

# MINA-NEWS

MINATEC  
NEWSLETTER  
FEBRUARY 2019

## TOP NEWS

### 300 mm: Leti brings state-of-the-art technology to industry

Thanks to Nano 2022 initiative funding, Leti will complete installation of its first wave of 30 pieces of 300 mm microelectronics equipment in 2019. The equipment will expand Leti's technological capabilities, positioning the institute to address tomorrow's innovations.

The Nano 2022 initiative, financed by the CEA, the Auvergne Rhône-Alpes Regional Council, and the French government via the Directorate General for Enterprise, is spectacular in scope and in terms of its budget. The equipment purchased under Nano 2022 will give Leti one of Europe's most advanced R&D cleanrooms in Europe. The most remarkable piece of equipment to be acquired is an ASML immersion lithography system.

#### 300 MM TECHNOLOGY TO CATCH UP WITH 200 MM WITHIN TWO YEARS

The new equipment also aligns with several strategic priorities. The first is to possess equipment similar to what is used by industrial customers (300 mm). The second is to ensure the confidentiality of customers' R&D projects, something that requires a complete fleet of equipment. Finally, with the launch of the Substrate Innovation Center, Soitec will move a significant portion of its R&D activities to Leti. This world-class prototyping center will primarily develop new materials.

Around fifteen pieces of equipment will be installed in 2019, rounding out the institute's existing resources, and the development of 300 mm processes will begin. These tasks will be completed by special project teams made up of employees of the CEA, the equipment manufacturers, and subcontractors. The institute's 300 mm activities should catch up with 200 mm within two years.

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## INNOVATION

### Design: Leti and Silvaco set up joint lab

US-based Silvaco, a world-class provider of electronic design automation software, has set up a joint lab with Leti. The three-year lab will focus on the development of electrical behavior models for nanowire CMOS transistors and gallium nitride power transistors. The models developed will be integrated into Silvaco's software, used to design and simulate circuits built on these technologies.

With the arrival of nanotechnology, simulation has become a crucial step in the design process, enabling advanced verification testing at circuit level before engaging in costly fabrication. The joint lab will also position Leti technologies on a competitive market and pave the way for broader dissemination of these technologies.

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### Weighing viruses is not as easy as it looks

How do you weigh a bacteria-eating virus that is too light for precision scales but too heavy for mass spectrometry? Researchers from Leti and BIG developed and patented a novel "nanoscale" technique to do just that. The technique uses an array of around 20 nanomechanical resonators that are made to vibrate. The virus is then introduced into a chamber with the array, and the system measures the difference in frequency.

The measurement is taken inside the chamber of a new type of spectrometer. The major challenge was to find the best way to introduce the viruses, which are in a solution, into the chamber. The researchers came up with a system to nebulize the solution, vacuum it into the chamber, and focus it onto the nanomechanical resonators. This very promising advance could be used to characterize viruses, biomarkers, and synthetic nanoparticles for medical applications.

Read the article in Science: <https://bit.ly/2KunWZg>

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### Germanium-tin could be a winning combination for silicon photonics

Researchers from INAC and Leti obtained a mid-infrared laser emission (2.7 microns to 3.2 microns) at 230 K in a germanium-tin (GeSn) alloy nanostructure. The advance paves the way toward photonic integrated laser sources on silicon chips. Currently, laser sources must be added to circuits one by one.

The major challenge was creating a tin-rich alloy, necessary to improving the material's light-emitting properties without altering its high crystallinity. The researchers came up with a new process resulting in a 16% tin ratio. They then created two types of optical cavities: microdisks and photonic crystals. They will now focus on developing a device that can operate at ambient temperature. With operation currently at 230 K, they have already gone well beyond the 90 K obtained in 2015 by the researchers who pioneered the GeSn laser.

