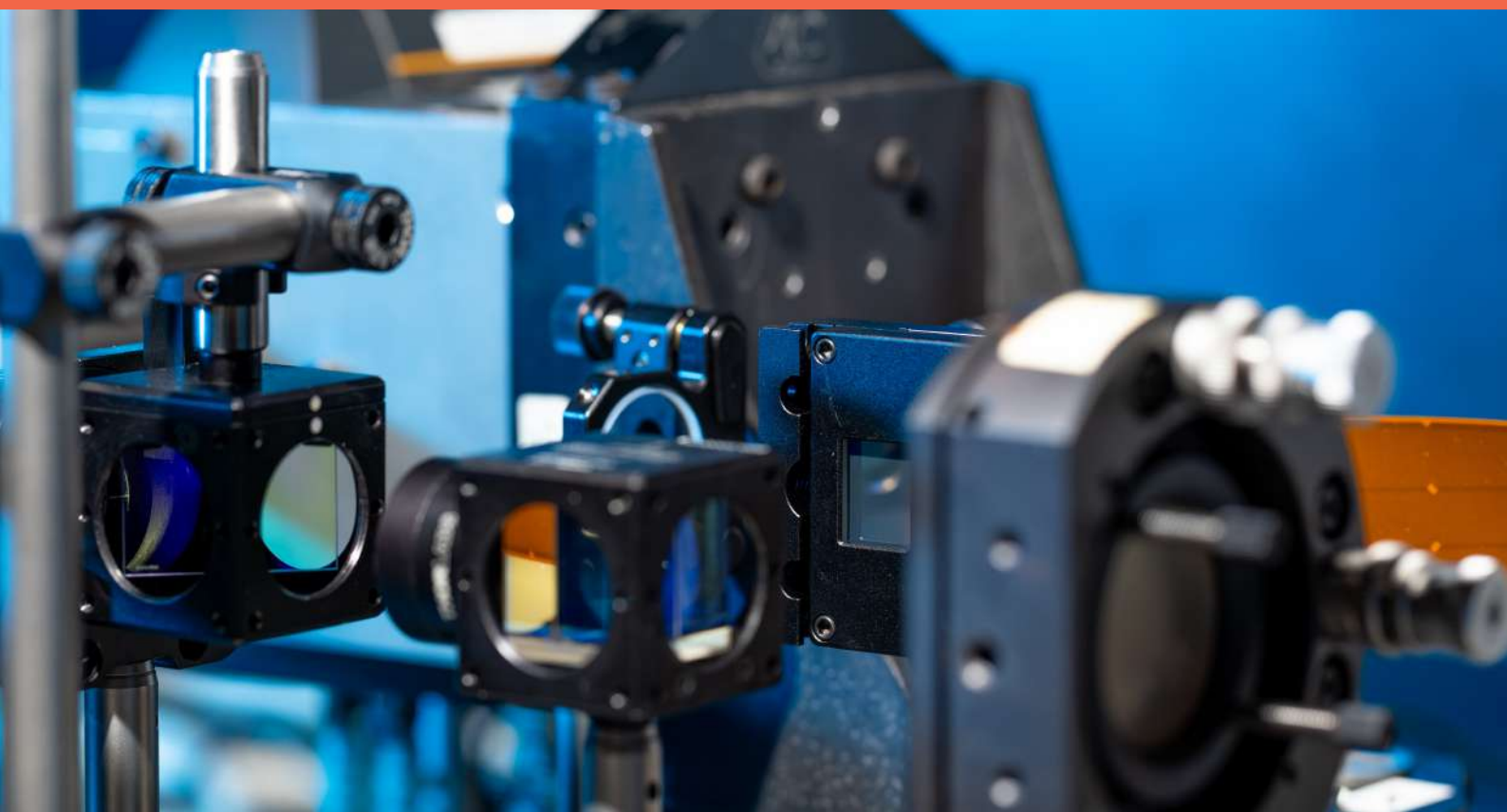
femto-st
SCIENCES &
TECHNOLOGIES

2025

# Annual Report



# FOREWORD

Exploring Science and Innovation, from basic research to industries and spin-offs, from theory to experiments through high technology facilities, developing micro and nanotechnologies, increasing the density of functions and integrating intelligence for the engineering of components and systems with optimized performances, contributing to the future of a knowledge-based improved society.

FEMTO-ST is a joint laboratory between the Centre National de la Recherche Scientifique (CNRS) and the faculties of Université Marie et Louis Pasteur (UMLP), including SUPMICROTECH and UTBM. We develop sciences and technologies (ST) across a range of scientific fields, focusing on five strategic priorities: ST for biology and healthcare, ST for sustainability, micro and nano ST, ST for Artificial Intelligence and optimisation, Quantum ST. This cross-cutting approach increases the impact and visibility of our research across all the institute's scientific disciplines. With 287 faculty members and more than 700 employees, FEMTO-ST is one of the largest CNRS laboratory in France involved in Engineering and Information Sciences. In 2025, FEMTO-ST invests in new talents and welcomes 18 new academic positions building the future of our institute.

In this annual report, you will find a selection of key scientific highlights that illustrate the excellence and diversity of our research activities. In 2025, we further strengthened our international presence by collaborating with 67 foreign universities across 30 countries and starting five new European projects. FEMTO-ST also invests in a shared technological infrastructure that provides all its members with a unique environment, designed to foster cutting-edge research and innovation. Furthermore, the FEMTO-ST Institute is committed to promoting science amongst young people and society as a whole.

This year, we are delighted to feature Michel de Labachelerie, Director of the CNRS, specialist in micro- and nanotechnology, who was awarded the French Legion of Honour for his role in structuring both national and regional research as the founder and first director of the FEMTO-ST institute.

We wish you to enjoy this 2025 annual report, whether keeping up in date the amazing scientific work carried out by our talented researchers and staff and discovering the range of our activities. We also hope this report will trigger opportunities and ideas to develop new collaborations and attract new talents to join FEMTO-ST. Finally, we would like to express our gratitude to all members of FEMTO-ST for their positive mindset, unwavering dedication to our shared scientific mission.

Michaël Gauthier, Director of FEMTO-ST
Thérèse Leblois, Vice-Director of FEMTO-ST
Marie-Ange Manier, Vice-Director of FEMTO-ST

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Cover

Experimental setup for the spatial control of quantum objects.

# FEMTO-ST

IN FIGURE

732

## WHO WE ARE

257 Professors & Associate Professors
30 CNRS Researchers
251 PhD Students
62 Postdocs
132 Engineers/Technicians

MORE THAN

100

WORLD WIDE INSTITUTIONAL ACADEMIC PARTNERS

7 RESEARCH DEPARTMENTS

+ 1 TEAM IN HUMANITIES AND SOCIAL SCIENCES

14 STARTUPS IN 12 YEARS

864

SCIENTIFIC ARTICLES IN 2025

1 INNOVATION TRANSFER UNIT (FEMTO ENGINEERING)

1 MICRO-NANO TECHNOLOGY CENTRE (MIMENTO)

10 RESEARCH FACILITIES

38M€

ANNUAL BUDGET

79

RESEARCH CONTRACTS IN 2025

# CONTENTS

# A BROAD RANGE OF SCIENTIFIC EXPERTISE

**FEMTO-ST INSTITUTE includes 7 departments that are encouraged to perform research collaboratively. Multidisciplinary research is carried out along the transverse axe and the team RECITS.**

### APPLIED MECHANICS

- Materials, surfaces, processes, structures
- Micromechanics, microfabrication
- Functionalization, smart structures
- Sustainability, reliability, bio-compatibility

### TIME & FREQUENCY (TF)

- Oscillators/ resonators
- Time & Frequency metrology
- Microwave systems and sensors

### ENERGY

- Hydrogen-energy
- Electromagnetic converters
- Thermal machines
- Metrology and energy management

### OPTICS

- Nonlinear photonics
- Complex optoelectronic systems
- Nano-photonics
- Quantum Optics

### ROBOTICS & AUTOMATION (AS2M)

- Microrobotics, mechatronics
- Automation
- Prognostic & Health Management (PHM)

### COMPUTER SCIENCE (DISC)

- AI and distributed computing
- Reliability, security in complex systems
- High performance computing
- Smart distributed microsystems

### MICRO-NANOSCIENCES & SYSTEMS (MN2S)

- Nanosciences and nano-structured materials
- Bio-microsystems
- Multimodal qualification of biological objects
- Phononic and Microscopy

### RECITS

- Research and Study of the Evolution of Industry, Technology, and Society

# HIGH IMPACT SCIENTIFIC PRIORITIES

**Since 2024, we develop cross-cutting inter-departmental themes. The main objectives are to address major scientific challenges collectively thanks to complementary expertise, to encourage the development of new multidisciplinary projects and increase our national and international visibility.**

### MICRO-NANO SYSTEMS AND TECHNOLOGIES

- Electro active materials ($LiNbO_3$, $LiTaO_3$)
- Metamaterials, advanced materials
- Microrobotics, microsystems, mechanical
- Microfabrication
- Femtosecond laser machining.

### ARTIFICIAL INTELLIGENCE AND OPTIMISATION

- Cybersecurity
- WIreless networks
- Photonic neuromorphic computing
- Explainable AI
- Prognostic and health management.

### SCIENCE AND TECHNOLOGIES FOR A SUSTAINABLE DEVELOPMENT

- Hydrogen energy, biomaterials
- Green data centers
- Sustainable mechanics
- Green robotics, sensors
- Sustainable AI

### QUANTUM TECHNOLOGIES

- Atomic clocks
- Quantum sensors
- Quantum photonics
- Quantum computing.

### SCIENCE AND TECHNOLOGIES FOR BIOLOGY AND HEALTHCARE

- Biosensors
- Microfluidics of cell engineering
- Microrobotics
- Nano bio characterization
- Data mining for neuroscience
- AI for health and data security
- Organ on chip, lab on chip.

# FACILITIES

# MAIN FACILITIES

FEMTO-ST's main facilities are grouped into centers to make them accessible for research and development projects not only to FEMTO-ST members, but also to teachers and regional, national, and international industrial and academic partners. Each has its area of specialization. :

### AMETISTE

Mechanical characterization of materials, surfaces, and structures in a wide range of dimensions and frequencies

### MIFHYSTO

Micromanufacturing, mechanics, micromachining, powder injection molding, metal additive manufacturing, surface treatment, filled polymers, metrology, and material characterization

### CLIPP

(Bio) chemistry, chemical physics, nano- and micro-engineering, biostatistics, and bioinformatics

### MIMENTO

Micro-nano-optics, micro-nano-acoustics, micro-opto-electro-mechanical systems (MOEMS), and micro-robotics. Member of the «RENATECH» network.

### CMNR

Micro/nanocomponents, characterization, manipulation, and micro-assembly

### OSCILLATOR IMP

Oscillator instability measurements, frequency references (from RF to optics), and state-of-the-art comparative measuring instruments

### FLUIDIX

Fluidic and thermal characterization of complex flows

### SMARTLIGHT

Photonics for AI and AI for photonics facilities (photonics and optoelectronic state-of-the-art equipment)

### FRANCHE-COMTE MESOCENTRE

Numerical simulation, high-performance computing

### SURFACE

Development and characterization of thin-film materials

### HYDROGEN ENERGY (FCLAB)

Hydrogen energy and the testing of fuel cell systems, the durability of energy sources for electric and hybrid vehicles, and for stationary applications.

MIMENTO

OTHER FACILITIES

# RESEARCH

# NEW MEMBERS

**AS2M**

**Karim CHERIFI**

Junior Chair Professor

Karim CHERIFI earned his PhD in 2019 from the Institute of Electrical and Electronics Engineering in Boumerdès (Algeria), with a specialization in control theory. He subsequently completed a one-year postdoctoral fellowship at the Max Planck Institute in Magdeburg (Germany), where his research focused on nonlinear model reduction in electrochemistry (notably lithium-ion batteries) and data-driven identification of port-Hamiltonian systems.

He then held a research assistant position for three years at the Technical University of Berlin, working on the design of digital twins for large drive applications within the project “Elektrische Antriebe 2.0” at the Werner-von-Siemens Centre for Industry and Science. He later spent one year at Bergische Universität Wuppertal, continuing his work on the same research themes.

Since December 2025, he has been a tenure-track Junior Professor at SUPMICROTECH and the FEMTO-ST Institute. His research focuses on physics-informed data-driven modeling, with a particular emphasis on port-Hamiltonian systems. He aims to develop methodological advances and translate them into applications across multiple domains, including neuroscience, robotics, and healthcare.

**Contact:**

karim.cherifi@femto-st.fr

**AS2M**

**Nadège MARTHOURET**

Engineer in Electronics

From 1995 to 2003, Nadège Marthouret served in the naval aviation branch as an aeronautical electronics technician based in Nîmes-Garons. In 2005, she completed a Master’s 2 in Optoelectronics and Microwaves at the University of Montpellier 2.

In December 2005, she joined the FEMTO-ST Institute as an electronics engineer, working 80% of her time in the optics department and 20% in the electronics teaching department at UMLP. She developed skills in low-noise analog electronics, digital electronics, and instrumentation. Between 2020 and 2025, she was affiliated with the LNIT laboratory. Since December 2025, she has returned to the FEMTO-ST Institute (AS2M department), where she contributes to the activities of the Micro and Nano Robotics Center and serves as the point of contact for the Dimatix DMP 2850 functional fluid deposition printer installed at the CMNR. This equipment enables the microfabrication of thin 2.5D structures, with a resolution of approximately ±25 µm, on a wide range of rigid or flexible substrates up to A4 size. Current manufacturing proposals focus on sensors, electrodes, and flexible PCBs.

**Contact:**

nadege.marthouret@femto-st.fr



**AS2M**

**Yongxin WU**

Full Professor

Yongxin Wu has been a Full Professor in Automatic Control at Université Marie et Louis Pasteur (UMLP) since September 2025, affiliated with the AS2M department, FEMTO-ST. He previously served as an Associate Professor in Automatic Control at SUPMICROTECH. He is a Senior Member of IEEE and an active member of the “Distributed Parameter Systems” Technical Committee of the IEEE Control Systems Society, the IFAC Technical Committees on Distributed Parameter Systems and Mechatronic Systems, as well as the ASME Technical Committee on Distributed Parameter Systems. Since 2024, he has also been an Associate Editor for the IEEE CSS Technology Conference Editorial Board. He is additionally the co-director of the international Master’s program in Automatic Control and Robotics (Master ARMAC) at UMLP.

Yongxin Wu is interested in the modeling and control law design of nonlinear and distributed-parameter systems. His objective is to develop suitable tools for the modeling and control of electroactive-polymer-based actuators using a physically grounded interpretation within the port-Hamiltonian framework. His research activities have led both to theoretical results in control theory and to practical applications in the modeling and control of soft actuators based on electroactive polymers, supported by experimental validation.

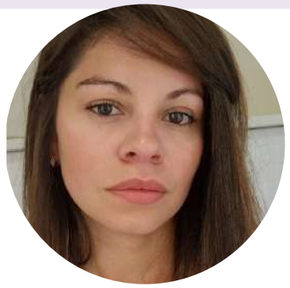
**Website:**

https://sites.google.com/site/yongxinwu1985

**Contact:**

yongxin.wu@femto-st.fr

# NEW MEMBERS



**DISC**

**Karla BRESCHI**

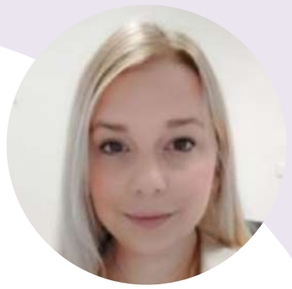
Assistant professor

Karla Breschi completed her PhD at Université Marie et Louis Pasteur (UMLP), within the FEMTO-ST Institute (DISC department), between 2015 and 2018. Her research focused on optimizing communications in heterogeneous wireless sensor networks. She then held two ATER positions at UMLP: the first at the UFR ST in 2019 and the second at the UFR SJEPG in 2024. She also gained industry experience as a development engineer at Cegid (formerly Meta4) for one year, followed by a two-year position as an R&D engineer at Seek-one. She is currently an assistant professor at UFR SJEPG and a member of the DISC department, more specifically within the DEODIS team.

Her research is structured around two main areas: on the one hand, scheduling—particularly job shop scheduling—and the impact of different metaheuristic components on performance; on the other hand, distributed artificial intelligence, and more specifically multi-agent systems.

**Contact:**

kjimenez@femto-st.fr



**DISC**

**Mélody CHARTON**

Financial Manager

After completing studies focused on business, Mélody Charton shifted her career toward administrative work and then accounting. Before joining FEMTO-ST, she worked as an accountant in a construction company. Today, she leverages her versatile background as the financial manager of the DISC department, where she secured a permanent position in 2025.

**Contact:**

melody.charton@femto-st.fr



**DISC**

**Antoine CHEVROT**

Assistant professor

Antoine Chevrot is an assistant professor in Computer Science at Université Marie et Louis Pasteur (UMLP) and a member of the FEMTO-ST Institute. After graduating with an engineering degree from INSA Lyon, he completed his thesis in the VESONTIO team at DISC on anomaly detection in time series data from commercial aircraft trajectories. Before obtaining his position at UMLP, he worked for a year as a scientist at the ONERA institute on the environmental impact of aviation and two years in the AI laboratory at Smartesting, where he contributed to the integration of artificial intelligence solutions into software testing support tools.

