_Annual report 2018

ELECTROPHYSIOLOGY AND HEART MODELING INSTITUTE
BORDEAUX

Electrophysiology and heart modeling institute

_Endy Pierre,
Research support technician at Liryc

Front cover: **Nicolas Derval**, Cardiologist, electrophysiology and pacing, University Hospital of Bordeaux.

LIRYC: THE ELECTROPHYSIOLOGY AND HEART MODELING INSTITUTE

Liryc is a unique institute dedicated to heart rhythm disorders. These rhythm disorders are the cause of many cardiovascular diseases which account for nearly a third of deaths worldwide.

Liryc is one of the six University-Hospital Institutes (IHU in French) funded by the government through its Investments for the Future Programme, with the aim of boosting research and medical innovation in France.

Liryc has 4 missions to reduce cardiovascular disease: research, innovation, patient care, and training and education. The goal is to understand the mechanisms underlying cardiovascular diseases, develop therapeutic and diagnostic tools, manage patients, and share the knowledge gained.
Liryc brings together within the same institute researchers, doctors, engineers and mathematicians around patients. These experts, who come from all over the world, work every day to better understand and treat cardiac electrical disorders:

- ***atrial fibrillation***, the most common rhythm disorder, affecting more than 10 million people in Europe,
- ***ventricular fibrillation***, primarily responsible for 50,000 sudden deaths in France each year or one sudden death every 10 minutes,
- ***heart failure*** which affects 9 million people in Europe, including 1 million in France, or 1 in 10 hospital admissions.

Liryc is inventing the therapeutic tools of the future to meet this major public health challenge in a unique technological environment and dynamic ecosystem.

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

_**Manuel Tunon de Lara**, President of the university of Bordeaux

LIRYC: AN ICONIC SUCCESS FOR THE UNIVERSITY OF BORDEAUX

The Liryc Institute is a prime example of success related to scientific rigour, stakeholders' talent and a cross disciplinary approach.

Its story starts with a gamble taken around a small but excellent research team which had to change scope to meet the ambitious challenges it was faced with. Therefore, it is also a story of trust and collective support for a project, its leader and his team, in which each institution played a part.

The creation of this University-Hospital Institute is also symbolic of the dynamics of change which accompanied the foundation of the University of Bordeaux. It was a question of bringing together the strengths of the region, making strategic choices in scientific fields that we could bring up to the highest level, making a change in the offer of training and education, and reconsidering our organisation in terms of international standards.

Finally, Liryc demonstrates our ability to innovate, create start-ups and transfer our best research to industrial partners, with whom we are now developing strong, successful and productive relationships for the region. In the field of health, this is facilitated by our direct relationship with the university hospital, but this ability also exists in other scientific fields at our university, which are themselves outstanding, but sometimes under-utilised generators of innovation.

All these aspects, which, in our eyes, make the Liryc Institute iconic, are transcended by its research objective: a public health challenge which is measured each year in thousands of lives across our country.

Liryc has been structured as a scientific co-operation foundation, under the Foundation Bordeaux University.

Its founding members are the University of Bordeaux, the Hospital University of Bordeaux, Inria, and the Nouvelle-Aquitaine Council. They ensure the Institute's smooth running and support Liryc's strategic direction.

Liryc also has two major academic partners: Inserm and CNRS.

Dotation ANR n°ANR-10-IAHU-04

2018 IN FIGURES

144 members

19 nationalities

10.4 M€ expenditure

_RESEARCH

226 scientific publications

31 projects supported by grants in 2018

1st contributor in terms of abstracts at HRS *

_INNOVATION

14 ongoing patents

2 start-ups

21 ongoing industrial agreements

_PATIENT CARE

3 626 hospital stays

5 660 medical consultations

2 282 surgical procedures

_TRAINING AND EDUCATION

310 professionals trained

23 PhD students

13 training sessions

* Heart Rhythm Society – American conference of cardiac electrophysiology

_Michel Haïssaguerre, Director of Liryc

A MESSAGE FROM THE DIRECTOR

2018 was eventful and I sincerely thank the Liryc teams for their commitment. This year they have again worked their respective fields, with the common goal of improving the treatment of heart rhythm disorders.

In terms of research, Liryc has been able to publish major advances on the causes of unexplained sudden deaths in young people, and propose a new therapeutic concept for atrial fibrillation. This very common arrhythmia will be further investigated through the creation of a new Chair, led by Professor Stanley Nattel, a leading Canadian expert. Emphasis was also placed on medical innovation, with strong industrial partnerships with a view to develop new, more effective and safer solutions for cardiologists and patients. Finally, considerable effort was made to increase the Institute's training and education programmes, and to provide the greatest number of French and international professionals with the knowledge and techniques gained at Liryc.

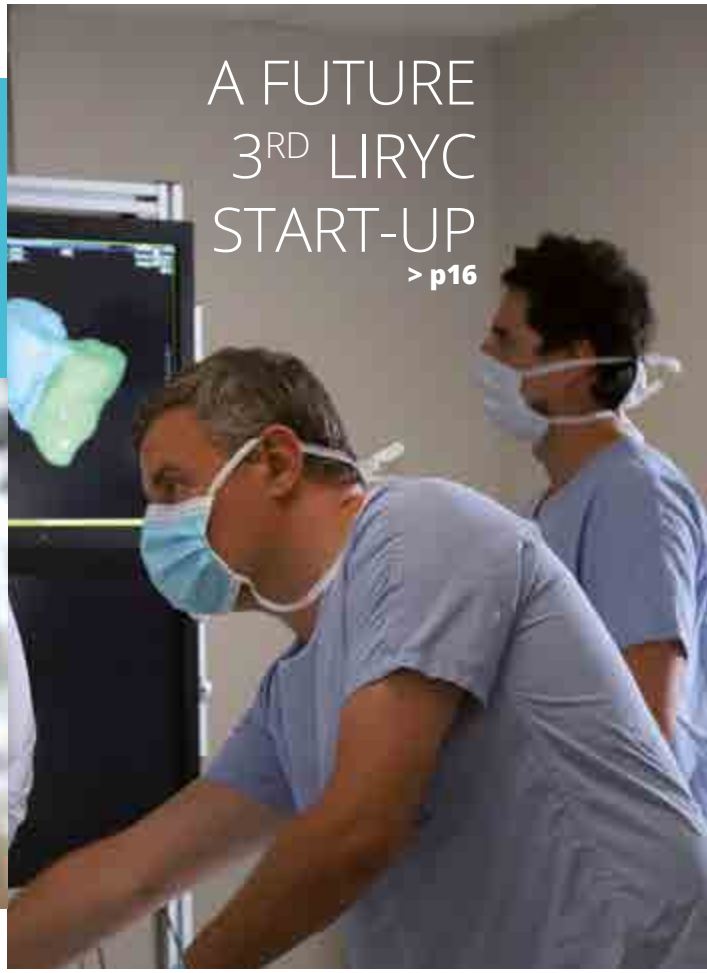
The Liryc teams have again worked in each of their fields, with the common goal of improving the treatment of heart rhythm disorders.

There are still many challenges ahead.
Liryc hopes to provide solutions for major public health issues related to cardiac electrical disorders, and with its partners, to meet the objective imposed on the IHU of becoming self-sufficient.

