

ACTIVITY REPORT 2019



**Electrophysiology and Heart
Modelling Institute**

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Amanda Belle Isle,
Receptionist
at LiryC

Cover photo: **Geneviève Bulidon**, Healthcare supervisor, Cardiac Electrophysiology Department, LiryC & CHU de Bordeaux

ABOUT LIRYC

LiryC is the only institute in the world entirely dedicated to cardiac rhythm disturbances. Rhythm dysfunctions are associated with many cardiovascular diseases, which account for almost a third of deaths worldwide.

LiryC is one of six University Hospital Institutes (Instituts Hospitalo-Universitaires, IHU) created by the French government as part of the Investments for the Future Program (Programme des Investissements d'Avenir), to stimulate medical research and innovation in France.

LiryC is committed to 4 missions: research, innovation, patient care and training. The objective is to understand the underlying mechanisms of cardiac rhythm dysfunctions, to develop therapeutic and diagnostic tools, to treat patients and to disseminate the acquired know-how to the greatest number of centers around the world.

LiryC brings together, within the same institute, scientists, doctors and engineers around patients. These multidisciplinary international experts are committed every day to a better understanding and treatment of the electrical disorders of the heart :

- **atrial fibrillation**, the most common arrhythmia, affecting nearly 33 million people worldwide,
- **ventricular fibrillation**, the main cause of 4.25 million sudden cardiac deaths per year worldwide, or 10% of deaths in Western societies,
- **heart failure**, which affects 26 million people worldwide.

In a unique technological environment and a dynamic ecosystem, LiryC aims to **revolutionize the treatment and prevention of cardiac rhythm diseases, directly benefiting the greatest number of people in the world.**

For more information, please visit www.ihu-liryC.fr

Liryc was structured as a foundation for scientific cooperation under the aegis of the Bordeaux University Foundation. Its founders are the University of Bordeaux, the Bordeaux University Hospital, Inria and the Nouvelle-Aquitaine Council. The founding members provide resources to the Institute, support its strategic orientation and ensure its proper functioning. Liryc also has two major academic partners, Inserm (National Institute of Health and Medical Research) and the CNRS (National Center for Scientific Research).



ANR No.ANR-10-IAHU-04 grant



Yann Bubien,
CEO
of the Bordeaux
University Hospital

Seven years after its launch, the University Hospital Institute Liryc has taken a new step.

On June 24, 2019, an international evaluation panel auditioned the key members of the Institute: past successes and planned future strategy convinced the public authorities to provide an additional support of 16 million euros for the period 2020 - 2024. This exceptional support also reflects the firm commitment of all the founding members and the enthusiasm for the project.

The University Hospital Institute - Liryc - is fully involved in the strategy of the Bordeaux University Hospital. The intertwining of the treatment-research-teaching dimensions is the key to success. Research in cardiology in general, and in particular rhythmology and electrophysiology, allows the Cardiology hospital of the Bordeaux

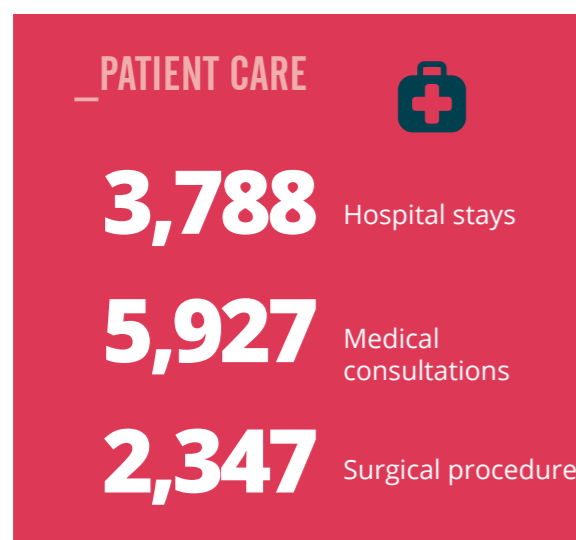
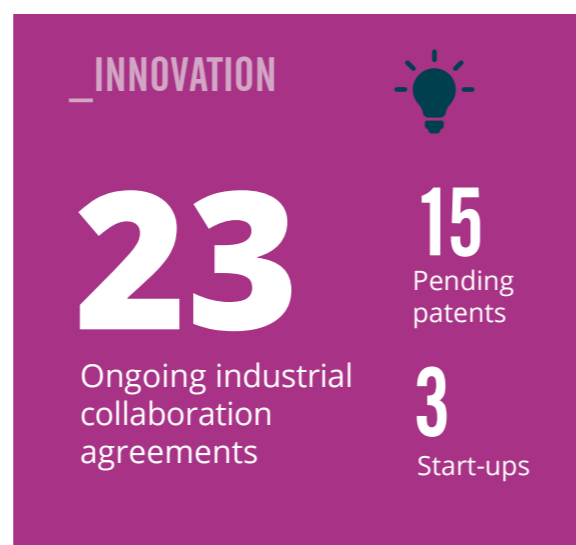
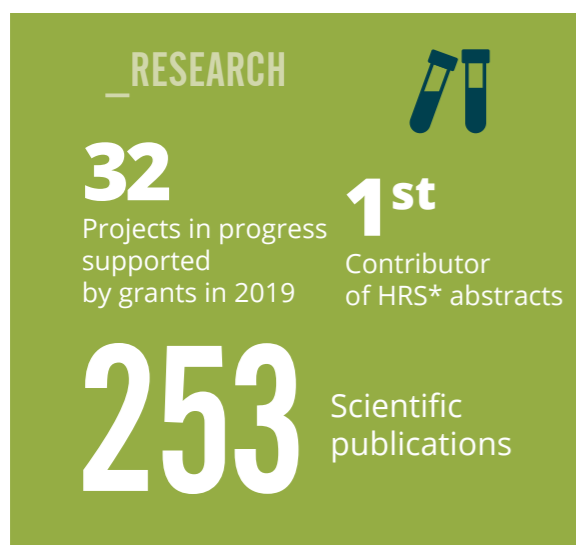
University Hospital to provide excellent care, and to disseminate innovations very quickly. The Institute's concerns are essential and have major repercussions in terms of public health: atrial fibrillation affects 10 million people in Europe; ventricular fibrillation causes 50,000 sudden deaths each year in France; heart failure accounts for a tenth of hospital admissions in France.

The ambition to improve human health, which underlies the IHU project, is useless without the ability to disseminate innovations and knowledge to as many people as possible.

The ambition to improve human health, which underlies the IHU project, is useless without the ability to disseminate innovations and knowledge to as many people as possible. In this regard, the IHU maintains privileged relationships with industrial partners, demonstrating its ability to create start-ups, establishing itself as a pioneer in the dissemination of knowledge through master classes and welcoming foreign physicians and researchers.

The new phase of growth and expansion of the IHU is ambitious and realistic: it can rely on local participants, working with the best worldwide networks in their domains, serving the major societal issues of our time.

2019 IN FIGURES



A MESSAGE FROM THE PRESIDENT OF THE ADMINISTRATIVE BOARD



Michel Vounatsos,
president
of the Liryc Administrative
Board

As a French Director of an international and innovative biotechnology company, I am particularly honored to join the Liryc Institute.

I find within Liryc the same determination and pioneering approach to advancing scientific and medical research on cardiac rhythm disorders as we do for neurological diseases.

I am convinced that innovation and major scientific advances result from the collaboration between academics and private and public partners, through the experience of world class leaders and renewal brought by young investigators. The model of the Institute perfectly brings together these different dimensions.

The diversity and international influence of the Institute, which brings together the best in the discipline, coming from all over the world and united by a common mission, (...)

The diversity and international influence of the Institute, which brings together the best in the discipline from around the world, united by a common mission, provides a cultural richness from which emerge great ideas and innovations that transcend individual policies and interests.

I am inspired by the institute's progress and the new strategic challenges that are opening up, in particular the change in the funding model, the search for new innovative projects and the foundation of new start-ups.

I look forward contributing to this new chapter, and assure you of my commitment to the advancement of research and innovation at the service of the medical and scientific community, and of all patients with cardiac rhythm disorders.

