

# MINA-NEWS

MINATEC  
NEWSLETTER  
DECEMBER 2022

# #72

## Multi-project circuit prototyping at CIME Nanotech

**CIME\* Nanotech now offers multi-project circuit prototyping, which significantly lowers fabrication costs. This new service rounds out the organization's circuit design and validation activities.**

In multi-project circuit prototyping, a single silicon wafer is used to prototype circuits for up to thirty clients, who each purchase a tiny amount of space on the wafer. This approach dramatically lowers the cost of R&D, increasing accessibility for a wide range of clients.

CIME Nanotech began offering this service for academic research labs and manufacturers in November. Two to three manufacturing runs will be sent to a foundry each year. CMOS, RF, photonic, and power circuit prototypes can be fabricated. "We were already providing design and validation services, so we now cover the whole value chain: This is unique in France," says director Ahmad Bsiesy.

### EXCLUSIVE ACCESS TO STMICROELECTRONICS TECHNOLOGY

The Grenoble center enjoys exclusive access to design kits from STMicroelectronics, alongside those of other European foundries. It also handles electrical and radiofrequency validation testing. A 220 Ghz HF characterization bench, unique in France, covers 5G, 6G, and LiDAR system specifications.

Another advantage of working with CIME is accessibility: Unlike ILL or ESRF, CIME does not impose a selection process, as long as the project passes a simple technical validation step designed to ensure that a planned circuit can be fabricated and will work as intended.

*\*Inter-University Center for Microelectronics and Nanotechnology, a Grenoble INP - UGA technology platform.*

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### INNOVATION

## Micron-level accuracy in die-to-wafer bonding

CEA-Leti and equipment manufacturer SET have developed a new hybrid die-to-wafer bonding process that boasts micron-level accuracy. The solidity of the bond is achieved using the molecular force between the copper and oxide surfaces alone. Several patents have already been filed for this now-mature technology, which will soon be brought to market in a new machine developed by SET.

This bonding method is crucial for the heterogeneous 3D circuits just over the horizon. Component miniaturization means that existing microbead assembly technologies will become obsolete, since they limit interconnection density. Possible applications for the new technology include AI processors that combine LEDs or image sensors, memory, and CMOS circuits.

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## Cybersecurity: Schneider Electric signs on for three more years

Schneider Electric and the CEA have extended their cybersecurity partnership (a joint lab with dedicated premises and equipment) for at least three more years. Schneider Electric hopes to improve the security of its energy management and industrial automation products. Cyberattacks, which are becoming increasingly widespread and sophisticated, can slow production, damage machines, or reveal sensitive data.

Solutions coming out of the joint lab are secure by construction: Security is a key consideration throughout the design process. Schneider Electric and the CEA are also developing innovative test benches that will be used to validate the cybersecurity credentials of future projects.

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## INNOVATION

HMM... OPTICAL TWEEZERS THAT "PICK UP" BACTERIA ...



## On-chip photonic tweezers for bacteria capture and characterization

Researchers from Irig, LTM, and CEA-Leti have developed an almost-instant means of testing bacteria viability after a thermal shock. The new device features an optical nanocavity and two micromirrors. A laser beam bounces back and forth between the mirrors hundreds, or even thousands, of times before escaping: This resonance creates a gradient force\* that attracts nearby bacteria. The viability of the bacteria alters their effect on the resonance frequency.

The new nanosystem could be used to check how bacteria react to antibiotics, reducing test times from around 48 hours of culture time in a Petri dish to mere moments. Potential benefits include more targeted use of antibiotics, lowering the risk of antibiotic resistance.

\*Phenomenon discovered by the American physicist Arthur Ashkin, 2018 winner of the Nobel Prize in Physics.

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## Advanced computing: Irig researcher honored for second time

Irig researcher Ivan Duchemin has earned recognition for his work as runner-up in the annual Atos-Joseph Fourier award for advanced computing and artificial intelligence. Duchemin won a previous award for his expertise in high-performance computing in 2014.

