

Top news

# Dark matter found at MINATEC?

**A group of researchers at INAC studying Josephson junctions back in 2004 may have unwittingly stumbled upon axions—the hypothetical elementary particles thought to make up dark matter.**

**W**hen applying a low voltage, the researchers noted a detectable electrical signal, but they were unsure of where it came from. At the time, they chalked it up to a measurement error, barely giving their “discovery” a brief mention in the article François Lefloch and his team published about their research.

But last September, theoretical physicist Christian Beck at Queen Mary University of London got in touch with Lefloch to let him know about his plans to submit an article to the journal *Physical Review Letters*—an article in which he announced that the mysterious signals observed in 2004 could very well have been produced by axions. Beck posits that—with a reasonable estimation of the other relevant parameters—the signals appear at a voltage consistent with his axion theory.

Beck’s article, published in November, has created quite a stir. Lefloch has been bombarded by calls from reporters and has bounced Beck’s theory off of several esteemed colleagues, all of whom found the idea plausible. So, Lefloch could very well try to reproduce his 2004 experiment.

However, dark matter is notoriously elusive, and skeptics question how likely it is that a coincidence that occurred during a simple lab experiment could reveal what much more ambitious research programs have long searched for in vain. Perhaps the only way to find out is to try again!

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Innovation

## Bimetallic nanoparticle synthesis just got simpler

**T**he process of synthesizing bimetallic nanoparticles from organometallic precursors no longer requires an organic solvent and stabilizers (which must be treated after processing). A team of researchers at Leti experimented with ionic liquids and obtained stable suspensions that can be applied directly to high-tech substrates.

The ionic liquids—salts dissolved at ambient temperature—have some surprising properties. The researchers have already used them to obtain ruthenium, copper, nickel, platinum, tantalum, and magnesium nanoparticles with perfectly-controlled sizes and structures. For example, the team produced 2 nm to 3 nm ruthenium-copper nanoparticles with a ruthenium core and copper shell. The research is being conducted in conjunction with ESCPE Lyon at the Nanochemistry Platform.

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## Fluoptics combines color and fluorescence imaging

**S**tart-up Fluoptics is working with Leti to develop a dual-mode endoscope camera head that can simultaneously capture images of structures marked with fluorescent contrast medium and surrounding tissue in natural color. This advancement will give surgeons a clear picture of cancerous tissue superimposed on a color image of the surgical site. Currently, for minimally-invasive surgery, doctors must constantly switch between the two types of images and then manually adjust.

The Fluoptics prototype boasts two CCD cameras (one monochromatic, the other color) that receive two types of light signals via a series of mirrors and filters. The acquisition frequency is 25 images per second. The main challenge is to simultaneously acquire a color signal and a fluorescence signal that is a million times less intense.

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## Wavelength multiplexing optimizes gas sensors

**R**esearchers at Leti have come up with an innovative integrated wavelength multiplexer design that will speed the development process for single- and multiple-gas sensors, resulting in competitively-priced and energy-efficient products offering high performance. The key? The sensors’ lasers produce only those wavelengths needed to detect the gases targeted.

The design was originally intended for a sensor that could distinguish between and measure three greenhouse gases simultaneously. The multiplexer, which is comprised of a network of 200 to 250 optical guides, boasts special optics that make it both more sensitive and selective. And transfer from one optical guide to another is reduced for a more homogeneous output wavelength. The research is being conducted with the III-V Lab, which is providing the laser arrays for the device.

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## Innovation

## “Pseudo-supercondenser” balances power and energy requirements

A “pseudo-supercondenser” capable of delivering either high power in just a few seconds or a supply of electricity over several hours has been developed by two teams of researchers at INAC. The development hinges on silicon nanowires implanted on silicon using a CVD process that ensures full control over the nanowires’ length, diameter, and number.

When the device is used in condenser mode, the nanowires boost the electrodes’ developed surface and raise total capacity to 30 times that of planar systems. When used in battery mode, the electroactive polymer deposited on the nanowires further doubles the already-increased capacity. The researchers are currently looking at several potential improvements, such as replacing the nanowires with “nano trees” to increase the electrodes’ developed surface even more.

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## Nanocharacterization Platform combines four surface-microscopy techniques

The Nanocharacterization Platform (PFNC) has created a state-of-the-art microscopy unit combining four surface-microscopy techniques. Samples are shuttled from one piece of equipment to another in a controlled atmosphere or under high vacuum, which means that researchers can conduct various tests—gleaning elementary, chemical, and structural information at scales ranging from the millimeter down to the nanometer—without exposing the samples to the ambient air.

