IDEAAL Work Package 4

Innovation and Industries

WP4 objectives

- The Innovation and Industries workpackage focuses on actions towards industrial users and on actions for industrial valorisation and innovation

- It will provide
  - access dedicated for new applications to the existing GANIL accelerators and to the new SPIRAL2 facility

  - general support for industrial applications and technology transfer

  - increase of innovation potential for GANIL

WP4 Tasks and associated coordinators

- **Task 1 : Access provision to research teams from industries and involvement of industrial users (GANIL - MH Moscatello/X.Ledoux)**

- **Task 2 : Industrial Applications and Technology Transfer (NUCLEOPOLIS - N.Renard)**

  Sub-Task 2.1 – Provide industrial application tools to GANIL
  Sub-Task 2.2 – Operational implementation (*General Case*)
  Sub Task 2.3 – Operational implementation : Support for the technology transfer of the beam profile monitors
  Sub-Task 2.4 – Operational implementation: Innovative radioisotope production

- **Task 3 : Increase of innovation potential (CEA/DRF - A.Leservot)**

- **Workpackage leader: M-H. MOSCATELLO GANIL**

- **Workpackage deputy leader: E. DUVAL NUCLEOPOLIS**

Status of Task1

Access provision for research teams from industries and involvement of industrial users (GANIL)

- Financement of 240 hours of beam time (and travel expenses) for some new industrial experiments that would like to test the capabilities of the SPIRAL2 and GANIL facilities in order to confirm industrial's interest in the available beams.
- Creation of an international selection panel to assess the proposed experiments

Status

- **Creation of the selection committee in 2018**
- **First call for proposals launched in 2018 for GANIL beams in 2019**
- **Selection of experiments in January 2019 (2 proposals received)**
- **2 experiments scheduled in 2019 (RADEC in April and SEIBERSDORF in July)**

Next

- **If the project is extended, a second call will be launched in September 2019 for beam in 2020 (to be discussed: less constraining criteria)**

- **Business plan to be proposed for membrane production at GANIL** (with the person being recruited for Task 3)

Sub-Task 2.1 – Provide industrial application tools to GANIL

- Mapping of existing potential at GANIL (technologies – Know-How - competences) and identify industrial candidates for technology transfer
- Identify new areas for industrial applications (market research) and potential customers for existing facilities GANIL and SPIRAL2
- Build the implementation arrangements for transfers (financial and legal aspects)
- Build tools to promote this activity in connection with the communication service

STATUS:

- Mapping of existing potential: meetings and interviews with most of the groups at GANIL (~ 40 meetings occured) ➔ report completed in July 2018

