MINATEC® NEWSLETTER

Keep your eyes peeled: This issue contains an April Fools prank article!

MINA-NEWS

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Apr. '15

Top news

MIT chooses CEA Leti to supply suspended microresonators

The news dates back to early 2014 and has been kept under wraps for almost a year. A Massachusetts Institute of Technology biology lab is turning to CEA Leti to develop some highly complex suspended microresonators. After receiving the initial components, which delivered satisfactory performance, the lab decided to switch foundries, and has now placed an order for 1,500 of the resonators with Leti for June.

The resonators boast a beam that vibrates at several hundred kHz and microfluidic channels through which cells flow. The frequency varies depending on the cells' mass, which can be measured accurately down to the femtogram (10^{-15} g). This level of precision makes it possible, for instance, to separate cancerous cells from healthy ones.

One of the most technically-complex devices ever made at Leti

According to the researchers at Leti, the microresonator is one of the most technically-complex devices they have ever made. It packs in three substrates (silicon, SOI, and glass) and three sealing techniques (molecular, anode, and eutectic). The width of the microfluidic channels varies from 10 microns to 3 microns all along their path.

The fabrication process includes an impressive 150 steps (compared to just 50 for a traditional MEMS process). The quality factor, at more than 13,000, is very close to the state of the art for this type of resonator.

MIT generally does not initiate this type of partnership with other research organizations. The fact that the school turned to a lab halfway around the world is something Leti can be proud of. In the meantime, the researchers hope that this initial collaboration will lead to new partnerships.

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Innovation

When sol-gel films present inhomogeneities

Thin films formed by sol-gel synthesis are not, in fact, homogeneous! Researchers at Liten's INAC made the discovery observing an InGaZnO thin film at the ESRF, where x-ray microscopy and grazing-incidence small-angle scattering revealed the formation of mesopores and self-assembled nanometric aggregates rich in zinc and gallium. Indium oxide played the role of matrix.

Now that these inhomogeneities have been observed, scientists could find new methods for engineering sol-gel films with specific properties. The researchers are now looking at the relationship between how the aggregates are assembled and the material's electrical properties. They foresee applications in electronics (InGaZnO is a semiconductor), magnetism, and thermoelectricity.

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Gaia compute node could help keep servers cool

Leti joined forces with STMicroelectronics to develop the Gaia compute node, which could help reduce the energy consumption of powerful calculation servers without affecting their performance. The circuit leverages technologies like FDSOI substrates and ARM 64-bit architecture originally developed for embedded systems. The node's energy efficiency has been evaluated at 7.5 gigaflops per watt—that's four times higher than Intel's best-performing compute node.

The main design challenge resides in the circuit's architecture, which is divided into four chips, each with eight compute cores, making flow of data between these elements tricky. Once Gaia has been validated on an emulator, it will be fabricated and packaged later this year. It will also be used as a technology demonstrator for Euroserver, an EU FP7 project.

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Electrical current circulates in silicon nanonets

Many scientists said it wasn't possible, but PhD research supervised by LTM and LMGP recently proved the naysayers wrong, demonstrating that electrical current does, in fact, flow through silicon nanonets, unorganized networks of silicon nanowires. The research also looked at a reproducible process for making the nanonets and hybridizing them with strands of DNA. A second PhD research project—this one supervised by LMGP and IMEP-LAHC in conjunction with LTM—kicked off immediately after the previous project to evaluate field effects and look at the transistors.

The nanonets are flexible, and offer more homogeneous electrical properties than the individual nanowires that make them up. They are also less costly to make than the nanowires. These advantages could be of interest to the flexible electronics industry.

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Innovation

Adipose stem cells for human skin rejuvenation and regeneration

It has now been proven that injecting fatty tissue is effective at human skin rejuvenation. The discovery, first made by a surgeon specializing in burn treatment, has now been confirmed *in vitro* by researchers at Grenoble's INAC and Lyon's HCL, who injected adipose stem cells into a reconstitution of human skin.