His research lies at the crossroads of machine learning, security, and software validation for complex, safety-critical systems. He develops data-driven and generative AI approaches to enhance the trustworthiness of both infrastructures and software. His work includes anomaly detection in multivariate time series, particularly to identify cyberattacks in cyber-physical systems, with applications in aviation data. In parallel, he explores the use of AI to support the entire software testing lifecycle, from requirements analysis to automated test execution using autonomous agents. He also applies anomaly detection to execution logs and sensor data to evaluate system robustness. Overall, his goal is to design explainable and scalable machine-learning-based validation frameworks that improve the security and reliability of modern systems.

**Contact:**

antoine.chevrot@univ-fcomte.fr

# NEW MEMBERS

**DISC**

**Luc DARTOIS**

Assistant professor

Luc Dartois completed his PhD in formal languages theory at Université Paris Diderot (now Université Paris Cité) under the supervision of Olivier Carton and Jean-Eric Pin, which he defended in 2014. He then worked for one year as an ATER at Aix-Marseille Université, followed by a three-year postdoctoral position at Université Libre de Bruxelles. Between 2018 and 2025, he served as an associate professor at Université Paris-Est Créteil before joining UMLP in September 2025.

His expertise lies in Formal Methods. His research focuses on automata theory, verification, synthesis, transducers, and logic over words. He is mainly interested in developing and studying frameworks for the automatic verification of programs. More precisely, he studies programs that transform their inputs, such as streams, which are modeled by transducers.

**Contact:**

luc.dartois@femto-st.fr

**DISC**

**Vincent FAGNON**

Assistant Professor

Vincent Fagnon is an Associate Professor in Computer Science at Université Marie et Louis Pasteur and a member of the DISC department at the FEMTO-ST Institute. He completed his PhD in Grenoble, where he specialized in operational research and the algorithmic foundations of parallel scheduling. Before joining UMLP, he held positions at ENSIIE, Université de Lorraine, and Université Grenoble Alpes, contributing to projects on scheduling theory, operations research, and optimization. His broader objective has been to design frugal and robust algorithmic scheduling solutions for modern computing systems.

At FEMTO-ST, his research focuses on parallel scheduling, optimization, and decision-making under uncertainty. He studies how prediction models, whether accurate or imperfect, can be incorporated into classical scheduling algorithms to improve theoretical performance guarantees. His work also extends previous efforts on large-scale scheduling for heterogeneous and hybrid processor architectures. In parallel, he is developing an interest in energy-aware scheduling, including scenarios where computing platforms rely exclusively on green energy or operate under battery-based constraints.

**Website:**

https://vfagnon.gitlab.io/

**Contact:**

vincent.fagnon@femto-st.fr

**DISC**

**Sassi MAALOUL**

Assistant professor

Sassi Maaloul is an Associate Professor at Université de Technologie de Belfort-Montbéliard (UTBM) and a member of the FEMTO-ST Institute (DISC department). He received his PhD in Information and Communication Technology from the Higher School of Communication of Tunis (SUP'COM), University of Carthage, in March 2016. In 2020, he obtained a two-year postdoctoral position in the COSY-ERENA team at the University Gustave Eiffel, then an Associate Researcher position until August 2025. His primary research areas include Cooperative Intelligent Transport Systems (C ITS), wireless networks, V2X vehicular communication, and mobility management. Since 2020, he has been involved in various regional, national, and European projects related to automated and connected vehicles.

His work focuses on CITS, wireless networks, V2X vehicular communication, and mobility management, all of which relate to large-scale heterogeneous communication systems and advanced mobility solutions. His research background aligns with the "Wireless Networks and Mobility" theme of the laboratory, focusing on modelling, optimisation, and performance evaluation of wireless communication.

**Contact:**

sassi.maaloul@utbm.fr

# NEW MEMBERS

## ENERGY

**Mondher ABIDI**

Contract Lecturer Researcher

Mondher Abidi is a contract lecturer researcher in electrical engineering at UTBM and the FEMTO-ST Institute in the Energy Department. As part of the SHARPAC team, he focuses on developing advanced control strategies and innovative solutions for hybrid energy systems.

His work integrates theoretical modeling, numerical simulation, and experimental validation to advance the transition towards more sustainable and resilient power systems. He is particularly interested in smart energy management, optimization of distributed generation systems, and grid stability in the face of renewable intermittency. Mondher Abidi also teaches courses in electrical engineering and energy systems.

**Contact:**

mondher.abidi@utbm.fr

## ENERGY

**Qian XUN**

Junior Chair Professor

Qian Xun received her M.S. in power electronics and electric drives from Nanjing University of Aeronautics and Astronautics (China) in 2015, and her Ph.D. in electric power engineering from Chalmers University of Technology (Sweden) in 2022. She is currently a Junior Chair Professor at UTBM and the FEMTO-ST Institute in Belfort. Previously, she held positions as Senior Researcher at the Unit of Energy Conversion, Research Institutes of Sweden; Research Fellow at the Center of Electronic Energy Systems, Fraunhofer Institute for Silicon Technology (Germany); and Lecturer at Huzhou University (China). She has been involved in several EU-funded and national research projects in the fields of hydrogen energy systems, power electronics, and integrated energy systems.

Qian Xun focuses on advanced modelling, control, and optimization of hydrogen-based hybrid energy systems, with a strong emphasis on real-time simulation and digital-twin technologies for power electronics in emerging energy systems. Her work aims to develop high-fidelity models and intelligent control strategies that accelerate the clean energy transition through improved system efficiency, reliability, and integrability.

**Contact:**

qian.xun@utbm.fr



## MIMENTO

**Aurore ANDRIEUX**

Operations Manager

Aurore Andrieux holds a PhD in Materials Science (2015) from Université de Lorraine. She previously worked at the FEMTO-ST Institute in 2017–2018 as co head of the Deposition Division of the MIMENTO platform. In 2018, she joined CNRS as an engineer in thin film materials and spent seven years at Laboratoire ICB (Dijon) within the Nanofabrication Division of the ARCEN CARNOT platform.

Her work has primarily focused on the development and characterization of materials for photonic applications.

Since December 2025, she has been the operational manager of the MIMENTO technology center, which is a member of the national RENATECH network, dedicated to major technological research facilities in micro and nanotechnology.

**Contact:**

aurore.andrieux@cnrs.fr

# NEW MEMBERS

## MIMENTO

**Toufik NOUIRI**

Clean Room Facilities Assistant Engineer

After graduating in mechanical and energy engineering, Toufik Nouiri began his career in France in 2008 with short-term assignments in the automotive and construction sectors, which helped him gain familiarity with French culture and language. He then trained in thermal equipment maintenance and worked in the heating sector, servicing small- and medium-capacity boilers through installation, troubleshooting, and maintenance.

He also served as an HVAC technician at PSA Sochaux, focusing on the paint shop's HVAC systems, where he managed air handling units to ensure proper operation and optimal energy performance. In the pharmaceutical industry, he worked at Vetoquinol Laboratories in Magny Vernois (Lure), operating energy production systems (compressed air, chilled water, steam, etc.), overseeing maintenance services, and proposing efficiency improvements.

Since 2024, he has been working at the MIMENTO Technology Center in facility management, initially on a one-year contract, before being recruited this year by CNRS.

**Contact:**

toufik.nouiri@femto-st.fr

## RECITS

**Cyril LACHEZE**

Lecturer in History

Cyril Lacheze is a historian of technology with training in history and archaeology from Paris 1 Panthéon Sorbonne University. He specializes in modern and contemporary techniques, particularly the 17th century, with a multidisciplinary and systemic approach. His doctoral research focused on the production of architectural terracotta in France from the 13th to 19th centuries, examining both practical applications and innovation processes. He also explores digital humanities, the intersections of history with board and video games, and popular culture. Additionally, he conducts research in early music, performing Baroque violin and other period instruments at a semi professional level.

He works as a lecturer researcher at UTBM and FEMTO ST (RECITS team). He works on the Techn'hom Time Machine project: this digital humanities project combines historical and archaeological research, 3D modeling, knowledge modeling, and an educational component for engineering students. A second research project concerns the travels of engineering students from the École des Mines de Paris in the 19th century. Finally, he develops a project to reconstruct the technical system of the Belfort region in the first half of the 17th century, examining the links between technology and territory for a crucial historical period in local history.

**Website:**

https://www.femto-st.fr/fr/personnel-femto/cyrillacheze

**Contact:**

cyril.lacheze@utbm.fr

## TIME AND FREQUENCY

**Gonzalo CABODEVILA**

Assistant professor

Gonzalo Cabodevila holds the Agrégation in Electrical Engineering and is a graduate of ENS Paris Saclay, specializing in control systems and robotics. After completing a PhD in robotics focused on walking robots, he was appointed Associate Professor at ENSMM in Besançon, where he developed research at the interface between modeling, control, and instrumentation. He then spent three years at LIMMS in Tokyo, training in cleanroom microtechnology and working on microneedles and MEMS for biomedical applications. After returning to France, he contributed to a European project on microneedles and their healthcare applications. For six years, he served as Deputy Regional Delegate for Research and Innovation (DRARI), contributing to the regional coordination of research and innovation.

He currently works on control systems for time frequency applications, addressing issues related to metrology, system stability, and advanced control systems. Current research focuses on time frequency studies centered on the ULISS cryogenic ultrastable oscillator, one of the world's most stable oscillators. This activity combines refined models of thermal dynamics, system identification, design of advanced control laws, and experimental validation on metrological test benches. In parallel, he contributes to White Rabbit technology for precise time and frequency distribution over deterministic Ethernet networks, focusing on control and signal stability to optimize high precision synchronization for distributed measurement and communication systems, in collaboration with J M Friedt.

**Contact:**

gonzalo.cabodevila@femto-st.fr

# NEW MEMBERS

## TIME AND FREQUENCY

**Emmanuel KLINGER**

CNRS Research Scientist

Emmanuel Klinger earned his Master's degree in Physics from the University of Burgundy (Dijon) in 2016. He then completed a joint international PhD between the ICB Laboratory at the University of Burgundy and the Institute for Physical Research of the Armenian Academy of Sciences, which he defended in 2019. After a first postdoctoral position in D. Budker's group at Johannes Gutenberg University in Mainz (Germany), he joined the Time Frequency Department of the FEMTO ST Institute in 2022. He was appointed CNRS Research Scientist in 2025. His work focuses on atomic physics, quantum metrology, and the development of miniaturized sensors, such as atomic clocks and optically pumped magnetometers.

Emmanuel Klinger's research project centers on creating a single photon source using Rydberg atoms confined in vapor cells with optical spacing at or below the micrometer scale, commonly referred to as nanocells. To achieve this, he will leverage advanced microfabrication technologies for vapor cells—an area in which the FEMTO ST Institute is a recognized world leader—to produce nanocells innovatively. In parallel, he aims to develop quantum sensors based on microfabricated vapor cells, such as nuclear magnetic resonance gyroscopes, for high precision navigation and metrology applications.

**Contact:**

emmanuel.klinger@femto-st.fr

## APPLIED MECHANICS

**Solène BARLEMONT**

Assistant Professor

After earning a Master's degree in engineering from the University of Technology of Compiègne (UTC) in 2020, she completed a PhD in mechanics and materials at the University of Burgundy Franche Comté in 2023, within the FEMTO ST Institute (DMA department). Her doctoral research investigated the tribological behavior of copper and zirconium based bulk metallic glasses for potential micromechanical contact applications. From 2024 to 2025, she taught physics and mathematics at Biomedal, a preparatory school for medical entrance exams in Besançon. Since September 2025, she has been an Associate Professor at Université Marie et Louis Pasteur (UMLP) and the FEMTO ST Institute.

Her current research focuses on the tribology of bio based materials, particularly natural, modified, or functionalized wood. While the diversity of wood species results in varied mechanical and tribological properties, it also introduces heterogeneity and instability. By applying wood modification techniques, she aims to produce high performance functionalized woods tailored to specific applications, ultimately designing materials with superior tribological performance.

**Contact:**

solene.barlemont@femto-st.fr



## APPLIED MECHANICS

**François VILLETTE**

Assistant professor

He earned his PhD from Grenoble Alpes University in 2020, focusing on damage mechanisms in heterogeneous materials using paper as a model at the 3SR Laboratory. He continued there for one year as a postdoctoral researcher, developing super deformable papers via origami inspired microstructuring. From 2023 to 2024, at the Georges Friedel Laboratory in Saint Étienne, he worked on reduced microstructures for crystal plasticity finite element simulations, including a four month stay at the University of Alabama (USA). He then joined the FEMTO ST Institute to study the microcompression behavior of cork materials. Since September 2025, he has been an assistant professor at Université Marie et Louis Pasteur and the FEMTO ST Institute (DMA department).

His research explores the microstructure–property relationships of multiscale materials, with a focus on bio based materials, to understand nonlinear mechanical behaviors such as plasticity and damage. Using a combined experimental and numerical approach—including finite element modeling and digital image correlation—he studies small scale damage mechanisms in plant fibers and bio based reinforced composites. His goal is to identify the characteristic lengths that control fracture processes, supporting the development of high fidelity damage models to improve the durability and performance of bio based composites.

**Website:**

https://www.femto-st.fr/fr/personnel-femto/francoisvillette

**Contact:**

Email: francois.villette@femto-st.fr

# AWARDS

## I-PHD AWARD 2025 – FRANCE 2030 BY BPI FRANCE

**AS2M**

Valentin Reynaud

Project contributors: Joël Agnus, Cédric Clévy

The i-PhD program supports scientific entrepreneurs leading high-potential DeepTech projects in France. It recognizes breakthrough innovations originating from public research and provides national visibility and funding-readiness support. Receiving this award demonstrates both the scientific excellence and the market potential of the technology at the core of the future startup. The SensiTips project introduces a new robotic microforce metrology solution designed for scientists and industrial R&D teams to obtain reliable SI-traceable mechanical measurements on advanced 3D miniature and/or fragile samples in fields such as advanced materials, life sciences, and microsystems. Unlike AFM systems, nano-indenters, or testers originally dedicated to planar samples and extreme force ranges, SensiTips operates in the intermediate range (from 20 µN to 2 N), adapts to the geometry of the sample, and provides SI-traceable, configurable microforce measurements. This innovation allows researchers to obtain reliable mechanical characterization results, accelerating their scientific breakthroughs.

**Facility:** MIMENTO
**Website:** www.sensitips.com

**Reference:**

Ralf Hannouch, Valentin Reynaud, Guillaume Colas, Jean-Yves Rauch, Joël Agnus, Olivier Lehmann, François Marionnet & Cédric Clévy, In-situ SEM microrobotics for versatile force/deformation characterization: application to third-body MoS2 wear particles. J Micro-Bio Robot 20, 7 (2024).

https://doi.org/10.1007/s12213-024-00172-1

**Contact:**

valentin.reynaud@sensitips.com

## PLENARY TALK ON « ADVANCES IN PRECISION AND ULTIMATE MINIATURIZATION OF ROBOTICS WITH INTEGRATED ACTUATION FOR INDUSTRIAL AND ENVIRONMENTAL APPLICATIONS »

**AS2M**

Cédric Clévy

Microrobots with integrated actuation are highly innovative, offering unique tools and methods to locally interact with or deform matter in a controlled and versatile manner, well beyond the limits of human dexterity. In this presentation, I highlighted our recent research addressing two major challenges for this type of robot. First, the development of robots capable of performing tasks with nanometer-level precision, along with examples of their key potential in industrial and environmental applications. Second, the primary challenges in the ultimate miniaturization of integrated-actuation robots, illustrated by initial prototypes with typical dimensions as small as 100 µm.

**Facilities:** CMNR, MIMENTO
**Website:** https://marss-conference.org/

**Contact:**

cclevy@femto-st.fr

## MY THESIS IN 180 SECONDS

**APPLIED MECHANICS**

Will Liena Yonta

The MT180 competition organized by the CNRS and the CPU aims to disseminate PhD students' research topics to the general public. It consists of a three-minute free presentation to talk about research projects. Will Liena Yonta (Applied Mechanics department) participated in this competition to present the objectives of her work on the ***in vivo*** characterization of the female perineum during childbirth. She brilliantly won the jury prize and the high school students' prize at the regional level. The national competition brought together the regional winners. Although she did not win the national competition, this experience gave Will Liena the moral strength and enthusiasm to talk about her work.

**Website:** https://collegedoctoral.ubfc.fr/ma-these-en-180-secondes/

**Contact:**

will.yonta@femto-st.fr

## BEST PAPER AWARD AT IHM CONFERENCE

**DISC**

Ophélie Jobert, Thibaut Leone, Alix Goguey,

Bruno Berberian, Julien Bourgeois, Céline Coutrix

In Human–Computer Interaction, top conference papers are a major indicator of scientific excellence, often carrying greater visibility and impact than journal publications. IHM is the leading French-speaking conference in the field, making this Best Paper Award a strong recognition of the originality, quality, and relevance of this research.

«**Effect of Robotic Modular Interface Assistance Type on Sense of Agency»**

The awarded paper investigates how different types of robotic assistance affect users' sense of agency in cooperative tasks. Using a swarm robotic modular interface, the study compares nine assistance conditions that vary in autonomy and coordination between modules. The results show that increasing robotic autonomy tends to reduce the user's feeling of control, while the way modules coordinate also plays a significant role. The study further identifies three distinct agency profiles linked to coordination patterns. These findings provide important insights for the design of interactive robotic systems that support users effectively while preserving their sense of control and engagement.

