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Top news

Quantum technology: Europe is banking on Grenoble

Grenoble-based research project QuCube won an ERC Synergy Grant of €14 million over six years to develop a quantum processor. The grant is evidence that Grenoble's research and innovation ecosystem is gaining traction internationally.

Leti, INAC, and Institut Néel will receive €14 million from 2019 to 2024 to develop a quantum processor with at least a hundred physical qubits. The researchers could make the first-ever functional logic qubit and, in the process, achieve a major advance toward scaling up the technology.

Advances in basic science and technological breakthroughs

The researchers will have to overcome a number of obstacles. They will have to select the processor architecture, test qubit variability, come up with a process to correct quantum errors, and address heat dissipation. This will require advances in basic science and technological breakthroughs.

The three institutes put forward some convincing arguments to secure the grant. Institut Néel and INAC have been conducting basic research in quantum computing for fifteen years. Together, INAC, Leti, and Institut Néel have achieved several world firsts, the most recent of which was a 300 mm CMOS qubit.

More generally, however, it was the high quality of Grenoble's research and innovation ecosystem and, especially, a proven track record building partnerships that span academic research and industry that tipped the balance. In the field of CMOS technology, Grenoble is home to strong, long-term partnerships and new partnerships are already being formed in the area of quantum computing. Most notably, the Grenoble-Alpes University Quantum Engineering project, which kicked off in 2017, will receive funding of €1.7 million over four years.

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Innovation

Bringing chronic heart failure patients home for good

A powerful new remote monitoring system could track heart failure patients' blood levels right from their homes. Startup CardioRenal has been working with Leti since 2015 to develop just such a system. This summer, the partners ramped up their collaboration by creating a joint lab to make improvements to a lab-on-chip leveraging microfluidics and optical and electrochemical sensors. The goal is to scale the technology up to be able to launch clinical trials next year.

Fine-tuning a patient's drug doses once they have been released from the hospital is tricky. Kidney failure and pulmonary edema are two of the major risks physicians must head off. The future device will be able to run the necessary tests from just a single drop of blood. The blood tests will make fine-tuning drug doses easier, reducing the number of stressful and costly hospital stays.

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Automotive switches: resource-efficient MPC

Can automotive switches be controlled by MPC*-type rules despite the switches' limited processing power? EFI Automotive and Leti recently kicked off a research project to find out. If they are successful, EFI Automotive's future switches will deliver levels of performance never before seen on the market, whether it is in terms of speed, energy consumption, or reliability.

MPC uses a model of a switch to predict switch behavior and determine which action to take to achieve the desired performance. Of course, the model factors in the component's inherent constraints, such as maximum power supply voltage and position stops. The challenge is to develop a low-resource version of MPC without compromising efficiency.

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Thin layer materials: Sprint project aims high

LMGP is coordinating the EU Sprint project, which kicked off in September. The project involves a consortium of six academic research labs. And the project is an ambitious one. The objective is to develop a thin-layer deposition process for amorphous or crystalline materials that works at ambient temperature and pressure and that is compatible with all types of substrates. The process would mark a radical breakthrough with regard to the limitations and demands of current deposition processes (vacuum, high-temperature, etc.). It would also facilitate innovation in fields like photovoltaic cells, LEDs, and electronic and optoelectronic sensors.

For now, the researchers are keeping quiet about the details of their work. However, they did reveal enough to EU research authorities to secure €3 million in funding over four years.

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Innovation

Redfinch revitalizes mid-infrared detection technology

Leti will unveil the initial results of the EU Redfinch project, which it is coordinating, at Photonics West in San Francisco in early February. The project is developing a new generation of optical sensors to detect chemicals in gases and liquids. The mid-infrared sensors operate at wavelengths between 2 microns and 20 microns and are combined with quantum cascade lasers to obtain a spectrometer. The cost of the future system should be less than a tenth that of current systems for the same levels of performance.

