MINATEC® NEWSLETTER

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Top news

Quantum simulation sheds new light on physics of advanced transistors

Researchers at INAC and Leti recently developed a quantum simulation code that is providing groundbreaking insights into the physics of advanced FD-SOI and Tri-gate transistors.

What makes the researchers' work so significant is that semi-traditional simulation models do not factor in the quantum effects that play an increasing role as transistor sizes trend towards the 10-nm mark. For example, as electron confinement increases, the number of bands of energy available to carry electricity decreases.

To address this challenge, INAC, Leti, and STMicroelectronics partnered up under a French National Research Agency project titled Quasanova to develop TB_Sim, a quantum simulation code suitable for massively parallel computation. They used the code to model STMicroelectronics' latest FD-SOI transistor and Leti's next-generation Tri-gate technologies.

New electron-diffusion mechanisms

The researchers' work resulted in a better understanding of the role played by charges trapped in oxides and confirmed their theory of how FD-SOI transistors' backside electrode affects charge carriers. But perhaps the most important breakthrough was the identification of new electron-diffusion mechanisms.

Quantum simulation is not quite ready to replace semi-traditional methods—the calculation times required are still much too long. However, the technique does have a bright future. Transistor researchers have been trying to overcome several basic physics hurdles for a decade, and quantum simulation could help. The Quasanova project, completed in 2013, was granted an additional round of financing through 2016.

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Innovation

Miniature-antenna quality gets a boost

Today's mobile devices boast increasingly-miniaturized antennas. But tiny antennas are plagued by losses—detrimental to performance. In an effort to solve the problem, researchers from Leti and IETR recently devoted two Ph.D. dissertations to lanthanum titanate, a new perovskite oxide known for its high permittivity. And the results are promising. Antennas made using the material offer quality coefficients in excess of 100 for frequencies up to several GHz. The quality coefficients for many other thin-layer materials is limited to between 10 and 30.

However, lanthanum titanate still lacks sufficient agility to make it fully operational for use in reconfigurable radiofrequency systems. But the researchers are working on that, too, and on how to integrate deposition of the material into the fabrication process.

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Multi-core-circuit heat performance modelled to within 5% accuracy

Docea Power's decision to set up a joint lab with Leti turned out to be a smart one! Three years into the collaboration, the company has validated modelling capabilities for the heat performance of 2D and 3D multicore circuits and applied them to two real-life cases. The margin of error is less than 5%, a very high level of accuracy for fast, high-level modelling.

Advanced circuits generate anywhere from a few watts to tens of watts of heat during operation—and circuit designers have to find ways to manage all that heat, most notably by building in dynamic heat control mechanisms. The new heat performance models will let Docea Power do this earlier on in the design process, rather than simply checking performance after the fact. The company has extended its joint lab with Leti for another three years, through 2016.

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A high-spin polymer gets synthesized

Researchers from INAC and the Warsaw University of Technology have synthesized a polymer that spins when immersed in a solution. The material, made from a polyaniline-derived polymer, is stable at ambient temperature.

The spin remains moderate (S=2), but marks a first for a linear polymer. And, given the polymer's current tangled-chain structure, there's ample room for improvement. The next step will be to untangle the chains so that the couplings between individual spins can reach their full potential, and then stretch them to form films. A research contract from the French National Research Agency is currently pending.

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Innovation

Air pollution: small doses most harmful to DNA

Toxicology studies often look at the effects of exposure to high doses of pollutants. However, are the effects underestimated for smaller doses? INAC recently examined how polycyclic aromatic hydrocarbons (PAHs)—present in emissions from motor vehicles and heating systems—damage DNA.

The researchers observed the formation of covalent adducts, which modify gene sequences and participate in the development of cancer. Lung cells, for example, can react by triggering protective proteins, but only if PAH concentrations are above a certain threshold. Exposure to smaller doses is thus more harmful to DNA, a counter-intuitive conclusion that could change the way we think about traditional toxicity testing.

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Testing system picks up 3 ppb of benzene in indoor air in just 15 minutes

A new indoor-air-quality regulation will come into force in France on January 1, 2016. All buildings open to the public will have to prove that their indoor air contains less than 1 ppb of benzene. However, current portable testing systems are neither sensitive enough nor suitable for on-site testing. A research project backed by the French government's Single Interministerial Fund aimed to develop just such a system. By the end of the project, Leti researchers had successfully detected 3 ppb of benzene in 15 minutes.