The unit contains three electron spectroscopy (XPS and Auger) microscopes, two near-field (AFM and KFM) microscopes, and a time-of-flight secondary ion mass spectrometry (ToF-SIMS) microscope. The platform’s staff determines which techniques to use on a case-by-case basis.

Researchers can use the unit to examine materials for lithium batteries, organic and inorganic electronics, biosystems, and more.

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## X-ray diffraction confirms benefits of constrained silicon

Constrained silicon conducts electricity up to 2.5 times better than unconstrained silicon, earning the material a place in increasing numbers of integrated circuits. However, constrained silicon had never been observed at the nanometric scale *in situ*. But a team of researchers from INAC, Leti, ESRF, and Grenoble University just changed that!

The researchers used X-ray diffraction on 225 nm<sup>2</sup> x 70 nm<sup>2</sup> strips of constrained-silicon-on-insulator to produce the first-ever *in situ* two-dimensional single-line deformation profile. The experiment highlighted the deformation of the line, showing that the axial constraint that ensures increased charge-carrier mobility remains constant when the silicon-insulator interface is deteriorated. The system could be used to evaluate other nanoelectronic systems.

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## Spintronics without ferromagnetic materials

Spintronics usually uses ferromagnetic materials to achieve net spin polarization of an electric current. INAC researchers recently used a Rashba magnetic field to do the opposite. They used the field to recover spin information electrically at the interface between two non-magnetic thin-layer materials, bismuth and silver.

This basic mechanism could now be used to produce or detect spin currents or to control magnetization according to the intensity of the spin flow. Another possible use could be to harvest energy by injecting a spin current between two materials presenting a temperature gradient. The research was conducted with the CNRS and Thales in conjunction with University of Zaragoza as part of a program funded by the French National Research Agency.

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## Magnetic nanoparticles help destroy cancer cells

Magnetic nanoparticles can be used to send vibrations of 10 Hz to 20 Hz directly to cancer cells, triggering apoptosis, or programmed cell death. Researchers at INAC used disk-shaped nanoparticles that exert substantial mechanical force on the cells each time the direction of the magnetic field is inverted. Antibodies grafted onto the nanoparticles enable them to seek out and attach to the targeted cancer cells. This highly original approach stands out from the other research in this field, which mainly focuses on generating heat at frequencies of several hundred KHz.

The researchers assessed two potential types of nanoparticle in the early phases of their research. The project is ongoing, most notably in the form of two kinetic studies several hours in duration that will help determine how to get maximum effectiveness out of the vibrations produced.

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## New gamma sensor opens door to PET-MRI compatibility

Leti, working under the EU SPADnet project, assembled and characterized a gamma sensor for positron emission tomography (PET). Unlike photomultiplier tubes, the gamma sensor is compatible with the intense magnetic fields of magnetic resonance imaging (MRI).

The development could result in combined PET-MRI scans for cancer patients, providing the functional information of a PET scan with the anatomical information of an MRI on organs for which PET and MRI cannot currently be used or are not recommended for use in combination—such as on the brain or in children.

The sensor delivers state-of-the-art resolution in energy, time, and space, thanks in part to optical concentrators developed by Leti to enhance the sensor’s sensitivity.

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## Platinum in nanotube form boosts reactions in fuel cells

Researchers from INAC and Liten achieved a 30% increase in the current produced by an equivalent surface of platinum when they replaced a fuel-cell’s usual platinum-coated carbon electrode with a carpet made by bonding platinum nanotubes to the proton-exchange membrane.

The structure, made using CVD, is covered with a fine layer of proton-conducting polymer. The nanotubes are aligned, creating direct pathways to carry oxygen, water, protons, and electrons. Plus, the elimination of carbon from the electrodes should lengthen their lifespan—an added benefit.

The researchers are still working on improvements to the nanotubes’ geometry and density; their goal is to introduce other metals to reduce the total amount of platinum required.

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Keep your eyes peeled: This issue contains two April Fools prank articles!

Innovation

# Unlocking the secrets of piezoelectric-thin-film deformation

**T**hat an electrical field induces deformation in piezoelectric materials is well known—and the opposite is also true. However, the mechanisms underlying this deformation remain unexplained. Researchers at Leti have just characterized the mechanism for lead zirconate titanate (PZT) thin films. They took *in operando* measurements using the Nanocharacterization Platform's X-ray diffraction equipment, which is suitable for the environment in which the systems are habitually used.