HIGHLIGHTS

ADVANCES IN RESEARCH ON SUDDEN DEATH BY VENTRICULAR FIBRILLATION

> p12



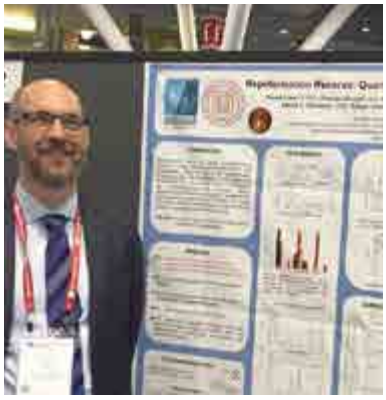
A FUTURE 3RD LIRYC START-UP

> p16

MILESTONES

27 and 28 January 2018:
Presentation of the SIMRIC simulator at the National Health Innovation Days at Cité des Sciences museum in Paris

May 2018:
Welcoming Professor Stanley Nattel from the Montreal Heart Institute for the launch of a new chair on the mechanisms of atrial fibrillation



8 – 11 May 2018:
Annual Heart Rhythm Society's meeting with Liryc the leading contributor of abstracts

* Cadence Project : research program on human hearts made possible thanks to the donation of organs and in agreement with the French agency of Biomedicine

1ST "LIVE CASE" ALLIANCE CONFERENCE AT LIRYC IN PARTNERSHIP WITH BOSTON SCIENTIFIC > p25

IMPLANTATION OF THE 100TH MICRA© MINIMALLY-INVASIVE PACEMAKER > p19

22 June 2018:
Public event "The Human Heart in Music", based around the Cadence* project, on National Day for Reflection on Organ Donation

29 September 2018:
1st open day at Liryc for the Heart Week

19 and 20 December 2018: Annual evaluation and recommandations by the International Scientific Advisory Board

« The list of scientific publications in 2018 reflects Liryc's excellence in the field of cardiac electro-physiology. »

_Olivier Bernus,
Liryc's Scientific Director

RESEARCH: HEADLINES IN 2018

1249
scientific articles, published since 2012 in prestigious journals showing advances made in the field

- **Advances for a better understanding of the mechanisms of ventricular and atrial fibrillation**

- Identification of the involvement of a specific ion channel in ventricular fibrillation. This will subsequently help to determine the link between mutations in patients and Brugada Syndrome.
- Identification of the role of Purkinje fibres in maintaining ventricular fibrillation.
- Welcoming Professor Stanley Nattel from the Montreal Heart Institute to conduct a research programme on atrial fibrillation.

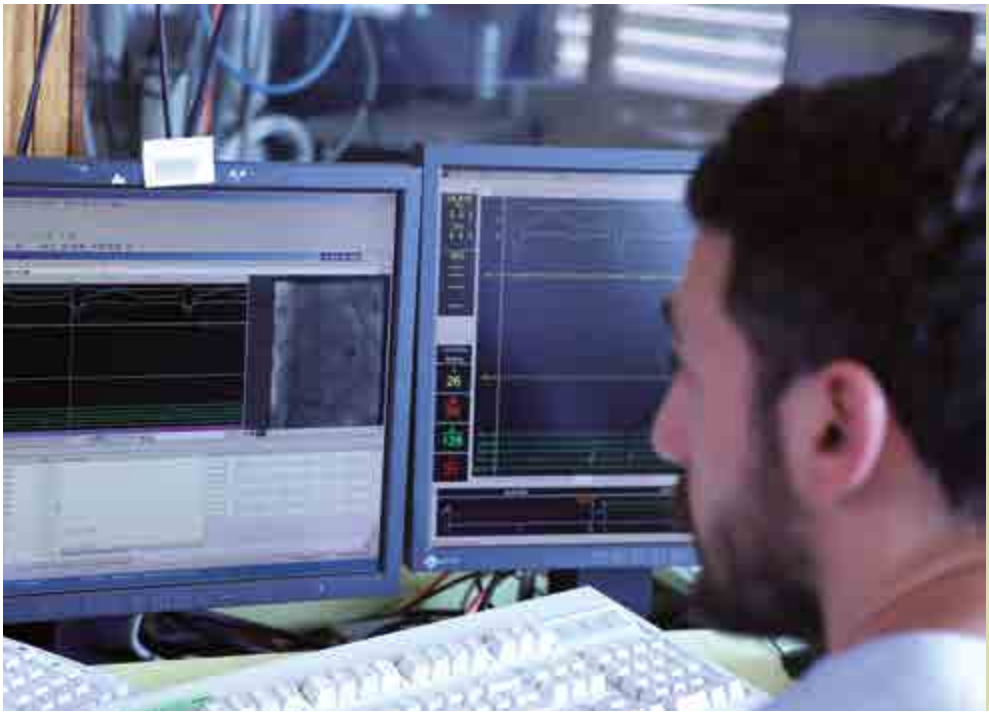
- **Innovative tools to further research and to better understand heart mechanisms**

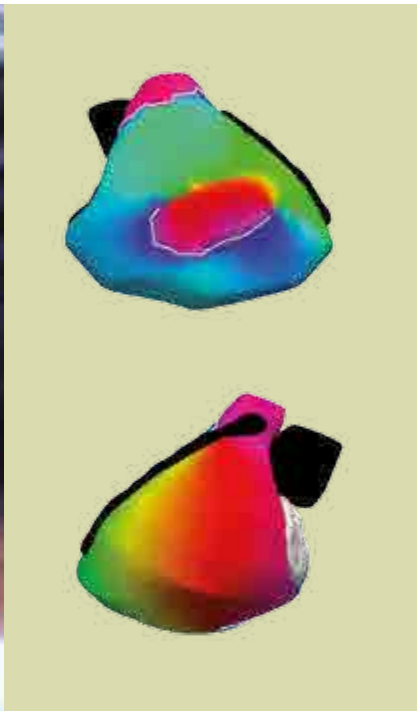
- Partnership with the Institute of Molecular Sciences to develop innovative analytical tools (micro and nano optical and electro-chemical devices) and biophysical approaches to monitor Ca2+ manipulation by isolated mitochondria and cardiomyocytes. These new data will provide better models to describe heart rate.
- High-resolution images of the heart: 3D visualisation (0.2 mm resolution) of fatty infiltration in the heart muscle, which is responsible for changing cardiac electrical properties, and the progression to fibrosis.
- Real-time visualization of catheter position in 3D (every 20 ms), temperature distribution and cumulative thermal dose (at each heartbeat) during treatment by means of an innovative MRI thermometry method, and the intracardiac electrical signals.
- Development of a new experimental device, a closed perfusion system combining the torso with high-resolution optical mapping. The purpose of this tool is to improve non-invasive mapping approaches.

- **Launch of clinical trials**

OP2 Drugs, Liryc's spin-off start-up, has begun a process with the FDA (Food and Drug Administration) for the launch of clinical trials in the United States on the drug OP2113, which is currently, the only commercial medication that specifically inhibits the production of mitochondrial ROS (reactive oxygen species).

- **Continuation of collaborative programmes:** the Leducq Fondation's Scientific Advisory Committee, at its meeting on 17 April 2018, recommended continuing funding for the transatlantic RHYTHM network, consisting of 3 US teams, 2 European teams and 1 New Zealand team. The main objectives of this network are to use a detailed understanding of the mechanisms of sudden cardiac death to identify at-risk patients and to develop new approaches for prevention and therapy.





CLOSE LOOK: ADVANCES IN UNDERSTANDING SUDDEN DEATH IN YOUNG PEOPLE

Ventricular fibrillation is responsible for 50,000 sudden deaths in France each year.

The majority of ventricular arrhythmias occur in association with structural heart disease, but in some young patients, these arrhythmias can occur without an apparent cause. In these cases, ventricular fibrillation is said to be idiopathic.

This advance in the understanding of the mechanisms of sudden death, emphasises that there is still significant progress to be made to develop new diagnostic tools.

Under Professor Haïssaguerre's leadership, Liryc's teams published a major scientific article in 2018 on their advances in understanding so-called idiopathic sudden death in young people.

The clinical trial, described in the publication, focused on 24 young patients who survived idiopathic sudden death.

Trial results

In these patients, the results demonstrated abnormal, recurring and localised electrical activity in one or both ventricles during fibrillation.

It seems that localised cauterisation of these areas prevented recurrence of the arrhythmias.

