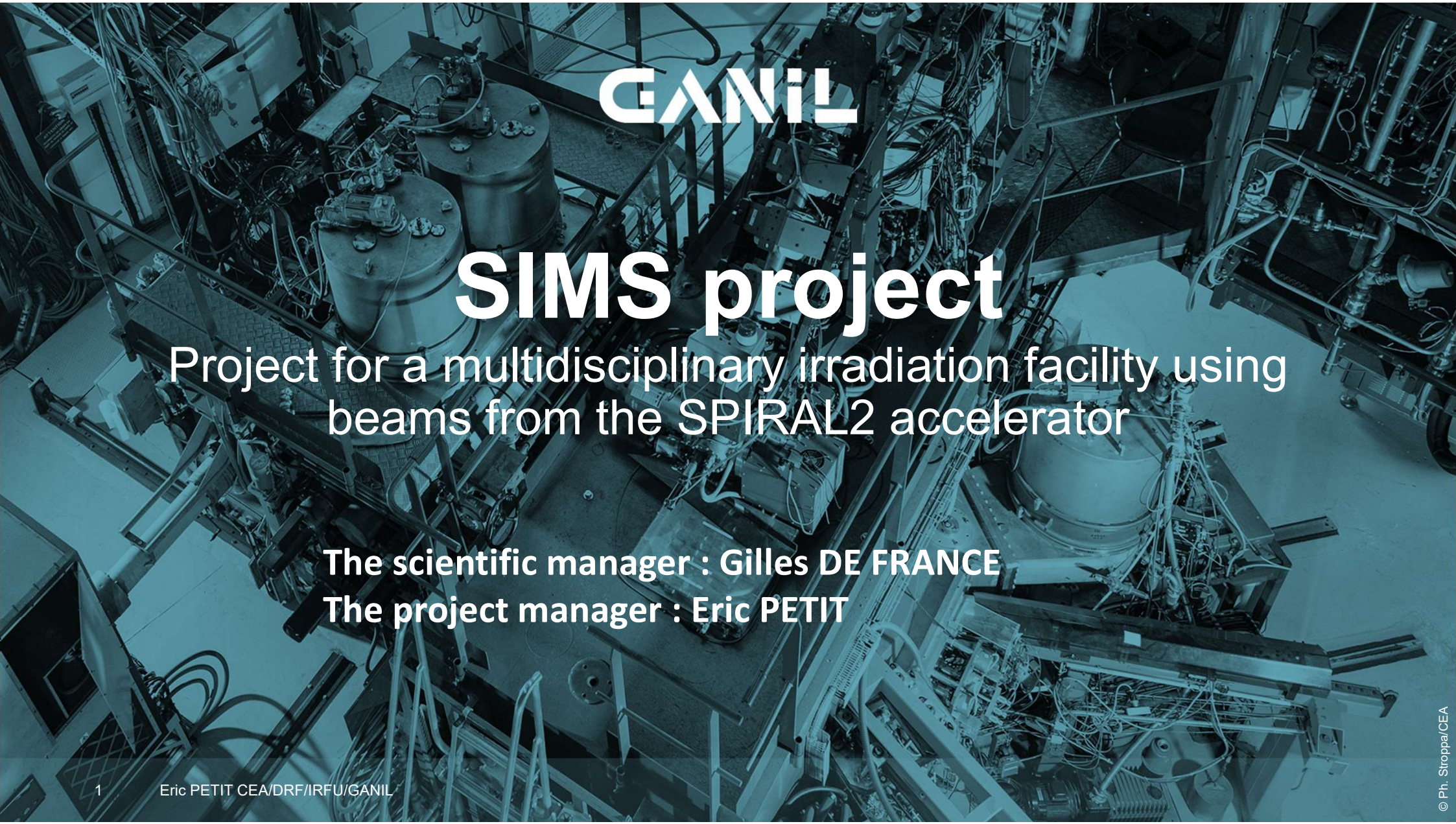


SIMS project

Project for a multidisciplinary irradiation facility using beams from the SPIRAL2 accelerator

The scientific manager : Gilles DE FRANCE
The project manager : Eric PETIT

SIMS project

Summary

- Project objectives
- Beam characteristics with SPIRAL2
- Preliminary identifed scientific topics/applications
- Possible localizations for SIMS facility
- Conclusions