The researchers now plan to conduct a proteomic analysis of the anti-age and regenerative factors secreted by the stem cells. Their work could improve the treatment of serious skin problems such as foot lesions in diabetics and burn scars.

Once the regenerative factors have been identified, the researchers hope to use them to create synthetic factors, making the jump from a stem-cell-based therapy to a drug therapy.

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New magnetic tunnel junctions get encouraging results

Flip-flops are data storage elements used in integrated circuits. And while flip-flops are good, non-volatile flip-flops are even better! The latest generation of magnetic tunnel junctions (MTJs), known as spin-orbit torque (SOT) MTJs, could be the key, delivering crucial speed, energy efficiency, and robustness. Researchers at Spintec created a model of the SOT-MTJs for the development of new circuit architectures. And the SOT-MTJs are four times faster and use twenty times less energy than spin-transfer torque (STT) MTJs.

These results have yet to be confirmed by a demonstrator that will be tested in June. The research was carried out under the EU-funded SPOT project, which Spintec is leading and in which Leti and Karlsruhe Institute of Technology (KIT) are participating.

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Clinatec aims to make diagnosing cardiac arrhythmia and epilepsy easier

Could magnetocardiography (MCG) and magnetoencephalography (MEG) one day be available to the masses? Clinatec is currently running a clinical trial to find the answer. The trial, named Minimag, will test the signal-recording capacities of an optically-pumped helium-4 magnetometer, originally designed for the Swarm space mission, on sixteen volunteer subjects.

MCG and MEG would be extremely useful to practitioners in locating the exact source of anomalies like cardiac arrhythmia and epilepsy before administering treatment or surgery. However, the technologies require 4 kelvin cooling systems and magnetic shielding of at least five tons, which only a few research institutes in the world can provide. Leti's magnetometers would remove this hurdle, potentially making these valuable diagnostic tests available to a wider population.

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Photonics-on-silicon for telecoms switching systems

Photonics-on-silicon components could dramatically reduce the form factor of the data switches used in telecommunications switching centers. Leti and the other partners in the Celtic-Plus SASER (Safe and Secure European Routing) project, which will run until the end of 2015, are looking at how.

The project consortium presented a demonstrator made up of two 16-wavelength demultiplexers, 32 optoelectronic attenuators, 2 multiplexers, and 2 input/output couplers at the ECOC conference. During tests conducted by Alcatel-Lucent, the data packets were transmitted at speeds up to 80 Gbps with low error rates.

A second demonstrator with more effective attenuators and new couplers will soon be available.

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Medical imaging for safer flap reconstruction surgery

Tissue flap surgery is a technique used in breast and maxillofacial reconstruction. A flap of tissue, which can contain bone, muscle, skin, and fat, is taken from another part of the body, and moved to a new site where the blood vessels are reattached. Because of the risk of clots and tissue death, patients are monitored closely for several days following this type of surgery.

Leti has developed a technique—deep endogenous optical imaging—that could make post-surgical monitoring more robust and reliable by detecting and locating any alterations in blood flow to the tissue flap early on. The technique has been tested with success on small animals in a joint project with Grenoble University Medical Center. A demonstration on a more representative model is planned for 2015. Two patent applications have been filed.

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TEM characterizes resistive RAM in action

Researchers at Leti have characterized RRAM (resistive random-access memory) in operation, at the nanometric scale, using a transmission electron microscope. And the method they used can be applied to other types of memory. The researchers mapped the on/off states' structures, compositions, and potentials on a memory whose active layer measures less than 20 nm thick.

To characterize the memory, the researchers had to overcome a number of challenges like applying an electric probe to the sample with nanometric resolution, making the electrical contacts without generating too much heat or mechanical stress, and identifying experimental artefacts.

They used a Titan TEM with high-resolution imaging and electron holography. In the future, other techniques could also be used.