Moving towards better diagnostic tools

The trial demonstrates that patients who survived a so-called idiopathic sudden death present either localised heart muscle damage, or Purkinje cell disorders, both of which currently elude standard upstream clinical examinations.

This advance, in the understanding of the mechanisms of sudden death emphasises that there is still significant progress to be made to develop new diagnostic tools, especially since these patients could be fitted with an implantable defibrillator, or treated by a procedure.

Localized Structural Alterations Underlying a Subset of Unexplained Sudden Cardiac Death. Circ Arrhythm Electrophysiol. 2018 Jul;11(7):e006120. doi: 10.1161/CIRCEP.117.006120 Haïssaguerre M, Hocini M, Cheniti G, Duchateau J, Sacher F, Puyo S, Cochet H, Takigawa M, Denis A, Martin R, Derval N, Bordachar P, Ritter P, Ploux S, Pambrun T, Klotz N, Massoullié G, Pillois X, Dallet C, Schott JJ, Scouarnec S, Ackerman MJ, Tester D, Piot O, Pasquié JL, Leclerc C, Hermida JS, Gandjbakhch E, Maury P, Labrousse L, Coronel R, Jais P, Benoist D, Vigmond E, Potse M, Walton R, Nademanee K, Bernus O, Dubois R.

A LOOK BACK AT 5 MAJOR PUBLICATIONS IN 2018

Haïssaguerre M, Hocini M, Cheniti G, Duchateau J, Sacher F, Puyo S, Cochet H, Takigawa M, Denis A, Martin R, Derval N, Bordachar P, Ritter P, Ploux S, Pambrun T, Klotz N, Massoullié G, Pillois X, Dallet C, Schott JJ, Scouarnec S, Ackerman MJ, Tester D, Piot O, Pasquié JL, Leclerc C, Hermida JS, Gandjbakhch E, Maury P, Labrousse L, Coronel R, Jais P, Benoist D, Vigmond E, Potse M, Walton R, Nademanee K, Bernus O, Dubois R. **Localized Structural Alterations Underlying a Subset of Unexplained Sudden Cardiac Death**. Circ Arrhythm Electrophysiol. 2018, 11. Doi : 10.1161/CIRCEP.117.006120

Dallet C, Roney CH, Martin R, Kitamura T, Puyo S, Duchateau J, Dumas-Pomier C, Ravon G, Bear LR, Derval N, Sacher F, Vigmond E, Haissaguerre M, Hocini M, Dubois R. **Cardiac Propagation Pattern Mapping with Vector Field for Helping Tachyarrhythmias Diagnosis with Clinical Tridimensional Electro-Anatomical Mapping Tools.** IEEE Trans Biomed Eng, 2018. Doi: 10.1109/TBME.2018.2841340

Martinez ME, Walton RD, Bayer JD, Haissaguerre M, Vigmond EJ, Hocini M, Bernus O. **Role of the Purkinje-Muscle Junction on the Ventricular Repolarization Heterogeneity in the Healthy and Ischemic Ovine Ventricular Myocardium**. Front. Physiol. 2018, 9. Doi : 10.3389/fphys.2018.00718

Strik M, Ploux S, Huntjens PR, Nguyên UC, Frontera A, Eschalier R, Dubois R, Ritter P, Klotz N, Vernooy K, Haïssaguerre M, Crijns HJGM, Prinzen FW, Bordachar P. **Response to cardiac resynchronization therapy is determined by intrinsic electrical substrate rather than by its modification**. Int. J. Cardiol. 2018. Doi : 10.1016/j.ijcard.2018.06.005

Roney CH, Bayer JD, Cochet H, Meo M, Dubois R, Jaïs P, Vigmond EJ. **Variability in pulmonary vein electrophysiology and fibrosis determines arrhythmia susceptibility and dynamics**. PLoS Comput. Biol. 2018, 14. Doi : 10.1371/journal.pcbi.1006166

« As a New Zealand researcher, I feel privileged to be able to work at LIRYC, which is at the forefront of cardiac electrophysiology research. »

_Laura Bear, Researcher, Signal Processing team

« Our goal is to develop, together with our academic and industrial partners, the diagnostic and therapeutic tools of the future. »

_**Rémi Dubois**,
Liryc's Innovation Director

INNOVATION: HEADLINES IN 2018

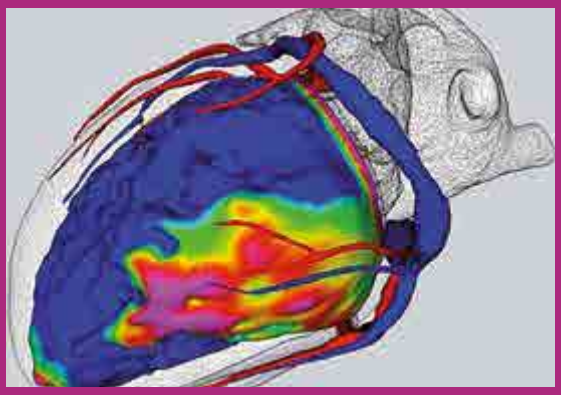
- **Roll-out of the "Strong Push Innovation"** initiative, with a budget dedicated to innovation, including the recruitment of engineers to accelerate the development of projects such as:

- The intracardiac navigation project: catheter guidance system in electrophysiology procedures,

- The StimUS project: development of an extracorporeal cardiac pacing probe as part of the emergency treatment of heart failure.

- **IDEX* funding for the StimUS project:** the Focused Ultrasound Cardiac Pacing project has received support from the University of Bordeaux, which has allocated a "pre-maturation fund" for the purchase of equipment to support the very early stages of the project.

- **A new Liryc spin-off start-up project. The TEMRI project** has received AST** maturation funding to work on its business model for the future company creation.



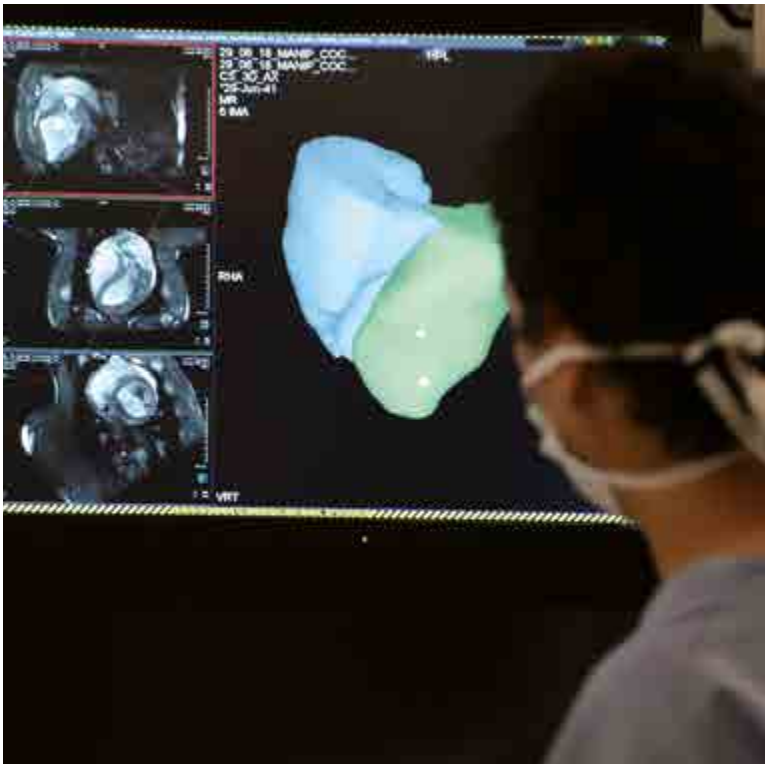
- **Partnership with the local start-up POIETIS** on the development of bioprinted heart valves in paediatric surgery.

