

Annual Report **2024**





www.genci.fr

GENCI



In charge of **PROVIDING** high-performance computing and massive data processing resources, **GENCI's** mission, at national and European level, is to promote the use of HPC combined with Artificial Intelligence and prototype quantum computing devices, for the benefit of scientific, academic and industrial **RESEARCH COMMUNITIES.**

More than 237 PFlop/s in 3 COMPUTING CENTERS

- CINES ADASTRA Supercomputer 91,6 PFlop/s
IDRIS JEAN ZAY Supercomputer 125,9 PFlop/s
TGCC JOLIOT-CURIE Supercomputer 20 PFlop/s.
- For the entire IR*, 2117 resource request files processed during the year, with **more than 4.4 billion core hours requested in CPU AND 140 million GPU hours.**
- **5,156 users** from academic and industrial research
- **11 Thematic Committees**

* Research infrastructure (IR)



FIVE
shareholders



04. AT THE HEART OF THE BIGGEST CHALLENGES

Editorial by Jean-Luc MOULLET , General Director for Research and Innovation	04
Foreword by Loïc LOARER , Coordinator of the Quantum national strategy	05
Foreword by Guillaume AVRIN , National coordinator for artificial intelligence	06
Interview with Philippe LAVOCAT , CEO of GENCI	07
2024 as seen by GENCI's Shareholders	08
What they say about us	10
The computing centers	12

16.



2024 CHALLENGES A YEAR'S DIARY

A lookback at a year full of progress and breakthroughs.

Towards Exascale	18
Quantum research	24
Artificial Intelligence	26
High performance computing (HPC) sustainability	28

30. AT THE SERVICE OF SCIENTIFIC RESEARCH

How does GENCI work ?	32
Research community	37
Thematic committees scientific results	42
Community of large industrial groups	52

55. GENCI AND ITS ENVIRONMENT

The GENCI's regional ecosystem	56
The GENCI's European ecosystem	57
GENCI, a civil company	60




**MINISTÈRE
 DE L'ENSEIGNEMENT
 SUPÉRIEUR
 ET DE LA RECHERCHE**
*Liberté
 Égalité
 Fraternité*

Jean-Luc MOULLET,
 General Director for Research and Innovation

2024 was **another key year** for artificial intelligence and high-performance computing infrastructures in France, of which GENCI is a key player. French excellence in this field, which has been steadily strengthening in recent years, is illustrated more specifically by Jean Zay supercomputer hosted at CNRS-IDRIS. Jean Zay supercomputer has been progressively extended since it was commissioned in 2019 – the last extension was carried out in 2025 thanks to the support of France 2030, which enabled it to quadruple its computing power – making GENCI an undisputed leader in high-performance computing and artificial intelligence.

Artificial intelligence has also been in the spotlight at European level. 2024 saw **the launch of the EuroHPC AI Factory programme**, which aims to provide Europe with a cutting-edge computing infrastructure to meet the needs of artificial intelligence. I am delighted that the French project, led by GENCI, has been selected. It will be based on the performance of Jean Zay supercomputer, and on the future Alice Recoque exascale supercomputer to be installed in 2026 at CEA-TGCC. Through GENCI, France is playing a full

part in Europe's attractiveness in the field of artificial intelligence.

In this context of intensive development of HPC infrastructures, one of the major challenges we face is to succeed in acquiring the highest-performance digital resources while being as eco-responsible as possible. I would therefore like to highlight the efforts made in France, and more widely in Europe, to **improve the energy efficiency** of our computing infrastructures, efforts that have been recognised by the Green500 2024 ranking of supercomputers. Eight of the top 10 supercomputers are European, and 2 French supercomputers are in the top 3, including GENCI's Adastra supercomputer hosted at CINES.

More than ever, GENCI is therefore an essential infrastructure for ensuring French excellence in artificial intelligence and high-performance computing, providing research and innovation players with instruments of the highest technological level. This will continue to be the case in the coming years, starting with the forthcoming commissioning of Alice Recoque supercomputer, which will be Europe's second exaflop-class supercomputer, positioning France as a European leader in this field.

“
 Trough GENCI, France is playing a full part in Europe's attractiveness in the field of artificial intelligence.”




**PREMIER
 MINISTRE**
*Liberté
 Égalité
 Fraternité*
**Secrétariat général
 pour l'investissement**

Loïc LOARER,
 Coordinator of the Quantum national strategy

In a world where technological expertise is a major geopolitical issue, France and Europe have taken the strategic decision to place quantum technology at the heart of their future. The national quantum strategy, supported by the French government, **aims to guarantee our scientific, industrial and digital sovereignty**. GENCI, as a key actor, plays a fundamental role in this ambition.

In addition to its role as an operator of high-performance computing equipment, GENCI is actively involved in the dissemination of quantum technologies. Through conferences and the launch of **Quantum Houses**, GENCI facilitates meetings between researchers, manufacturers and local authorities, making these technologies accessible to all and accelerating their adoption.

In 2024, **GENCI reached an important milestone** by integrating quantum computers into its infrastructure, enabling French researchers to prepare for the coming technological revolution. This in-depth work aims to establish a national and European value chain by strengthening the quantum ecosystem.

Quantum computing is still in its early stages, but today's investments will ensure that France and Europe are among tomorrow world leaders. GENCI will continue to support this ambition, contributing to a technological revolution that will benefit society as a whole.

“
 Europe aims to be the big winner in quantum computing, the driving force of the next technological revolution.”



National strategy for artificial intelligence

Guillaume AVRIN,
Coordinator for Artificial Intelligence

The National Strategy for Artificial Intelligence (SNIA) has made the development of a high-performance computing infrastructure one of its top priorities. In this respect, **funding the extension of Jean Zay supercomputer** in 2024 with the latest generation chips is fully in line with our desire to strengthen France's and Europe's technological and scientific sovereignty. Brilliantly operated by GENCI, this cutting-edge facility provides our researchers and industry with the computing power essential for innovation in AI, positioning our country as a European leader in the field.

This momentum was also reflected at European level with the selection of the French project as the winner of the 'AI Factory' call associated with EuroHPC, underlining the effective mobilization of the national ecosystem. This collective commitment underlines our ability to respond to major technological challenges and attract the best projects to our country.

In addition, the refinancing of the network of CNRS engineers dedicated to the operational support of Jean Zay **represents a strong commitment to user support**, which is essential to take full advantage of the exceptional capabilities of this supercomputer. By supporting these high-level human resources, we are ensuring an optimal use of the infrastructure in the service of a responsible, sovereign and high-performance AI.

These advances illustrate our determination to build a robust ecosystem that will drive sustainable competitiveness for French research and industry in the strategic field of artificial intelligence.



Jean Zay, a unique computing infrastructure to strengthen French and European sovereignty in AI.



Philippe LAVOCAT,
CEO of GENCI

HOW COULD YOU SUMMARIZE THE YEAR 2024?

P. L.: The explosion of large language models (LLMs) in France, Europe, and worldwide now benefits from the new Jean Zay 4 supercomputer at IDRIS. These are exceptional resources provided by GENCI to the French AI scientific community. This was made possible through France 2030 funding, in response to the presidential announcement of May 2023.

At the European level, EuroHPC launched the "AI Factory" initiative, for which a French consortium—led by GENCI and supported by all our partners—has applied. Additionally, EuroHPC, France, and the Netherlands have initiated the procurement process for the "Alice Recoque" machine, which will be installed at TGCC by the end of 2026.

Finally, 2024 was also marked by the deployment of quantum computing systems under the HQL initiative, in which GENCI is a partner.

WHAT WAS THE MAIN CHALLENGE FOR GENCI IN 2024?

P. L.: The main challenge has been striking a balance between the explosive growth of GENCI's activities in AI and quantum computing, and maintaining a high level of service to satisfy the scientists

using our resources. This creates tension in terms of human resources, as it is the women and men on our support teams who are driving the triple revolution in HPC, AI, and quantum computing.

HOW COULD YOU DEFINE THE YEAR 2025?

- P. L.:** 2025 will be a crucial and key year for GENCI.
- Selection of the supplier for the "Alice Recoque" machine;
 - Increased utilization of Jean Zay 4 at IDRIS and ADAstra at CINES, especially for AI projects;
 - Addressing political ambitions in AI through France's participation in the European AI Factory program;
 - First results from quantum machines.

More broadly, we aim to continue addressing societal challenges through science and innovation during a period of geopolitical uncertainty. In this regard, GENCI will also remain highly attentive to the energy efficiency of its machines—reducing

consumption through hardware optimization and software usage, while always increasing efficiency—in line with the mission entrusted by the Ministry of Higher Education and Research to develop its greenhouse gas emissions report.



Addressing societal challenges through science and innovation in a time of uncertainty.



Foreword by our shareholders



Denis VEYNANTE,
Deputy director with
responsibility for digital
infrastructures within
the research open data
department



An exceptional budget made it possible to increase the power of the Jean Zay computer from 37 to 126 Pflops in 2024. The call for tenders, installation and commissioning were completed in a remarkably short timeframe. However, the center's electrical and refreshing capacities required the dismantling of more than half of the CPU partition, raising legitimate concerns among users. We warmly thank the teams at GENCI, IDRIS, CINES et

TGCC whose decisive action enabled the continuation of scientific projects without damage. The computational landscape is evolving rapidly today (European resources, large private or public-private computing centers, etc.) and requires us to reexamine our strategy. This context reinforces GENCI as a tool for dialogue and resource sharing, to best meet the needs of our scientific communities.



The growing importance of access requests to GENCI's computing resources for AI was confirmed in 2024, accounting for nearly 66% of GPU computing hours consumed. Requests from Inria's AI teams represented a significant share of these hours, amounting to approximately 11% in 2024. These figures demonstrate the vitality of a field that involves nearly two-thirds of the Institute's 230 teams.

Last year, we announced the launch of the NumPEX PEPR, co-led by Inria, CEA, and CNRS, dedicated to the design and development of software components for exascale machines and to preparing key scientific and industrial fields to fully exploit the capabilities of these systems. The program has now reached cruising speed and is beginning to deliver its first algorithms, software, and methods (see the NumPEX article in this report). Furthermore, NumPEX initiated the International Post-Exascale Workshop Series, InPEX, which brings to-

gether most of the European, American, and Japanese institutions heavily involved in the development of exascale and post-exascale computing. Experiences, strategic visions, and roadmaps have been shared during the three workshops organized since June 2023. All proceedings are available at inpx.science.

Finally, the year was marked by the launch of the AI Factory call for proposals in autumn 2024. Inria, as coordinator of the national AI research strategy, partnered with GENCI to submit a French response, in coordination with a broad research and industry ecosystem. Building on a unique European AI strategy (SNIA), the project team made the strategic decision to dedicate a significant portion of its efforts to funding a team of business developers, engineers, and experts—primarily from public research—to accelerate the structuring of the ecosystem and support academic, industrial, and public service users in leveraging the services it will offer.



Jean-Yves BERTHOU
Deputy Chief Executive
Officer for Site Policy



Olivier SIMONIN
Professor at Toulouse
INP-ENSEEIH



France Université welcomes the fact that GENCI's activities in 2024 have led to a significant strengthening of national capabilities in high-performance computing, artificial intelligence and related quantum technologies. The highlights for CINES include the delivery and commissioning of ADASTR machine and the completion of the Grands Challenges. In the summer of 2024, ADASTR benefited from the addition of an AMD MI300A partition, making the machine the third most eco-efficient in the world according to the Green500 ranking. Thanks to its powerful and energy-efficient computing infrastructure, CINES is a crucial re-

source for supporting the high computing level required for AI projects in healthcare, whether for medical image processing, modelling or big data analysis. EQUIPEX MesoNet, coordinated by GENCI, has launched a project to develop a distributed national research infrastructure (MesoCloud) deployed across 21 mesocentres to provide researchers with HPC/AI computing resources and training and support for users. This initiative aims to create a national high-performance computing network, integrated at European level, while serving regional research and education communities.

The year 2024 was marked by major initiatives and successes for GENCI, and by particularly dynamic momentum at the TGCC. The signing of the hosting agreement for the future Alice Recoque exascale super-computer represents a new phase in the national and European HPC strategy. The CEA has mobilised to support this transition by launching work to adapt the infrastructure and scientific codes to GPU-based architectures. Among these codes, Dyablo (IRFU) and Gysela-X (IRFM and Maison de la Simulation) stand out. Dyablo, in the fields of astrophysics and geophysics, enables simulations ranging from cosmology to the formation of planetary systems. Gysela-X, in the field of theoretical and plasma physics, focuses on the kinetic modeling of turbulence in magnetised plasmas. In parallel, TGCC completed the installation of a dedicated room for hosting quantum computers and, in 2024, welcomed a first 100-qubit system from Pasqal, with the goal of coupling it to Joliot-Curie. A second

quantum system is already planned for 2025. These developments illustrate CEA's commitment to supporting the scientific community in exploring new computing paradigms, and to reinforcing France's position in the European high-performance computing landscape. **The year 2024 has been marked by major initiatives and successes for GENCI, and by a particularly dynamic momentum at TGCC.** Among these codes, **Dyablo** (IRFU) and **Gysela-X** (IRFM and Maison de la Simulation) stand out. **Dyablo**, in the fields of astrophysics and geophysics, enables simulations ranging from cosmology to the formation of planetary systems. **Gysela-X**, in theoretical and plasma physics, focuses on the kinetic modeling of turbulence in magnetized plasmas. In parallel, **TGCC** completed the installation of a dedicated room for hosting quantum computers and, in 2024, welcomed a first **100-qubit system from Pasqal**, with the goal of coupling it to **Joliot-Curie**. A second quantum system is already planned for 2025.



Marie-Hélène MATHON,
Head of Research
infrastructures

What they say about us

IN THE PRESS/
ON THE WEB

Digital & Assurance

12/18/2024
Modeling of the risk in climate simulation, a unique collaboration between Descartes and GENCI



The power of technology serving next generation insurance? Discover how GENCI's supercomputers allowed Descartes Underwriting to build a unique knowledge on fire-related risks and become a pioneer company in covering topics related to forest fires.

A concrete use case that demonstrates how our parametric insurance gem stands out by designing innovative insurance solutions to address threats posing exponential challenges to the ecosystem.



04/02/2024
Jean Zay supercomputer: extension of its capacities toward "a new step in sovereign AI"

In late March 2024, CNRS and GENCI announced an upgrade to the Jean Zay supercomputer, increasing its peak computing power from 36.85 to 125.9 petaflops/s, making it one of the most powerful machines in France. The company Eviden was selected to carry out this expansion, which marks "a new milestone for sovereign AI" (see AEF info), with the new infrastructure becoming available in the summer. Technically, the upgrade multiplies available computing capacity by 3.5 in double precision for HPC, and by 13 in "reduced or mixed precision, as used in AI." This supercomputer is also among the most energy-efficient in Europe and provides heating for more than 1,000 homes in Saclay. The capacity expansion represents an investment of €40 million, supplemented by an additional €10 million from the PNRIA, with support from the Ministry of Higher Education and Research, the Ministry of the Economy, and the SGPI.



L'USINE NOUVELLE

06/10/2024
Toward the hybridization of HPC and quantum: a 100 qubits system from Pasqal coupled to the Joliot-Curie supercomputer



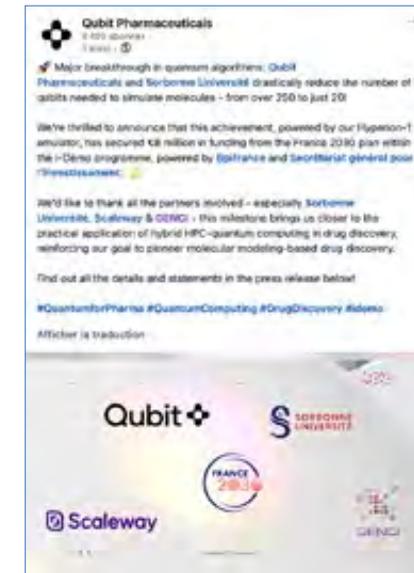
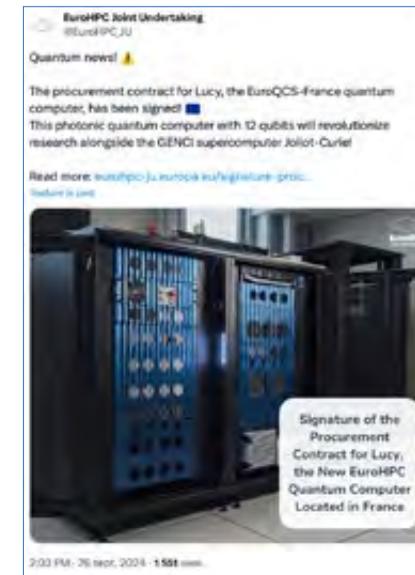
Expected since many months the quantum computer from Pasqal, acquired by GENCI, has come end of May at the TGCC computing center of CEA in the south of Paris. This system will be coupled to the Joliot-Curie supercomputer, offering to the researchers a possibility to really assess their algorithms, intrincating traditional HPC workloads with quantum computing in order to accelerate first industrial use cases.

Le Monde

04/22/2024
Quantum computing is stepping out of the shadows

Following the announcement of several technological breakthroughs in 2023, the global race for quantum computing has reignited. France is also in the race, with the announcement in early March of the launch of the Proqima project by the Directorate General of Armaments (DGA). This program aims to develop two quantum computer prototypes by 2032. Five French startups have been selected to participate.

On social media

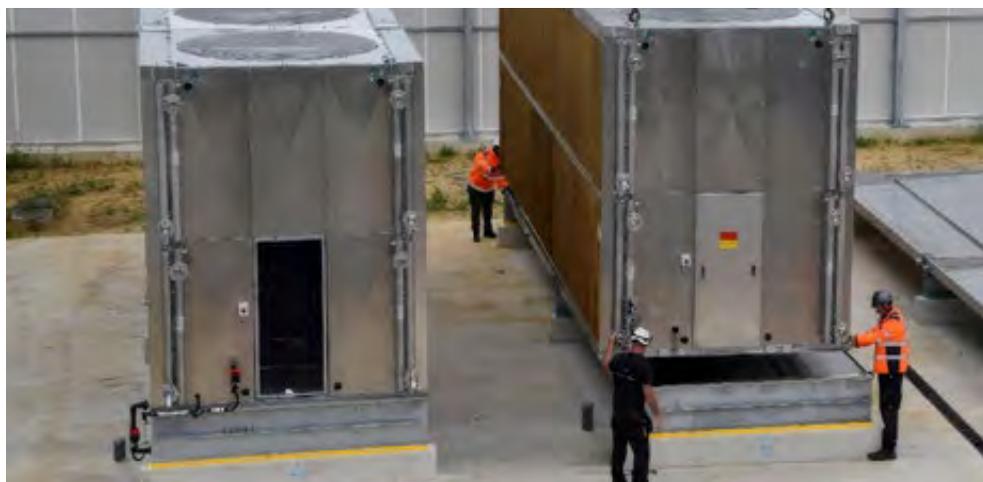


DISCOVER MORE GENCI'S NEWS

The computing centers in 2024

TGCC

Where the infinitely large meets the infinitely small



← Installation of the cooling towers for the Exascale project at TGCC.