Learn more: <https://bit.ly/2MDQ2SX>

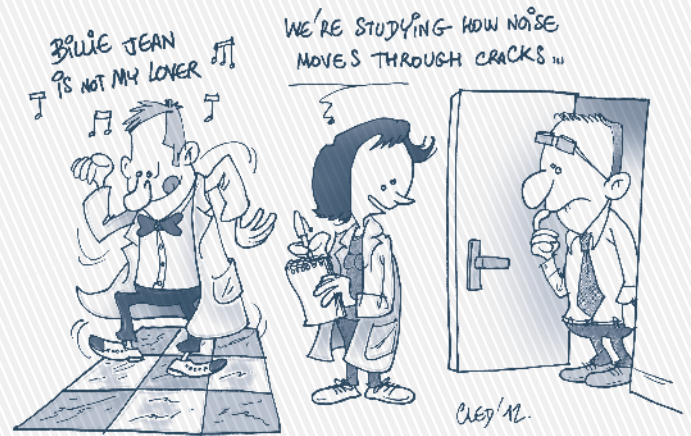
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## Noisy cracks, rough material

The acoustical waves emitted when a crack propagates in a material can change the crack's trajectory. The waves create alternating smooth and rough textures on the changed surface of the material. The phenomenon was observed during research conducted by INAC, Leti, and Soitec on SOI wafers, which are made by cleaving silicon.

Small cavities, like dotted cutting lines, are made to control the cleavage plane. However, additional roughness (cavities of around 0.05 nm) also appears. We now know that this additional roughness is caused by the "noise" produced by the crack, whose phase speed is equal to the speed of the crack. The researchers will now try to eliminate this additional roughness to continue to improve Soitec's substrates.

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## Leti focuses on embedded artificial intelligence

Can artificial intelligence be trusted to drive an autonomous vehicle if all of the computing is done in the cloud? Only if there are absolutely no transmission issues, which would delay the real-time decision-making required to operate these vehicles safely. Leti is investigating embedded artificial intelligence (AI embedded in the integrated circuit) as a solution to this problem.

The researchers working on the project already possess the algorithms, low-energy technologies, photonics, imagers, memory, and architectures they will need. They will focus on assembling these elements under self-financed R&D projects that will be presented to representatives of industrial companies at the upcoming Leti Days in June. The theme of this international event will be embedded artificial intelligence.

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## Life-sized IoT experiments underway at Maison MINATEC

In January, IoT-type sensors were rolled out for testing at Maison MINATEC. The sensors are measuring things like air quality, the use of mobile room partitions, and the number of visitors. Some of the underlying technologies were developed at Leti and being scaled up for manufacturing by companies like elichens, JYSE, and Adeunis RF. The test rollout is giving the sensor manufacturers a chance to demonstrate the benefits of their products, make improvements before they start manufacturing, and have a real-world use case to give their solutions more credibility on the market.

The test is part of the "Territoires Solutions" project run by French Tech in the Alps, which supports local startups. Other locations for further tests have already been identified (subsidized housing complexes, schools, sports fields, farmland, mountainous areas, etc.).

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## My Cube experiments with in-memory computing

Does separating circuits' logic and memory still make sense? Especially when we know that transferring data from one to the other is the biggest culprit when it comes to energy consumption? The Leti researchers gearing up to kick off the My Cube project on March 1 are convinced that the answer is no. The project, backed by the ERC to the tune of €2.75 million, will develop an original in-memory computing solution to the problem.

Silicon nanowire transistors and non-volatile resistive memory will be physically embedded using 3D integration. The interconnect

density will be very high, with a pitch of 100 nm or, possibly, even less. Leti's aim is to produce a circuit accelerator that uses 20 times less energy than a conventional state-of-the-art von Neumann circuit.

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## Aryballe Technologies and INAC, a winning partnership

Yanxia Hou-Broutin, a research scientist at INAC, and Tristan Rousselle, CEO of Aryballe Technologies, came in second in the European Association of Research and Technology Organisations (EARTO) European Innovation Awards in the Impact Delivered category in Brussels last fall. The award was granted for the partners' successful collaboration on the NeOse artificial nose. NeOse leverages surface plasmon resonance (SPR) imaging to recognize hundreds of simple and complex odors.