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Identifying pathogenic bacteria in just seconds

Field testing of a portable pathogenic bacteria alert and identification system began a few days ago in the South of France. The system, developed by Leti and List combines lensless imaging, Raman spectrometry, and supervised classification algorithms.

The system, named Bacram, was developed under the counter-bioterrorism research program of the French government's CBRND* policy. It is capable of generating a response in just minutes, with no need for cultures or markers. It is sensitive enough to detect an individual bacteria in a sample, even if contaminated.

The excellent detection results achieved in laboratory conditions have already garnered interest from a potential manufacturer, who is anxiously awaiting the field testing results.

**Chemical, biological, radiological, and nuclear defense*

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Innovation

Gas sensors benefit from union between III–V materials and silicon

Researchers at Leti recently created a photonic coupler with one waveguide made from III–V materials and another from silicon. The achievement marks an advance toward fast, accurate, low-cost multigas sensors. A complete gas testing system including waveguides would be capable of taking measurements at the liter scale, rather than at the cubic meter scale required by today's IR spectrometers.

The sensors have a mid-IR source made of III–V materials, which covers the majority of complex gases. Ultimately, they should be able to seek out predefined gases, such as for biomedical and industrial testing uses. Research and development is slated to continue under EU-backed projects, and MirSense, a spinoff of Leti and 3-5-lab, was established to commercialize the future products.

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The sun and cancer: Is melanin friend or foe?

When exposed to the sun, the human skin makes a pigment called melanin to protect itself—or so we thought! A team of researchers from around the globe (including several from INAC) recently demonstrated that, when exposed to UVA irradiation, the molecules that help synthesize melanin alter the DNA of the melanocytes (the cells that produce the pigment). These alterations can in turn cause genetic mutations and a serious form of skin cancer, melanoma. Even worse, the mechanism persists even after sun exposure, further increasing the direct damage from UVA rays.

Specifically, INAC researchers are investigating how to measure the damage to DNA using a unique mass spectrometry method developed at INAC. The research, which points out that UVA damage should not be underestimated as compared to UVB damage, was reported in *Science*.

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Go easy on the ToF-SIMS for organic materials

Organic materials are damaged by ToF-SIMS spectrometry, due to the high impact energy they are subjected to during exposure to the pulsed beam of ions. The Nanocharacterization Platform has a new piece of equipment that will eliminate this concern. The lab's new ToF-SIMS spectrometer with argon gas cluster ion beams creates impact energy of just a few eV per atom. Which means, first, that the material being observed undergoes virtually no degradation and, second, that the tests carried out are more reliable. The new spectrometer has already been used several times, including to test the effectiveness of barrier films and to characterize a complete OLED stack.

The lab still needs to develop comprehensive testing protocols. However, it is clear that the spectrometer will open new doors in the field of organic systems. ToF-SIMS provides information at the molecular level (3D composition, chemical degradation) to depths of several hundred nanometers.

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Veloce2 emulator flexes its muscles at Leti

Leti recently executed hundreds of billions of clock cycles to verify a 3D 96-processor multicore circuit using the institute's Mentor Graphics Veloce2 emulation system. Expansion cards were added to run the architecture with real peripherals and test it in a realistic environment.

Veloce2 emulation systems are 10,000 times faster than traditional RTL simulation, making it possible to verify multi-processor circuits that have several billion transistors. Leti has had the emulation system for around 18 months, but had not yet used it at this impressive power level.

Leti is planning to use the system for other tests, like the thermal co-emulation of complex circuits for Leti's joint lab with Docea Power.

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Day by day

Nanotech program enrollments 75% international

The international micro and nanotechnology program Nanotech is ushering in a particularly cosmopolitan class this year. Of the 38 students accepted into the program, 20 are from Italy and 9 are from France. The rest come from Ukraine, Russia, Greece, Egypt, Vietnam, and elsewhere. In terms of gender representation, however, there is still room for improvement; just a quarter of the incoming class this year is female.