Nicolas LARDJANE,
TGCC's manager
(CEA's center hosting the Joliot-Curies Supercomputer)

France is preparing a giant leap, with CEA and GENCI contributing to the commissioning of Alice Recoque from 2026 onward. Alice Recoque will be Europe's (EuroHPC) second exaflop supercomputer under EuroHPC and the keystone of the AI Factory France project. To power this exceptional machine, the TGCC's electrical capacity has been increased by 24MW and the cooling system redesigned with the installation of a dedicated warm water loop to maximize the system's energy efficiency. The engineering teams of CEA also oversaw the reinforcement of the concrete slab to support the unprecedented weight of the future compute cabinets. These major works, still ongoing at the time of writing, are being carried out in an operational context with minimal impact on the machines operating at TGCC.

The year 2024 was also marked by the delivery of Ruby to the TGCC as part of the national HQI initiative and the European HPCQS project. Ruby is the first quantum simulator from the Pasqal startup to be integrated into a computing center. It complements the emulators already in place and will be joined by other systems in 2025 and 2026. Ruby is a real physics experiment that will soon go into production. Ruby uses lasers to control rubidium atoms in order to solve complex optimization or physics problems. Its opening to users is planned mid-2025 and will enable the development of HPC-quantum coupling.

While the transition to tomorrow's systems is underway, the HPC resources currently in place are still very efficient, with a record production in 2024 for Joliot-Curie.

CINES - ADASTRA

Expansion, support for the scientific community, and collaborations



← View of the Daumas compute room with the ADASTRA supercomputer.



Michel ROBERT,
Head of CINES
(France Universités's center hosting the ADASTRA Supercomputer)

A year marked by strong momentum and a clear commitment to making the ADASTRA supercomputer ever more accessible, powerful, and aligned with scientific needs. From the very first half of the year, a dedicated organizational structure was put in place to facilitate the migration of DARI projects from IDRIS to CINES, following the decommissioning of the CPU partition on Jean-Zay.

This migration was supported by numerous initiatives: weekly training sessions, enhanced user support, expanded documentation, and the launch of a virtual assistant to help users get started with the environment.

In September, Adastra welcomed its first extension, inaugurated during CINES' 45th anniversary celebrations, boosting Adastra's computing power to 90 Pflop/s. Equipped with AMD's new Instinct MI300A processors, Adastra has become a powerful and efficient solution for the most demanding AI and HPC workloads, earning the **#3 spot on the Green500** list in November 2024.

The CINES teams played a key role in the **Adastra GPU Hackathons**, bringing together research lab teams supported by **six experts from HPE and AMD**. Finally, as part of its ongoing efforts to address energy challenges, CINES hosted the **CNRS Computing Group's event** titled "Energy, Infrastructure, and Computing: Striking the Right Balance?", gathering recognized national experts.

In 2024, CINES strengthened its collaborations to provide a high-performance environment for ADASTRA's HPC and AI workloads, while maintaining a strong focus on energy efficiency. In close partnership with research laboratories and actively present at major scientific events, CINES anticipates emerging scientific needs to ensure sustainable and responsible access.

The computing centers in 2024

IDRIS

A 4th extension answering to the acceleration of the needs of AI



↑ Pipes of the fatal heat reuse substation of Jean Zay.

The call of tender procedure for the fourth extension of the Jean Zay supercomputer, announced at VivaTech 2023 by the President of the Republic, concluded in mid-February 2024 with the selection of the solution proposed by the manufacturer Eviden. Since then, the IDRIS and Eviden teams have collaborated closely to adapt the technical infrastructure (reinforcement of the raised floor, extension of the hot water cooling and power supply networks) to accommodate this new partition. This includes 14 BullSequana XH3000 computing racks, integrating a total of 364 Intel Sapphire Rapids dual-processor nodes (48 cores, 512 GB of memory), each equipped with 4 NVIDIA H100 80 GB SXM5 GPUs, interconnected via 4 InfiniBand links at 400 Gb/s. This development represents a significant power gain of 100 PFlop/s and a 4-fold increase in Jean Zay's computing capacity. At the same time, the storage environment has been completely redesigned. It now consists of a first tier of 4.3 PB in flash technology, with read/write speeds greater than 1 TB/s, and a second tier of 39 PB in fast disks, offering more than 300 GB/s, both under Lustre and supplied by DDN.



Pierre-François LAVALÉE,
Director of IDRIS
(CNRS's center hosting the Jean Zay Supercomputer)



← Inaugural Day of the new H100 partition of Jean Zay (Jean Zay 4) with the participation of Hélène Mouchard Zay, the daughter of Jean Zay.

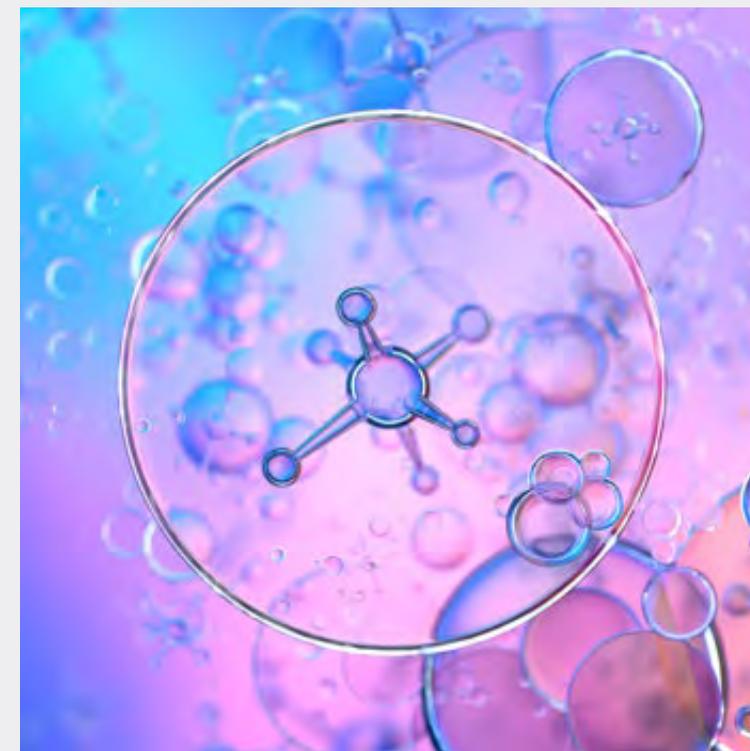
The production launch of this extension began in July 2024 with the opening to 13 selected "Grand Challenges" projects (3.7 million H100 GPU hours allocated), whose first scientific results will be presented shortly. Access has been extended to all DARI users since October 2024. This national infrastructure, essential for users dependent on extreme computing, is asserting itself every day as a strategic tool at the service of research, whose adoption and success continue to grow. Since its opening in mid-2019, its use has grown considerably, with the number of users tripling to reach 3,300 by the end of 2024, while the number of scientific projects supported has quadrupled to 1,600 - a great achievement for IDRIS and its teams.

The fourth extension was officially inaugurated on May 13, 2025, in the presence of 120 guests, including numerous officials and Jean Zay's daughter.



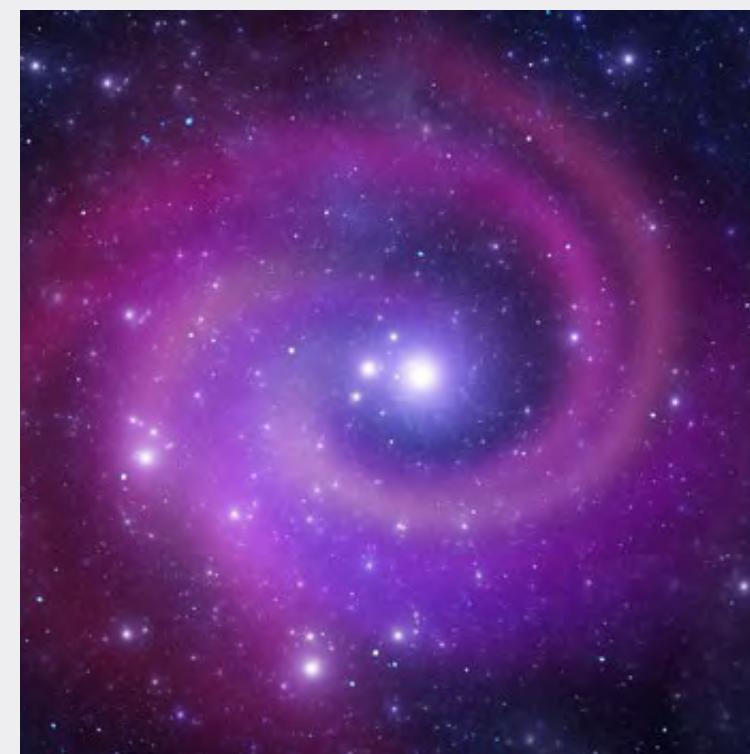
↑ View of the compute racks of the 4th extension of the Jean Zay supercomputer.

A year's diary



CONTENTS

- p.18** France is positioning itself in supercomputing in Europe
- p.20** An exploratory project to prepare for Exascale and Post-Exascale computing
- p.21** Sovereign cloud for public and private partners
- p.22** The power of MI300 APU serving science
- p.23** Jean Zay gets a refresh with H100 upgrades
- p.24** Delivery of Ruby (Pasqal) and Selection of Quandela for Lucy
- p.26** AI Factories, a new and unique offer of AI infrastructures and services in Europ
- p.28** Mastering the environmental footprint of HPC



Alice Recoque Supercomputer

France is positioning itself in supercomputing in Europe

In June 2024, EuroHPC and GENCI signed a hosting agreement for the installation and operation by the CEA of the Alice Recoque Exascale supercomputer. This machine will pave the way for new scientific discoveries and intensive computing and artificial intelligence services.

Following the official notification of the selection of the Jules Verne consortium in June 2023, EuroHPC, GENCI, and its partners in the consortium began discussions to formalize the project by signing a hosting agreement. This agreement was signed on June 18, 2024, enabling the actual launch of the project.

So, the procurement process for the Alice Recoque computer, led by EuroHPC, was launched in early September with technical support from GENCI and the CEA, which drafted the technical specifications. The main characteristics of the computer will aim to meet the strategic orientation of EuroHPC and the consortium members to

deploy modular, energy-efficient, and balanced HPC architectures, bringing together computing (scalar and closely coupled accelerated resources), network, and storage resources.

INCREASED USAGES

This computer will meet the new needs of the various scientific and industrial communities that will use the Alice Recoque computer. Standard uses of high-performance computing are now amplified by artificial intelligence (AI), either autonomously or coupled with numerical simulation workloads.

These communities range from climate research, energy science, biology and health, astrophysics and particle physics to emerging fields such as smart networks and cities, transportation and new forms of mobility, and agriculture 4.0.

GENCI has also been working with representatives of EuroHPC member countries, French public research organizations, and French industrials to encourage them to join the Jules

Verne consortium. Two research organizations and one industrial have informed us of their intention to join the consortium.

energy efficiency, reinforcement of the concrete slab) to enable the Alice Recoque computer to be hosted there. The Alice Recoque supercomputer will be made available to European researchers mainly for open research and to researchers from Jules Verne consortium members from the end of 2026 for a period of five years.

↓
Signing of the hosting agreement.



DISCOVER ALL THE NEWS OF GENCI



“ Alice Recoque will allow to answer to the stakes of the convergence between numerical simulation, artificial intelligence and hybrid quantum computing.

Corinne BEAL,
Exascale Project Manager at GENCI



CREATION OF AN APPLICATION SUPPORT TEAM

Beyond the machine itself, the Jules Verne consortium will provide support to European researchers for porting and optimizing their applications, as well as training. This support team will be set up before the machine arrives so that the scientific communities can prepare for it.

AIM FOR LATE 2026

Major work is currently underway at the CEA's *Très Grand Centre de Calcul* (increased electrical capacity, modification of the cooling system to improve

→
The TGCC computing center that will host and operate Alice Recoque.



↑
Alice Recoque, a pionnier researcher in computer science and AI.

WHO IS ALICE RECOQUE?

Alice Recoque is a French computer scientist and pioneer in artificial intelligence. Born in Algeria in 1929, she graduated from the *École Supérieure de Physique et de Chimie Industrielle* (ESPCI) in 1954 and, after specializing in computing architectures, particularly massively parallel computers, she worked on the design of the first minicomputers. In the 1980s, Alice Recoque became the strategic leader in AI for the Bull Group and was one of the first French scientists in the field of AI research.

NumPEX

An exploratory project to prepare for Exascale and Post-Exascale computing

Launched in 2023 for a six-year term, the NumPEX Priority Research Program and Equipment (PEPR) aims to contribute to the design and development of numerical methods and software components for future European Exascale and post-Exascale machines. NumPEX also seeks to support scientific and industrial applications in fully harnessing their potential.

In 2024, NumPEX was particularly active in preparing for the future of Exascale and post-Exascale computing. **A call for projects was launched, focusing on three key areas:**

- 1 • Emerging methods, algorithms, and software in AI for scientific computing and HPC for AI,
- 2 • Programming models tailored to accelerated architectures,
- 3 • Workflows for scientific data analysis, notably in collaboration with the SKA project.

With a budget of €4 million, the initiative aims to select 1 to 2 projects in early 2025.

The InPEX initiative, led by NumPEX, aims to accelerate the integration of AI and HPC/HPDA at an international scale, with a focus on the post-Exascale era. In 2024, **a workshop in Sitges (Spain) brought together nearly 100 European, American, and Japanese experts** to address key themes: software production, co-development, digital continuum, and AI for scientific computing.

SHAPING TOMORROW

The initiative will continue in 2025 with a new workshop in Kanagawa (Japan), focusing on HPC-AI coupling and—

convergence of technologies and generative AI, with the aim of strengthening international scientific collaborations. Finally, **NumPEX participated in the tender for Europe's future Exascale machine**, which will be installed at CEA/TGCC (France) by the end of 2026. Through the 'Synergies between NumPEX and HPC Centers' working group, the goal is to prepare for this deployment by ensuring consistency in usage, software development, and technological rollout. Multiple discussions with TGCC have addressed key challenges such as continuous integration, performance, software deployment, and energy efficiency. These efforts will continue in 2025 to ensure the sustainability and strategic alignment of NumPEX initiatives with the French Exascale ecosystem.



← Photo taken at the InPEX International Forum, co-organized by NumPEX in Sitges, Spain.



MORE ABOUT NUMPEX

CLUSSTER Project

Sovereign cloud for public and private partners



In the field of the Cloud national strategy the CLUSSTER project aims to setup a sovereign Cloud of AI infrastructures and services between public and private actors.

The CLUSSTER project (Cloud Unifié Souverain de Services, de Technologies et d'infrastructures) was launched on February 1, 2023, for a period of three years. Based on a public/private partnership, it aims to develop and strengthen a sovereign French and European cloud sector and to create a single point of entry for the academic and industrial community to a set of infrastructures and services. It is part of the CLOUD acceleration strategy of the Directorate-General for Enterprise (PIA4) and is funded by BPI France.

In 2024, the Technical Architecture file was finalized, enabling in particular the definition of interfaces with high-performance computing infrastructures and identity and access management. An instance of the CLUSSTER portal was deployed and has been accessible to partners since January.

GENCI, together with CNRS-IDRIS, worked on the specifications for the mini supercomputer called DALIA, which will be installed in a non-ZRR (Restricted Zone) area, and on the implementation of a first system, pending its deployment.

IN PRODUCTION IN 2025

The procurement procedure was rescheduled due to the installation at IDRIS in the first half of 2024 of an extension of Jean Zay announced by the President de la République at Vivatech 2023. The DALIA computer was purchased at the end of 2024 and will go into production in spring 2025. DALIA

will be made available to the CLUSSTER project immediately offering both training and model inference capabilities, as well as large-scale training proposals (via the MESONET portal coupled with CLUSSTER).

DALIA will consist of 72 new-generation nVIDIA GPUs called Blackwell, which offer 2.5 times the performance for model training tasks and almost 30 times the performance for inference tasks thanks to the introduction of new 4-bit floating point operators (FP4). This GPU perfectly complements the GPUs already available on Jean Zay (V100, A100, and H100).



← the DALIA supercomputer at IDRIS.



MORE ABOUT CLUSSTER

ADASTRA - CINES

The power of MI300 APU serving science

In summer 2024, CINES reached a new milestone in high-performance computing with the expansion of the ADASTRA system, now equipped with AMD MI300 accelerators. Its 112 APUs will offer a CPU/GPU unified architecture allowing to get rid from explicit memory transfers between CPU and GPU for an easier use of the researchers.

The integration of AMD MI300 accelerators into the ADASTRA supercomputer, supplied by HPE (EX4000), has added over 13 Pflops to the existing 78 Pflops already in production. These latest-generation AMD processors, designed for HPC and AI, introduce three major innovations:

- Hybrid architecture: Combines CPU and GPU cores to handle complex simulations and simplify programming.
- Energy efficiency: 30% reduction in power consumption thanks to 5 nm process technology.
- Unified memory: 128 GB of HBM3 per APU, enabling accelerated processing of massive datasets at over 5 TB/s bandwidth.

A TOP-3 ECO-EFFICIENT MACHINE

As usual when a new partition is deployed, several Grand Challenges were undertaken, including one that configured and trained an efficient multilingual language model with 3 billion parameters (SLM), featuring a new architecture optimized solely for encoders. A new dynamic is emerging at CINES, with 2 to 3 AI-related projects launched every week.

Ranked as the 3rd most eco-efficient supercomputer in the world (Green500) at 69 Gflops/W, ADASTRA has been serving AI and numerical simulation projects since September 2024. To optimize overall energy consumption, this new partition—like the first MI250-

based partition—uses direct liquid cooling with warm water and no fans, enabling it to dissipate 97% of the generated heat.