INAC patented the technology in 2012. The researchers are pursuing their work with the goal of improving the technology. In particular, they are using new biomimetic ligands capable of recognizing the molecules that make up odors. The advance could make NeOse ten times more sensitive than it is currently. NeOse could also become more precise, positioning it to respond to targeted applications like biomarker recognition.

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### DAY BY DAY

## Phelma climbs five slots in the 2019 L'Étudiant college rankings

Grenoble Institute of Technology's Phelma engineering school came in nineteenth in the overall rankings in L'Étudiant magazine's 2019 survey of 174 engineering schools, climbing five slots over the previous year.

Phelma tied with the prestigious *École Polytechnique* in the academic excellence category. The school's stellar results were due in part to the large number of faculty members that hold state-sanctioned research directorships.

The school's international activities have also expanded. The student body counted 98 international students, up from 70 the previous year. A total of 124 students earned dual degrees from international partner schools up from 94 in 2018.

And, in terms of career placement, Phelma came in second in the ICT and energy industries, with median annual salaries between €36K and €40K. Finally, the school has also increased diversity and strengthened corporate relations through non-traditional admissions processes and work-study programs.

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## MagIA raises €1 million to complete its analysis system

Startup MagIA Diagnostics, which is housed at CIME Nanotech, recently announced that it had raised €1 million from two investors active in medtechs and medical diagnostics. The influx of funds will be used to complete a pre-industrial prototype of the company's innovative blood analysis system. The system, which leverages developments made by G2ELab and LMGP, can perform tests in just fifteen minutes from a single drop of blood.

The funds will also position MagIA to complete clinical trials on a first Hepatitis B panel and, later, develop a combined test kit to screen for sexually-transmitted viruses. MagIA is targeting screening centers and nonprofit groups that provide services to drug addicts, the incarcerated, and migrants. The company plans to release its first products on the market in 2020.

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## MagIA cofounder Sarah Delshadi earns kudos from C'Nano

The Centre national de compétences en Nanosciences granted the C'Nano 2018 dissertation award in the Completed Research category to Sarah Delshadi in December.

Delshadi completed her dissertation on fast immunological diagnostic testing combining superparamagnetic nanoparticles and structured micromagnets at IAB and G2ELab. Earlier research by CNRS and Grenoble Institute of Technology (G2ELab, Institut Néel, and LMGP) had demonstrated that arrays of micromagnets do effectively capture magnetic nanoparticles in suspension. Delshadi went further.

She developed an immunological diagnostic protocol called Magnetic Immuno Assay, or MagIA, that represents a breakthrough with regard to current techniques. She also cofounded startup MagIA, where she co-directs R&D and manages quality and regulatory aspects.

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## Scintil Photonics develops faster, more affordable optical interconnects

Startup Scintil Photonics has set the ambitious goal of developing competitively-priced optical interconnects capable of achieving transmission speeds of 800 Gbit/s. The company, a Leti spinoff currently in incubation, won the Bpifrance i-lab competition in 2018. It was founded by Leti research scientist Sylvie Menezes and former Tronics CEO Pascal Langlois.

Scintil Photonics is leveraging Leti research that led to the integration of lasers into III-V semiconductor materials on silicon circuits. The mass fabrication of lasers on silicon reduces circuit cost, size, and energy consumption. The company has completed several demonstrator systems and is currently in talks with several foundries with a view to prototyping and, ultimately, manufacturing its 800G circuits.

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## DAMP project to develop deep characterization solution

The DAMP\* project, led by two research scientists from IMEP-LaHC, was accepted by incubator Linksum in December, and will receive €180,000 in support. The purpose of the project is to develop a probe built on commercially-available sensors to characterize the humidity, salinity, and conductivity of

liquid and solid environments. The probe will have to be robust, easy to use, and suitable for both types of environments. The goal is to create a functional prototype and, ultimately, a startup.

R&D will focus mainly on processing and transmitting the signals recorded by the probe. The team plans to target three applications: snow-cover testing (depth and density) to forecast dam fill levels; smart irrigation systems for farms; and building and infrastructure humidity monitoring.