**Facility:** MIMENTO

**Contact:**

julien.bourgeois@femto-st.fr

# AWARDS

## FRH2–CNRS 2024 PHD PRIZE IN HYDROGEN AWARD

**ENERGY**

Clotilde Robert

This national PhD prize, awarded by the CNRS FRH2 research federation, distinguishes the best doctoral work in hydrogen science and technology defended in France in 2024. It recognizes both scientific excellence and the societal relevance of the results for the development of sustainable hydrogen-based energy systems. Dr. Clotilde Robert (Energy department) has been awarded the national PhD prize by the CNRS FRH2 research federation for her outstanding work in hydrogen science and technology. Her research focused on optimizing hydrogen-electric powertrains for heavy-duty port vehicles, combining advanced system modeling with a novel multi-objective optimization framework that balances performance, environmental impact, and social responsibility. This integrated approach sets new standards for designing efficient, reliable, and sustainable hydrogen mobility systems, a contribution recognized by the FRH2 jury.

**Collaboration with other labs:** GAUSSIN Group

**Contacts:**

alexandre.ravey@utbm.fr

daniel.hissel@umlp.fr

## I-PHD AWARD 2025 – FRANCE 2030 BY BPI FRANCE

**ENERGY**

Gaultier Gibey

The highly selective national competition recognizes young researchers seeking to commercialize their work through the creation of deeptech startups. Winners benefit from a support program that includes personalized and group coaching sessions, Learning Expeditions, and an introduction to the deeptech ecosystem. In addition, this award provides national visibility for the project. This distinction recognizes the work carried out by Gaultier Gibey as part of the SupervHyse project. SupervHyse offers a predictive-maintenance software tool dedicated to hydrogen-energy systems (fuel cells and water electrolyzers). It monitors equipment in real time and predicts the optimal intervention date. The result: longer lifespan, increased reliability, and reduced operating costs. This work has also led to an international patent application, as well as various funding and support programs.

**Collaboration with other labs:** GAUSSIN Group

**Website:** https://www.femto-st.fr/fr/Departements-de-recherche/ENERGIE/Equipes-de-recherche/SHARPAC

**References:**


Gibey, G.; Pahon, E.; Zerhouni, N.; Hissel, D. Diagnostic and Prognostic for Prescriptive Maintenance and Control of PEMFC Systems in an Industrial Framework. J. Power Sources 2024, 613, 234864, doi:10.1016/j.jpowsour.2024.234864.

Gibey, G.; Pahon, E.; Zerhouni, N.; Hissel, D. Predictive Maintenance of Proton-Exchange-Membrane Fuel Cells for Transportation Applications. Energies 2025, 18, 2957, doi:10.3390/en18112957.


**Contacts:**

alexandre.ravey@utbm.fr

daniel.hissel@umlp.fr



## FRENCH PHOTONICS DAYS 2025 THESIS AWARD

**OPTICS**

Sara Bassil

The organizing committee selects between 12 and 15 PhD thesis posters for display, ensuring that they align with the event's theme and highlight regional research strengths. The event concludes with an award presentation, recognizing outstanding contributions. In 2025, Sara Bassil, supervised by Nadège Courjal, was honored for her work combining Thin-Film Lithium Niobate (TFLN), Silicon Nitride (SiN), and Indium Phosphide (InP) in integrated photonic circuits, enabling the development of high-speed, tunable lasers operating at 1550 nm.

**Website:** https://fpd2025.fr/theses/

**Contact:**

nadege.courjal@femto-st.fr

## IFCS-EFTF 2025 STUDENT AWARD

**TIME & FREQUENCY**

Ghida Fawaz

Ghida Fawaz, a PhD student and award winner, presented experimental results on the self-cleaning system of a surface acoustic wave (SAW) device for air quality monitoring. The system uses SAW technology to move a droplet of water and thereby remove particles that accumulate on the sensors. It is integrated into a cascade impactor equipped with SAW sensors for the measurement and separation of fine particles.

**Facility:** MIMENTO

**Website:**

Aiman Zinaoui, Lucas Grosjean, Arthur De Sousa Lopes https://www.femto-st.fr/en/The-institute/news/two-femto-st-phd-students-win-awards-ifcs-eftf-2025-international-conference

**Contact:**

ghida.fawaz@femto-st.fr

# AWARDS

## YOUNG MIND BEST PRESENTATION AWARDS CLEO/EUROPE-EQEC

### OPTICS

Aiman Zinaoui

The growing demand for broadband and tunable frequency converters in fields such as quantum computing, environmental sensing, and optical communications has driven significant advancements in nonlinear photonic platforms. However, existing solutions based on type III quasi-phase-matching face spectral limitations, offering tunability of approximately 10 nm or less.

The awarded PhD student, Aiman Zinaoui, together with his supervisors, has developed an innovative lithium niobate frequency-conversion platform using air-suspended rib waveguides and type I birefringent phase matching. Unlike conventional type 0 approaches, it achieves a tunability bandwidth of up to 900 nm while easing fabrication tolerances by a factor of five. This compact, broadband, and energy-efficient solution is a promising candidate for next-generation nonlinear optics, quantum technologies, and broadband optical communications.

**Facility:** MIMENTO

**Reference:**

A. Zinaoui, L. Grosjean, A. De Sousa Lopes Moreira, M. Angel Suarez, S. Queste, L. Robert, L. Gauthier-Manuel, M. Chauvet, N. Courjal; Broadband and widely tunable second harmonic generation in suspended thin-film LiNbO3 rib waveguides. APL Photonics 1 October 2024; 9 (10): 101303. https://doi.org/10.1063/5.0230481

**Contacts:**

nadege.courjal@femto-st.fr
aiman.zinaoui@femto-st.fr

## IFCS-EFTF 2025 STUDENT AWARD

### TIME & FREQUENCY / MN2S

Carlos Rivera-Aguilar

Carlos Rivera-Aguilar was awarded for the development and demonstration of a CPT-based microcell atomic clock with a stability in the low 10-12 range at 1 day, an order of magnitude better than current commercial chip-scale atomic clocks. This clock, based on a cesium vapor microcell developed at FEMTO-ST, exploits advanced pulsed interrogation sequences for the mitigation of light-shift effects. The strength of C. Rivera's work lies in having implemented these techniques, without an external optical modulator, using an FPGA electronic board through direct modulation of the laser current, thus maintaining a clock architecture compatible with full integration.

**Facility:** MIMENTO, Oscillator-IMP

**Reference:**

https://www.nature.com/articles/s41598-025-19732-x

**Website:**

https://www.femto-st.fr/fr/L-institut/actualite/deux-doctorants-de-femto-st-primes-la-conference-internationale-ifcs-eftf-2025

**Contact:**

carlos.rivera@femto-st.fr

## MARCEL ECABERT PRIZE, EFTF 2025

### TIME & FREQUENCY

François Vernotte

The Marcel Ecabert Award of the European Frequency and Time Forum (EFTF) is a lifetime award and honors the outstanding achievements of the recipient in the field of time and frequency. It is named after the late Marcel Ecabert, a founding member of the EFTF and member of its Executive Committee.

François Vernotte received this prestigious award for his lifelong commitment to time and frequency stability measurement, as well as for his outstanding contributions to the timing community.

**Website:** https://www.eftf.org/awards

**Contact:**

francois.vernotte@femto-st.fr

# RESEARCH HIGHLIGHTS

## DESIGN OF A COMPLIANT PIEZOELECTRIC ACTUATOR USING SIMULTANEOUS MULTI-MATERIAL TOPOLOGY OPTIMIZATION FRAMEWORK

**AS2M**

Kipkemoi Peter Rono, Michael Gauthier and Abdenbi Mohand Ousaid

Intuition and conventional fabrication techniques are no longer sufficient to ensure the performance of microrobots in terms of precision, reliability, and compactness. This challenge becomes even more critical with ongoing miniaturization. In this context, topology optimization of microrobots emerges as a promising solution. It involves systematically distributing a given amount of material without predefined topological constraints. This approach relies on a purely mathematical process to generate structures that exhibit similarities to biological organisms.

In this framework, the design of a compliant actuator was investigated. The optimization algorithm places piezoelectric material where actuation is most effective and passive material where structural support is needed. Simulations and experiments show good agreement, demonstrating the potential of multi material topology optimization for the design of multifunctional microrobots.

**Collaboration with other labs:** Dedan Kimathi University of Technology (DeKUT), Siemens Center, Kenya

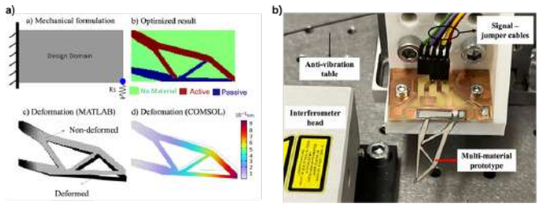
**Facility:** CMNR

**Reference:**

K. Peter Rono, A. Homayouni Amlashi, J.B. Byiringiro, M. Gauthier and A. Mohand-Ousaid. "Design of a compliant piezoelectric actuator using simultaneous multi-material topology optimization framework", International Journal of Precision Engineering and Manufacturing, 2025 (in press).

**Contact:**

abdenbi.mohand@femto-st.fr




Multi-material topology optimization framework. a) Topology optimization of a compliant piezoelectric actuator, b) Experimental bench

## YOU SOUND A LITTLE TENSE: L2 TAILORED CLEAR TTS USING DURATIONAL VOWEL PROPERTIES

**AS2M**

Jean-Julien Aucouturier

Understanding rapid speech, such as subway announcements, can be challenging. Traditional text to speech (TTS) systems often slow down or over enunciate speech, but this can sound unnatural.

Using reverse correlation, researchers identified a more effective solution: selectively lengthening specific vowels (like those in «sheep» or «fool»). Integrated into Matcha TTS, this «clarity mode» reduced errors by 9% among French learners of English compared to simply slowing the speech down. Even native speakers benefit in noisy environments by relying on timing cues.

"Slowing down everything doesn't always help–it can actually hurt comprehension and make the voice feel less respectful," said lead author Paige Tuttösi. "But slowing just the right vowel at just the right time improves both understanding and the listener's perception of the voice."

Presented at the ISCAS Speech Synthesis Workshop 2025, this innovation, focused on auditory perception, makes voice technology more accessible.

**Collaboration with other labs:** Simon Fraser University

**Website:** https://www.sfu.ca/fas/computing/news-events/news/2025/september/new-speech-tech-makes-text-to-speech-clearer-without-sounding-condescending.html

**Reference:**

13th ISCA Speech Synthesis Workshop (ISCA 2025) / Leeuwarden, Netherlands

**Contact:**

jean.aucouturier@femto-st.fr


Computer scientists, linguists, and cognitive scientists have developed a new method to make synthetic speech easier to understand, particularly for second language speakers in noisy environments.

## A PDMS/SILICON ADHESION CONTROL METHOD AT MILLIMETER-SCALE BASED ON MICROVIBRATION

**AS2M**

Jiawei Yi, Wissem Haouas, Michaël Gauthier, Kanty Rabenorosoa

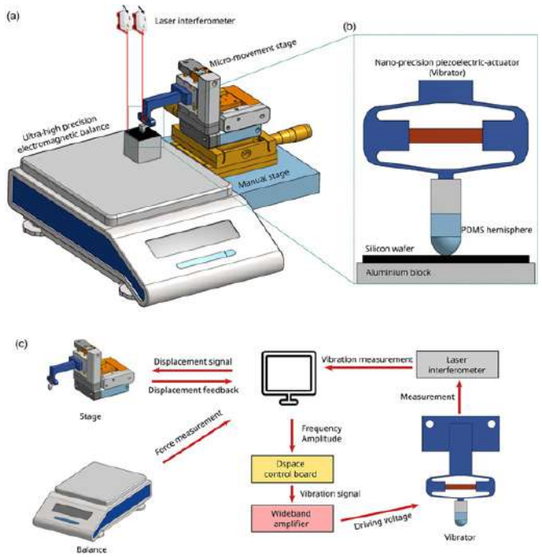
Switchable surface adhesion at a small scale is crucial for robot end effector design, allowing the manipulation of small objects. In this work, a detailed characterization of a millimeter scale adhesion modulation method is performed, demonstrating its effectiveness for switching adhesion on small, lightweight objects with smooth surfaces. This modulation phenomenon arises from the viscoelastic behavior of PDMS when it interacts with a rigid surface and is controlled via microvibration. A maximum apparent adhesion enhancement of 2400% and a reduction of 50% are achieved with a 1 mm diameter PDMS hemisphere vibrating at a 30 µm amplitude and a 700 Hz frequency. The effects of different parameters on adhesion performance are analyzed. A monotonic increase in maximum adhesion is observed with increased device size and surface smoothness, while nonlinear relationships between other factors are captured with a numerical model. A long working lifespan and high endurance are also observed.

**Facility:** CMNR, MIMENTO

**Reference:** https://advanced.onlinelibrary.wiley.com/doi/full/10.1002/aisy.202400394

**Contact:**

kanty.rabenorosoa@femto-st.fr




Schematics of the experimental setup for precise adhesion strength measurement in a dynamic process.

## REACHABILITY IN 3-VASS IS ELEMENTARY

**DISC**

Ismaël Jecker

The reachability problem in 3 dimensional vector addition systems with states (3 VASS) is known to be PSPACE hard, and to belong to the Tower. We significantly narrow down the complexity gap by proving the problem to be solvable in doubly exponential space. The result follows from a new upper bound on the length of the shortest path: if there is a path between two configurations of a 3 VASS, then there is also one of at most triply exponential length. We show this by introducing a novel technique for approximating the reachability sets of 2 VASS by small semi linear sets.

**Collaboration with other labs:** Wojciech Czerwiński, Sławomir Lasota, Łukasz Orlikowski (University of Warsaw, Poland)

**Reference:** https://drops.dagstuhl.de/storage/00lipics/lipics-vol334-icalp2025/LIPIcs.ICALP.2025.153/LIPIcs.ICALP.2025.153.pdf

**Contact:**

ismael.jecker@gmail.com

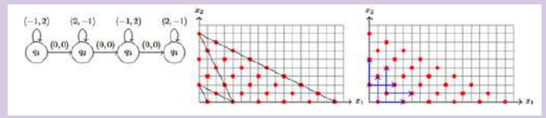


Illustration of over-approximation of reachability sets by semi-linear sets, the key novel technique introduced in the paper.

# RESEARCH HIGHLIGHTS

## JOURNAL APPLIED ENERGY

### DISC, ENERGY

Sarad Basnet, Karine Deschinkel,

Luis Le Moyne, Marie Cécile Péra

This paper proposes a MILP based optimization framework to jointly size and operate a hybrid renewable energy system—solar PV, wind turbines, electrolyzers, hydrogen storage, and grid connection—to supply both Dijon's electricity demand and hydrogen for a 30 bus fleet. Two strategies are assessed: (1) flexible 24 hour scheduling and (2) a restricted 3–7 a.m. window.

Implemented in the KLMS OPT tool, the model co optimizes the hourly bus refueling pattern together with electrolyzer, storage, and dispenser sizing. The flexible scenario dramatically reduces infrastructure needs: only one electrolyzer, one dispenser, and less than 100 kg of storage versus three units in the restricted case. It also lowers total annual cost by 0.35%.

The study demonstrates that coordinating refueling operations with renewable availability significantly improves economic efficiency and regulatory feasibility compared with fixed refueling windows.

**Collaboration with other labs:** DRIVE, Nevers

**Reference:**
DOI: 10.1016/j.apenergy.2025.127128

**Contact:**
karine.deschinkel@femto-st.fr

## APPROXIMATE PROBLEMS FOR FINITE TRANSDUCERS

### DISC

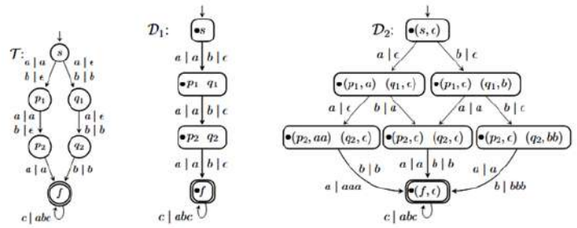
Ismaël Jecker

Finite (word) state transducers extend finite state automata by defining a binary relation over finite words, called a rational relation. If the rational relation is the graph of a function, this function is said to be rational. The class of sequential functions is a strict subclass of rational functions, defined as the functions recognized by input deterministic finite state transducers. The class membership problems between those classes are known to be decidable. We consider approximate versions of these problems and show they are decidable as well. We prove decidability results for several classical distances, including Hamming and Levenshtein edit distance. Finally, we investigate the approximate uniformisation problem, which asks, given a rational relation R, whether there exists a sequential function that is close to some function uniformising R. As in its exact version, we prove that this problem is undecidable.

**Collaboration with other labs:** Emmanuel Filiot (Université libre de Bruxelles, Belgium), Khushraj Madnani (Max Planck Institute for Software Systems (MPI-SWS), Saarbrücken, Germany) Saina Sunny (Indian Institute of Technology Goa, India)

**Reference:** https://drops.dagstuhl.de/entities/document/10.4230/LIPIcs.ICALP.2025.155

**Contact:**
ismael.jecker@gmail.com




An unambiguous non-deterministic transducer T, along with two sequential approximations D1 and D2 with respect to the Levenshtein distance, respectively Hamming distance.

## GLOBAL WARMING POTENTIAL OF BATTERIES FOR VEHICLE APPLICATIONS, FROM PRODUCTION TO RECYCLING

### ENERGY

Clotilde Robert, Alexandre Ravey, Daniel Hissel

This article provides a synthesis of more than sixty Life Cycle Assessment (LCA) studies dealing with the environmental impact of batteries used in mobility applications. Six main chemistries are compared. The work focuses on the global warming potential (GWP) of battery capacity, and covers all relevant life cycle stages.

The paper harmonizes published data and introduces a data quality indicator to quantify uncertainty for each chemistry. On this basis, GWP values are derived, together with the relative contributions of production, end of life, and recycling. Results show, for instance, that lithium ion batteries typically exhibit around 110 $kgCO_2eq/kWh$ on average, while recycling can reduce the overall GWP by about 40%. PbA batteries display a lower GWP but significantly lower specific energy and cycle life.