Initial feedback indicates that the AMD MI300A APU performs slightly below the Nvidia H100, but it offers 40% more memory (128 GB vs. 80 GB on Jean Zay's H100) and superior memory bandwidth, which is crucial for training large models. More broadly, this gap is also due to the fact that AMD's software stack still needs to mature. AMD is currently investing heavily in both software and hardware to close this gap.

The MI300A also delivers excellent performance-per-watt efficiency at an acquisition cost roughly half that of its competitors. Additionally, the APU architecture is a key factor in facilitating the migration of codes toward more energy-efficient technologies. The unified memory between the scalar and accelerated components eliminates the need for codes to manage data locality.



← ADASTRA is ranked 3rd world most energy efficient supercomputers (Green500).

- Additional Description: **APU-accelerated partition**
- Peak Performance (PFlops): **13.7**
- Number of Nodes: **28**
- Accelerator Type: **AMD MI300A**
- Accelerator Frequency (GHz): **2.1**
- Accelerator Memory Type: **HBM3**
- Memory per Accelerator (GB): **128**
- Accelerators per Node: **4**
- Accelerator Memory per Node (GB): **512**
- Total Accelerator Memory (TB): **14**
- Total Number of Accelerators: **112**
- Interconnect Network: **Slingshot-11 200**

JEAN ZAY - IDRIS

Jean Zay gets a refresh with H100 upgrades

In 2024 the Jean Zay supercomputer operated by CNRS received a major extension thanks to a France 2030 funding. The integration of powerful NVIDIA H100 GPUs powered its capacities especially for AI, making Jean Zay a key asset for the French research facing many computational skates and the strong rise of foundational models.

The year 2024 marked a significant milestone for French high-performance computing with the successful deployment of the Jean Zay supercomputer extension at IDRIS. Strategically supported by the France 2030 plan with a €40 million investment, this upgrade aims to strengthen France's position in numerical simulation, high-performance computing (HPC), and—above all—artificial intelligence (AI). Acquired in 2019, Jean Zay had already established itself with its hybrid CPU/GPU architecture, particularly effective for AI and large-scale data processing. Facing the rapid growth of next-generation AI demands, this fourth

extension—designed by Eviden—integrates 14 BullSequana XH3000 racks equipped with 1,456 NVIDIA H100 GPUs (80 GB each). This expansion boosts peak performance to 125.9 PFlop/s, multiplying HPC capabilities by 3.5 and AI computing power by up to 13.

UNPRECEDENTED POWER IN FRANCE

The core objective of this H100 extension is to provide researchers and industry with a sovereign tool of unprecedented power in France for training large-scale AI models (foundation models, generative AI). This opens new avenues for exploring complex challenges in natural language processing, computer vision, medicine, climatology, and physics.

A significant portion of these new H100 resources is allocated strategically, separate from standard allocations, prioritizing academic excellence and industrial collaborations aligned with France 2030's national AI strategy. The goal is to develop sovereign technologies and accelerate the French AI ecosystem, including AI clusters. Access is open to both academic and industrial players to drive R&D and technology transfer.

Beyond raw computing power, the extension is supported by a high-performance storage infrastructure, essential for efficiently managing the massive datasets required by AI.

IDRIS plays a central role in hosting, operating, and supporting Jean Zay. Its teams are fully engaged in hardware/software integration and user support through training and workshops to maximize the use of these new capabilities.

Jean Zay also stands out for its eco-efficient approach. Intensive GPU usage and a warm-water cooling system continue to recover waste heat, which is reused to heat buildings on the Saclay campus, aligning with energy sobriety goals.

2024 represents a major transformation for Jean Zay with the H100 upgrade. This evolution equips France with a world-class infrastructure, enhancing its ability to tackle future scientific and technological challenges and positioning the supercomputer among Europe's most powerful and versatile machines for open science and innovation.

- Peak Performance (PFlops): **99.9**
- Number of Nodes: **364**
- Processor Type: **Intel Sapphire Rapids**
- Frequency: **2.1 GHz with 48 cores per processor**
- Memory Type: **DDR5-4800**
- Processors per Node: **2**
- Memory per Node (GB): **512**
- Accelerator Type: **Nvidia H100 SXM5 with 80 GB HBM3**
- Accelerators per Node: **4**
- Total Number of Cores: **34,944**
- Total Number of Accelerators: **1,456**

FIRST QPUS ARRIVE ON THE HQI PLATFORM

Delivery of Ruby (Pasqal) and selection of Quandela for Lucy

In 2024, GENCI saw the emergence of several key projects within the HQI program, including the acquisition of Lucy, the installation of Ruby, and the selection of the EuroSSQ-HPC consortium by the EuroHPC Joint Undertaking. This year also provided an opportunity to take stock of the uses and applications of these technologies.

In 2024, GENCI actively advanced the acquisition of quantum systems. Through participation in a consortium with SURF—selected by EuroHPC—users will gain access to a quantum computer based on spin qubits hosted in the Netherlands. Beyond the installation of Ruby (100+ neutral-atom qubits), the acquisition of Lucy (12 photon-based qubits, controlled and interacting with single photons) was finalized via EuroHPC. Installed at CEA's TGCC, Lucy will provide users with access to the first universal digital quantum computer under the HQI initiative.

→ The Quandela photonic quantum computer.



SELECTION OF FIVE "MAISONS DU QUANTIQUE" LABELED PROJECTS

Inspired by the Dutch Quantum Delta model, the Maisons du Quantique initiative aims to bring together local ecosystems of hybrid quantum computing stakeholders—uniting industrial and academic talent across France.

Five projects were selected in the regions of Grand Est, Auvergne-Rhône-Alpes, Aquitaine, Occitanie, and Île-de-France. These projects focus on identifying flagship locations to promote training and dissemination of hybrid quantum computing knowledge.

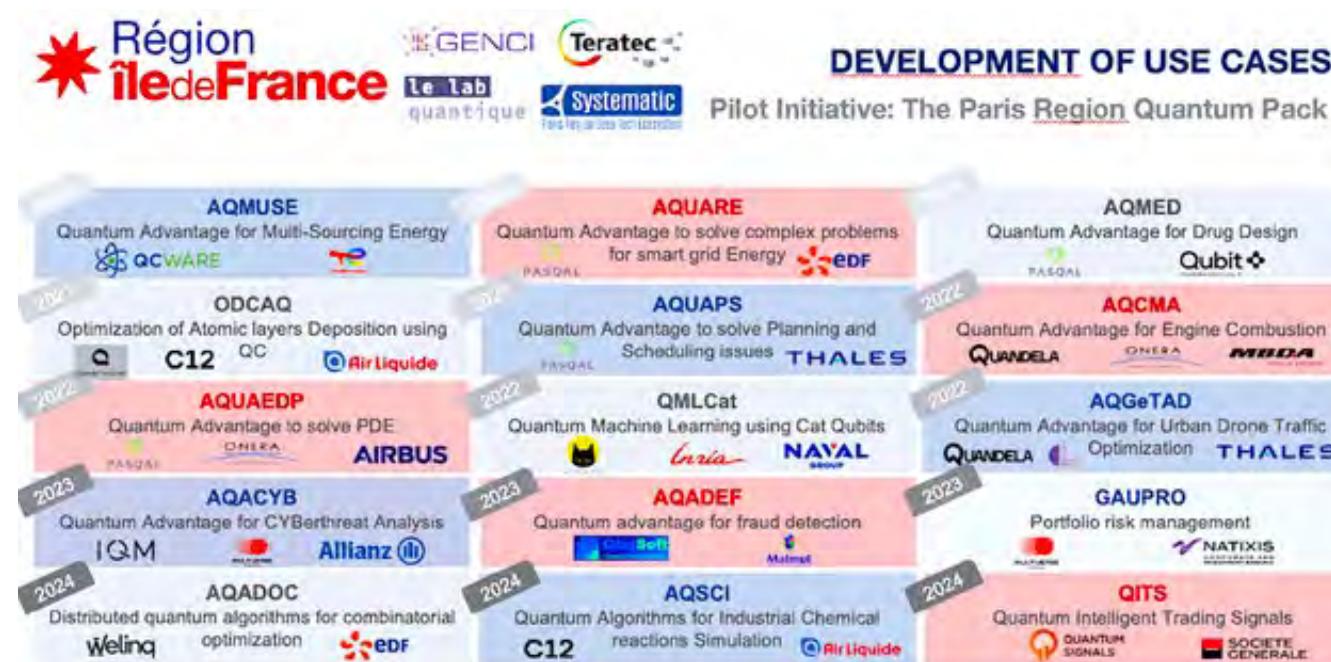
Their mission also includes fostering academic-industrial collaborations to develop use cases. The network is coordinated nationally to ensure maximum territorial coverage and impact.

Focus on:

THE PROJECT PRESENTATION DAY OF THE PACK QUANTIQUE ÎLE-DE-FRANCE

Since 2020, GENCI has been supporting candidates for the co-financing of the Pack Quantique program from the Île-de-France Region in submitting their projects. Four years and 12 projects later, it was time to assess the results of these early explorations into hybrid quantum computing applied to industrial use cases. On April 24, 2024, at EDF's headquarters in Palaiseau, Teratec, the Systematic Cluster, the Lab Quantique, and GENCI organized a project presentation day for the Pack Quantique.

MORE ABOUT THE PACK QUANTIQUE



INCREASED VISIBILITY FOR THE HQI PROGRAM AT VIVATECH 2024

The 2024 edition of VivaTech was a major success for the HQI Quantum Village. Over four days, 12 French and European quantum technology startups showcased their innovations. The village welcomed high-profile visitors, including Sylvie Retailleau (Minister of Higher Education and Research), Bruno Bonnell (SGPI), Emmanuel Chiva (DGA), Patrick Aufort (AID), and Amandine Reix

(DGE). Major companies such as EDF, Société Générale, LVMH, and L'Oréal included the Quantum Village in their VIP tours.

A series of panel discussions covered topics such as the intersection of AI and quantum computing, the role of public authorities, ecosystem funding, and the place of women in the industry, rounding out a packed program for the week.

The Pack Quantique is truly a catalyst for the use of the HQI platform.

Jacques-Charles LAFOUCRIÈRE (CEA) HQI program coordinator

AI FACTORY

AI Factories, a new and unique offer of AI infrastructures and services in Europe

As part of the “AI Innovation Package” launched by the Commission in early 2024 to foster the use by startups and SMEs of artificial intelligence (AI), and following the publication of the Draghi report “The Future of European Competitiveness” calling for a strengthening of European capabilities in AI, the European Commission tasked EuroHPC in mid-2024 with setting up a network of AI Factories in Europe.

AI Factories aim to address the triple challenge of AI: computing, data, and skills by setting up a unique service offering (known as a “one-stop-shop”) combining both computing resources optimized for AI and, above all, high value-added services such as training, expertise/support, and access to data sources, tools, and models for industry, research, and public services.

To this end, in October 2024, EuroHPC launched a call for projects to select, in two to three phases, a group of around 15 AI Factories in Europe. A first wave of seven AI Factories was announced by EuroHPC at the end of 2024 in Germany, Spain, Finland, Greece, Italy, Luxembourg, and Sweden, with the aim of strengthening EuroHPC’s computing capabilities and developing AI in vertical sectors such as healthcare, manufacturing, culture, earth sciences, energy, and finance.

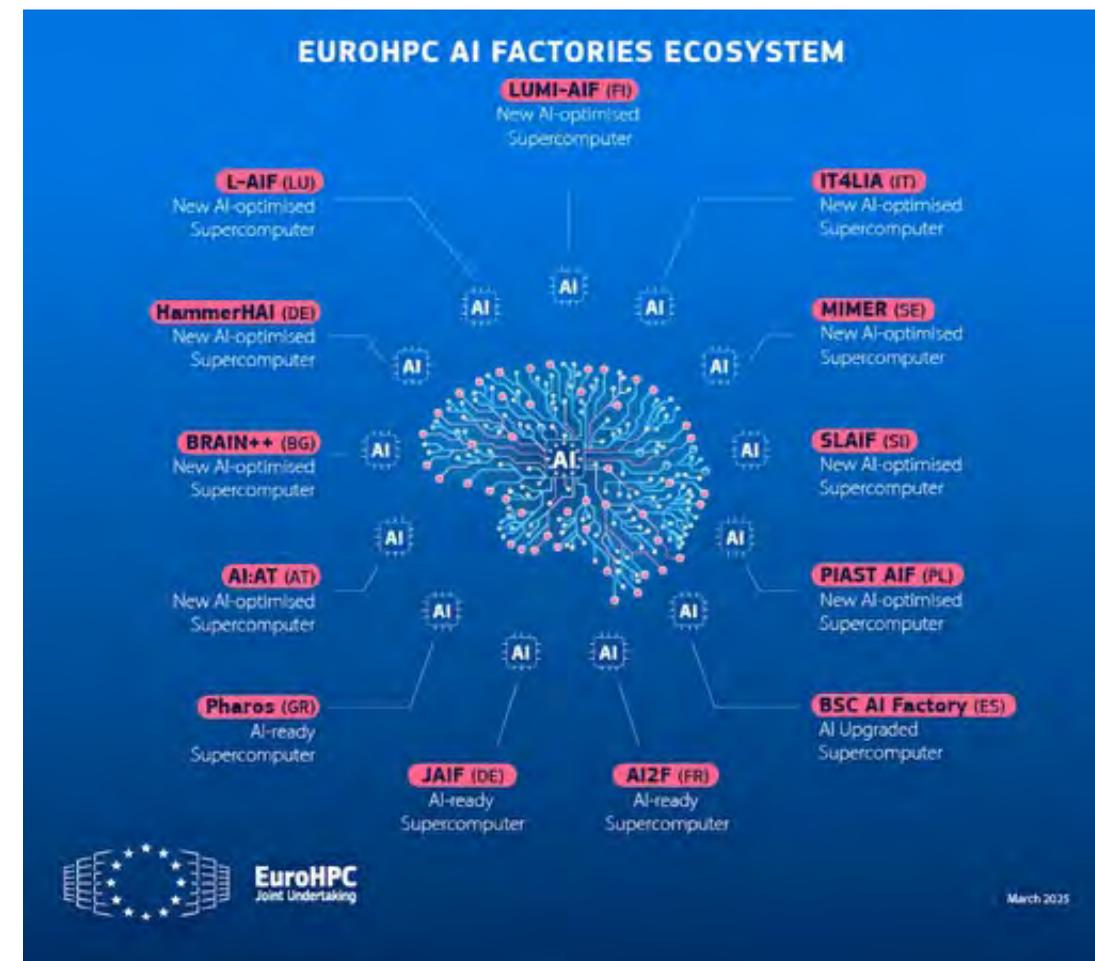
→ Group family photo of 13 AI Factories during the EuroHPC Summit 2025 conference in Krakow.



START IN AUTUMN 2025

In March 2025, as part of the second phase, the “AI Factory France” project led by GENCI and involving a broad public/private partnership with AMIAD, CEA, CINES, CNRS, 10 universities (Grenoble-Alpes, Institut Polytechnique de Paris, Nice Côte d’Azur,

Paris-Saclay, Paris Sciences Lettres, Reims Champagne-Ardenne, Rennes, Sorbonne Université, Toulouse, Universités de Lorraine, and Strasbourg), as well as French Tech, Station-F, and HubFrance IA, was selected by EuroHPC. With a budget of €30 million over three years, AI Factory France



MORE ABOUT AI FACTORY

↑ Network of 13 AI Factories selected mid 2025 by EuroHPC.



The AI Factory France project is organized around a unique partnership of research organisations and innovation leaders serving the use of AI for industry, research and public services.

Stéphane REQUENA,
GENCI’s CTO and Innovation Manager



is relying on the national #AIForHumanity strategy, which includes training from the nine AI Clusters, as well as computing resources provided

by GENCI, Jean Zay (IDRIS), Adas-tra (CINES), Joliot Curie (TGCC) and, soon, the EuroHPC Alice Recoque Exascale machine (TGCC), and finally the support and expertise provided by all partners. In a strengthened public/private partnership, AI Factory France will address the needs of industry, research, and public services, particularly within 13 vertical sectors (energy, aerospace, health, defense and cybersecurity, earth sciences, digital continuum, materials science, robotics, agriculture, finance, AI for education (edtech), mobility, and human sciences), illustrating the richness of the French AI ecosystem. The IA Factory France project will begin in the fall of 2025.

Sustainable High Performance Computing

Mastering the environmental footprint of HPC

Between 2012 and 2025, the computational efficiency relative to energy consumption has increased by a factor of 20. Concurrently, the power required to operate the most advanced HPC systems has risen from approximately 8 MW to around 30 MW (source: *Top500.org*). Such consumption levels require responsible management.

Since the 1940s, High Performance Computing (HPC) has established itself as the third pillar of research, alongside theory and experimentation. Today, it serves as an indispensable path across all scientific domains. Since 2022, the most powerful systems have entered the Exascale era, capable of performing over a quintillion (10^{18}) calculations per second, accompanied by a significant increase in energy demand for these configurations.

SEVERAL APPROCHES CONSIDERED

The environmental footprint of HPC is shaped by multiple factors—hosting infrastructure, integration and cooling solutions, technology and architecture choices, hardware lifespan, and computational code efficiency—requiring a systemic approach to optimization. Consequently, GENCI and the national computing centers have undertaken to study and implement several strategies:

- **Reduction of PUE (Power Usage Efficiency)**, the ratio of total energy

consumed by the operating center (including cooling) to that used by the computing systems, has reached its optimal level (closest to 1) with the widespread adoption of DLC (Direct Liquid Cooling) without the need for additional cooling production: all GENCI calculators have embraced this technology.

Because the criteria defining the environmental footprint are multiples, GENCI and the computing centers are applying several approaches.



Reuse of the fatal heat of Jean Zay to contribute to the heating of more than 1500 houses on the Paris-Saclay area.

Focus on: METRICS SPECIFICALLY TAILORED TO HPC

In partnership with Labos 1point5 (labos1point5.org), a collective from the academic world dedicated to studying and reducing the carbon footprint of technologies, GENCI has developed metrics specifically tailored to HPC. Users of GENCI's machines can thus quantify the energy envelope of their numerical simulations and the associated emissions, enabling a precise assessment of environmental impact—an essential foundation for decision-making and optimization. This collaboration exemplifies a proactive strategy in service of sustainable science.