Launched in 2004, Nanotech is a joint international Master's program offered by Politecnico Di Torino, École polytechnique fédérale de Lausanne (EPFL), and Grenoble Institute of Technology. Today, it is one of Phelma's most sought-after programs. Because all courses are taught in English (except foreign languages, of course), the program garners particular interest from students from outside France. International students at Phelma (on their Erasmus exchange) often choose to register for some of the Nanotech courses.

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Phelma's driverless car in Freescale Cup European finals

For the first time ever this year, a duo of students from Grenoble Institute of Technology's Phelma engineering school has entered the Freescale Cup, an international student competition in which teams must build and program a smart miniature vehicle capable of navigating a 300-meter circuit, unseen before the actual competition, in the shortest possible amount of time. What started out as a personal project evolved into a group project for a first-year class, taking the Phelma duo first to the Europe-Africa finals and, now, the European finals.

From now until the finals, the duo will be working on improving their car's performance, and, especially, the camera, sensors, and embedded software that will keep the vehicle on the track even at high speeds. Find out who the winner is on April 29 in Turin!

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FEI extends joint lab for three more years

FEI, a US-based manufacturer of scanning electron microscopes (SEM) and transmission electron microscopes (TEM) has decided to extend its joint lab with the Nanocharacterization Platform (PFNC).

The joint lab was set up in 2010 to conduct research in two fields: fine tuning precession electron nanodiffraction to measure deformation at the nanometric scale with applications for tomorrow's 14 nm nodes; and improving the hardware and software for a SEM x-ray tomography technique. FEI will now pursue this research for an additional three years, with the help of two new microscopes, a Quanta SEM with a field emission source, which has already been set up, and a Titan Themis TEM, which will arrive in April.

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Interview

Dominique Noguet, Head of Communication and Security Technology, Leti, an institute of the CEA

"Standards will help us position our technologies"

Leti has been working on a standard for cognitive radio since 2011. Why?

We developed a cognitive radio technology that leverages TV white space. In other words, it takes advantage of UHF bands allocated to TV broadcasting, but that are not being used locally. If we want to get manufacturers on board with this new technology, there has to be some kind of standard to ensure the compatibility of future products.

Who approves the standard? Is it up to each country or the international standards organizations?

There are several telecommunications standards organizations. We are working with one of the most influential, the Institute of Electrical and Electronics Engineers (IEEE), which issues major standards like those for Wi-Fi and ZigBee.

However, each country has its own regulatory authorities responsible for broadcast frequency allocation. And we are looking at that aspect as well. Our strategy is to show the benefits of sharing the spectrum. We feel that a given band can be used for more than one purpose, like TV broadcast and cognitive radio, for instance. This is a shift from most countries' single-use policies.

How is Leti helping with the standard?

The workgroup is chaired by an organization in Japan and counts around 50 members from around the world. We hold a monthly conference call and three or four meetings per year in the US, Europe, and Asia. We are all working toward the same goal, but we all have stakes in different technologies. So, we have to keep our eye on long-term objectives. We have been working on the standard since 2010 and the earliest we can expect the standard to be released is late 2015.

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Day by day

Leti components used in LHC experiment at CERN

Not many organizations can say they work for CERN! Well, Leti can! On November 10, 2014, the beam at CERN's Large Hadron Collider was equipped with silicon microcoolers made in Leti cleanrooms. The microcoolers disperse heat from detectors bombarded by particles.

The project was not without some serious technical challenges, like carving out 200-micron-deep pools in the silicon. But Leti rose to the occasion, showing CERN what its researchers are capable of—just as it did in 2013 when it supplied the Geneva institute with high-pressure-resistant silicon components. The next step will be to make around 30 microcoolers by mid-April. The microcoolers will help keep the LHC and its experiments going until 2025.