- **Liryc's clinical teams are focusing on the role of the vein of Marshall** in cardiac electrical dysfunctions. Two new patents were filed for the development of catheters for ethanol infusion of a new therapeutic target, the vein of Marshall. These new catheters will simplify atrial fibrillation procedures.

- **Simplification of the terms and conditions of industrial** partnerships with single-signature mandates given by the founding partners as part of Liryc's scientific scope to accelerate the signing of partnership contracts and, hence, the development of innovation.

Why have an innovation policy?
Liryc aims to transfer knowledge gained in research to develop innovative technologies to diagnose and treat heart rhythm disorders.

* Program Excellence Initiative of university of Bordeaux. - ** Aquitaine Sciences Transfert, society with the aim to boost technology transfer



A THIRD LIRYC SPIN-OFF START-UP

It is the future Liryc start-up's ambition to guide the clinicians' action in real time and help them assess the effectiveness of the procedure!

In 2018, the TEMRI project, which resulted from Liryc's interventional imaging team's research studies, led by Bruno Quesson, received funding from Aquitaine Sciences Transfert (AST). This investment will consolidate the existing technology and prepare for the creation of a future start-up.

Software for safer and more effective treatment. The standard treatment for heart rhythm disorders, thermoablation, consists of using a catheter to cauterize the areas causing the disorders without the need to open up the thorax.

The interventional imaging team has designed an MRI image acquisition and rapid processing software suite to guide the clinician in the ablation procedure.

The software uses temperature data from the tissue treated during procedures using thermotherapy devices (radiofrequency catheter, focused ultrasound (HIFU), laser, etc.).

Being able to temporally and spatially control the energy dose supplied to the diseased tissue during the procedure is a real breakthrough, ensuring optimal and more effective treatment for patients.

In addition to cardiology, the areas of oncology and neurology could also benefit from these medium-term advances.

STRATEGY FOR ACCELERATING MEDICAL INNOVATION

As part of Liryc's innovation policy, the Innovation Department identifies research projects with strong potential at their earliest stages within the Institute.

A reflection on the commercialisation methods and required funding is initiated as soon as possible, in order to give the project the best chances of success, by interacting with the local, national and international ecosystem.

Because of its innovation budget, Liryc is able to offer complete assistance for supported projects, including seeking additional funding. The Innovation Department also ensures overall consistency between projects in its various relationships with manufacturers.

Clear decision-making processes with its founders and partners allow Liryc to maximise its chances of contributing to the invention of new medical devices for the therapies of the future.

> *« Poietis likes challenges and working with Liryc on this project has been proof of that! »*
>
> **_Fabien Guillemot**, CEO, Poietis

A PARTNERSHIP IN THE SPOTLIGHT: LIRYC-POIETIS, A SCIENTIFIC AND TECHNICAL CHALLENGE!

Professor François Roubertie and his team are working on an innovative therapy, offering patients with heart valve diseases a solution from regenerative medicine as close as possible to native tissue.

A "living" heart valve. This ambitious project to develop a "living" heart valve is the story of a scientific synergy between surgeons from the cardiothoracic cluster and the start-up, Poietis.

The surgeons want to be able to offer their paediatric patients a lasting solution, which current products on the market do not provide. The Poietis teams, specialised in the laser printing of living tissues are ready to invest in this scientific and technical challenge.

Moreover, with a unique platform to design and manufacture bioprinted products for regenerative medicine, the Pessac-based company, has the advantage of being close to Liryc.

It's the story of a scientific synergy between surgeons from the cardiothoracic cluster and the start-up, Poietis

Initiated in April 2018, this partnership primarily aims to show that it is possible to manufacture tissue made up of living cells, whose properties are similar to those of native heart valves, using Poietis' unique expertise and cutting-edge technology. The first results are very promising!

« The medical and paramedical teams care about continuously improving the management of heart rhythm disorders, from prevention to the most innovative therapies. »

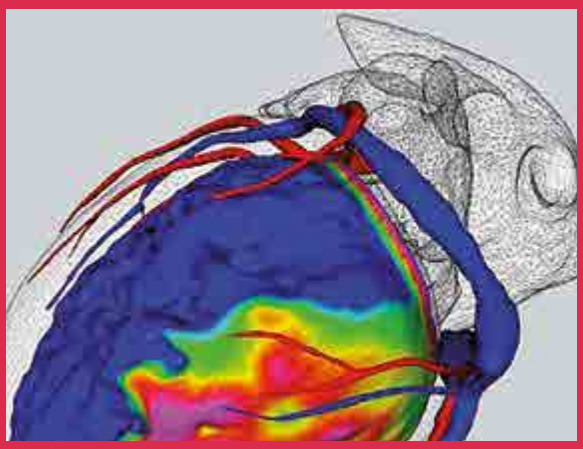
_**Sylvain Ploux**,
Cardiologist,
Pacemaker and
Defibrillation
Department,
University Hospital
of Bordeaux

PATIENT CARE: HEADLINES IN 2018

1057
ablation procedures in 2018. Liryc's teams account for the largest volume of thermoablation procedures in France.

- **Leading cardiology remote monitoring centre in France.**

  On 31/12/2018, the remote monitoring of implantable cardiac devices accounted for 4,768 patients at the University Hospital of Bordeaux and in Aquitaine. Many trials have shown its benefit, both for improving the care pathway, and for patient safety.



- **Implantation of the 100th MICRA© pacemaker at University Hospital of Bordeaux.**

  Liryc's teams fitted the 100th MICRA© pacemaker, sold by Medtronic, on 28 November 2018.

  MICRA is the smallest minimally-invasive pacemaker in the world. Its size is comparable to that of a large pill or one-tenth of the size of a conventional cardiac pacemaker.

  Dr Ritter performed the 1st implantation on a patient in 2014. Since then, a training school opened at Liryc, in partnership with Medtronic, to teach the implantation technique to French and European cardiologists.

- **Launch of the first paramedical clinical trial "Rythm-up AOD"**

  Presented in 2018 at several professional congresses, the trial is measuring the impact of a specialised nursing consultation on the patient's understanding of their condition. The first patients were enrolled in this trial at the beginning of the year.

- **An innovative procedure for the curative treatment of atrial fibrillation: ethanol infusion of the vein of Marshall**

  Liryc's clinicians continue to develop curative ablation techniques for persistent atrial fibrillation beyond the pulmonary veins. This technique consists of injecting ethanol into the vein of Marshall which has the effect of ablating an area irrigated by the vein, increasing the effectiveness of the treatment.

FRENCH LEADER IN REMOTE MONITORING IN CARDIOLOGY

The remote monitoring of implantable cardiac devices started in France in 2001 after the implantation of the first remote-monitoring pacemaker at the University Hospital of Bordeaux.
The hospital is now a leader in the field with an active list of more than 4,800 patients, the greatest number of procedures in France.

What is telemedicine?
Telemedicine is a remote medical practice which uses new technologies to put one or more healthcare professionals in touch with each other or a patient.
In particular, it meets the requirement for safer in-depth cardiac monitoring. Remote monitoring is one of the five telemedicine procedures. It enables a professional to remotely interpret data collected at the patient's home.

How does it work?
Data from the cardiac device is sent regularly, via a remote transmitter, a box placed in the patient's home, to a dedicated website. The telemedicine technicians collect and analyse the data on a daily basis. They submit alerts considered relevant to a doctor for patient management.

And what happens at the cardiothoracic cluster at the University Hospital of Bordeaux?
In the rhythmology department, three doctors and clinical research staff form a team dedicated to implementing and managing remote monitoring.

This activity, praised by both doctors and patients, has become the method of choice for monitoring cardiac devices.

Since 2012, remote monitoring has also been provided to other partner centres, so that they can benefit from Bordeaux's expertise.