The key to the advance will be photonic integrated circuits designed by Leti and fabricated in the institute's 200 mm cleanroom. The developments made under the Redfinch project will target three applications: process gas analysis for refineries; gas leak detection for the petrochemical industry; and protein analysis for the dairy industry.

Learn more online at: http://www.redfinch.eu/

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Epilepsy: What if cold could prevent seizures?

Cold can reversibly modify neural dynamics, including those involved in epileptic seizures. The challenge is how to produce cold deep in the brain and let the heat generated by the production of cold escape. Clinatec is investigating the issue under the Epicool project (part of the Carnot Exploratoire program).

The future implantable device will measure less than 3 mm in diameter; the energy produced will be released as light rather than as heat. Once implanted in the brain, the system will detect the precursors to epileptic seizures and will trigger the production of cold until neural activity has returned to normal.

The research, which is still in the very early exploratory stage, will include tests to assess the feasibility of the technology in terms of size and other factors. Proof-of-concept testing has already allowed the researchers to overcome several technological hurdles. Researchers at Clinatec are now tackling miniaturization of the system.

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Spintronics gets new materials

It turns out that electrical insulator yttrium iron garnet (YIG) is also a great conductor of spin current. The material also possesses non-linear transport properties when the current exceeds a certain threshold. Researchers from INAC worked with three other teams* to demonstrate the material's capabilities, measuring spin conductance between two platinum wires on a thin layer of YIG. A patent on the material's non-linear properties will soon be filed to protect further developments.

The findings of the research confirm that spintronics, which has been highly focused on metals, can now be expanded to magnetic materials that are also electrical insulators and, especially, metal oxides. The downside is that the metal oxides must be in monocrystalline form obtained by epitaxial growth, a process that is both complex and costly.

**Brest University, IRAMIS, CNRS-Thales Joint Research Unit*
**Model Predictive Control*

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Germanium reveals hidden talents

Germanium produced with very few impurities is thought to be compatible with ballistic (impact-free) transport of electrons or holes. In addition, theoretically, holes offer strong spin-orbit coupling. Researchers from INAC working with colleagues from the UK and the Netherlands* recently demonstrated these two theoretical properties in the lab on a quantum electronic system built specifically for the research. The system is made from a 2D germanium layer with an electrostatic grid sandwiched between two silicon-germanium layers.

Superconducting aluminum electrodes were connected to the system, enabling the propagation of a superconducting current in the germanium. The results, obtained at 17 mK, will create new possibilities in spintronics and quantum computer design.

**The Universities of Warwick and Delft*

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Photosynthesis is better two by two

Artificial photosynthesis systems present a major shortcoming: Their photosensitizer delivers electrons one by one while the catalyst uses them two by two. A team of researchers from Grenoble and Germany* recently found a solution to this problem. They developed a ruthenium-based photosensitizer that stores two electrons and two protons reversibly, similar to the plastoquinones in living organisms.

It took the researchers three years to find a suitable structure and the optimal process for synthesizing it, and then characterize it. The pattern they selected is planar and consists of eight conjugated aromatic cycles. The next steps toward preparing the technology for future applications will be to improve the photosensitizer so that it can store more energy and test it for use in catalytic processes.

**CEA (including BIG and INAC), Grenoble-Alpes University, and Friedrich Schiller University Jena (Germany)*

Read the abstract here: https://rsc.li/2raPABA

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Interview

Etienne Vogt, General Manager, Utilities Services, Engie:

"Our renewable hydrogen costs less than hydrogen produced using fossil fuels."

You have been supplying hydrogen produced via water electrolysis to the CEA and the hydrogen filling station at GEG since October. What is the story behind the innovation?

It all started with the HyWay hydrogen-powered mobility demonstrator project, which needed a partner to produce renewable hydrogen. Engie was already supplying the CEA with hydrogen at the time, and demand from the cleanrooms was growing. So, we built our first local renewable hydrogen production unit in France. The unit produces hydrogen using water electrolysis and supplies industrial users and vehicles.

Is the innovation in the concept or in the equipment itself?