SIMS project objectives

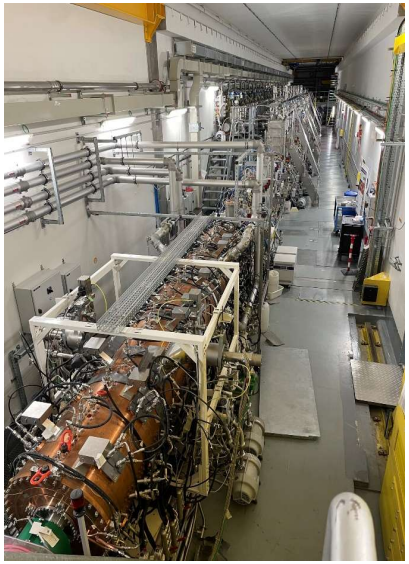
The mission of SIMS project is to carry out a preliminary project for this new facility

The objectives set for this preliminary project are as follows :

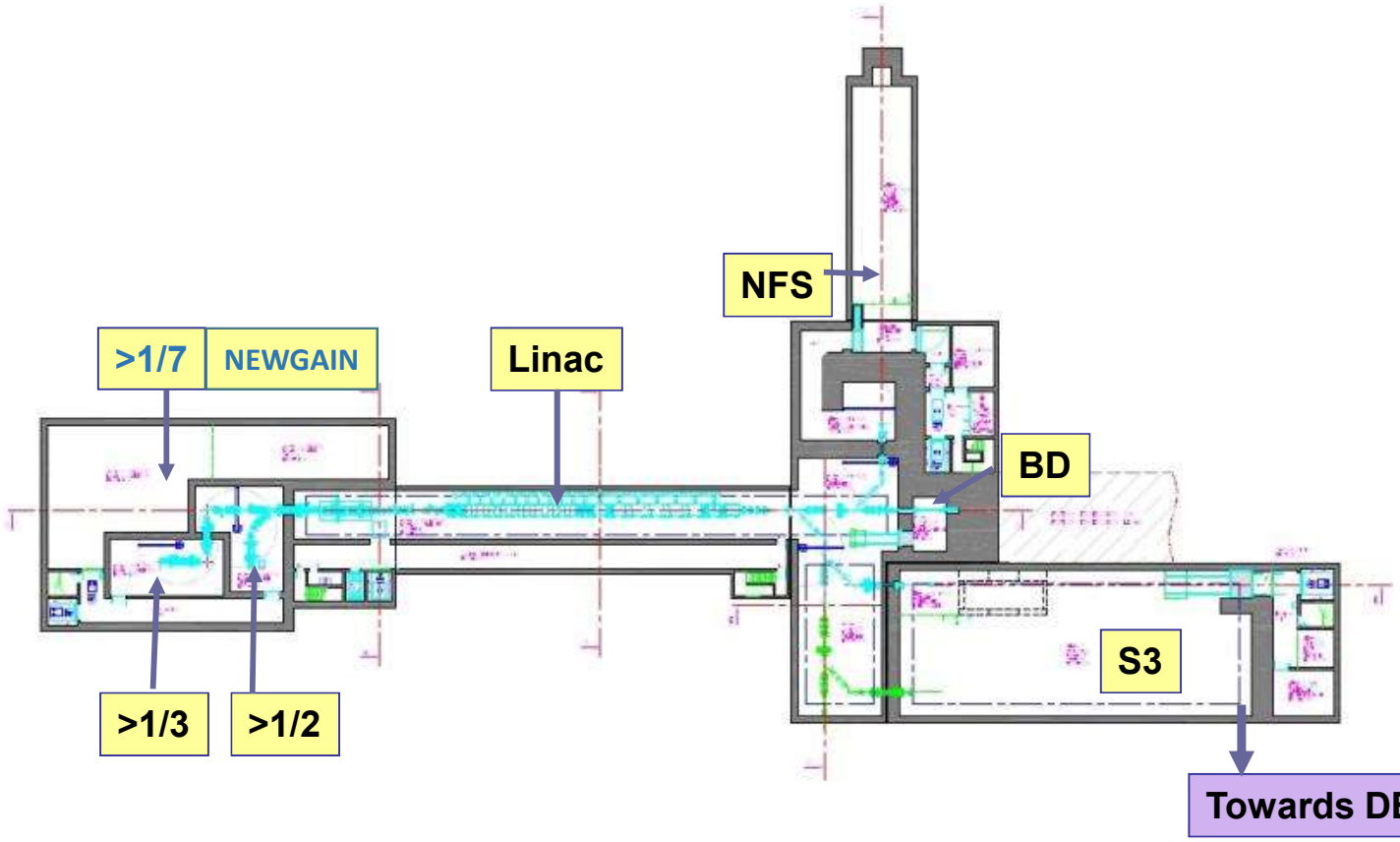
- Identify potential multidisciplinary users from laboratories or industry
- Identify the ions beams characteristics required for the envisaged experiments and applications (Ion type, beam intensity, beam energy, beam structure, irradiation times, frequency of acces ….)
- Evaluate the different possible locations by considering the associated modifications and impacts on existing facility, and the operating conditions and constraints with this new facility
- And based on the previous 3 points, propose different implementation scenarios outlined and evaluated in terms of schedule, full costs, project risks and operating constraints