* Heart Rhythm Society - American cardiac electrophysiology conference

MODELING:
TOWARDS A NEW ELEC-
TROTHERAPY > p12



LIRYC SPIN-OFFS, AT
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PROMISING
NEW
TREATMENTS
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KEY EVENTS



July 3, 2019: LiryC symposium in the presence of top international experts to share advances in research on cardiac rhythm diseases.



August 2019:
1st place in the ranking of the newspaper "Le Point" for the LiryC cardiac rhythmology teams. (This ranking includes 350 hospitals in France).



September 28, 2019: 2nd edition of the LiryC Open Day to raise awareness about research, treatment and prevention of cardiac rhythm diseases, in the presence of Olympic champion Jean Galfione.



October 4, 2019: Creation of the start-up CERTIS Therapeutics, which designs innovative software solutions for the treatment of cardiac diseases, resulting from the research performed at the institute.



October 14 & 15, 2019: Atrial Signals conference organized by LiryC, which brought together a hundred international experts, to assess the state of the art on technological developments in electrophysiology.



AGENCE NATIONALE DE LA RECHERCHE
ANR

November 2019:
LiryC was confirmed by the National Research Agency for the next 5 years with the allocation of funding.



HIGHLIGHTS IN 2019



1,378
SCIENTIFIC ARTICLES,
published since 2012 in
high-ranking journals.

- **Advances in the understanding of the mechanisms of ventricular and atrial fibrillation**

- Establishment of two new chairs of excellence: one led by Prof. Peng-Sheng Chen, from the Krannert Institute of Cardiology (USA) on ventricular fibrillation, and the second led by Prof. Matthias Stuber, from CHUV (Lausanne, Switzerland) on cardiac imaging. Continuation of the work of Prof. Stanley Nattel, as part of his chair studying the mechanisms linked to ageing in atrial fibrillation.
- Study of the ionic mechanisms of cardiac heterogeneity and their roles in the initiation and maintenance of ventricular fibrillation.
- Mitochondrial-scale study of the mechanisms of paroxysmal and persistent atrial fibrillation.
- Favorable mid-term evaluation of the ambitious transatlantic Rhythm program, supported by the American Leducq foundation, on the mechanisms of sudden cardiac death.

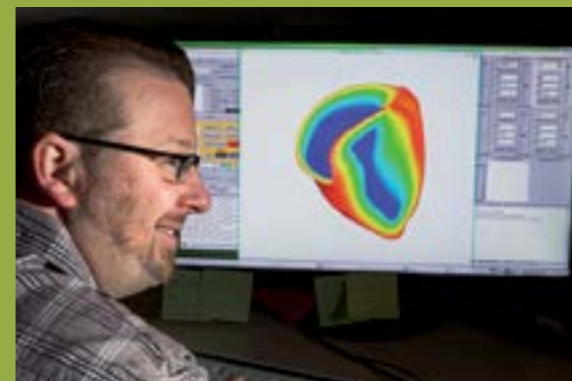
- **Validation and improvement of novel research and clinical tools for improved characterization of cardiac properties**

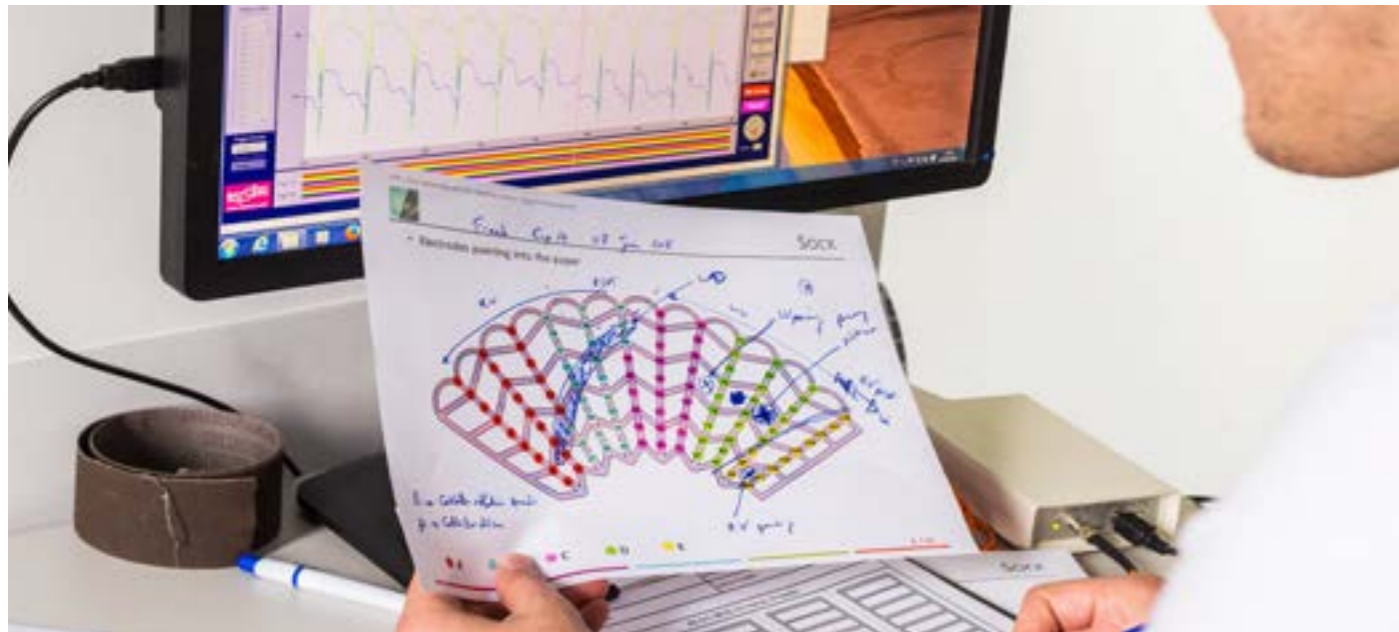
- Development of new approaches for high resolution imaging of the cardiac microstructure, with a unique high-field MRI system (less than 100 micron).

- Validation and improvement of non-invasive mapping techniques, to measure the complexity of ventricular fibrillation, from body surface potential maps.
- Development of a real-time navigation system for catheters and validation of the performance of thermometry methods for catheter ablation procedures.
- Development of a preclinical telemetry platform for real-time monitoring of atrial fibrillation, as part of the UNMASC research project.

- **Research management**

- Structuring of Liryc's teams into 4 major research departments to promote the implementation of translational projects by interaction between the different teams and specialties. These are the modeling, the pathophysiology, the technology for health and the clinical department.
- Site visit of the International Scientific Council as part of the 3rd scientific workshop, to evaluate the 2019 progress report and advise on overall research strategy.





REVIEW OF 5 MAJOR PUBLICATIONS IN 2019

- Ozenne V, Constans C, Bour P, Santin MD, Valabrègue R, Ahnine H, Pouget P, Lehericy S, Aubry JF, Quesson B. **MRI monitoring of temperature and displacement for transcranial focus ultrasound applications.** Neuroimage. 2019 Oct 6;204:116236. doi: 10.1016/j.neuroimage.2019.116236. PubMed PMID: 31597085.
- Nademanee K, Haïssaguerre M, Hocini M, Nogami A, Cheniti G, Duchateau J, Behr ER, Saba M, Bokan R, Lou Q, Amnueypol M, Coronel R, Khongphatthanayothin A, Veerakul G. **Mapping and Ablation of Ventricular Fibrillation Associated With Early Repolarization Syndrome.** Circulation. 2019 Oct 29;140(18):1477-1490. doi: 10.1161/CIRCULATIONAHA.118.039022. Epub 2019 Sep 23.
- Jalal Z, Sacher F, Fournier E, Cochet H, Derval N, Haïssaguerre M, Fernandez ET, Iriart X, Denis A, Ploux S, Pillois X, Bordachar P, Thambo JB. **Right Ventricular Electrical Activation in Patients With Repaired Tetralogy of Fallots.** Circ Arrhythm Electrophysiol. 2019 Jun;12(6):e007141. doi: 10.1161/CIRCEP.119.007141. PubMed PMID: 31113235.
- Duchateau J, Sacher F, Pambrun T, Derval N, Chamorro-Servent J, Denis A, Ploux S, Hocini M, Jaïs P, Bernus O, Haïssaguerre M, Dubois R. **Performance and limitations of noninvasive cardiac activation mapping.** Heart Rhythm 16(3):435-442 (2019).
- Moreno A, Walton RD, Constantin M, Bernus O, Vigmond EJ, Bayer JD. **Wide-area low energy surface stimulation of large mammalian ventricular tissue.** Sci Rep. 9(1):15863 (2019).