The system's nanoporous sensors transmit varying amounts of UV rays depending on the benzene concentration detected. The system can still be improved, most notably by using thinner sensors. Currently, the only product on the market is a €5,000 VOC detector with a limit of 50 ppb for benzene-only detection. The researchers are hoping to develop a new product to meet the upcoming regulatory requirements, but at half the price.

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MEMS and NEMS: releasing moving parts faster

Researchers at Leti have developed a simulator to validate the position and size of the holes used to remove, via etching, the sacrificial material used to temporarily support structures during the fabrication of MEMS and NEMS—and release the systems' moving parts. The holes substantially shorten a critical phase in the process of releasing moving parts, thereby improving production yields.

Today's manual techniques aren't perfect—inaccurate placement of the holes sometimes means that the sacrificial layer of material cannot be totally removed.

The simulator, which is based on a computer-aided-design rule-verifying program, gives designers a preview of any residual sacrificial material that would need to be removed. This breakthrough marks a first step toward additional capabilities, like automatic hole positioning.

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Spintronics: diffusion barriers make cooperation easier

To optimize the magnetic coupling in memory-type spintronic systems, the ferromagnetic (FM) and antiferromagnetic (AFM) parts must be very close to each other. Surprisingly, researchers at Spintec achieved a jump in performance by doing the opposite when they separated the FM and AFM parts with a diffusion barrier.

Their unexpected results can be explained by the fact that the barrier—just a few nanometers thick—prevents the diffusion of atoms into the FM/AFM interface, an undesirable phenomenon that could be the culprit of malfunctions at certain memory points. Significantly reducing this phenomenon more than offsets the effects of increasing the distance between the FM and AFM parts.

In related news, the researchers also developed a versatile method for quantitatively measuring the magnetic quality of the FM/AFM interface in lab conditions.

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GaN wires for LEDs offer brilliant electrical properties

The geometry of gallium nitride (GaN) wires makes it tough to characterize a single wire's electrical properties and n and p doping. Researchers from Leti and Institut Néel have found a solution. Using electronic lithography, the researchers connected a wire attached to an insulating substrate to four metal blocks and created a source of heat nearby, making it possible to measure carrier concentration and mobility.

The researchers' earlier work focused on silicon-doped GaN (n-doping) wires, which turned out to be better conductors than similar planar layers. The researchers are now looking at p-doping characterization. Their goal is to develop high-performance LEDs using GaN wires, which would be must less costly than today's planar LEDs.

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Make your own pushbutton controls with an inkjet printer

Researchers from Leti, Ecole des Mines de Saint Etienne, and Gemalto recently produced a smartcard pushbutton on a flexible material (PET) using inkjet printing. The technique differs from screen printing in that it does not require the use of masks. The researchers presented their results at the 2013 IEEE Holm Conference, where Daniele Sette, Ph.D. candidate and co-author of the paper on this promising research, won the Young Investigators Award.

The pushbutton, which is just 300–400 microns thick, was printed with regular commercial ink to which 50-nm silver nanoparticles had been added. Once the ink is deposited on the material it is annealed to ensure consolidation. The process offers considerable potential for research and development, especially for rapid prototyping. A demonstrator will be unveiled in March.

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Lithium-ion batteries undergo graphene doping

Lithium-ion batteries' energy-storing capacity can be boosted tenfold when the batteries' electrodes are doped with silicon nanoparticles. Until now, the enhanced performance has only lasted a few cycles. This is because the electrode cannot withstand the tripling in volume the nanoparticles undergo during charging.

Researchers at INAC and IMN Nantes recently maintained the doped performance for 200 cycles on a very-high-capacity electrode (2000mAh/g). The researchers blended the silicon nanoparticles with graphene, whose 2D structure follows the particles' change in size and maintains their connection to the electrode. The results, in terms of material weight and number of cycles, are close to commercial battery specs—and should reenergize the French National Research Agency Graf'N'stock project currently underway on the same topic.

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Day by day

CEA: Tony Prézeau new strategic marketing head

In January Tony Prézeau was appointed head of the Strategic Marketing Department of the CEA Technology Transfer Division. A graduate of France's Ecole Centrale engineering school, Mr. Prézeau, 39 years old, brings an impressive track record in industry. He spent three years with ArcelorMittal in Dunkerque and more than twelve years at Winoa (formerly Wheelabrator Allevard), where he served as VP Research & Innovation until December 2013.

