GANIL COMMUNITY MEETING

Concluding remarks

On behalf of the **GUEC**

GCM 24 : SESSIONS

Session 1: CYREN and GANIL future

Session 2: Interdisciplinary Physics and Applications

Session 3: Beam and target development

Session 4: AGATA/GRIT @ GANIL 1

Session 5: S3/SIRIUS/S3-LEB

Session 6: Status of GANIL & nomad detectors

Session 7: Next-generation electronics and DAQ

Session 8: DESIR

Session 9: AGATA/GRIT @ GANIL 2

GCM 24 (S1): GANIL FUTURE

CYCLOTRON RENOVATION–

➢ *Initial statement:*

Cyclotrons were built in 1980

Cyclotrons maintenance and refurbishment reduced to the strict minimum for ten years due to the GANIL manpower dedicated to :

- ✓ SPIRAL2 construction & commissioning
- ✓ Compliance projects after the 1st safety review (RXS1)

➔ **Aging ↗ Reliability ↘ GANIL user satisfaction ↘ Manpower for curative maintenance ↗**

2 scenarios:

+ 3 cavities

The *TIMELINE* of the project is driven by the full scenario *most impacting* : construction, testing and exchanging the 4 CSS cavities.

The *Human resources* are impacted by:

- New power supplies and renovation of the remote control system (already started !)
- But many more items are considered (Access units, storage building, vacuum systems)

CYREN survey – scientists point of view

30 persons contacted by GUEC

The cyclotron viability is required for all communities

Hope for more reliability of the primary beams, better time structure, less breakdown, more time for beam development SPIRAL1, optimizing the human resources involved in the cyclotron operation, possible renovation of all beam diagnostic devices.

concerns:

- We have to pay attention to programming and possible negative interferences with other projects (AGATA, DESIR, GRIT, ACTAR-TPC etc.).

Request : Communicate ASAP with the scientific communities the renovation schedule: anticipation of beam times for PhD students, avoid temporal conflicts with funded projects

- Is a resonator upgrade scientifically worthwhile ? *(not included in the renovation project)*
- Upgrade possible only on the beam intensity? However, we need to study the benefits of developing a more intense beam at cavities, as the limitations are mainly due to the heat resistance of the targets and production at the sources.

GCM 24 (S1): GANIL FUTURE

GANIL Future :

- A project proposition has been submitted in Sept. 2024, and are to be *discussed with GANIL stakeholders and ministry in Nov. 24.* (Based on the SPIRO report)

  A scientific strategy and an action plan for achieving the scientific objectives including:

  - Initial costing, Timetable, Risk analysis and Guidelines for the technological developments to be undertaken.

- Presentation of GANIL timeline *2024 – 2029 very busy !!!*

  - 2024 – 2026 : Start-up of S3
  - 2027-2028 : Start-up of DESIR
  - 2029 : NewGAIN startup and CYREN renovation done

Message talk from Fanny Farget on GANIL future :

A lot of project have been constructed and are in a construction/installation of start-up phase.

Proposing to the scientific community: ***Start monitoring the studies of the different options:***

- Optimisation of the extraction efficiencies of RIB from target ion-sources
- SIMS (Station d'Irradiation Multidisciplinaire de SPIRAL2) : Preliminary project for an HI irradiation room in the current LINAC building.
  - production of radioisotopes, R&D studies on MNT gas cell
- e-RIB colliders : start R&D on dedicated traps or electron beam

Start discussions around new organisation around the experiments

Why: Evolution of GANIL with increased amount of experimental facilities + parallel operation.

GANIL facility is running and maintaining the installations and gives support for the users but the diversity has led to a lack of manpower for installation, testing and running the experiments the same way as in the past by the GANIL staff.

GCM 24 (S2): INTERDISCIPLINARY & APPLICATIONS

4 presentations:

- *FLASH carbon ion irradiation at GANIL*
- *Involvement of radiation damage in the densification of mesoporous silicas*
- *On the use of swift heavy ions to study polymers: what next?*
- *Project for a multidisciplinary irradiation facility using beams from the SPIRAL2 accelerator*

Fundamental research

Societal issues

- Material science
- Chemistry under irradiation
- Radiobiology
- Nuclear waste management
- Space applications
- …

GANIL beams needed for multiple interdisciplinary research fields

- On a regular basis
- Early discussed and scheduled
- Also concerned by CYREN renovation (D35 dipole)
  Leakage suspicions and several canceled experiments due to failures in 2024

Specific constrains
(cell culture for exp)

Examples of need to develop activities

- Punctual increase of Imax for FLASH irradiations
  To be discussed with SPR and SSR
- Device for irradiation in a humid environment of mesoporous silica for the storage of radioactive waste
- Electron Paramagnetic Resonance spectroscopy device for online measurement of radicals in polymers under irradiation
- Possibility of a multidisciplinary irradiation station