Duchemin developed *ab initio* algorithms to simulate and characterize unique defects in boron nitride flakes of over one thousand atoms in size. These defects are significant as potential single-photon emitters. His new, very-low-power BEDEFT code, parallelizable across thousands of cores, is an important step towards simulating quantum properties in increasingly realistic systems.

The Atos-Joseph Fourier second prize comes with 200,000 GPU hours on the Genci\* supercomputers.

\*A national supercomputer infrastructure in France

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## Low-cost, global IoT connectivity now a reality

CEA-Leti team has designed an ultra-low-power radiofrequency chip that connects fixed or mobile IoT devices to nanosatellites manufactured by the Swiss company Astrocast. Terrestrial IoT networks cover a mere 15% of the planet's surface, meaning that this new technology is desperately needed in industries such as maritime transportation, fishing, and offshore oil, which operate on the oceans or in other remote areas.

The chip, developed and transferred in just three years thanks to CEA-Leti's industrial-grade testing facilities, works with Astrocast's propriety frequencies. It detects satellites in geostationary orbit and corrects the Doppler effect induced by the high speed of these satellites. The module built around the chip is three times cheaper to run than traditional satellite IoT alternatives.

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## A first step towards controlling skyrmion movement

Skyrmions are in the news again, thanks to an advance made by a Spintec team, in conjunction with two other laboratories\*. The researchers successfully controlled the movement of skyrmions—quasi-particles with potential applications for magnetic memories—in *situ* by applying a gate voltage to reverse their chirality, or spin direction.

This is an important step towards controlling the movement of individual skyrmions, a prerequisite to their use as memory units or logic gates. The team now needs to do some basic research into chirality inversion and explore possible applications. The idea is to replicate their initial experiment using nanometric skyrmions, with the long-term goal of optimizing memory density, and to create nano-equipment with movement guidance channels.

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## Electric vehicles: Valeo and CEA-Leti to bring power electronics to market

In September, Valeo and CEA-Leti signed a power electronics partnership. Their goal is to optimize the EV powertrain, which encompasses the battery, motor, wheels, and a variety of components in between. The partners' aim is to improve energy yields while reducing size, weight, and cost. Further priorities include reliability improvements and eco-design: When you add up driving time, charging, and discharging into a smartgrid, electric vehicles run for tens of thousands of hours during their useful life.

Valeo and CEA-Leti will work with new wide-bandgap (SiC or GaN) components to create innovative sub-systems. A digital twin of the power converter is also planned. Staff exchanges between partners' organizations are also planned.

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## Optoelectronics: goodbye cadmium, hello zinc oxide?

An Irig team, working alongside Polish researchers\*, has successfully synthesized and characterized controlled-thickness, highly stable, nanometric zinc oxide (ZnO) nanoplatelets. These nanoplatelets may offer an alternative to classic cadmium chalcogenide 2D nanostructures in optoelectronics. Cadmium chalcogenide is toxic and rare, and its use is tightly regulated by a European directive.

Irig researchers studied 2D ZnO nanoplatelets using dynamic nuclear polarization (DNP), a high-sensitivity NMR technique. They showed that the benzamidine ligands used in synthesis distribute across all faces of ZnO crystals, limiting the dimensions of each crystal and contributing to the stability of the nanoplatelets.

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## Vibration: new hope in the fight against cancer

Researchers from Irig and Inserm recently made a surprising and promising discovery: Cancerous cells die spontaneously (apoptosis) on contact with magnetic particles vibrating at between 2 Hz and 5 Hz under the influence of an external field. The phenomenon is being investigated further by a Spintec-LTM PhD candidate, who is measuring the forces at work on the cells in order to understand the underlying mechanisms.

LTM's traction force microscopy technique is being used to detect cell withdrawal, shrinking, or stretching. Cell mobility, a parameter which is known to impact metastasis, is also being observed. This exploratory PhD research will provide biologists with the data they need to reconstruct the cascade of reactions resulting in apoptosis.

