



IDEAAL Work Package 4

Innovation and Industries





WP4 objectives

- The Innovation and Industries Work Package 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

- 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)





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

M.Kurzyp – X.Ledoux - MH.Moscatello

STATUS

- 2 experiments scheduled in 2019
- 1 experiment scheduled in 2020
- Call for industrial experiment on SPIRAL2/NFS to be scheduled in November 2020 (no answer yet)
- Proposal of a business plan for the development of R&D on membranes at Ganil with CIMAP collaboration

IN PROGRESS:

Deliverable D4.1 almost completed: Business plan for the industrial application activities at GANIL





Applications and Technology Transfer - Normandie Energies / Nucleopolis

M.Grar – MH.Moscatello – N.Renard (until August 31st 2020) – P.Rouxel

Sub-Task 2.1 – Provide industrial application tools to GANIL

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 outsourced to ERDYN Company
- Communication tools in collaboration with GANIL/WP5

IN PROGRESS:

- New transfer to industry : Patent on Aluminium Flanges to be transferred to a company (Ganil)
- Deliverable D4.2 in progress (Nucléopolis): Report on the technology transfers identified and developed in the framework of the project





Sub-Task 2.2 – Operational implementation (General Case) STATUS:

- Exchange of good practices with GSI laboratory:
 - Meeting in GSI in November 2017 (practices for technology transfer, meetings with companies
 - Meeting with GSI on September 24th 2020
- Participation in WNE 2018 with Nucleopolis (June 26th to 28th Paris Nord Villepinte)
- Participation to the ENSAR2/NUPIA Workshop in October 2018 (Varsovie)
- Organisation of a workshop with companies on GANIL know-how on February 5th 2019
- (ion sources, beam diagnostics, vacuum technologies, mechanics, radioisotopes)
- Participation to the the ENSAR2/NUPIA Workshop in November 2019 (Sevilla)
- Sub-Task completed

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

- STATUS:
- Transfer contract signed in December 2017 and transfer to Pantechnik in progress
- Collaboration contract signed in January 2020
- MS9 on Month 9: delayed to Month 37
- Sub-Task completed





Sub-Task 2.4 – Operational implemantation: Innovative radioisotope production

STATUS:

Study and proposals of possible methods for transfer with the M2 trainee - January to June 2017 (GANIL/Nucleopolis) – MS10 at Month 30: OK

→ 211At and <u>212Pb</u>

- ARRONAX collaboration: presently on stand-by, but multilateral collaboration within the frame of the ANR REPARE
- TRISKEM : possible collaborations have been identified (meeting in December 2019)
- ORANO MED: meeting in January 2020 at GANIL -> OM not willing to be involved in this R&D in the next few years
- Sub-Task completed





Increase of innovation potential - CEA/DRF

A.Leservot - MH.Moscatello - M.Kurzyp

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

- Identify new applications with 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:

- General study during the first 2 years
- 2 subjects investigated in details from 2018:
 - Membranes & filtration (detailed presentation in January) deliverable almost completed (D4.1 and D4.3)
 - Electromagnetic Isotopic Separation: in progress
- Deliverable D4.3 in progress







Electromagnetic isotopic separation

Main objective of the undergoing study : identify a future activity at Ganil for this topic

- > main applications and global market
- > added value of GANIL
- > isotopes which could be separated in GANIL
- > strategic position of GANIL in France/Europe
- > actions needed to start isotope separation activity in GANIL



Task 3





Electromagnetic isotopic separation

Global situation for Isotope Production



(2016 – 2025) The Isotope Program in USA (DOE) dedicated to production/separation, R&D and distribution of isotopes (stable/unstable) in short supply or high local/global demand

https://isotopes.gov/



(2019) The ROSATOM organization in Russia is a world lider (40% of the market) with its own network of nuclear medicine and R&D centers



Japan Radioisotope Association

Japan has an integrated system, from the supply of radioisotopes through to the management of wastes.







The Isotope mass Separator On-Line (ISOLDE) as a main isotope separation facility in EU with more than 40s of experience.

