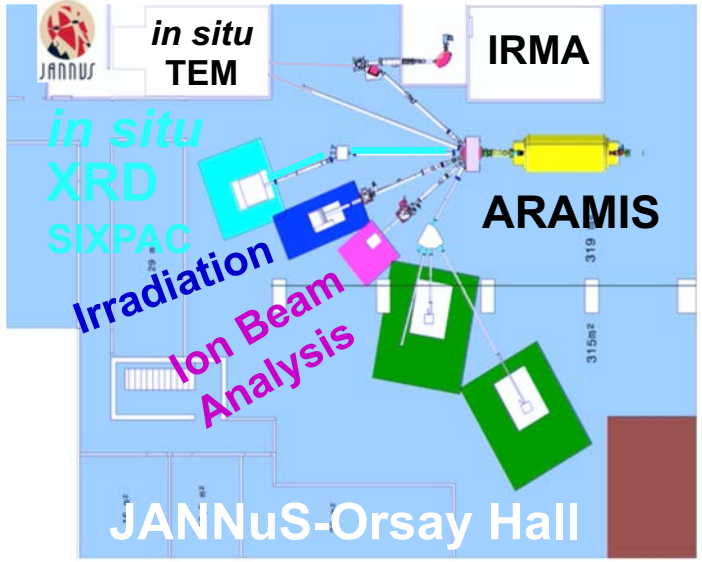
In situ X-Ray Diffraction for studying structural modifications of materials under ion beams

High performance 4-circle X-ray diffractometer connected to ARAMIS 2 MV beam line

- ✓ Phase transformations: amorphization, recrystallization …
- ✓ Elastic strain in single crystalline ceramic materials: sensitive to point defects, first damage states

Bruker D8 Discover modified for *in situ* experiments
delivered in March 2025





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Pôle Ingénierie Mécanique

E&E Energie & Environnement Energy & Environment

FUNDING

Région îledeFrance SESAME 2022

anr ANR CIRANO 22-26

université PARIS-SACLAY FACULTÉ DES SCIENCES D'ORSAY ERM 2021

IJCLab Irène Joliot-Curie Laboratoire de Physique des 2 Infinis

SUPPORTS

Almae Technologies

orano

EDF

cea

SIXPAC project: Setup for In situ X-ray diffraction coupled to an ion ACcelerator

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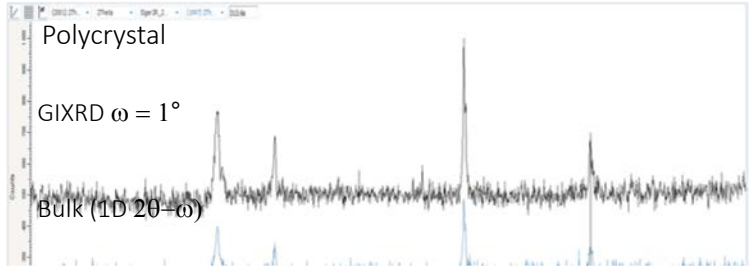
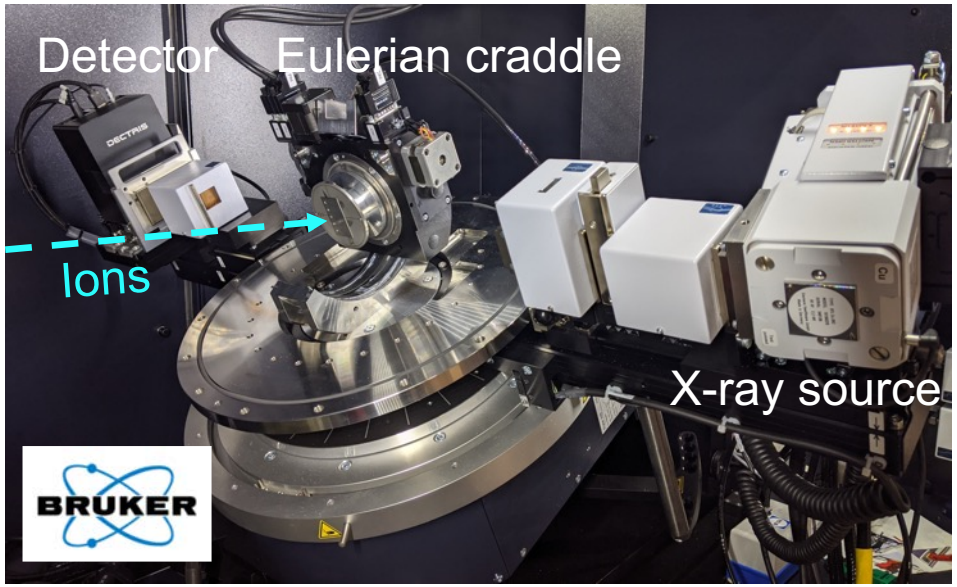
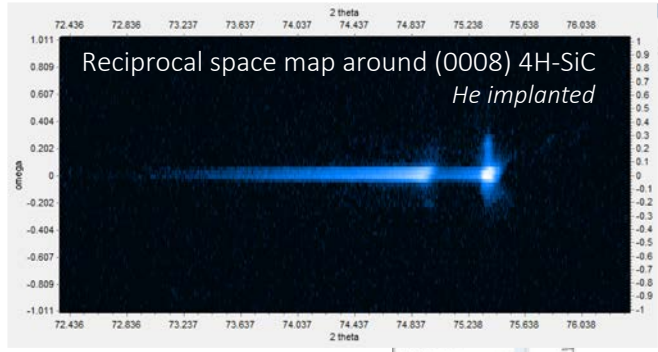