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### DAY BY DAY

## Fame Master's program to include AI

The Erasmus Mundus Fame international master's program, coordinated by Grenoble INP – Phelma, UGA, has a new component and a new name. The Fame<sup>AI5</sup> program will cover artificial intelligence (AI) tools, used to accelerate the development of functional materials, optimize their properties and performance, and ensure that final designs enable sustainable solutions.

The AI elements of the program will draw on the expertise of both European and local partner institutions, such as MIAI in Grenoble. AI techniques can be applied to a vast range of materials, including semiconductors and magnetic, non-linear optical, and multi-functional materials. Fame<sup>AI5</sup> was launched in September with a first cohort of 21 students, split between Grenoble and Darmstadt.

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## Semiconductors: CEA ranks 4<sup>th</sup> among European patent filers

European patent applications are booming in the semiconductor industry, with an increase of 21% in 2021 alone. The biggest contributors to this increase are multinational companies: The latest edition of the EPO's\* annual innovation barometer places Samsung, Intel, and TSMC in first, second, and third place. The CEA, at number four, is the highest-ranked European player.

The rankings confirm CEA-Leti's status as a groundbreaker in semiconductor R&D, with 320 patent applications in 2021. This result is a significant improvement on 2020 levels, which were adversely affected by the Covid-19 pandemic.

Across all industries, the CEA comes in second in the French rankings with 528 applications, just behind Safran (540 applications) and ahead of Valeo (500 applications).

\*European Patent Office

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## Engineering student athlete races to an exciting ski season

Constance Lay, 22, hasn't missed a gate yet! With two student championship titles to her name, the downhill skier slaloms between the slopes, the classroom—Lay is in her second year at Grenoble INP - Phelma, UGA—, and a position as a ski instructor at nearby resort Alpe-d'Huez.

All this is made possible by Lay's sense of organization, her passion for skiing, and the special arrangements in place for elite athletes at the school. So, what does the future hold for Constance? Hopefully, developing sporting goods: Her ultimate dream is to apply her engineering skills to ski design. Right now, however, she's focused on something closer to home: the first ISF\* competition of the new season, in Val-Thorens on December 16.

\*International Ski Federation

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## Hydrogen education gets a major boost

The hydrogen industry is growing rapidly, with 1,500 new positions to fill over the next three years in France's Rhône-Alpes region alone. The AMHY\* project, centered around Grenoble, was created in response to the need for qualified personnel. Eight partners, including Grenoble INP, will share a total budget of €3 M.

Grenoble INP – Phelma, UGA, a major participant in the project, will recruit specialist teaching staff and technicians, and is set to invest €150 K in fuel cells and electrolyzers for educational use. There will be extra lab classes and more in-company experiences for electrochemical and materials engineering students. Other initiatives include a hydrogen major, due to launch in 2024, for the employment-based engineering program; a joint graduate degree in engineering focusing on hydrogen; and a "hydrogen certification" program with 150 hours of continuing education.

\*Hydrogen education accelerator

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**CHRISTINE CHIRAT**, Professor at Grenoble INP - Pagora, UGA and researcher at LGP2, is also the Associate Dean for Academics and Student Life at Grenoble INP - UGA.

## Kaleidoscope Week: a new event at Grenoble INP - UGA

**MINA-NEWS: The first edition of Kaleidoscope Week welcomed 1,600 students from Grenoble INP - UGA this October. Can you tell us more?**

**Christine Chirat:** Kaleidoscope Week was an innovative educational event for students across all our schools. Classes were cancelled for the week so that students from the different schools could come together and explore 31 options on offer on seven main themes, from ethics to research to transitions. Each option included a variety of activities: serious games, lectures, creative workshops, lab visits, and more. All students were required to attend and hand in an individual written report.

### What was the purpose of the project?

**C. C.:** First and foremost, we wanted to highlight the wealth and diversity of engineering and business expertise at our schools and encourage students to broaden their horizons by discovering new disciplines and practices. We also wanted the students to improve on marketable skills, such as the ability to interact easily with people from a variety of professional backgrounds, or expertise in sustainable development practices. Finally, the event strengthened connections between all eight schools\* as we worked together to build this ambitious project from the ground up.