- Market research externalised to ERDYN Company

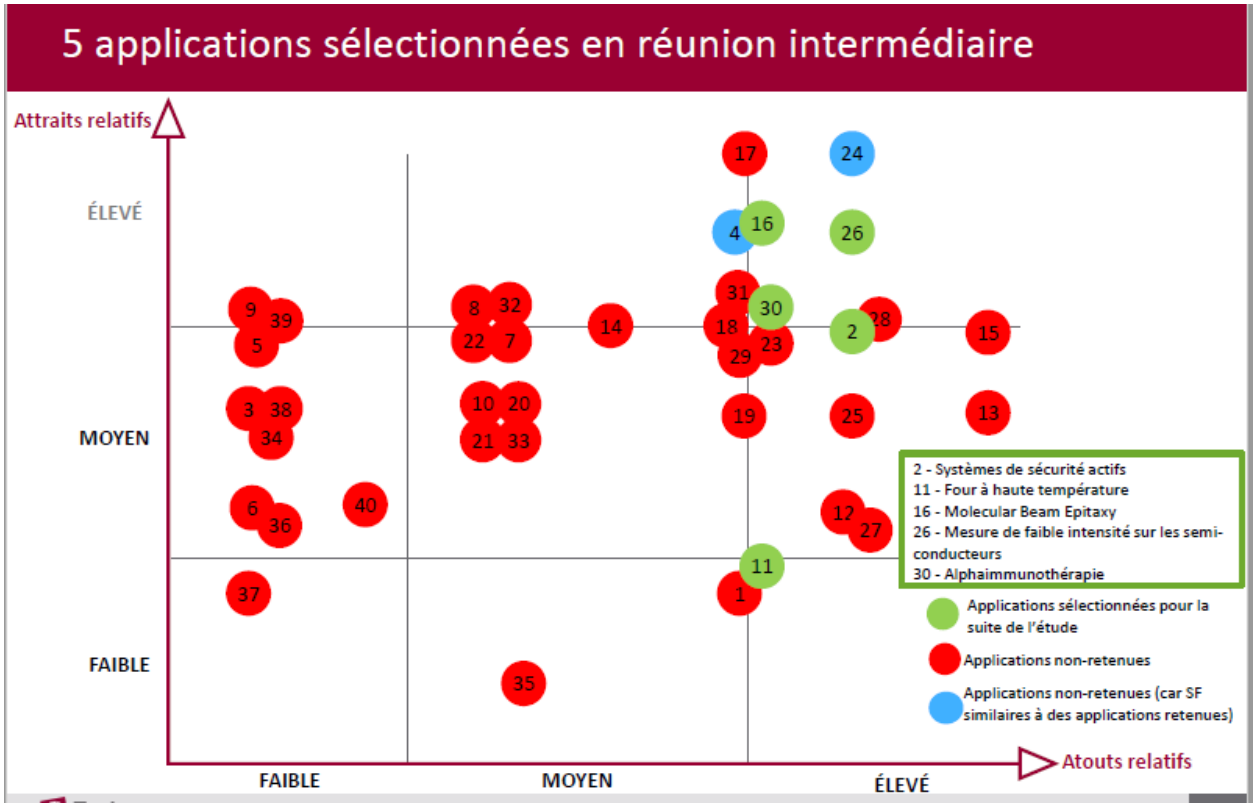
- Communication tools in collaboration with GANIL/WP5

TO DO:

- Implementation arrangements for transfers (financial and transfers) : 1st subject to be chosen, as soon as Ganil organisation for valorisation is finalised (April 2019)

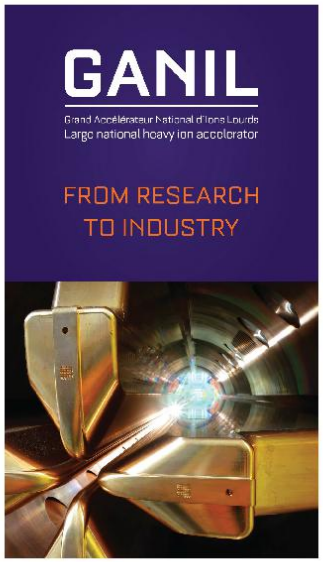
Different steps:

1. Know-how selection (meeting GANIL/ERDYN and Nucleopolis)
2. Bibliographie analysis
3. Selection of 5 applications (meeting GANIL/ERDYN and Nucleopolis)
4. Topic analysis of these applications



Sheets produced in collaboration with WP5
(and several Ganil groups involved)

Wallet cover



GANIL SPIRAL2
A UNIQUE FACILITY FOR RESEARCH INDUSTRY COLLABORATIONS AND SERVICES

GANIL is one of the five largest laboratories in the world for research using ion beams for nuclear physics and astrophysics, atomic physics, material science and radiobiology.