\*Device for Analysis of Moisture Profiles

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## Hydrogen: Phelma to take part in EU TeachHy2020 program

TeachHy2020, a European educational program that kicked off in late 2017, focuses on fuel cells and other hydrogen technologies. The purpose is to increase the number of Masters programs available on these topics. And the need is pressing: by 2030 Europe's FCHT (Fuel Cell and Hydrogen Technology) programs will have to train 100,000 engineers and technicians to keep up with demand.

Grenoble Institute of Technology is one of the project's twelve academic partners and engineering school Phelma is playing an active role. Faculty from the school's Electrochemistry and Processes for Energy and the Environment program are creating course content for a future Masters program on hydrogen technologies.

During the first semester, eight Phelma graduate students took an online course designed by Ulster University in order to provide their feedback to the TeachHy2020 consortium.

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## Interactive fitness specialist Moovlab raises €253,000

Moovlab's crowdfunding campaign ended in November. The Leti spinoff raised €253,000 from around twenty new investors, including angel investors and two investment funds.

The fresh capital will be used to scale up the activity measurement sensors in the company's innovative and twice-patented Let's Play Fitness solution. The funds will also be used to develop and market fun, interactive programs.

Moovlab already counts KeepCool (France's second-largest gym operator) among its customers and hopes to equip at least 30 gyms with its solution in 2019. The company hopes to equip 2,000 gyms, securing 4% of the European market, by 2022.

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## Synchrotron to shut down for 20 months

The Synchrotron's Extremely Brilliant Source project commenced on December 10. Over the 20 months of the project, the entire X-ray source—magnets, vacuum tubes, RF cavities, cryogenics—will be replaced. The new X-ray source will be more energy efficient and will emit a beam that is ten times smaller and, therefore, a hundred times brighter than the old beam. Future experiments will benefit from resolutions ten times higher than what the source currently provides.

The €150 million project will affect INAC, which operates five CRG\* beamlines at the Synchrotron. During the project the INAC team will not be hosting outside researchers or helping design their experiments. The downtime will be used to update the operating software. In addition, the team has submitted requests to use the facilities at other synchrotrons in France and further afield for its own experiments.

\*Collaborating Research Groups

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LAURENT FESQUET,  
RESEARCH SCIENTIST, TIMA

## “Rebooting Computing challenges the very foundations of today’s computers”

**MINA-NEWS: The ICRC conference, to be held in Grenoble in April, will provide insights into the Rebooting Computing initiative that began in the United States in 2016. What is it all about?**

**Laurent Fesquet:** The idea is to rethink how computers are designed. Today, most machines are built on the von Neumann architecture. This architecture was invented in 1945 to perform exact computations, something that uses a lot of energy. We are now seeing other, more economical approaches like neural networks, approximate computing, and probabilistic and quantum architectures.

**MINA-NEWS: And technology is creating even more new alternatives...**

**LF:** Precisely. In 2018, Intel presented its Loihi neuromorphic chip, which contains a record 130,000 neurons. And advances in microelectronics are enabling very dense neural networks. Not to mention the first quantum computers and the advent of nanocomponents, which will bring computation closer to memory. And there is also the use of statistical distributions for probabilistic computing...

**MINA-NEWS: What are you working on at TIMA?**

**LF:** We are developing clockless, or asynchronous, circuits. An asynchronous neural network uses less energy than an equivalent synchronous network. This is because only those neurons used for a computation are activated. This is how Intel’s chip works. At ICRC I will present research that combines asynchronous technology and probabilistic computing with a view to designing a probabilistic computer. This is work we are doing in partnership with our colleagues at LIG (Grenoble Information Systems Lab). ■

*\*International Conference on Rebooting Computing*

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## European microelectronics roadmap ready to roll

**M**ission accomplished! EU H2020 project Nereid, coordinated by Grenoble Institute of Technology, has delivered on its promise of creating a fifteen-year European micro and nanoelectronics roadmap. Parts of the European roadmap were included in the IRDS global roadmap.