SPIRAL 1 beam development

SPIRAL1 as a strong motivation for CYREN, as was largely discussed during the WS

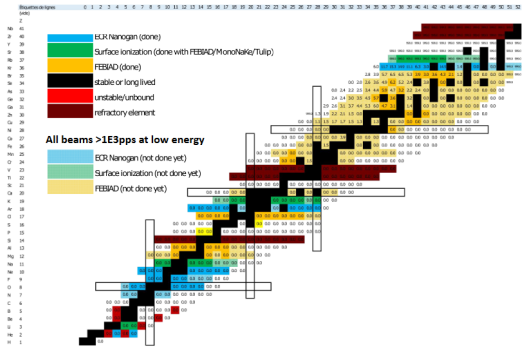
- Especially in view **of the future campaigns of AGATA + GRIT @ VAMOS**
- And of the **DESIR physics**

Many beams already developed – from Nanogan / FEBIAD / Mononake / TULIP

Many developments are also going on, among others

- New targets and Fe-Co-Ni with FEBIAD,
- ^{74}Rb from TULIP
- ^{9}Li from Mononake

Production summary



But the beam purity is limiting the scope, especially with **reaccelerated beams and FEBIAD** source

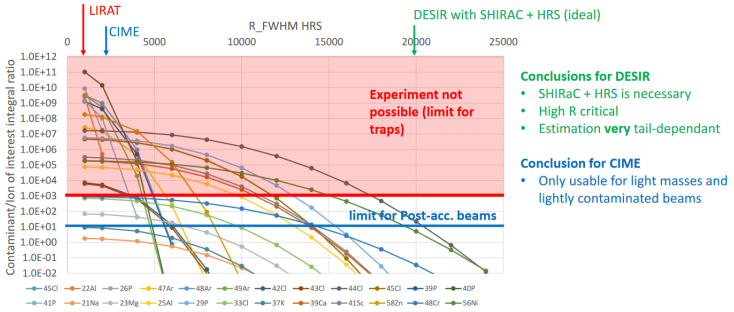
Addressing this beam purity issue by

- Using CIME as a separator
- Using stripping after CIME
- Molecular beams?

Interesting questions on:

- The potential development of a **Laser Ion Source**
- Developing a target ion source, TULIP like for **MNTs**

Purity in DESIR



Conclusions for DESIR

- SHIRaC + HRS is necessary
- High R critical
- Estimation **very** tail-dependant

Conclusion for CIME

- Only usable for light masses and lightly contaminated beams

P. Chauveau and GCS, P. Delahaye

GCM 24 (S3): BEAM & TARGET DEVELOPMENT

Save the date: 10th – 13th/14th of March, 2025

- **Workshop on R&D for new ISOL beams**
  - In the framework of MP Ions radioactifs
  - And in the hospices of SCIPAC

Program and organizing committee in discussion
Inputs / remarks for content welcome

- **Concentrating on perspectives at SPIRAL1 for**
  - **reaccelerated beams**, including specifically **AGATA+GRIT@VAMOS**
  - **DESIR future programs** (« DETRAP, BESTIOL, LUMIERE »)
  - We welcome input from the community
- **Including talks on innovative beam R&D and organization**
  - Batch mode, Laser ionisation @ SPIRAL1
  - What perspectives for operation in 2029 (how many beams/y, what beams)
  - R&D conducted at ALTO for beams from photofission

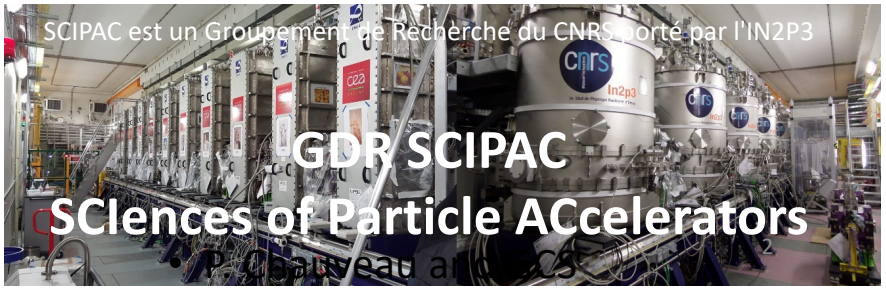
Master Projet Ions Radioactifs:

GANIL

IJCLab Irène Joliot-Curie Laboratoire de Physique des 2 Infinis

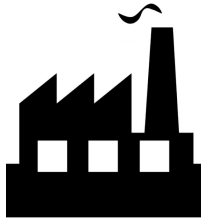
LPSC Grenoble

P. Delahaye & F. Ibrahim, M. Dubois & E. Ramirez



Summary- Target Development at GANIL

Demand of a large number of high quality targets made of various isotopic material for S3 experimental program, + need of actinide targets (S3, NFS)
Limits to outsourcing targets' production (few labs dedicated for their own facility, …)



- PALAIS – Plateforme Cibles pour GANIL SPIRAL2 – for Stable material + ^{238}U
  almost on track :purchase of evaporators and renovation of the existing laboratory, PVD technics mastered
  New persons (AI + post-doc)
  Successfull first Lanthanide targets
  Characterisation : on site new system + partners' platform (CIMAP, JANNUS-SCALP, MOSAIC…)
  DC magnetron sputtering (^{238}U to ^{232}Th): technic to master & LTR to be furnished
- Grand PALAIS (actinide) :