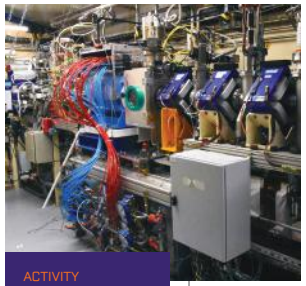
GANIL-SPIRAL2 facility in Caen, Normandy

KEY FIGURES*

- 232 permanent staff (physicists, engineers, technicians, administration)
- ~ 300 users/year
- 4 months of operation (around 6000 beam hours)
- 5 cyclotrons, 1 superconducting linear accelerator
- Involved in 2 European projects with a workpackage dedicated to research/industry collaborations development
- SPIRAL2 selected by ESFRI (European Strategy Forum on Research Infrastructure) committee as one of the most important EU infrastructure research project

*2017 data

ECR ION SOURCES



Charge breeder in the middle of the SPIRAL1 LEBT

ACTIVITY DESCRIPTION

The GANIL Ion Source staff has been developing their expertise in the domain of ECR (Electron Cyclotron Resonance) ion sources for 35 years; they took out a first patent (CEA & CNRS) for an ECR ion source in 1991. They have also developed numerous methods for metallic ion beam production, are experts in 3D electromagnetic simulations and in the design of high temperature devices.

PERMANENT STAFF

5 researchers/engineers
7 technicians

ION BEAM DIAGNOSTICS & CONTROL SYSTEMS

Electrode of the beam energy monitor, detection of the electric field from the beam bunches, energy calculated by time of flight method

ACTIVITY DESCRIPTION

Ion beam diagnostics and beam control systems have been developed at GANIL since its construction in 1976, for tuning and monitoring of both the accelerators and physics experiments, and more recently for safety requirements. Recent developments have been undertaken for the SPIRAL2 project.

PERMANENT STAFF

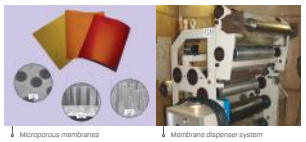
2 engineers
4 technicians

INDUSTRIAL APPLICATIONS
WITH GANIL-SPIRAL2 FACILITY

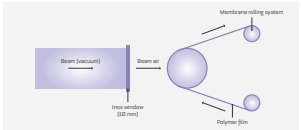
GANIL-SPIRAL2 facility and beams allow the irradiation of materials for tests and research and development. Beams are now mainly used for the manufacture of microporous membranes and the irradiation of electronic components.

MICROPOROUS MEMBRANES

- Beam intensities allow the production of several hundreds of m^2/h membranes
- Membrane thicknesses to be irradiated: 10 to 125 µm PET, Kapton...

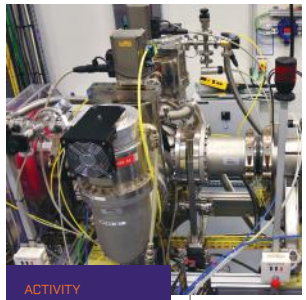


Microporous membranes | Membrane dispenser system



Membrane production system

VACUUM TECHNOLOGIES



Turbopumping system on the Low Energy Transfer Beam Lines of SPIRAL2

ACTIVITY DESCRIPTION

- Study and development of complex vacuum systems for accelerator and experimental facilities, including functional analysis of associated automation
- Simulation and measurements of low pressure gas fluxes
- Operation and maintenance of numerous vacuum systems (pumps, valves, sensors) in radioactive environment

PERMANENT STAFF

3 engineers
3 technicians

MECHANICAL MANUFACTURING

Welding in a glove box at GANIL

ACTIVITY DESCRIPTION

- Complex mechanical manufacturing of vacuum chambers in stainless-steel, aluminium
- Complex mechanical manufacturing of prototypes for accelerator needs (ion sources, beam diagnostics, detectors, complex vacuum chambers)
- Quality procedures
- Development of welding and machining on various materials
- Development of a new method for rhenium welding
- Development of a new aluminium flange concept
- Three dimensional metrology with high precision instruments for large scale measurements

PERMANENT STAFF

1 engineer
5 technicians

RADIOISOTOPES
DEVELOPMENT OF NEW ACCELERATOR BASED PRODUCTION METHODS

Design of a 10 kW irradiation station. The system carrying the targets is rotating (approx. 500 rpm). A water cooling system (in blue) is planned.