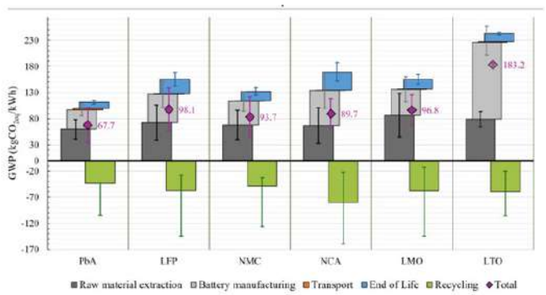
Finally, the study proposes practical guidelines for selecting the most suitable battery chemistry for different electric mobility use cases.

**Collaboration with other labs:** GAUSSIN Group (Héricourt, France)

**Facility:** Hydrogen Energy

**Reference:** C. Robert, A. Ravey, R. Perey, D. Hissel, "Global warming potential of batteries for vehicle applications, from production to recycling," *Journal of Energy Storage*, vol. 124, 2025, 116777. https://doi.org/10.1016/j.est.2025.116777

**Contact:**
Alexandre.ravey@utbm.fr




Total global warming potential of six battery chemistries, broken down by production, transport, end-of-life stages and recycling credits.

## HEAT TRANSFER INVESTIGATION NEAR THE ONSET OF NUCLEATE BOILING ON A SINGLE ARTIFICIAL NUCLEATE SITE: INFLUENCE OF THE WALL ORIENTATION

### ENERGY

Himanshi Kharkwal, Magali Barthes, François Lanzetta

The study of the transition from natural convection to nucleate boiling is crucial for the efficiency and safety of thermal systems. The present work aims to examine the heat transfer characteristics during the transition between these two regimes. A setup with a boiling meter mounted on a pivoting axis was developed to conduct experiments with the fluid FC72 on a flat heating wall that can be inclined from 0° to 180°.

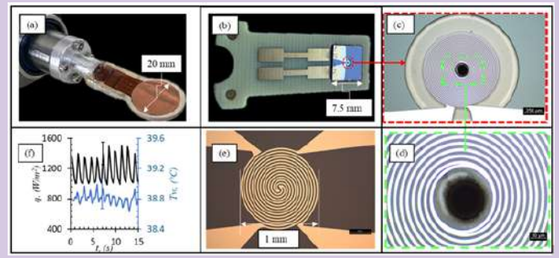
This work provides a better understanding of local wall heat transfer behavior and nucleation dynamics under different gravitational configurations, providing novel data on single site boiling physics. Intermittent behavior with typical heat transfer cycles is observed. Two criteria are identified as governing this intermittency: the wall temperature threshold for bubble nucleation and the heat flux threshold required to sustain bubble emission. The presence of a single nucleation site leads to variations in the heat transfer coefficient. Changing the wall inclination increases the heat transfer coefficient in the bubble emission regime but decreases it in the natural convection regime.

**Collaboration with other labs:** IUSTI CNRS, Marseille
IJL CNRS, Nancy , IMFT CNRS, Toulouse

**Facility:** MIMENTO, FluidiX

**Reference:** H. Kharkwal, M. Zamoum, M. Barthes, F. Lanzetta, H. Combeau and L. Tadris, «Heat transfer investigation near the onset of nucleate boiling on a single artificial nucleate site: Influence of the wall orientation», Applied Thermal Engineering, vol. 279, Part A, n°127503 (13 pages), nov. 2025, https://doi.org/10.1016/j.applthermaleng.2025.127503

**Contact:**
francois.lanzetta@umlp.fr




Micro boiling meter

# RESEARCH HIGHLIGHTS

## EXPERIMENTAL VALIDATION OF FAULT-TOLERANT CONTROL WITH SIGNAL-BASED DIAGNOSIS APPROACH FOR INTERLEAVED BOOST CONVERTER IN FUEL CELL APPLICATIONS

**ENERGY**

Meryem Benzine, Issam Salhi, Arnaud Gaillard, Fei Gao

This work presents the experimental validation of a fast and robust fault tolerant control strategy for a four phase interleaved boost converter used in fuel cell electric vehicle applications. Open circuit switch faults (OCFs) can degrade the performance of the converter and increase the fuel cell current ripple and accelerate stack ageing. The proposed approach introduces a signal based fault detection and identification (FDI) method that exploits the inherent multiphase structure: by comparing each phase current with the instantaneous average current, OCFs are detected in less than one switching period, without additional sensors or extra signal processing.

The FDI and controller are implemented on a MicroLabBox DS1202. Once an OCF is detected, the algorithm automatically isolates the faulty phase and re shifts the remaining phases to ensure optimal interleaving. Simulations and hardware experiments confirm fast, accurate, and disturbance resistant detection, even under load variations. Post fault phase reconfiguration significantly reduces input current ripple, preserving fuel cell durability.

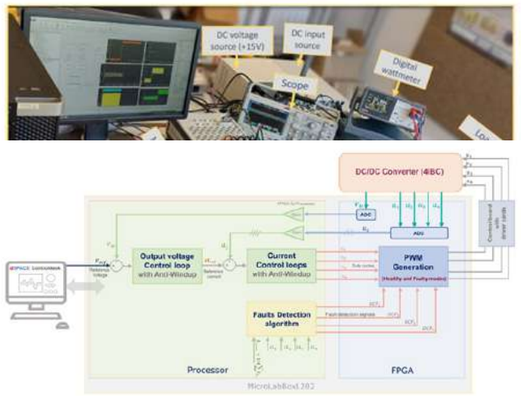
**Facility:** Hydrogen Energy

**Reference:**

https://ieeexplore.ieee.org/document/10812066

**Contact:**

arnaud.gaillard@utbm.fr




Experimental setup with dual-loop cascade control and OCF detection algorithm implemented in MicroLabBox

## RESULTANT INCIDENCE ANGLE: A UNIQUE CRITERION FOR CONTROLLING THE INCLINED COLUMNAR NANOSTRUCTURE OF METALLIC FILMS

**MN2S**

Aurélien Besnard, Hamidreza Gerami,

Marina Raschetti, Nicolas Martin

The Oblique Angle Deposition technique, an innovative specificity of physical vapor deposition, consists of controlling the substrate orientation compared to the metallic flux. The resulting films present a unique columnar microstructure (1D inclined columns, 2D zigzags, or 3D spirals). The films show increased porosity and strong anisotropy. The original technique was developed for evaporation, where the substrate tilt angle can be considered equal to the incidence angle of the evaporated atoms. With sputtering, the conditions differ. As a result, classical growth models are no longer suitable for describing the incoming atomic flux.

In this work, a transport simulation is developed. Different representations of the flux are discussed, and several typical examples of the resulting incidence angles are presented.

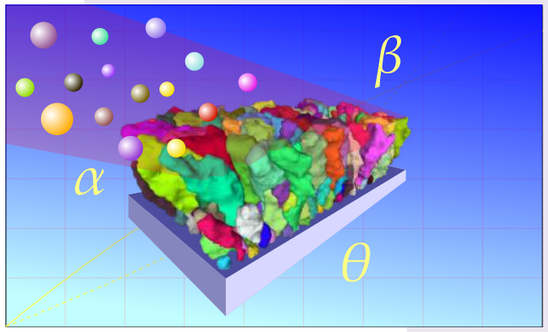
**Facility:** MIMENTO

**Reference:**

https://doi.org/10.3390/nano15080620

**Contact:**

aurelien.besnard@femto-st.fr




Growth of an inclined film by oblique angle deposition (OAD).
θ: substrate tilt angle, α: flux incidence angle, β: column tilt angle.



## GIANT BAND GAPS IN A PHONONIC CRYSTAL WITH TOUCHING SOLID INCLUSIONS

**MN2S**

David Röhlig, Vincent Laude

A team of researchers from Besançon and Chemnitz has demonstrated a surprisingly simple system capable of blocking sound waves across a wide range of frequencies using ordinary wax candles. Their approach builds on the concept of sonic crystals, periodic structures that control sound propagation. Numerical simulations showed that a grid of touching cylinders can replicate the performance of more complex ideal

structures, such as bubble crystals. Remarkably, the effectiveness depends less on the shape of the elements than on their contact points, where sound energy becomes concentrated. Experimentally validated, this configuration acts as a simple, robust, and efficient acoustic filter, significantly reducing sound transmission without the need for sophisticated technology or special materials.

This has potential for technical applications ranging from soundproofing in urban planning to acoustic protection in industry and acoustic filters in various contexts.

**Collaboration with other labs:**
Chemnitz University of Technology

**Facility:** MIMENTO

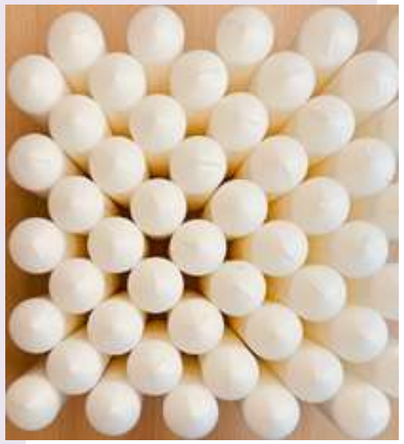
**Website:** https://journals.aps.org/prapplied/

**Reference:**

D. Röhlig, A. Thränhardt, V. Laude, T. Blaudeck, ``Giant band gaps in a phononic crystal with touching solid inclusions,'' Physical Review Applied 23 (5), 054055 (2025). https://doi.org/10.1103/PhysRevApplied.23.054055

**Contact:**

vincent.laude@femto-st.fr



A sonic crystal of wax candles. Candles are touching at infinitesimally small contact points, forbidding sound transmission over a large part of the audible frequency range

## SENSOR AND METHOD FOR MONITORING THE CHANGE IN THE VISCOELASTIC PROPERTIES OF A MATERIAL

**MN2S**

Thérèse Leblois, Jean-François Manceau,

Vincent Humblot, Julien Dufourmantel

The invention relates to a sensor for measuring the viscoelastic properties of a liquid. Although the patent covers a very broad range of applications, the application targeted by the project concerns the agri food industry, mainly the production of dairy products. This sensor consists of a membrane chemically modified by a hydrophilic ceramic coating on its outer surface to promote interaction between the milk matrix and the membrane surface. A piezoelectric device bonded to the membrane excites it in resonance and captures the resulting signal after interaction with the milk. Thus, changes in the signal are correlated with a milk coagulation index for cheesemaking. The sensor was tested in the laboratory on various milk matrices (powdered milk, pasteurized milk, and raw milk) and then in a pilot laboratory at INRAE in Poligny, before being validated on an industrial scale on the production lines for Mamirolle, Comté, and Morbier cheeses at ENILEA in Mamirolle.

Finally, a complete demonstrator was produced: a food compatible device, a waterproof interface, and a human machine interface on a tablet allowing control of the sensor and retrieval of smooth coagulation curves for real time signal processing.

**Collaboration with other labs:**
UMR PAM, INRAE Poligny platform, ENILEA Mamirolle
ACTALIA Poligny

**Facility:** MIMENTO, MIPHYSTO

**Contact:**

vincent.humblot@femto-st.fr

Acquisition and visualisation of coagulation curves during Comté cheese production. The sensor at the end of the rod is immersed in an 800-litre Comté vat.

# RESEARCH HIGHLIGHTS

## WHITE LIGHT SPECTROSCOPY FOR SAMPLING-FREE BACTERIAL CONTAMINATION DETECTION DURING CAR T-CELLS PRODUCTION: TOWARDS AN ON-LINE AND REAL-TIME SYSTEM

### MN2S

Bruno Wacogne, Annie Frelet-Barrand, Alain Rouleau

Advanced Therapy Medicinal Products (ATMPs), particularly effective against cancer, remain costly due to their reliance on genetically modified T cells. Contamination during production is a major concern, as traditional quality control methods rely on sampling, which can itself introduce contaminants. Therefore, there is a need for real time, non invasive contamination detection.

We developed a white light spectroscopy method based on the analysis of the absorption spectrum's shape. As contamination develops, the spectrum evolves from an approximately Gaussian shape to one influenced by the 1/λ component of bacterial absorption. Experiments show that contamination can be detected within a few hours, allowing an alarm to be triggered and production to be quickly halted. This time saving could reduce the cost of these therapies, making them more accessible to patients.

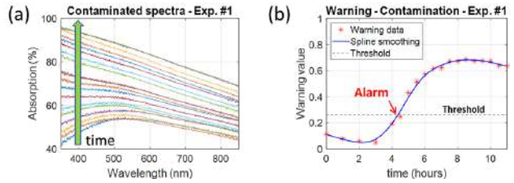
**Collaboration with other labs:** Etablissement Français du Sang, SMALTIS, MedInnPharma

**Reference:**

"White light spectroscopy for sampling-free bacterial contamination detection during CAR-T cells production: towards an on-line and real-time system", B. Wacogne, N. Vaccari, C. Koubevi, C.-L. Azzopardi, B. Karib, A. Rouleau and A. Frelet-Barrand, Biosensors 2025, Vol. 15, N°8, Art. 512 (28 pp.). https://doi.org/10.3390/bios15080512

**Contact:**

bruno.wacogne@univ-fcomte.fr




Data recorded with during a culture contamination. (a) Absorption spectra evolution with time. (b) Corresponding warning values compared to the warning threshold.

## EXTENDED-RANGE AND FASTER PHOTON-COUNTING BRILLOUIN OPTICAL TIME DOMAIN REFLECTOMETER

### OPTICS

Maxime Romanet, Jean-Charles Beugnot, Kien Phan-Huy

Distributed fiber optic sensors, such as Brillouin optical time domain reflectometers (BOTDRs), are widely used for monitoring civil infrastructure and detecting earthquakes. The range of applications was limited by signal to noise ratio (SNR) constraints. To overcome this, we introduce a fast, long range measurement technique with high SNR using a gated single photon detector triggered by multiple delayed pulses. This approach reduces measurement time without sacrificing spatial resolution, range, or sensitivity.

We experimentally demonstrate this method by measuring Brillouin signals up to 150 km in standard single mode fiber, surpassing current state of the art performance. Additionally, we achieve a 20 m spatial resolution at 125 km, detecting localized temperature changes. By extrapolating these findings, we envision future BOTDR systems reaching 200 km, enabling unprecedented long distance monitoring capabilities.

This breakthrough paves the way for next generation fiber optic sensing, enhancing infrastructure safety and environmental monitoring.

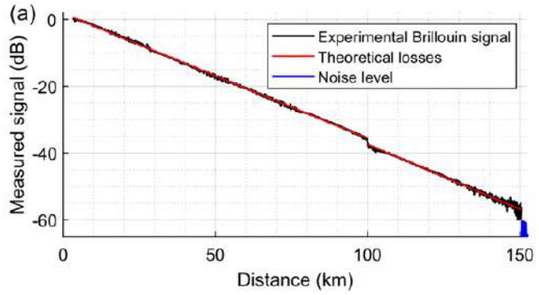
**Collaboration with other labs:** EOSS/ Prysmian Group Morges, Switzerland

**Reference:**

Romanet, M., Rochat, É., Beugnot, J. C., & Phan Huy, K. (2025). Extended-range and faster photon-counting Brillouin optical time domain reflectometer. Optica, 12(5), 564-569.
https://doi.org/10.1364/OPTICA.549392

**Contact:**

jc.beugnot@femto-st.fr






## TRAINING OF PHYSICAL NEURAL NETWORKS

### OPTICS

Anas Skalli, Daniel Brunner

Physical neural networks (PNNs) are emerging AI systems that use physical properties to perform computation, offering potential breakthroughs in scalability and efficiency. Unlike traditional AI models, PNNs could enable training of models 1,000× larger while allowing private, on device inference on edge devices like smartphones. PNNs represent a transformative opportunity in AI.

To realize their potential, PNNs require rethinking AI model design and training, aligning with the constraints of physical hardware. Research is exploring both backpropagation based and alternative training methods, each with trade offs. By leveraging physical systems, PNNs may overcome current AI limitations, offering faster, more energy efficient, and privacy preserving solutions. However, significant research is needed to scale these systems effectively.

**Collaboration with other labs:** EPFL, Microsoft, Cornell, Max Planck, Univ. Rennes, UCLA, Rain AI, University of Cambridge, Stanford, Google Deep Mind, Politechnico Milano, IBM Research, CNRS Thales – Albert Fert, Ecole Normal Supérieure, University of Pennsylvania, City University of New York, Paris-Saclay

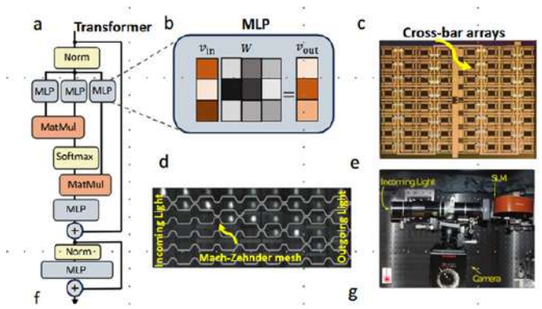
**Facility:** MIMENTO

**Reference:**

Momeni, A., Rahmani, B., Scellier, B., Wright, L. G., McMahon, P. L., Wanjura, C. C., ... & Fleury, R. (2025). Training of physical neural networks. Nature, 645(8079), 53-61.
DOI:10.1038/s41586-025-09384-2

**Contact:**

daniel.brunner@femto-st.fr




## TRAINING OF PHYSICAL NEURAL NETWORKS

### OPTICS

Aiman Zinaoui, Martin Khouri, Jean-David Frayssaud, Arthur De Sousa Lopes Moreira, Miguel Angel Suarez, Samuel Queste, Laurent Robert, Ludovic Gauthier-Manuel, Mathieu Chauvet, Nadège Courjal

We introduce a monolithic LiNbO3 membrane platform that bridges bulk and thin film approaches, enabling custom tailored waveguide cross sections. Using a combination of saw dicing and reactive ion etching, we fabricate LiNbO3 structures with adaptable thicknesses ranging from 400 nm to several microns, identifying 2 µm as an optimal value for addressing key challenges in frequency conversion. Our platform demonstrates robust second harmonic generation with a broad pump wavelength response of up to 150 nm within the C band at room temperature, achieved by tuning the waveguide thickness, while maintaining low coupling losses of 0.8 dB/facet. These results represent a significant step toward versatile integrated photonic systems, advancing applications in broadband spectroscopy, quantum information processing, and sensing through efficient and spectrally agile nonlinear frequency conversion.