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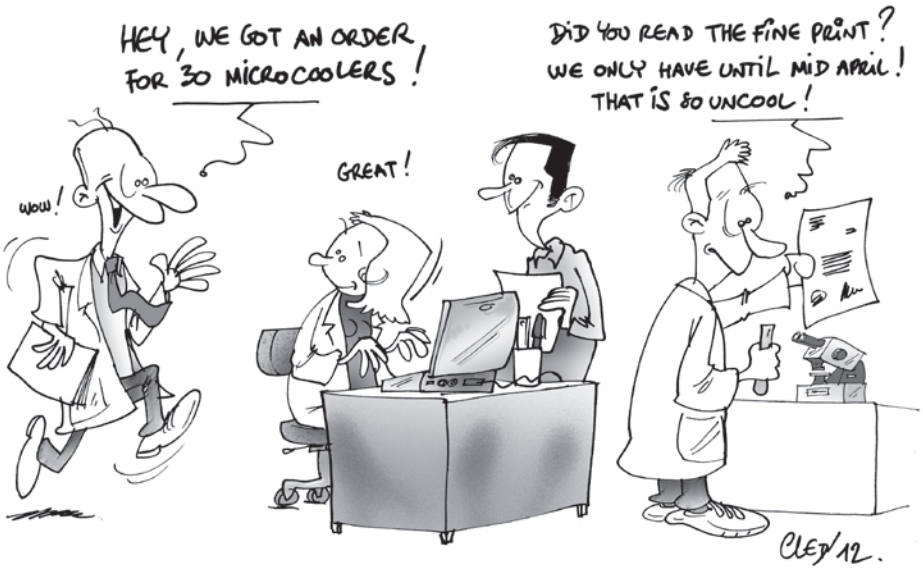

CEA Europe's top patent filer among public research organizations

The CEA, with 558 patent applications published, has held on to the position of number one among public research organizations in the European Patent Office's 2014 rankings. The CEA also did well in the overall rankings, moving up a slot from the previous year to 32nd. The CEA is France's third-leading patent filer, just behind Alcatel-Lucent and Technicolor.

Europe is strategic for the CEA, which goes through the EPO to request the geographical extension of protection for virtually all of its patents. Most of the CEA's requests are for patents in microelectronics, new energy technologies, robotics, instrumentation, healthcare, and materials.

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Horizons

PhD career placement one of IRT Nanoelec's new priorities

IRT Nanoelec is rolling out a new strategy for 2015–2017 with three main pillars. One of the pillars is career placement for PhDs in electronics. IRT Nanoelec will be working with Grenoble-Alps University's Doctoral School using data from the Employment Observatory to come up with a more accurate picture of PhDs' prospects. The goal is to identify areas for improvement throughout the PhD program.

The two other pillars of IRT Nanoelec's new strategy will pursue the objectives of the 2012–2014 strategy plan. First, the institute will continue to support the technology platforms (CIME Nanotech, Predis MHI, and Esynov); second, it will continue to contribute to joint Grenoble Institute of Technology-GEM degree programs like the Master's in Big Data and the Technical Management continuing education program.

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Horizons

CEA helps Rosetta space mission analyze comets

Here's something you might not have known: Leti provided an irreplaceable component to help the Rosetta space mission analyze the gases that make up comets. The adventure began in 1998, when the University of Bern asked Leti to come up with a microtip cathode for a pressure gauge to equip the mission's COPS, or comet pressure sensor. The cathode measures the speed of gas molecules given off by the comet's core.

Leti offers unrivalled know-how in microtip cathode technology, originally developed for flat-screen displays, as well as in instrumentation that can operate in vacuum. And the component reflects the institute's solid expertise, offering top-notch reliability and low energy consumption. Rosetta's comet pressure sensor, outfitted with the cathode, took off for the Churyumov–Gerasimenko comet in 2004 and reached its destination in late 2014.