- **Recovery of waste heat** at IDRIS.
- **Adoption of energy efficiency criteria** for selecting calculators: the EtS (Energy to Solution) metric takes precedence.
- **Adjustment of hardware lifespan** to strike the best balance.
- **Strengthening of support teams** at computing centers for the transition to Exascale (via "Application Support Teams") to address the accelerating pace of technological renewals by providing assistance in porting and optimizing codes to fully leverage these advancements.
- **Photonic technology.**
- **Specialized architectures** (memory on chip).
- **Quantum computing**, integrated into a hybrid approach with HPC.
- **Breakthrough algorithmic approaches** (low-rank matrices, mixed precision).

PROSPECTS FOR ENHANCED ENERGY PERFORMANCE

This systemic approach is also central to future developments. Within the framework of the CVT (*Cellule de Veille Technologique*), GENCI supports and monitors:

- **Cooling techniques** (immersion, phase-change liquids).



The selection of calculators during GENCI's tender processes is guided by a commitment to the lowest possible "Energy to Solution" metric.

Eric BOYER, Project Officer HPC/HPDA/IA at GENCI



At the service of scientific research



CONTENTS

p.32 A full range of services	p.36 Grands Challenges at CINES, IDRIS and TGCC	p.38 Forewords by the chairs of the thematic committees (CT)
p.34 Access terms and conditions to national resources	p.37 Foreword by the Chair of GENCI's Assessment Committee	p.42 Research results
p.35 Computing infrastructure available resources in 2024		p.52 Community of large industrial groups

HOW DOES GENCI WORK?

Today SUPERCOMPUTERS

A full range of services

Supercomputer

ADAstra



HPE Cray EX4000 of 91,60 Pflop/s
 Scalar and converged architecture, composed of 3 main partitions
 Scalar nodes: 3,9 Pflop/s – AMD GENOA: 544 nodes – 104 448 cores
 Converged nodes: 87,7 Pflop/s
 • AMD MI250X – 74 Pflop/s – 1424 GPUs
 • AMD MI300A (APU) – 13,7 Pflop/s – 112 GPUs

Supercomputer

JOLIOT CURIE/IRENE



Bull Sequana X1000/XH2000 of 20,00 Pflop/s
 Multiple partitions offer a wide variety of processors
 Scalar nodes: 18,9 Pflop/s
 • ROME: AMD – 2292 nodes – More than 293000 cores
 • SKL: INTEL – 1656 nodes – More than 79000 cores
 Converged nodes : 1,1 Pflop/s – V100 – 32v GPUs

Supercomputer

JEAN ZAY



HPE / ATOS SGI 8600 / XH3000 of 125,90 Pflop/s
 Scalar and converged architecture, composed of 4 main partitions
 Scalar nodes: 2,3 Pflop/s – CSL: 720 nodes – 28 800 cores
 Converged nodes: 121 Pflop/s
 • NVIDIA V100 – 15,5 Pflops/s – 1832 GPUs
 • NVIDIA A100 – 8,2 Pflop/s – 416 GPUs

Supercomputer

JEAN ZAY 4



The new partition of Jean Zay
 99,9 Pflop/s, 1456 GPUs
 NVIDIA H100

Available Soon

RUBY QUANTUM



A 100 qubit analogue quantum computer based on neutral atoms provided by Pasqal (HPCQCS)

LUCY QUANTUM



A 12 qubit digital quantum computer based on photonics provided by Quandela (EuroQCS-France)

SUPERCOMPUTER ALICE RECOQUE

The 2nd EuroHPC Exascale system for addressing HPC and AI (AI Factory) at TGCC end of 2026

DALIA HPC GPU IA



An NVIDIA NVL72 supercomputer for addressing new needs in AI (large scale training, inference, new services)

PROJECTS

AI FACTORY FRANCE AI2F

A federated one-stop-shop of infrastructures and services for the AI community

EPICURE & MINERVA

A panEuropean task force for User support in HPC and AI

EPI2/ EUPEX

Developpement of EU microprocessor technologies

EUROQHPC INTEGRATION

A joint project between the 6 EuroHPC QC Hosting Entities toward HPC and QC integration

CLUSSTER

Implementing a sovereign public/private Cloud of infrastructures and services

- HARDWARE AND SOFTWARE TECHNOLOGICAL WATCH
- ACCESS TO HPC AND HYBRID HPC/QUANTUM COMPUTING SYSTEMS FOR OPEN RESEARCH
- ACCESS TO STORAGE CAPACITIES (FROM FLASH TO LONG TERM STORAGE USING MAGNETIC TAPES)
- USER SUPPORT
- TRAINING
- DISSEMINATION OF SCIENTIFIC RESULTS



HOW DOES GENCI WORK?

Access terms and conditions to national resources

The national HPC facilities composed today by scalar and accelerated compute partitions will soon welcome hybrid quantum partitions, available for open research for academia, industry including startups.

National computing and storage resources are made available free of charge for one year for scientific projects in high-performance computing and Artificial Intelligence (AI), originating from academic institutions with an RNSR number and industrial entities with a SIRET number. To be eligible, open research work must result in a publication at the end of the allocation period. Two steps are required: first, request and obtain resources on one or more supercomputers, then request an account on the selected supercomputers for which users have been granted resources.

Both requests must be submitted through the portal www.edari.fr, which is shared by the three national computing centers (CINES, IDRIS, and TGCC). Across all access types, 14% of applications in 2024 came from industry, including 9% submitted directly by private entities such as startups.

REGULAR AND DYNAMIC

In 2024, two types of resource requests were available depending on users' needs: Regular Allocations and Dynamic Allocations.

The first type is open twice a year to project leaders who require large compu-

ting resources: more than 50 million CPU core-hours or 50,000 GPU hours. These requests require a peer reviewed evaluation including a scientific and a technical assessment before being granted.

The second type, dynamic allocations, which are easier to obtain, are available throughout the year and are intended for projects with lower computing-hour requirements. This type of access was chosen by 78% of project leaders across all scientific fields. Three-quarters of these dynamic allocations concern AI research projects or projects using AI. They are also accessible to PhD candidates and Master's (M2) students, whereas regular allocations are strictly reserved for permanent staff in research institutions (faculty, researchers, engineers, post-doctoral fellows).

These resource request files will be supplemented with your publications. The entire resource allocation process managed by GENCI is still certified ISO9001.



EXPLORE THE ACCESS TERMS INFOGRAPHIC

AVAILABLE INFORMATION

All information on the opening dates of the Regular Allocation campaigns is available on the portal www.edari.fr. Access conditions, user guides, and current news are also available there.

For academic researchers, you can now log in via Renater's identity federation to access your user space and benefit from the digitalization of validation procedures for requests in most cases.

For everyone, you will also find all the essential actions for your project (monitoring all your requests: additional hours, usage, account management, adding collaborators, etc.), as well as information on the financial cost in euros and the carbon footprint in CO₂ equivalent represented by the resources requested and allocated to the project. These indicators are provided for reference on the DARI site, also accessible from your user space.

Computing infrastructure available resources in 2024

90% of GENCI calculation capacities (in PFlop/s) are provided by GPU accelerators. All GENCI calculators are accompanied by partitions for pre/post processing and visualization freely accessible to supercomputer users.

Supercomputer **Cray EX4000**

ADASTRA



The CINES hosts an HPE supercomputer with a performance of 91.6 PFlop/s, featuring a scalar partition of 544 nodes equipped with AMD EPYC Genoa processors totaling 104,448 cores, and two converged partitions: one with 356 nodes equipped with AMD MI250 GPUs for a total of 1,424 GPUs, and another with 28 nodes equipped with AMD MI300 GPUs totaling 112 GPUs called APUs (CPU + GPUs).



DISCOVER DETAILS OF CALCULATORS ON WWW.EDARI.FR

Supercomputer **Sequana X1000/XH2000**

JOLIOT-CURIE



The TGCC hosts a supercomputer from Atos with a peak performance of 20 PFlop/s, composed of three production partitions, including two scalar partitions. The first scalar partition consists of 2,292 AMD Rome nodes, providing 12.2 PFlop/s and 293,376 cores. The second scalar partition, which was missing from the English translation, consists of 1,656 Intel nodes based on Skylake processors, delivering 6.9 PFlop/s and 79,488 cores. A third accelerated partition includes 32 Nvidia V100-based nodes, providing 1.2 PFlop/s and 128 GPUs. In addition, there are two prototype partitions: • The first is composed of 80 nodes equipped with an ARM v8.2A processor with 40 cores each, for a total of 3,648 cores and 0.3 PFlop/s, designed to prepare codes for the transition to the European exascale machine. • The second is an Atos QLM, intended for quantum environments and emulation, serving as a frontend for the simulator and future quantum machine.

Supercomputer **SGI 8600 + ATOS XH3000**

JEAN ZAY



IDRIS hosts a supercomputer assembled by two manufacturers (HPE and Eviden), with a peak performance of 125.9 PFlop/s, consisting of one scalar partition and three converged partitions. The scalar partition includes 720 Intel Cascade Lake nodes, providing 2.5 PFlop/s and 28,800 cores. One accelerated partition delivers 15.5 PFlop/s and is composed of 437 nodes equipped with Nvidia V100 GPUs (16/32 GB), totaling 1,832 GPUs. Another accelerated partition provides 8.2 PFlop/s with 52 nodes equipped with Nvidia A100 GPUs (80 GB), totaling 416 GPUs. The final accelerated partition delivers 99.9 PFlop/s and consists of 364 nodes equipped with Nvidia H100 GPUs (80 GB), totaling 1,456 GPUs.

AT THE SERVICE OF SCIENTIFIC RESEARCH



Grands Challenges at CINES, IDRIS and TGCC

Commissioning a new machine begins with a phase dedicated to verifying its stability. Access to significant computing capacity is then restricted to a few users, who in return agree to the usage conditions of a machine that is still in its 'burn-in' period.



↑ Couvertures des deux revues présentant les Grands Challenges 2024.

It was an eventful year for GENCI with regard to the Grand Challenges:

• **At CINES**
On the AMD MI250X (1,424) and MI300A (112) accelerated partitions – which are particularly energy-efficient (#3 in the international Green500 ranking) – eleven projects carried out simulations, including work on accelerating the occurrence of extreme storms, the electromagnetic radiation of solar bursts in the radio-wave range, and the use of a foundational model for autonomous driving. A debriefing day was organized, and a report is available.

• **At IDRIS**
The commissioning of the NVIDIA H100 (1,456) partition (Jean Zay 4) provided an opportunity for eight projects – all sharing a common focus on artificial intelligence (language models, AI and biology, autonomous driving) – to access 3.8 million GPU hours. Articles and publications are currently in preparation.

• **At TGCC**
In conjunction with CINES, and in order to meet the largest demands and make optimal use of the available resources, a scalar Grand Challenges campaign was launched. It resulted in the publication of a joint 'Scalar Grand Challenges' report (based on AMD GENOA technologies on ADASTRA, and AMD ROME and Skylake on Joliot-Curie).

1 - <https://www.genci.fr/evenements/la-journee-de-restitution-des-grands-challenges-sur-les-partitions-accelerees-amd-mi250x>
2 - https://genci.fr/sites/default/files/brique/fichier/02-2025/VF_Cahier_Grands_Challenges_Accelérés.pdf
3 - https://genci.fr/sites/default/files/brique/fichier/01-2025/Cahier_Grands_Challenges_Scalaires.pdf

The Grand Challenges provide an opportunity to publish scientific results from simulations using state-of-the-art technologies.

FORWORD BY

MARJORIE BERTOLUS,
Chair of GENCI's
Assessment Committee

In 2024, the GENCI Evaluation Committee carried on its goal of providing support to researchers by evaluating requests for computational resources and proposing allocations that would provide researchers with the necessary means to carry out their work. A number of thematic committee chairs were renewed, which introduced new viewpoints and strengthened the collective dynamics.

Thanks to the joint effort of the chairs of the thematic committees, the centre directors and the GENCI team, the majority of projects submitted were able to benefit from the resources necessary for their work. This collective commitment illustrates the ongoing desire to meet the growing and varied needs of the scientific communities, in a context of high demand on existing machines.

2024 also offered opportunities to open up new perspectives. The integration of a quantum machine into the GENCI ecosystem reflects the ambition to investigate innovative computing approaches, which will eventually complement traditional methods. Furthermore, preparations for the arrival of the new Alice Recoque machine represent an important milestone: it will provide increased capacity to better support researchers with the transition to Exascale computing.

Beyond infrastructure, dialogue with users remains a pillar of our work. Following the laboratory meetings initiated in previous years, the launch of the 'GENCI Users' programme in autumn 2024, with an initial webinar dedicated to the quantum platform, has opened up a new space for direct exchanges with the research communities using GENCI resources. These online meetings, which enable in-depth discussion of usage, sharing of experiences and collective anticipation of needs related to rapidly evolving architectures, will continue in 2025.



The integration of a quantum machine into the GENCI ecosystem reflects the ambition to investigate innovative computing approaches.



RESEARCH COMMUNITY

Forewords by the chairs of the thematic committees (CT)

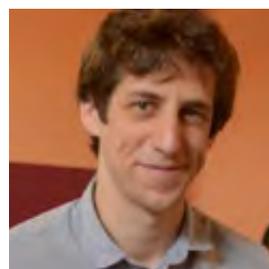
CT1
ENVIRONNEMENT



Jean-Louis DUFRESNE
Chair of CT1

The fifty or so projects submitted each year remain of the highest quality. They mainly concern the study of the Earth, its climate, atmosphere, ocean, biosphere and cryosphere, but one project also studies other planets. Half of the resources are allocated to around 5 projects for simulations of past climates and recent and future climate changes. The use of GPUs is still marginal, and the reduction in CPU hours available at IDRIS has led users to transfer a large proportion of their simulations to the TGCC and CINES computers.

CT2A
NON REACTIVE AND MULTIPHASE FLOWS



Rémi ZAMANSKY
Chair of CT2a

High-performance computing is an essential component of research in fluid mechanics. The continuous increase in computing resources enables the fundamental mechanisms of hydrodynamic instabilities, turbulence and emerging 'multiphysics' couplings (acoustics, transfer, radiation, rotation, stratification, elasticity, etc.) to be explored. Supercomputers are also invaluable for generating databases of reference simulations useful to develop new application-oriented models that are more economical in computing resources. The number and diversity of projects (66 applications in 2024) show that computational fluid dynamics is at the crossroads of many of today's challenges: energy, environment, processes, etc.

CT2B
REACTIVE AND MULTIPHASE FLOWS



Benoît FIORINA
Chair of CT2b

CT2b projects are characterized by the diversity of themes involving multiphase and/or reactive flows, mainly in the fields of energy and the environment. This is reflected in the applications for the 2024 grant which, in particular, are aimed at securing energy systems and reducing their consumption and emissions in order to develop transportation and production means of low-carbon energy. One of the highlights has been the ongoing development of calculation codes, particularly the efforts to port them to GPU machines, which are significant for codes dealing with many complex and coupled physical phenomena. CT2b has also hosted several applied research projects led by industry, as well as several new subjects in 2024.

CT3
BIOLOGY AND HEALTH



Yolanda PREZADO
Chair of CT3

In 2024, TC3 (Biology and Health) evaluated 11 projects in A16 and 8 in A17. The projects concern the usual themes in the field: genetics, molecular dynamics, fluid dynamics, biomechanics, medical imaging, radiotherapy, etc. Many of the projects are supported by national funding (e.g. ANR, INCA). Most of the projects involve doctoral and post-doctoral students. Most of the users are academics, but there have also been one proposal from industry. To illustrate, the number of hours allocated in A16 was distributed as follows: 77 kh on IDRIS Jean Zay H100, 5 kh on CINES ADASTRA MI250x and also 1,805 kh GPU on CINES ADASTRA Genoa, 180 kh on IDRIS Jean Zay A100, 11,000 kh on CCGT Joliot Curie/Irene Rome, 1,710 kh on IDRIS Jean Zay CSL 65 kh on IDRIS Jean Zay V100, 1,500 kh on CCGT Joliot Curie/Irene Rome, 10,670 kh on Joliot Curie SKL.

CT4
GEOPHYSICS AND ASTROPHYSICS



Geoffroy LESUR
Chair of CT4

In 2024, CT4 (Astrophysics and Geophysics) evaluated a total of 45 proposals, with 300 million CPU hours requested and 2.5 million GPU hours requested. The transition to GPUs seems to be slowing down, and applications requiring adaptive mesh refinement (AMR) for cosmology and galactic physics remain on the scalar Genoa and Rome clusters. However, the next generation of AMR codes is expected to arrive in 2025 and should be a game changer. Seismology, particularly wave inversion, is fully benefiting from GPU porting, as are fixed-grid codes used for astrophysical plasmas, yielding very promising results.

CT5
THEORETICAL PHYSICS AND PLASMA PHYSICS



Virginie GRANDGIRARD
Chair of CT5

In 2024, the overall volume of computations performed by our community (thermonuclear and inertial fusion, cold plasmas, field and particle theory, etc.) saw a 15% increase compared to the previous year, with a constant number of projects (30 projects, including 5 new ones). With a total allocation of 850 million CPU hours and 3 million GPU hours, CT5 is one of the largest consumers of GENCI computing time (~30% of CPU hours and ~15% of GPU hours). It alone consumes 50% of the hours available on the Irene-Rome partition, which remains its preferred partition. Efforts to port codes to GPUs continue, but the main consumers remain QCD (Quantum ChromoDynamics) codes, which have successfully adapted to both NVIDIA and AMD GPUs, accounting for more than 35% of the consumption on ADASTRA MI250X. Projects incorporating AI remain marginal, but there is no doubt that this trend should intensify in the future.

CT6
COMPUTING, ALGORITHMS AND MATHEMATICS



Héléne BARUCQ
Chair of CT6

CT6 is a small committee (12 applications in 2024) which mainly brings together large-scale simulation projects requiring access to large-scale computers. The application fields represented are quite varied: healthcare, fluid-structure interaction, seismic imaging, language models, algebraic geometry, to name but a few. There has been a slow but clear evolution in the demand for GPU resources, with CPU resources still in the majority when it comes to simulations. We can cite a few AI user projects that remain in the minority, as well as a few requests for quantum computing. Ambitious initiatives using real data can be appreciated, giving the projects concerned a high profile.