Europe’s major technology research organizations and academic research labs in the field of microelectronics contributed to the roadmap and were supported by around a hundred experts and professionals from companies like NXP, Infineon, and STMicroelectronics. The authors focused on market needs and took into account the current state of the art and expected advances in technology. The roadmap provides guidance on materials, systems, circuits, and electronics for Europe’s main applications. One of the major challenges addressed by the roadmap is energy consumption.

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Read the final version of the roadmap at: <https://www.nereid-h2020.eu/roadmap>

## April 3 to April 5: two conferences to broaden your horizons

MEP-LaHC and Sinano will organize the first International Nanodevices and Computing Conference from April 3 to 5 in Grenoble. The event is actually two conferences in one. The first one is about IRDS, the International Roadmap for Devices and Systems. The second will address Rebooting Computing, an international initiative created in addition to IRDS. Rebooting Computing is rethinking our computing paradigms, from the basic physical concepts down to algorithms and system architectures.

A full program of talks will cover the major challenges and technological solutions as well as recent and promising research results, with a fifteen-year outlook. This event is ideal for people who want to see the future through the lens of these two very exciting topics.

Website: <http://icrc.ieee.org/>

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## IMEC and Leti form new partnership

**I**n late November Leti and Belgian research organization IMEC announced that they had signed a Memorandum of Understanding on embedded artificial intelligence and quantum technology. Both have pioneered advances in microelectronics and will combine their complementary know-how in this unprecedented partnership. The purpose of the partnership is to speed up research and help scale up new technologies for industrial rollout at the European level.

The partners will develop, test, and experiment with breakthrough concepts in these two high-potential fields. They will also address new paradigms for the components industry with the goal of supporting the design of new, more powerful and energy-efficient processors for embedded artificial intelligence.

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## Diabeloop obtains CE marking

**D**iabeloop’s DBLG1 automated type-1 diabetes management system obtained the CE marking (for conformity with health, safety, and environmental protection standards) in November. The system, developed in partnership with Leti and CERITD\*, consists of a continuous glucose sensor and an insulin pump that communicate with a terminal equipped with artificial intelligence.

The self-learning and customizable system was designed to make type-1 diabetes patients' and their families' lives easier and reduce the mental burden of managing the disease.

This year, Dabeloop will gradually release the DBLG1 on the French market and will continue talks with several other interested countries in Europe. The startup raised €13.5 million in 2017, and kicked off another round of fundraising in late 2018.

\*A diabetes research and treatment development center

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## SOI Academy Shanghai launch a success

In order to promote FDSOI, their advanced CMOS technology, to Chinese manufacturers, Leti and Soitec are ready and willing to organize events in China. In late November they met with some 200 managers, technicians, and circuit designers in Shanghai. The two-day "SOI Academy" was facilitated by experts from Leti and Soitec, and featured speakers from IMEP-LaHC, IBM, and Shanghai-based SITRI.

FDSOI enables the fabrication of low-power circuits capable of achieving high frequencies for RF applications. However, in order for FDSOI to carve out a position, the associated stakeholders (foundries, fabless manufacturers, designers, etc.) will need to consolidate further, especially in Asia. Leti and Soitec plan to run two or three more SOI Academy events in China in 2019.

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## Nano 2022: €35 million earmarked for nanotechnology R&D

In late 2018 the Auvergne-Rhône-Alpes regional government announced that it would provide €35 million in financing for the Nano 2022 initiative. The vast majority of the funds will be invested in the Grenoble area, with stakeholders like Leti, STMicroelectronics, Soitec, Sofradir, and ULIS among the beneficiaries. The R&D conducted under Nano 2022 will focus on four technologies: low-power processors, power semiconductors, smart sensors, and compound semiconductors for microelectronics.

Nano 2022 was set up after the European Commission gave the green light to an Important Project of Common European Interest (IPCEI) to drive advances in microelectronics. This cross-border project involving Germany, Italy, the UK, and France, will receive an estimated €1.75 billion by 2024; Nano 2022 is the French national component of the project. By all accounts 2019 is off to a great start!