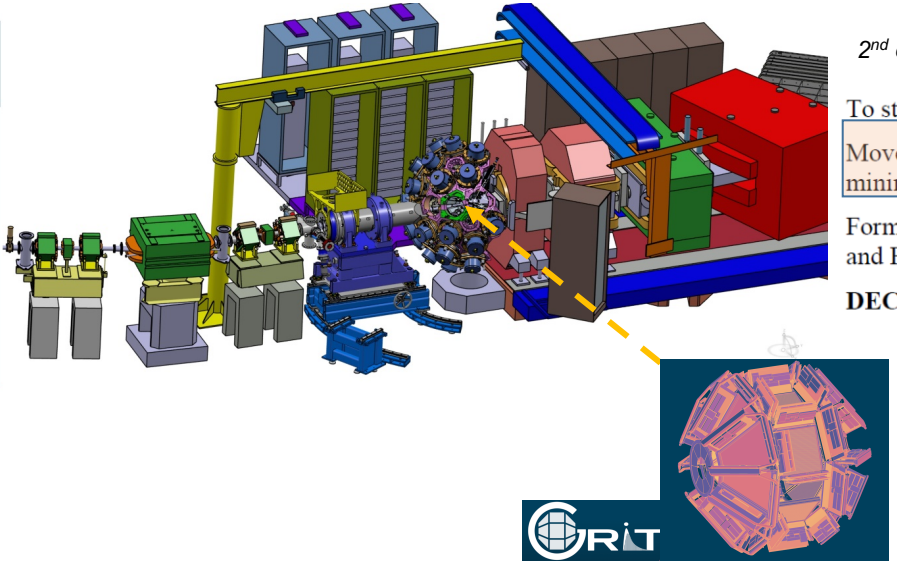
Radiochemistry skills, Laboratory equipments,
New building, Safety files, authorization…..

➢ Expected requests and feedback from users for optimal preparation of targets

Discussion on actinide material supply with ORNL, on the expected beam power acceptable at S³, on required homogeneity and its impact on S³ transmission.

GCM 24 (S4) : AGATA+GRIT @ GANIL

AGATA (2π) – GRIT – VAMOS – SPIRAL1



2nd of October 2024 – ASC meeting after ACC prospectives

To stay at LNL until mid 2028 to complete the zero-degree campaign.

Move to GANIL to start the campaign in March 2029 to have (at least) two campaigns with a minimum of 100UT per year dedicated to AGATA.

Formal decision on location after 2030 to be decided in 2027 once more information on SPES beams and FAIR timescales/funding become available.

DECISION: AGREED

→ Next steps :

- coming back in front of the community (GCM is part of the exercise)
- Preparing a more detailed white book detailing the precise needs in term of detection geometry to constrain the implementation and SPIRAL1 beams requiring development.
- Organizing this new collaboration in term of workload, PBS, milestone and collaboration between the partners