CLOSE LOOK: THE "RYTHM-UP" TRIAL, LISTENING TO PATIENTS

The "Rythm-up" trial, conducted by the Cardiology-Electrophysiology Department's paramedical team, started its clinical trial phase in October 2018.

The purpose of this trial is to assess the impact of a specialised nursing consultation on the patient's understanding of their condition and their compliance with medication to improve their care.

How does the trial work?
The trial compares two groups of patients managed by the department for supraventricular arrhythmia with a prescription of direct oral anticoagulants.

The first group follows a standard pathway, while the second group consults with a nurse specialist about their condition and medication. This consultation is guided by a checklist, put together by the paramedical team, mainly based on tools developed with the Bayer pharmaceutical group (question-answer sheets, games, tutorials, welcome booklet).

Expected impact
For the patient, the consultation and availability of the nurse should demonstrate better compliance with the medication, better knowledge of their own condition and a reduction in complications.

22
PATIENTS ENROLLED IN THIS TRIAL IN 2018

It is also a tool to formalise the consultation and is part of optimal patient management, along with an increase in the nursing staff's skills.

In December 2018, there were already 22 patients enrolled in this trial.

« Liryc's research and outreach work is extremely important for patient organizations like AMOC. I thank Liryc and Dr. Hocini for sharing the latest news about research, interventions and patient treatments during medical conferences. »

_Michelle Remignon,
AMOC's President, association of heart diseases' patients.

« The ambition for the next 5 years is to make Liryc THE international reference centre for cardiac electrophysiology training and education. »

_**Pierre Bordachar**,
Liryc's Director
of Education

TRAINING AND EDUCATION: HEADLINES IN 2018

- **Launch of the Cardiocases website** dedicated to cardiac electrophysiology training in partnership with Stimuprat.

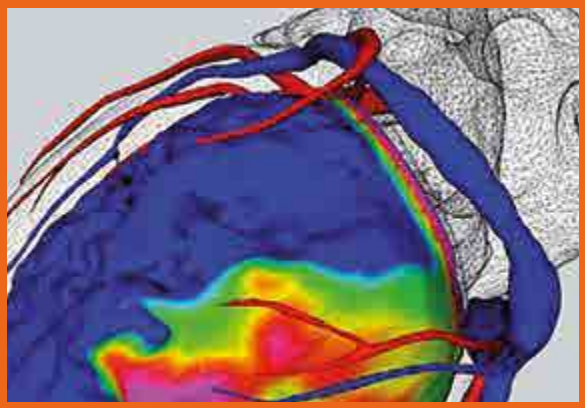
  The website offers free training for health professionals on the essentials of cardiac electrophysiology, surface and endocardial ECG readings.

- **Development of the SIMRIC** (Mechanically Realistic Pedagogical Simulator for Cardiac Interventions) **training simulator**.

  This simulator allows professionals to practice handling catheters.

- **Development of an ambitious training strategy** based on the establishment of a dedicated team.

  This strategy includes a project to launch a University Research School in cardiology with the introduction of an international Masters degree program and an electrophysiology Summer School.



- **Hosting the Alliance Conference at Liryc together with Boston Scientific**, one of the Institute's industrial partners.

  This event brought together nearly 100 European cardiologists for high-level "live case" training sessions on catheter ablation in electrophysiology.

- **Training 128 doctors at the Micra Academy** led by Dr Philippe Ritter.

  The Micra Academy trains French and European professionals in the implantation and monitoring of the smallest, minimally-invasive Micra© pacemaker.

- **8 training sessions with Stimuprat, Medtronic and Abbott** on therapeutic tools and implantable cardiac devices.

88
PhD students
hosted since 2012 who were trained in the best practices in electrophysiology

EXPANDING EDUCATION AND TRAINING

Education and training is one of Liryc's 4 missions. By meeting the objective of transfering knowledge gained within the Institute, through its research, innovation and patient care, we enable the greatest number of patients to benefit from it.

In 2018, Liryc put education and training at the centre of its strategy for university education and continuing professional development. Liryc wants to establish itself as an international reference training centre for cardiac electrophysiology to reflect the excellence of its scientific and clinical studies.

Liryc wants to establish itself as an international reference training centre for cardiac electrophysiology to reflect the excellence of its scientific and clinical studies.

New training tools

To support the increase in education and training activities, the Institute is rolling out new tools and innovative equipment:

- training on educational simulators like SIMRIC*,
- digital training and the digital "cardiocases" library developed by Liryc's cardiologists in partnership with Stimuprat.

Partnership programmes with the University of Bordeaux

Liryc also relies on the University of Bordeaux, a founding member of the Institute, to set up training programmes available by 2019-2020:

- An international cardiac electrophysiology Summer School will be held in the summer of 2019.
- A University Diploma in the remote monitoring of implantable cardiac devices for the 2019 academic year.
- A University Research School in Cardiac Electrophysiology with a Masters' 2 programme in cardiac electrophysiology for the 2020 academic year, which will cover the different aspects of the specialty.

These programmes expand the current continuing professional education, set up with industrial partners (like the Micra Academy, the Stimuprat sessions, etc.) to train international professionals in optimal patient management.

* Mechanically Realistic Pedagogical Simulator for Cardiac Interventions

CLOSE LOOK: ALLIANCE CONFERENCE, "LIVE CASES" TRAINING FOR THE BENEFIT OF MEDICAL INNOVATION

The Alliance Conference was hosted for the first year at Liryc on the 7th and 8th of February 2018.

Approximately one hundred cardiologists from all over Europe met to learn about catheter ablation in electrophysiology.

On the agenda at this training event, set up with Boston Scientific, were practical cases and procedures in duplex, broadcast live to the lecture hall from the hospital's operating theatres.

An interactive conference

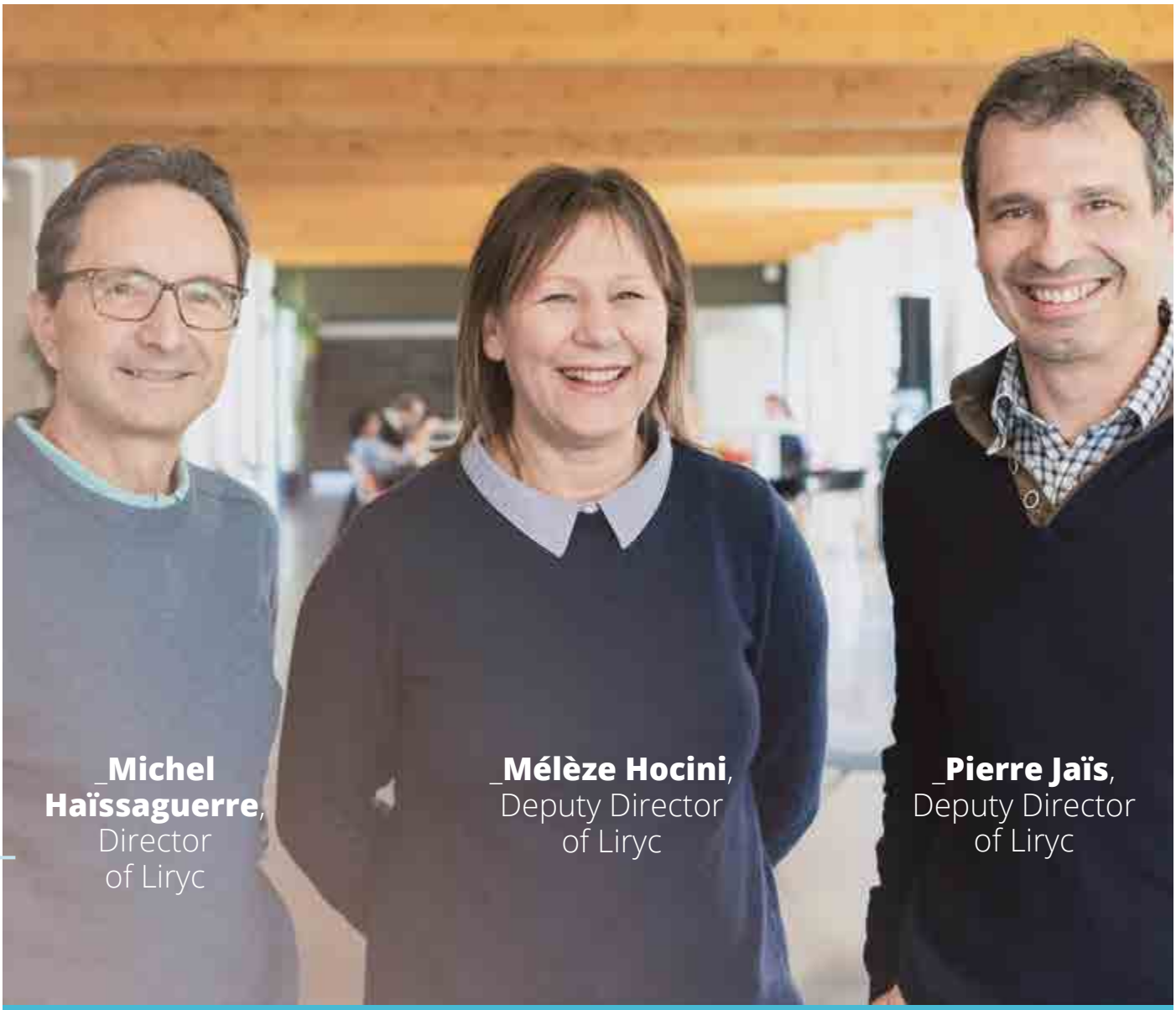
Each year, the Alliance Conference tackles a different key subject in electrophysiology. Open to electrophysiology cardiologists, of any level of experience, it offers participants access to cutting-edge technology through case studies, new therapeutic strategies, and practical advice from experts.