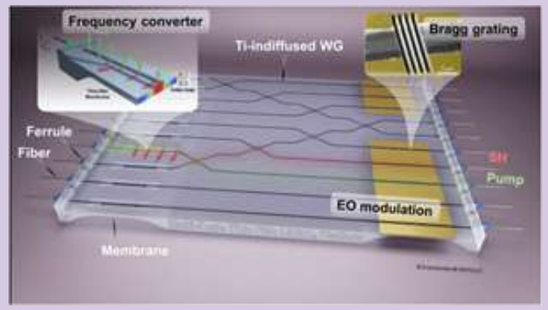
**Facility:** MIMENTO

**Reference:**

A. Zinaoui, M. Khouri, J.D.Fayssaud, A. De Sousa Lopes Moreira, M.A. Suarez, S. Queste ... & N. Courjal (2025). A $LiNbO_3$ Platform with Tailored Thickness Bridging Bulk and Thin Film: Application to Broadband Frequency Conversion. ACS photonics, 12(10), 5614-5622.
DOI: 10.1021/acsphotonics.5c01334

**Contact:**

nadege.courjal@femto-st.fr




Monolithic $LINbO_3$ platform for the fabrication of custom-tailored waveguide cross section

# RESEARCH HIGHLIGHTS

## PHOTONIC EXTREME LEARNING MACHINE

### OPTICS

Andrei Ermolaev, Mathilde Hary Anas, Skalli,

Daniel Brunner, John M. Dudley

Optical computing offers potential for ultra high speed and low latency computation by leveraging the intrinsic properties of light, such as parallelism and linear as well as nonlinear ultra high bandwidth signal transformations. The research of Andrei Ermolaev (UMLP PhD thesis) and Mathilde Hary (UMLP and Tampere, Finland PhD theses) has shown how broadband supercontinuum generation in optical fibers can serve as a computational resource for AI based image classification.

**Collaboration with other labs:** Photonics Laboratory, Tampere University, Finland, Institut Universitaire de France

**Reference:**

Ermolaev, A. V., Hary, M., Leybov, L., Ryczkowski, P., Skalli, A., Brunner, D., ... & Dudley, J. M. (2025). Limits of nonlinear and dispersive fiber propagation for an optical fiber-based extreme learning machine. Optics Letters, 50(13), 4166-4169.

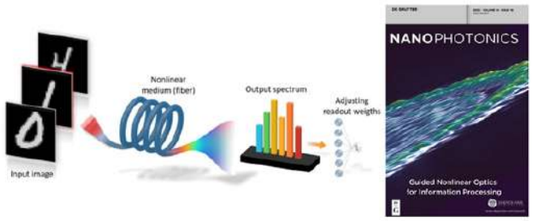
https://doi.org/10.1364/OL.562186

Hary, M., Brunner, D., Leybov, L., Ryczkowski, P., Dudley, J. & Genty, G. (2025). Principles and metrics of extreme learning machines using a highly nonlinear fiber. Nanophotonics, 14(16), 2733-2748.

https://doi.org/10.1515/nanoph-2025-0012

**Contact:**

john.dudley@univ-fcomte.fr




Non linear optics for information processing

## BOOK: AT THE ORIGINS OF TECHNICAL DEMOCRACY: TECHNICAL CREATIVITY

### RECITS

Pierre Lamard, Yves-Claude Lequin, Bénédicte Rey, Michel

Olinga, Laurent Heyberger

This twelfth issue of the Cahiers de RECITS is the result of a session at the 14th Congress of the French Society for the History of Science and Technology (2023), organised by P. Lamard. It addresses the issue of technical democracy through the prism of technical creativity and emancipation, using the concept of DIY (Do it Yourself), applied in various fields, from home studios to photovoltaic cells and biohacking. It also analyses the case of major technophile events such as the SAM (Salon des Arts Ménagers) and certain achievements of the World Expos in Shanghai and Milan (2010 and 2015).

The second part, which focuses more on sociology and is coordinated by B. Rey, is devoted to sustainable mobility in medium sized cities, through four case studies, three of which are French (coordination between urbanism and transportation policies, installation of electric vehicle charging points) and one Algerian (Setif tramway).

**Website:** https://shs.cairn.info/editeur/UTBM?lang=fr&tab=revues

**Contact:**

laurent.heyberger@utbm.fr


The last issue of the Cahiers de RECITS "At the origins of technical democracy: technical creativity"

## BOOK: L'HYDROGÈNE PAR LES SCIENCES HUMAINES ET SOCIALES

### RECITS

Nathalie Kroichvili, Nicolas Simoncini, Mathieu Triclot

Hydrogen is today considered by many countries, including France, as a key chemical element for achieving the energy transition. However, it is often perceived as a purely technical issue to be dealt with by the natural sciences or engineering sciences in isolation, with the human and social sciences only inheriting it afterwards. Bringing together contributions from several disciplines, this book invites us to change our perspective.

On the one hand, it intends to report on the multiple facets of hydrogen—technical, but also historical, social, economic, political, and legal—and on the other hand, it aims to highlight the potential of the human and social sciences to contribute to debates on its role in our contemporary societies, beyond the mere issues of social acceptability and economic feasibility to which they are too often reduced.

**Collaboration with other labs:** co-writers from UMR TREE (CNRS & Univ de Pau), Univ de Caen et CERREV, Univ Marie et Louis Pasteur, CRESE, FRAMESPA (CNRS & Univ de Toulouse II), Univ de Nantes, Centre François Viète, DINÂMIA'CET-Iscte de l'Iscte-Instituto Universitário de Lisboa, EDF R&D.

**Website:** https://shs.cairn.info/l-hydrogene-par-les-sciences-humaines-et-sociales--9791091901772?lang=fr

**Reference:**

Nathalie Kroichvili, Nicolas Simoncini (dir.), L'hydrogène par les sciences humaines et sociales, Belfort : Pôle Multimédia de l'UTBM (coll. Environnement et Technologie), 2025.

**Contacts**

nathalie.kroichvili@utbm.fr

nicolas.simoncini@utbm.fr


Hydrogen through the lens of the humanities and social sciences

## MICROCELL CPT ATOMIC CLOCK USING LASER CURRENT-ACTUATED POWER MODULATION WITH 10-12 RANGE STABILITY AT 1 DAY.

### TIME & FREQUENCY, MN2S

Carlos Manuel Rivera-Aguilar, Andrei Mursa, Clément Carlé,

Jean-Michel Friedt, Emmanuel Klinger, Moustafa Abdel Hafiz,

Nicolas Passilly and Rodolphe Boudot

A microwave microcell atomic clock with a stability in the low 10 12 range at 1 day was demonstrated. This clock, based on coherent population trapping, relies on Cs atoms, confined in a microfabricated vapor cell (developed at FEMTO ST/MIMENTO), interacting with an optically carried microwave field, obtained by direct modulation of a vertical cavity surface emitting laser (VCSEL). Reported performances were obtained through the implementation of a Ramsey spectroscopy based pulsed interrogation sequence that allows mitigating the detrimental effect of light shift effects on the clock frequency. Using this approach, the clock frequency dependence on laser power, microwave power, and laser frequency has been dramatically reduced. These results might stimulate the development of chip scale atomic clocks using Ramsey based sequences, with reduced light shift sensitivity, and enhanced long term stability performances.

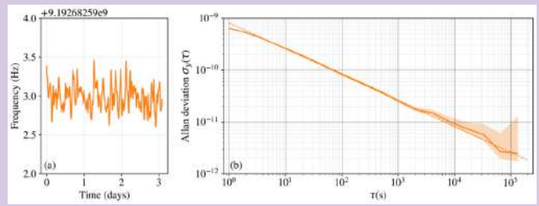
**Facility:** MIMENTO, Oscillator-IMP

**Reference:**

https://www.nature.com/articles/s41598-025-19732-x

**Contact:**

rodolphe.boudot@femto-st.fr




(a): Temporal trace of the clock frequency over 3 days. A 1-hour moving average is applied for illustrative purposes only. (b): Allan deviation of the clock frequency. The dashed orange line represents the slope of 8 × 10−10 -1/2, with  the integration time.

# RESEARCH HIGHLIGHTS

## ENERGY HARVESTING ON AC POWER LINES FOR A BATTERY-FREE LORA NODE

### TIME & FREQUENCY

Ausrine Bartasyte, Hatim Bakhtaoui, David Vernier,

Philippe Abbé, and Samuel Margueron

Faced with the growing risks of sabotage, intrusions, and the effects of climate change, power grids and critical infrastructures require continuous monitoring. An innovative system has been developed to power these monitoring devices without cutting the electrical cables. It harvests energy directly from the electric field of the lines using a mechanism that combines a magnet with a lead free piezoelectric material. Environmentally friendly, this technology has been patented and received the National Gendarmerie Innovation Award in 2024.

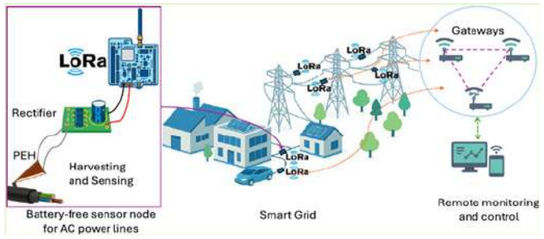
This article presents work on powering ultra low power microcontrollers connected via LoRa, conducted jointly by STMicroelectronics, the University of Palermo, the University of Genoa, Tyndall, and FEMTO ST, as part of the European UBIGIoT project.

**Collaboration with other labs:** C2N, Tyndall National Institute, University of Genoa, STMicroelectronics

**Reference:** F. Nicora, H. Bakhtaoui, D. Vernier, P. Abbé, A. Bartasyte, A. Pagano, M. Costanza, C. Boragno, O. Aiello, R. La Rosa, S. Margueron, Energy Harvesting on Ac Power Lines for a Battery-Free Lora Node. Available at SSRN: https://ssrn.com/abstract=5226721 http://dx.doi.org/10.2139/ssrn.5226721

**Contact:**

samuel.margueron@femto-st.fr




This paper presents a piezoelectric energy harvesting system designed to power a LoRa-based Wireless Sensor Node.

## TUNABLE ENERGY TRANSFER IN COUPLED NONLINEAR MEMS RESONATORS UNDER PARAMETRIC MODULATION FOR ENHANCED SENSOR PERFORMANCE

### APPLIED MECHANICS

Najib Kacem

This paper demonstrates coherent control of coupled microelectromechanical resonators in the nonlinear regime using red sideband parametric modulation, enabling dynamic tuning of inter mode coupling and energy transfer governed by classical analogs of quantum phenomena. A nonlinear reduced order model captures the induced virtual coupling and modal interactions, and the concept is experimentally validated on a DC electric field sensor achieving a two order of magnitude sensitivity enhancement while preserving a wide measurement range, with implications extending to optomechanics and two level systems

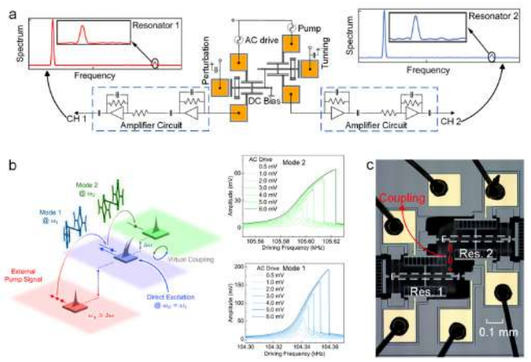
**Collaboration with other labs:** The Nanoscience Centre / University of Cambridge, School of Mathematics and Physics / University of Science and Technology at Beijing

**Reference:**

Wang, G., Hou, S., Kacem, N., Ran, L., Wen, X., & Seshia, A. (2025). Tunable energy transfer in coupled nonlinear MEMS resonators under parametric modulation for enhanced sensor performance. Microsystems & nanoengineering, 11(1), 210

**Contact:**

najib.kacem@femto-st.fr




The schematic overview of the phonon-cavity system using the MEMS resonator-based testing platform.



## JOURNAL: ADDITIVE MANUFACTURING

## MULTIPHYSICS OPTIMIZATION OF ADDITIVE MANUFACTURING OF HEMP FIBER REINFORCED POLYLACTIC ACID COMPOSITE HONEYCOMB STRUCTURES

### APPLIED MECHANICS

Thierry Barrière, Vincent Placet

This study optimizes pellet based additive manufacturing of hemp/PLA bio composite honeycomb structures to enhance interlayer adhesion and compressive performance. Using the Diffusion–Coalescence–Crystallization (DCC) model, transient heat transfer during layer deposition was simulated with an implicit Backward Differentiation Formula to determine temperature histories in previously printed strands. The model incorporates the bio composite's thermal properties and evaluates interfacial temperatures through virtual probes to calculate the DCC parameter. Mechanical tests on samples printed under varying conditions significantly improve compressive modulus and strength. The results validate the thermal simulation and confirm the benefits of optimized printing parameters.

This article balances all of the research department's key strengths: process control through pellet based additive manufacturing, in depth understanding of the bio composite material, mechanical experimentation, and advanced modeling. This integrated process–material–simulation approach demonstrates the department's ability to develop comprehensive research workflows, from understanding physico thermal mechanisms to optimizing structural performance.

**Collaboration with other labs:** Laboratory of Automatic Generation of Meshing and Advanced Methods (GAMMA3) Université de Technologie de Troyes

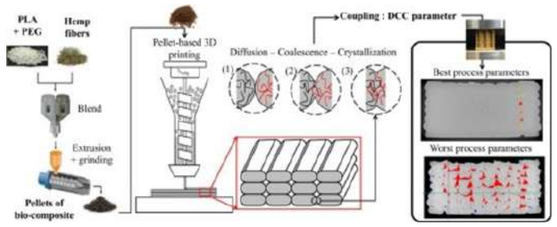
**Facilities:** MIFHYSTO, AMETISTE

**Reference:**

https://doi.org/10.1016/j.addma.2025.104697

**Contact:**

thierry.barriere@univ-fcomte.fr




Multiphysics optimization of additive manufacturing of hemp fiber reinforced polylactic acid composite honeycomb structures

## ASSESSMENT OF ANISOTROPIC MECHANICAL RESPONSE OF HUMAN SKIN: INSIGHTS FROM A CLINICAL TRIAL

### APPLIED MECHANICS

Aflah Elouneg, Arnaud Lejeune, Emmanuelle Jacquet

Jérôme Chambert

As part of the S Keloid collaborative project, which aims to model the cellular and tissue growth mechanisms that promote keloid scar development, an original image correlation analysis method was used to analyse the anisotropy of a skin disc tested mechanically (commercial CutiScan® CS 100). This test was carried out in a clinical context at the CHU in Besançon and consisted of multi axial extension being applied by annular suction at different load levels. During the test, the sensor recorded the microscopic texture of the skin disc. Following a preconditioning preload, stress is applied at increasing depression levels from 10 kPa to 50 kPa, interrupted by load holding times on a skin ring surrounding the tested tissue. The texture images are then analysed using a digital image correlation method to identify the directions of mechanical anisotropy in the stressed tissue. Knowledge of these mechanical directions provides useful data for developing prevention device specifications, if necessary.

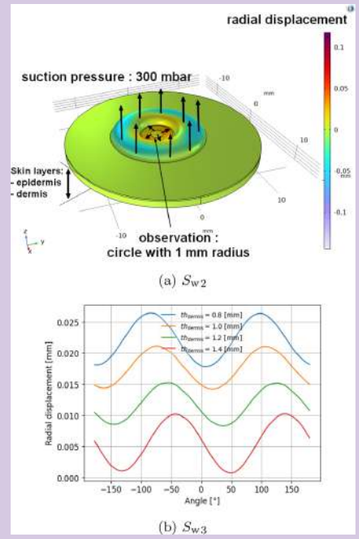
**Collaboration with other labs:** Université du Luxembourg : Stéphane Bordas, CHU de Besançon (CIC) : Thomas Lihoreau, RIGHT (uMLP) : Gwenael Rolin, CHU de Besançon (service maxillo-facial) et laboratoire SINERGIES (uMLP) : Brice Chatelain

**Website:** https://s-keloid.cnrs.fr/

**Reference:** Elouneg, A., Lejeune, A., Rolin, G., Lihoreau, T., Chatelain, B., Bordas, S., ... & Chambert, J. (2025). Assessment of anisotropic mechanical response of human skin: insights from a clinical trial: A. Elouneg et al. Biomechanics and Modeling in Mechanobiology, 1-18.