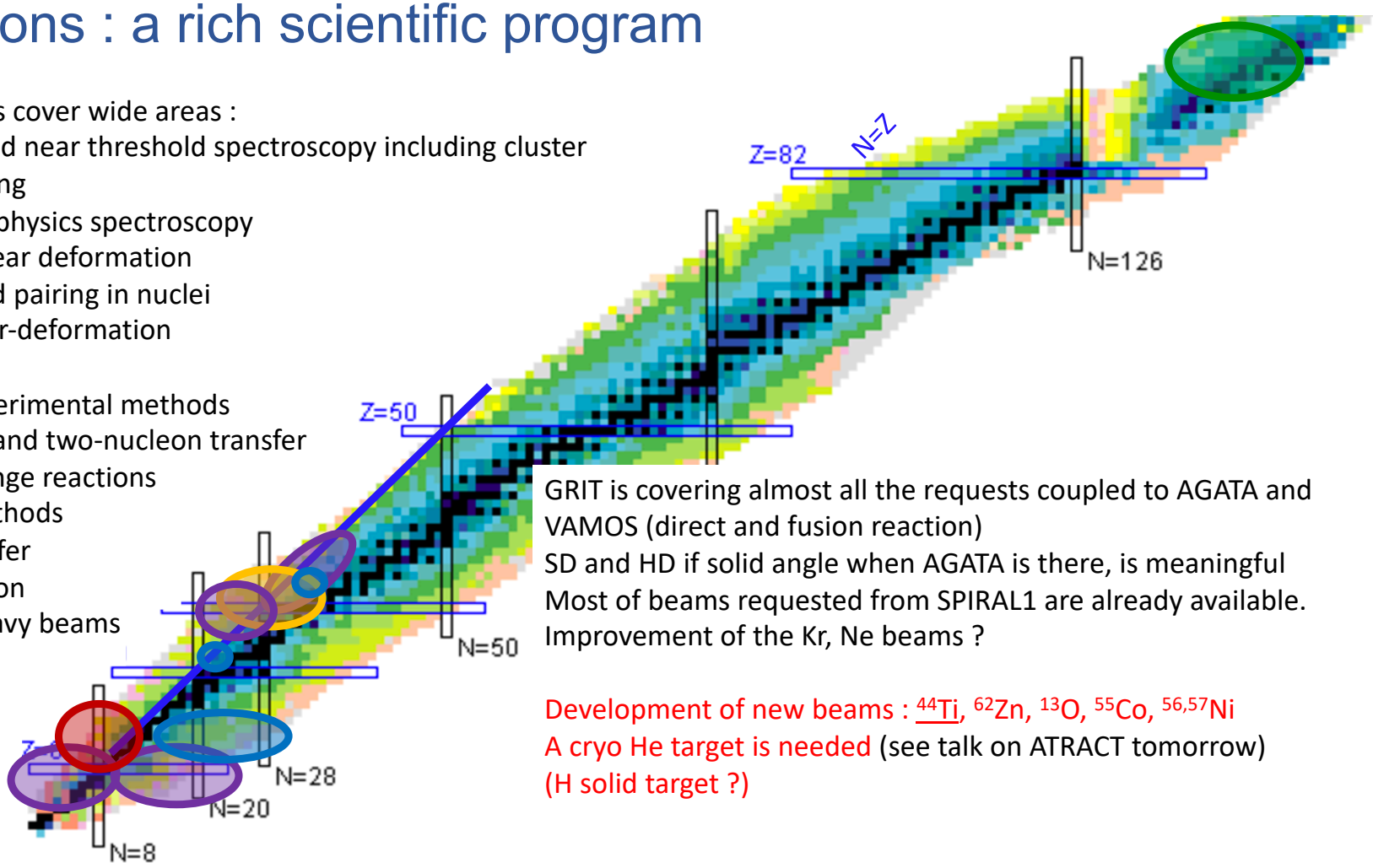
Conclusions : a rich scientific program

The physics cases cover wide areas :

- Resonance and near threshold spectroscopy including cluster
- Ab-initio testing
- Nuclear astrophysics spectroscopy
- Study of nuclear deformation
- Clustering and pairing in nuclei
- SHE and hyper-deformation

with various experimental methods

- one-nucleon and two-nucleon transfer
- charge exchange reactions
- surrogate methods
- DSAM + transfer
- coulex or fusion
- MNT with heavy beams

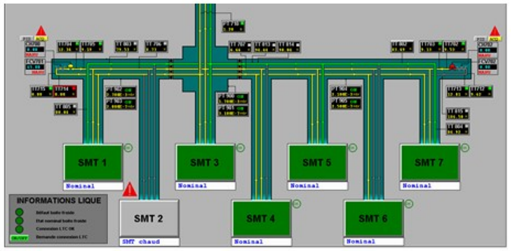


GRIT is covering almost all the requests coupled to AGATA and VAMOS (direct and fusion reaction)
SD and HD if solid angle when AGATA is there, is meaningful
Most of beams requested from SPIRAL1 are already available.
Improvement of the Kr, Ne beams ?

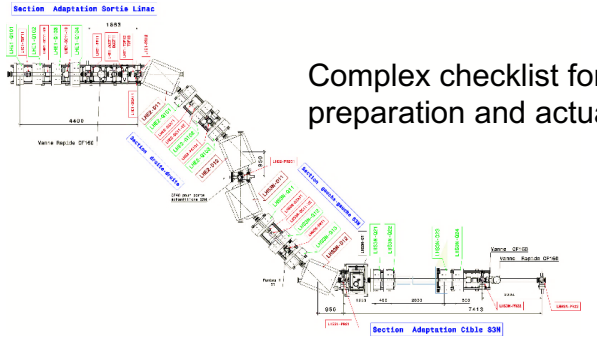
Development of new beams : ^{44}Ti, ^{62}Zn, ^{13}O, ^{55}Co, ^{56,57}Ni
A cryo He target is needed (see talk on ATRACT tomorrow)
(H solid target ?)

S^3 construction & commissioning

- The cryogenic-system problems have been solved with so far no recurrence

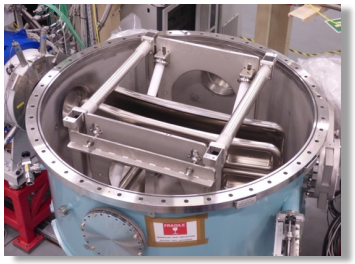


- Milestone J6A in November 2024: LINAC beam transport/optimization on target

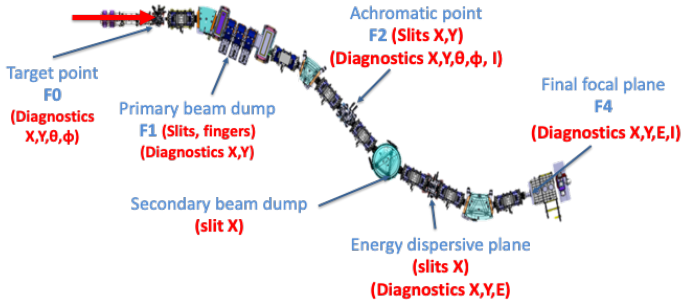


Complex checklist for preparation and actual test

- Critical period following for two of the key S^3 systems: SMT6 and electrical dipole