The innovation is in the concept. All hydrogen is produced on-site for combined use, and hydrogen is only produced using fossil fuels for the backup supply. The equipment we use (alkaline electrolyzers, a 200-bar compression unit, a gas purifier) is proven. Above all, our goal is to provide a continuous supply. We are currently producing around 70,000 cu. m per year.

What have you learned from the experience?

From a technical standpoint, the construction process went very well. However, we did fall a year behind schedule bringing the unit up to code in terms of safety. Safety regulations are still a significant obstacle to the development of hydrogen energy.

At this point, the unit has reached cruising speed and my team has operation under control. We are pleased to be producing hydrogen–and renewable hydrogen at that–locally and at a price that is lower than the hydrogen produced using fossil fuels delivered in tanks.

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Live from MINATEC

Phelma tenth anniversary celebrations to draw to a close

On December 20, Grenoble Institute of Technology's Phelma engineering school will end its tenth anniversary celebrations on a high note. Some 200 Phelma students, alumni, faculty, partners, and neighbors (labs, technology platforms, MINATEC, CEA, CNRS, GIANT) will gather at the Grenoble Institute of Technology auditorium.

Pierre Benech (Grenoble Institute of Technology Administrative Dean and former President), Louis Zangara (former Chairman of the Board), and Anne Vilcot (President) will speak, reviewing highlights in the school's history since its inception. There will also be a panel talk about millennials. The main topic will be how this generation of digital natives often catches older people off guard, especially in the workplace. The afternoon will end with an anniversary cake!

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RFIC-Lab focuses on RF design

In September, RFIC-Lab*, staffed by seven scientists and fifteen PhD candidates, made it onto the list of research facilities managed jointly by Grenoble Institute of Technology and Grenoble-Alpes University. The lab's staff, headed by Sylvain Bourdel, is from IMEP-LaHC. The restructuring will raise the international-caliber lab's profile. RFIC-Lab has authored many articles and presented numerous papers at high-level conferences. Currently, the lab is engaged in two EU projects and two national projects. The lab's industrial partners include STMicroelectronics and Anritsu.

The researchers design active and passive circuits for RF and millimeter-wave communications. One of their specialty areas is design on "unusual" substrates like metal-nanowire membranes; another is low-power RF.

**Radiofrequency and circuit integration lab*

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Avalun ramps up production at MINATEC

LabPad®, Avalun's "pocket lab," is currently sold around the globe, with customers in Germany, Italy, the UK, the Czech Republic, South Africa, and other countries. The startup recently decided to automate its consumables manufacturing line at the BHT. The robotized machine recently commissioned can produce 15,000 blood coagulation tests per day, up from 1,500 previously. The increased production capacity will meet growing demand from doctors, pharmacists, hospitals, and individuals looking for a coagulation test solution that saves them the step of taking samples to a lab.

Avalun, which currently has 21 employees, will focus on manufacturing and sales over the next few months. At the same time, the company is working on obtaining the CE mark for its new tests. Finally, Avalun is partnering with Leti on the e-Meuse Santé project to develop remote healthcare solutions for rural areas.

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Horizons

Auvergne-Rhône-Alpes regional digital innovation hub opens

The new regional digital innovation hub will guide businesses through the digital transition, drawing on the region's high-level digital technology experts. Leti will present the hub, called "minaSmart Auvergne-Rhône-Alpes" in Vienna, Austria on December 4. The organization should receive funding from the Auvergne-Rhône-Alpes regional government and from the European Commission, which has expressed a desire to certify this type of initiative under the European Digital Innovation Hub name.

The CEA, INRIA, Minalogic, Grenoble-Alpes University, and the Regional Council are all founding members. Drawing on the technology and software platforms within the scope of the region's Digital Campus initiative, minaSmart Auvergne-Rhône-Alpes will assist businesses with all aspects of the digital transition, from hardware and software to user services.