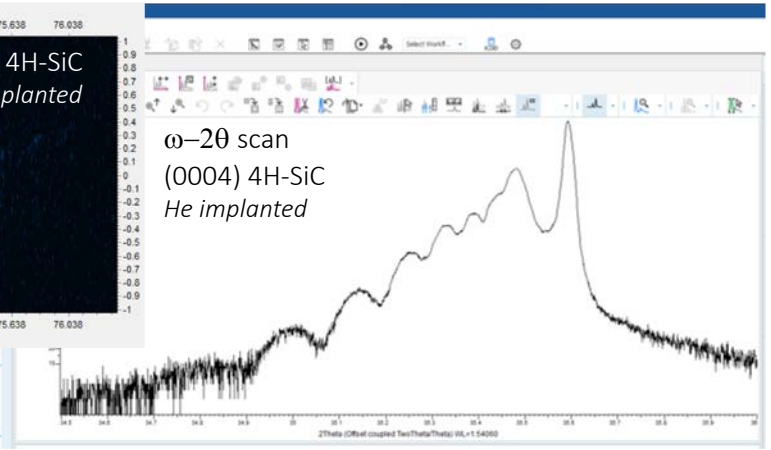
Bruker D8 Discover modified for *in situ* experiments
delivered in March 2025



Performance tests

- Single crystals: strain measurements (ω–2θ), reciprocal space maps
- Polycrystals (powder diffraction, grazing incidence)
- *Tests with kapton window*





SIXPAC project: Setup for In situ X-ray diffraction coupled to an ion ACcelerator

In situ X-Ray Diffraction for studying structural modifications of materials under ion beams

Beam line

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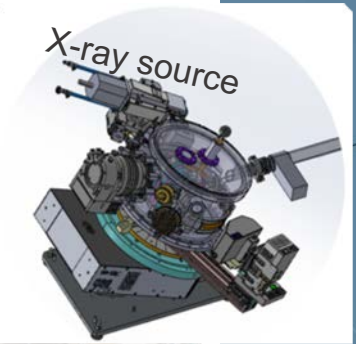
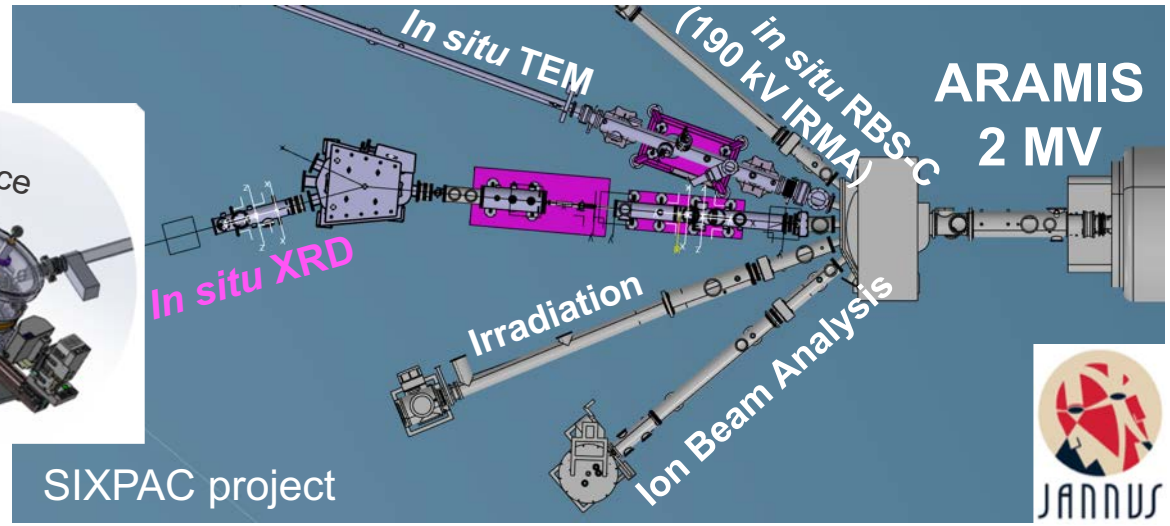
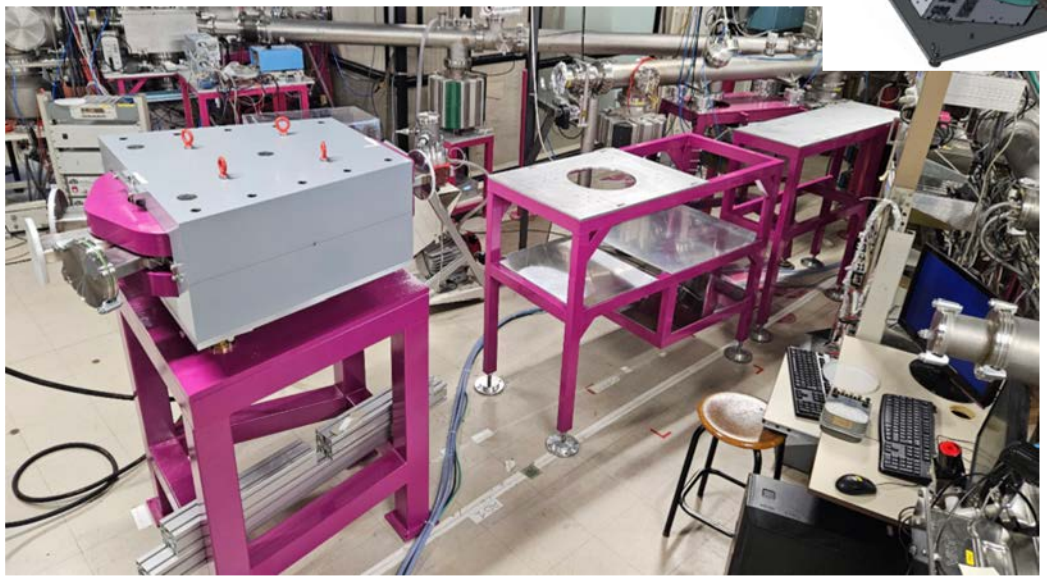
Pôle Ingénierie Mécanique