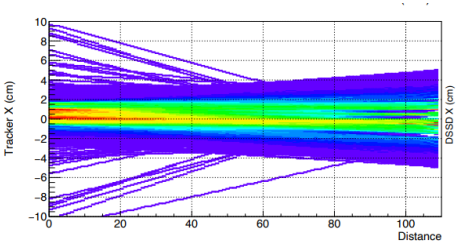
- Milestone J6B : Spectrometer optical commissioning: 2025-2026 but depending on progress of critical operations

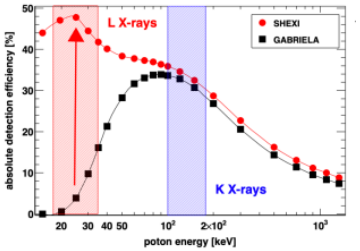


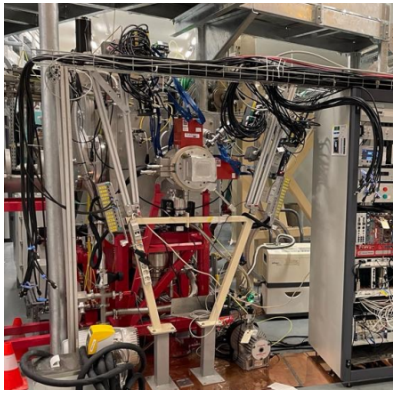
GCM 24 (S5): S3/SIRIUS/S3-LEB

S^3 detection systems

- **SIRIUS:**
  - Detector ready for experiments
  - In-beam tests performed (June 2023), continuous improving of components, electronics and software
  - SHEXI: a critical upgrade for element (Z) identification

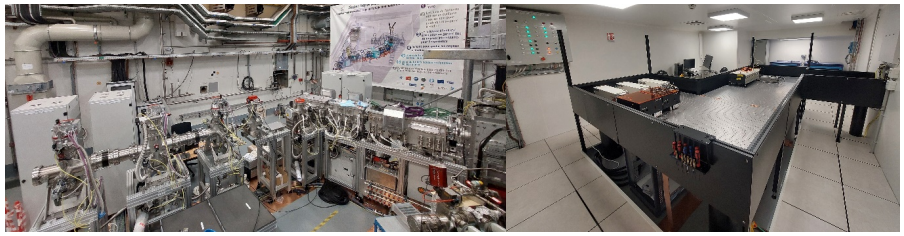




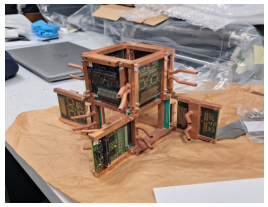


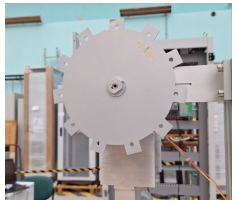
- S^3 experiments currently reliant on GANIL Ge pool

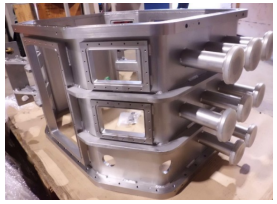
- **S^3-LEB:**
  - Setup at focal plane of S^3, off-line tests starting soon
  - New laser lab at S^3: off-line measurements 2025
  - Continuous tests of ionization schemes and ongoing developments (a necessity)



- **SEASON:**
  - Mechanics and detectors completed, assembly in progress
  - Test at GANIL in full configuration January 2025 with SIRIUS electronics







GCM 24 (S6): Nomad detectors

Status of GANIL & Nomad detectors

TAGS@GANIL

Experiments @ ISOLDE, IGISOL, RIKEN

STAR : DTAS or ROCINANTE upgraded with 16 LaNr3 (2x2x4) and 1 DSSD (GANIL); (NA)2STAR Collaboration

STAR @ GANIL : Nuclear structure + nuclear astrophysics / one experiment accepted at GANIL/LISE;

Next collab meeting in December 2024 : future experiments in GANIL should be discussed (present installation or DESIR)

New G2 line

Problem adressed : CIME min energy limited at 1.2 MeV/u

Solution : degrade the beam energy after CIME (2.5MeV/u to 1.2MeV/u) and use 3-qp system to recover optics + ToF measurements

First astrophysics experiment : 4He(8Li,n)11B using ACTAR

New opportunities for nuclear astrophysics to be explored by the community (call for ideas)

INDRA/FAZIA upgrades : thin Si detectors & ionisation chambers

first stage Si detectors (30 µm) in FAZIA to lower detection thresholds => PSA done in the second stage

INDRA ionisation chambers : new design for more reliability

Custom made Photodiodes for FAZIA CsI(Tl) : better light collection, better efficiency (in search for providers)

GANIL Ge pool & Exogam

EXOGAM : 17 4-fold HPGE (12 EXOGAM detectors available for experiment at any time with 1-2 as backup);

Easing maintenance (room infrastructure to host EXOGAM); Refurbishements of BGO/Csi is needed

Next generation of digital electronics ? SMART to replace GTS

More detectors : simpler (not segmented) is required in future (S3, DESIR, …) -> 4 ?