ACTIVITY DESCRIPTION

- Thermal calculations for the development of high power targets
- Design studies of high power targets
- Calculations for alpha-emitter isotopes production (various ions, various targets)
- Production measurements and characterization using gamma-ray spectroscopy techniques
- Dosimetry using alpha particles

PERMANENT STAFF

5 researchers/engineers
1 technician

Sub-Task 2.2 – Operational implementation (General Case)

To allow the "matching" between industrial application opportunities and the companies

- B2B meetings
- GANIL conferences
- Set up a virtual trading place on the website -> taken into account by Ganil (Website)
- Participation in exhibitions

STATUS:

- **Exchange of good practices with GSI laboratory: meeting in GSI on November 30th**
  - **Practices for technology transfer**
  - **Meetings with companies**

- **Participation in WNE 2018 with Nucleopolis (June 26th to 28th Paris Nord Villepinte) – booth J141**
  Organization of the stand for WNE in progress (together with WP5)

- **Participation to the ENSAR2/NUPIA Workshop in October 2018**

- **Participation to the RdV Carnot in Lyon from 16th to 18th October 2018**

- **Organisation of a workshop with companies on GANIL know-how on February 5th 2019**
  (ion sources, beam diagnostics, vacuum technologies, mechanics, radioisotopes)

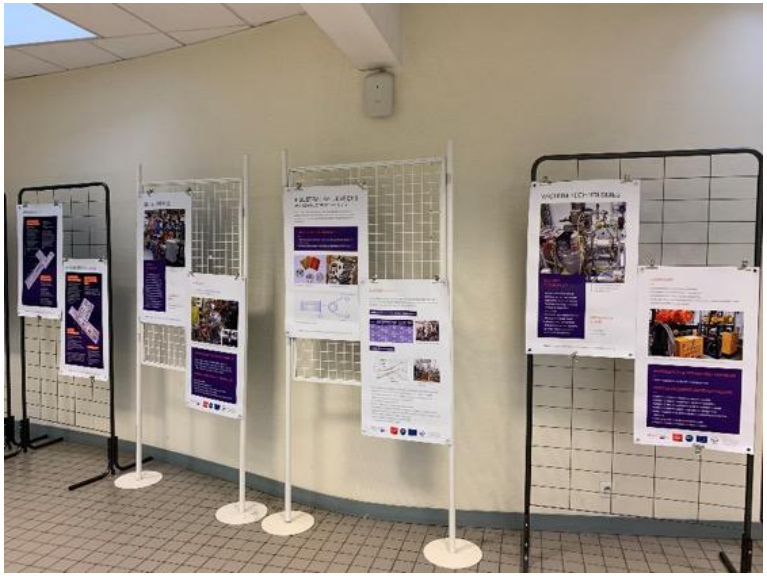
NEXT:

- European Association of Nuclear Medicine '19 - Oct 12-16, Barcelona, Spain ?
- International Symposium on Trends in Radiopharmaceuticals (ISTR-2019) 28 October–1 November 2019, Vienna, Austria ?

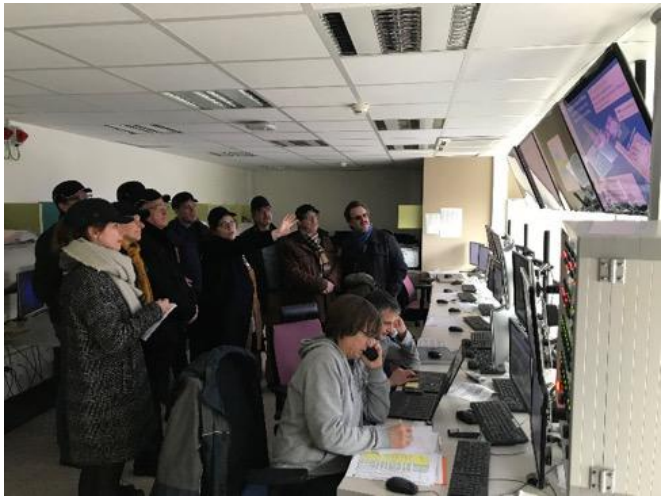
Kakemonos produced for the RdV Carnot 2018 in Lyon (in collaboration with WP5)

5th of February at GANIL ➔ 40 participants !

communication tools (”From Research to Industry Wallet” prepared with WP5 and Ganil groups)



Presentations in the morning



Visits of GANIL-SPIRAL2 facilities and technical laboratories (for the first time at Ganil!)