The cases broadcast live from the hospital operating theatres provide a practical demonstration, but also direct interaction with Liryc's clinicians who have a wealth of experience.

The Alliance Conference allows for much more interaction between professionals and experts than at conventional conferences.

« Doing my PhD at Liryc is exciting. It is rewarding to see the beauty of science while solving clinical problems. Each day, I learn something new from professionals from all over the world. »

_Yingjing Feng,
PhD student, researcher,
Liryc's modeling team



_Michel Haïssaguerre, Director of Liryc

_Mélèze Hocini, Deputy Director of Liryc

_Pierre Jaïs, Deputy Director of Liryc

« Liryc operates within a privileged environment, it has strong support on a daily basis from its founding members and close backing from the experts on its International Scientific Advisory Board. »

_Michel Haïssaguerre

INTERNATIONAL SCIENTIFIC ADVISORY BOARD

Liryc's International Scientific Advisory Board is made up of international leaders in the field of cardiac electrophysiology. It provides a critical assessment of the Institute's major scientific direction and its annual scientific programme.

Pr Michiel JANSE,
International Scientific Advisory Board's President
University of Amsterdam, Netherlands

Pr André KLEBER,
Harvard Medical School, Boston, USA

Pr Jean-Claude DAUBERT,
University of Rennes, France

ADMINISTRATIVE BOARD

The administrative board decides on the strategic direction while exercising control over Liryc's management and financial health.

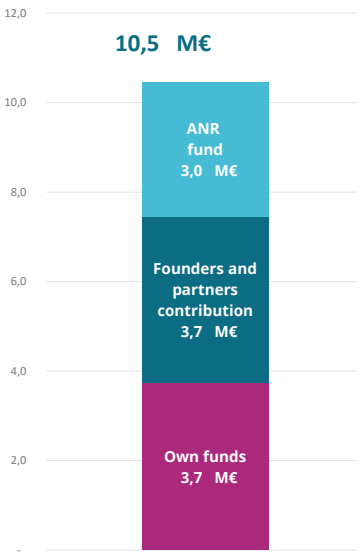
- **Manuel Tunon de Lara & Philippe Moretto,** University of Bordeaux
- **Philippe Vigouroux & Jonathan Belcastro**, University Hospital of Bordeaux
- **Françoise Jeanson**, Nouvelle-Aquitaine Council
- **Nicolas Roussel**, Inria
- **Charlyne Quercia**, University of Bordeaux's foundation
- **Younis Hermès**, CNRS
- **Richard Salives**, INSERM
- **Michel Haïssaguerre**, **Michiel Janse, Alain Ripart,** Liryc

FINANCIAL STATEMENT

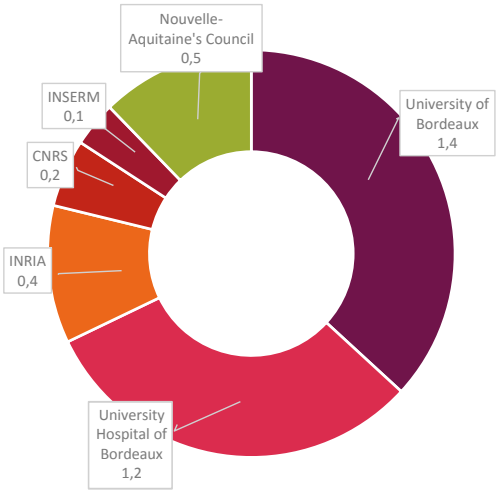
The financial statement is presented for the entire Institute. It takes into account:
- funds managed by the Foundation Bordeaux University,
- funds managed by the founding members on the Institute's behalf (both for the ANR agreement and for other research agreements),
- the value of staff contributions from Liryc's founding members and partners.

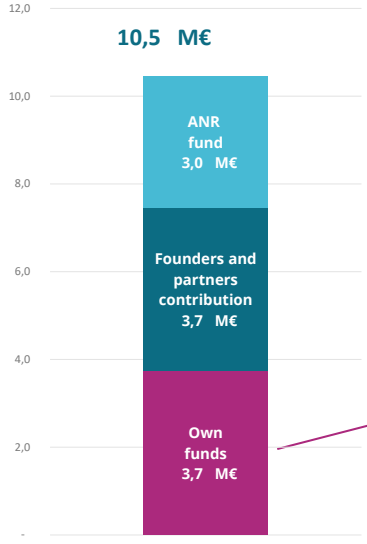
Funds related to patient care are not included as they are managed directly by the University Hospital of Bordeaux.

2018 income

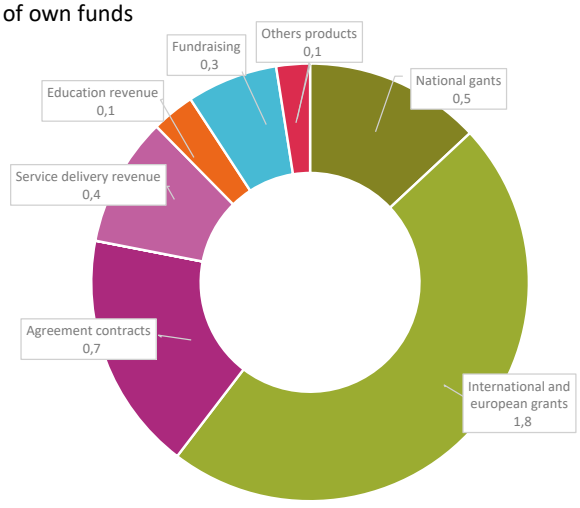


Allocation of founding members' and partners' funds (€)