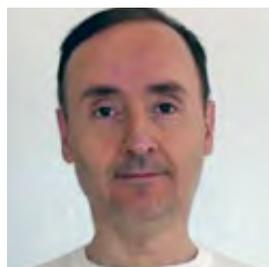
CT7
MOLECULAR
MODELLING APPLIED
TO BIOLOGY



Patrick FUCHS
Président du CT7

The number of applications evaluated by CT7 in 2024 was 52. CPU resources requested were around 143 million hours, and GPU hours (V100 equivalent) were 9.11 million hours. The number of applications and CPU and GPU hours have now been fairly constant for 2 years. GPUs have become the main means of calculation for our community. Users quickly appropriated the new GPU partitions H100 from IDRIS and Mi300 from CINES. The molecular dynamics of membrane systems still accounts for a significant part of CT7 activities. Nucleic acid/protein and small molecule/protein interactions can also be mentioned. Some projects also use the AlphaFold program to predict protein structure. GENCI's resources remain essential to CT7 users.

CT8
QUANTUM CHEMISTRY
AND MOLECULAR
MODELLING



David LOFFREDA
Chair of CT8

During 2024, the granulometry of projects submitted to CT8 evolved with an overall lower number of requests, with at the same time a few projects which were expanded and whose annual demands increased significantly. The success of dynamic accesses remains strong for our committee, and these continue to allow many researchers to access GENCI's computing resources, in order to develop quality research activities. Applications and developments of methods and codes continue to cover many areas from reactive interfaces, materials science, homogeneous and bio-inspired systems, including the description of excited states and strong electronic correlation systems. Chemists are progressing in the fundamental knowledge of the systems they explore, also thanks to the constant support of the GENCI teams and the application support of the technical centers.

CT9
PHYSICS, CHEMISTRY AND
MATERIALS PROPERTIES



Michele RAYNAUD
Chair of CT9

The CT warmly thanks Thierry Deutsch who has been president of the committee since 2017. The requests for resources to the TC9 are numerous: 88 projects in 2024 for a volume of hours allocated of 429 million, and of very diverse sizes ranging from a few hundred thousand to several tens of millions of hours. Despite a significant increase in computing capacity and the increasing use of AI (31% of resource requests in 2024), there has been no decrease in the number of hours requested as increasing resources are mobilized for studies of increasingly complex systems. The projects submitted are very varied covering the fields of physics, chemistry and properties of a wide range of materials (2D materials, quantum materials, nanomaterials and porous materials) for a wide range of potential applications for environmental or energy sobriety issues. The main methods used are ab-initio approaches to electronic structure calculations mainly using the formalism of density functional theory (DFT) and molecular dynamics coupled with machine learning techniques. They allow the calculation of spectral properties, physicochemical and thermodynamic properties and transport phenomena.

CT10
NEW APPS AND
MULTIDISCIPLINARY
APPLICATIONS OF HPC

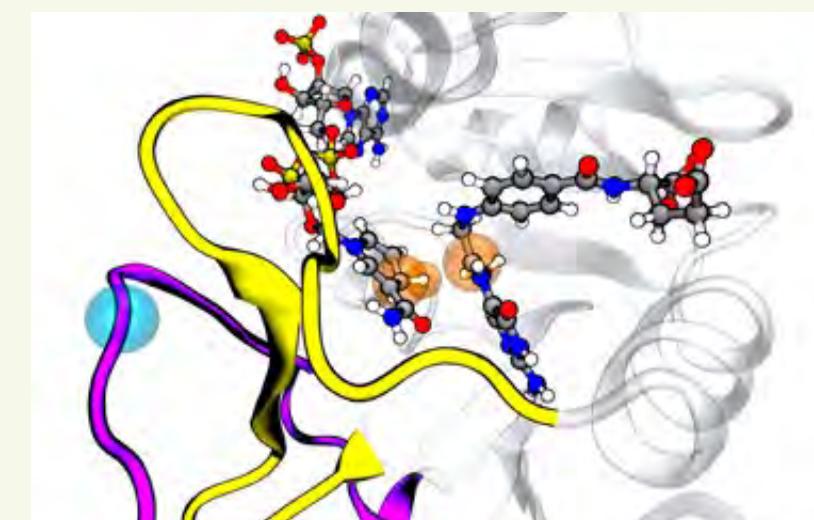


Michaël KRAJECKI
Chair of CT10

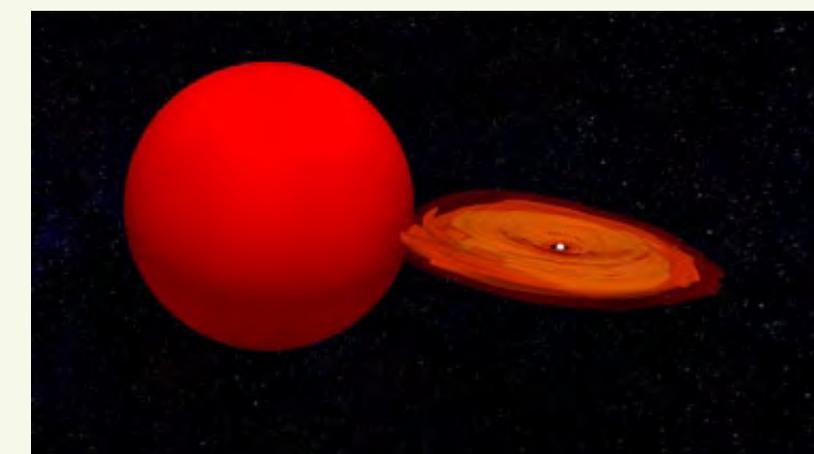
In 2024, the CT10 evaluated around 60 projects as part of regular access, setting a new record and demonstrating the dynamism of our community. Unsurprisingly, this increase in the number of projects is accompanied by an increase in the number of hours across the three national centers. The new extension of Jean Zay has therefore been welcome! Despite this new national effort, we can already anticipate a saturation of national resources in the short term. It is now essential to support French researchers in submitting projects within the EuroHPC calls, which aim to extend the results obtained at the national level.

Examples of simulation

↓
Allosteric effect of a residue mutation (blue sphere) on the reactivity of an enzyme. (Guillaume STIRNEMANN – ENS and CNRS, UMR8640 Pasteur) – ADASTRA Grand Challenges.



↓
Global simulations of an accretion disk at extreme temperatures (Marc Van den Bossche - IPAG, CNRS, Grenoble Alpes University) - Grands Challenges ADASTRA.



CT1

Environment

CNRS, LOCEAN-IPSL, SORBONNE UNIV.



Julie Deshayes
Research Director



Gurvan Madec
Research Director



Martin Vancoppenolle
Research Director

David Kamm
PhD student

Casimir de Lavergne
Researcher

Clara Burgard
PostDoc

Birte Güllk
PostDoc student

LOCEAN-OSU, SORBONNE UNIV.

Sébastien Masson
Physician

RESEARCH RESULTS

• Supercomputer Jean Zay/Jean Zay V100: 500,000 hours CPU / 5,000 hours GPU • Joliot-Curie/Rome: 1.5 millions hours CPU

Modeling the global ocean for climate studies

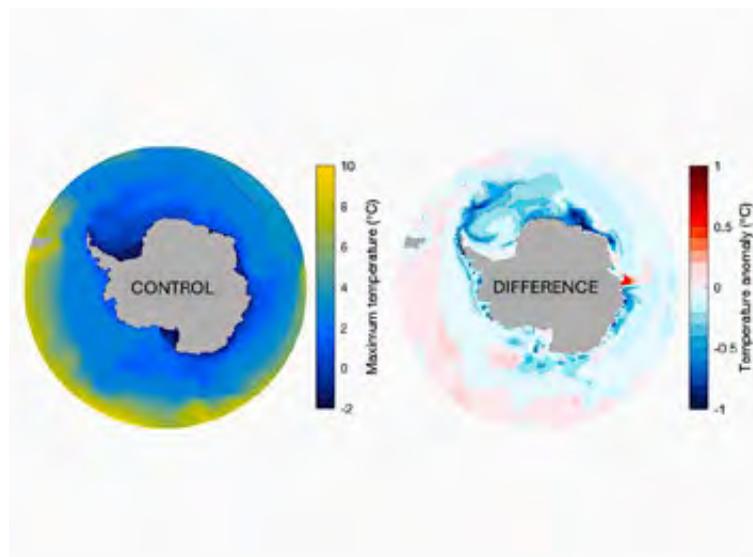
The ocean regulates the Earth's climate by absorbing heat and carbon and redistributing them at depth. Modeling vertical transport in the ocean is therefore essential to deciphering the present climate and possible futures. Our ocean simulations are becoming increasingly reliable and efficient.

The ocean is the dominant reservoir of heat, carbon and nutrients in the climate system. It is traversed in all its dimensions by large, interconnected currents, and dotted with eddies and filaments ranging in size from 1 m to 100 km. All these dynamic structures contribute to the exchange of heat and dissolved substances between the ocean surface and the deep ocean, and thus to the regulation of the global climate. Turbulent structures of small spatial scale play a particularly important role in vertical transport, and represent a major challenge for climate modelling. Indeed, the computing power available does not allow ocean turbulence to be explicitly simulated over the thousands of years required

for climate simulations. The challenge is therefore to establish simplified models that mimic the effect of small-scale turbulence (< 100 km) on larger scales.

BETTER SIMULATE THE TURBULENT OCEAN

We have developed new simplified models of ocean turbulence and optimized our numerical simulations of the world ocean using the NEMO community code. Three advances are particularly noteworthy. Firstly, vertical exchanges due to internal tidal waves are now fully represented. Our simulations show that they play a key role in the thermal equilibrium of the seas surrounding Antarctica (Figure 1). Secondly, emerging representations of oceanic macro-turbulence (10–100 km), some derived from machine learning, have been evaluated and compared in a new, light configuration of the world ocean. Finally, the computational cost of our simulations was reduced by a factor of two, thanks to in-depth optimization of the NEMO code.



← **Figure 1** : Maximum water column temperature in the Southern Ocean. On the left, we show the maximum temperature within the water column, as simulated by a global ocean configuration using NEMO. On the right, we show the impact of a more exhaustive representation of tide-generated turbulence on this same temperature. The temperature maximum is lower around Antarctica due to increased vertical mixing.

CT4

Geophysics and astrophysics

ASTROPHYSICS AND PLANETOLOGY RESEARCH INST., UMR 5277 – CNRS & TOULOUSE UNIV.



Jean Kempf
PhD student



François Rincon
Researcher

RESEARCH RESULTS

• Supercomputer ADASTRA: 150,000 hours GPU MI250

Resolving magnetised dynamics in galaxy clusters

The cosmological evolution of galaxy clusters is constrained by their internal hot-plasma dynamics. High-resolution 3D simulations of stratified magnetohydrodynamic turbulence, in magnetisation regimes typical of high-energy astrophysical environments, are required to understand these effects.

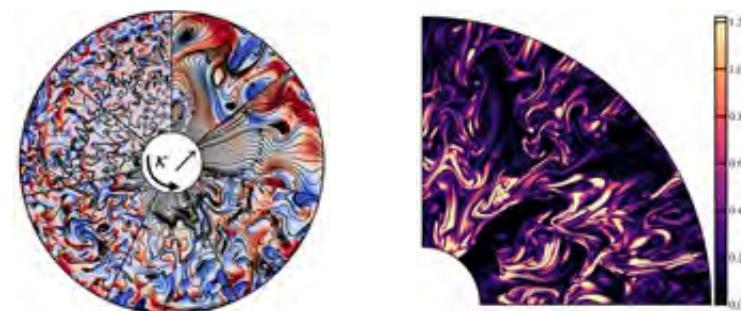
The dynamics of the intra-cluster medium (ICM), a hot ($T \sim 10^8$ K), diffuse plasma that glows in X-rays and makes up to 15% of the total mass of galaxy clusters, plays a key role in the evolution of large-scale cosmological structures. Understanding this dynamics requires to characterise complex, multiscale turbulent plasma flows interacting with electromagnetic fields. As the ICM is magnetised and weakly collisional, thermal conduction operates mainly along dynamic magnetic field lines. This notably gives rise to a magneto-thermal instability (MTI), similar to thermal convection, that may stir turbulence in cluster halos.

To finely describe MTI-generated turbulence and to understand its effects, we developed a high-resolution numerical model, based on the astrophysical fluid dynamics code IDEFIX, of a spherically stratified cluster, using the framework of anisotropic Braginskii magnetohydrodynamics.

ENERGY TRANSPORT AND DYNAMO EFFECT

We have recently established that the spatial scale and intensity of MTI turbulence increase with thermal conduction (Fig. a). For typical cluster conduction, we found that these turbulent fluctuations may be marginally detectable with the future European X-ray observatory NewAthena/X-IFU (Kempf, Rincon, Clerc, A&A 2023). We have also quantified the properties of the associated radial energy fluxes, providing new insights into the thermodynamics of galaxy clusters (Kempf et Rincon, A&A 2025).

We are now tackling the problem of magnetic-field amplification by MTI turbulence through a fluid dynamo effect. Our first, unprecedented 3D simulations of such a dynamo in a stratified cluster model, in regimes of very weak electrical resistivity typical of clusters, are performed on 256 GPUs to reach 10243 grid resolutions required to resolve fine-scale magnetic folds and current sheets (Fig. b). These simulations will help to determine if a turbulent dynamo in the ICM can amplify, on timescales shorter than the age of the Universe, tiny cosmological seed magnetic fields up to energetic equipartition ($\sim 10 \mu\text{Gauss}$) with turbulent kinetic energy.



↑ **Figure a**. Left: variation of the injection scale of MTI turbulence with thermal conductivity "k" (red/blue: hot/cold). The dynamical geometry of magnetic field lines creates convoluted thermal fronts due to anisotropic thermal conduction. **Figure b**. Right: magnetic-field intensity in a 3D simulation of MTI-driven dynamo effect. The radial anisotropy of structures is due to the buoyancy forcing of the MTI (gravity points towards the center).

CT2a

Non reactive and multiphase Flows

LEGI LABORATORY

Elliott Alloin
PostDoc student



Guillaume Balarac
Professor
Grenoble-INP/UGA

Olivier Métais
Professor
Grenoble-INP/UGA

RESEARCH RESULTS

• Supercomputer Jean Zay/CSL: 10 millions hours CPU

HPC for hydropower flexibility

Hydroelectric pump-turbines are an essential element in increasing the share of renewable energy. High-fidelity simulations have enabled us to achieve an unprecedented level of detail in the flows involved, and thus gain a better understanding of the instabilities limiting their use.

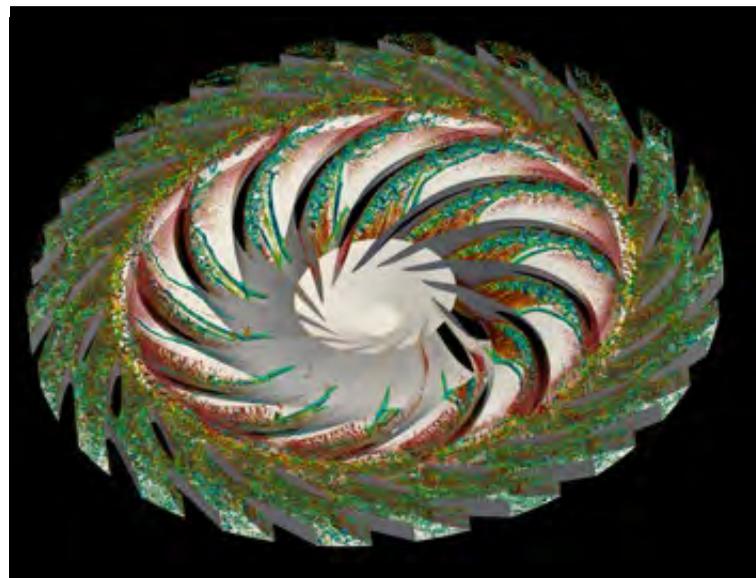
Pump-turbines balance the electrical grid by storing electrical energy in the form of potential energy in the event of a production surplus, and re-injecting this energy in the event of a consumption surplus/production deficit. But at partial load in the pumping mode, an unstable zone appears, limiting their operating range. A precise understanding of the origins of this instability is essential to extend the operating conditions of these machines. This is a key element in enabling the introduction of a larger share of intermittent renewable energy sources (wind, solar) without compromising grid stability.

AN EXPLICIT DESCRIPTION OF TURBULENT DYNAMICS

Standard statistical simulations fail to capture this unstable zone. So, in collaboration with GE Vernova, advanced simulations have been carried out using the HPC code YALES2. These simulations make it possible to explicitly describe a significant part of the vortex dynamics (LES approach). The original feature was to simulate the entire machine using dynamic meshing approaches to take account of impeller rotation. Physical mesh adaptation criteria were also used to guarantee the validity of the simulations. These simulations, considering different operating regimes, required almost 10 million hours on the Jean-Zay supercomputer (IDRIS).

These simulations enabled us to reproduce the performance measured in experimental tests, demonstrating the relevance of the approach. Above all, they provided a complete description of the flow dynamics for the different operating regimes. The study of vortex dynamics in the vicinity of the impeller has enabled us to gain a better understanding of the origin of operating instabilities occurring at partial load.

← Vortex structures generated near the impeller of a hydroelectric pump turbine.



CT2b

Reactive and multiphase Flows

LABORATORY EM2C



Stéphane Q. E. Wang
PhD student



Christophe O. Laux
Professor



Benoît Fiorina
Professor

RESEARCH RESULTS

• Supercomputer ADASTRA/Genoa: 3 millions hours CPU

Understand plasma-assisted combustion

Large-eddy simulations of turbulent flames stabilized by plasma, using a phenomenological model of nanosecond discharges, enable us to reproduce, predict and understand the multiphysics behind plasma-assisted combustion, as a complement to experimental studies.

Answering the climate challenge requires decarbonizing combustion systems and reducing nitrogen oxides emissions. An approach is to burn e-fuels, produced from renewable energy sources, at a leaner mixture equivalence ratio. Nevertheless, it leads to flame instabilities and extinctions. A promising solution for stabilizing these lean premixed flames is to generate high-voltage plasma discharges at the flame basis, which interact with combustion. Especially, Nanosecond Repetitively Pulsed (NRP) discharges, whose impact on combustion is being studied at the EM2C lab, represent an energy-efficient technique.