Bureau d'études et atelier mécanique







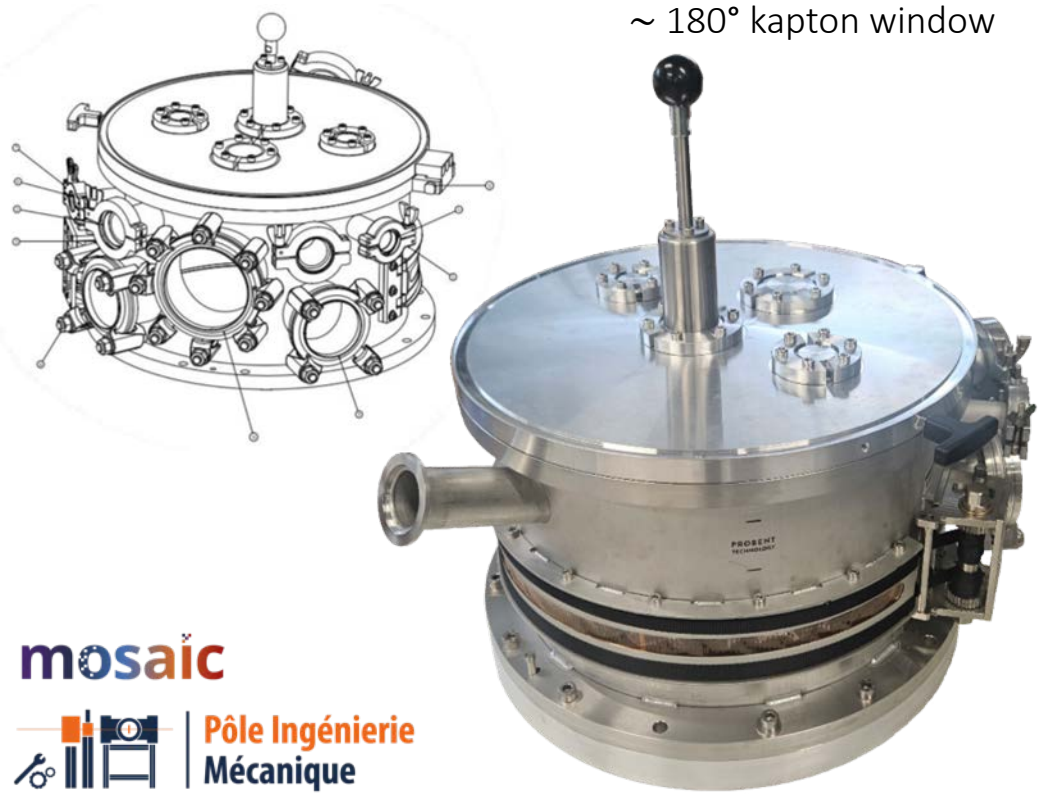
- Magnet delivered in may 2023
- Beam line partially constructed
- Beam line aligned with respect to the XRD goniometer

