The MoU of the FAZIA collaboration 2023-2027

FAZIA

Forward A and **Z** **I**dentification **A**rray

Mature Exploitation Phase

Signed in March 2023

Memorandum of Understanding

2023-2027

ANNEX A.1

List of Parties

FRANCE:

- IN2P3/CNRS, Institut National de Physique Nucléaire et de Physique des Particules: 3 rue Michel-Ange 75794 Paris Cedex 16
- GANIL, Grand Accélérateur National d'Ions Lourds: Boulevard Henri Becquerel BP 55027, 14076 Caen Cedex 05

ITALY:

- INFN, Istituto Nazionale di Fisica Nucleare: Via Enrico Fermi, 54 00044 Frascati (Roma)

POLAND:

- COPIN, Consortium of polish governmental and Public Institutions: Instytut Fizyki Jądrowej im. Henryka Niewodniczańskiego Polskiej Akademii Nauk (The H. Niewodniczański Institute of Nuclear Physics Polish Academy of Sciences), ul. E.Radzikowskiego 152, 31-342 Kraków

SPAIN:

- University of Huelva: Dr. Cantero Cuadrado 6, 21004 Huelva

SOUTH KOREA:

- CENuM (Center for Extreme Nuclear Matters), Korea University, Seoul 02481, Republic of Korea

The current MoU, covering the period 2023-2027, contains three pillars hereby referred as P1, P2 and P3.

1. **P1:** The first one is to exploit the current well-performing apparatus in operation at GANIL within the INDRA-FAZIA set-up and cyclotron beams;

2. **P2:** The second is to guarantee the starting of first experiments at the RAON facility in South Korea. The construction of at least four new updated blocks (in term of electronics, silicon detectors and upgraded mechanics) is the goal of the present MoU, in order to participate to the first commissioning with Ar beams;

3. **P3:** The third pillar concerns the developments to be done towards experiments with RIBs both at low-energies experiments, as those feasible at SPES and at SPIRAL2 and at Fermi energies via in-flight fragmentation, as available at GANIL-LISE and in future at LNS-FRAISE. It includes the collaboration with other groups of research physics enlarging the usual thematic of INDRA and FAZIA.

The MoU does not include FRIB activities implicitly!

Fundings

Year	Funding	Details : investment, equipment, purchase, maintenance
2023	**25 k€**	LPC Caen : new prototype design for INDRA Ionisation Chambers (ChIo) **P1 & P3**
2023	**45 k€**	GANIL : INDRA Si detectors, new Ionisation Chambers (ChIo) and control/command **P1 & P3**
2023	**50 k€**	Italy : INFN Florence+Napoli+Catania: repair of FEE cards, production of mock up thin silicon detectors with mechanical and assembling developments; preproduction of ultrathin sensors 20micron in a geometry 2x2 sensor matrices. Construction of a forward counter for absolute cross section calibration **P2 & P3**
2023	**100 k€**	Korea: CENuM:-Construction of a new entire block from detectors to FEE boards for first-day experiment at RAON **P2**
2024	**30 k€**	LPC Caen : mechanical parts, additional FEE cards for 2 new blocks **P1, P2 & P3**
2024	**70 k€**	GANIL : Cryogenic pump, new gas-unit for Ionization Chamber, command and control, additional FFE card **P1, P2 & P3**
2024	**50 k€**	Italy : INFN Florence+Legnaro+Napoli+Catania**:** production of a first small set of ultrathin sensors (20micron) for low-E experiments (geometry based on 2x2 matrices 20micron sensors); detectors and equipment parts for the 2 new blocks. Contribution to installation and integration of detectors in Korea **P2 & P3**
2024	**200 k€**	Korea: CENuM: Construction of two entire blocks from detectors to FEE boards for first-day experiment at RAON **P2**
2025	**30 k€**	LPC Caen : mechanical parts, additional FEE cards for 2 new blocks, optical fibres and maintenance **P1, P2 & P3**
2025	**70 k€**	GANIL : additional FEE cards for 2 new blocks, renewal of silicon detectors **P1, P2 & P3**
2025	**50 k€**	Italy : INFN Florence+Legnaro+Napoli+Catania; maintenance of the whole FAZIA array (electronics, detectors); integration electronics for coupling blocks with other equipments; computing and disk storage needs for experiments; contribution to integration and installation of blocks both in Korea and at LNS in the new experimental site (according to the Fraise project) **P1, P2 & P3**
2025	**40 k€**	Korea: CENuM. **P2**
2026	**20 k€**	LPC Caen : upgrade of the electronics, maintenance **P1, P2 & P3**
2026	**40 k€**	GANIL : upgrade of the electronics, maintenance, mechanics **P1, P2 & P3**
2026	**30 k€**	Italy : INFN Florence+Legnaro+Napoli+Catania: maintenance of the whole FAZIA array (electronics, detectors); contribution to installation of experiments in Korea **P1, P2 & P3**
2026	**40 k€**	Korea: CENuM. **P2**
2027	**20 k€**	LPC Caen : upgrade of the electronics, maintenance **P1, P2 & P3**
2027	**40 k€**	GANIL : upgrade of the electronics, maintenance; mechanics **P1, P2 & P3**
2027	**40 k€**	Italy : INFN Florence+Legnaro+Catania+Napoli: maintenance of the whole FAZIA array (electronics, detectors); contribution to operation of experiments in Korea **P1, P2 & P3**
2027	**40 k€**	Korea: CENuM. **P2**