He succeeds Claire-Noël Bigay, now Deputy Director of the CEA Technology Transfer Division.

The Strategic Marketing Department counts more than 30 engineers specializing in innovation marketing and business intelligence and provides nearly 3,000 days of market research services to CEA labs and partners each year.

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Chile's APEX telescope gets new bolometers

Leti is gearing up to deliver sixteen bolometer matrices with wavelengths of 200, 350, and 450 microns for the APEX telescope in Chile. The telescope, located at 5,100 meters above sea level on the Chajnantor plateau, already boasts four 350-micron matrices delivered by Leti in June 2013.

The bolometers serve as the eyes of the Artemis camera installed on the telescope. They are cooled to 300 mK in a cryostat developed at INAC's low-temperature lab (SBT). The IFRU Astrophysics Laboratory (Saclay), also the project lead, integrated components like the optics, filters, and electronics. Leti's matrices will boost the equipment's current speeds by a factor of three, revealing details—like gas clouds involved in the formation of stars—that have been invisible until now.

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LMGP explores ALD at ambient pressure

Atomic layer deposition (ALD) expert David Muñoz-Rojas joined LMGP in November as a CNRS researcher. He uses a spatial atomic layer deposition method at low temperature and ambient pressure in order to eliminate the constraints of using a vacuum chamber and more easily scale up processes for industrial rollout.

This new approach to ALD—very versatile and much faster than traditional ALD—has already been the topic of several scholarly articles.

Muñoz-Rojas completed his Ph.D. in Barcelona and, for the past five years, has worked at the University of Cambridge. He hopes to develop new materials for energy and electronics, as well as oxide-based functional layers with his lab's Thin Films, Nanostructures, and Nanomaterials (FM2N) team.

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LMGP gets new management team

LMGP, a CNRS joint research unit affiliated with Grenoble Institute of Technology, got a new management team on January 1 of this year. Franz Bruckert and Carmen Jiménez were appointed Director and Deputy Director, respectively. They succeed Bernard Chenevier and François Weiss.

Mr. Bruckert is a faculty member in the Biophysics Department at Grenoble Institute of Technology's Phelma engineering school. He is also a researcher with LMGP's Biological Materials-Matter Interface team, where he studies protein-material and cell-material interactions.

Ms. Jiménez, a CNRS researcher, joined LMGP in 2002. Her work focuses on metal oxides, superconducting materials, and materials for microelectronics and energy production and conversion.

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INAC: Yves Samson succeeds Engin Molva

Yves Samson was appointed Director of INAC, the Institute for Nanoscience and Cryogenics. He succeeds Engin Molva, who will replace Samson as head of the institute's cross-disciplinary nanoscience program.

Mr. Samson is a member of Science Europe's Physical, Chemical and Mathematical Sciences Committee and the French National Research Agency's Scientific Steering Committee for the Information and Communication Society.

A graduate of the Ecole Normale Supérieure de Lyon, Mr. Samson holds a Ph.D. and French state certification to direct research. He has been at the CEA since 1995, where his responsibilities have included heading the Nanostructures and Magnetism Lab (2001–2007) and serving as Associate Director of INAC (2007–2010). INAC today boasts a team of 500, including 200 Ph.D. candidates, post-docs, and interns.

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Interview

Mélaine Feriel, Ph.D. candidate, Nanobioscience, INAC-SPrAM
Editor of student newspaper *Chercheurs d'horizons* for the 2012–2013 school year

"Ph.D. students produce their own newspaper"

Your student newspaper* Chercheurs d'horizons *is written entirely by Grenoble University Ph.D. students. Can you tell us more about it?

The newspaper was launched in 2010–2011 following a workshop given under the school's Professional Training & Job Support Program for Ph.D. students. I worked on it in 2012–2013 with three other Ph.D. students. We did everything ourselves: writing, editing, translation, photography, and page layout. We published the third issue in September 2013, with a print circulation of 500 plus an online version.*

What type of subjects do you cover?

We decided that we did not want to focus solely on our research; we wanted to make the newspaper interesting for students by addressing the challenges they face, with articles on topics like studying abroad and balancing Ph.D. research with teaching activities. The newspaper does include a review of the latest research news, however, and an arts & culture section. We also feature puzzles—including one that's a real brainteaser! This year we published the newspaper in both French and English for the first time.