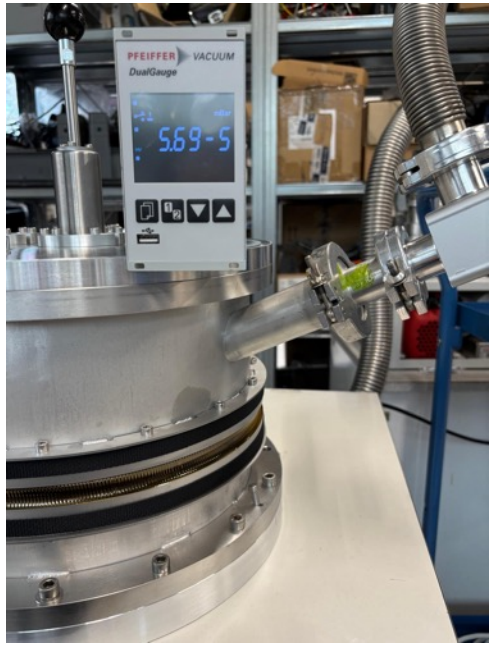
SIXPAC project: Setup for In situ X-ray diffraction coupled to an ion ACcelerator

In situ X-Ray Diffraction for studying structural modifications of materials under ion beams

Vacuum chamber

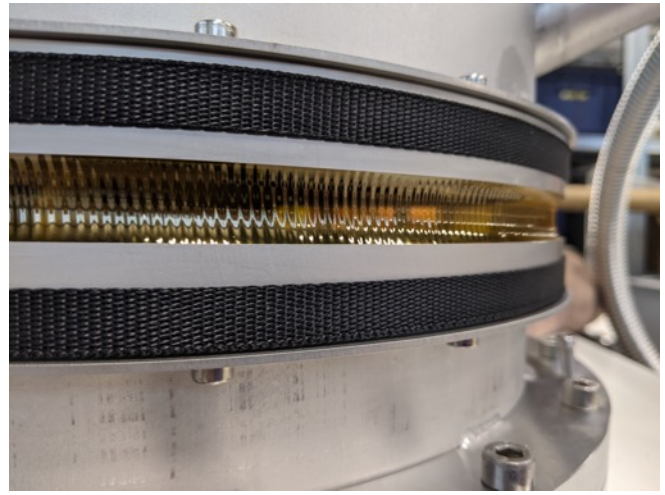
~ 40 cm in diameter
~ 180° kapton window





25 µm kapton window tested under vacuum

Up to now, a few 10^{-5} mbar …



First *in situ XRD* tests scheduled for late 2026

Subject to radiation safety authorisation

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Pôle Ingénierie Mécanique

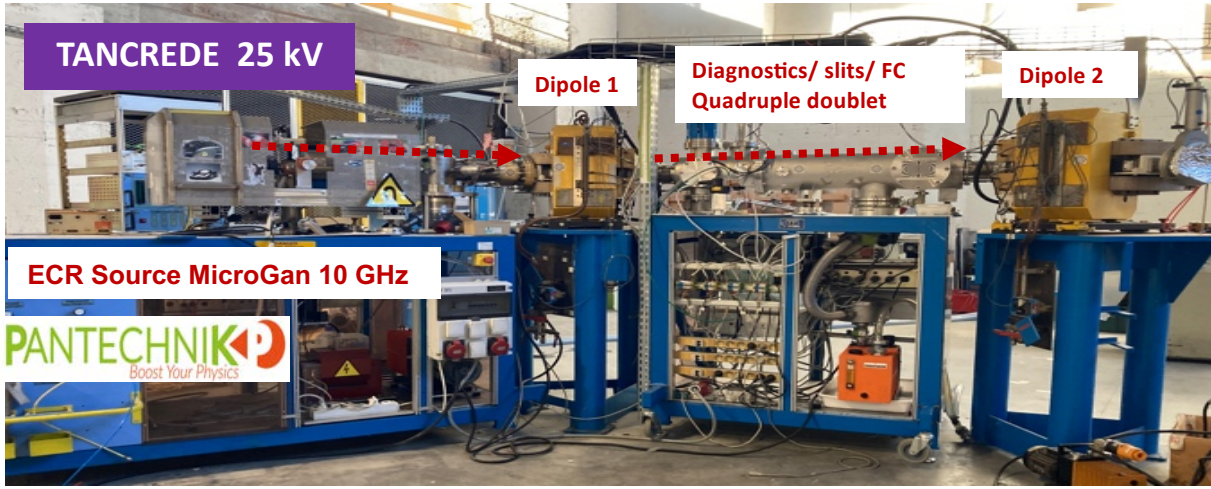
Denis Reynet, Sylvain Brault

Tancrède: Focus on recent upgrades and characterizations

10 GHz ECR Plateform source

Production of multi-charged atomic and molecular ions.

