

Scientific Newsletter

WINTER 2023



Editorial

This end of the year 2023 marks the time of the publication of our fourth quarterly scientific newsletter, bringing together a selection of highlights from our UMRs (Unités Mixtes de Recherche) working on the key themes of Biology/Health, Energy/Environment, Physics/Digital and Cryotechnologies.

In the healthcare field, one of the highlights is the repair of DNA damage by the photolyase enzyme, observed using time-resolved crystallography on large free-electron X-ray lasers; another is the development of tumoroids for kidney cancer that can be used in pre-clinical studies.

In the field of Energy and Environment, you will discover the development of an innovative 3D confocal imaging methodology for the observation of photosynthesis at the cell level and studying photoprotection mechanisms in the face of light; a second highlight takes a look at the development of new materials with photochromic properties for dynamic dye solar cells to be used in stained glass windows, for example; another highlight exposes the orange protein as a catalyst for the photoreduction of water for hydrogen production.

In the field of Physics and Numerics, the first highlight presents an artificial intelligence topic that shows how spintronics in magnetic tunnel junctions can improve the energy performance of neural networks; a second highlight describes the miniaturization of a gallium nitride nanowire-based system to create a UV LED source; and a third highlight is about an international team in collaboration with IRIG that has investigated the fundamental principles of the Hall effect using a laser-based quantum simulator.

Finally, you will discover two illustrations of the instrumentation and engineering skills developed at IRIG: a new compact nanoscale resonator based on NEMS nano-electromechanical systems integrated into a mass spectroscope for the detection of nanoparticles or viruses; and the development of the HELIOS cryogenic loop based on liquid or supercritical helium to study heat transfer phenomena in accidental situations.

2023 was a very good year for the institute, first and foremost thanks to all the results obtained by the researchers at IRIG, which led to numerous high-level publications. This wealth is also remarkable by a very high level of participation in calls for projects issued by the French National Research Agency (ANR) with a historic success rate for IRIG of over 40%, compared with the national rate of 23.4%.

This year saw the launching more than 15 Priority Research and Equipments Programs (PEPR) which were initiated in 2022 thanks to the considerable efforts of our research and support teams. IRIG is the co-leader of two of them: the PEPR SPIN will be officially inaugurated on January 29, 2024 in Grenoble, at the Spintec team site, in the presence of Sylvie Retailleau, Minister of Research; and the PEPR Medoc, which has just received its official letter of funding agreement, and is being led by our BGE team.

In parallel with the PEPRs, the European side has also been very dynamic this year, with a number of structuring successes such as the award of a prestigious European ERC Advanced grant to our IBS Institut de Biologie structurale, a dynamic that we must maintain in the future to reinforce our position of excellence in Europe.

Finally, the year was very active, with the extension of long-standing private partnerships strengthening our collaborations, and several new partnerships taking shape, illustrating our policy of valorizing our research and our capacity for innovation. For example, as part of the CEA Magellan maturation program, IRIG is leading two start-up projects and is preparing two others for the next selection committee.

We are also a co-founder of the FITInnovE university innovation cluster within the Université Grenoble Alpes, which will enable a better coordination of our activities in the field of technology transfer.

Thanks to our commitment and our collective efforts, this year has once again been a landmark one, establishing UMRs and IRIG as recognised players on the major issues facing our planet and our society.

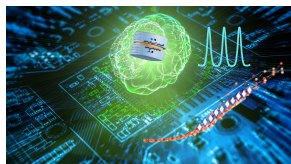
I wish you all a merry Christmas and excellent vacation.



Pascale BAYLE-GUILLEMAUD
Head of the Interdisciplinary Research Institute of Grenoble



At the front page of IRIG



[On IRIG website](#)

Spintronic spiking neuron

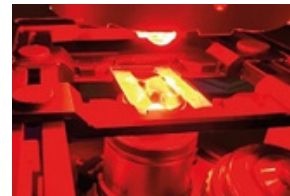
In the field of artificial intelligence, the design of a spiking neuron incorporating a spintronic magnetic tunnel junction improves neural network performance while reducing energy consumption.