RESEARCH

FOCUS ON: THE WAYLESS* PROJECT, MODELING SUPPORTING THERAPEUTIC INNOVATION

the WAYLESS project, a pioneering project in France is developing a new electrotherapy, taking advantage of the cutting-edge computational approach of the modeling teams, to improve the treatment of ventricular fibrillation.

Ventricular fibrillation is the most deadly cardiac arrhythmia, responsible for 50,000 deaths in France every year. Currently, the only effective treatment is electric shock, which restores normal sinus rhythm. This treatment is provided by an automatic (available in certain public places) or implantable defibrillator, in patients at risk. For the shock to be effective against severe arrhythmias, it must be sufficiently strong, which, in addition to being extremely painful, can cause irreversible damage to cardiac tissue.

The WAYLESS project, supported by the National Research Agency, offers the development of a safer and painless alternative to overly aggressive defibrillation of the heart by electric shock.

The WAYLESS project, supported by the National Research Agency and led by the researcher Jason Bayer with Olivier Bernus, Edward Vigmond and Richard Walton,

proposes the development of a safer and painless alternative to the overly aggressive electrical shock defibrillation of the heart. It aims for a new therapy by minimizing the energy necessary to stop a cardiac arrhythmia with a low energy direct current stimulation, administered by surface electrodes strategically placed over large areas of the heart.

The innovation in the WAYLESS approach is in the development a computerized rapid calculation approach to simulate and study fibrillation in a virtual human heart, then to be tested and validated experimentally using an advanced optical imaging approach.

The initial computer simulations have determined that a single low energy pulse <0.1 J, delivered by electrodes to the surfaces of the heart, optimally ended ventricular fibrillation, without causing damage to cardiac tissue. In practice, this has reduced the energy requirement for defibrillation from >20 J to <10 J, but not yet below the human pain threshold of 0.1 J.

At this point, additional research is underway to better understand obstacles to the efficacy of WAYLESS. The project nevertheless brings us closer to the goal of saving lives by already improving the quality of life of patients

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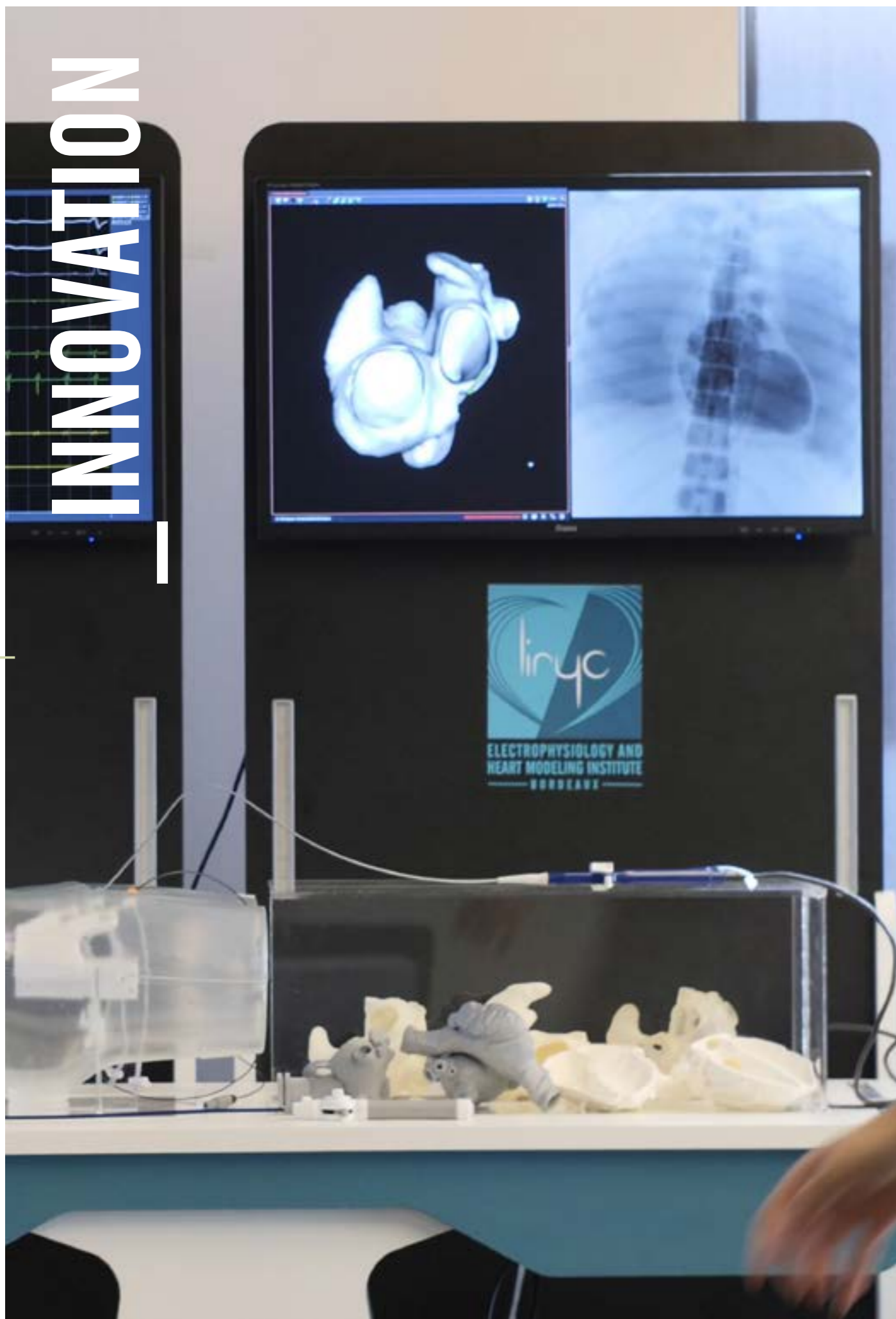
As a clinical researcher, working at Liryc allows me to benefit from a single platform, to better understand congenital cardiac diseases and to improve care for our patients.

”



Zakaria Jalal,
Translational hospital practitioner, congenital cardiopathy, at Liryc.

* WAYLESS: Wide-Area Yielding Low-Energy Surface Stimulation



HIGHLIGHTS IN 2019

45



COLLABORATION AGREEMENTS concluded since 2012 with the industry.

• **Telemonitoring for better treatment of patients with heart failure**

Establishment of a partnership with the Careline Solutions company, based on the data collected. The objective: to use this mass data to be able to identify markers and predictive scenarios of cardiac decompensation*.

• **Launch of the start-up Certis Therapeutics**

CERTIS Therapeutics, launched in October, designs innovative MRI-based solutions for the treatment of cardiac disease, cancers and neurological disorders. Based on Liryc's research work, these solutions allow to optimize the use of existing thermal ablation equipment, for safer and more effective procedures.

• **Validation of phase 1 trials for the drug developed by OP2 Drugs, a spin-off and partner of Liryc**

After a successful phase 1 for the drug OP2113, the start-up OP2 Drugs conducted a computerized phase 2 clinical study to demonstrate its efficacy in myocardial infarction, in collaboration with the FDA (Food and Drug Administration). A world first, before being marketed in the United States in 2023.

• **A transatlantic collaboration to improve therapeutic tools**

Liryc signed a collaboration agreement with the Canadian company Agile MV, specializing in the manufacturing of medical devices. The collaboration with Liryc will permit development of a new type of catheter for the treatment of atrial fibrillation by alcoholization of the vein of Marshall.

• **Prizes and funding**

- InHeart won the 3rd place in the Digital Health category of the European Health Catapult competition organized by the EIT network, which promotes medical innovation in start-ups.
- Certis Therapeutics won the grand prize of the 2019 i-Lab competition, organized by the French Ministry of Higher Education and Research in partnership with Bpifrance. This competition supports projects for the creation of innovative technology companies.
- The StimUS project, for non-invasive ultrasound cardiac stimulation, a project to develop a multimodal optical fiber for the detection of fibrosis, and the SIMRIC electrophysiology simulator project, have received support from the Nouvelle-Aquitaine Council.