The measurements revealed that the main thin-layer PZT deformation mechanism is phase change, which increases the average volume of the atomic stacks—and not a change in crystal texture as previously believed.

The findings, surprising for thin-film materials, should open up a number of new possibilities for improving the materials' manufacturing processes and the resulting piezoelectric properties.

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Day by day

# LMGP finds inspiration in international sabbaticals

**L**MGP is pleased to be hosting Hironori Yamazoe, a researcher from the University of Tsukuba on sabbatical in Grenoble since mid-March. Yamazoe is an expert in microtechniques used to selectively deposit proteins on biomaterials—a process that could be used to build musculoskeletal tissue.

And on July 1<sup>st</sup>, the University of Illinois at Urbana-Champaign's Amy Wagoner-Johnson will arrive at the lab for a one-year sabbatical. A specialist in biomaterials whose research focuses on engineering bone scaffolds, Wagoner-Johnson is the recipient of a Fondation Nanosciences Chair of Excellence.

LMGP welcomes high-level international researchers like Yamazoe and Wagoner-Johnson. They deliver valuable new research insights that help push the lab's work further while building bridges across scientific disciplines and cultures.

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Day by day

# Master's in Nanotech both popular and diverse

**T**he Master's in Micro- and Nanotechnology just turned ten! And 120 students, faculty, and alumni gathered at Grenoble Institute of Technology's Phelma engineering school on January 31 to celebrate.

The international program is offered jointly by Politecnico di Torino, Ecole Polytechnique de Lausanne, and Grenoble Institute of Technology. Each year, around 40 students from around the globe are granted admission, which is becoming increasingly competitive. The program is now one of Phelma's most popular, particularly for international students, as all instruction is delivered in English. Erasmus students often register for certain courses.

Half of graduates go on to complete a Ph.D., while the other half enter the job market.

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# Clinatec tests lower-extremity exoskeleton

**C**linatec now has a lower-extremity exoskeleton for paraplegia. The Rex Rehab is capable of providing the balance necessary for walking on its own. It was designed by a New Zealand-based firm and funded by the CEA-Grenoble Disability Commission. It is the first device of its kind to be tested in Europe. Three Grenoble patients suffering from paraplegia have already tried it out.

The Rex Rehab should provide Clinatec researchers with valuable feedback they can then use for their ambitious brain-computer interface (BCI) project to develop a four-limbed exoskeleton for quadriplegic patients.

Clinatec plans to set up partnerships with several rehabilitation centers, which could use the exoskeleton, evaluate it on their patients, and provide further information for the BCI project.

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# MRAM on stage at MINATEC this summer

**T**he InMRAM 2014 summer school, organized by Spintec for the second year running, will be held at MINATEC on July 2–4. Participants will get an introduction to magnetic random access memory (MRAM).

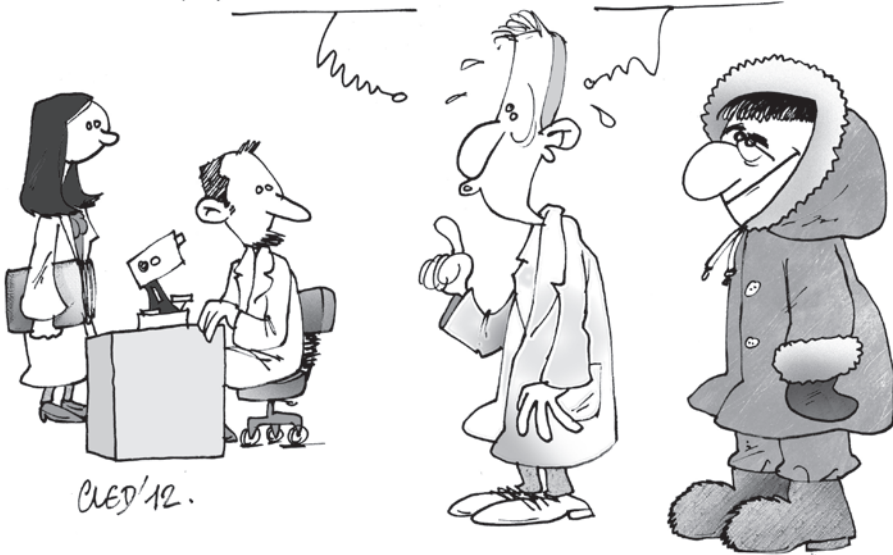
Ph.D. students, research scientists, and engineers are eligible to register. The purpose of the summer school is to introduce professionals with "traditional" microelectronics backgrounds to MRAM physics, materials, and fabrication processes.