SPIRAL2 : beam characteristics

	Q/A	I (mA)	Min energy (Mev/u)	Max energy (Mev/u)
Protons	1/1	5	0.75	33
Deuterons	1/2	5	0.75	20
Ions	1/3	1	0.75	14.5
Ions	1/7	1	0.59	7



SPIRAL2 : beam characteristics



Beam intensities puA 100% enriched ON TARGET	SPIRAL2 GANIL, Caen		
	LINAG A/q≤3 Phoenix v3	NEWGAIN* A/q≤6 Phoenix V3	NEWGAIN* A/q≤7 SC source
^{18}O	80	>64	300
^{40}Ar	16	38	38
^{36}S	23	30	30
^{40}Ca	2.9	16	16
^{48}Ca	1.2	8	16
^{58}Ni	1.1	3,2	6.4
^{86}Kr	0.1	8	16
^{136}Xe	0.001	5,6	>10
^{238}U	<<0.001	0,06	8

Preliminary identified scientific topics and applications

The main topics/applications preliminary identified to date :

- Medical radioisotopes synthesis for cancer treatment R&D
- Tests of equipments for spatial industry
- Others topics in interdisciplinary physics
  - Materials science
  - Nanostructuration
  - Astrophysics
  - Collision physics
  - Radiobiology

Ganil Community Meeting is an opportunity to identify other potential topics or applications

=> Express your needs by contacting

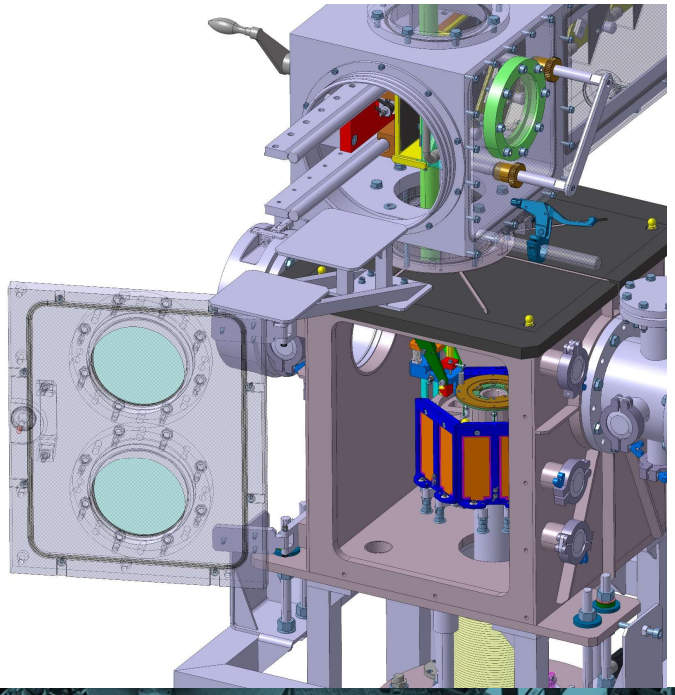
- **The scientific manager : Gilles DE FRANCE**
- **The project manager : Eric PETIT**

Medical radioisotopes synthesis (1)