• **Conference: discussion about innovation in cardiology**

Along with Michel Vounatsos, new president of the Liryc Administrative Board, the start-ups FineHeart, OP2 Drugs, InHeart and Certis Therapeutics discussed and shared their cardiology innovation experience on December 12.



* Cardiac decompensation: disruption of the balance between the capacities of a weakened heart and the needs of the organism, leading to generalized organ dysfunction.

START-UPS: DRIVING INNOVATION IN CARDIOLOGY

From research project to the creation of the company and its international development. Liryc's spin-offs and partners start-ups participate to medical progress in cardiology. Liryc brought together a hundred researchers and clinicians last December 12 to address these questions, enlightened by the vision of Michel Vounatsos, worldwide CEO of Biogen and new president of the Administrative Board of the Institute.



Start-ups also incite the interest of large groups. Indeed, collaborations with large multinationals in the sector, which are more efficient in improving devices and in-house production can be a solution to a more iterative innovation.

To remove certain obstacles, Liryc's start-ups rely on numerous collaborations and have chosen growth models based on internationalization.

Michel Vounatsos underlined the strength of Liryc's spin-offs and partner start-ups: evolving in a unique environment, in contact with experts from research to patient care, for translating innovation, both into added value for the patient, and into commercial value.

Since the invention of the ECG by Einthoven in the 1890s, innovation - technological or medical - in cardiology has been inspired by the resolution of clinical problems and the development of ideas to the direct benefit of patients. Driven by this design, at the interface between fundamental research and clinical application, spin-offs* and partner start-ups have emerged: OP2 Drugs, InHeart, Certis Therapeutics and FineHeart.

Invited to share their experience at the conference on December 12, the start-ups highlighted the regulatory and financial constraints that have currently significantly increased the complexity of the innovation process, as well as the different steps required to bring innovations to the market.

With 28 billion euros in sales in 2019 in France, start-ups appear to be very creative and sometimes more flexible than certain large multinationals in the sector.



"I met young talent who came from different backgrounds, and I reminded them of the great value to listen to different and contradictory ideas in order to challenge yourself. I've always embraced the diversity of culture and opinion to achieve objectives."

Michel Vounatsos,
worldwide CEO, Biogen

* originated from Liryc's research work



INNOVATION

INVENTING NEW MEDICAL DEVICES,

PARTNERSHIP WITH AGILE MV

Liryc's cardiologists have been pioneers in highlighting the role of the vein of Marshall in the mechanisms underlying atrial arrhythmias and have anticipated the need for novel catheters for the ablation of this specific tissue.

The vein of Marshall, an embryonic vestige, remains largely insensitive to conventional ablation techniques using radiofrequency. An alternative innovative solution proposed by the Liryc clinical team consists in chemical ablation through direct alcohol injection at the vein entrance.

Building on their experience with existing tools and possible improvements, the clinicians Drs. Derval, Pambrun, Duchateau, Denis and Jaïs have conceptualized innovative catheters.

Once the design was completed and the specifications for these new catheters defined and formalized in a patent application, it was essential to turn to a manufacturer of medical devices for creating the prototypes, which requires very specific skills.

Constructive discussions began with the Canadian company Agile MV, specialized in the manufacture of electrophysiology catheters for many years. It was obvious to Agile MV, as well as to the clinical team, that everyone's skills would be the key to success. Agile MV was responsible for manufacturing the prototypes and the clinical team for their experimental validation.

The partnership started in September 2019 and the first prototypes are eagerly awaited for the start of 2020!

"The strength of this collaboration is the complementarity of skills ! It's a win-win partnership!"

Jean-Luc Pageard,
CEO, Agile



HIGHLIGHTS IN 2019



19.77/20

IS THE GRADE OBTAINED BY THE CARDIAC RHYTHMOLOGY DEPARTMENT, in the assessment of the newspaper Le Point, for its list of the best institutions in France.

- **Bordeaux University Hospital and the Cardiac Rhythmology Department: 1st rank in 2019**

For the 3rd time in the last four years, the Bordeaux University Hospital has been recognized as the best public institution in France in the awards list of the newspaper Le Point. This ranking includes the 350 hospitals in France which treat cardiac rhythm disorders by the installation of pacemakers, defibrillators or ablation.

- **New approaches and new sources of energy to improve procedures**

Liryc's teams are implementing new therapeutic approaches for the treatment of atrial and ventricular fibrillation as part of clinical research protocols such as pulse field ablation (Farapulse) or cryoablation (Adagio Medicals). Other innovative approaches for the treatment of persistent atrial fibrillation, such as alcoholization of the vein of Marshall, are also being explored.

- **1st event of the Referral Center for Hereditary Rhythm Diseases**

The first conference day dedicated to patients welcomed 135 people on March 9, 2019 at Liryc. This event is an opportunity to put patients in contact with patient associations, to inform them about hereditary rhythm diseases, and to answer questions about their daily life.

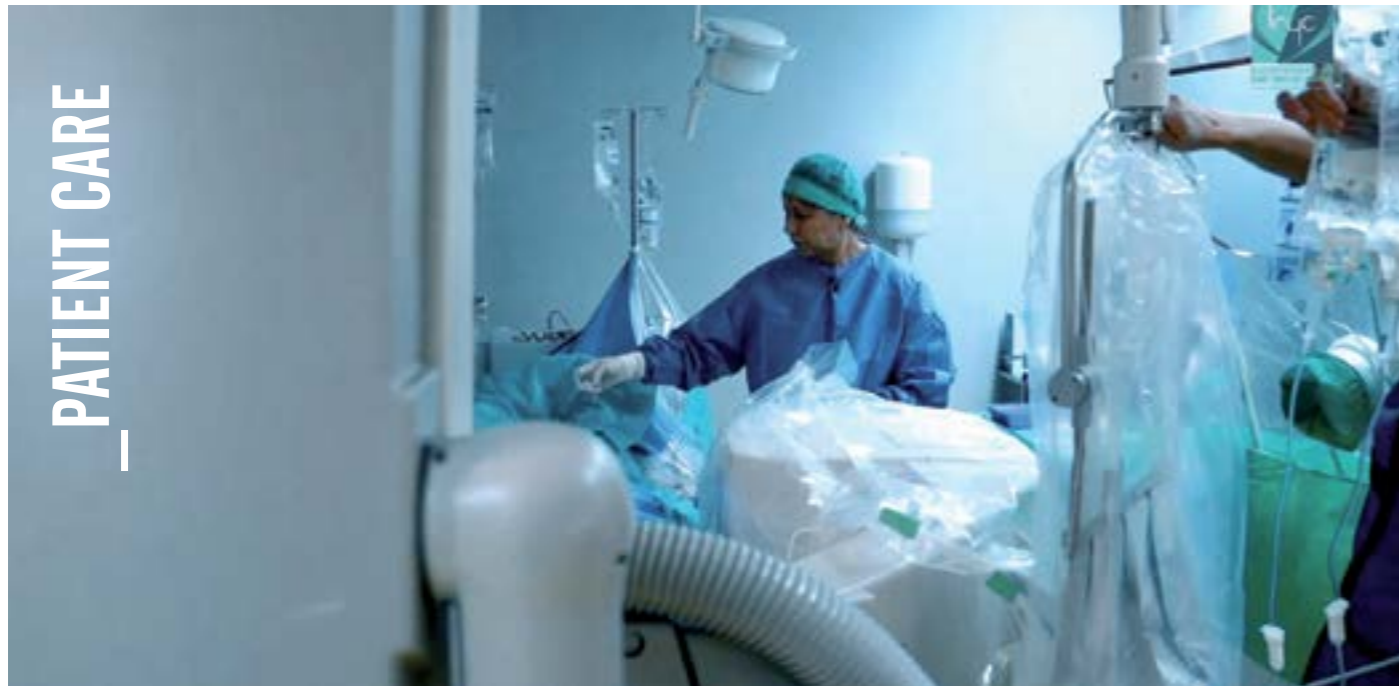
- **5000th patient telemonitored in cardiology**

On March 27, 2019, the teams at the Bordeaux University Hospital include the 5000th patient telemonitored in cardiology. A pioneer in the discipline, the Cardiac Electrophysiology Department of the Bordeaux University Hospital is now the leader, with the greatest activity in France, all specialties combined.