This year's program includes two introductory tutorials to ensure that the lectures that follow are well-suited to participants' prior knowledge of the subject. Also new is a guest speaker from Yole Développement, a strategy consultancy specializing in emerging silicon technologies, who will provide a comparison of the different non-volatile memory technologies.

Go to [www.inmram.com](http://www.inmram.com) to view the complete program and to register.  
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HEY, CAN ANYBODY TRANSLATE FOR ME?

OUR NEW TEAM MEMBER IS INUIT!



## Interview

Jean-Michel Fournier, head of the integrated systems design apprenticeship program at Grenoble Institute of Technology-Phelma

*It took our apprentices about a semester to get their bearings*

### What does the first incoming class in the integrated systems design apprenticeship program look like?

The class has ten students, nine male and one female. All have a two-year degree in Electrical Engineering and Industrial IT; two have prior experience with apprenticeship programs, which combine classroom instruction with an in-company placement.

This year's apprenticeship host companies are Asygn, Sagem (in Valence), Sorin, E2V, and STMicroelectronics, which hired six apprentices. The in-company apprenticeship supervisors have been impressed by how well the students have adapted to their work environments and commended their strong commitment to the tasks they have been assigned. These tasks will evolve as students advance through the course curriculum and acquire new knowledge.

### Has this first class experienced any particular difficulties?

It took the students a semester to get their bearings. They had to get used to alternating one month at school and one month at work. They also had to adapt to the heavy workload, especially for theoretical courses where they have to grapple with major new concepts. The faculty has been really pleased with their level of involvement.

### Are you planning to change anything moving forward?

We would like to help students adapt to their in-company work environments faster. We will do this by distributing the theoretical and practical course content a bit differently over the year. As for the in-company placements, it is too soon to tell. We are working closely with the host companies to get their feedback and recommendations for improvements.

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## Day by day

### From Facebook to LinkedIn with the Phelma student club

In April the Grenoble Institute of Technology-Phelma student club will offer a new workshop to help students get control of their online presence.

While most students are well-versed in online social networks, they are not as comfortable on professional networks like LinkedIn—a crucial resource in the career placement process. The workshop will help the school's budding engineers make sure their personal and professional profiles are consistent—and raise their awareness of potentially-embarrassing online content they may not want recruiters to see!

The workshop will be facilitated by staff from the school's career placement service. Participating students will come away with personalized advice to help them get the most out of their online presence.

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### An instrumented tester to regulate industrial conveyors

Industrial conveyors are often made up of an assembly of several modules. So, it is not always easy to check that the goods being moved make it to their destination without getting lost or damaged. Leti has developed an original new way to solve this problem. The device, the same size and weight of the most frequently-moved items on the conveyor, packs in accelerometers, gyrometers, and a distance sensor. With each trip down the conveyor, it picks up vibrations, impacts, rotations, and vertical movement—extremely useful information for making adjustments to the conveyor settings or troubleshooting.

A functional demonstrator is on display at the showroom.

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### MINATEC spins off six start-ups in Q1 2014

Since January, MINATEC has spun off four start-ups, with an additional two just over the horizon. While this is a new record for the innovation campus, it is largely to chance! The new companies are:

**ISKN**, maker of the iSketchnote smart iPad cover that digitizes handwritten notes and drawings - **Pollen Technology**, a specialist in data fusion for metrology for microelectronics-industry applications - **Aryballe Technologies**, which is developing a portable odor-detection device for patients who have lost their sense of smell - **Enerbee**, which is developing a self-powered generator that harvests energy from very slow movements - **Exagan**, which is developing power components made from gallium nitride on silicon - **Genel**, a specialist in high-content, high-throughput molecular screening using RNAi.

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### MINATEC welcomes US Ph.D. students in nanocharacterization

As part of the inaugural edition of FADEX, the French-American Doctoral Exchange seminar, the French Embassy in Houston organized a trip to France for a group of ten US Ph.D. students in nanocharacterization.

The visiting Ph.D. students attended lectures on the latest developments in nanometric chemical analysis in Toulouse before travelling to Grenoble on March 20–21 to tour MINATEC, GIANT, Institut Néel, ESRF, and the Nanocharacterization Platform.