**Contact:**

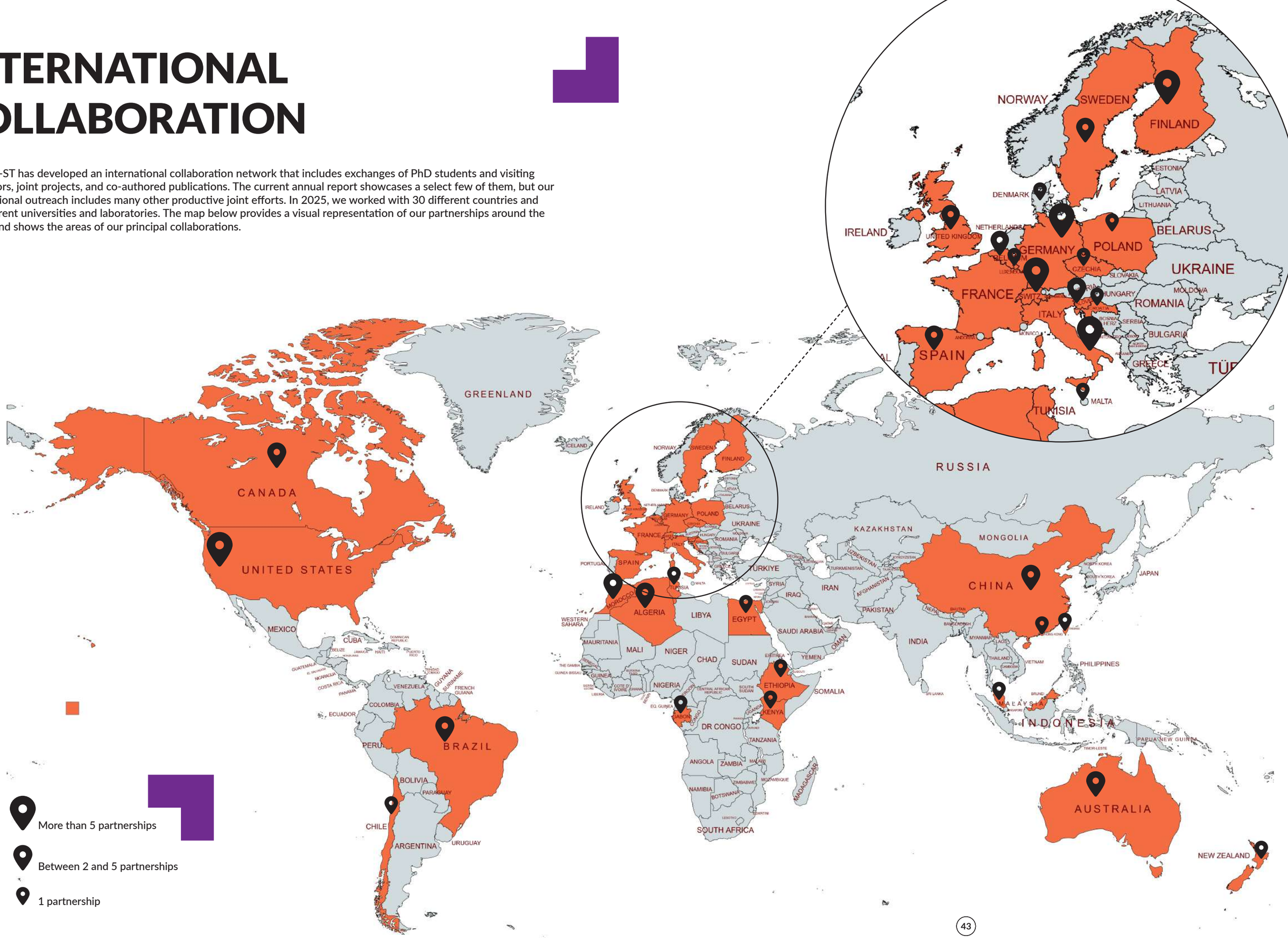
Jerome.chambert@univ-fcomte.fr




Relationship between skin structure and anisotropic behavior through numerical simulations conducted in COMSOL Multiphysics.

# INTERNATIONAL COLLABORATION

FEMTO-ST has developed an international collaboration network that includes exchanges of PhD students and visiting professors, joint projects, and co-authored publications. The current annual report showcases a select few of them, but our international outreach includes many other productive joint efforts. In 2025, we worked with 30 different countries and 67 different universities and laboratories. The map below provides a visual representation of our partnerships around the globe, and shows the areas of our principal collaborations.



# EUROPEAN PROJECTS

## INTSURFACE - INTELLIGENT SPACE-TIME RECONFIGURABLE ACOUSTIC METASURFACE

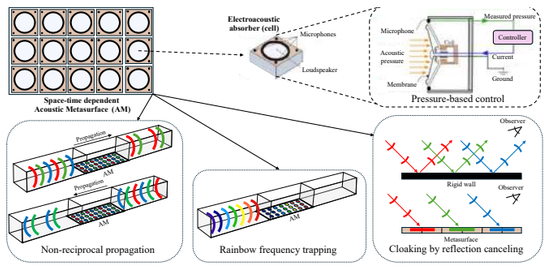
### HORIZON-MSCA-2024-PF-01

Leonardo Ferreira, Morvan Ouisse

Noise pollution is a growing concern in many urban areas, with transport noise having a significant impact on residents in densely populated regions. Existing solutions often fall short in effectively reducing this type of pollution. Meta-surfaces can enable spatiotemporal modulation and transform how we control and manage sound; however, progress has been hindered by experimental challenges and limitations in current control algorithms. Supported by the Marie Skłodowska-Curie Actions programme, the INTSURFACE project will develop a real-time, adaptive meta-surface capable of spatiotemporal modulation. The project will draw on a range of theoretical and numerical frameworks, create machine-learning-based control systems for the meta-surface, and ultimately build and test working prototypes.

**Funding for FEMTO-ST:**
242 k€

**Total funding:**
242 k€




Proposed acoustic metasurface with electroacoustic absorber representation, pressure-based control strategy, and potential applications in non-reciprocal wave propagation, multi-frequency rainbow trapping, and acoustic cloaking.

**Website:**
https://projects.femto-st.fr/INTSURFACE/en

**Contact:**
leonardo.ferreira@femto-st.fr

## FAMEPIC-FAST ADDITIVE MANUFACTURING FOR ENHANCED PHOTONIC INTEGRATED CIRCUITS

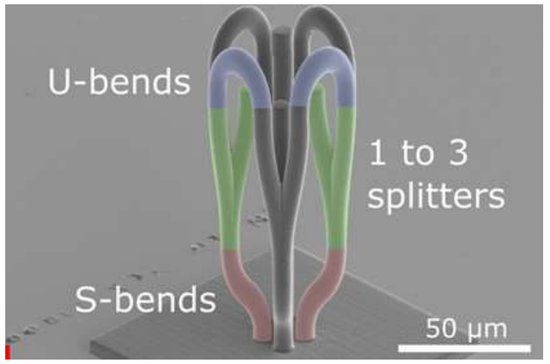
### ERC PROOF OF CONCEPT (POC)

Daniel Brunner

The large-scale deployment of integrated photonic circuits (PICs) is hindered by high costs and design constraints, largely due to the encapsulation and packaging process. FAMEPIC tackles these challenges head-on with a groundbreaking approach: it leverages grayscale volumetric lithography via two-photon polymerization to 3D-print photonic interconnections between PICs and onto PICs. This method enables real-time alignment by fabricating various optical components directly on PIC substrates, combining chip manufacturing and packaging in a single step—a strategic breakthrough for PIC packaging. FAMEPIC will demonstrate key features—low optical losses, rapid design iterations, and low production costs—to accelerate PIC prototyping and unlock new industrial capabilities for Europe's integrated photonics ecosystem.

**Funding for FEMTO-ST:**
150 k€

**Total funding:**
150 k€




3D integration and packaging enable densities unattainable with classical 2D methods. Our advanced concept leverages commercial systems and is substrate-agnostic. Through FAMEPIC, we will demonstrate its potential to drastically reduce the cost of photonic packaging.

**Website:**
https://erc.europa.eu/system/files/2025-07/erc-2025-poc-1-results-list.pdf

**Contact:**
daniel.brunner@femto-st.fr



## OCEAN H2 - OFFSHORE CLEAN HYDROGEN PRODUCTION FOR MULTI-USE PURPOSES

### EUROPEAN SUSTAINABLE BLUE ECONOMY PARTNERSHIP

Fei Gao, Elena Breaz, Issam Salhi, Umar Majeed Sada

OCEAN-H2 is a European research project involving five partners that tackles offshore hydrogen production across diverse sea basins—the Mediterranean, North Sea, and Baltic Sea—each with specific environmental constraints, including deep waters, shifting weather patterns, and seasonal ice. By applying technologies tailored to each basin, OCEAN-H2 seeks to optimize hydrogen production. The project focuses on compact, modular seawater electrolysis integrated into offshore microgrids for green hydrogen production, where offshore renewable energy sources, energy storage systems, and electrolyzers are interconnected through power electronic converters in a multi-terminal direct-current network. This integrated approach is intended to improve system adaptability and efficiency under a wide range of offshore operating conditions.

**Partners:**
Coordinator: Università di Malta

RISE Research Institutes of Sweden, ISIT (DE), Università di Napoli Federico II, UTBM

Blue Partnership-2024 (SBEP)

**Funding for FEMTO-ST:**
300 k€

**Total funding:**
1,5 M€

**Website:**
https://projects.femto-st.fr/INTSURFACE/en

**Contact:**
leonardo.ferreira@femto-st.fr


Offshore hydrogen production

# FEDER PROJECT

## I-NANOT – THERANOSTIC NANOVECTORS INNOVATIONS

### FEDER-FSE+ BOURGOGNE-FRANCHE-COMTÉ 2021-2027 PROGRAM

Almar Al Assaad, Wilfrid Boireau, Benjamin Brunel,

Jérôme Dejeu, Céline Elie-Caille, Alain Rouleau

The i-NanoT project aims to establish a structured, competitive nanomedicine ecosystem in Bourgogne-Franche-Comté, focusing on innovative methodologies for the synthesis, characterization, and biological evaluation of theranostic nanovectors for oncology, inflammatory, and infectious diseases. A global objective is to address the field's major challenges in quality, reproducibility, and scalability. The FEMTO-ST institute, through the Nano2Bio team, plays a central role by designing and characterizing advanced biointerfaces on biochips to explore and optimize the targeting and stealth of these nanovectors. The team deploys cutting-edge biophysical instrumentation and its expertise in surface physicochemistry to qualify biomolecular interactions and investigate structures at the nanoscale. Ultimately, the project seeks to translate these advanced nano-delivery systems from the lab to clinical use.

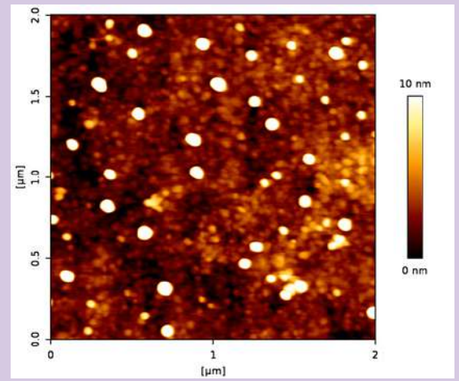
**Partners:**
UBE (ICMUB, ICB), UMLP (Chrono-Env., RIGHT & FEMTO-ST), CHU Dijon, CGFL Dijon, SON SAS, VIVEXIA, DELPHARM, SANTENOV, SATT Sayens.

**Funding for FEMTO-ST:**
486 k€

**Total funding:**
18.4 M€

**Website:**
i-nanot.fr

**Contact:**
wboireau@femto-st.fr




AFM image of EV chemically functionalized, immunocaptured on anti-CD63 arrays on a gold chip.

# EUROPEAN PROJECTS

## SSUWAI - SAFE SURGERY WITH ARTIFICIAL INTELLIGENCE

### INTERREG VI FRANCE-SUISSE 2021-2027

Christophe Lang

The goal is to design a predictive system for identifying risky situations for patients within the operating room. It must generate real-time alerts for medical and paramedical professionals, warning them of the risk of adverse events before an accident occurs. To achieve this goal, the system will rely on both pre-existing data (from previous procedures, patient, staff, and biomedical equipment characteristics) and will analyze real-time data transmitted by various sensors. The data will be processed through a simulator capable of modeling the complex environment of an operating room, which is governed by strict rules and protocols designed to ensure patient safety.

**Partners:**

Coordinator
UMLP – SINERGIES : Yann Chaussy

FEMTO-ST (FR) – Christophe Lang – Scientific lead for the simulator, CHRU Besançon (FR), Aprogsys – Company (FR)

AEGLÉ – Company (FR), Haute Ecole d'ingénierie et de Gestion du Canton de Vaud (CH), CFI SA – Company (CH)

**Funding for FEMTO-ST:**

170 k€

**Total funding:**

422 k€ (French part)

**Contact:**

christophe.lang@univ-fcomte.fr

## PHOTONHUB FACTORY

Nadege Courjal, Hervé Maillotte

PhotonHub is a pan-European innovation hub dedicated to photonics, acting as a centralized resource for businesses and researchers. Funded by the European Union, its mission is to accelerate the adoption and integration of photonic technologies across diverse industries, enhancing competitiveness and fostering innovation. The hub unites a vast consortium of leading European competence centers, pooling expertise, facilities, and cutting-edge technologies. It provides comprehensive support—technical, business, and training—covering technology readiness levels (TRL) from 3 to 8. By offering end-to-end services, PhotonHub aims to streamline the development and commercialization of photonics-based solutions.

**Partners:**

Coordinator: Vrije Universiteit Brussel (Belgium), with 32 European partners.

For FEMTO-ST: Nadège Courjal participates as a member of the Program Evaluation Team and is responsible for a technological platform. Hervé Maillotte and Laurent Oreiller coordinate CNRS interactions. Roland Salut, Franck Chollet, Jean-Charles Beugnot, and Sylwester Bargiel serve as experts within the network.

**Funding for FEMTO-ST:**

450 k€

**Total funding:**

15 M€

**Website:**

https://photonhub.eu/about/phactory/

**Contact:**

nadege.courjal@femto-st.fr



# PEPR PROJECTS

## MINIRO – MINIATURE ROBOTICS

### PEPR ACCÉLÉRATION ROBOTIQUE

Cédric Clévy, Kanty Rabenorosoa, Wissem Haouas

The MINIRO project aims to structure the national scientific community around miniature robotics and develop disruptive approaches to key scientific challenges.

It focuses on creating and integrating innovative technologies for miniature robots that can operate in constrained environments (e.g., inside machines or the human body) and address major societal and industrial needs. In particular, it targets tethered manipulator robots capable of controlled interaction with their environment, while tackling two main challenges: flexible slender robots for reaching distant targets, and sub-millimeter robotic systems enabling real-time operations at the micrometer scale.

**Partners:**

Coordinator: FEMTO-ST
Cédric Clévy. Kanty Rabenorosoa, Abdenbi Mohand Ousaid
Joel Agnus, Freddy Romero Leiro

Université Marie et Louis Pasteur / FEMTO-ST Institute,
Université de Strasbourg / Icube Institute,
Sorbonne Université / ISIR Institute,
Université de Montpellier / LIRMM Institute,
École nationale supérieure Mines-Télécom Atlantique Bretagne Pays de la Loire / LS2N Institute,
Université de Technologie de Compiègne / Roberval Institute,
CNRS / TIMC and Lab-Sticc institutes,
CEA List lab.

**Funding for FEMTO-ST:**

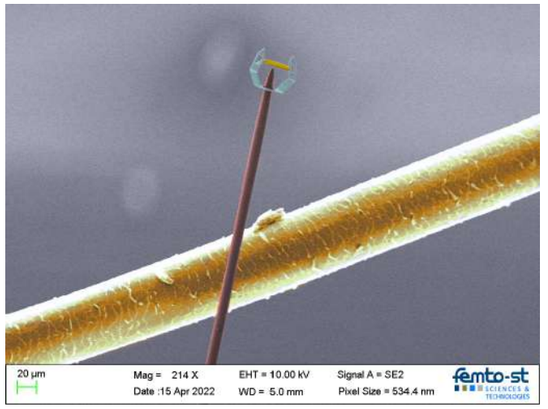
679 k€

**Total funding:**

3 M€

**Contact:**

cclevy@femto-st.fr




## DECO – PHYSICAL DEFORMATION AND COLLABORATION

### PEPR ENSEMBLE/CALL MANAGED BY ANR

Kanty Rabenorosoa, Wissem Haouas

DÉCO studies the dynamic deformation of digital interfaces to enhance collaboration between humans and systems, and among users through the system. Focused on aviation (e.g., shared piloting, remote towers, drone teleoperation), it develops deformable interface prototypes, evaluates them through experiments, and advances theories on collaborative and reconfigurable systems through an interdisciplinary approach.

DÉCO involves collaboration among researchers in human-computer interaction, robotics, mechatronics, cognitive science, and ergonomics, as well as aeronautics professionals, to develop scenarios and evaluate the proposed interactions.

**Partners:**

Coordinator: Université Grenoble Alpes, LIG

INSA Strasbourg / Icube Institute

Université Marie et Louis Pasteur / FEMTO-ST Institute,
Université de Toulouse / ENAC

**Funding for FEMTO-ST:**

204 k€

**Total funding:**

958 k€

inTouch CSCW '98

Digital [collaborative] spaces often pale in comparison to the richness and facility of interactions in the physical world

**Website:**

https://deco.univ-grenoble-alpes.fr/

**Contact:**

rkanty@femto-st.fr

# EVENTS

## INAUGURATION OF THE ARTWORK RÉESPIRATION, BY ARTIST SAMUEL BIANCHINI

### AS2M / SMART PLATFORM

Pierre Roux, François Marionnet,

Maude Guirault, Kanty Rabenorosoa

**Place:**

Pitié-Salpêtrière Hospital - Paris

**Number of participants:**

80

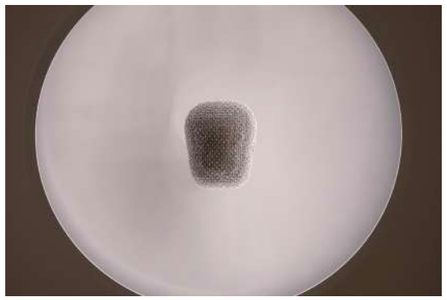
An interactive artwork born from a unique dialogue between artists, healthcare professionals, and researchers, designed to raise awareness of breathing and its soothing power.