REPARE : Research and d**E**veloppement for the **P**roduction of innov**A**tive **R**adio**E**lements

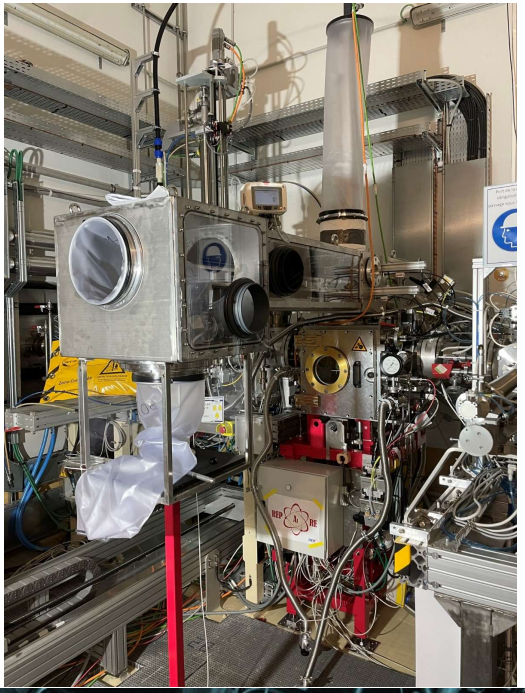
- The first objective of REPARE project was to test the production of ^{211}At in NFS cave (converter room)
- Tests performed with $^{4}He^{2+}$ beam on a solid Bi target at 28 MeV and 2kW beam power

→ 2 targets/racket; 6 rackets/wheel
→ Target cooling (direct water cooling + rotation)
→ Monitoring (beam setting, current measurement)
→ Radioprotection/safety
→ Retractable



2 kW (α, 7MeV/A):

- ~10h irradiation time at I_{moy} ~14.5μA
- ~900 MBq/target sent to ARRONAX



Medical radioisotopes synthesis (2)

REPARE : Research and d**E**veloppement for the **P**roduction of innov**A**tive **R**adio**E**lements

Next step : production of ^{211}At for a more global R&D program for the characterization of the response of tumors cells to treatment

- To use $^{4}He^{2+}$ ion beam on a Bismuth target at 28 MeV and 10kW beam power
- To plan more production runs (goal: 1-2 months of LINAC time)
- To consolidate local partnership (ExtrAt project):
  - Radiochemistry (CYCERON, CERMN)
  - Radiolabelling of anti-VLA4 with At (CYCERON-CERMEN-IMOGERE)
  - Ex vivo evaluation ^{125}I-anti-VLA4 (ISTCT-Baclesse)
- To participate to a national initiative on alphatherapy
- To get involved in international networks: PRISMAP/PRISMAP+, COST NOAR and follow up,…
- To enlarge portfolio of possible innovating radioelements

Tests of equipement for spatial applications (1)

SAGA project (Spatial **A**pplications at **GA**nil**) =>** Propose solutions to provide GANIL beams for spatial applications

- Among the requests expressed by space industry, neutron beam is identified to test equipments under neutron irradiation
- NFS facility could be a solution to answer this request => it is not its primary vocation and not an ideal location

⇒ **SIMS facility could be a way to satisfy this request**

Summary of identified needs :

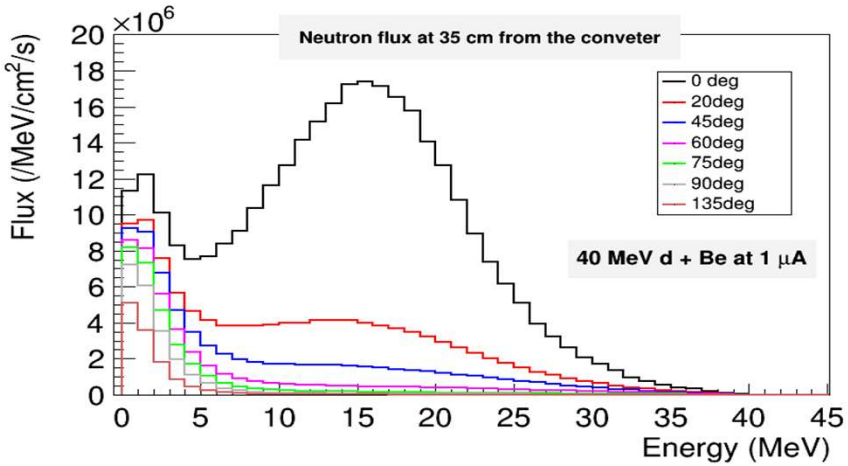
- Irradiation of eletronic equipment of various size :
  - 2cmx2cm components
  - Electronic cards in A4 format
  - Electronic racks
- Irradiation at different angles
- Not clear informations about instant doses and integrated doses required for irradiation