Is it intended only for Ph.D. students?

They are our main target audience. We wanted to give them more concrete information than what's typically published by research institutes, with articles relevant to their specific concerns. For example, we wrote an article on the Doctoriales seminar to help Ph.D. graduates find jobs. We do include articles for a wider audience, like a recent one on the French government's summit on research and higher education.

**Read online at http://chercheursdhorizons.wordpress.com/*

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Day by day

CEA researcher appointed head of French Optics Society (SFO)

CEA-Leti researcher Jean-Jacques Aubert was appointed President of the French Optics Society (*Société française d'optique*, or SFO) in September 2013. This learned society brings together optics and photonics researchers and other professionals from across France. The appointment is a first for the CEA, which is very active in the organization.

The SFO's mission is to promote optics as a scientific discipline and driver of technological innovation and to provide its members—researchers, professionals from the world of industry, and representatives of major institutions—with strategic information and networking opportunities. The SFO also liaises with government agencies, weighing in on policy issues like the future of optics programs in France's schools and the restructuring of AERES, the government agency that assesses France's research and higher education programs.

Learn more at: www.sfoptique.org
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CIME Nanotech gets new lithography machine

CIME Nanotech recently acquired a new lithography machine that performs two innovative processes. The first, nano-printing with control of the pressing and separation stage via an actuator matrix, reduces the number of defects compared to manual pressing and separation. The second process enables resin-free lithography using plasma situated between the substrate and mask, making it suitable for substrates that do not tolerate photosensitive resins or exposure to UV rays.

The equipment was financed in part by the IRT NanoElec research institute and is already being used by researchers from LTM and Leti for research and training in spintronics and surface functionalization for fluid MEMS, for example.

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Phelma Dean Pierre Benech enters second term

Pierre Benech, Dean of Grenoble Institute of Technology's Phelma engineering school, was officially reappointed for a second five-year term in January. He intends to pursue the strategy he has spearheaded since taking up the position in 2008, with a particular focus on further expanding the school and strengthening the school's role in major institutional initiatives (MINATEC, GIANT, CPER, and programs financed under the French government's economic stimulus package) during his second term.

Mr. Benech continues to teach electromagnetics and guided optics and conduct research in optics and optoelectronics. He also oversees the development of academics on the GIANT campus for Grenoble Institute of Technology, a position he has held since 2012.

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Phelma once again makes it into *l'Etudiant* magazine rankings

This year, France's *l'Etudiant* magazine has come up with a new method for ranking the country's 160 CTI-accredited engineering schools, using a series of 37 indicators which students can select to come up with a personalized ranking to meet their individual needs.

Grenoble Institute of Technology's Phelma tied for first place (with Polytechnique and ENSCP) for academic excellence, coming in a point ahead of rival schools Ecole Centrale and Ecole des Mines. Phelma was also the only school outside Paris to earn a top slot in the ranking. In terms of research, Phelma also ranked first for research in the IT industries and third for research in the field of energy.

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Horizons

A breakthrough RFID tag compatible with metal objects

Leti—working on a project for Montpellier-based start-up Oridao—has developed a miniature RFID tag for all kinds of metal objects, from those no bigger than a centimeter to those the size of a filing cabinet. Metal objects drastically diminish the effectiveness and bandwidth of the tiny antennas in RFID tags. Leti engineers came up with a unique antenna topology in two versions: one for American frequencies and one for European frequencies. They have a range of about one meter, making them entirely suitable for Oridao's target applications.

Oridao makes secure RFID systems for part traceability and surveillance for industrial and military applications. The company has been working with Leti since 2011 and is planning two new R&D projects: one to develop RFID tags with pressure sensors, and one to develop flexible RFID tags for metal parts with non-planar surfaces.

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Book translation strengthens ties with Latin America

For the past several years, the Franco-Peruvian organization Puya de Raimondi (headed by a CEA scientist) and the NanoAndes network have been fostering research ties between France and Latin America. This transatlantic collaboration recently marked a new milestone with the publication in Mexico of *Física de semiconductores y componentes electrónicos*—the Spanish translation of a book by Montpellier University professor Henry Mathieu and Leti engineer Hervé Fanet. University students and researchers from Peru, Argentina, Mexico, Ecuador, Venezuela, and Spain translated the 13-chapter book for free. Robert Baptist, a Leti research director who did voluntary service in Peru, served as the book's editor in association with Universidad Nacional Autónoma de México.