The most recent EU initiative: PRISMAP (PRoduction of hIgh purity iSotopes by Mass separation for medical APplication), submitted in March 2020– GANIL is a

partner



IDEAAL Collaboration Meeting – September 18th 2020 – Videoconference









Electromagnetic isotopic separation

The Isotope Program in USA



> Isotope Program in USA has made dramatic improvements in operations in response to the recommendations of the 2009 Long Range Plan



Task 3





Electromagnetic isotopic separation

Isotope Applications and Social Benefits



1. Particle Therapy

- Helium-3 with similar biological effectiveness to protons due to sharper dose fall-off
- Oxygen-18 for high biological effectiveness (non-toxic)

2. Diagnostic Imaging

Lanthanum Bromide (LaBr₃:Ce) for fast scintillators

3. Isotopes for 'Theranostics'

- ^{48g}Sc/⁴⁷Sc; ⁶⁴Cu/⁶⁷Cu; ⁶⁸Ga/⁶⁷Ga; ⁷²As/⁷⁷As;
 ⁸³Sr/⁸⁹Sr; ⁸⁶Y/⁹⁰Y; ^{110g}In/¹¹¹In; ¹²⁴I/¹³¹I;
 ¹⁵²Tb/¹⁶¹Tb and ¹⁵²Tb/¹⁴⁹Tb
- Lutetium-177

ENERGY



2.

- **1.** Next-generation fusion reactors new data models and materials able to sustain harsh conditions or liquid heavy metal coolant pool (ITER)
 - I, Te, Ru, Cs, actinide (U, Am)O2 as fission products
 - Be, Fe, V, Cr, Mo, Nb, Ta, Zr, W for high-flux neutron test damage

Production of electricity in space missions (photovoltaic replacement)

 Am-241 for nuclear power sources for deep space missions (replacement of Pu-238)

ENVIRONMENT AND SPACE



- V, Ni, Cu, Zn, Pb as anthropogenic markers
- Na, Cl, Si, Al, Ca, Fe, Ti, Sr as natural sources
- Ca-45, C-14 for accelerated mass spectrometry AMS, radiotracers and carbon dating
- Be-10 for AMS
- Cs-134/135/137, Np-237, Am-241, H-3, Be-7, C-14, Tl-226, Pb-210, Bi-214, Rn-222, Ra-223/226/228, Ac-228/234/235, U-238, K-40, Rn, Ra... in nuclear waste

SECURITY

FLI

1. High-sensitivity Portable Radiation Detectors

 Helium-3 and its alternatives (LaBr3:Ce, LaCl3:Ce, CeBr3, Srl2, Cs2LiLaBr6:Ce, Cs2LiYCl6:Ce) for neutron detection

CROSS-DISCIPLINARY...

1. Study the structure of materials and atomic matter even in extreme conditions as in plasma

NUPECC Long Range Plan 2017, Perspectives in Nuclear Physics









Electromagnetic isotopic separation

GANIL Potential

- Isotope Separation in GANIL: IDEAAL project looks for unique application of GANIL and use of its expertise
 - GANIL uses electromagnetic separation for production of beams in nuclear physics only
 - GANIL is not a world leader in EMIS but can bring some innovation on the R&D level (an added value)
- Top Competences identified at GANIL towards EMIS:
 - Electron Cyclotron Resonance Ion Source (mono-charged)
 - Production of metallic beams with high energy / intensity
 - Ion Optics and Mass Spectrometry
- Possible development of EMIS activity in GANIL:
 - Building a R&D project with local impact, with long term future perspectives of production (spin-off?)
 - Collaboration/R&D project with another facility in Europe
 - Initiating/participating to a european network for isotope production/separation, R&D, distribution like in US, Russia or Japan
 - R&D ideas (to be developed in the next months):
 - Comparative studies of the ECR+1 (MONO1000) with Nier-Bernas ion sources for separation of difficult stable metallic elements to see the overall ion source efficiency / robustness.
 - Stable isotopic elements to work on to be selected (first pre-selection to be confirmed: calcium-48, palladium-102, ytterbium-176, lutetium-176, thallium-203)







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 -> M51)
- Task 2: Industrial Applications and Technology Transfer
 - D4.2 Report on the technology transfers developed in the framework of the project (M36 -> M51)

Task 3: Increase of Innovation Potential

- D4.3 Report on the increase of innovation potential study (M36 ->M51)