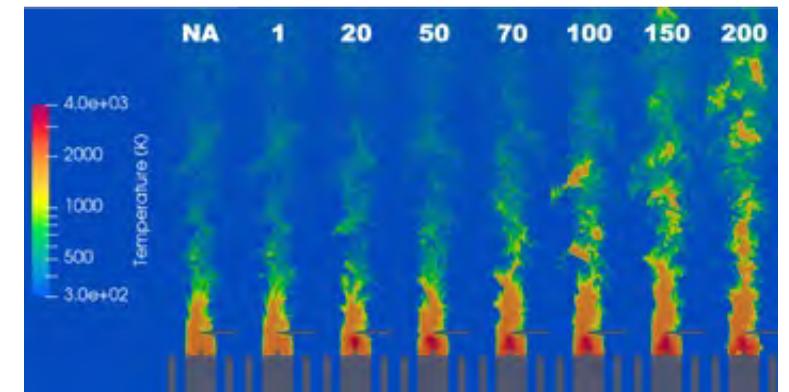
HIGH-PERFORMANCE AND HIGH-FIDELITY SIMULATION

High-performance computing complements experiments for exploring the fundamental questions raised by plasma-assisted combustion. However, given the diversity of spatial and temporal scales between plasma, combustion and tur-

bulence, to accurately simulate their interactions is a challenge. The thermochemical effects induced by NRP discharges, such as ultra-fast heating and dissociation, have a major impact on the behavior of turbulent flames.

To perform large-eddy simulations with reasonable cost, the effect of plasma on combustion is described by a phenomenological model developed by EM2C's combustion and plasma teams. The turbulent flow and its interactions with the complex combustion chemistry and the plasma are then solved by the YALES2 CFD code developed at the CORIA lab. Simulations of the Mini-PAC burner, studied at EM2C, with this modeling have enabled us to quantitatively reproduce the experiments and explain the mechanism of flame-plasma interactions at the origin of stabilization.

→ A large-eddy simulation of the Mini-PAC burner with Blanchard's NRP discharge model: instantaneous temperature field at different discharge numbers between 1 and 200. Discharges are applied between the two electrodes. The non-assisted flame (NA) is also shown for reference.



CT5

Theoretical physics and plasma physics

SORBONNE UNIV. - LULI



Anna Grassi
Associate Professor



Caterina Riconda
Professor



Arseny Mironov
CNRS Researcher

CNRS - LULI



Mickael Grech
Researcher

PLYMOUTH UNIV.



Anthony Mercuri-Baron
PostDoc student

RESEARCH RESULTS

• Supercomputer Joliot-Curie/Rome & SKL: 2 millions hours

QED cascades in extreme light

Large-scale simulations of plasma-stabilized turbulent flames, using a phenomenological nanosecond discharge model, make it possible to reproduce, predict, and understand the multiphysics behind plasma-assisted combustion, complementing experimental studies.

Relativistic electron-positron pair plasmas, or QED plasmas, are associated with spectacular astrophysical phenomena that are still poorly understood, near black holes or neutron stars. Studying them in the laboratory could greatly improve our understanding of these environments, as well as of QED effects in the Universe.

Producing such plasmas remains a challenge, as particles must be confined to achieve a sufficient density for collective effects to dominate over in-

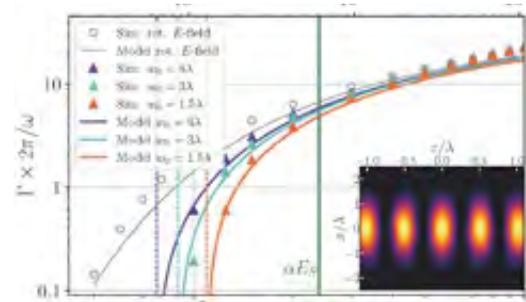
dividual interactions. Multi-petawatt lasers such as Apollon (France) or ELI-beamlines (Czech Republic), with intensities $>10^{23}$ W/cm², open the way for this research. Their fields can trigger nonlinear QED processes – photon γ emission (Compton) or pair creation (Breit-Wheeler) – potentially leading to avalanches in which the number of pairs grows exponentially.

Due to the unique nature of the laser systems required, rigorous numerical modeling of the experiments and precise predictions of observable phenomena are essential to guide future studies.

PLASMAS & QED IN STRONG FIELDS

This work is based on the SMILEI* kinetic code and the computing resources of TGCC. Combining multidimensional simulations and analytical modeling, our recent studies* have advanced the fundamental question of the avalanche growth rate in realistic field configurations. We have identified the criteria for triggering avalanches and demonstrated the existence of an intensity threshold. Our simulations, which reveal a rich particle dynamics, have made it possible to determine the conditions for achieving collective effects induced by the pair plasma, such as laser field screening.

*<https://smileipic.github.io/Smilei/>
** <https://iopscience.iop.org/article/10.1088/1367-2630/ac1975> ;
<https://journals.aps.org/prx/abstract/10.1103/PhysRevX.15.011062>



↑ **Figure :** On the left, schematic representation of a QED avalanche developing at the focal point of two counter-propagating laser beams. On the right, dependence of the avalanche growth rate on the laser field E_0 and laser intensity for an avalanche developing in the standing wave formed by two counter-propagating Gaussian beams. The results of 3D simulations for three beam widths (w_0) are shown with triangular markers. Solid lines represent our model. Vertical dashed lines correspond to the threshold field E_0 for each w_0 value (with the corresponding color). The inset shows a snapshot of the electric field (lighter colors correspond to higher field values).

CT9

Physics, chemistry and materials properties

GRENOBLE-INP-UGA/ SIMAP



Noël Jakse
Professor
Sébastien Becker
Researcher

CNRS-LIG/UGA

Émilie Devijver
Researcher

FOURNIER INSTITUTE, UGA

Rémi Molinier
Researcher

RESEARCH RESULTS

• Supercomputer Jean Zay, Irene and ADASTRA: 4.3 millions hours CPU

AI for understanding solidification

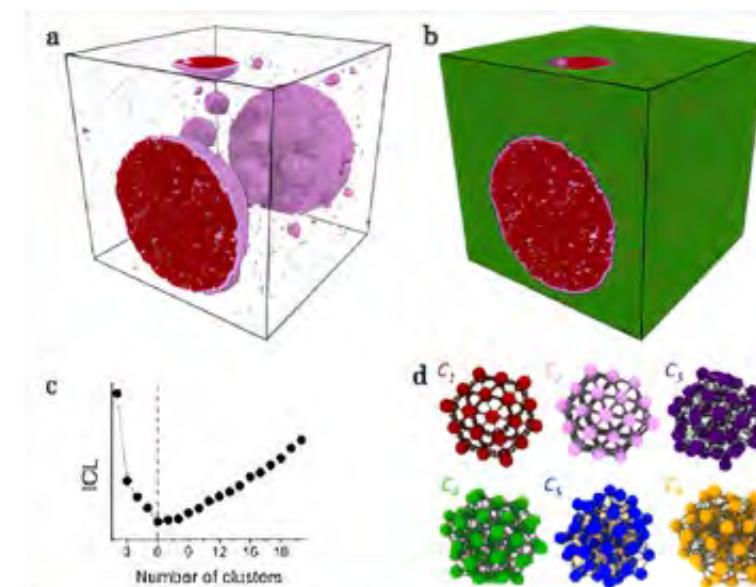
We have developed unsupervised machine learning methods combined with topological descriptors to gain insight into crystal nucleation phenomena in metals and metallic alloys.

Nucleation phenomena are of fundamental, technological, and societal importance, yet their most intimate mechanisms remain to be elucidated. Crystal nucleation – the initial stages of the liquid-to-solid transition during undercooling – begins at the atomic scale, on nanometric length scales and sub-picosecond time scales. It involves complex, multidimensional mechanisms with symmetry breaking, which are difficult to observe experimentally. Molecular dynamics simulations with tens of millions of atoms, combined with AI, reveal features that go beyond the assumptions of Classical Nucleation Theory, with unprecedented accuracy.

METHODS AND RESULTS

1. The realism of these large-scale simulations relies on classical force fields with quantum-level accuracy, made possible by machine learning using high-dimensional neural networks trained on ab initio simulations.
2. The data generated requires post-processing with clustering methods to autonomously extract local structures. These structures are represented topologically using persistent homology.

One of the key findings for several alloys is that the liquid is highly heterogeneous, and nucleation initiates in regions of the liquid that exhibit chemical ordering similar to that of the crystalline structure. This makes the study of nucleus morphology and growth kinetics an achievable goal.



← **Unsupervised learning of homogeneous nucleation.** Snapshot from a molecular dynamics simulation: (a) nuclei in formation, (b) all atoms displayed according to their classification obtained through clustering, (c) Bayesian criterion used to autonomously determine the optimal number of relevant clusters, illustrated in (d). *Scientific Reports (Nature)* **12** 3195 (2022).

CT8

Quantum chemistry and molecular modelling

INST. OF MINERALOGY, MATERIALS PHYSICS & COSMOCHEMISTRY



Line Mouaffac
PhD student



Fabio Pietrucci
Associate Professor

MAX PLANCK INST. OF BIOPHYSICS



Karen Palacio-Rodriguez
PostDoc student

RESEARCH RESULTS

• Supercomputer Joliot-Curie/ROME: 1.376,760 hours CPU • Jean Zay: 500,000 hours CPU

Prediction of Protein Dissociation Rates

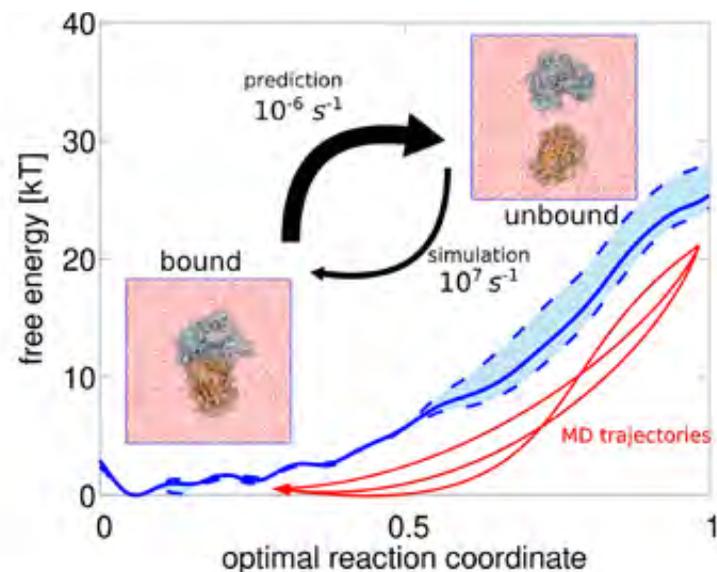
The formation and dissociation of protein complexes ensure proper cell function and response to pathogens. Molecular dynamics simulations of the spontaneous association of the barnase-barstar complex have, for the first time, made it possible to predict the kinetics of the reverse process.

Modeling protein-protein interactions represents a major challenge in biophysics, particularly for predicting kinetic parameters that are crucial for cell function. The ability to modify the kinetics of complex formation or dissociation, on the other hand, is of great pharmaceutical interest. The barnase-barstar complex, which has been extensively studied, serves as a model for these interactions. The experimental association rate is on the order of 1/100 nanoseconds, while the dissociation time is about 1 day, completely inaccessible to classical molecular dynamics simulations.

A COUNTER-INTUITIVE METHOD

To overcome this challenge, we generated and exploited 175 trajectories of spontaneous association, irreversible in silico, to predict dissociation. Our model of the barnase-barstar complex in water contains 100,000 atoms, with a total simulation time of 30 microseconds. Once projected onto a series of reaction coordinates, the trajectories enabled the parameterization of stochastic models (Langevin equations) that provide the free energy landscape and the diffusion profile representing the system's dynamics. Relying on a recent variational theorem, these models allow calculation of the kinetic rate for the reverse process of the one simulated – namely, dissociation – in reasonable agreement with experiments. This advance paves the way for the systematic study of fundamental interaction mechanisms in numerous protein-protein complexes, as well as for better quantitative prediction of the kinetics of biologically and pharmaceutically relevant systems.

Free energy landscape as a function of an optimal reaction coordinate. The simulated transition is the passage from the dissociated state (1) to the associated state (0) of the barnase-barstar complex. This transition is kinetically asymmetric, with a barrier of about 30 kT and a difference of 13 orders of magnitude between the association and dissociation rates. Nevertheless, by exploiting molecular dynamics association trajectories and a statistical inference approach developed in our group, it is possible to accurately predict the dissociation rate.



CT7

Molecular modelling applied to biology

CNRS



Paulo C.T. Souza
Research Scientist



Luís Borges-Araújo
Research Scientist



Mariana Valério
Postdoctoral Researcher

RESEARCH RESULTS

• Supercomputer Joliot-Curie/ROME: 1.349,760 hours CPU

Lipid Nanoparticles, Health and HPC

Using multiscale molecular dynamics simulations on HPC systems, we developed new models and tools to promote in-silico design and optimization of lipid nanoparticles (LNPs), key for vaccine and gene therapy delivery.

Lipid nanoparticles (LNPs) are essential vectors for mRNA delivery, especially in vaccines and gene therapies. Their performance hinges on a delicate balance between multiple lipid components, each with distinct roles.

Rational design remains challenging due to their structural sensitivity to biological environments such as pH or to interactions with the membrane of the target cell for delivery. With high-performance computing, we simulated LNP self-assembly and structural organization using the coarse-grained Martini 3 force field.

BUILD A VALIDATED LIBRARY

We conducted hundreds of microseconds of simulation time, screening nearly 1000 LNP compositions, varying the ionizable lipid component. The

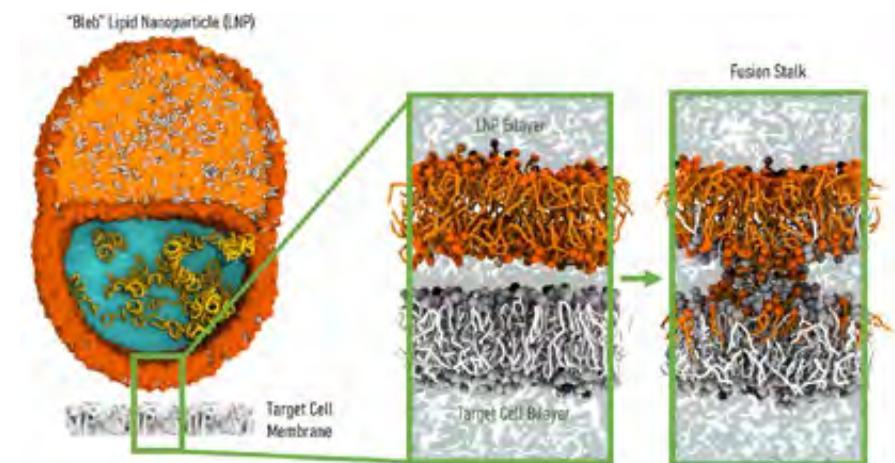
resulting dataset enabled us to build a validated library of lipid properties that can be correlated to experimental RNA delivery efficiency. By modelling LNPs in various physiological conditions, we uncovered key mechanisms such as pH-triggered membrane fusion, an important first step for the delivery into cells.

These insights offer a quantitative foundation to guide the engineering of safer, more effective LNP formulations for biomedical applications. Looking ahead, integrating AI-based methods will further accelerate formulation discovery and screening in close collaborations between industry and academy.

Structure and fusion mechanism of a phase-separated "bleb" lipid nanoparticle (LNP).

(Left). A bleb LNP shows internal compartmentalization: an aqueous core with RNA (yellow) and ions (cyan), and a lipid-rich compartment of neutral ionizable lipids (light orange) and cholesterol (white), enclosed by a shell of charged ionizable lipids (dark orange). The LNP approaches the target cell membrane (gray, bottom).

(Right). Zoomed views of the LNP (top) and cell membrane (bottom) bilayers before (left) and after (right) fusion. Fusion is triggered in the acidic endosome via protonation of ionizable lipids and initiates with fusion stalk formation.



CT3

Biology and health

ASCII CMAP-
INRIA-ÉCOLE
POLYTECHNIQUE

Denis Talayv
Research Director
INRIA

Carl Graham
Head of Research
CNRS

Quentin Cormier
Head of Research
INRIA

Maxime Colomb
Engineer

Josselin Garnier
Professor

UMR LASTIG-UGE-
IGN-ENSG-EIVP

Julien Perret
Research Director
IGN

TRiBE INRIA

Aline Carneiro Viana
Research Director
INRIA

Razvan Stanica
Associate Professor
(INSA Lyon)

GRESS-INSERM

Philippe Ravaud
Professor

Raphael Porcher
Professor

Viet-Thi Tran
Professor

RESEARCH RESULTS

• Supercomputer Joliot-Curie/ROME: 1 million hours CPU

Controlling pandemics using digital twins

Generating accurately a population, its trajectories, and the contaminations between individuals in order to simulate the spread of various pathogens and enable public authorities to evaluate and compare different targeted health policies.

According to D. Adam (Nature, 2020), of all research projects during the COVID-19 pandemic, epidemiological modelling probably had the most direct and significant impact on health policy and the lives of citizens. However, while the timing of decisions was often based on modelling, the modalities and the nature of decisions were, for the most part, taken on the basis of weak or non-existent evidence and with little quantified information on their benefits, risks, and possible alternatives.

The ICI project models digital twins of territories and their populations. By integrating multiple data on the population (density, composition, etc.), individuals (age, co-morbidities, profession, social category, healthcare behavior, etc.) and the environment (geography, urban organization, transportation, etc.), the ICI individual-centric model is able to simulate the spread of epidemics within a city or a region.

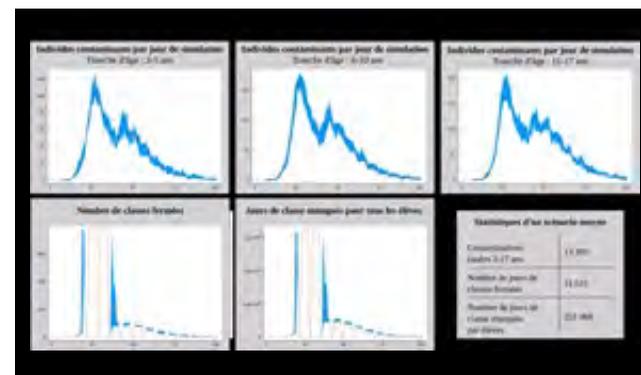
TO ASSESS THE EFFECTIVENESS OF HEALTH POLICIES

ICI ambitions to enable health authorities to assess the effectiveness of health policies during pandemics in a differentiated way, to estimate the effects of different public health interventions targeted by territory and by sub-population, to guide health decisions in fine detail, and to prepare care offers adapted to future pandemics. The GENCI allocation has been used to carry out

massive aerosol epidemic propagation simulations on the 20 arrondissements of Paris. The results of our Monte Carlo simulation campaigns can be consulted on a web application <https://ici.saclay.inria.fr/dist/>.