Sub Task 2.3 – Operational implementation: Support for the technology transfer of the beam profile monitors

Technology and pre-existing know-how transfer (legal, economical and marketing aspects)
and research agreements – started in June 2016 because of urgent need

STATUS:

Milestone in June 2017: not completed

- **Transfer contract signed in December 2017 and transfer to Pantechnik performed**
- **Collaboration contract: an agreement has been defined at the national level between CNRS and CEA -> should be finalised in the coming weeks**

Sub-Task 2.4 – Operational implemantation: Innovative radioisotope production

Innovative medical radioisotope production methods are a new research topic at GANIL

- Develop R&D programs for innovative radioisotope production
- Identify possibilities and methods of transfer

STATUS:

- **Study and proposals of possible methods for transfer with the M2 trainee - January to June 2017 (GANIL/Nucleopolis)**

  ➔ 211At and 212Pb

  Milestone in June 2019 (Report on the methodology for the technology transfer for radioisotope production)

- **ARRONAX collaboration: discussions in progress with Ganil Direction, before a GO decision to finalise the MOU (End April 2019)**

- **TRISKEM : to be contacted to identify possible collaborations**

- **ORANO MED: to be contacted to discuss a potential collaboration on new production methods for ^{212}Pb**

Status of Task 3

Increase of innovation potential (CEA/DRF)

Study the possibilities of increasing the innovation potential of the GANIL laboratory:

- Identify new applications to heavy and light ions beams, in order to replace the reactor technology with the accelerator technology, for as many applications as possible.
- Identify new R&D subjects that might lead to innovative technologies and application
- Identify the necessary technical developments to adapt the facility to these future and new applications

Status :

- **Bibliography and brainstorming (discussions with nuclea physicists, to be organised with CIMAP physicists) – cf. slide 10**

-> Intermediate internal milestones have been defined

- **Year 1: Identification of possible applications / markets (those not studied by Task 2)**
  Brain storming on potential applications linked to Ganil science

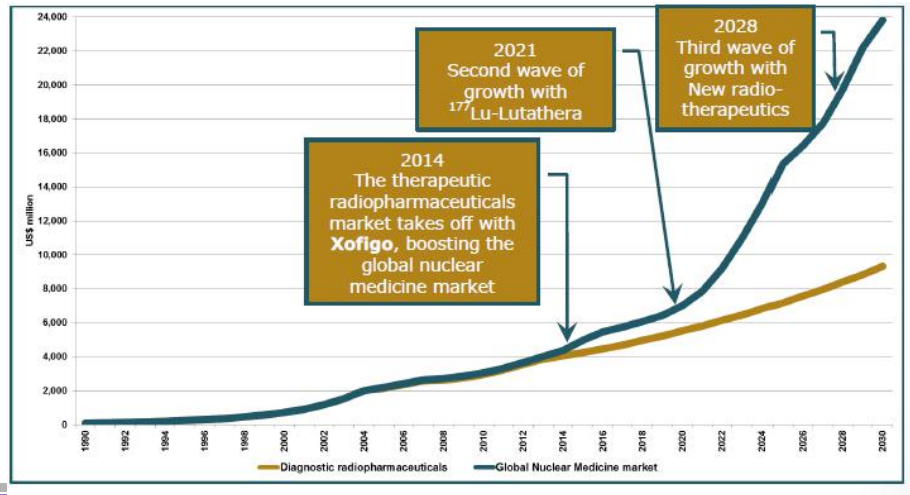
- **Year 2: Quantify markets of some selected foreseen applications**
  Qualify some application issued of « science to application » brain storming

- **Year 3: Propose a strategy to adress applications identified in Y1 & Y2 (beam modification…).**
  Estimate a budget to the proposed strategy