Strategy for securing the purchase of new germanium (what type and when ?) ; More general, semiconductor pool ?

Need to start thinking/working on Nomad detector implementation within the GANIL DAQ proposed frame !! (survey done by GUEC?)

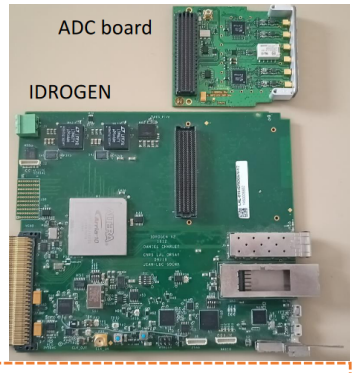
Electronics and data acquisition systems

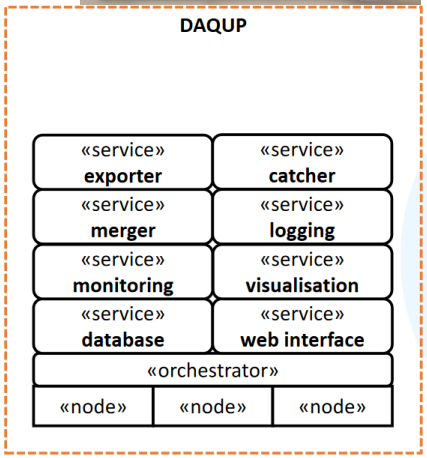
Of course we did not have time to present all the electronics and acq. dev. done for nuclear physics but these three presentations are a good example of the dynamism of these subjects in our laboratories

- Faster (LPC Caen): Complete acquisition system with various acquisition boards, V2 and V3
- NewComet (IJClab): Complete prototype of digitizer + coreboard (IDROGEN)+ acquisition for Alto decay station
- DAQUP: a deep renovation of GANIL data acquisition system based partly on HTTP existing applications, after an evaluation phase together with collaborators (in particular DCOD), a demonstrator will be done

❑ Still, the futur after numexo2 has to defined even though some pre-studies have already been initiated

❑ During the discussions several aspects were tackled like the rising complexity of our systems, the needs to get feedback and help from the collaborations and the importance of improved synergies at in2p3/Irfu levels to put in common the efforts while R&D possibilities in each lab. is of major importance