At the crossroads of art, medicine, and technology, RÉESPIRATION is an immersive artwork designed by artist Samuel Bianchini, initiated by the healthcare team of the Pulmonology and Respiratory Intensive Care Department at Pitié-Salpêtrière Hospital, with the support of the French Ministry of Culture and the Fondation de France.

This artistic and scientific installation draws on advances in soft robotics, respiratory physiology, and sensory intelligence to offer a unique experience: an object that breathes with you in real time, using a thermal and LiDAR detection system. Its embroidered surface, light, and sounds deepen the immersive experience, creating a genuine space of calm and relaxation.

The FEMTO-ST laboratory played a central role in the technical design of the work, developing the soft robot, the pneumatic actuation system and its control, and integrating all the technologies that allow the installation to interact with the viewer's breath.

RÉESPIRATION raises awareness of the importance of breathing, its regulatory power over body and mind, and the often invisible reality of respiratory diseases and the suffering they cause. Already being studied in a hospital setting with patients, the artwork will also be exhibited in contemporary art venues to reach a broader public.



**Website:**

https://reespiration.org/

**References:**

Numerous media outlets have covered the RÉESPIRATION installation:

- France Inter radio featured it in May (https://www.radiofrance.fr/franceinter/podcasts/l-info-de-france-inter/l-info-de-france-inter-7112350)
- TV5 Monde and Le Monde newspaper featured it in June (https://information.tv5monde.com/culture/video/nuit-blanche-paris-linstallation-reespiration-la-pitie-salpetriere-2776239) and (https://www.lemonde.fr/sciences/article/2025/06/05/reespiration-une-uvre-pour-panser-le-souffle-a-la-pitie-salpetriere-a-paris_6610600_1650684.html)
- Inserm Magazine no. 65, in the article 'RÉESPIRATION, at the crossroads of arts and sciences' (pp. 49–52) (https://www.calameo.com/read/00515445025d8aa2d7563)

Involved persons from FEMTO-ST in event organisation: Pierre Roux, François Marionnet, Maude Guirault, Kanty Rabenorosoa

**Contact:**

reespiration@dispotheque.org

## AFADL - FORMAL APPROACHES FOR SOFTWARE DEVELOPMENT ASSISTANCE

### DISC

Olga Kouchnarenko, Pierre-Cyrille Héam

**Place:**

Pau

**Number of participants:**

80

The AFADL days on Formal Approaches for Software Development Assistance aim to bring together actors from academia and industry interested in the implementation of formal techniques at the various stages of software and/or system development.

**Website:**

https://gdrgpl2025.sciencesconf.org/resource/page/id/1

**Contact:**

olga.kouchnarenko@femto-st.fr

## QUANTUM DAYS IN BOURGOGNE FRANCHE-COMTÉ

### DISC, OPTICS, TIME & FREQUENCY

Alain Giorgetti, Benjamin Rousseaux, Clément Lacroute

**Place:**

FEMTO-ST Institute, Besançon and UBE Dijon

**Number of participants:**

15

From September 30 to October 2, 2025, a series of three consecutive scientific events focusing on quantum science was jointly organized by FEMTO-ST, the Laboratoire Interdisciplinaire Carnot de Bourgogne, and the doctoral schools SPIM and Carnot Pasteur, bringing together researchers and students to explore recent advances and key challenges related to quantum contextuality.

Adán Cabello, Professor of Physics at the University of Seville, Spain, was invited to present a talk about the unexpected renaissance of Kochen-Specker sets. This event was partly supported by the PEPR integrated project EPiQ (Étude de la Pile Quantique), part of Plan France 2030. It is part of the events organized within the Quantum Sciences and Technologies axis at FEMTO-ST and contributes to the United Nations International Year of Quantum Science and Technology.

**Website:**

https://www.femto-st.fr/fr/L-institut/evenements/quantum-days-en-bourgogne-franche-comte-adan-cabello-unexpected-renaissance

**Contact:**

alain.giorgetti@femto-st.fr

# EVENTS

## INDENTATION 2025

### APPLIED MECHANICS

Florian Boutenel, Yves Gaillard, Violaine Guicheret, Arnaud Lejeune , Christine Petit , Fabrice Richard , Philippe Stempfle, Delphine Travaglini, Olivier Estienne , Jalal Smiri, Israà Arafat

**Place:**
SUPMICROTECH-ENSMM, Besançon

**Number of participants:**
90

The Indentation 2025 symposium was held in Besançon, from 1st to 3rd October 2025. Every two years, this symposium brings together academics and engineers involved in the field of mechanical characterization of surfaces. This year, the symposium was organised by the FEMTO-ST Institute and LPMT.

Two half-day training sessions also took place on the afternoon of 30 September and the morning of 1 October. A total of 30 registered participants, together with about forty students from the Besançon site (11 SUPMICROTECH, 8 ISIFC and 30 master's students in mechanical engineering from UFR-ST) participated in these sessions.


**Website:**
https://indentation2025.sciencesconf.org

**Reference:**
https://www.linkedin.com/posts/femto-st_indentation2025-gime-femtost-activity-7381999193315516417-CIuJ/

**Contact:**
fabrice.richard@univ-fcomte.fr

## 15TH EDITION OF THE FORUM OF YOUNG RESEARCHERS IN ACOUSTICS, VIBRATIONS AND NOISE (JJCAB 2025, JOURNÉES DES JEUNES CHERCHEURS EN ACOUSTIQUE, VIBRATIONS ET BRUIT)

### APPLIED MECHANICS

Leonardo Ferreira (President), Camila Almeida, Mohamed Amine Belahcen, Emre Cavdar, Marie Cianci, Grégoire Bilal Sabillah

**Place:**
FEMTO-ST Institute, Besançon

**Number of participants:**
90


JJCAB is the annual Forum of Young Researchers in Acoustics, Vibrations and Noise co-organised by the French Society of Acoustics (SFA) and the French Association for Mechanics (AFM). This meeting is traditionally organised by PhD students and postdoctoral researchers from one of the major French laboratories in vibration and acoustics.

After 2015 and 2019, FEMTO-ST was once again chosen to host the event. Two plenary talks were also given: Rafael TELOLI talked about physics-informed machine learning with different levels of model knowledge, while Gaël MATTEN – the CEO of the VIBISCUS spin-off – shared his experience of bridging the gap from the lab to industrial activity. The downtown gala dinner was an opportunity for networking, while practicing vibroacoustics through the traditional jam session.

**Website:**
https://jjcab2025.sciencesconf.org

**Contact:**
jjcab2025@femto-st.fr



## MICHEL DE LABACHELERIE RECEIVES THE LEGION OF HONOUR

This national recognition honors the CNRS scientist and specialist in micro- and nanotechnology who played a major role in structuring both national and regional research as the founder and first director of the FEMTO-ST institute.

An engineer from the École Supérieure d'Optique, he earned a doctorate at the Laboratoire de l'Horloge Atomique in Orsay and joined CNRS in 1985. From the 1980s onward, he distinguished himself through pioneering work in laser metrology, earning several scientific awards.

During a three-year stay in Japan, he initiated in 1994 the creation of a Franco-Japanese laboratory in Tokyo between CNRS and the University of Tokyo, focusing on Micro-Mechatronic Systems.

Upon returning to Besançon, he played a key role in developing regional microtechnology, establishing a large academic cleanroom for the Franche-Comté site. As founder and first director of FEMTO-ST, now one of CNRS's largest engineering and computer science laboratories, he promoted interdisciplinary research, enhanced its international reach, and advanced innovation, as reflected in the Carnot label awarded in 2006 and the INPI Trophies in 2010 and 2011. He also co-founded the Microtechniques Competitiveness Cluster.

After two terms as FEMTO-ST director, he continued to be heavily involved at regional and national levels. A central figure in the national and European structuring of micro- and nanotechnology, he coordinated the interregional Labex ACTION, chaired the national Renatech network of CNRS nanofabrication cleanrooms, and contributed to the creation of EuroNanoLab, involving 15 countries and 44 European technology centers. He also coordinated the national excellence infrastructure project NanoFutur, which was ranked first in the 2020 Equipex+ national call.

Simultaneously, he helped structure regional academic research as Vice-President for Research at the University of Bourgogne-Franche-Comté from 2016 to 2018.

Recognized for his dedication, teamwork, and contributions to France's scientific prominence, he was awarded the rank of Knight in the National Order of the Legion of Honour.

The prestigious award was presented by the former President of the Bourgogne-Franche-Comté Region, Marie-Guite Dufay, on Monday, December 8, 2025, at the FEMTO-ST Institute.

# EVENTS

## 11TH PLENARY CONFERENCE OF THE GDR ONDES

**MN2S, OPTICS**

Vincent Laude, Jean-Charles Beugnot, Nicolas Brosseau-Habert, Simon Colombel, Michel Devel, Benjamin Rousseaux, Patrice Salzenstein, Fehima Ugarak, MaximZerbib

**Place:**
SUPMICROTECH-ENSMM, Besançon

**Number of participants:**
160

The GDR Ondes is a national group of researchers active in the field of wave physics. We had the pleasure of organizing its eleventh plenary conference in October 2025 in Besançon, on the premises of SUPMICROTECH. Plenary conferences are organized every two years and gather the entire French scientific community involved in the field. GDR Ondes is a friendly, open forum, supported jointly by CNRS and a Partners Club. For the last 20 years, it has promoted basic research on waves and the transfer of knowledge. We also aim at offering opportunities to young researchers to present their research freely.

**Website:**
https://gdr-ondes2025.sciencesconf.org/?lang=fr

**Contact:**
vincent.laude@femto-st.fr

## CNRS SUMMER SCHOOL SURF@1HEALTH

**MN2S**

Vincent Humblot

**Place:**
Institut d'Etudes Scientifique de Cargèse, Cargèse, Corse

**Number of participants:**
61

The Surf@1Health Thematic School aims to explore the One Health concept by examining three key areas: prevention, monitoring, and therapy. The subject will be approached through the lens of interface bioengineering and the associated applications and tools.

Surf@1Health explores interdisciplinary topics at the interface of chemistry, physics, and biology, with the aim of providing a shared knowledge base on functional materials and surfaces for "One Health" applications. The program supports young researchers and professionals in career transition while also addressing broader societal dimensions through public lectures and roundtables. By fostering discussion and collaboration, it seeks to unite a wide scientific community—within the CNRS and beyond (universities, INSERM, INRAE, CEA, etc.)—as reflected by the support of several research groups dedicated to interface science.

**Website:**
https://events.femto-st.fr/GdR_B2i/fr/ecole-thematique-surf1health-cargese-21-26-septembre-2025

**Contact:**
GDR-B2I@femto-st.fr

## GDR I GAIA 2025

**OPTICS**

Daniel Brunner

**Place:**
SUPMICROTECH-ENSMM, Besançon

**Number of participants:**
47


The CNRS Research Group (GdR) I-GAIA aims to bring together researchers in the fields of solid mechanics, fluids, structures and processes, electronics, photonics, and multiphysics coupling, focusing on the applications of Artificial Intelligence and machine learning to engineering science research. This year's theme focused on the relevance and potential of generative AI applied to engineering sciences.

**Website:**
https://gdr-i-gaia-2025.sciencesconf.org/

**Contact:**
daniel.brunner@femto-st.fr

## AFRICAN NETWORK FOR ARITHMETIC GEOMETRY AND APPLICATIONS

**MN2S, OPTICS**

Christian Maire

**Place:**
West Africa

**Number of participants:**
40

ANAGA – African Network for Arithmetic Geometry and Applications – is a network bringing together mathematicians from about ten countries in Central and West Africa. It is co-led by Christian Maire (FEMTO-ST). Its aim is to strengthen ambitious and innovative collaborations while training a new generation of researchers. It brings together established researchers, post-doctoral fellows, and African doctoral students, in close collaboration with international specialists.

In 2025, ANAGA organized three two-week research schools, each bringing together about forty participants: Libreville (Gabon), Brazzaville (Congo), and Abidjan (Côte d'Ivoire). The Abidjan school, ERAACI, received exceptional support from the CNRS as part of the Residential Research Schools 2025 call for projects. On this occasion, the CNRS Chairman and CEO, Antoine Petit, visited ERAACI on September 5, 2025.

**Website:**
https://anaga.math.cnrs.fr/

**Contact:**
christian.maire@univ-fcomte.fr

# EVENTS

## JOURNÉES SCIENTIFIQUES DU GDR CNRS ELIOS : OPTIQUE NON LINÉAIRE & APPLICATIONS

### OPTICS

Thibaut Sylvestre

**Place:**
FEMTO-ST Institute, Besançon

**Number of participants:**
80

This GDR brings together 25 labs and 150 researchers focused on nonlinear effects in optical fibers and integrated optics. Its mission is to foster scientific collaborations, ANR/European projects, and industrial partnerships. The research spans specialty fibers, photonic chips, lasers, sensors, frequency combs, AI, supercontinuum generation, and second-harmonic generation—from UV to mid-IR.

The thematic workshops aim to disseminate knowledge and strengthen the research community around nonlinear optics, covering: optical fibers and integrated optics, nonlinear effects, quantum photonics, lasers, Brillouin and Raman scattering, solitons, bio-imaging, and metrology.

**Website:**
https://elios2025.sciencesconf.org/?lang=fr

**Contact:**
thibaut.sylvestre@univ-fcomte.fr

## DISCUSSING CONTEMPORARY POSITIVE DISCRIMINATION AND EQUAL OPPORTUNITIES POLICIES IN FRANCE AND THE ENGLISH-SPEAKING WORLD

### RECITS

Michel Olinga, Laurent Heyberger, Bénédicte Rey,

Catherine Cuisance

**Place:**
UTBM, Belfort

**Number of participants:**
175

A two-day international colloquium held at UTBM (Belfort, 9–10 April 2025) brought together researchers from multiple countries to examine persistent inequalities related to race, gender, ethnicity, and disability.

Through interdisciplinary and comparative perspectives, discussions addressed the legal, political, and societal implications of contemporary equal opportunity and affirmative action policies.

Its key themes included debates surrounding theoretical frameworks, action policies and models, recognition and access to rights, including a final roundtable mainly focusing on affirmative action in Boston (USA). The event, which also engaged around 150 students, positioned UTBM as a key venue for critical reflection on diversity and inclusion in a global context.


**Website:**
https://elios2025.sciencesconf.org/?lang=frhttps://www.utbm.fr/wp-content/uploads/2025/02/prog-semaine-diversite.pdf

**Contact:**
michel.olinga@utbm.fr

## SUBSTITUTION DES ÉNERGIES FOSSILES

### RECITS

Nathalie Kroichvili, Nicolas Simoncini

**Place:**
UTBM, Belfort

**Number of participants:**
50

As part of the CNRS-SHS 2024–2025 seminar on "Energy," this event contributed to a national series of sessions exploring key challenges of the energy transition (including consumption and sobriety, efficiency and flexibility, environmental impacts, etc.). Hosted by FEMTO-ST, the session focused on the substitution of fossil fuels, examining the benefits, limitations, and deployment conditions of alternative energy technologies to ensure a sustainable and context-sensitive transition.

**Website:**
https://www.inshs.cnrs.fr/fr/evenement/seminaire-substitution-des-energies-fossiles-30-janvier-2025-belfort

**Contacts:**
nathalie.kroichvili@utbm.fr
nicolas.simoncini@utbm.fr


## LE TEMPS

### TIME & FREQUENCY

Ausrine Bartasyte, Samuel Margueron

**Place:**
MSHE - Besançon

**Number of participants:**
160

Time is a central concept across many scientific disciplines and contemporary research questions, from precision time measurement and the dynamics of physical, chemical, and mathematical systems to engineering, biological rhythms, ecosystems, epidemiology, and social, historical, and economic processes. Each field offers a distinct perspective on temporality and its implications for the sustainability of human societies.

This interdisciplinary conference aims to explore these diverse approaches by bringing together multiple perspectives to deepen and enrich our collective understanding of time.


**Website:**
https://2025iuf.sciencesconf.org/

**Contact:**
ausrine.bartasyte@femto-st.fr

# EVENTS

## LES HOUCHES SCHOOL ON QUANTUM METROLOGY

### TIME & FREQUENCY

Marion Delehaye

**Place:**
Les Houches

**Number of participants:**
54 participants + 18 speakers

The Les Houches School on 'Quantum Metrology: From Optomechanics to Tests of Fundamental Physics' offers an in-depth exploration of key concepts and recent advances in quantum metrology. The first week was dedicated to foundational lectures covering ultracold atomic physics, atomic clocks, quantum squeezing, and optomechanics. In the following week, the school focused on various aspects of quantum metrology, including precision measurements with quantum systems and their applications to fundamental physics.

**Website:**
https://leshouches2025-metrology.quantumoptics.fr/

**Contact:**
marion.delehaye@femto-st.fr

## GDR EX-MODELI

### APPLIED MECHANICS

Emeline Sadoulet-Reboul

**Place:**
ENSAM, Lille

**Number of participants:**
80

The EX-MODELI Research Group (GdR CNRS) aims to bring together and stimulate the activities of the French community in nonlinear dynamics, with the objective of strengthening collaborations, promoting the emergence of new ideas, training young scientists, and consolidating the central position of the French community within the international landscape.