### Will this be an annual event?

**C. C.:** We hope so! Kaleidoscope Week was a huge success, with students and teaching and research faculty all giving their best. For the 2023 edition, we want to improve on certain organizational aspects, and focus on increasing student diversity within the different options.

*\*Grenoble IAE and Polytech Grenoble joined Grenoble INP - UGA in 2020, bringing the total number of schools from six up to eight. ■*

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## DAY BY DAY

### Bic acquires AMI

**A**MI (formerly ISKN), a CEA-Leti spinoff founded in 2014, has been acquired by Bic—so, rather than going to the US or China, the company will remain French-held. In September, Bic snapped up the totality of AMI's share capital, consolidating its position on what it calls the "digital expression" market. AMI is the creator of the ISKN Repaper tablet, which allows users to capture elements written or drawn on normal paper in a digital format.

Good news, too, at the local level: The startup's 30 employees will be staying in Isère. Better still, CEO Jean-Luc Vallejo plans to hire ten to fifteen people per year in 2023 and 2024 to increase the company's capacity to innovate new concepts. The Grenoble-based team looks set to become a major asset to Bic's R&D activities.

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## LIVE FROM MINATEC

### GIANT Orientation Day 2023: supporting new PhD and post-doc students

**S**ave the date: Tuesday, February 14, 2023 is GIANT Orientation Day at Y.SPOT Partners. The event is intended to show new doctoral and post-doctoral students the research facilities and expertise available in our area, notably through tours of the GIANT labs and institutes. It's also an opportunity to build connections between junior scientists in different areas.

The 2023 edition will highlight services on offer for doctoral students. Participants include the GIANT institutes' graduate student associations, the UGA PhD Alumni network, and *Ma Thèse Émoi*, a new organization which promotes mental and physical wellbeing among PhD and post-doc students.

*Program and registration, from January:*

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### Full house for Maison MINATEC!

**A**fter two years of purely digital or hybrid meetings, the Maison MINATEC conference center has played host to 150 different events since March 2022: a welcome return to pre-pandemic levels. One positive takeaway from the Covid years is a massive upsurge in video recording, meaning that replays of event highlights can be made available.

Recent visitors to the facility may have noticed improvements to the seating. All 400 chairs have been reupholstered; the backs were still in good condition and did not need replacing. The orange fabric from the original chairs has been transformed into bags, which are being sold to raise money for Emmaüs, a nonprofit that helps the homeless.

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### Work starts on BHT3, Place Nelson-Mandela

**W**ork has started on the third BHT (high-tech building), next to Y.SPOT Partners on the Presqu'île. Now that the major excavation work is finished, the next stage will be the foundations. Building above ground will begin in 2023, with delivery scheduled for early 2024. Interior finishes and fittings requested by the future tenants will be installed prior to opening, for a fast and easy move-in.

Commercialization began in September and is now in full swing. Meetings have been held with a dozen companies, and a growing list of startups have expressed interest in the location. Why is the BHT so popular? Put simply, because it's unique: MINATEC Entreprises is the only organization in the area offering this type of mixed-use facility (offices, cleanrooms, and labs) with additional services.

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## HORIZONS

## European University alliance: onward and upward for Unite!

Following a successful three-year pilot phase, the Unite! European University alliance has moved onto the next stage in its development. Two new partners, in Austria and Poland, have come alongside the seven founding institutions (including Grenoble INP – UGA). The total number of students involved has grown from 180,000 to 280,000. Unite! has received €14 M in funding, with €1.4 M earmarked for the UGA campuses in Grenoble and Valence.

Current goals for Unite! include enriching and increasing the visibility of Metacampus, a digital platform hosting online courses, MOOCs, thematic workshops, PhD subjects, internship offers, and more. A number of scholarships and multi-partner research projects will be established in four main areas: renewable energy, AI, Industry 4.0 and entrepreneurship.