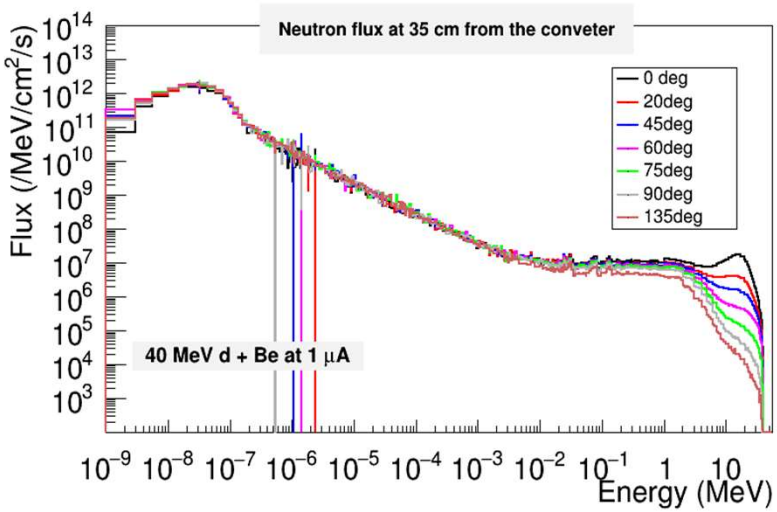
Some interest expressed for proton beam around 30MeV for prototypes tests.

Tests of equipement for spatial applications (2)

In this context what I propose is the use of a fixed (Be+Cu) target

- 2kW of *deuterons beam à 40MeV*
- Neutron flux of **10^{11} n/cm²/s à 0° (à ~10cm)**
- Neutrons medium energy around 15MeV
- Possible different angles for the tests





If higher neutron fluxes were required => it would be necessary to develop a rotating target !

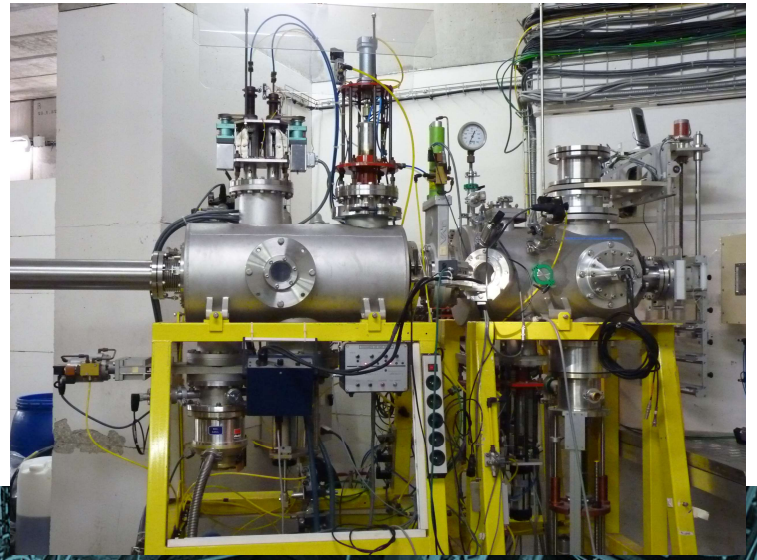
Interdisciplinary physics (1)

Main physics cases :

- Materials science
- Nanostructuration
- Astrophysics
- Collision physics
- Radiobiology

⇒ **Needs quite similar to those of the experiments carried out on the GANIL facility with cyclotrons :**