Organization and Task Groups

Organization:

- Spokesperson: *Giovanni Casini* INFN Firenze, Italy
- Co-spokesperson: *Nicolas Le Neindre* LPC Caen, CNRS-IN2P3, Université de Caen, ENSICAEN, France

FAZIA Project Management Board:

- *Giovanni Casini*, INFN Sezione di Firenze, Italy
- *Nicolas Le Neindre*, LPC Caen, CNRS-IN2P3, Université Caen, ENSICAEN, France
- *John Frankland*, GANIL Caen, France
- *Diego Gruyer*, LPC Caen, CNRS-IN2P3, Université de Caen, ENSICAEN, France
- *Sandro Barlini*, INFN and University of Firenze, Italy
- *Simone Valdrè*, INFN Sezione di Firenze, Italy
- *Tomasz Kozik*, Institute of Physics, Jagiellonian University, Poland
- *Josè Dueñas*, University of Huelva, Spain
- *Byungsik Hong,* Department of Physics, Korea University & CENuM

Task Groups, managers and duty list:

TG1: DACQ and control (Simone Valdrè & John Frankland)

- Updates and improves the current DACQ system; provides coupling with other devices; takes care of the slow control system. The TG1 covers the three main pillars of this MoU being involved in both old and new acquisition systems; it works to ensure back-compatibility with the old electronic cards and takes care of the installation in any site where the collaboration perform experiments. France, Italy and Poland are the main historical parties involved in this task.

TG2: Analysis and simulation (Sandro Barlini & Diego Gruyer)

- Takes in charge the data reduction (calibration/identification); updates the continuous data improvement; takes care of the data analysis; organize regular specific meetings (FAZIA days); manages the KaliVeda software (database, filter, simulations…); performs simulations. All parties are contributing to the TG2, having PhD students and Post Docs in their group, as well as any people wanting to access the reduced data for physics analyses and model comparisons.

TG3: Detector and instrumentation (Giovanni Casini & Nicolas Le Neindre)

- Develops and oversees the detector construction; maintains the various parts of FAZIA (detectors, electronics, mechanics…); improves the global set-up reliability; prepares the experiments in various facilities worldwide; manages the budget. Again, all three pillars of the present MoU will be addressed by the TG3. All parties are also involved here, with a special contribution of Italy and France, participating according to the respective manpower and to the available funds, year by year requested to the specific national agencies.

TG4: Physics case and collaborations (Giuseppe Verde & Gabriele Pasquali)

- Follows the scientific activities in various facilities worldwide and informs regularly the collaboration; keeps contacts with relevant laboratories, proposes possible developments regarding the future beams and general equipment in those facilities (SPES, FRAISE, FRIB, RAON, FAIR…); coordinates the preparation of proposals/LoIs for the various PACs; keeps connection with theoreticians; promotes and stimulates collaborations. This group is in close connection with TG2 and is mainly focused on the experimental program at GANIL with the INDRA and FAZIA coupled devices, (pillar P1) preparing PAC proposals and LoIs. Future programs and partnerships (pillars P2 and P3) with other collaborations are also discussed in the TG4. The possible nascent proposals are then evaluated within the FPMB.

Pillars of the MoU	FAZIA Task Groups	FAZIA parties	Tasks & responsibilities
P1 (INDRA-FAZIA operational phase at GANIL)	**TG1**	GANIL, IN2P3, INFN, COPIN	Acquisition system + coupling
	TG2	GANIL, IN2P3, INFN, COPIN, Huelva University, CENuM Korea University	Data reduction and analyses
	TG3	GANIL, IN2P3, INFN, CENuM Korea University	New detectors and electronics for maintenance, repairs, improving reliability
	TG4	GANIL, IN2P3, INFN, COPIN, Huelva University, CENuM Korea University	PAC proposals and LoIs
P2 (construction of at least four new complete FAZIA blocks for the start of the RAON facility)	**TG1**	GANIL, IN2P3, INFN, COPIN	Acquisition system for RAON
	TG2	GANIL, IN2P3, INFN, CENuM Korea University	Simulations
	TG3	GANIL, IN2P3, INFN, CENuM Korea University	Construction of four updated new blocks for RAON
	TG4	GANIL, IN2P3, INFN, CENuM Korea University	Physics cases and LoIs
P3 (development towards RIB and collaboration with other groups/devices)	**TG1**	GANIL, IN2P3, INFN, COPIN	Coupling with other devices
	TG2	GANIL, IN2P3, INFN, COPIN, Huelva University, CENuM Korea University	Simulations
	TG3	INFN, COPIN, CENuM Korea University	Thin silicon detectors 20-100 μm
	TG4	GANIL, IN2P3, INFN, COPIN, Huelva University, CENuM Korea University	PAC proposals and LoIs