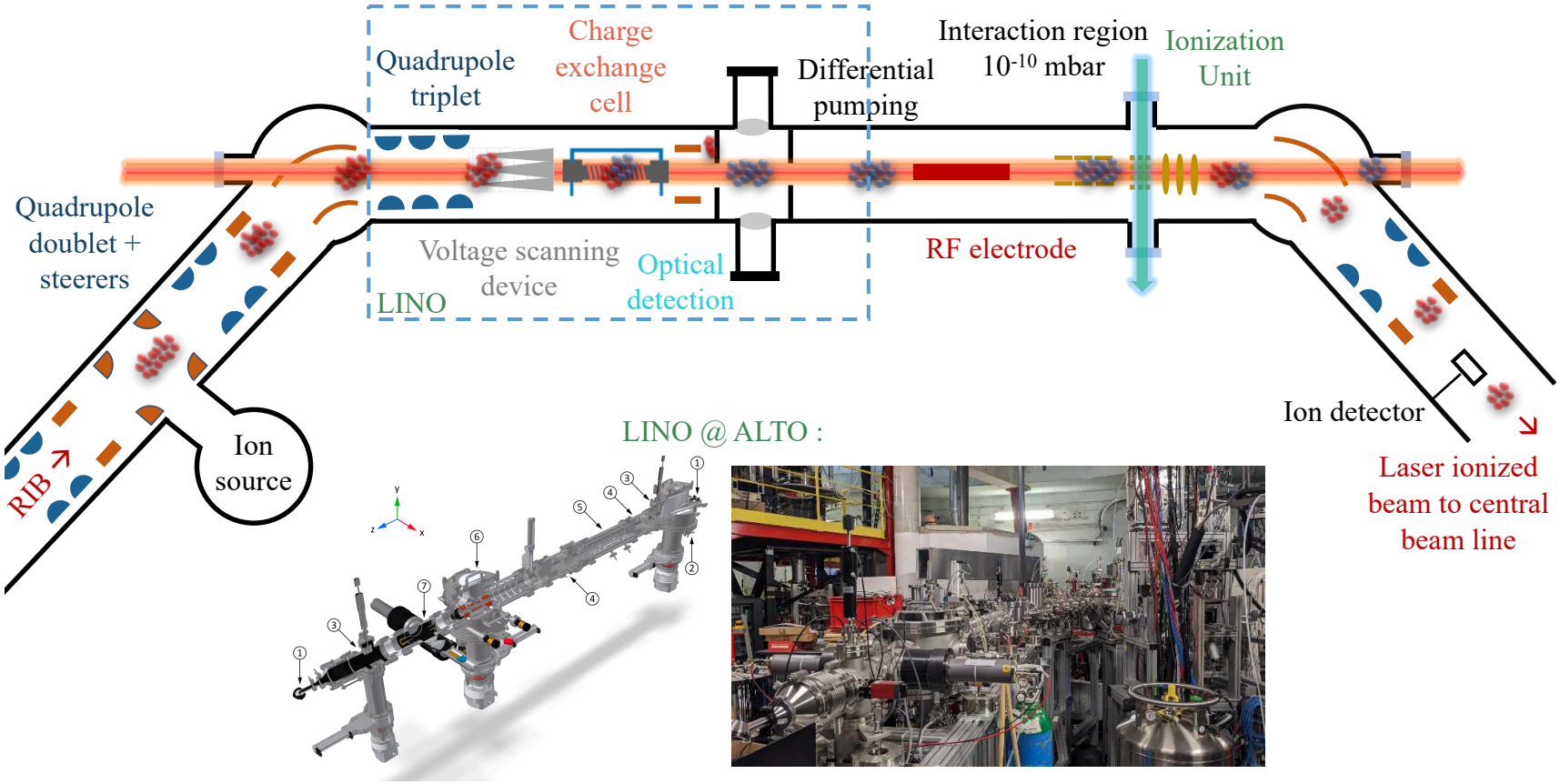


GCM 24 (S8): DESIR

- DESIR infrastructure
  - Building construction: end of 2024
  - Building reception: end of 2025
  - -> Important manpower required for installation
  - Operation licensing: end of 2027 (or beg 2028)
- DESIR instrumentation & experimental equipment
  - Installation (2026), Commissioning (2027), Operation with RIBs (2028)
  - Detailed timeline to be consolidated, including "small size" setups: Workshops, LoIs, ... 2025-2026
- Laser spectroscopy at DESIR
  - From LINO (2027-fluorescence spec.) to LASAGN (2029-high resolution collinear laser spec.)
  - RIB polarization and isomeric selection for decay studies and mass measurements
  - New project, t.b.c. (P. Campbell, Univ. Manchester): sympathetic cooling

GCM 24 (S8): DESIR

LASAGN @ DESIR

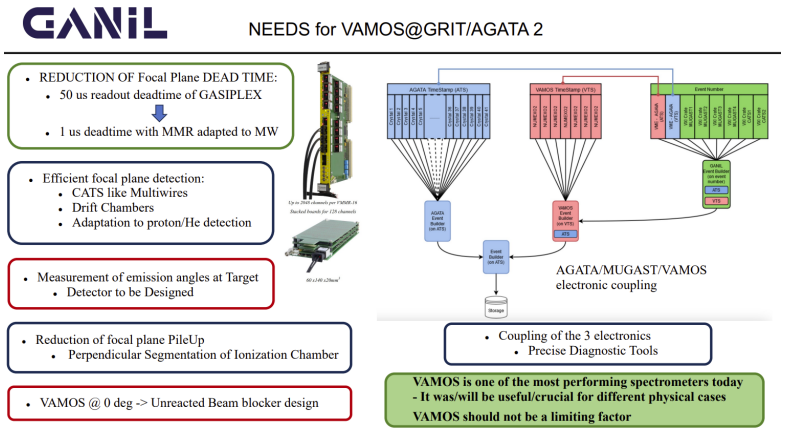


LINO @ ALTO :

GCM 24 (S9): NFS/NEWGAIN/AGATA @ GANIL2

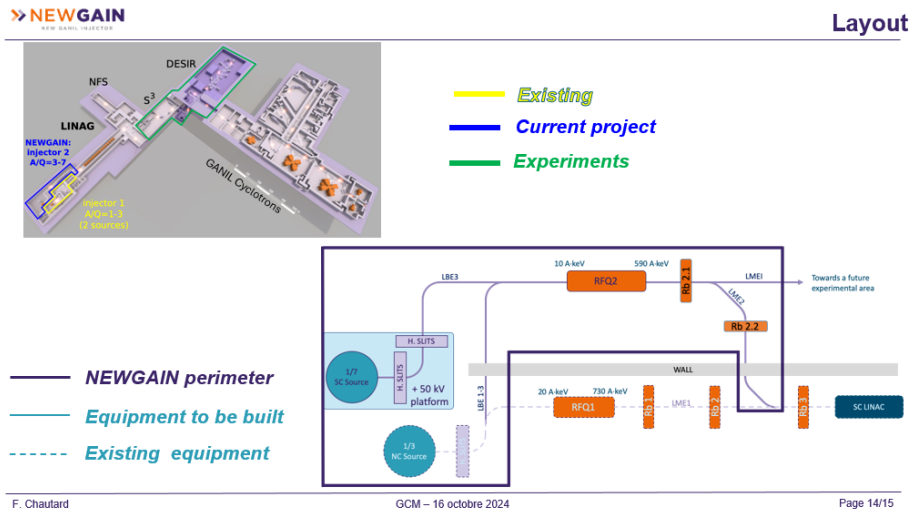
- NFS → Preliminary results from first experiments (SCONE, FALSTAFF, MEDLEY, SCALP)
  - →First irradiation measurement performed at NFS.
  - →Structure : PDR ^{140}Ce Monster + PARIS / ^{56}Ni(n,3n) with EXOGAM
  - → Ion-induced reaction: p+natFe, p+Mo, production of ^{211}At