- Focusing : Einzel lens and quadruple doublet
- 2 beam lines: 0° et 51°



Modernisation 2024–2026

- Power supplies: dipoles, QP
- Infrastructure security

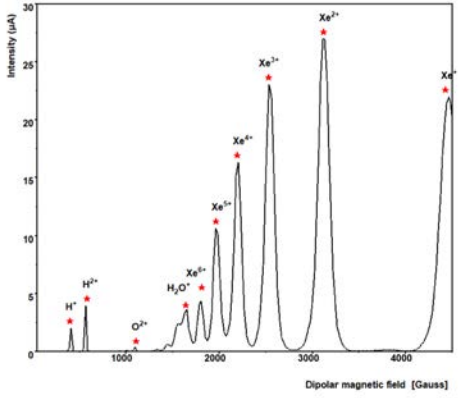
université PARIS-SACLAY GRADUATE SCHOOL Physique

AAP Jouvence 2024

Recent characterization and validation of the production of multicharged ion

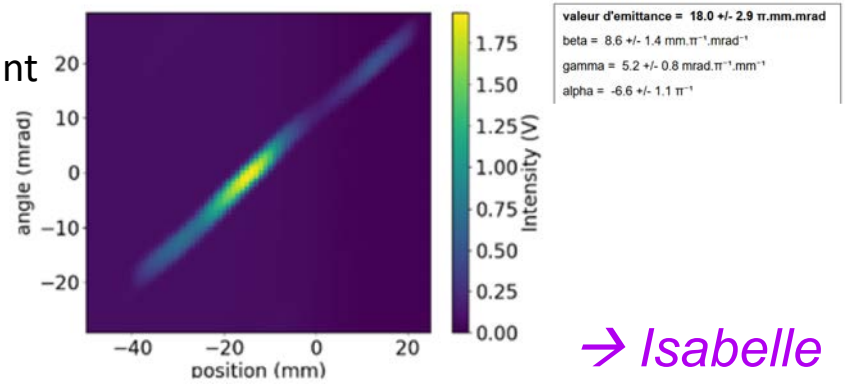
- Charge state distribution

Xe (14.5 kV)



- Emittance measurement

Ar⁺ (14.5 kV)