The annual scientific meeting, held this year at ENSAM Lille, combined doctoral training and research exchange. The first day featured courses on advanced methods, while the second day focused on scientific seminars, complemented by industrial presentations from ONERA and CEA-CESTA on nonlinear dynamics applications.

**Website:**
https://events.femto-st.fr/GdR-EX-MODELI/fr/journees-annuelles-16-et-17octobre-2025-lille

**Contact:**
gdr-exmodeli-bureau@groupes.renater.fr

## SURVISHNO

### APPLIED MECHANICS

Emeline Sadoulet-Reboul, Gaël Chevallier

**Place:**
ISAE SUPMÉCA Saint-Ouen

**Number of participants:**
100

SURVISHNO is a joint conference bringing together the Surveillance, VISHNO (Vibration, Shocks and Noise), and EVA (Experimental Vibration Analysis) communities to foster exchanges between researchers, academics, and industrial practitioners in vibration engineering, structural dynamics, and structural health monitoring. The 2025 edition, held from May 21 to 23 at ISAE SUPMÉCA in Saint-Ouen, gathered around 100 participants. It featured three plenary lectures on topics such as squeal phenomena, instantaneous angular speed, and vision-based measurements, along with start-up presentations and peer-reviewed scientific contributions, promoting interaction in a collegial and interdisciplinary environment.

**Website:**
survishno2025.sciencesconf.org

**Contact:**
survishno2025@sciencesconf.org
emeline.sadoulet@femto-st.fr

# INNOVATION

# TRANSFER SUCCESS STORIES

## ZETA-SE

### APPLIED MECHANICS

Kevin Jaboviste (founder), Gaël Chevallier

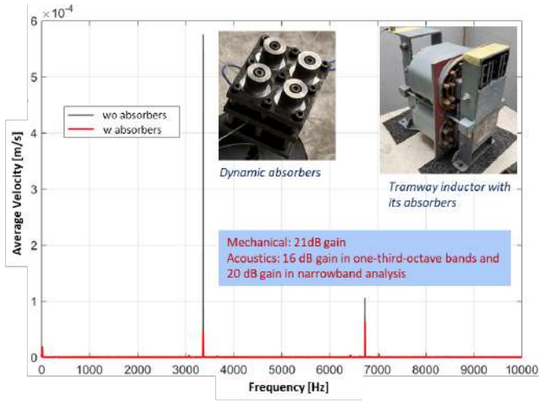
**Date of creation:** July 30, 2025
**Location:** 18 rue Alain Savary, Besançon

Founded in late July 2025, the company develops and provides tailored anti-vibration solutions for industry.

Vibration attenuation is a critical challenge in fields such as transportation, aerospace, and energy, where vibrations can reduce comfort, damage structures, and interfere with sensitive instruments. Existing solutions have reached their limits, making vibrations a key constraint in modern system design. ZETA-SE aims to develop a new generation of customized, robust vibro-acoustic control devices that provide high attenuation while remaining insensitive to temperature and frequency variations. Using specialized predictive design tools, these devices can be tailored to specific applications, thereby ensuring optimal performance for industrial needs.

The company's manager, Kevin Jaboviste, who has benefited from strong support from the Bourgogne-Franche-Comté region through the "Itinéraire-Chercheur-Entrepreneur" program, has already secured research contracts with major industrial groups (THALES, ALSTOM, STELLANTIS, etc.).

**Facility:** AMETISTE
**Contact:**
kevin.jaboviste@zeta-se.fr




Experimental results on a tramway inductor with and without dynamic vibration absorbers (test campaign conducted at Alstom Transport in Charleroi)

# EDUCATION

# EIPHI GRADUATE SCHOOL

## STRUCTURING ROLE IN THE RESEARCH-TRAINING-INNOVATION TRIAD

### EUR EIPHI and the National Networking of Graduate Schools: A Collective Dynamic for Academic Excellence and Internationalization

A national network of Graduate Schools of Research (EUR), initiated by EIPHI and later joined by 7 other EURs (Grenoble, Saint-Étienne, Strasbourg, Cergy, Rennes, Le Mans, Poitiers), was structured in 2025 in the form of an association. This unifying initiative creates unprecedented synergies between education, research, and international outreach. This article explores a model that builds on the experiments of the Investments for the Future Program (PIA) to sustain pedagogical innovation, strengthen the research-education link, and enhance France's global influence.

Since 2017, Graduate Schools of Research (EUR) have emerged as a key lever for transforming the French master's and doctoral ecosystem by bringing together laboratories, institutions, and socio-economic partners around strategic themes. Among them, EUR EIPHI (Engineering and Innovation through Physical Sciences, High Technologies, and Cross-Disciplinary Research), initially led by the Université Bourgogne-Franche-Comté and now by the Université Marie & Louis Pasteur, plays a pioneering role in structuring these schools into a network. Through a dedicated association, created in June 2025, and three thematic working groups, this network aims to build on EUR experiments from the PIA and, more broadly, the Graduate Schools model to ensure sustainability, optimize funding (particularly from the ANR), and promote the French university system internationally.

National Seminar of the Graduate School Network France, October 23-24, 2025 in Rennes, in the presence of the Head of the EUR Action at the ANR and the Deputy Director of the Higher Education and Research Strategy Coordination Department - France 2030 Coordinator at the MESR

### A National Proactive Network

EUR EIPHI initiated the creation of an association to unite French EURs, structured around three strategic working groups:

#### 1. Collaboration with Other National Networks

Partnerships with the Réseau Figure (Master's in Engineering programs), France 2030 initiatives such as SFRI*, CMA*, or NCU*, the National Network of Doctoral Colleges, Technological Research Institutes (IRT), and Institutes for Energy Transition (ITE).

- Objective: Pool resources, avoid duplication, and create bridges between training, research, and innovation ecosystems.
- Examples for EIPHI: New partnerships with IRTs like SystemX or Bioaster for joint projects in engineering and health with Bionoveo, or with IRT M2P in metallurgy.

**2. Internationalization and Global Partnerships** with Campus France Development of common strategies to attract international talent, in collaboration with Campus France. Initiatives have already been launched with Oman and Mexico.

- Implementation of joint programs with foreign universities (e.g., dual degrees, joint PhD supervision).
- Tools: Digital platforms to enhance the visibility of the EUR model and the English-taught master's programs offered by French universities: https://graduate-schools-network.fr/master-training.

#### 3. Pedagogical Transformation and Sustainable Development

- Reflection on new teaching methods (hybrid learning, project-based learning, interdisciplinary modules, tutoring, etc.).
- Integration of the Sustainable Development Goals (SDGs) into curricula and EUR governance.
- Flagship Example: The annual «French+Science» Summer Schools of the EIPHI Graduate School and now INTHERAPI & TRANSBIO, which combine French language learning with intensive scientific training for international students. These one-month programs, in close collaboration with CLA Besançon and endorsed by Campus France, exemplify the alliance between international attractiveness and academic excellence: https://gradschool.eiphi.ubfc.fr/?page_id=3100.

EIPHI's annual «French+Science» summer school in collaboration with CLA Besancon – 2024 edition, 1-month integration of Bachelor students from Canada, Ghana, India, Latvia, Mexico, Niger, Singapore, Taiwan.

EUR EIPHI stands out for its «French+Science» Summer School program, launched in 2021 and recognized by Campus France as a unique national initiative:

• Target Audience: International bachelor's and master's students seeking to combine linguistic immersion with cutting-edge scientific training.

• Format:

- Morning: French as a Foreign Language (FLE) courses at CLA.

- Afternoon: Scientific discovery workshops (physics, engineering, computer science, nanotechnology) led by EUR doctoral students and researchers.

- Visits to laboratories, technological platforms, and meetings with industrial partners.

• Impact:

- Strengthening France's appeal as a scientific destination.

- Creating a pool of international talent for French laboratories and companies. One example is a Nigerian student who participated in the 2024 edition: after returning in 2025 for an end-of-studies internship at FEMTO-ST's Time-Frequency Department, he will join the ARMAC master's program in the fall of 2026 with an Eiffel Excellence Scholarship.

- A replicable model now being studied by other EURs.

### Why an Association? The Challenges of Sustainability

The creation of the National EUR Network Association aims to address several major challenges:

#### 1. Capitalizing on PIA Experiments

- - EURs have benefited from significant funding through the Investments for the Future Program (PIA). The Network allows for the sharing of best practices and avoids the dispersion of successful initiatives.

#### 2. Sustaining EURs and Optimizing Funding

- - By structuring themselves into a national network, EURs gain visibility and the ability to respond to national (e.g., France 2030) and European (e.g., Horizon Europe, Erasmus+) calls for proposals.
- - The association acts as a lobbying force with academic and governmental institutions to advocate for EUR interests and their long-term sustainability.

#### 3. Enhancing Visibility and Promoting the French University System

- - Unified Communication: Common website (https://graduate-schools-network.fr/), participation in international fairs, and joint events.
- - «EUR» Label: A strong identity to attract students and industrial partners.

### Perspectives and Challenges

• Challenge 1: Securing funding beyond the PIA by diversifying sources (philanthropy, European partnerships, France 2030).

• Challenge 2: Expanding the network to include SFRI*, CMA*, and other excellence programs integrating training, research, and innovation.

• Perspective: Creating a «Quality EUR Label» for master's and doctoral programs, guaranteed by the association.

### Conclusion: A Model for the University of Tomorrow?

The structuring of the National EUR Network Association, initiated by EUR EIPHI with 6 other EURs in France (now totaling 42 EURs and Graduate Schools), embodies a modern vision of the French university system:

• Collaborative: Breaking down silos between disciplines and stakeholders.

• International: Attracting global talent through innovative programs like the French+Science Summer Schools.

• Sustainable: Building on the successes of the PIA to create a lasting ecosystem.

*SFRI: Structuring Training through Research Initiatives;

CMA: Skills and Jobs of the Future;

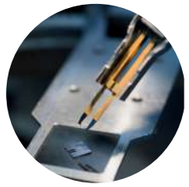
NCU: New University Programs.

# SCIENCE AND SOCIETY

## FEMTO-ST INSTITUTE FOSTERS RESEARCH AND INNOVATION TO ADDRESS SOCIETAL CHALLENGES

### HEALTH AND WELL-BEING

- Therapy
- Diagnosis, Screening, and Biological Qualification
- Food Safety
- Ethics and Acceptability



### CLEAN, SAFE & EFFICIENT ENERGY

- Hydrogen energy
- Energy Harvesting
- Energy Efficient Systems

### ENVIRONMENT

- Environmental sensors
- Geodesy
- Water and Air Treatment
- Vibration and Noise Protection
- Preservation of Resources

### INTELLIGENT SYSTEMS

- Artificial Intelligence: Distributed Systems, Diagnosis and Prognosis
- Smart Objects and Complex Systems
- Ethics

### COMMUNICATION AND INFORMATION

- Ultra-localized optics
- Quantum Technologies
- Telecommunication Systems and Materials

### INDUSTRY OF THE FUTURE

- New Materials and Processing
- Sensors and Actuators
- Factory 4.0

### DEFENSE - SECURITY

- Network and Software Security
- Intelligent Systems for Defense

# SCIENCE AND SOCIETY

## 2025 SCIENCE FESTIVAL

### FEMTO-ST IN BESANÇON

The 2025 Science Festival was once again a great success in Besançon, welcoming 1,200 school students and 3,500 members of the general public. Several FEMTO-ST departments were actively involved in this edition.

Led by the AS2M department, a robotics booth offered three activities, including building a hydraulic arm.

FEMTO-ST opticians organized two workshops:

- an educational game titled “Question pour un photon”,

- a cross-disciplinary activity combining arts and sciences, “What Colors Tell Us”.

A dedicated booth organized by the MN2S department highlighted the European BioImp project, which combines biology and technology to make next-generation biomedicines more widely available.

### FEMTO-ST AT THE BELFORT SCIENCE VILLAGE

In Belfort, several members of the DISC department engaged the public with interactive AI demonstrations under the national theme “Intelligence(s)”: image and emotion recognition, voice cloning, image generation, and comparisons of AI’s environmental impact via the ComparIA platform.

Finally, the ENERGIE department participated in a joint stand with FCLAB dedicated to hydrogen energy. The stand drew strong attention with its stage presence, featuring the Lego H2 FCLab model and demonstrations of an electrolyzer and fuel cell.






## LE BFORT

**Place:** Belfort

**Number of participants :** about 230

**Involved persons from FEMTO-ST:** Marie-Cécile Pera, Zhongliang Li, Joëlle Marc, Gaultier Gibey, Fatimatou Wade

The BFort event is a TED-style talk series focused on the hydrogen sector, research, and thesis accomplishments. Each participant had roughly 15 minutes to share their motivations, insights, and conclusions about hydrogen, based on their personal experience in the field.

The event featured seven speakers, all coached by a professional in public speaking. From FEMTO-ST, participants included a professor-researcher, an entrepreneurial PhD student, and a former PhD student who completed her thesis in collaboration with a company. Additionally, a designer who had been in residence with the SHARPAC team presented his final project on renewable energies, inspired by the team’s research. Over the course of an hour and a half, the 230 attendees were engaged and inspired by the variety of talks and perspectives.

This event was co-organized with UMLP, CCI, and Grand Belfort.


**Website:**

https://www.eventbrite.fr/e/le-bfort-2025-tickets-1819120531479?aff=oddtdtcreator

## LE TOUR DE L’HYDROGÈNE

**Place:** Belfort

**Number of participants :** 200

**Involved persons from FEMTO-ST:** Around 8 PhD students, the project team, and support staff: Joelle Marc, Zhongliang Li, Karine Diez.

Université Marie et Louis Pasteur and the FEMTO-ST Institute hosted the first stop of the Hydrogen Tour in Belfort on June 16th, 2025. The event visited four Green SKHy project countries—France, the Netherlands, Germany, and Luxembourg—and informed more than 800 people about hydrogen.

The event adopted a playful approach to engage the public and middle school students, with activities such as the Lego Hydrogen City and the interactive H2 exhibition. PhD and undergraduate students guided visitors, while four companies (Forvia, H2SYS, Mincatec Energy, and Automobiles Dangel) demonstrated their equipment. The H2 utility vehicle and the interactive H2 exhibition particularly caught the attention of the public, with more than 200 visitors attending that day.

**Contact:**

joelle.marc@umlp.fr


## CONFERENCE BY PROF. PHILIPPE GRANGIER:

**« Des fondements de la mécanique quantique aux technologies quantiques »**

**Place:** Besançon

**Number of participants :** 300, including at least two-thirds students (UFR-ST, UFR-SLHS, engineering schools, and CPGE), approximately one-fifth teachers and professors, and attendees from outside the University.

**Involved persons from FEMTO-ST:**

Simon Neves, Benjamin Rousseaux, Mayeul Chipaux

This event was organized as part of UNESCO’s International Year of Quantum Science and Technology and the 2025 Fête de la Science. Prof. Philippe Grangier, a pioneer in quantum science, delivered a one-hour lecture for the general public at UMLP. He traced the historical breakthroughs that led to quantum theory, highlighted key experiments revealing the nature of light, and described current applications in the control of single atoms. Despite the complexity of the topic, the talk was widely praised, including by non-scientists. Attendees appreciated Prof. Grangier’s clear explanations, his anecdotes about participating in Prof. Aspect’s experiments, and his presentation of striking demonstrations such as rotating light through a sugar column. Prof. Grangier himself expressed his appreciation for the event, praising both the organization and the audience’s enthusiasm.

**References :**

https://quantum2025.org/fr/

https://www.femto-st.fr/fr/L-institut/evenements/conference-des-fondements-de-la-mecanique-quantique-aux-technologies

# SCIENCE AND SOCIETY

## ARTIFICIAL INTELLIGENCE: UNDERSTANDING IT TO SUPPORT BETTER DECISION-MAKING. AN INSTITUTIONAL PRESENTATION AT THE GENERAL ASSEMBLY OF THE PREFECTURE OF DOUBS.

**Place:** Besançon
**Number of participants:** around 200 participants
**Involved person from FEMTO-ST:** David Laiymani

During an hour-long presentation to the staff of the Prefecture of Doubs, David Laiymani provided a non-technical overview of artificial intelligence, its development, and its current fields of application. He highlighted the extent to which AI is already embedded in everyday life and public services, including healthcare and emergency response. The presentation also examined major challenges associated with these technologies, including bias and discrimination, limited transparency, privacy and security issues, and malicious uses such as deepfakes, while also emphasizing the broader stakes of Europe's digital sovereignty. It concluded by reaffirming that AI is a powerful yet imperfect tool, one that must be properly understood and responsibly guided in order to serve the public interest.

## TWO INTERVIEWS ON FRANCE 3

**Place:** Besançon
**Number of participants:** one participant in the first interview; three in the second
**Involved person from FEMTO-ST:** Raphaël Couturier

In February 2025, Raphaël Couturier appeared on French regional television news, where he shared his views on recent developments in AI, discussed several FEMTO-ST research projects in the field, and highlighted both the benefits and the risks associated with the technology.

He was also interviewed alongside a newspaper journalist and a startup CEO, offering a scientific perspective on AI and its tangible impact on everyday life. During the discussion, he referred to FEMTO-ST projects such as predictive tools for firefighters' operations and medical applications of AI. He stressed that AI is neither inherently good nor bad and that the way it is used depends on conscious and responsible choices, making it above all a political issue.

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**FEMTO-ST Institute**
**15B avenue des Montboucons**
**F - 25030 BESANÇON cedex - France**

Tel.: +33 (0)3 63 08 24 00

**www.femto-st.fr**