The trip also provided a valuable opportunity to raise the young researchers' awareness of career opportunities in Grenoble. A cocktail reception held at the end of the trip was attended by the US Consul General, representatives of the City of Grenoble, and Grenoble researchers.

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Horizons

## Green chemistry specialist BT3 Technologies moves to BHT

**B**T3 Technologies, a spinoff of the CNRS and CTP, a center for paper engineering, moved to the BHT in January. The company holds seven international patents for green chemistry processes that make corrugated cardboard and other papers resistant to water, fats, and gases. The innovative processes hinge on "chromatografting," a BT3 technology for printing microdroplets of a reagent on a material, and then disseminating them across the entire surface of the material by applying heat until the liquid is transformed into a gas.

BT3 Technologies, which has six employees, conducts R&D for customers that include Germany-based BASF, the world's largest chemical company. BT3 also works with Pagora, Grenoble Institute of Technology's paper engineering school, and is actively seeking partners to explore applications in other industries like textiles.

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## Leti signs new sporting-goods partnership

**L**eti, which already works with Oxylane on the brand's Nabaiji MP3 player for swimmers and Babolat on an instrumented tennis racket, is now joining forces with a running-shoe manufacturer to develop instrumentation for an ultra-thin insole. The product will leverage a series of sensors to give runners data like whether they are pronating or supinating, their stride, speed, hydration—and even their motivation level. In May, around 20 CEA joggers will be equipped with prototypes; a kiosk will be set up at the entrance to H3 to read and display the data after each run.

The results will be used to select the ideal team for the Ekiden marathon to be held on October 19. On the day of the race, data from the insoles will be displayed on a giant screen throughout the event.

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## Four medical imaging techniques now available via online simulator

**T**he Virtual Imaging Platform, created in 2012 as part of a project funded by the French National Research Agency and managed by INSA Lyon, is becoming increasingly popular. In 2013 alone, the number of users registered grew from 230 to 545, and users from 53 countries consumed a total of 627 years of computing time for the various techniques on offer (MRI, ultrasound, PET, and X-ray tomography using Leti's Sindbad simulator).

Users can complete various tasks, from prototyping new imagers to evaluating image-processing algorithms. Computation is distributed over several processors. On the Sindbad simulator, this distributed computation speeds results by a factor of 73 over what a single PC could do.

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Virtual Imaging Platform: <http://vip.creatis.insa-lyon.fr>

## Phelma teaches prep program faculty electrochemistry basics

**O**n May 5, 6, and 7 Grenoble Institute of Technology's Phelma engineering school will hold an electrochemistry course for faculty teaching physics and chemistry in the national prep program. The course will give faculty a chance to discover—or refresh their knowledge of—electrochemistry basics and industrial applications like energy storage, anti-corrosion treatments, and electrosynthesis, which play an increasing role in the school's new programs in a variety of disciplines.

The course was developed in partnership with LIESSE, which coordinates continuing professional development for faculty in France's higher education system. Participants will complete a core curriculum (lecture-style classes) and electives on topics like corrosion, batteries, and fuel cells. The course will also include a tour of a manufacturing facility in the Grenoble area.

See the full program at <http://goo.gl/tWIZDY>  
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## Algeria's Constantine University creates nanotech center with help from MINATEC

**T**he MINATEC Nanolab consortium was selected by the Ecole Polytechnique Nationale de Constantine (Algeria) to provide technical support for the school's 500 sq. m, \$6 to \$7 million nanotechnology center.

The consortium, made up of CIME Nanotech, 40-30, and the CEA, will consult on the project development stage, draw up the project specifications, select suppliers for the clean room equipment, and train local research scientists and technicians.

The project will also mark the start of a long-term relationship with the new nanotechnology center. Future plans include student and researcher exchange programs, characterization support, joint conferences, and technology transfer training.

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### Live from MINATEC

## Construction starts on Phelma 2

**I**n mid-February French Minister for Higher Education and Research Geneviève Fioraso broke ground on the Grenoble Institute of Technology-Phelma expansion slated for delivery in mid-2015.

The campus expansion project includes a seven-story building—with classrooms, labs, a student lounge, and a tech transfer center for second-year student projects—and a 500-seat auditorium with enough room for an entire Phelma class as well as special events. These new facilities will be linked to the existing building.