→ *Isabelle*

Tancrède: Experiments

Ion source

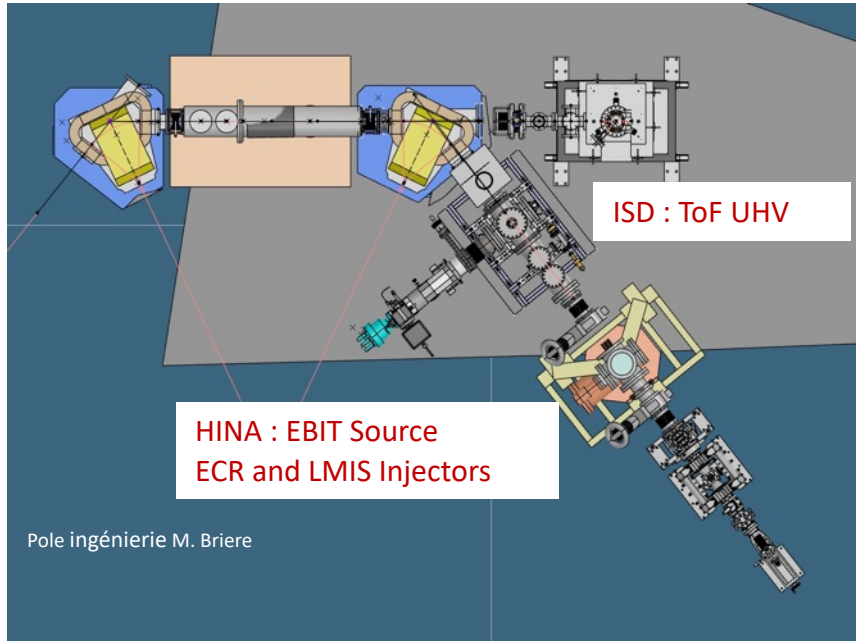
Thèse CIFRE 2023-2026:
R. Bellet

Ion thruster based on the ECR ion source principle

TP Master Plato

Ar^{n+} production vs gaz flow and RF power

2 Beam lines
0° and 51 °



ISD
Suheyla BILGEN

Physique des Accélérateurs
Accelerator Physics

Suheyla Bilgen
Tomorrow, 9h50

Surface Analysis
Ion stimulated desorption

In-house designed time-of-flight mass spectrometer

HINA
Sarah NAIMI

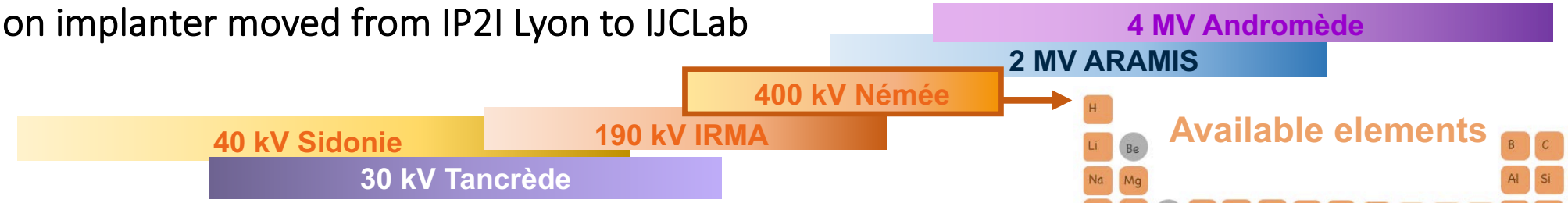
PHYSIQUE NUCLÉAIRE
NUCLEAR PHYSICS

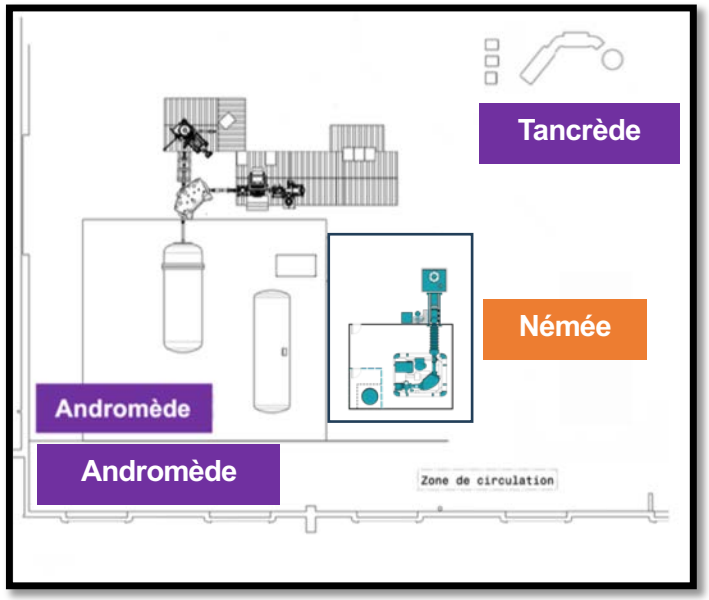
Michele Sguazzin
Today, 11h55

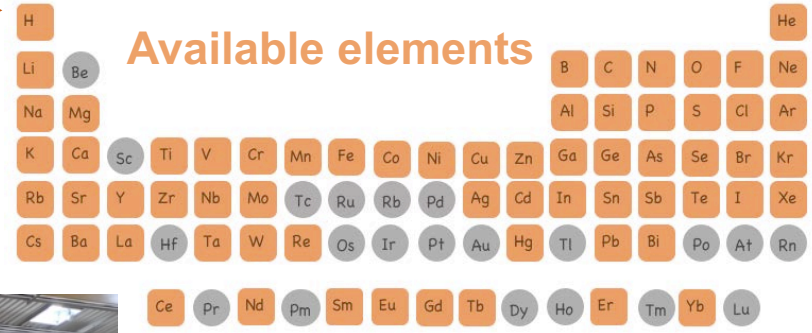
Highly charged ions for nuclear physics and astrophysics