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## Leti kicks off four strategic programs

This year Leti is kicking off four new strategic programs. These cross-disciplinary programs are designed to respond to the major challenges over the horizon. So, what will the new programs address?

First, quantum computing for HPC\*: Leti will create a platform for the development of qubit-on-silicon technologies.

Second is embedded artificial intelligence, which will focus on innovative circuit architectures built on non-volatile memory and 3D integration.

The third program on cyberphysical systems, will focus on developing low-cost LIDAR\*\* on fully-integrated semiconductors for data fusion and artificial intelligence.

Finally, the 5G program will create tomorrow's telecommunications infrastructure based on smart antennas whose dynamic transmission will boost both network speed and energy efficiency.

\*High Performance Computing

\*\*Light Detection and Ranging

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## Arts et Métiers ParisTech students assigned to CEA Tech

Since October, three Masters students from engineering school Arts et Métiers ParisTech have been coming to CEA Tech to complete their work-study placements. All three are part of the first cohort of the school's new Innov'ance work-study program.

One of the students is working at Clinatec on a prosthetic hand for Leti's exoskeleton project. The other two have been assigned to CEA Tech's regional branches in Metz and Bordeaux.

The CEA has had a partnership with the school since 2013; however, it is the first time students have come to CEA Tech for their work-study placements. CEA Tech would like to see the program expand, bringing more of the school's highly-qualified engineers to the organization. Currently, of the 4,600 CEA Tech employees, just 30 are graduates of the prestigious Arts et Métiers ParisTech engineering school.

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## Technology transfer: Sylvain Colomb succeeds Alain Briand

Sylvain Colomb took over from Alain Briand as head of the CEA Grenoble's tech transfer and spinoff programs in January.

Colomb, 41 years old, is an electronics engineer and has personal experience starting a spinoff. He is one of the cofounders of Ethera, spun off from the CEA in 2010 to develop indoor air quality analyzers based on a nanoporous material. Colomb came back to the CEA in 2016, taking a position at the CEA Tech regional branch in Hauts-de-France.

His roadmap aligns with the national CEA policy to boost startup creation. His strategy is to increase the number of spinoffs by identifying and supporting researchers with potential startups and by leveraging the local networks of startups spun off from the CEA.

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## AGENDA

**February 7 [CEA Grenoble]**  
YOU, TOO, CAN BE A SCIENTIST!

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**February 13–15 [MINATEC]**  
SESSION 1 OF INN.OTECH  
WITH LOCAL HIGH SCHOOLS  
ARISTIDE-BERGÈS  
AND EMMANUEL MOUNIER

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**February 16 [Grenoble Institute  
of Technology - Phelma]**  
OPEN HOUSE

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**March 11–15 [MINATEC]**  
ALIENS – SCHOOL FOR ADVANCED  
MATERIAL CHARACTERIZATION

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**March 15–17**  
[Auditorium Grenoble INP  
Parvis MINATEC]  
SCIENTIFIC GAME JAM 2019  
<https://www.grenoblegamefab.com/>

**March 16–23 [Grenoble INP]**  
SUSTAINABLE DEVELOPMENT WEEK  
OF THE GRENOBLE INSTITUTE  
OF TECHNOLOGY SCHOOLS

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**April 3–5 [Grenoble]**  
INTERNATIONAL NANODEVICES  
AND COMPUTING CONFERENCE  
Website: <http://icrc.ieee.org/>

**April 3–5 [MINATEC]**  
SESSION 2 OF INN.OTECH  
WITH LOCAL HIGH SCHOOLS  
GRÉSIVAUDAN AND EAUX-CLAIRES  
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**April 15 [GIANT Campus]**  
GIANT ORIENTATION DAY FOR NEW  
STUDENTS AND PHD CANDIDATES  
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**June 24–28 [Grenoble]**  
LETI INNOVATION DAYS 2019  
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