-> Select 2 subjects to be studied into details during T1 2018

Potential Topics	Impact GANIL / SPIRAL	Connex impact	Comment
BNCT	SPIRAL2 adaptation	Development of neutron capture studies	Complementary to Archade
Neutrons for analysis and Neutron Activation Analysis	NFS : Structure neutronography, diffusion & hot cells	Visibility of neutron offer to be increased	Discuss with LLB
Production & separation of RadioIsotopes	Development of new production/separation methods (ISOLDE process) ? Use of the Beam Dump ?	Radiochemistry	Strong demand for health developments. Some may increase for Information Tech
Membranes & filtration	Adapt the GANIL facility (CIME) Develop instruments with CIRIL for these applications	Give more visibility to this activity	Ganil environment positive for these applications
Low Energy Focused Ion Beams	PELIICAEN Project (Maskless material modification at nanometer scale)	What about a low energy radioactive focused ion beam and its potential applications?	Micro-electronics, quantronics, spintronics, data storage, quantum cryptography, nano-sensors, high speed electronic components… Energy: Studies for solar cells, LEDs, catalysis, piezo-electrics conversion…

Extract of the table of subjects to be deepened

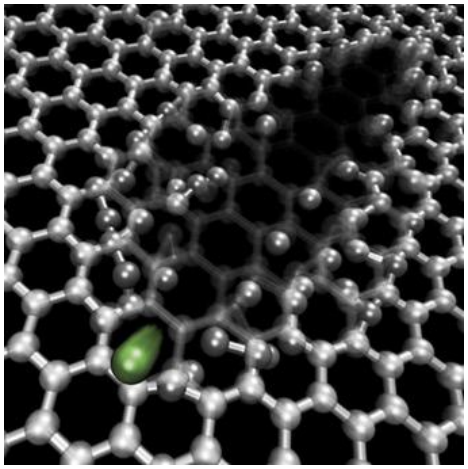


Source: MEDraysintell (2015)

→ **Task 2.4**

Medical radioisotope tendancy

Nanostructuration with Middle and High Energy Ion Beam



http://www.futura-sciences.com/sciences/actualites/chimie-dessaler-eau-mer-graphene-cest-possible-52599/

Nanometer tracks with high aspect ratio induced by ion irradiation (membranes):

- Controlled size, shape and fluence
- High area available (m^2 scale)

Field of applications:

- Health: Filtration of biological particles (agro chain, bioproduction, depollution), sea water desalination…
- Energy: Salinity Gradient Energy, piezo-electrics conversion, electrical power storage…
- Devices: micro and nano sensors/actuators, Multi Channel Foil…

2 subjects investigated in details from 2018 :

- Separation of radioisotopes (non health) by ISOLDE process
- Membranes & filtration

Preliminary evaluation in 2018

Detailed study will start on these 2 subjects in May 2019 (person being recruted by CEA*)

*: the person will propose also a business plan for membrane production in the frame of Task 1

Innovation and Industries deliverables

Task1: Limited pilots of access provision to research teams from industries and involvement of industrial users

- **D4.1 Business plan for the industrial application activities at GANIL (M36)**

Task 2: Industrial Applications and Technology Transfer

- **D4.2 Report on the technology transfers developed in the framework of the project (M36)**

Task 3: Increase of Innovation Potential

- **D4.3 Report on the increase of innovation potential study (M36)**

Innovation and Industries milestones

Milestone number	Milestone name	Due date	Means of verification
MS9	Beam profile monitors: Licence contract and R&D collaboration contract with the company	Months 6 DELAYED	Report
MS10	Report on the methodology for the technology transfer for radioisotope production	Months 30	Report

Budget and human ressources

Partner	Budget (Euros)	Human Ressources Person.Month
GANIL	422500	6
NUCLEOPOLIS	222500	30
CEA/DRF	146085	15* (6 p.m CEA staff)

*: 9 p.m for Task3

Thank you for your attention