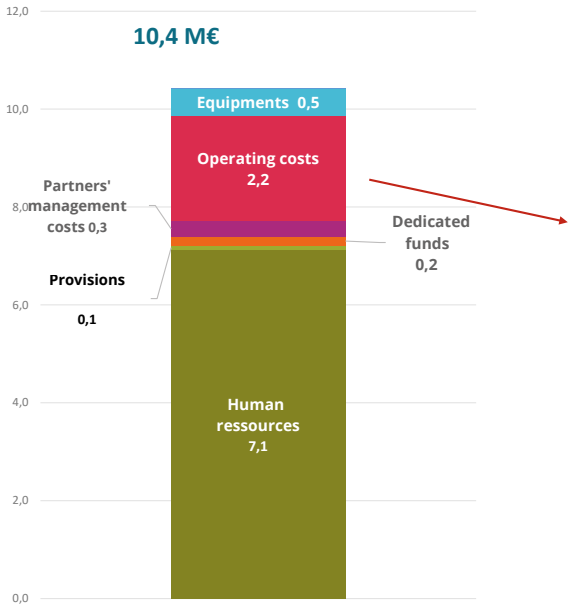




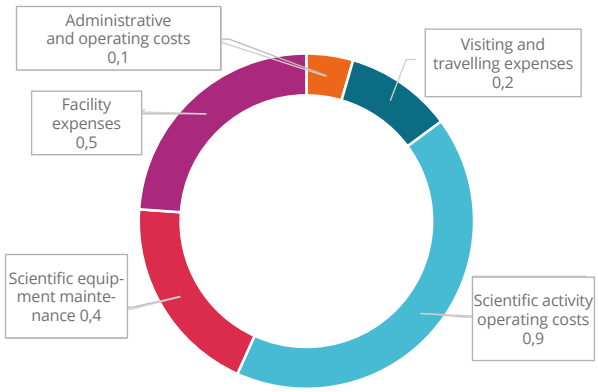
Allocation of own funds



2018 expenses



Allocation of own funds (M€)



HUMAN RESSOURCES

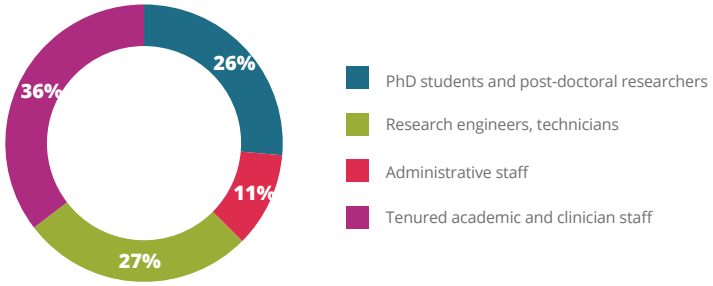
144
MEMBERS IN 2018

59% of men

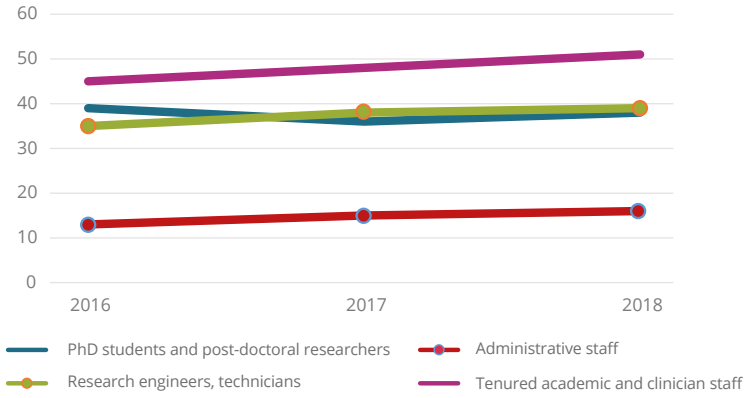
41% of women

35 years
AVERAGE AGE

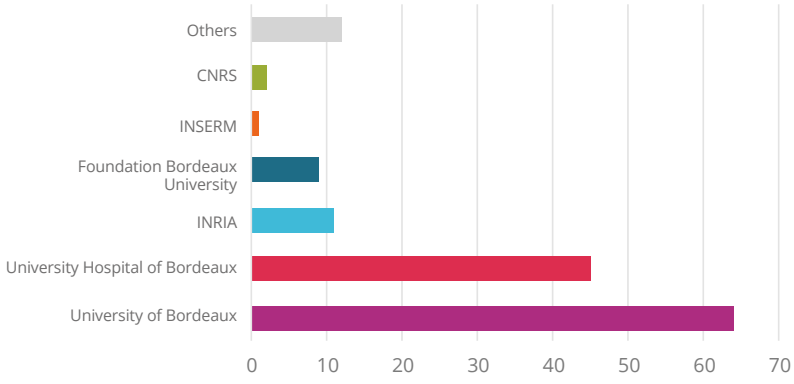
Breakdown of employees by role



Evolution of staff



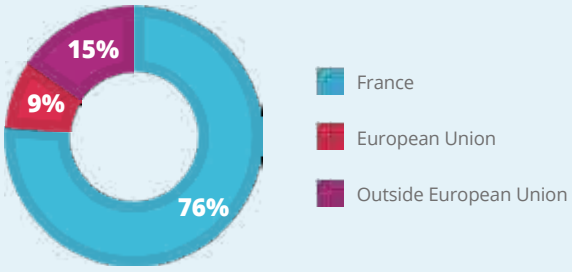
Breakdown by major employers



19 NATIONALITIES

- Belgium
- Cameroon
- Canada
- China
- Denmark
- France
- India
- Italy
- Japan
- Lebanon
- Mexico
- Morocco
- Netherlands
- New Zealand
- Spain
- Tunisia
- United Kingdom
- United States of America
- Venezuela

Breakdown by nationality




« Each euro collected helps in its own way to advance research in cardiac electrophysiology and save lives. »
_Anne-France Contentin,
Liryc's fundraiser

FUNDRAISING IN 2018

2018 marks the launch of fundraising activities at Liryc and the introduction of:

- A logo and a dedicated slogan for fundraising "Open your heart to save hearts" resulting from an internal consultation with employees.

Pour sauver des cœurs
OUVREZ LE VÔTRE*
Liryc
* Open your heart, to save hearts

- New communication materials: brochures, online donations and social networking to create links with future sponsors and inform the Liryc community.

- The recruitment of a full-time fundraiser to support the Director of Development at Foundation Bordeaux University.

In 2018, fundraising accounted for € 253,710.

HEART WEEK: FIRST PUBLIC EVENT

As part of World Heart Day, Liryc organised its 1st event of Heart Week, a heart rhythm disorder awareness event.

The opening of this week was launched by **the "Cœur de Femmes – Femmes de Cœur" conference** which highlighted women in medical research in cardiology. Three women, a doctor, a researcher, and a patient, presented their different perspectives on the characteristics of these still largely unknown disorders, the specific features of their care, and their prevention.

- ***Dr Mélèze Hocini***, cardiologist, Deputy Director of Liryc
- ***Marianna Meo***, a researcher at Liryc
- ***A patient***

The week continued with **the opening of hEARt**, a sound installation by the composer Christophe Ruetsch. A successful collaboration between artists, technicians and scientists, this work explores through "heart portraits", the paradox of the heart both as an essential mechanical pump for valves and as one of the key points of emotions in Western culture.

The week ended with the **1st Open Day**. Liryc invited the general public to meet its researchers and talk to them about scientific and technological advances to better understand the functioning of the heart, and to treat heart rhythm disorders. The day was punctuated by entertaining workshops and innovative stands: cellular, ECG, SIMRIC, inHEART start-up and an introduction to First Aid procedures with the student association Carabins de Bordeaux and i-Share.

THANKS TO OUR DONORS

In 2018, Liryc was proud to be able to once again count on loyal support from M. Jean-François Debrois whose donation is being used to award and encourage young researchers.

