MINA-NEWS
#66
MINATEC
NEWSLETTER
OCT'21

TOP NEWS

Startup Direct Analysis racking up the milestones

Direct Analysis, the 70th startup from CEA-Leti, has stayed under the radar since it was founded at the beginning of the year. The company has won an i-Lab award, completed twelve demos of its food testing solution, and secured preliminary regulatory approvals. Direct Analysis could open its own plant near Grenoble as early as 2022.

Direct Analysis can deliver biological test results in just six hours instead of 24 without compromising on sensitivity—an advance that is sure to please the food industry, where faster results can ensure that bad batches are pulled before they reach consumers, avoiding costly product recalls. The rapid testing solution can also be used preventively on factory equipment.

A CEA-LETI INNOVATION PROTECTED BY ELEVEN PATENTS

The key to Direct Analysis' innovative solution is a microfluidic chip that extracts DNA from the sample and completes a PCR test. Because it can handle samples a hundred times larger than standard microfluidic devices, less incubation time is required to be able to detect any pathogens present.

Direct Analysis currently has seven employees, including two from the CEA. The company brought an experienced founder on board to lead it to growth.

Up next: at least one fundraising round and, potentially, a factory near Grenoble, maybe as early as 2022.

Direct Analysis has completed demos at the manufacturing plants of twelve food companies, mainly multinationals. The demos are expected to lead to regular use of the solution.

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INNOVATION

New accelerator at Ganil gets high-precision control system

Ganil* in Caen has a new superconducting linear accelerator. Researchers at Irig recently tackled the challenge of achieving millibar-precision pressure control of 26 superconducting accelerator cavities cooled to 4.5 K by a liquid helium bath.

The researchers used Simcryogenics, Irig's simulation tool for large cryogenic equipment, to model the accelerator. The modeling and subsequent development of ad hoc control laws were also the topics of a PhD dissertation.

A few final adjustments to the control system were made on site during commissioning.

The high degree of precision will help ensure robust operation of the accelerator, which is extremely sensitive to even tiny fluctuations in helium pressure. It should avoid shutting the beamline down several times a day.

**Ganil is the national large heavy ion accelerator, an economic interest group of the CEA and CNRS.*

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Photonic chips: toward high-throughput alignment of optical fibers

In research for the European Union H2020 Pixapp project, CEA-Leti scientists have developed a sub-micron-precision passive automated microlens alignment process.

If the new process' potential is confirmed, it will allow photonic chips to be connected to several optical fibers five to ten times faster than today's processes.

Here's how it works. First, capped copper bumps are placed on the chip. Next, a small gold bead is placed on the microlens.

When the chip and microlens are welded together, capillary action automatically aligns them.

The process is effective on fibers initially misaligned by up to seven microns. It was tested on chip-to-chip assemblies. Next up: wafer-level testing.

A patent has been filed to protect the process.

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OxRAM memory almost ready to scale up for manufacturing

Rapid advances in resistive oxide memory (OxRAM) could soon put the technology on manufacturers' production lines.

In a recent demonstration by CEA-Leti, 16-kbit arrays were successfully fabricated on 300 mm, 28 nm FDSOI wafers and run for 100,000 cycles with zero memory-point failures.

OxRAM is affordable, high-density, and easy to manufacture. This latest demonstration also proves it is robust and reliable. CEA-Leti introduced a tiny amount of silicon into the active metal (hafnium oxide), an innovation that makes it possible to use a lower voltage, which is easier on the 28 nm transistors closest to the memory.

Several patents were filed as a result of this research and talks are underway with potential manufacturers.

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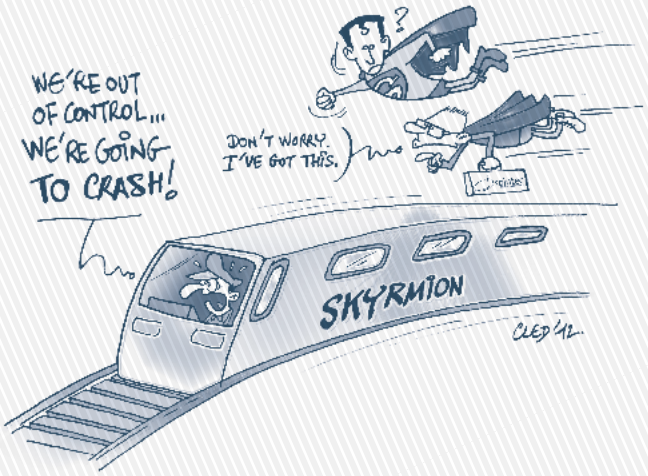

Creating and manipulating skyrmions with helium ions

Researchers from Spintec and their Paris-based partners* successfully generated and controlled the movement of magnetic pseudo particles called skyrmions by first irradiating a magnetic track with helium ions. Until now, skyrmions were impossible to control, moving toward the edges of the track and disappearing.