Némée 400 kV implanter

Ion implanter moved from IP2I Lyon to IJCLab







NEED FOR
- Radiation shielding
- Electrical work
- Cooling

→ *Cyril*

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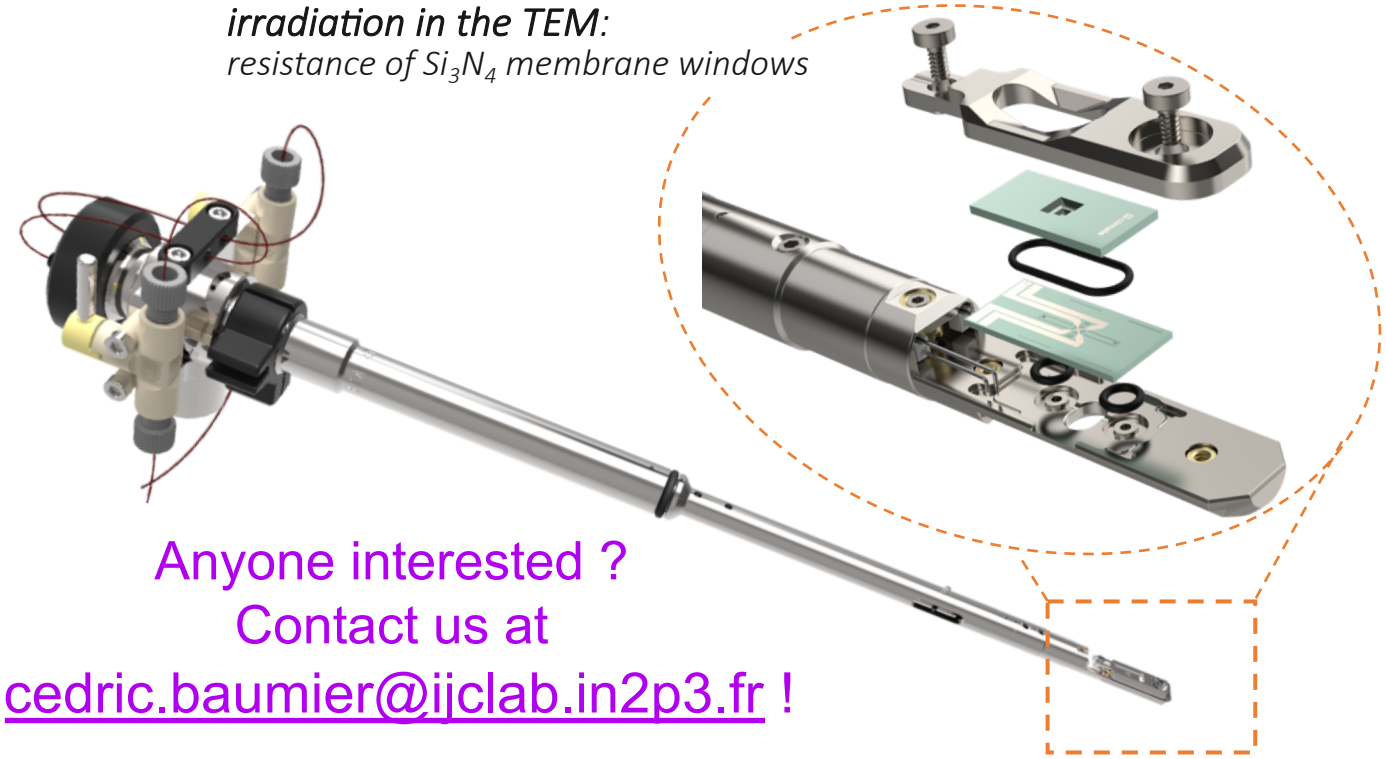
JANNUS

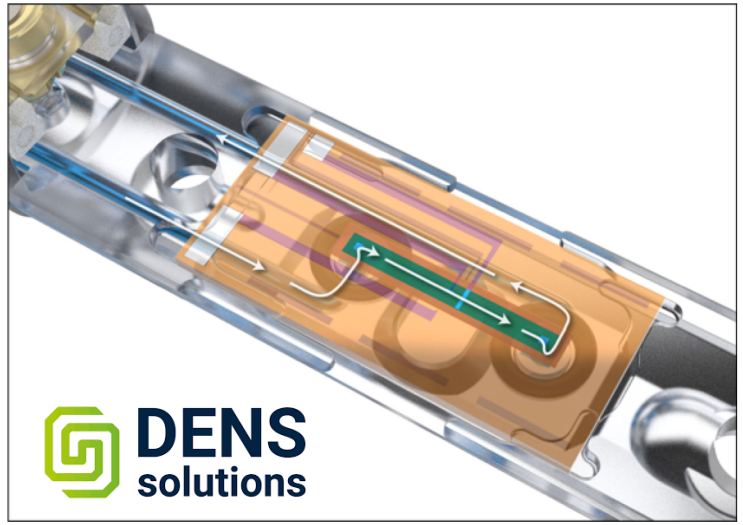
Partnership with **ELOISE SAS** for tests in 2025-26

Sample holder for *in situ* TEM studies **under irradiation in liquid environment**

▶ *Cell successfully tested under irradiation in the TEM:*
resistance of Si_3N_4 membrane windows



Anyone interested ?
Contact us at
cedric.baumier@ijclab.in2p3.fr !



Many possible applications
- Ionotherapy
- Corrosion under irradiation
- Battery for space
- Biomechanism under irradiation…

In conclusion, …

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- ✓ A large variety of ion and cluster beams
- ✓ Experts of specific *in situ* analysis devices, known worldwide
- ✓ Keeping the facility at the state-of-the-art with upgrades and developments associated to scientific projects
- ✓ Attractive interdisciplinary platform for research internships and PhD thesis
- ✓ A dedicated team welcoming all users (collaborations, services, practical works)

the MOSAIC technical staff

Cyril Bachelet, Cédric Baumier, Philippe Benoit-Lamaitrie, Jérôme Bourçois, Bryan Bragance, François Daubisse, Laurent Delbecq, Silvin Hervé, Florian Pallier, Sandrine Picard, Isabelle Ribaud

the local contacts (Phys. Nucl. and E&E poles)