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Grenoble Institute of Technology adventure Race turns 20 this year

The 20th annual Grenoble Institute of Technology Adventure Race will take place from May 8–10, offering up three days of outdoor thrills instead of the usual two. A total of 30 mixed-gender teams (150 participants) will hit the trails in Savoie and Chartreuse for a grueling 160 km route with an elevation gain of 5,500 meters. Disciplines will include orienteering, mountain biking, trail running, target shooting, climbing, and canoeing—plus a few surprises. An adaptive circuit is available to teams with disabled members.

One big innovation this year will be the ranking system, based on points instead of time. The new system is intended to be more motivating for the participants and easier to manage for the 50-student organizing committee.

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Grenoble experiments with salt-free deicing this winter

The City of Grenoble tested a more environmentally-friendly deicing method this winter, using a sodium-chloride-free product, *DéneigeVert*, manufactured by Selvert, a local startup founded in 2012 by Enseeg (now Phelma) alumnus Guy Baret. This winter's measurements were skewed by the wildly fluctuating temperatures, so an additional measurement campaign will likely take place in winter 2015–2016.

Calcium-acetate-based *DéneigeVert* is biodegradable and non-corrosive to concrete and vegetation. The product's composition—lime and acetic acid—results in a cost five times that of traditional salt. But Selvert is working on making the product more affordable, most notably by making its own acetic acid from local dairy industry byproducts, a goal the company hopes to reach by 2017.

Selvert also sells a range of environmentally-friendly weed killers and a product that traps particulate matter from car exhaust. The company is gearing up to raise €400,000 in fresh capital.

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Enerbee brings in €2.5 million in capital

Enerbee, the company that developed a microgenerator to enable self-powered connected objects, raised €2.5 million in capital in March. Enerbee's unique technology, combining magnetic and piezoelectric materials, makes it possible to harvest the energy from an object in motion, even if that motion is very slow or irregular. It leverages research conducted at Grenoble Institute of Technology, Leti, CNRS, and Grenoble-Alps University's UJF School of Science. The technology is protected by five patents.

The company is testing the technology with several manufacturers and hopes to get its first mass-produced products to market by the end of 2016. The influx of capital—which will fund additional R&D and a new production line in the Grenoble area—will help make that happen!

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Phelma student reports on stay in Japan

Phelma student Florian Castellane is crazy about robotics. Last year, he decided to take a gap year in Japan, where he spent time at a signal-processing lab at Tokohu University in northeastern Honshu. He is currently working on his culminating project on reconstructing 3D scenes from video at Japan's National Institute of Informatics in Tokyo.

Florian has been thrilled with his stay in Japan so far, and rightly so. He has reached all of the goals he set for himself: gain initial experience in a research lab, be proficient in Japanese, volunteer in the tsunami relief effort, set up a French-language exchange group, and tour the country.

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Tronics announces successful IPO

Tronics announced the success of its IPO on the Alternext Paris market on February 9. IPO investors netted a 25% gain on the offer price of €13.20 before trading closed for the day; the company raised €12 million in fresh capital. The funds will be used to support development in Asia (North Korea, China, and Japan) and the United States, where the company already has a plant (Dallas, TX). Specifically, Tronics will double the size of its sales staff and aims to push sales revenue from €12 million to €40 million in three years.

Tronics also plans to pursue its ambitious innovation policy, leveraging its breakthrough M&NEMS technology and its MEMS for medical applications. New joint R&D contracts will be formed with Leti to back this strategy. Tronics was founded 18 years ago to develop and commercialize MEMS technologies hatched at Leti.

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Live from MINATEC

Phelma eschews moving vans for "moving trams"!

Construction of the Grenoble Institute of Technology-Phelma extension has been delayed due to bad weather, with delivery pushed back to late summer. But preliminary work in the run-up to the move is already underway. And Phelma has opted for an original solution, to say the least, opting for "moving trams" instead of the traditional moving vans! The school's Facility Management Department conducted an environmental audit of the different moving vehicles available. And the tramway came out on top, with a carbon footprint three times smaller than that of combustion-engine-powered moving vans.