This advance bodes well for the use of skyrmions to build processors and memory.

Here, the "trains" of skyrmions the researchers were able to create on the tracks were a few hundred "cars" long.

When an electrical current was applied, the skyrmions moved along the irradiated area, even if the current was not perfectly aligned with it. The technique was tested on a 200 nm wide track, but simulations indicate that it could work on a track as narrow as 10 nm.

**C2N (CNRS) and startup Spin-Ion*

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The perfect fuel-cell membrane remains elusive

Tomorrow's clean vehicles will run on hydrogen fuel cells. But what will the membranes inside those fuel cells be made of? We don't know…at least not yet!

Nafion is often cited as a front-runner. But the material's mechanical properties suffer at temperatures above 100 °C. Scientists at Irig investigating alternatives are getting some encouraging results with sPEEK, an ionic polymer.

Unlike Nafion, sPEEK can stand up to high temperatures. However, inside a fuel cell it oxidizes too rapidly. Here, it was hybridized with a stabilizing sol-gel precursor. The hybridized sPEEK performs better in a fuel cell stack than sPEEK alone, and accelerated aging tests in the lab look promising.

The sol-gel precursor is used up over time, so the researchers are looking at ways to regenerate it.

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Beamforming improves the angular resolution of PMUTs

Piezoelectric Micromachined Ultrasonic Transducers, or PMUTs, are a type of MEMS. The devices are currently plagued by an angular resolution in excess of 90° in some cases.

CEA-Leti brought the figure down to 18° for the detection of an object placed 40 cm away from the device. Their solution consisted of a network of five PMUTs with specially developed components and a technique called beamforming.

The devices used here have two layers of aluminum nitride, a piezoelectric material, so that beamforming can be used to leverage the interference between the PMUT measurements.

The research won a Best Paper Award at Smart Systems Integration 2021. The system will be of use in human-machine interfaces, instrumentation for robots, and sensors for autonomous vehicles.

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Mystery of disappearing photons solved

When photons interact with matter, a few per million are transformed into lower energy photons. In a specific kind of superconducting quantum circuit, the proportion of photons that undergo this transformation rises to one in three!

Researchers at Irig recently discovered that the phenomenon is related to the nature of the circuit: a chain of large Josephson junctions terminated by a smaller junction that behaves like a qubit coupled to a transmission line.

The electrical charge displaced in the vicinity of the qubit modulates the qubit's energy.

Quantum jumps in the superconducting phase "break up" the incident photon in resonance with the qubit to form a slightly smaller photon and several low-energy photons.

This breakthrough in theoretical physics marks a step toward the long-term objective of generating multiple entangled photons in a controlled manner.

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Making IoT devices more resilient to attacks

Currently, when an IoT device (a "node" on the network) is attacked by hackers, the entire network can be affected, as can internet-connected third-party infrastructure services.

A new solution called iMRC uses a control server to detect attacks and takes over any devices that have been compromised to find out what vulnerability the hackers used to get in so that a software patch can be sent out.

Developed by CEA-Leti, CEA-List, and Tiempo Secure, iMRC won a *Grand Défi Cyber* award from the French government.

The solution includes a secure physical element and an embedded supervision system that interacts with the control server.

It should be ready for production by the end of next year and will be of particular interest for critical systems for the energy industry, the medicine of the future, and transportation.

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Marion Gruart wins award and PhD grant for red LED research

Marion Gruart, who did her PhD research at Irig from 2016 to 2020, won a Grenoble-Alpes University innovation award for her dissertation. She was also hired for a research position by startup Aledia.

Her work on a high-stakes topic, InGaN (indium gallium nitride) nanowire red LEDs, has resulted in four patents. To emit red light, optimally, the material has to contain 35% indium. The problem is that a 35% indium content creates a mismatch in the lattice and dislocations in the standard planar-layered heterostructures. This is detrimental in terms of light emission.

Marion developed original structures made up of a network of nanowires with a pyramidal morphology to solve this problem.

Aledia has even decided to co-finance another PhD candidate's research at the same Irig lab this year.