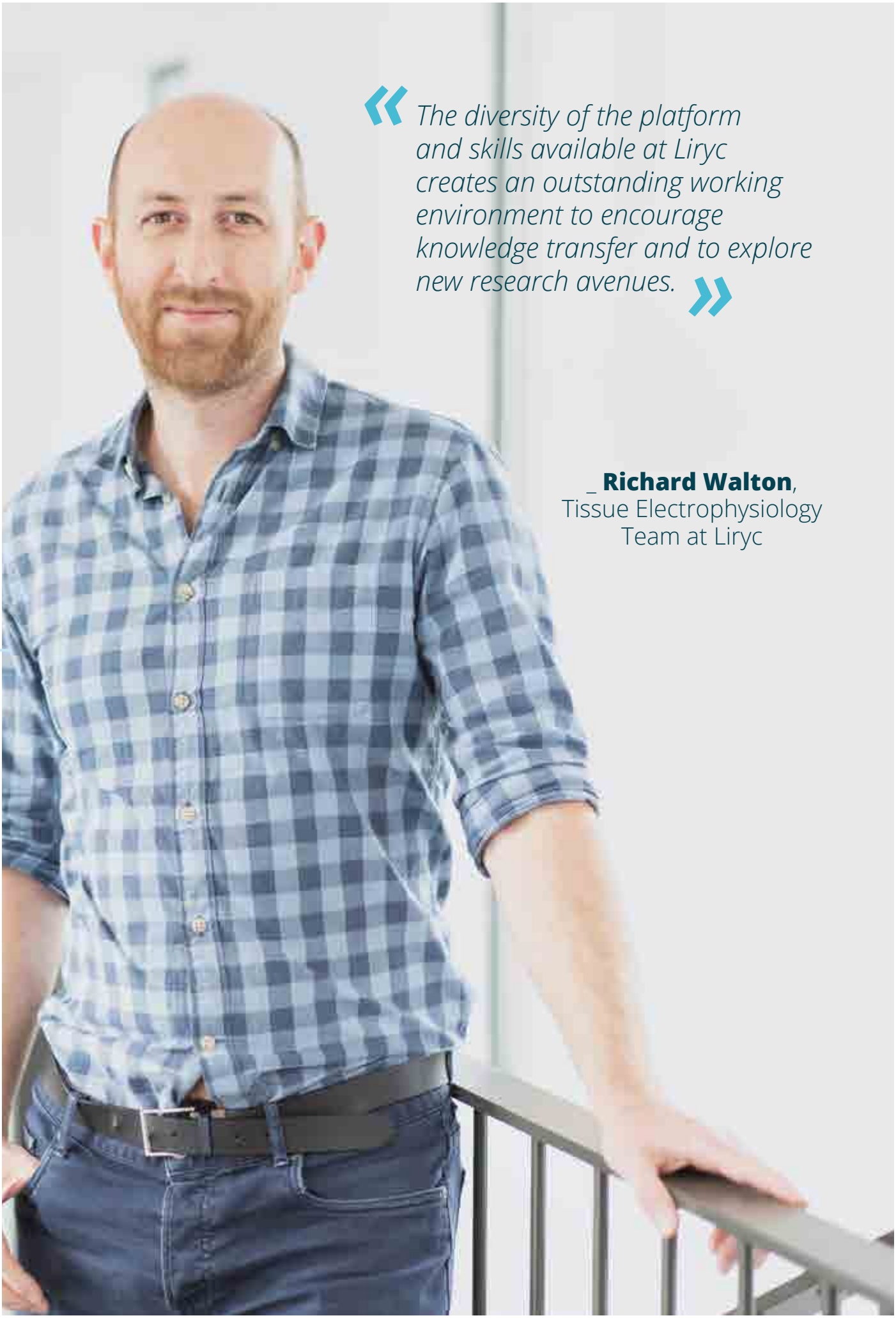
"During my visit, I really liked the Institute and was convinced I had seen science at work for the first time in my life. That is when I decided to make a personal donation. The managers at Liryc then suggested that a part of my donation be used to grant an award to the Institute's young researchers, which I immediately accepted of course. A big thank you to all of you, for the lives you have already at least improved and at best saved... and thank you for all the ones you have yet to save; that's what really moves me. Congratulations on everything you do."

_**Jean-François Debrois**, donor

Thanks to our sponsors:

Thank you to our top individual donors:

Amanda Belle-Isle, Julie Boussuge-Roze, Sonia Brunetaud, Jean-François Debrois, Laurent Direz, Anna Gerykova, Mélèze Hocini, Maryline Lopez, and also to our 14 anonymous donors.



« The diversity of the platform and skills available at Liryc creates an outstanding working environment to encourage knowledge transfer and to explore new research avenues. »

_ **Richard Walton**,
Tissue Electrophysiology
Team at Liryc

AWARDS AND HONOURS

- ***Pierre Jaïs*** was awarded the **"Eric N Prystowsky Lectureship Award"** bestowed during the 2018 HRS Congress in Boston.

- ***Michel Haïssaguerre*** was awarded a research grant by the **Fondation Coeur & Artères**.

- ***Pierre Jaïs*** received **European funding as part of the "Knowledge and Innovation Communities | EIT Health" programme** for the P3 Stroke project, led by SIEMENS.

- ***Marianna Meo, Alice Récalde and Peter Langfield*** were awarded **Fondation Lefoulon Delalande research grants**.

- ***Pierre Bour*** received **the Innovation Prize** for his work focusing on the non-invasive treatment of cardiac arrhythmia with MRI-guided, high-intensity focused ultrasound (HIFU).

- ***Peter Langfield*** was the recipient of the **European Prestige Post-doc Fellowship Programme** for arrhythmogenic risk assessment due to the heterogeneity of repolarization in patient-specific models.

- ***Pierre Bour*** was awarded **the 2017 Thesis Prize by the French Society of Magnetic Resonance in Biology and Medicine and the French Society of Biological and Medical Engineering**.

- ***Richard Walton*** was awarded **European funding as part of a co-Eranet ERA-CVD programme** for his project *to develop a multimodal fibre optic probe for high-resolution, in vivo localization of cardiac fibrosis*.

- ***David Benoist*** obtained **national funding as part of the ANR AAP generic 2018 – JCJC programme**. His project focuses *on the mechano-electrical coupling in the healthy right ventricular infundibulum and pressure overload.*

- ***Edward Vigmond*** received funding from **the Nouvelle-Aquitaine council** for his project on a *new safe and painless method for cardioversion of atrial fibrillation*.

PLANS FOR 2019

- **Final assessment of the Investments for the Future Programme PIA1**

The investments for the Future Programme, launched by the French government, allowed the creation of the IHU Liryc with funding of € 45 million for the 2010-2020 period. An assessment by an international panel will happen at the end this programme and decide whether or not to renew funding for an additional 5-year period up to 2025.

- **International experts are joining Liryc**

Liryc will have the honour of welcoming two internationally renowned professors in 2019 to lead new chairs: Professor Matthias Stuber, of UNIL-CHUV in Lausanne for cardiac imaging, and Professor Peng-Sheng Chen of the Krannert Institute of Cardiology in Indiana for ventricular fibrillation.

- **Launch of training and education programmes**

2019 will see the development of training and education programmes set up in 2018:

- The first electrophysiology Summer School in July; the opportunity to train future generations of scientists and clinicians in the essentials of electrophysiology.
- A university diploma in telecardiology in October, which will share the teams' expertise, as leaders in the field.

- **Major structuring of sponsorship and fundraising**

Liryc will develop an overall strategy to launch a major fundraising campaign. In this context, several public awareness actions will be implemented: generosity month, open days, etc.

« 2019 will be a pivotal year for Liryc with the end of PIA1; it will open up a new chapter for the Institute, building its future by developing all of its activities while addressing the change in its business model. »*

_ **Julie Boussuge-Rozé**, Liryc's Executive Director

* Investments for the Future Programme.

ELECTROPHYSIOLOGY AND
HEART MODELING INSTITUTE
BORDEAUX

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heart modeling institute

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