Learn more online at: www.minasmart.auvergnerhonealpes.eu

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IFCEN and Phelma to sign two dual-degree agreements

Since its inception in 2010, the Sino-French Institute of Nuclear Engineering and Technology (IFCEN) has enjoyed the support of a consortium of French institutions of higher education, including Grenoble Institute of Technology. IFCEN provides nearly 120 Chinese engineers with French-style education each year.

IFCEN and Phelma are now deepening their relationship with two new dual-degree programs. The associated agreements will be signed very soon and the programs will be in place for the start of the 2019-2020 academic year. The first program is IFCEN's Masters in Physics/Nuclear Energy; the second is Phelma's Nuclear and Energy Engineering degree.

The agreements will position Phelma to host top Chinese engineering students (who also speak fluent French) and create new international mobility opportunities for students at home.

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Air Liquide signs five-year contract with the CEA

Air Liquide and the CEA have a long-standing partnership. They recently extended their cooperation through a five-year joint lab. INAC, along with institutes IRFM and IRFU, plays a major role in two research topics addressed by the joint lab.

The first is improving the performance of pulsed-gas tube cooling units. These cooling components cool the sensors on board satellites to temperatures between 15 K to 50 K.

The second is dynamic simulation of the three refrigeration units (from 25 kW to 4 K) used in the ITER Tokamak reactor. The simulation will support the preparation and configuration of acceptance testing and commissioning. Air Liquide, which already provides cooling for part of the Large Hadron Collider, has also been tasked with installing and assembling the refrigeration units at ITER. Acceptance testing is expected to begin in late 2019.

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Grenoble team takes home two wins in iGEM competition

In late October, a multidisciplinary team from Grenoble that included several Phelma students brought two wins home from the iGEM International Genetically Engineered Machine competition in Boston.

Their phagotherapy project, entitled "Phagyzer," won a bronze medal, and was also selected in the Best Hardware category. In just a few months, the team developed a liquid handler capable of extracting and purifying a DNA sample. However, they did not have enough time to identify pathogenic bacteria and the phages likely to eliminate them.

Now, the question is whether or not the winning team will continue to develop the Phagyzer...perhaps in the form of a startup? They are expected to announce their plans soon. Stay tuned!

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HOPE mobilizes talents to counter energy poverty

The Grenoble Institute of Technology Foundation established the HOPE Chair at GreEN-Er in late September to help counter energy poverty by coordinating the efforts of local government, businesses, researchers, and government agencies. Today, 20% of France's population suffers from energy poverty*. The consequences of energy poverty can include health problems and social isolation.

The HOPE Chair will take a pragmatic approach to countering energy poverty based on generating ideas that work. The partners will focus on real-world solutions, deepen their understanding of the mechanisms that underpin energy poverty, and support existing initiatives (EU H2020 projects and projects in pioneering countries like the UK and Ireland). Their goal is to innovate, both in terms of technology and in terms of coordinating stakeholders in social welfare, housing, and healthcare.

**Households whose energy bills are more than 10% of their income*

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Day by day

Sneak preview of Leti innovations at CES 2019

Leti will exhibit at the CEA Tech Village booth at the Consumer Electronics Show (CES) in Las Vegas in January, unveiling two of the institute's latest innovations: Pixcurve and Sigma Cells.

Pixcurve is a bio-inspired technology that enables curved optical components capable of reducing lens sizes by up to 60% while minimizing the optical aberrations that can damage image quality. The technology targets the high-end photography, smartphone, action camera, and virtual reality markets.

Sigma Cells is a switched-cell battery technology for electric vehicles. The three-in-one batteries offer integrated switching, charging, and battery management features. The batteries are longer-lasting, more compact, and lighter in weight than conventional batteries. They also deliver extended battery life (20% longer) and more reliable charging status information.

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Biomedical research: Eveon and LMGP set up joint lab

Eveon and LMGP have been working together for several years through the Grenoble Institute of Technology-Phelma Biomedical Engineering program. Today, the partners are ramping up their collaboration through a joint lab funded by the Grenoble-Alpes University IDEX. The lab will investigate the impact of different materials and fluidics processes on the stability of therapeutic proteins. Eveon develops and manufactures automated medical systems for preparing and administering drugs that could contain the proteins being studied.