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Reversing magnetization with an electric field

Researchers at Irig working with colleagues in Romania* recently discovered that the magnetization of an MRAM-cell-type nanostructure can be reversed by applying an electric field rather than an electric current. Their results should lead to some exciting developments.

When an electric field is applied, the write speed is ten times faster and uses 100 times less energy compared to standard STT-MRAM. And, because Joule effect losses are reduced to a similar degree, the memory stack doesn't get as hot, which is good news for STT-MRAM reliability and robustness.

Simulation was used to determine the optimal switching parameters, which were then confirmed experimentally.

The research, which is ongoing, could lead to the design of innovative components.

A patent has also been filed.

** Babes-Bolyai University and Technical University (Cluj-Napoca, Romania)*

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LIVE FROM MINATEC

Leti Innovation Days get a new four-session format

CEA-Leti had to move its Leti Innovation Days online during Covid. The change sparked a new format for the event this year. The traditional multi-day in-person event in June will still be held in 2022. But there will also be three half-day online sessions on specific topics.

The December session will address electronic components, and the March session healthcare use cases. The third session has not been scheduled yet.

This new format will give attendees and sponsors the flexibility of focusing on those topics that interest them most. Plus, the online sessions will be easier for a worldwide audience to access.

The format may have changed, but the event is still a major one for CEA-Leti and one that helps generate new ideas to feed the institute's research pipeline.

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Survey: Midis MINATEC phygital format a hit

A survey sent out in July to past Midis MINATEC lunch talk speakers and attendees got an excellent completion rate, evidence of the event's popularity. More than 90% of respondents were satisfied and 80% appreciated having access to the recordings.

The results confirmed that streaming is here to stay, offering a clear advantage to people who are far from MINATEC or don't have time to come to campus.

More than two-thirds of the speakers who responded reported that they would like the recordings of their talks to stay on YouTube for several months.

Since October 2020 an average of 140 people have attended the live streams. But the recordings on YouTube have tallied up nearly 18,000 views!

The jury is in: the Midis MINATEC lunch talks will stay phygital!

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Science outreach program *Parvis des Sciences* to be held in person this year

The popular *Parvis des Sciences* science fair will finally take place in person again at MINATEC from October 5 to 9. Last year's event had to be held online.

To facilitate social distancing, the activities will be spread out over five days instead of three, including a full four days for school groups. Around 60 classes, mainly from elementary schools, have reserved their slots. The students will take a series of three workshops covering a variety of science topics. Saturday will be open to the general public. Visitors select a thematic tour when they register.

There will be a few new exhibit booths this year on topics like carbon capture, smartphone lifecycles and recycling, cryptography and secret codes, and micro-algae.

See the program and register at: *parvis-des-sciences.com*

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DAY BY DAY

Irig turns to YouTube to spread the word about its research

Irig recently posted two videos on the *CEA Recherche* YouTube channel. The idea is to help the general public understand how scientific research can contribute to solving society's major challenges.

The first video, on the basic research supporting the transition to clean energy, highlights research addressing biofuel production from micro-algae, the development of dye-sensitized solar cells, and energy storage systems. The second video, on quantum computing and spintronics, explores how the emergence of new digital technologies is being driven by research on physical phenomena involving electrons, photons, and spin.

Irig plans to get its scientists on board to make more videos like these for the general public.

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PATRICK LÉVY,
FORMER COORDINATOR
OF THE GRENOBLE-ALPES UNIVERSITY IDEX*

"Winning a national IDEX grant was not a given."

MINA-NEWS: Grenoble-Alpes University's application for national IDEX (Initiatives of Excellence) funding was approved in late June. Were you surprised?
Patrick Lévy: We wanted it and our local stakeholders certainly worked hard to make it happen.

We were careful not to take anything for granted. This was not a given. You have to remember what has been happening on other campuses. Toulouse's grant was revoked in 2016, and Lyon's in 2020. The Paris-Saclay and Paris Sciences-Lettres campuses had their probationary periods extended through 2020.

MINA-NEWS: What was the committee looking for?
PL: What they wanted to see were education and research already working together at the local level to provide a solid foundation for an international-caliber campus. The University president's office has to have full autonomy to make strategy decisions. Grenoble-Alpes University strengthened its relationships with national research organizations like the CEA, CNRS, Inserm, and INRIA. This was structured around an Experimental Campus that also includes schools Grenoble INP, Sciences Po Grenoble, and ENSAG.