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## CEA-Leti to put digital health in the spotlight at CES 2023 in Las Vegas

CEA-Leti will be exhibiting at the Consumer Electronics Show again this year, presenting three projects in the field of digital health. CES—the world’s largest trade show in the industry—will take place in Las Vegas from January 5 to 8.

The first project is CEA-Leti startup Admir, which won a 2022 i-lab award. Admir has developed an infrared spectroscopy technique for analyzing cancerous tissues. The second project, Injectpower, produces high-energy-density batteries for long-lasting medical implants. The product has recently been integrated into its first real-world application, an intraocular pressure sensor for glaucoma. The final project on show is NIR’s intracranial modules, which use light to slow the progression of Parkinson’s disease. A world-first clinical trial of the technology was launched at Cinatec in 2021.

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## ByCommute: from shipping containers to bike shelters

ByCommute was founded in April 2022 by two student entrepreneurs from Grenoble, including an engineering student from Phelma. The startup buys shipping containers that no longer meet regulatory standards and transforms them into bespoke bike boxes.

Each product is fully customizable according to the customer’s desires and budget. The first step is to determine the dimensions of the box and the number of stands, before choosing other features to include, like electric bike charging points, surveillance cameras, planted roofs, locking systems (RFID, connected locks), and more.

The boxes are transformed in Pontcharra, near Grenoble, using mostly French-made components (the rest are of European origin). A customized box has already been installed at the UGA campus in Valence. Demand is growing steadily, with several new projects already on the order books.

<https://bycommute.fr>

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## Cinatec Endowment Fund raises awareness of biomedical research

What if light could be used as a drug? That’s the question asked on half of all Grenoble’s city buses over the course of a week this fall. The high-impact advertising campaign, run by the Cinatec Endowment Fund, was timed to coincide with World Alzheimer’s Day on September 21. The aim was simple: to raise public awareness of biomedical research, particularly in the field of neurodegenerative diseases.

An infrared illumination technique leveraging a CEA technology has shown a lot of potential, and three patients with Parkinson’s disease are currently receiving treatment under the NIR\* protocol. The Cinatec Endowment Fund is also working on the pre-clinical phase of a new treatment for Alzheimer’s disease.

\*Near Infra Red, a protocol run by Grenoble University Medical Center, in collaboration with the CEA, UGA and Boston Scientific.

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## Wormsensing raises €3.5 M to fund pilot line

Wormsensing, a CEA-Leti startup founded in 2020, has recently raised €3.5 M in fresh capital. The company’s ultrathin piezoelectric vibration sensors, designed to measure warping, can be installed on any component or surface in mere minutes. The sensitivity level of the sensors is one thousand times that of standard strain gauges, for one-tenth of the standard measurement cost.

Wormsensing is moving from its previous base at MINATEC to its own location in the greater Grenoble area and will build a pilot line to produce higher product volumes. The company intends to accelerate business development in new markets, such as industrial instrumentation and maintenance, onboard electronics for the automotive industry, and digital health. Wormsensing will continue to collaborate with CEA-Leti on R&D activities via their joint laboratory.

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**AGENDA**

**December 8 [World Trade Center]**  
**IFORUM, INNOVATION**  
**(EX-FORUM 5i)**  
*iforum-2022.insight-outside.fr*

**January 5 to 8 [Las Vegas]**  
**CONSUMER ELECTRONIC SHOW,**  
 Exhibitors include CEA-Leti  
 (digital health)  
*sylvain.colomb@cea.fr*

**January 16 [MINATEC]**  
**LETI HEALTHCARE**  
**WORKSHOP 2023**  
*urlz.fr/jWW1*

**February 14 [Y.SPOT Partners]**  
**GIANT ORIENTATION DAY**  
*floriane.marcuccini@cea.fr*

**February 25 [Phelma]**  
**GRENOBLE INP - PHELMA,**  
**UGA OPEN HOUSE**  
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**April 17 to 28 [les Houches]**  
**PHYSICS SCHOOL:**  
**OPTOMECHANICS AND**  
**NANOPHONONICS**  
*urlz.fr/jWVU*

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