ICI having been selected as one of the priority projects of the Inria-IGN-Cerema digital twin program for France and its territories, the simulations will now be extended to multiple territories with their diverse populations and to a variety of epidemics.

↓
A relaxed scenario of the closing of the schools in Paris 11th district. Classrooms were closed for 10 days when the incidence factor was > 770.



CT10

New apps and multi-disciplinary applications of HPC

INRIA

Pierre-Yves Oudeyer
Research Director

Clément Romac
PhD student

Thomas Carta
PostDoc student

Loris Gaven
PhD student

Julien Pourcel
PhD student

Grgur Kovac
PhD student

Marko Cvjetko
PhD student

Olivier Clerc
PostDoc student

Sina Khajehabollahi
PostDoc student

Ludovic Matar
Research engineer

Gauthier Hamon
PhD student

Jeremy Perez
PhD student

Timothée Boulet
PhD student

Clément Moulin-Frier
Head of research

RESEARCH RESULTS

• Supercomputer Jean Zay/CSL: 300,000 hours CPU • Jean Zay/A100: 200,000 hours
• Jean Zay/H100: 220,000 hours • ADASTRA/MI250X: 45.000 hours

Curiosity-driven Agents in Generative AI

Our project develops autonomous AI agents based on LLMs. Thanks to GENCI resources, we have created an agent capable of learning through interaction with a virtual world and selecting its own learning tasks via curiosity models.

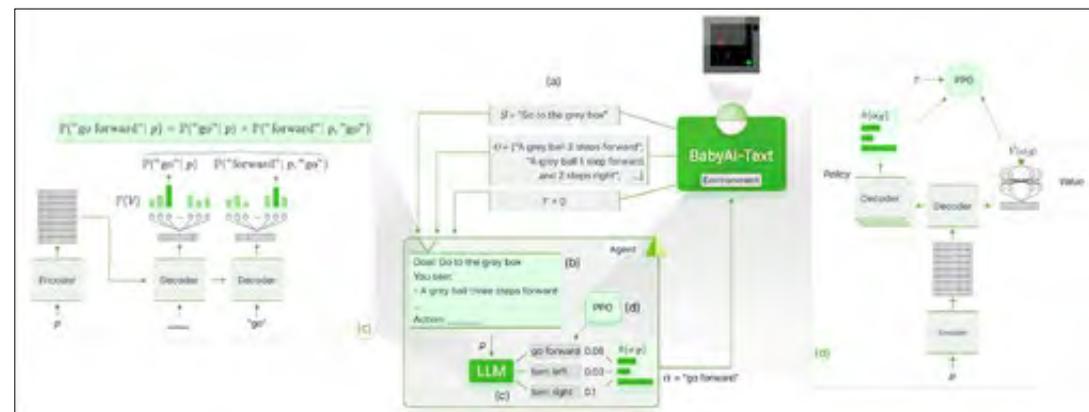
A major challenge in AI is designing agents capable of autonomous learning and exploration, while being guided and understood by humans through rich natural language interactions. Although curious agents have been studied for a long time, they remain very limited, both in learning complex skills and in human guidance. The recent arrival of LLMs opens a new perspective: capable of solving complex tasks and communicating in natural language, they appear as excellent candidates for curious agents. Nevertheless, making these LLM agents truly curious remains an open challenge.

CHALLENGES AND ADVANCES

Methods allowing curious agents to explore and learn autonomously rely on exploring a vast space of tasks. However, integrating LLMs – already very resource-intensive in terms of computing power

– into such curious agents requires massive access to GPUs. Thanks to GENCI resources, we have conducted several pioneering works in the development of curious LLM agents. We notably proposed the first method allowing an LLM agent to learn, by interacting autonomously with a virtual world, to perform tasks and anchor its knowledge on the physical rules governing this environment. This year, we went further by enabling such an LLM agent to choose for itself, via our curiosity models, the tasks it wishes to learn. In addition, we have developed an agent capable of generating and solving programming problems in diverse ways, building on our curiosity models.

<https://proceedings.mlr.press/v202/carta23a.html>
<https://arxiv.org/abs/2502.07709>



← Workflow of the GLAM (Grounded LAnguage Models) method allowing the development of autonomous AI agents based on LLM through an interactive textual reinforcement learning (RL) environment called *BabyAI-Text*.

COMMUNITY OF LARGE INDUSTRIAL GROUPS

ARDNA Project, a collaboration dedicated to the long-term geological storage of radioactive waste

The ARDNA project is the result of a collaboration between public and private research. At its Meuse/Haute-Marne Underground Research Laboratory, Andra is investigating the potential of artificial intelligence (AI) to enhance the monitoring of the rock mass surrounding storage-facility demonstrators after excavation.

The ARDNA project (AI Research on Data for Nuclear Application), selected at the end of 2021 by the French government as part of the France Relance plan and as a winner of the call for projects supporting investment and modernization of the nuclear sector, was carried out in partnership with Aquila Data Enabler, a consulting and R&D firm specializing in AI and the project lead; Andra (National Agency for Radioactive Waste Management), the public institution responsible for the long-term management of radioactive waste produced in France; and SpotLight, a DeepTech startup and winner of the I-Nov 2020 call for projects, specialized in seismic data analysis for predictive monitoring of CO₂ storage sites (CO₂ CCS – Carbon Capture and Storage).

Supported by the competitiveness clusters Avenia (geosciences) and Nuclear Valley (nuclear), the project aimed to assess the potential of AI for the non-destructive monitoring of the mechanical response of clay

formations during excavation, complementing classical seismic inversion methods, which are particularly time-consuming. More specifically, the work focused on the ability of AI to estimate the spatial distribution of seismic wave propagation velocities in the rock from recordings obtained using sensors such as geophones, accelerometers, or DAS optical fibers. These propagation velocities are related to the mechanical properties of clay formations and constitute one of the parameters used to characterize the state of the rock around underground structures. Monitoring the mechanical response of clays during excavation, which can locally modify their properties, is an essential aspect of research on deep geological storage.

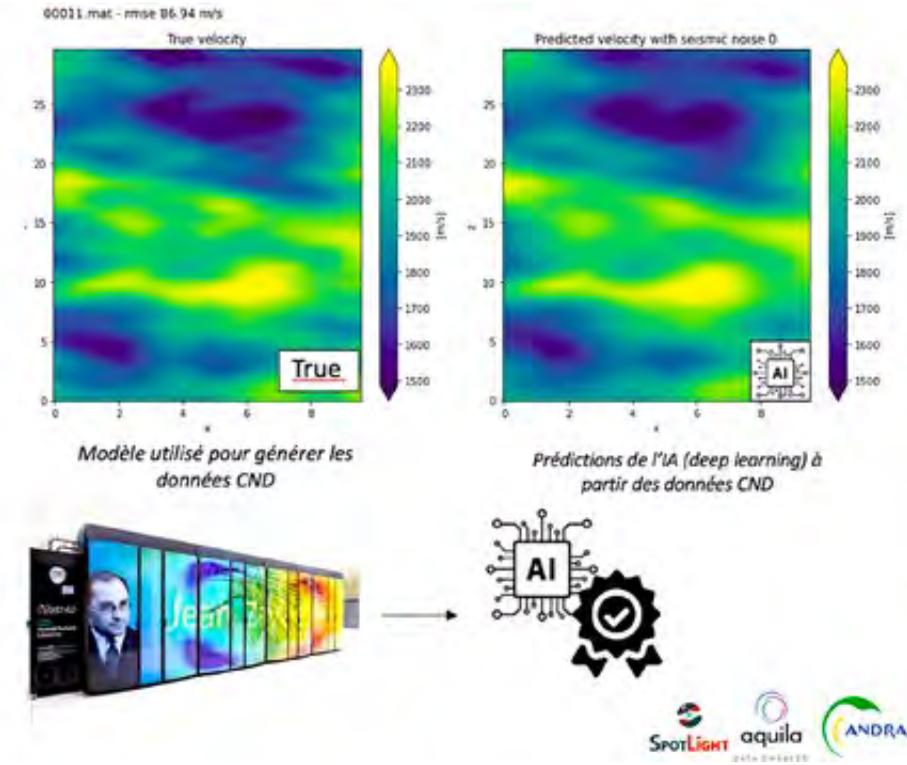
ASSISTANCE FOR UNDERGROUND STRUCTURE MONITORING

The developments relied on geophysical experiments conducted within the laboratory to demonstrate the feasibility of a tool to assist in monitoring underground structures, with

an industrial perspective for Cigéo (Industrial Center for Geological Storage), the future deep geological disposal site, located at about 500 meters depth, intended for the storage of high-level and long-lived radioactive waste (HA and LLW) produced by all French nuclear facilities (images) representing the spatial distribution of P-wave propagation velocities in the rock were generated using a random Gaussian field simulator. For each of these models, seismic wave propagation was simulated using a numerical



→ Comparison between the reference model (left) and the predictions obtained by the AI (right).



finite-difference method, allowing the computation of the full seismic response of the medium. The outputs of these simulations correspond to time-series recordings equivalent to those that would be obtained at Andra's underground laboratory. These simulated recordings were used to train a deep learning model based on a U-Net architecture, in order to learn how to reconstruct the velocity fields from seismic signals. The training was carried out on high-performance computing resources, notably the **Jean Zay machine (GENCI – IDRIS)**, due to the large volume of data and the complexity of the model. The results obtained on simulated data within the ARDNA project, a training database was built, consisting of several thousand 2D models.

These results suggest that the developed methodology is validated within the scope of the simulations and that a deep learning model can be used as

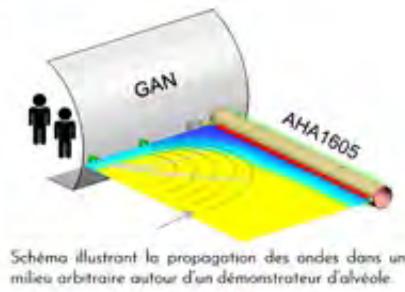
a rapid method for inverting P-wave propagation velocities from seismic recordings. However, this conclusion remains limited to synthetic datasets.



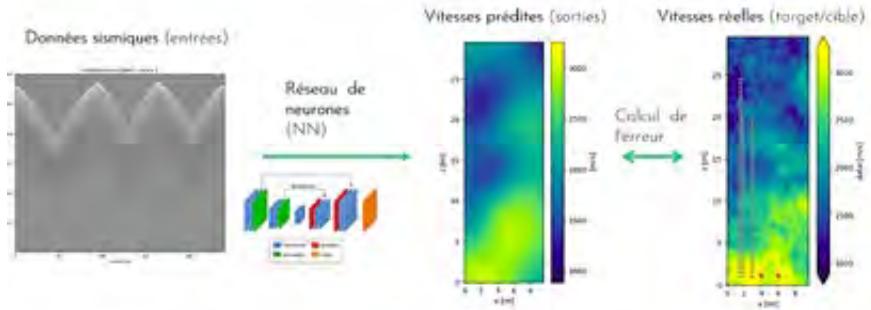
Deep learning on Jean Zay then allows us to infer seismic wave propagation velocity maps with the same accuracy as classical methods, but in a fraction of a second.

Julien COTTON,
Head of the Data and Digital Chain Department
at the Scientific and Technical Directorate of Andra





←
Top left: Photo taken at Andra's underground laboratory, in front of a HA cell demonstrator.
Top right: Conceptual diagram illustrating wave propagation in the rock around the demonstrator.
Bottom: Principle of training the AI model.



VALIDATED DEVELOPED METHODOLOGY

Tests conducted on real data did not yield fully satisfactory results, which was partly anticipated. Several factors explain these difficulties. On one hand, the illumination of the medium is limited due to the small number of sensors, the restricted number of source points, and the limited azimuthal coverage, which does not allow proper probing of the investigated rock volume. On the other hand, the presence of noise in real recordings, including aliasing phenomena, degrades the signal-to-noise ratio and complicates the accurate reconstruction of velocity fields. Moreover, the use of 2D simulators to generate training data, while wave propaga-

tion in the field is three-dimensional, introduces a gap between simulated and real conditions. Finally, the representation of the source wavelet in the simulations remains an approximation, which can also limit the model's ability to generalize.

Despite these challenges, the ARDNA project, completed in May 2025, enabled the validation of the developed methodology for the rapid estimation of velocity fields from seismic recordings. The results obtained on simulated datasets show that, in a controlled environment, deep learning achieves performance comparable to classical inversion approaches, with significantly reduced computation times. These studies also open ope-

rational perspectives for planning acquisition campaigns: the methodology could be used to evaluate, in near real-time, different source and sensor configurations in order to optimize medium illumination and prepare for future acquisitions.



MORE ABOUT THE PROJECT

GENCI and its environment



CONTENTS

p.56
 Toward the Creation of a Research Infrastructure

p.57
 EPICURE, toward a pan-European user support service

p.58
 GENCI participates in EPI-SGA2 and EUPEX

p.60
 Multiple commitments and wide azimuth activities

p.64
 Internal organization

p.65
 Committees members and official bodies

p.66
 GENCI IN 2025

GENCI IN REGIONS/Mesonet project



Toward the Creation of a Research Infrastructure

The objective of Mesonet project (2021-2027) is to strengthen the structuring of national and regional offers in digital simulation, the high performance computing (HPC), associated with artificial intelligence (AI) methods and quantum computing. The defining asset: local support.

The Ministry of Higher Education and Research aims to establish a Research Infrastructure designed to structure and sustain a digital service offering for scientific computing and data processing within the French higher education and research sector (ESR), integrated into an international framework. This solution would have the dual benefit of rationalizing public investments in human and financial resources for the digital sector in the ESR and providing national and European users, through EGI and EOCS, with a unified and clear catalog of services that local initiatives can join.

mode, through a federated operational structure (mutualized, rationalized, and devolved) that addresses users' needs for massive data processing in HPC, HTC, AI, and quantum computing. This offering would span access to regional computing and storage resources, user support, and access to national and European resources. The initiative also aims to address the insufficient national talent pool in the digital domain by providing services essential for initial and continuing education, maintaining a group of experts distributed across the territory, and fostering interactions, skills development, and complementarities.

TO ESTABLISH A COMPREHENSIVE OFFERING

In 2024, Mesonet and France Grilles partners worked on a proposal to pool complementary services for the benefit of the scientific and teaching communities. These stakeholders have historically supported services such as cloud or grid computing, distributed storage, and HTC, HPC, and AI services for a broad audience. The goal is to establish a comprehensive offering, in cloud

LINK WITH BUSINESSES

The French Competence Center (CC-FR) relies on the resources of participating Mesonet mesocenters to facilitate proofs of concept (PoC) using computing resources (see illustration). The CC-FR is also highly active in awareness campaigns and disseminating training sessions and webinars targeted at businesses and the academic sector.

MesoNET's partners.



GENCI IN EUROPE

EPICURE, toward a pan-European user support service

EPICURE (Eurohpc aPpLIcation sUPport pROject) is a project funded by EuroHPC. Its mission is to set up a Europe-wide distributed Application Support Team for high-performance computing.

The project began on February 1, 2024, and will run for four years. It brings together researchers and experts from all the computing centers that currently host EuroHPC computers or will do so in the coming months.

A second component of the EPICURE project is the organization of specific training courses on supercomputers architectures, hackathons, webinars, and workshops. To prepare the arrival of the Alice Re-coque supercomputer, GENCI is a partner in the EPICURE project, and CINES is also participating in the project as a third-party of GENCI.



MORE ABOUT THE PROJECT



↓ EPICURE kickoff meeting.

HOW CAN YOU GET SUPPORT FROM EPICURE EXPERTS?

Do you need to optimize your code on EuroHPC supercomputers? EPICURE can provide its services.

- **WHO IS ELIGIBLE?**
A project can obtain support from EPICURE if it has been allocated resources on a EuroHPC computer.
- **HOW LONG DOES THE SUPPORT LAST?**
It can last between 3 and 12 months, depending on the actions to be taken.
- **HOW DO YOU APPLY?**
Project owners can apply for support through the portal developed by EPICURE (<https://pm.epicure-hpc.eu/support/request>).



GENCI EN EUROPE

GENCI participates in EPI-SGA2 and EUPEX

The challenge of the EPI-SGA2 and EUPEX projects: defining a second-generation European processor and its accelerator, as a pathway to Exascale computing for France.

Following the first phase of the EPI (European Processor Initiative) project, known as SGA1, Europe continues to support the development of the second generation of the European processor and its accelerator by committing €70 million in funding to the EPI SGA2 project, which started in February 2022 and will run for three years. EPI-SGA2 aligns with the vision of the European 'Chip Act' [1]. SiPearl's roadmap delays worsened in 2024, and the availability of RHEA1 is now uncertain for the deployment announced in the 2023 activity report of 4,000 processors in the first quarter of 2025 on 'Jupiter' [2], the first European Exascale machine, which will be hosted at the JSC in Germany. Nevertheless, European technology remains a priority for the second Exascale machine led by the Jules Verne [3] consortium, which is expected to be deployed at the end of 2026."

TECHNOLOGICAL SOVEREIGNTY OBJECTIVE

The EUPEX project (European Pilot for Exascale), launched at the beginning of 2022, aligns with the vision of developing sovereign technologies that could equip future European Exascale architectures. Co-financed by the EuroHPC Joint Undertaking as well as France (via Bpifrance), Germany, Italy, Greece, the Czech Republic, and Croatia, it has a budget of €40.8 million over four years and brings together industry and academia (including in France: Atos, CEA, Inria, GENCI, and the SME CybeleTech).