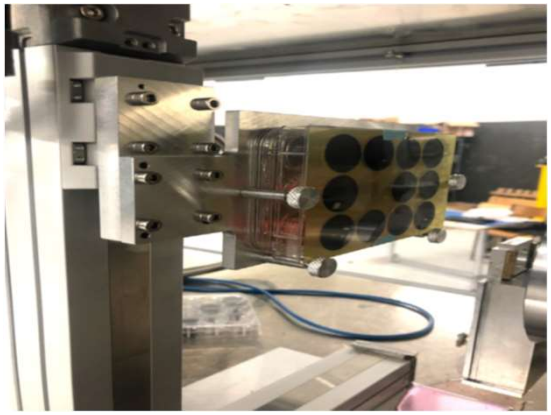
- Ion beams : C, Ar, Kr, Xe, Pb, U **and now H and He with SPIRAL2 facility**
- Beam intensity from a few nA to a few tens of µA
- Time structure from 500ms/1Hz to 1µs/100kHz
- Scanning system to get 4x4 cm2 on target point
- Adjustment of HO and VE emittance
- Beam diagnostics to monitor beam characteristics
- Interchangeability of experimental devices



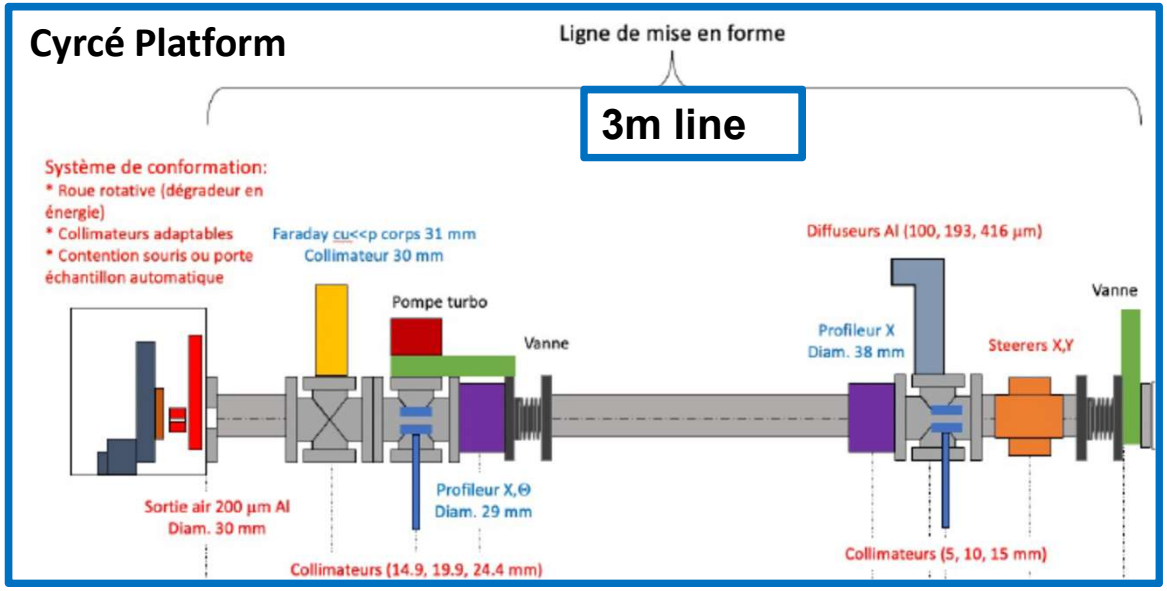
Interdisciplinary physics (2)