Liliana Buda | SPINTEC | *NanoLetters* 2023

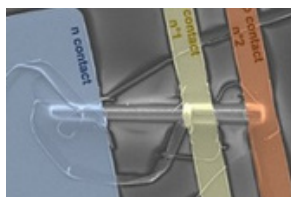
Méthode 3D pour étudier la photosynthèse

Researchers at IRIG have developed an innovative method to observe photosynthesis at the scale of a single cell using confocal microscopy. It unveils the specialization of various tissues and organisms, showcasing their photoprotection mechanisms in response to light.

Dimitri Tolleter | LPCV | *Cell Reports Methods* 2023



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UV MicroLEDs: Nanowires light the way!

The development of new UV-emitting LEDs is gaining significant interest, especially for bactericidal and virucidal applications. Researchers at IRIG have achieved a major breakthrough by miniaturizing a UV LED on a micrometer scale using gallium nitride nanowires.

Christophe Durand | Pheliqs | *Applied Physics Letters* 2023

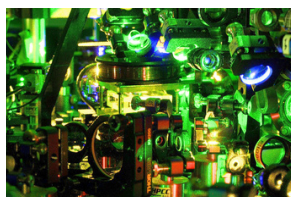
Green hydrogen produced by illuminating orange protein

The energy transition aspires to decarbonized and renewable energy. This could be achieved by producing hydrogen. To this end, researchers at IRIG, in collaboration with researchers at College de France, have studied the ability of the Holo-Orp protein to catalyze the photo-reduction of water to H_2 .

Mohamed Atta | LCBM | *Journal of the American Chemical Society* 2023



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A laser light bends the trajectory of atoms

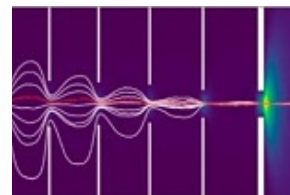
In collaboration with an international team, researchers at IRIG explain the microscopic origin of the Hall effect, by modifying the quantum trajectory of atoms using laser light in a quantum simulator. In purely classical systems, the Hall effect forms the basis of techniques for measuring the magnetic fields of our domestic appliances, such as cell phones.

Michele Filippone | MEM | *Science* 2023

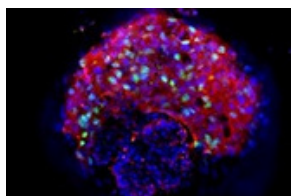
New compact modular nano-resonator mass spectrometer

A team of researchers at IRIG and CEA-LETI has developed a new compact, mobile mass spectrometer technology, incorporating a nano-electro-mechanical resonator (NEMS) capable of measuring the mass of nanoparticles and viruses.

Christophe Masselon | BGE | *Frontiers in chemistry* 2023



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[On IRIG website](#)

Tumoroids for personalized anti-tumor treatments

Researchers at IRIG are developing tumoroids - structures with molecular, genetic and morphological characteristics that mimic the original tumor - to facilitate pre-clinical applications. Their studies will make it possible to offer personalized care for every kidney cancer patient.

Odile Filhol-Cochet | Biosante | *Cell Death and Disease* 2023

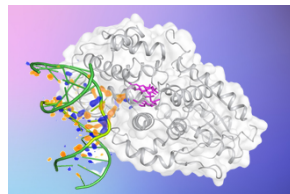
Photochromic dyes for solar cells

Researchers at IRIG are developing dye-based solar cells. They have just produced a photochromic cell that darkens when illuminated, but faithfully reproduces colors. This phenomenon is reversible and paves the way for applications in the field of glazing with dynamic optical properties.

Renaud Demadrille | SyMMES | *Chemical Science* 2023



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Molecular movie of DNA repair by a photolyase

An international collaboration involving researchers at IRIG has revealed the details of DNA lesion repair by the enzyme photolyase using time-resolved femtosecond crystallography, from lesion bond breaking to enzyme/DNA complex dissociation.