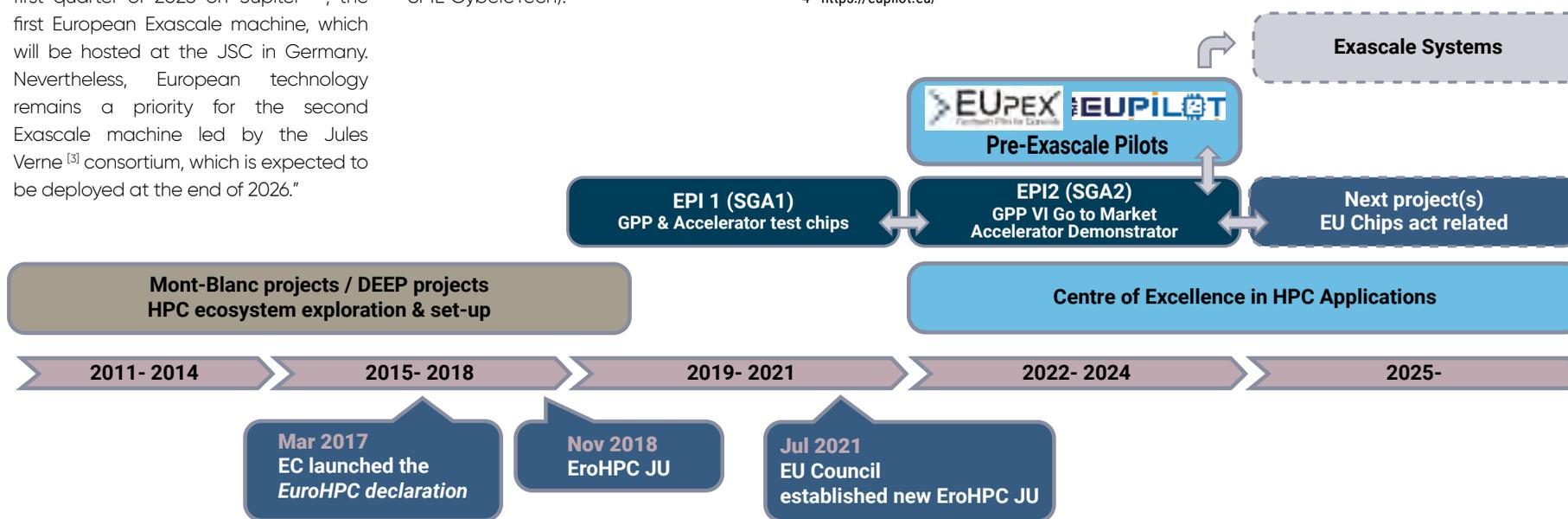
EUPEX aims to deploy the first pilot HPC systems, notably integrating the processor developed within the EPI project. In this context, the RHEA processor from the European company SiPearl is expected. EUPEX, EPI, and EUPILLOT^[4] (a related project) work together with the goal of technological sovereignty (as demonstrated by their joint stand at ISC24).

1 - https://ec.europa.eu/commission/presscorner/detail/fr/STATEMENT_22_891
 2 - <https://www.fz-juelich.de/en/ias/jsc/jupiter>
 3 - <https://www.genci.fr/exascale>
 4 - <https://eupilot.eu/>



← EUPEX Workshop in Heraklion.

↓ EUPEX, EPI and EUPILLOT had a common booth during SC24.



GENCI, A CIVIL COMPANY

Multiple commitments and wide azimuth activities

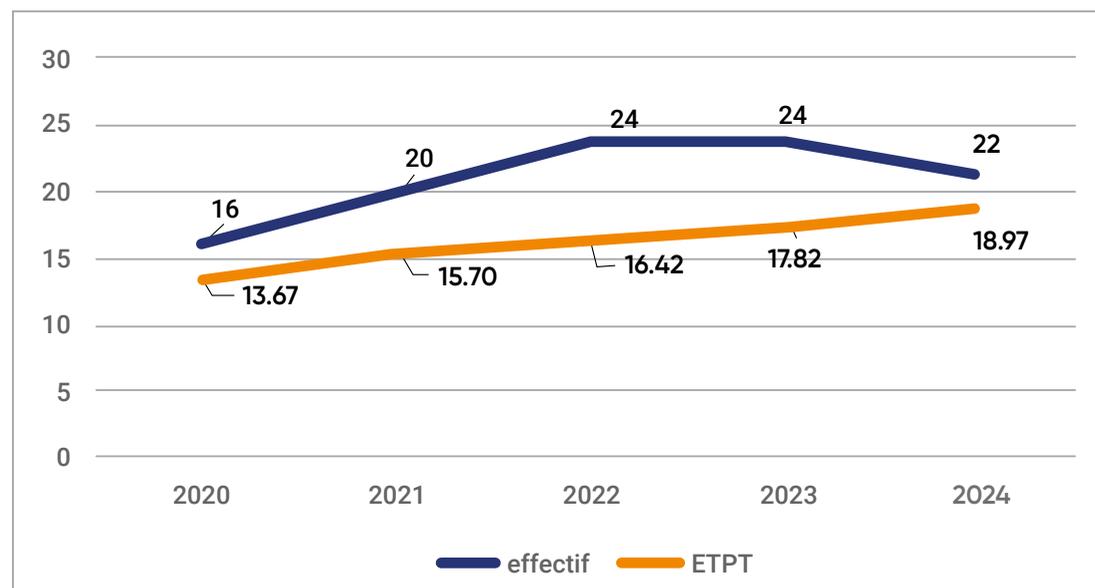
Since 2020, GENCI has pursued its efforts to dematerialize internal processes, continuously improve them and introduce internal charters.

In the same spirit as the deployment of electronic signature tools for GENCI's various commitments, an in-depth review was carried out to organize the process of committing expenditure with the different budget managers by relying on delegations of responsibility enabling GENCI to commit expenditure within a precise framework and at an appropriate level

in compliance with the rules of public procurement.

This system, which is due to be implemented by early 2025, will be accompanied by staff training sessions. As part of this commitment to improving and securing internal processes, two new internal charters came into force at the end of 2024:

- **A procurement process best practice charter** to ensure the legal compliance of procurement procedures and guarantee compliance with the main principles of public procurement, to ensure the proper use of public funds, to promote responsible procurement (including sustainable development, social inclusion, etc.) and to protect GENCI and its employees



← The following table present the evolution GENCI's workforce since 2020.



With the setup of new tools and processes in 2024 GENCI is even more committed to responsible acquisitions and ethic management serving transparency and trust.

Edouard BRUNEL
GENCI's General Secretary



by encouraging the adoption of best practice.

- **An ethics charter** to remind employees of the rules of good conduct to be observed in order to prevent any type of offence, fraud or crime in their interactions with external partners and to prevent possible conflicts of interest. It is aimed at all GENCI employees, at all levels of responsibility, encouraging them to act with ethical probity in the scope of their professional activity, while preserving GENCI's reputation.

TIME SAVINGS ACCOUNT AND EMPLOYEE RETIREMENT SAVINGS PLAN

At the request of its Shareholders, GENCI reviewed its policy of postponing holiday pay by establishing a chart relating to the rules for taking holiday pay, strictly applying from 1 January 2024 the stipulations of the Collective Bargaining Agreement for Technical Consultancy Firms, Engineering Consultancy Firms and Consultancy Companies of 15 December 1987, extended by decree on 13 April 1988.



To support this paradigm shift, GENCI has set up a time savings account enabling a certain amount of unused leave to be invested in the year concerned. This system has been combined with a retirement savings plan with the aim of fostering staff motivation and enabling them to build up additional income.

GENCI, A CIVIL COMPANY

The legal and financial activity of GENCI had a strong growth in 2024.



In terms of human resources, the activities around the CLUSTER, DALIA, EUPEX, HPCQS, EUROQCS and HQI projects, with their occasionally complex legal and financial set-up, mobilized the GENCI staff very heavily at the technical, administrative, legal and financial levels, in particular with the ongoing or future installations of quantum machines.

GENCI staff were also heavily involved in the Exascale project, with the technical, legal, tax and financial negotiations on the contractual documents with EuroHPC (Hosting Agreement, Administrative Agreement, Grant Agreement, Consortium Agreement) and the drawing up of the documents for the consultation of companies as part of the competitive dialogue launched at the end of the year to choose the next supplier for the French exaflop machine to be installed at the CEA.

In addition to these large-scale projects, GENCI is also rationalizing the eDARI system, for which it has been asked to ensure secure management and operation.

All of the technical and legal activities described above are in addition to GENCI's recurring activities, which were particularly sustained over the year.

GENCI has multiplied the number of

legal projects with the various centers, leading to an increase in legal and financial activity: agreements with the centers, in particular for the hosting of the exaflop machine at the CEA and the associated revenue phases in the context of the renewal of the centers computing resources (ADASTRA computer at CINES and Jean Zay at IDRIS). An intense legal and tax review was carried out to prepare the conditions for the admission and sale of hours of GENCI's computing resources to private users, and to re-examine its tax model with regard to VAT.

These varied and intense activities underline the ever-increasing workload to which GENCI's staff are subjected.

GENCI had 1 departure and 1 arrival for a workforce of 22 persons. In 2024, GENCI recruited a new employee for the position of 'Infrastructure Project Manager' in the Operations Division. An employee in the Technical and Innovation division left the company in April 2024.

Thus, taking into account arrivals and departures during the year and absences due to illness (for at least one



In 2024, GENCI strengthened its communication efforts by defending its brand, image, and reputation against competing trademark filings and online defamation campaigns. At the same time, the organization continued its compliance actions, particularly regarding the protection of personal data and adherence to the GDPR.

Marieke PODEVIN,
Data Protection Officer (DPO) at GENCI



month), the number of FTEs (full-time equivalent employees) is 18.97. The graph below presents an overview of the evolution of GENCI's workforce from 2020 to 2024.

DEFENCE OF ITS BRAND, ITS REPUTATION AND INFLUENCE

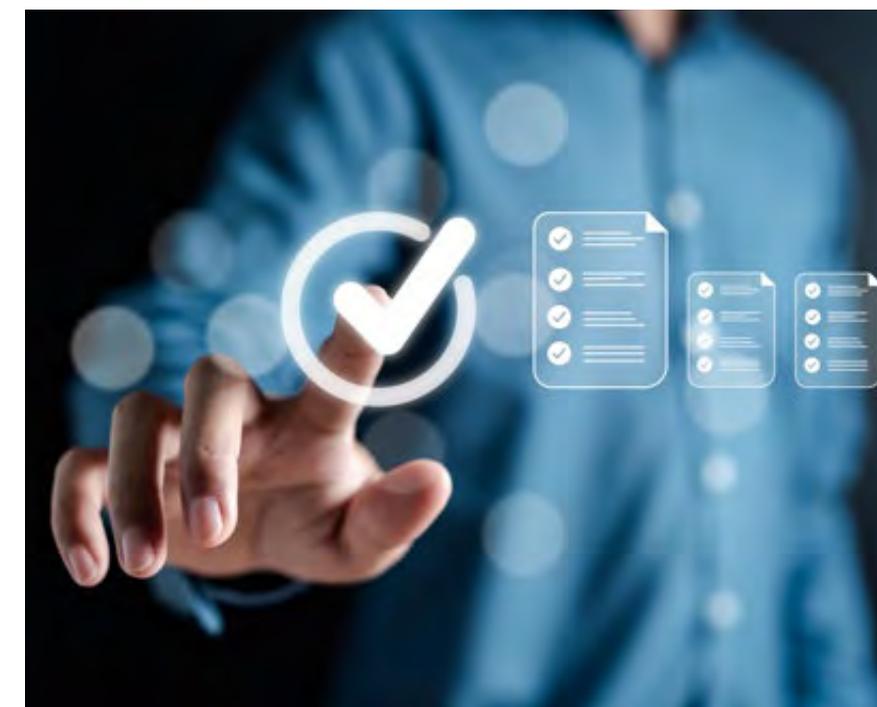
GENCI was particularly solicited on the aspects of communication, pursues the defence of its brand and, assisted by its CPI (Conseil en Propriété Industrielle), monitors the registration of potentially competing brands throughout the year and regularly files oppositions.

As part of its communications activities, and in particular its presence at the Vivatech exhibition as part of the HQI program, GENCI has also had to defend its image and reputation in the face of an online denigration campaign by an American organization contesting the use by civil society of the name 'Quantum Village', which brings together quantum start-ups hosted by GENCI on its stand.

As part of its compliance obligations in terms of personal data, in addition to its internal actions to monitor and update

compliance, GENCI is also continuing to monitor the allocation of access to computers under the subcontracting agreements signed with each of the three computing centers with regard to the GDPR.

In 2024 GENCI continued to develop its action toward its compliance diligences.



Internal organization

MANAGEMENT COMMITTEE



Philippe LAVOCAT
CEO



Édouard BRUNEL
General Secretary



Jean-Philippe PROUX
Operations and Security Officer



Stéphane REQUENA
CTO and Innovation Manager



Marie-Hélène VOUETTE
Partnership Manager
Institutional Relationship Advisor

ADMINISTRATIVE & FINANCE DEPARTMENT



Maïté CAMPEAS
Executive Assistant



Jason LAFRENIÈRE
Administration & Finance Manager



Célia LAGIÈRE
Legal Officer
(since 08/23/2022)



Christèle COCHARD
Office manager
(since 09/11/23)



Marieke PODEVIN
Senior Legal Officer
Data Protection Officer (DPO)



**Rasa VAICIEKAUSKAITE
FALLAHZADEH**
Administrative project Manager

COMMUNICATION



Nicolas BELOT
Communication Manager
and European relations



Annabel TRUONG
Communication Officer



TECHNICAL & OPERATIONS DEPT.



Éric BOYER
Project Officer HPC/HPDA/IA



Anna RIVET
Project Operations Manager
(since 09/18/2023)



Sabine MEHR
Chief Quantum Project Officer



Corinne BEAL
Exascale Project Manager



Félix GIVOIS
Quantum computing project
engineer (since 09/01/2023)



Guillaume LECHANTRE
Infrastructure Project Manager

Committees members and official bodies

(at 12/31/2024)

MEMBERSHIP OF THE GENCI COUNCIL

State and MESR representative:

Mr Laurent CROUZET - Mrs Karen AMRAM

CEA representative:

Mrs Maria FAURY - Mr Hervé DESVAUX

CNRS representative:

Mrs Adeline NAZARENKO - Mr Denis VEYNANTE

Universities' representative:

Mr Guillaume GELLÉ - Mr Olivier SIMONIN

Inria representative:

Mr Jean-Frédéric GERBEAU.

MEMBERSHIP OF THE ADMINISTRATIVE AND FINANCIAL COMMITTEE (CCAF)

State and MESR representative:

Mr Antoine PERRANG, Chairman of CCAF

CNRS representative:

Mrs Anne-Françoise DUVAL

CEA representative:

Mrs Louise JULIEN-TAMISIER

Inria representative:

Mrs Catherine GALLET-RYBAK

Universities' representative:

Mr Michel DELLACASAGRANDE.

MEMBERSHIP OF THE COMMITTEE AUDIT CONTRACTS (CM)

State representative:

Mr Philippe AJUELOS, *Ministerial Administrator of Data, Algorithms and Source Codes – digital education department of the Ministry of National Education and Youth, President of the Markets Commission*

Mrs Lara MONTANTIN, *Legal Officer performance, financing and contractualization with research Department of organization management support and regulation*

CEA representative:

Mr Éric STEHLE, *Head of Commercial Service and Strategic Partnership of Paris-Saclay (CEA)*

Mr Thibault PELLETIER, *Head of Reference Service and the Markets Commission at the Commercial and Strategic Partnership Department (CEA)*

CNRS representative:

Mr Sébastien TURCI, *Deputy Director for Purchasing and Innovation of the CNRS*

Mrs Marie-Laure COLIN, *Head of Public Economic Law and Regulations at CNRS*

TECHNICAL ADVISORY COMMITTEE (CT)

State and MESR representative:

Mr Guillaume AULANIER, *High-Performance Computing Officer, Digital Services and Infrastructures Department*

CEA representative:

Mrs Valérie BRENNER, *Fundamental Research Department*

Mr Émeric BRUN, *Directorate for Nuclear Energy*

Mr Nicolas LARDJANE, *Head of TGCC*

CNRS representative:

Mr Michael KRAJECKI, *Scientific Delegate*

Mr Pierre-François LAVALLÉE, *Director of IDRIS*

Universities' representative:

Mr François BODIN, *Professor at University Rennes 1*

Mr Michel ROBERT, *Director of CINES*

Inria representative:

Mr Lucas NUSSBAUM, *Head of experimentation platforms program at the Executive Committee for Innovation*

Mr Frédéric DESPREZ, *deputy of the scientific director, in charge of the "Networks, Systems and Services" area*

COMMITTEE FOR STRATEGIC GUIDANCE ON INVESTMENTS (COSI)

Committee with responsibility for advising and providing assistance to GENCI in its investment strategy covering in particular the compilation of a multi-year investment plan based on the indications given by the MESR scientific committee and guiding the work of the CT and CCAF.

State and MESR representative:

Mr Laurent CROUZET, *Head of Numerical Services and Infrastructures Department*

CEA representative:

Mr Christophe CALVIN, *Fundamental Research Department*

CNRS representative:

Mr Denis VEYNANTE, *Chairman for the Steering Committee of the Compute & Data Mission*

Universities' representative:

Mr Olivier SIMONIN, *Chairman of National Polytechnique Institute (Toulouse)*

Inria representative:

No representative

GENCI IN 2025

In 2025, GENCI's business will be bookmarked by many challenges

Infrastructures, users and projects

- ▶ Inauguration and commissioning of Jean Zay 4 Supercomputer
- ▶ Inauguration and availability for users of Ruby, the quantum computer from Pasqal at TGCC
- ▶ Development of the Maisons du Quantique (Houses of Quantum)
- ▶ Installation of the Lucy, quantum computer from Quandela
- ▶ Selection of the technical provider of the Alice Recoque supercomputer
- ▶ Jean Zay 4 Grands Challenges Day
- ▶ Call for projects on DARI resources A18 and A19
- ▶ Scientific results

A huge thank you goes to the authors and contributors for your time and the energy you have dedicated to this Annual Report outlining all the work of GENCI during 2024.

It is only thanks to the people in this report, as well as many others, that GENCI is able to achieve its objectives and be part of the emergence of new possibilities every year.

Events

EuroHPC summit Week 2025 **ISC**
Forum ORAP
Vivatech AI Action Summit
France Quantum
 Supercomputing

And so much more...

Publication director: Philippe LAVOCAT – **Coordination:** Annabel TRUONG – **Design & production:** avec des mots – **Photos & illustrations:** AEF Info ; Agence Oblique/ Cyril Marilhacy ; Guillaume BALARAC ; Bureau/CRA/photo ; CINES ; Maxime COLOMB/ICI ; Casimir DE LAVERGNE/CNRS-LOCEAN-IPSL-Sorbonne Université ; Digital & Assurance ; DR ; Cyril FRESSILLON/IDRIS/CNRS Images ; Anne GRASSI ; iStock ; Noël JAKSE ; Jean KEMPF ; Le Monde ; L'Usine Nouvelle ; François RINCON ; TGCC/CEA – **Printing:** Quarante Six – GENCI: 6 bis, rue Auguste Vitu 75015 Paris - France – Tél. : +33 1 42 50 04 15 © GENCI – november 2025



GENCI – 6 bis, rue Auguste Vitu 75015 Paris – France
Tél. : +33 1 42 50 04 15
www.genci.fr/en



Follow GENCI