For radiobiology : needs are more a less different

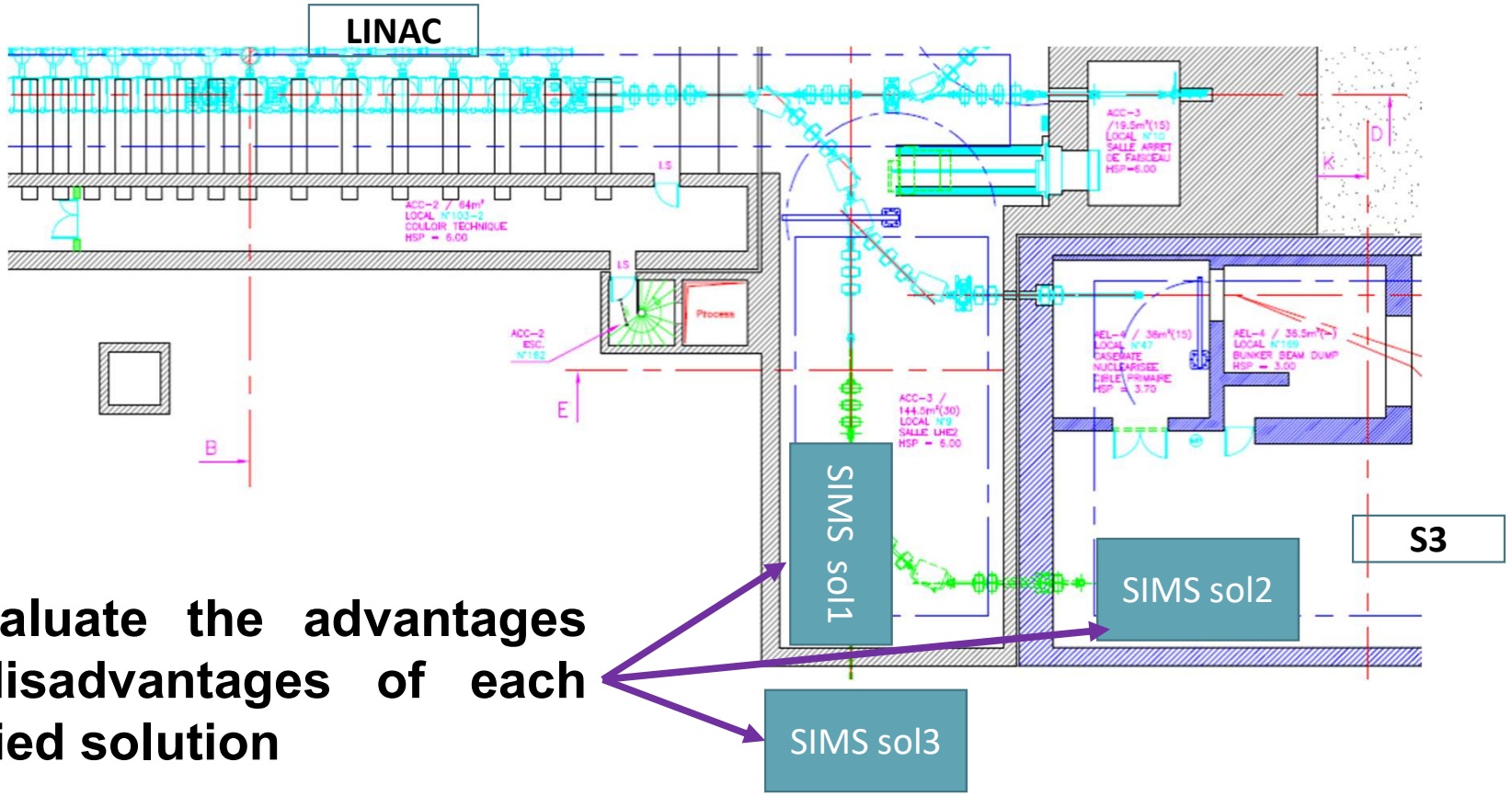
- Ions beams : only H and He but a priority for He
- Beam intensity from a **few pA to a few nA**
- Possibility of ultra-short pulses ~1µs
- Possibility to scan the beam on the sample
- Possibility of beam energy variation
- Irradiation on air (window)
- Frequent access to the setup



Example of a beam line section for the beam preparation : beam diffusion and collimation to get homogeneous irradiation surface



Where to localize the SIMS facility?



=> Evaluate the advantages and disadvantages of each identified solution

Conclusions :

- ✓ **SIMS project is in its early stage with the identification of needs/requirements**
- ✓ **The next steps will be :**
  - ❑ To do a very preliminary design of the SIMS setup meeting the identified needs/requirements
  - ❑ For each possible localization
    - ○ Analyse the integration of such a setup
    - ○ To have risk analysis on safety aspects
    - ○ To evaluate the impacts on safety systems
    - ○ To evaluate operation impacts and constraints
    - ○ To evaluate necessary budget and planning for the construction phase
  - ❑ To take a decision on basis of theses analysis end evaluations : **which applications and which location**

From there, the detailed design and then the construction phases can be launched.

Thank you for your attention