- **The Rhythm-up AOD study extended for one year**

In September, the study led by the paramedical team in the Electrophysiology Department was extended for one year. It will continue to assess the impact of a nurse consultation specialized in the patient's better understanding of their illness and their adherence to treatment. By the end of 2019, the study had included 176 patients (more than 600 visits and 300 specialized consultations).





NEW ENERGIES TO REVOLUTIONIZE THE TREATMENT OF ATRIAL FIBRILLATION

Affecting 1% to 2% of the world's population, atrial fibrillation is the most common arrhythmia. Despite progress made over the past 20 years, challenges remain in improving the safety and efficacy of treatments.

Liryc clinicians identified the sources of atrial fibrillation in the 1990s, allowing the development of a treatment: a catheter ablation procedure. Currently, radiofrequency (RF) is the most commonly used form of energy in these ablation procedures.

These procedures eliminate sources of arrhythmia and restore sinus rhythm. However, the intervention is lengthy and has a limited success rate, too often requiring repeated procedures. To increase the efficacy of these procedures, new ablation methods are being tested at Liryc as part of clinical trials.

Cryoablation has been used in routine practice for more than 10 years. However, the temperatures generated by the technology are

quite modest, and the effectiveness is similar to that of radiofrequency. Liryc researchers are currently testing,

with a start-up, a more powerful cryoablation, which can freeze the targeted tissue at -196°C using pressurized nitrogen. A circular catheter specifically developed for this purpose is placed around each pulmonary vein, and the tissue in contact with the catheter cools and necroses. Cryoablation would allow a shorter ablation time and a simplified procedure.

Pulsed field ablation has been used in oncology for 20 years and very recently for cardiac ablation. 2000V pulses are transmitted repeatedly for a few microseconds in a very precise sequence. The pulses open nanoscale pores in the membrane of the heart cell, leading to its rapid destruction. Cardiac cells are very sensitive to these pulses, unlike cells in other organs in direct contact with the heart. This sensitivity allows to selectively injure cardiac cells. The lesions also seem to be more durable over time, making it possible to considerably reduce repetition of the procedures.

Liryc is among the few centers in the world to test these very promising energies for improving treatment of the greatest number of patients and for the benefit of health systems.

FOCUS ON: THE REFERRAL CENTER FOR HEREDITARY RHYTHM DISEASES AND PREVENTION OF SUDDEN DEATH

Certified in 2017, the Referral Center for Hereditary Rhythm Diseases brings together the multidisciplinary skills of a medical team specializing in hereditary rhythm diseases and the prevention of sudden death. This center, a member of the Cardiogen* network, is at the interface of treatment, with overall patient management, research and prevention.

Located within the Bordeaux University Hospital, the referral center treats patients with hereditary rhythm diseases (Brugada syndrome, long QT, arrhythmogenic dysplasia of the right ventricle, etc.) and patients at risk of sudden death. Its aim is to improve the management of these patients, in particular by optimizing access to diagnosis.

As such, the center is very involved in the implementation of preventive activities through training of physicians, and also through the organization of discussion events with patients.

The first of these professional/patient dialogues gathered 135 people at Liryc to discuss about the diseases and questions of daily life.

The team, led by Prof. Frédéric Sacher, has been working on these topics for several years to better understand these diseases and develop innovative therapeutics. It implements and conducts research or therapeutic trials to establish good professional practices concerning diseases, in liaison with national and international teams working in the same field.

* Cardiogen gathers the various participants in the treatment of hereditary cardiac diseases, with the objective of organization and coordination.

400,000 patients around the world benefit each year from a catheter ablation

“

I participated in the 1st patient information day event in March 2019, because it's important to be informed. It was very reassuring about our daughter's future. We met young patients who had the same challenges and who, despite their illness, got their driver's license, obtained credit to buy housing, etc.

”

Ms. F., 50 years old, with cardiac disease, mother of a 20-year-old woman, with the same disease





HIGHLIGHTS IN 2019

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STUDENTS, DOCTORAL STUDENTS,
POST-DOCTORAL STUDENTS, AND
FELLOWS welcomed in 2019 at
Liryc to be trained by researchers
and clinicians.

- **A success for the 1st edition of the "CARDIAC EP" Summer School**

The Summer School welcomed 42 international students in July 2019 for 5 days of intensive training, given by the world's leading experts in the field.

A success which opens the way to 3 different Summer Schools in the coming years.

- **Launch of the University Diploma for Telemonitoring of implantable cardiac devices**

16 participants attended this first edition of the University Diploma. This new course is entirely dedicated to teaching the practical and theoretical bases of telemonitoring of patients with implantable cardiac devices.

- **Participation in the Master Class in cardiology with Stimuprat**

Liryc's teams participated and organized sessions during the Master Class in Cardiology offered for the first year by Stimuprat in June. An event which brought together nearly 150 cardiologists, general practitioners, emergency physicians, technicians and nurses in Bordeaux to discuss clinical cases.

- **Collaboration with the Mayo Clinic for the creation of an international continuing education program**

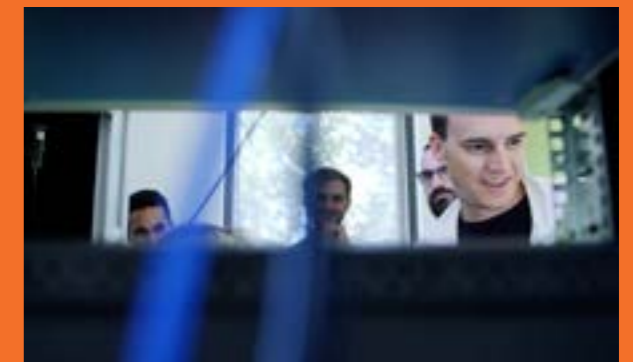
Liryc's teams of clinicians are working with the Mayo Clinic to organize a Bordeaux edition of the Complex Ablation and Device Tracing Summit, a continuing education program offering a unique innovative approach to the management of difficult ablation cases and tracings.

- **Atrial Signals Conference in Bordeaux in 2019**

The 3rd edition of the Atrial Signals conference took place in Bordeaux in October 2019, coordinated by the Liryc teams. The conference brought together one hundred clinicians and engineers to assess technological, diagnostic and therapeutic developments in electrophysiology.

- **Two new continuing education programs in collaboration with the industry**

Two new training programs have been provided at Liryc to train clinicians in innovative medical devices, with the collaboration of the industry. The "Microport academy" is intended to apply the knowledge of cardiac stimulation algorithms and Microport defibrillators in actual cases. "MelodyTM" by Medtronic is dedicated to training in implantation of the pulmonary valve prostheses through the transcutaneous venous route.





FOCUS ON: THE ATRIAL SIGNALS CONFERENCE, INNOVATION IN ELECTROPHYSIOLOGY BETWEEN ENGINEERING AND THE CLINIC

TRAINING AND EDUCATION

A hundred international professionals gathered in Bordeaux last October 14 and 15 for the 3rd edition of the Atrial Signals conference. This edition, led by the Liryc teams, enabled an encounter between experts from the clinical, physiological and engineering fields of atrial fibrillation.



The field of electrophysiology and catheter ablation is rapidly evolving, with profound changes in indications, techniques and technologies, requiring constant adaptation by professionals. The Atrial Signals conference fits into this context by offering discussions on the mechanisms that lead to atrial fibrillation or on controversies in therapeutic management and new technologies.

The sessions provided access to the best up-to-date scientific knowledge: imaging and modeling, medical devices and pharmaceutical approaches, catheter ablation and new therapeutic interventional approaches.

The conference, which brought together over a hundred international professionals for two days, is of interest both to engineers, who develop methods to extract information from signals, displaying information, and clinicians and biomedical scientists, who then interpret that information.

This Bordeaux edition, provided by the Liryc teams, is a new opportunity for exchanges between peers, with the ultimate aim of improving patient care.

24 – A SUMMER SCHOOL TO MEET INTERNATIONAL EXPERTS IN ELECTROPHYSIOLOGY

The first cardiac electrophysiology Summer School brought together 42 international students for a week of intensive training, combining research and clinical practice, and meeting the top electrophysiology experts in the world.

Liryc offered the first edition of its Summer School from a perspective of multidisciplinary, capitalizing on a state-of-the-art experimental platform and equipment. The training program was constructed to treat all aspects of electrophysiology, attracting participants from various backgrounds in the field: modeling and engineering, research and clinical.