MINA-NEWS: What does it mean in terms of funding?
PL: It gives us substantial security. We know we will be getting €30 million per year for research, research-driven education, and education in general—for programs with a positive impact on student life, arts and culture, and the campus' overall identity.

There are also other national grants that haven't yet been awarded. The ExcellenceS grants, for example, will bring an additional €400 million to the 20 existing IDEX and ISITE** campuses. ■

**Patrick Lévy has been working on a new IDEX grant proposal with stakeholders in France's Occitanie region since January 2021.*
*** Initiatives for science, innovation, business, and communities*

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Nonprofit *La Puya Internationale* on the ground in Madagascar

Nonprofit *La Puya Internationale*, of which MINATEC is a long-standing partner, was established to facilitate scientific cooperation. Next on the agenda is a session on solar photovoltaic energy in Madagascar from December 6 to 12. Around 30 graduate students will attend this summer school on renewable energy, which will include hands-on workshops via Zoom.

Fianaralab, a nonprofit affiliated with the University of Fianarantsoa, is organizing the event. The connection with Grenoble is Fianaralab's chair, Herinirina Fanevamampiandra, a Phelma engineering graduate currently working on a PhD in France.

La Puya Internationale members are already remote-teaching photovoltaic lab classes in partnership with nuclear science and engineering training center INSTN in Tananarive using equipment sent to Madagascar last spring.

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Tech transfer: Magellan stays the course

The Magellan startup program kicked off with a call for projects in June. More than 100 submissions, covering everything from digital technology and energy to healthcare were received. A total of 29 potential founders received or are still receiving support services that include training, consulting, and help finding financing. Fifteen of the beneficiaries are from the CEA Grenoble campus.

The CEA created Magellan in 2020 to support startup creation nationwide. All CEA employees, without exception, are eligible to apply. Potential founders from outside the CEA are also invited to apply, especially experienced founders with a desire to bring a CEA technology to the market. The target: 150 startups by 2030.

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Anne Vilcot reappointed director of Phelma, focuses on 2030 strategy

Anne Vilcot, director of Grenoble INP - Phelma, UGA since 2016, was reappointed for a new five-year term. She will be focusing on two major projects as part of the school's 2030 strategy.

First, with several department heads expected to retire in the next two years, the school will need to plan ahead for a smooth transition to the new administrative team.

Second is continuous improvement, which will be intensified to achieve more efficient overall operations and make the school a better place to work for faculty and staff.

Director Vilcot plans to pursue the work she has already begun on the school's academic programs, corporate relations, and international projects.

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INSTN offers online courses on eco-innovation for the circular economy

INSTN is a center for training in nuclear science and engineering. That hasn't changed.

However, the institute has been expanding its course offering into other areas in recent years.

The latest addition is a series of three online courses developed in partnership with the CEA Technology Research Division on eco-innovation. They are intended for project developers, engineers, technicians, and anyone in charge of doing lifecycle analyses (LCAs).

The core concepts are taught as they relate to research and innovation projects.

INSTN is also supporting CEA-Leti's pivot toward hardware for quantum computing, and has developed a one-day course for CEA-Leti employees new to R&D projects in this emerging field. The course covers quantum physics basics and is designed to ensure that all employees share the same common core of knowledge.

Learn more: http://www-instn.cea.fr/

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Class of 2020 career placement numbers are good

According to a January 2021 survey by the *Conférence des grandes écoles* higher education consortium, 88% of the Grenoble INP - Phelma, UGA class of 2020 found jobs upon graduating. Given the impact of Covid on the economy, this is good news.

And those who found jobs were hired quickly: 98% within six months and 60% even before they graduated—mainly because many of the students were hired by the companies where they completed their culminating projects!

In terms of compensation, the median gross annual salary not including bonuses is €36,800. For PhD students it is €24,500. There was virtually no change from the previous year.

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HORIZONS

Minalogic cluster introduces WAM*, a new online community

Minalogic's 475 member organizations can use WAM* to find and post news and information; showcase their products, solutions, and expertise; work together on multi-partner project proposals; create market- or technology-specific interest groups, and more! A total of 1,500 individual users are expected to take advantage of the platform initially.

Minalogic has traditionally supported its members mainly through events. With WAM, the cluster hopes to support its members every day of the year!

The online community will also make preparing project proposals more efficient, a necessary improvement given the sharp rise in the number of projects, up from 60 to more than 100 for 2019–2020, with similar growth again this year.

WAM will not replace popular Minalogic events like Minalogic Day scheduled to take place on December 16.