Antoine Royant | IBS | *Science* 2023

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Protecting against overpressure in cryogenics

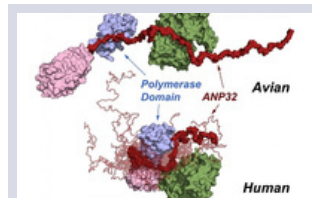
Researchers at IRIG design cryogenic systems based on liquid or supercritical helium to maintain cooling in the equipment of major research instruments requiring refrigeration at very low temperatures, of the order of 4 K or less. The HELIOS experimental platform has been adapted to study heat transfer phenomena in accident situations.

Jean-Marc Poncet et **Eric Ercolani** | DSBT |



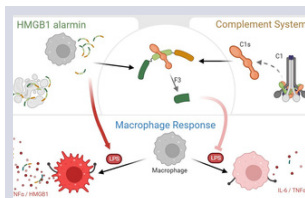
[On IRIG website](#)

Other scientific news of the laboratories



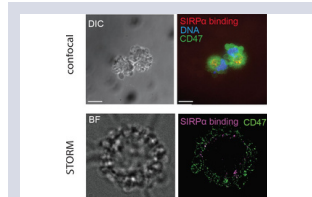
NMR reveals how bird flu exploits multivalency and intrinsic disorder to adapt its replication machinery to humans

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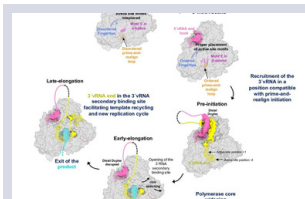
HMGB1 cleavage by complement C1s and its potent anti-inflammatory product

[On IBS or LCBM website](#)



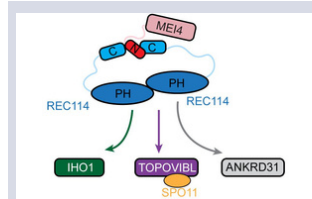
Super-resolution microscopy on the surface of cells in apoptosis reveals the play of molecules involved in their elimination by phagocytosis

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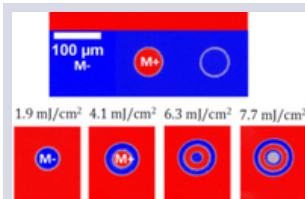
Molecular movie of Hantaan virus genome replication by its viral polymerase revealed using high resolution cryo-electron microscopy

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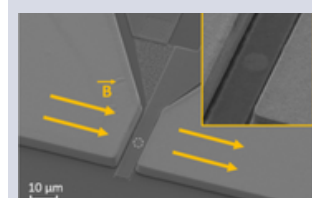
Characterization of a key meiosis regulatory complex

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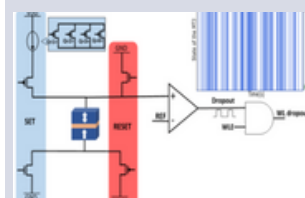
In plane reorientation induced single laser pulse magnetization reversal

[On Spintec website](#)



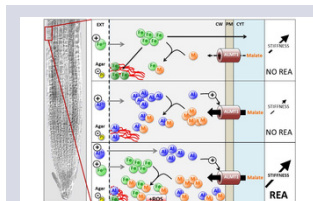
A high gain flux concentrator greatly amplifies the sensitivity of a magnetic field sensor

[On Spintec website](#)



SpinDrop: Dropout Based Bayesian Binary Neural Networks with STT-MRAM

[On Spintec website](#)



10 plus 10 does not make 20 : the stress response of Arabidopsis thaliana seedling to Fe and Al metals

[On IBS website](#)



3D printing to reconstruct a long bone

[On Biosante website](#)

Press releases – Prizes – Others



Jérôme Boisbouvier wins ERC Advanced Grant 2022

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Renaud Demadrille co-winner of the Académie des Sciences' Ivan Peychès 2023 prize

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Rebekka Wild laureate of the 2023 Impulscience® program Fondation Bettencourt Schueller

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Start-up Nellow wins 1st prize at the HEC Challenge + Forum

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