The different sessions provided for 5 days alternating theoretical approaches, practical workshops, simulations and "live case" broadcasts, bringing fundamental and clinical science together.

Another key point of the program, widely acclaimed by the students, was a limited format, which allowed them to be in close proximity in discussions with the 21 speakers, all internationally recognized experts.

Building on the success of this first edition, Liryc will renew the program, and will also expand the "Summer School offer" with two new programs: one on congenital cardiac disease, and another from a more technological perspective on software for the reconstruction of MRI images. This success also encourages the Institute in its desire to become a referral center for worldwide training in electrophysiology.

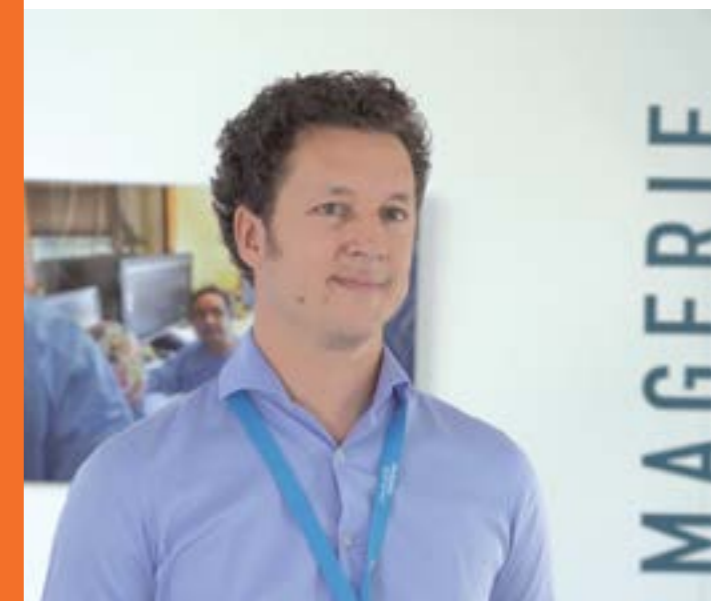


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PARTICIPANTS,
INTERNATIONAL
EXPERTS

" I am honored to participate as an invited professor to the Summer School for cardiac electrophysiology, along with world leader experts in the field, to train the professionals of tomorrow. "

_ Joost Lumens,
invited Professor
to the Summer School 2019





RENEWED CONFIDENCE FROM THE NATIONAL RESEARCH AGENCY

Following the very positive evaluation made by an international jury at the end of its visit, the National Research Agency (ANR) decided to allocate additional public funding of €16M to the IHU Liryc for the period 2020-2024.

The roadmap proposed by the Institute for the next 5 years should enable Liryc to reach the goal of self-funding by 2025.

The ANR will provide 29% of the total funding of the IHU Liryc, necessary for the operation of the Institute over the period 2020-2024. It complements the contributions of the founding members and its own generated resources (research projects, industrial partnerships, training and education, fundraising, etc.).

Convinced of the quality and credibility of the scientific program and the strategic plan, the jury made several recommendations to guarantee lasting success at the IHU Liryc. The roadmap provides for major investment projects, notably in the area of innovation and research, and also in education and training.



" This is great news! It allows us to contemplate the future and the implementation of ambitious projects conducted by Liryc with ease, to reduce cardiac rhythm diseases. This is a very positive signal, which supports our activity and the trajectory taken by the institute towards self-financing. "

**_ Julie
Boussuge-Rozé,**
Executive
Director of Liryc



INTERNATIONAL SCIENTIFIC ADVISORY BOARD

As part of its annual meeting, Liryc welcomed two new members to the International Scientific Advisory Board: Professors Barbara Casadei and Katja Zeppenfeld. Alongside their peers, they will give an opinion on the main scientific orientations of the Institute.



Prof. André Kléber,
Harvard Medical School, Boston, United States

Prof. Michiel Janse,
President of the International Scientific Advisory Board, University of Amsterdam, Netherlands

Prof. Barbara Casadei,
Oxford University, United Kingdom

Prof. Katja Zeppenfeld,
University of Leiden, Netherlands

Prof. Jean-Claude Daubert,
University of Rennes, France

“ Liryc is an excellent institute with the huge advantage of having been actually initiated by clinicians, where basic science joins clinical science in one building. It’s a great opportunity! ”

Prof. Katja Zeppenfeld,
Center for Clinical Electrophysiology, Leiden, Netherlands and Aarhus University Hospital, Denmark

“ Liryc is a center of excellence that allows a unique integration between very dedicated clinicians and researchers. It was a real pleasure to discover an environment that encourages such a level of clinical and basic science. ”

Prof. Barbara Casadei,
current President of the European Society of Cardiology, British Heart Foundation, John Radcliffe Hospital, Oxford, United Kingdom

ADMINISTRATIVE BOARD

The Liryc Administrative Board brings together the founding members, who decide on the strategic directions of the Institute, while exercising control over its management and functioning.

The Administrative Board, renewed in 2019, elected a new president, Michel Vounatsos, worldwide CEO of the Biogen company.

MANAGEMENT



BOARD MEMBERS

- Michel Vounatsos, president
- Manuel Tunon de Lara & Philippe Moretto, Bordeaux University
- Yann Bubien & Jonathan Belcastro, Bordeaux University Hospital Center
- Françoise Jeanson, Nouvelle-Aquitaine Council
- Nicolas Roussel, Inria
- Charlyne Quercia, Bordeaux University Foundation
- Younis Hermès, CNRS
- Richard Salives, INSERM
- Michel Haïssaguerre, Liryc

“ The investment and involvement of founding members and partners have allowed Liryc to realize major scientific advances for better patient care, using innovative techniques and training at Bordeaux practitioners from all over the world. ”



Charlyne Quercia,
General director, Bordeaux University Foundation

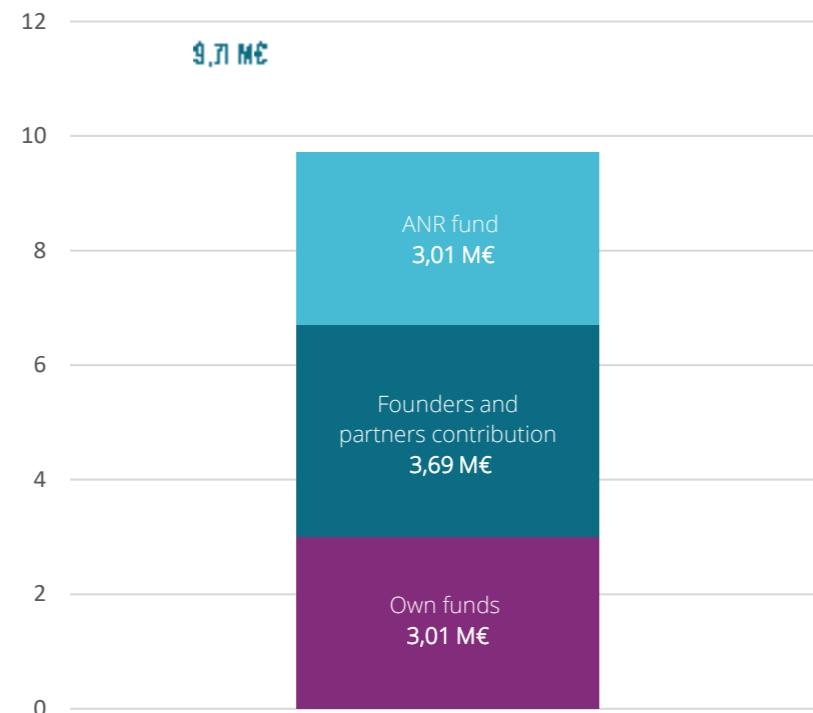
FINANCIAL STATEMENT

The financial statement is presented on the global scope of the IHU. It takes into account:

- Funds managed by the foundation, sheltered by the Bordeaux University Foundation,
- Funds managed by the founding members on behalf of the IHU (both for the ANR agreement and the other research agreements),
- The value of the staff contributions of the founding members and partners of Liryc,
- Its own sources of funding: training, provision of service, industrial collaborations, fundraising and national and international grants.

Funds related to the management of patient care activity are directly managed by the Bordeaux University Hospital.