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Grenoble Institute of Technology holds an information day

Grenoble Institute of Technology will be holding an information day for high school, prep school, and technology institute students on February 22. It will be held at the Ense^3 engineering school in Saint-Martin d'Hères.

The goal is to show what life is like for students of Grenoble Institute of Technology's engineering schools and engineering prep school. The presentations will show why Grenoble Institute of Technology is an attractive place to study—complete with a host of student clubs. The information day was purposely scheduled during the winter break for Paris-area schools, to reach out to students who don't usually attend college fairs. Over 25% of the 600 students who attended last year came from cities outside Grenoble—including Paris. The Grenoble Institute of Technology information day will be held on the same date as that of Polytech Grenoble, so that people coming from outside Grenoble can easily visit the two universities.

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New continuing education program gives technicians management skills

Grenoble Institute of Technology's Continuing Education Department has teamed up with Grenoble Ecole de Management to offer a new part-time program in Technology Management. It is open to technicians with at least three years of work experience who want to move into a management position.

The 22-month program will start this September with 20–30 students. It consists of a set of core classes in organizational and project management, as well as a technical elective. The electives currently on offer are Microelectronics & Applications (headed by two Grenoble Institute of Technology-Phelma professors) and Energy System Efficiency & Applications (headed by a professor from the Ense^3 engineering school). The next information session will be held at Grenoble Ecole de Management on February 27 at 5:30 p.m. Register online at the Grenoble Institute of Technology website.

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FIRST Tech Challenge a growing success

France's 3rd edition of the FIRST Tech Challenge international robotics competition—hosted by Grenoble Institute of Technology—will be held on May 14–15, 2014. The competition is open to high-school students; the number of teams participating soared from seven in 2012 to seventeen this year! Students from Grenoble Institute of Technology (Phelma, Esisar, ENSGI, and Ense^3 engineering schools) will help the students through the various steps of building and programming a robot. The robots will be judged through a contest to see which one can put the most cubes into a crate.

The FIRST Tech Challenge in France is held in association with the Rhône-Alpes Region and two corporate sponsors: PTC and National Instruments. This year the City of Grenoble is also providing support by making the Reyniès-Bayard gymnasium available—which not only supplies a venue, but also helps boost the competition's visibility.

Learn more at: www.ftcfrance.com
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Hybrid-En platform gets off to a running start

The €1-million Hybrid-En platform for developing advanced energy generation and storage systems started up in early February. Located in the 10.05 Building, this 300 m^2 facility brings together physicists and chemists to conduct experiments at the crossroads of semiconductor and polymer research.

The scientists come from INAC, CNRS, and UJF, and will conduct early-stage and proof-of-concept research that Leti and Liten researchers can then use for further development-stage work.

Hybrid-En has special R&D equipment like gloveboxes and synthesis tools, as well as an area where scientists can network and share ideas. Projects are already underway on supercapacitors, batteries, and thermoelectric power.

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List and Leti revolutionize embedded system design

The Embedded Systems Design Platform—created by Saclay-based List and Grenoble-based Leti—ended 2013 with a remarkable achievement. Its engineers developed a revolutionary new system design approach that enabled high-tech firm M3Systems to double the performance of one of its systems, while optimizing its size and power consumption. The new approach uses a high-level virtual prototyping environment that lets engineers rapidly map out and test innovative ideas for algorithms, processors, architecture, and embedded software. They can then design, make, and test their new ideas in record time.

These systems can meet even the most demanding specifications for size, power consumption, and safety. One example is a new cable-testing ASIC that is 8 times more accurate and 30 times faster than the current benchmark!

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Live from MINATEC

MINATEC construction projects right on track

The many construction projects underway at MINATEC are all advancing according to plan. The second floor of the Skills Center Building is set to be completed by end-2015, and will accommodate over 500 Leti and CNRS researchers. The additional floors being added to the B2I building will be ready in May to house Leti's bridging technology research team. And in February work will begin on plans to expand the Phelma 2 building and build a 500-seat auditorium in front of Maison des Micro et Nanotechnologies (MMNT).

But that's not all. This summer will see construction work begin on the Photonics Platform—a modern complex comprising laboratories, clean rooms, and offices—with delivery scheduled in 2016. At the end of this year, work should begin on the Software Center addition to MMNT; bids to select the prime contractor are currently under review.