- AGATA /GRIT @ GANIL2
  - Cryogenic Target ATRACT → ANR-^{3}He target →Ready for 2029
  - VAMOS configurations :
    - →Versatile device for different physics program
    - → Needs for VAMOS @ AGATA+GRIT campaign



GCM 24 (S9): NFS/NEWGAIN/AGATA @ GANIL2

- NEWGAIN→
- -New injector A/Q=7 → Increased intensity (Phoenix + FRIB)
- -Begin construct (2023) , Commissioning (2027-2028), First beam (2028), superconducting (2031)
- Opportunities for n-deficient nuclei S3/DESIR and for SHE
- -MNT suitable for the production of n-rich scpecies building a collaboration,



GCM 24

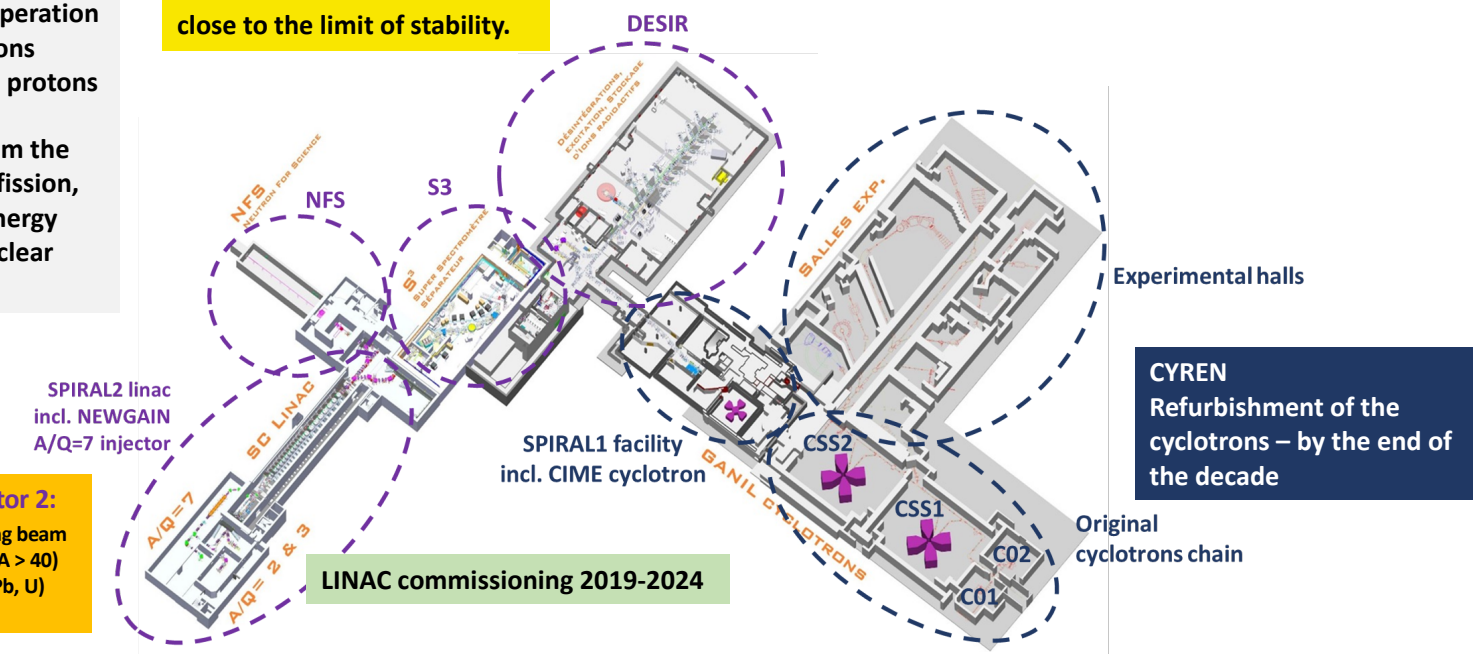
New GUEC member early career representative :
Armand Bahini → GANIL (post-doc)

GANIL 2030

Commissioning of the Super Separator Spectrometer (S3) planned in 2024-2026: nuclei with very low cross sections, such as superheavy elements or neutron deficient nuclei close to the limit of stability.

DESIR in 2027-2028
unique opportunities in terms of exotic nuclei selection and beam purity.
masses, laser spectroscopy, beta-decay spectroscopy, … building construction started in 2023.
First stone ceremony on November 10, 2023

Neutrons for Science (NFS) started operation in 2021. Neutrons produced from protons and deuterons accelerated from the LINAC: mainly fission, but also low-energy excitations, nuclear data,…



CYREN
Refurbishment of the cyclotrons – by the end of the decade

NEWGAIN, Injector 2: A/Q =3-7 Increasing beam intensities of heavy (A > 40) and very heavy (Xe, Pb, U) nuclei

LINAC commissioning 2019-2024

Courtesy M. Grasso

See you all in 2026