2019 Income

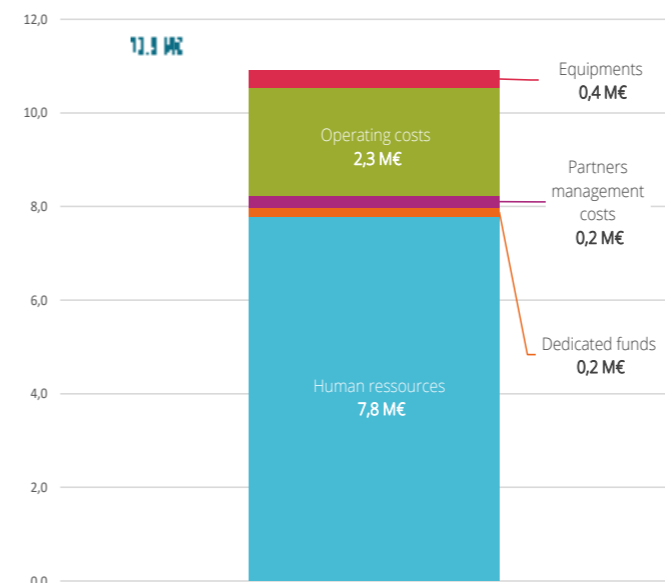


”

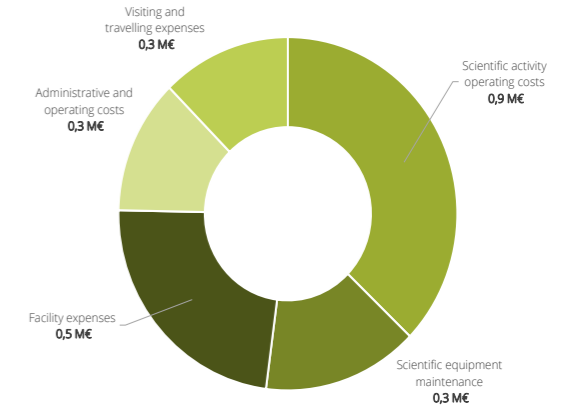
The attractiveness of Liryc, through its state-of-the-art equipment and the expertise of its teams, results in numerous industrial collaboration or service provision agreements, sources of income for the Institute ”

Agnes Chenu,
Valuation manager at Liryc

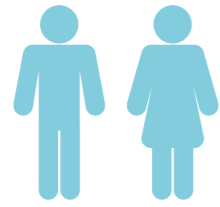
2019 Expenses



Allocation of operating costs (M€)



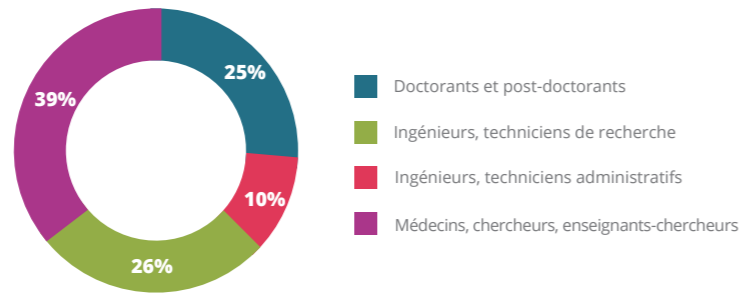
HUMAN RESOURCES



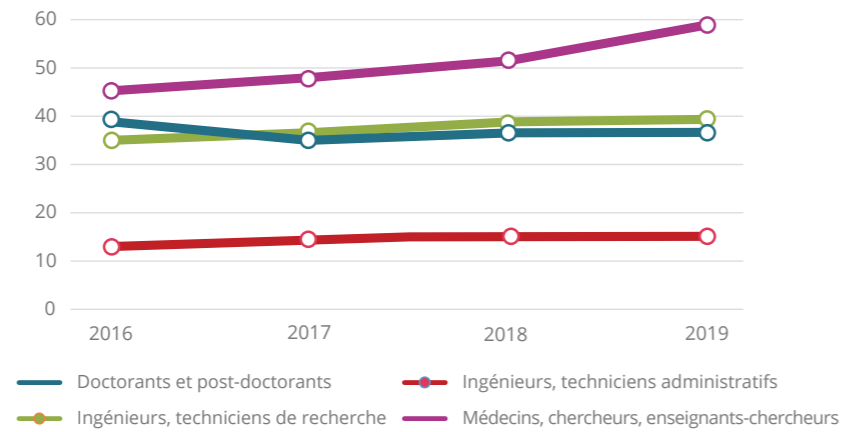
153 WOMEN AND MEN
TOTAL WORKFORCE IN 2019

38 years old
AVERAGE AGE

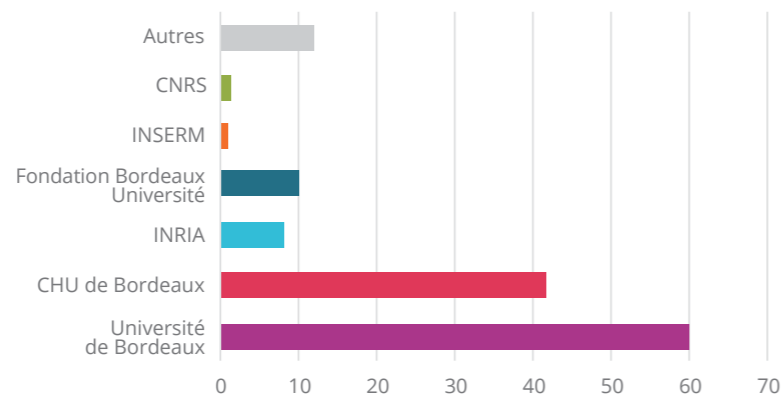
Breakdown of employees by functions



Evolution of staff



Breakdown by main employers

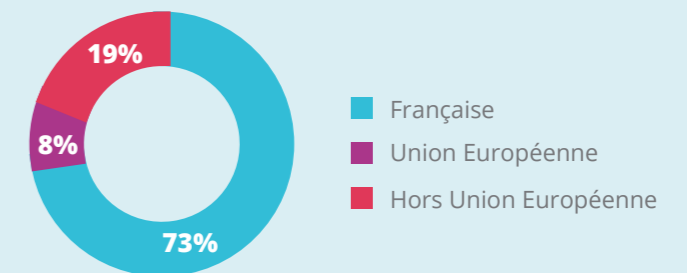


24 NATIONALITIES

- Belgium
- Cambodia
- Cameroon
- Canada
- China
- Denmark
- Spain
- United States
- France
- Greece
- Mauritius
- India
- Italy
- Japan
- Lebanon
- Morocco
- Mexico
- New Zealand
- Netherlands
- United Kingdom
- Switzerland
- Chad
- Tunisia
- Venezuela



Breakdown by nationality

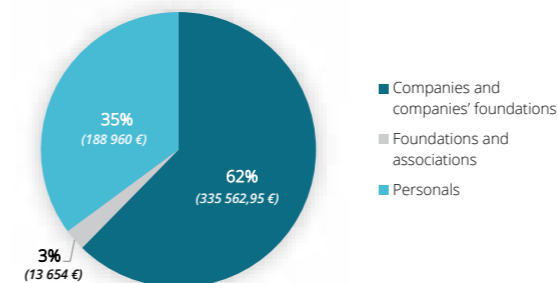




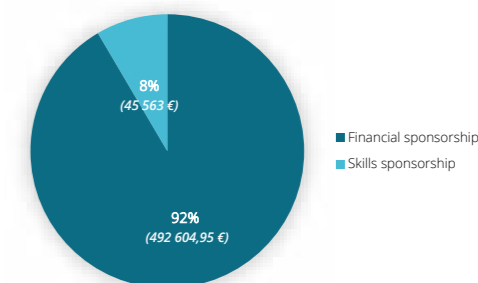
HIGHLIGHTS IN 2019

€ 538,168
OF COLLECTED DONATIONS,
+ 112% increase compared to
the 2018.

• Who are donors ?



• What kind of sponsorship ?



• **General public event: the success of the second Open Day**

Liryç's teams welcomed close to 300 people during the Open Day on September 28 on the occasion of World Heart Day.

Patients or just curious crowd could interact with scientists in research demonstration workshops, raising awareness of life-saving activities. This day, made it possible to discuss the question of the risk of sudden death during sports in the presence of Olympic champion Jean Galfione and Profs Frédéric Sacher and Olivier Bernus.