The main challenge is medical: If the proteins adsorb or clump together, their activity can be diminished. There is also a more strategic challenge, however. The joint lab will advance scientific knowledge of the phenomena at work so that Eveon can offer its customers the optimal system for the drug being administered.

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Day by day

Rosi recycles photovoltaic manufacturing waste

Solar panels produce renewable energy, of course. However, like any manufactured product, solar cells also produce waste. In fact, 40% of the ultra-pure silicon used to make photovoltaic cells goes to waste during the diamond-wire cutting process. Startup Rosi was created in late 2017 to reduce this massive waste. The company is combining a chemical process with a metallurgical process developed in partnership with SIMAP* to transform cutting waste into polycrystalline silicon that can be used to produce cells. The material can also be used to produce more ultra-pure silicon.

SIMAP is already home to a pilot line that can process 16 tons of solid waste per year. Rosi has applied for EU funding under a H2020 project with the goal of building an industrial-scale demonstrator capable of processing between 200 tons and 500 tons per year. The company is hoping to get the green light from the EU in early 2019.

**Laboratory for materials science and engineering, a partner of Grenoble Institute of Technology's Phelma school of engineering*

Learn more about Rosi at: www.rosi-solar.com

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Agenda

December 6, Grenoble
Annual Minalogic Day
https://www.minalogic.com/fr/actualite/journee-annuelle-du-pole-exposez-vos-produits-innovants

December 20, Grenoble Institute of Technology Auditorium
Grenoble Institute of Technology-Phelma tenth anniversary
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February 7
"You, too can be a scientist!"
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February 16, Grenoble Institute of Technology-Phelma
Open House
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Activage tested by 150 senior citizens

The EU Activage project, coordinated by IRT Nanoelec and the Isère General Council in France, has now entered the testing phase. Between now and April of 2020, 150 senior citizens in Isère will engage in a year-long test of digital solutions developed to meet their needs. The solutions, designed to boost comfort and safety at home, are based on a touch tablet, a gateway, and sensors. The goal is to keep senior citizens safe in their homes and facilitate caregivers' work.

The solutions will also be implemented in patient rooms at a hospital near Grenoble to support caregivers. IRT Nanoelec worked with the CEA and STMicroelectronics to come up with the specifications for the gateway and ensure that it adequately protects the data from the sensors in compliance with the European GDRP regulation.

https://www.isere.fr/activage

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IMEP-LaHC gets an AFM unlike any other

The new Bruker Icon AFM installed at IMEP-LaHC in late October offers conventional topographical measurement capabilities with resolutions of around a nanometer. There's nothing revolutionary about that. However, the microscope does have some new capabilities that are not available anywhere else in Grenoble. The equipment's "Data Cube" mode delivers point-by-point electrical and physical measurements across the entire surface of a sample. The sample can also be mapped in terms of current, voltage, and force curves.

Also new is "SMIM"* mode, which measures a sample's capacity and resistivity with resolutions of 50 nm.

The new AFM will be operational in a few months. And, as part of the Open RA platform, outside researchers will be able to use the microscope.

**Scanning Microwave Impedance Microscopy*

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INAC PhD candidate wins For Women in Science award

On October 8, Farsane Tabataba-Vakili was one of 30 women scientists in France to win a L'Oréal-UNESCO For Women in Science award. Ms. Tabataba-Vakili earned recognition for her research in optoelectronics, which aims to improve micro light sources. She is currently completing her dissertation, co-supervised by CNRS-C2N and INAC.

Specifically, Ms. Tabataba-Vakili's work focuses on the fabrication and characterization of photonic circuits and micro-lasers injected into the nitride-based semiconductor materials used in LEDs and Blu-ray lasers. Her goal is to develop micro-lasers (for discs just tens of microns in diameter) injected electrically and coupled with photonic circuits capable of guiding and spectrally filtering light.

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