**We Are Minalogic*

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CEA-Leti builds a demonstrator like no other

If you have been by the CEA Tech showroom recently, chances are you have noticed a giant smartphone.

The designers at Y.SPOT came up with the concept and built the hulking CEA-Leti demonstrator, with a bit of help last spring from students at design school *Pôle supérieur de design de Villefontaine*.

The objective of the collaborative workshop was to completely rethink what a demonstrator is. The ubiquitous smartphone—packed with CEA-Leti technologies—was the perfect test case.

The students explored different ways of representing a phone and developed five of their ideas into actual demonstrators.

The workshop gave CEA-Leti some new outreach ideas that will undoubtedly help the institute impact a wider audience in the future.

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Back to school, (almost) business as usual

Things were almost back to normal as this year's incoming engineering students arrived on the Grenoble INP - Phelma, UGA campus.

Most of the 370 students were present in the auditorium on the first day of school, apart from a few international students.

This year's breakdown is fairly typical: 20% of students came from INP prep or transferred from other undergraduate programs; 80% came from non-INP prep programs. Admissions are up slightly, and the number of female students is also up to a record 30% of the cohort—good news.

The new students, required to show proof of vaccination and wear masks, were able to enjoy many of the usual orientation activities and learn about the student clubs on offer.

Campus life is slowly getting back to normal as everyone continues to adapt to Covid restrictions.

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LYNRED and IMEP-LaHC set up joint lab

Leading global infrared detector manufacturer LYNRED and IMEP-LaHC have formed a five-year joint lab to study the fundamental physical mechanisms of cooled infrared components to improve the components' performance.

The partners will leverage DLTS*, LFNS**, and other advanced characterization methods, as well as modeling and new approaches developed specifically for their research.

LYNRED and IMEP-LaHC have already co-supervised two PhD dissertations; the company also has research partnerships with CEA-Leti, ONERA, and III-V Lab.

The joint lab will give IMEP-LaHC an opportunity to apply its physics know-how to new components. Quentin Rafhay, who heads micro and nanocomponent research at IMEP-LaHC, will lead the joint lab.

**Deep Level Transient Spectroscopy*

***Low-frequency Noise Spectroscopy*

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MINATEC sweeps the i-Lab competition

Three projects initiated at MINATEC have won awards in the French government's national i-Lab innovation competition.

The sweep included two of the ten Grand Prizes, one for startup Direct Analysis *(see article on p.1)* and one for the Agilite project to develop a silicon photonic LiDAR sensor. Both winners are from CEA-Leti.

The tiny, robust, powerful, and affordable Agilite sensor is being developed for the industrial robotics market. Ultimately, it will also be of interest to the automotive market for integration into ADAS. The man behind the sensor, François Simoens, used to head CEA-Leti's LiDAR program.

Cornel Ioana of Gipsa-Lab won a National Award for the Golten project. Golten is an electrical inspection software application for preventive maintenance that costs ten times less than current techniques.

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The GIANT Junior Ambassadors need you!

If you are a GIANT PhD student with international affinities looking for a chance to build a local network and be part of a community of professionals, then the GIANT Junior Ambassadors could be a great fit for you!

The Ambassadors represent the GIANT Campus within their host labs and outside GIANT, including at their home universities. They also help organize Orientation Day in January and the Junior Scientist and Industry Annual Meeting (JSIAM) in March, where PhD students get a chance to explore career opportunities outside the traditional research space.

There's a kickoff meeting in late October, and ongoing support from the GIANT team all year long. Ambassadors receive academic credit for volunteering.

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AGENDA

October 5–9 [MINATEC]
PARVIS DES SCIENCES
Science fair for school groups (October 5–8) and the general public (October 9)
Check out the program and register at: *https://parvis-des-sciences.com/*
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October 10 [Parvis MINATEC]
GRENOBLE EKIDEN
Relay marathon for teams of six runner
https://www.grenoble-ekiden.fr

October 18–20 [online]
INMRAM 2021
Introduction to MRAM memory
https://www.inmram.com/

October 26–29
[World Trade Center Grenoble]
GRAPHENE 2021 CONFERENCE
http://www.grapheneconf.com/

November 7–10 [MINATEC]
HIGH LEVEL FORUM ANNUAL SUMMIT
Reinventing industry for a more resilient society
https://hlf-giant-grenoble.org/
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November 17–18 [Lyon]
RENDEZ-VOUS CARNOT 2021
https://www.rdv-carnot.com/

December 16 [online]
LETI INNOVATION DAYS:
electronic components session
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