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Nanocharacterization platform beefs up 3D microscopy capabilities

The MINATEC nanocharacterization platform now boasts two new state-of-the-art machines: a rapid plasma etching system using xenon ions; and a unique x-ray tomographic microscope for generating 3D images. This cutting-edge equipment will help scientists better understand and improve the reliability of large-scale 3D components.

The etching system operates some 60 times faster than conventional gallium-ion-beam systems. It can be used to prepare "large" samples measuring 100 µm x 100 µm x 100 µm. The X-ray tomographic microscope can generate images with 100 nm resolution—almost the same as that of a synchrotron. With this powerful tool, MINATEC researchers can quantify materials buried 100 µm deep, observe pore structures in silicon and fuel cells, spot defects in through-silicon vias and copper pillars, and much more.

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Start-ups Cellipse and Avalun set up shop at the BHT

Two new biotech start-ups moved into the MINATEC High-Tech Building (BHT) on January 1.

Cellipse is a R&D company focusing on new therapies targeting LIM kinases (to treat certain types of leukemia and sarcoma, for instance). The company is expected to sign cooperation agreements with CEA labs and strengthen its ties with other BHT tenants this year.

Avalun is developing a portable in vitro diagnostic system, the LabPad®. The system features communication capabilities and can carry out several biological analyses using the same reader. It is designed for use by healthcare professionals and patients. Avalun is working with Leti's DTBS lab to develop a new range of tests to monitor patients with cardiovascular disease.

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Test wireless systems from the comfort of your own lab

Now Leti researchers can test wireless connections without having to perform costly and time-consuming on-site tests. Leti (via the IRT NanoElec research institute) has recently acquired a wireless channel emulator—the first of its kind in France. It lets engineers easily test the effects of electromagnetic environments (like multipath channels) and electromagnetic disruptors on the performance of wireless connections.

Thanks to this new system, smartphones, tablets, and other connected devices can be tested in anechoic chambers to ensure maximum connectivity for business and consumer applications.

Leti researchers have already implemented exclusive models for wearable equipment, harsh industrial environments, airplane cabins, and wireless car sensors. They could also develop specific models for other applications.

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Renovation: 300 mm clean room to get 500 m^2 of new space

The old 200 mm clean room in the 41.02 Building (near the H3 cafeteria) is getting a €5.3 million makeover. The space will be renovated and expanded to create a new 300 mm clean room spanning 500 m^2.

Twenty high-tech machines were moved out of the building this summer and the old 200 mm clean room was torn down in the fall. Renovation work started in December, which included installing a new air treatment system and new recyclers, and raising the ceiling to 3.80 m to accommodate the 300 mm equipment.

The construction area has been completely isolated from the rest of the building to avoid disturbing research in neighboring clean rooms. And the construction workers are taking special care to use methods that minimize noise and vibration. The new clean room should be ready by July 1 of this year.

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Agenda

February 10–11, 2014
Maison MINATEC
Commission des Titres d'Ingénieur (CTI) Annual Symposium
http://www.cti-commission.fr/Colloque-annuel-de-la-CTI-2014-a

February 13, 2014
Leti Day @Paris-Orly
http://www-leti.cea.fr/fr/Bloc-Annual-Review/Leti-Days-2014

February 21, 2014
Maison MINATEC
6th Junior Scientist and Industry Annual Meeting
http://www.jsiam-giant-grenoble.org/

February 22, 2014
Grenoble Institute of Technology-Ense³, Saint-Martin d'Hères
Information day for high school and prep school students
Contact: christine.escafit@grenoble-inp.fr

February 28, 2014
Maison MINATEC
Architecture & Digital Technology Symposium: Today's Bridging Technologies from Materials to Cities
http://mc2014.research-unit.net/

April 7–9, 2014, Grenoble
Transmission Electron Microscopy (TEM) training given by LMGP and the Grenoble Institute of Technology Continuing Education Department
http://formation-continue.grenoble-inp.fr/formations/microscopie-electronique-en-transmission-met--250611.kjsp?RH=FC_fSMATE&ONGLET=1

May 14–15, 2014
Reyniès-Bayard gymnasium in Grenoble
3rd FIRST Tech Challenge in France
www.ftcfrance.com

June 16–18, 2014
Grenoble Institute of Technology-Phelma
MAT4ENERGY, International Workshop on Materials and Technologies for Renewable Energy Applications
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