The project represents an investment of more than €25 million, and is being financed by the French government, the Rhône-Alpes regional government, the Isère General Council, the Greater Grenoble Intermunicipal Authority, and the City of Grenoble.

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## Live from MINATEC

## GIANT will now organize MINATEC Summer Program

This year, the GIANT International Internship Program will take over where the former MINATEC Summer Program, founded in 2011, left off. A total of 20 students, mostly from the University of Pennsylvania, the Massachusetts Institute of Technology, and Louisiana State University, but also from the University of Tsukuba, Chiba University, and Keio University in Japan, will come to campus from May 19 to July 25. Participating students will complete research internships at IBS, CEA-Leti, INAC, LMGP, and ICA.

The third edition of the French-American Workshop will be held on the MINATEC campus at the same time (on June 19–20) and will welcome academics, research scientists, and professionals from the business world. This year's topic is Franco-American cooperation and research opportunities.

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## Introducing the new, improved Maison MINATEC

The year 2013 saw some major renovation work at Maison MINATEC. The improvements include automatic doors to improve handicapped accessibility, digital signage at the entrance to the main corridor and in front of each conference room to better steer visitors to their destinations during events, and new lighting and projection equipment in the auditorium for a more personalized atmosphere for each event—event organizers can even project their logos or other images on the auditorium's side walls.

In 2013 Maison MINATEC hosted more than 700 events and meetings and welcomed 38,500 visitors, similar to the facility's 2012 volumes.

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## Midi-MINATEC brown-bag lunch series now recruiting sandwich team

Starting on April 11, the complimentary sandwiches offered to attendees of the Midi-MINATEC brown-bag lunch talks will be made by a volunteer "sandwich team." The idea is to help break the ice and make the event even friendlier and more welcoming by getting as many people as possible to participate.

To sign up for the sandwich team, check the schedule that will be posted online at the start of each week. Volunteers will be asked to report to the H1 or H3 kitchens for duty the Friday of the event from 8 a.m. to 9:30 a.m. The on-duty cook will supervise the making of 400 to 500 sandwiches and volunteers get free breakfast!

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### Agenda

**April 7–9, Grenoble**  
**Transmission electron microscopy (TEM)** course organized by LMGP and Grenoble Institute of Technology  
 Department of Continuing and Executive Education  
<http://goo.gl/LBFmR1>

**May 5–7, Grenoble Institute of Technology-Phelma**  
**Electrochemistry course for prep program faculty**  
[goo.gl/tWIZDY](http://goo.gl/tWIZDY)

**May 12–13, Maison MINATEC**  
**PESM 2014 Workshop**  
 Sébastien Barnola: +33 4 38 78 29 21  
[Sébastien.barnola@cea.fr](mailto:Sébastien.barnola@cea.fr)

**May 14–15, Reyniès-Bayard Gymnasium, Grenoble**  
**3<sup>rd</sup> French edition of the FIRST Tech Challenge (FTC) robotics competition**  
[www.ftcfrance.com](http://www.ftcfrance.com)

**May 19–20, Autrans**  
**National biomaterials research conference**  
<http://www.biomat.fr/News/News.php>

**May 19–July 25, Grenoble**  
**GIANT International Internship Program**  
<http://goo.gl/lySQ70>

**May 20–22, MINATEC**  
**MINaPAD Forum 2014** – Micro-nanoelectronics packaging and assembly, design, and manufacturing forum  
<http://goo.gl/6kMbh5>

**June 12–13, Maison MINATEC**  
**Pumamid workshop on multiscaling modeling for PEMFCs**  
<http://goo.gl/ZPmzfM>

**June 16–18, Grenoble Institute of Technology-Phelma**  
**MAT4ENERGY**, international workshop on materials and technologies for renewable energy applications  
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<http://www.lmgp.grenoble-inp.fr/mat4energy-2014/>

**June 17, Maison MINATEC**  
**GIANT Assistants Day**  
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**June 25–26, Maison MINATEC**  
**Leti Days**  
<http://www.letidays.com/2014/>

**July 2–4, MINATEC**  
**InMRAM summer school**  
 Program and registration: [www.inmram.com](http://www.inmram.com)

**July 7, Grenoble**  
**MIGAS 2014**, 17<sup>th</sup> session  
 Micro & Nano Technologies for Microwave and Photonic Devices  
<http://migas.fr>

**July 7–9, Phelma auditorium**  
**Workshop on low-temperature electronics**  
<http://www.wolte2014.org/>

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