And the Greater Grenoble Intermunicipal Authority (La Métro) is backing Phelma's choice, making tramways and conductors available to the school for the move, which will take place at night so as not to disrupt normal daytime traffic. In all, five tramways will be needed to move the 650 cu. m of tables, chairs, computers, and other equipment from the school's lecture halls, classrooms, and language labs—not to mention the 10,000 volumes from the school's library.

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Live from MINATEC

B41 gets new-generation roof

Building 41's 5,000 sq. m of roofing was totally replaced over the course of last year. The rainy summer didn't delay the huge job and, for B41's cleanrooms just below, it was business as usual.

The former 25-year-old rockwool and asphalt roofing is now just a memory. The new roof boasts a new-generation material similar to a swimming pool liner that will stand up to rain and snow for a long time to come.

And that's not all—the new roof's gentle pitch will keep water flowing off of it, while protective panels will prevent damage from mobile snow removal equipment.

The roof has already seen ample rain and snow this year, without a leak in sight!

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Inno'Cup Junior showcases teen inventors' bright ideas

The final round of the Inno'Cup Junior challenge will be held at MINATEC on July 8 and 9. This national competition* is the latest incarnation of the Franco-American Young Innovators Award. It targets a broad audience—anyone between the ages of 15 and 18 with a new idea can take part. Plus, participants don't need any technical or other specific knowledge to compete.

Each two- to three-person team will post a three-minute video presenting their innovative idea on a dedicated website. There are eight themes, including art and design, health and wellness, the environment, and daily life.

The winners will go all expenses paid to the US, where they will tour leading university campuses and innovative companies.

**Organized by the US Embassy, science education center la Casemate, Xerox, the CEA, MINATEC, and Grenoble Ecole de Management.*

Learn more at: www.innocupjr.fr
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April Fools!

This issue's April *Fools* Day hoax article is—you guessed it!—the one about the Phelma "moving tram." The school will not, as reported, be moving by tramway, but rather by the far less original moving van. There is a bit of truth to the story, however! The idea of using the tramway was discussed at a meeting to plan the move, but it was intended purely as a joke. But the school really does have a whopping 650 cu. m of furniture and equipment to move!

Agenda

April 13–15,
Aix-les-Bains
11th International Concentrator Photovoltaic (CPV) Systems Conference
Hosted by CEA Tech and INES (the French National Institute for Solar Energy Research)
www.cpv-11.org

May 6,
Maison MINATEC
Engineering Science Olympics
High-school teams compete for the best sci-tech project awards
www.scienceiscool.fr/evenements/olympiades-des-si/

May 8–10
20th annual Grenoble Institute of Technology Adventure Race
contact.raid@grenoble-inp.fr

May 18,
Maison MINATEC
ITC 2015 Conference
Contact: didier.louis@cea.fr

May 28,
World Trade Center Grenoble
18th Annual Forum 5i
www.forum5i.fr

June 7–10,
Maison MINATEC
13th IEEE International NEW Circuits And Systems (NEWCAS) conference
http://newcas2015.sciencesconf.org

June 9,
Maison MINATEC
Middle-school scientific poster contest *(Affiche ta Science !)*
www.scienceiscool.fr/evenements/affiche-ta-science

June 15–16,
Maison MINATEC
GIIP Program Franco-American Colloquium
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June 24–25,
World Trade Center Grenoble
LetiDays Grenoble 2015
http://www.letidays.com/2015/

June 30,
Maison MINATEC
Assistants Day
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July 1–3,
Maison MINATEC
InMram Introductory Course on Magnetic Random Access Memory
http://www.inmram.com

July 2,
Maison MINATEC
11th International Conference on Research in High Magnetic Fields, RHMF 2015
http://rhmf2015.lncmi.cnrs.fr/

July 8–9,
Maison MINATEC
Inno'Cup Junior Finals
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