• **A new edition of the Communications Awards to reward the research work of young researchers and their scientific popularization**

The 2019 competition rewarded Nolwenn Tan, a signal processing researcher, and Thomas Hof, a cell electrophysiology researcher, for their ability to popularize their work in 180 seconds. This competition was organized thanks to the support of a loyal donor. The prizes were presented by Prof. Barbara Casadei.



• **Philanthropic agreement: €1 million to advance research and training**

September 3, Liryç signed a philanthropic agreement with the global medical technology group Boston Scientific for a grant of 1 million euros over 5 years.

• **Development of international philanthropy**

Liryç has set up a "Friend of Liryç" fund with the King Baudouin US Foundation. This fund allows the institute to receive tax-deductible donations from the United States.

An opportunity which allowed Liryç to receive his first major individual gift at the end of the year.

• **A month of generosity to raise awareness of cardiac rhythm diseases**

Liryç dedicated the month of June to several activities in order to increase awareness of cardiac rhythm diseases: conferences for the general public and portrait videos of researchers and clinicians. The initiative allowed to raise €10,000.





Marina Bellouin-Volant,
director and founder of the My
Beautiful Value workshop

A MESSAGE FROM A DONOR

In 2019, Liryç was able to count on the support of Marina Bellouin-Volant, director and founder of My Beautiful Value, who chose the skills sponsorship in order to contribute to the cause of the Institute.

What encouraged you to support Liryç?

Unquestionably it is the influence, geographic, professional, economic and societal of the Institute that most interested me.

Geographic because, based in Pessac, Liryç has an influence beyond regional and national borders. The site and every member working there on a daily basis are multi-profile, multicultural. Professional, because through its research and training projects, Liryç is a referral center of expertise that brings together the top professionals in cardiology. Economic, because Liryç is a business creator. In order for researchers' inventions to become a reality in the medical world, companies are being created, and industries are developing to go from idea to product. And finally, the social influence, because the very mission of the Institute has an impact on us, our society, our health, our well-being.

What strikes you about the mission to reduce cardiac rhythm diseases?

The diversity of cardiac diseases is not well known. Heart failure is troubling problem. And what I find interesting in Liryç's work is that, beyond the medical performance, through information, knowledge, research and prevention, it is possible to relieve

patients and, best of all, to save lives.

Any last comments?

Sponsors and donors are in great demand from many institutions, and giving a direction to their social commitment is difficult. What caught my attention at Liryç was the passion shared across all levels of the institution. The passion for the profession, the passion for research and the passion of patients who benefit from the innovations developed by Liryç. So I would say that becoming a donor of Liryç is helping to fuel this passion. It also means joining a team of the very best professionals, who all have the humility to speak to you as a true member of this community of enthusiasts.

The sponsorship of skills

This involves the provision of staff free of charge during their working time. The company offers, within a specific framework, a free transfer of skills for the benefit of a project, by providing volunteer employees.

Beyond tax deductions, the sponsorship of skills also encourages broadening the environment of the company towards new collaborations.

THANKS TO OUR SPONSORS AND PARTNERS FINANCIAL



Thanks to our donors

Rondro ANDRIAMANDROSO, Gaëlle ANDRIEU, India BANIER, Laura et Marc BAILEY, Frédéric BERGERO, Agnès CHENU, Nicole and Michel CHEVILLET, Nicole DEBOSSCHER, Jean-François DEBROIS, Sylvie DESJARDINS, Gérard DU CREST, Nathalie DROUIN, Hélène and Patrick GAILLACQ, Jean GUILLOT, Guillaume HOUSSET, Hilary KOZIOL, Maryvonne LEON, Maryline LOPEZ, Maryvonne and Patrick MAZURIEZ, Franck McCABE, Françoise MENNECHET, Michel NORMAND, Cathie PLANTIER, Fatima PASQUIS, Philippe PASDOIS, Bernard ROSS, Béatrice VAILLANT, Jeannine VIDAL and to our anonymous donors who support us.

FOCUS ON: THE BOSTON SCIENTIFIC PHILANTHROPIC AGREEMENT, 1 MILLION EUROS TO ENCOURAGE MEDICAL INNOVATION

Innovation and training to improve the treatment of cardiac rhythm diseases is the cornerstone of the philanthropic agreement with the global group Boston Scientific, signed last September 3.



A scientific, industrial and academic partner of the Institute for many years, Boston Scientific joins with Liryc's sponsors today with a support of up to one million euros for 5 years.

This donation will accompany over the years the Institute's strategic plan. It will come in support of research programs, particularly programs on atrial

fibrillation or the chair on cardiac imaging. On the training side, the donation will help organize Summer Schools to train future generations of researchers and clinicians.



Angelo De Rosa,
Vice-president of Rhythm Management,
Boston Scientific

"We have a long-term relationship with the Liryc Institute. In associating with the Liryc Institute, our goal is to support research and development of vital importance, and to contribute to ongoing studies on cardiac electrical problems in order to save lives."

“

The Liryc environment gives us the opportunity to work from the cardiac cell to the patient, in order to advance knowledge together.

”

Fanny Vaillant,
engineer in the bio-energy team
at Liryc

FUNDRAISING AND COMMUNICATION

AWARDS AND DISTINCTIONS

- **Michel Haïssaguerre** received the **Luigi Luciani Electrophysiology Award at Ascoli**, in Italy, on June 22 as a reward for his scientific merit.
- **Pierre Jais** received the **Eli S. Gang Most Innovative Abstract Award** as part of the Heart Rhythm Society's international conference in San Francisco on May 11, 2019.
- **Jason Bayer and Zakaria Jalal** received a **prize from the Rotary District Bordeaux Ouest**, on June 13.
- **Pierre Bour** received a **prize from the Interventional MR Study Group** at the 27th ISMRM annual conference in Montreal.
- **Yingjing Feng** received the **Rosanna Degani Young Investigator Award** at the Computing in Cardiology 2019 conference at Singapore.
- **Jason Bayer and Richard Walton** were winners of a **European Eranet ERA CVD co-funding**.
- **Michel Haïssaguerre, David Besnoit and Bruno Quesson** obtained **funding from the generic AAP ANR 2019-PRC**.
- **Rémi Dubois, Bruno Quesson, Edward Vigmond and Richard Walton** obtained **funding from the Nouvelle-Aquitaine region**.
- **Thomas Hof** received a **scholarship from the Lefoulon Delalande Foundation**.
- **Fanny Vaillant** received **funding from the Crédit Agricole d'Aquitaine Foundation**.
- **Mélèze Hocini** is recipient of the **2019 research grant from the French Federation of Cardiology (Fédération Française de la Cardiologie)**.
- **Bruno Quesson and Dounia El Hamrani** received a **2019 thematic grant from the French Federation of Cardiology**.
- **Pierre Bour, Marion Constantin, Josselin Duchateau, Zakaria Jalal, Alice Récalde and Richard Walton** were winners of **the Liryc 2019 in-house appeal**.

THE PROGRAM FOR 2020

• Support for the collective struggle against the Covid-19 epidemic

Liryc plans to carry out several research and innovation projects within its field of competence to contribute to the fight against Covid-19, in particular the electrocardiographic monitoring of patients on antiviral treatment, the characterization of cardiac damage linked to the virus or even the prevention of rhythm disturbances associated with cardiac sequelae of the virus.

• Implementation of its 2020-2025 strategic plan

The trajectory proposed by Liryc having been supported by the National Agency for Research and the Prime Minister with the allocation of additional public funding, the year 2020 will mark the deployment of its new ambitious strategic plan, in particular with:

- Conducting a large research program on the prevention of sudden death and more generally for a better understanding of cardiac rhythm disorders.
- The construction of a new cardiac bioengineering platform and a future training center with simulators, with the support of the Nouvelle-Aquitaine Council.

• Major structuring of sponsorship and fundraising

The institute should launch at the end of 2020 a major fundraising campaign to raise 10 million euros over a 5-year period, essential for the achievement of the Institute's ambitious program.



Michel Haïssaguerre,
Director of Liryc

“ 2020 is an unusual year for all of us ... it will be up to Liryc to learn from it and to adapt with new working methods and collaborations in our commitment to fight cardiac rhythm diseases. ”



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Electrophysiology and Heart Modeling
Institute

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