Serge Della Negra, Frédérico Garrido, Aurélie Gentils, Stéphanie Jublot-Leclerc, Isabelle Ribaud

the MOSAIC scientific committee at IJCLab

Charles-Olivier Bacri, Faïrouz Hammache, Frédérico Garrido, IJCLab direction (Fadi Ibrahim/Aurélie Gentils), MOSAIC representatives and managers (Isabelle Ribaud, Cédric Baumier, Jérôme Bourçois, Cyril Bachelet, Stéphanie Jublot-Leclerc), and the SPR service

A big thank you to the support services and the engineering pole, the users, the collaborators, IJCLab direction, CNRS/IN2P3, and Université Paris-Saclay

Merci pour votre attention

PROGRAM

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Thursday, 12th March

09:30 – 10:30 Accueil (café et viennoiseries)
Pause | Site: IJCLab, 100/-1-??? - Espace Joliot-Curie, Bâtiment 100

10:30 – 10:45 Mot de bienvenue (Direction IJClab)
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

10:45 – 11:30 Présentation générale et nouvelles de la plateforme MOSAIC
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

11:30 – 11:55 Ewelina Kucal (IJCLab, EE), Investigation of the lattice location of chromium in uranium dioxide single crystals with using PIXE/C analysis (ARAMIS, IRMA)
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

11:55 – 12:20 Michele Sguazzin (IJCLab, Phys. Nucl.), La production et l'étude des noyaux multi-charge dans le cadre du projet HINA (Tancrède)
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

12:20 – 12:45 Oihan Allegret (XLIM, Limoges), Physical properties of vanadium dioxide microstructures obtained by modified vapor liquid solid method (ARAMIS)
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

13:00 – 14:00 Déjeuner
Pause | Site: Restaurant Universitaire du CESFO

14:15 – 14:40 Karen Pacho Dominguez (University of Birmingham, UK), In-Situ Ion Irradiations in V-4Cr-4Ti (TEM+ARAMIS)
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

14:40 Louise Goodwin (CIMAP, Caen), Defect control in ion-irradiated III-Nitrides (IRMA)

15:30 – 16:15 Pause café et posters
Pause | Site: IJCLab, 100/-1-??? - Espace Joliot-Curie

16:15 – 16:40 Francesca Chiodi ou Aiken Van Waveren (C2N, Palaiseau), (The importance of) Ion implantation for superconducting silicon devices (IRMA)
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

16:40 – 17:05 Beyhan Bastin (GANIL, Caen), État des données New JEDI sur l'anomalie du 8Be (Andromède)
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

17:05 – 17:30 Vincent Humbert ou Malik Ayachi (Laboratoire Albert Fert, Palaiseau), High Critical Temperature heterostructures combining the superconductor YBCO with 2D TMDs: From fundamental science to new technology (IRMA)
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

https://indico.ijclab.in2p3.fr/event/12150

Friday, 13th March

08:45 – 09:00 Accueil
Pause | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

09:00 – 09:25 Marie-Laure David (Pprime, Poitiers), Nitrogen doping of 2D transition metal carbides multilayers (MXenes) by in situ ion implantation in the TEM (TEM+IRMA)
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

09:25 – 09:50 Aurore Gorlas (I2BC, Gif), Biomineralization and iron sulfide production by hyperthermophilic archaea (Andromède)
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

09:50 – 10:15 Suheyla Bilgen (IJCLab, Acc.), Mesures ISD sur Tancrède (Tancrède)
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

10:15 – 11:00 Pause café et posters
Pause | Site: IJCLab, 100/-1-??? - Espace Joliot-Curie

11:00 – 11:25 Mervin Naidoo (University of the Witwatersrand, South Africa), Exploring Electron Transport in Near-Surface Implanted Channels in Diamond (IRMA, ARAMIS)
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

11:25 – 11:50 Sabrina Gouasmia (RBI, Croatia), Études des interactions matière-nanoparticules d'or sur la plateforme MOSAIC-Andromède (Andromède)
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

11:50 – 12:15 Camilo A.F. Salvador (CEA, Saclay), Deep learning segmentation of TEM micrographs acquired via in-situ irradiation: challenges and perspectives (TEM + ARAMIS)
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

12:15 – 12:40 Rosario Brunetto (IAS, Orsay), Ion irradiation and implantation from Mercury to the outer Solar System: some recent results from INGMAR@Sidonie (Sidonie)
Contribution | Site: IJCLab, 100/-1-A900 - Auditorium Joliot Curie

13:00 – 14:00 Déjeuner (pour celles et ceux inscrits pour visiter la plateforme)
Pause | Site: Restaurant Universitaire du CESFO

14:00 – 16:00 (sur inscription) Visite de la plateforme MOSAIC (Bât. 201 Hall Super ACO, et Bât. 108 Sidonie et Hall JANNuS-Orsay)
Contribution