IBEC ANNUAL REPORT 2017

2017 in review

IBEC ANNUAL REPORT 2017

2017 in review

Contents

Introduction

2017 saw IBEC celebrate its first ten years of research activity, with June's 10th Anniversary Symposium kicking off the celebrations.

By 2017, IBEC had published more than 740 indexed scientific papers, more than half of them in the top decile of high-impact journals. Its group leaders had achieved no fewer than 11 research grants from the European Research Council (ERC), and six of them had support from ICREA, the Catalan Institution for Research and Advanced Studies, with more to come. The institute has coordinated five European or worldwide consortia of EU-funded projects under FP7 and Horizon 2020, as well as being a partner in countless others.

With 23 patents under its belt and three spin-off companies, IBEC can claim such advances as new pancreatic cancer molecules, a drowsiness indicator for vehicles, novel wound-healing particles, and many others in the pipeline. So far 104 PhD students have defended their theses here. Its students and other researchers have gone on to work in prestigious institutions and companies all over the world and have been part of some tremendous scientific advances. These are undeniably impressive feats for a centre that, upon its launch at the end of 2006, was little more than five research groups from the UB and the UPC who had come together to pool their knowledge.

To reflect that 2017 was spent in celebration on our decade of these and other achievements, this Annual Report takes a different approach. It starts with a selection of the highlights of the decade: scientific breakthroughs, institutional milestones and personal bests. Of course, it also contains all the usual facts, figures and highlights of the year in question, too, but this time many of these are presented as 'top tens', not only to reflect the occasion of our tenth birthday, but also because our output is becoming so great that it seems more judicious to select the best of them, rather than allowing this book to get heavier every year.

The Annual Report is still our usual round-up of the highlights and statistics that show that 2017 was another great year in the consolidation of IBEC as a global reference in bioengineering. We joined BIST, the Barcelona Institute of Science and Technology, and gained two new ICREA group leaders, Prof. Silvia Muro and Prof. Paul Verschure. We expanded physically, too, with some groups taking up residence in our new facilities at the UPC's Campus Diagonal-Besòs. 2017 saw the start of the largest European project ever coordinated at IBEC, MECHANOCONTROL, and the institute became part of a multi-million euro 3D printing infrastructure, the Global 3D Printing Hub. We welcomed Edvard Moser, Nobel Prize in Medicine or Physiology 2014, as the keynote speaker at our event "From the Science of Memory to the Future of Neuroengineering", and celebrated the awarding of the Premi Nacional de Recerca al Talent Jove to group leader and ICREA research professor Samuel Sánchez, who, along with Lorenzo Albertazzi, also added to our ERC count during 2017. 74% of our 134 indexed journal papers in 2017 were in the first quartile.

It hasn't all been plain sailing, though. It would be remiss of me not to mention the difficulties in developing and managing research due to administrative constraints, such as changes in the VAT criteria applied to research, new rules of public bidding for consumer goods and scientific equipment, or administrative difficulties in recruitment of personnel. Also, the economic intervention and the cessation of the Catalan government through article 155 of the country's constitution of 1978 inevitably had an impact on the IBEC foundation's activity and on the management of research in Catalonia. I hope that, next year, dialogue and the spirit of democracy, together with a rational criticism of the scientific method, will enable us to engage our society in a new deal.

All in all, though, 2017 was a fitting pinnacle for our first ten years of activity, and we're looking forward to many more anniversaries to come.

Josep Samitier
Director of IBEC

Annual Report 2017
Ten years of IBEC

During 2017, IBEC celebrated its first ten years of scientific activity and the tenth IBEC symposium. Preparing the programme of events and activities and the associated materials involved trawling through IBEC's archives, which helped us collate the following major milestones in the history of the organization.

2007

First Nature paper

X. Trepat, L. Deng, S. S. An, D. Navajas, D. J. Tschumperlin, W. T. Gerthoffer, J. P. Butler, J. J. Fredberg (2007). Universal physical responses to stretch in the living cell. Nature, *447, 592-595*

2008

First Science paper

P. Gorostiza, E. Y. Isacoff (2008). Optical switches for remote and noninvasive control of cell signalling. Science, *322, 395*

First ERC grant won by an IBEC researcher

Pau Gorostiza of the Nanoprobes and Nanoswitches group was awarded a Starting Grant from the then newly-established European Research Council (ERC) to study neurosecretion by remote control of exocytosis and endocytosis with light, one of only 201 successful proposals from 9,167 submissions.

2009

First EU-funded project coordinated at IBEC

BOND, or Bioelectronic Olfactory Neuron Device, proposed a new bioelectronic nose based on olfactory receptors. It was made up of a multidisciplinary European consortium of eight partners.

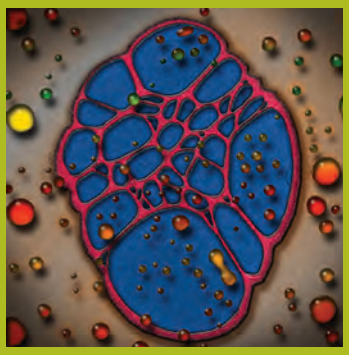
First spin-off

Aleria Biodevices was the first spin-off to come out of IBEC. The company developed tools to measure the electrical activity of neurons *in vitro*.

Nature Physics study sheds light on cell movement

Xavier Trepat found that collective cell mobility is the result of a cooperative process in which each cell contributes to the movement of the group, stretching to those around with a mechanism similar to a tug-of-war.

Trepat, X., et al (2009). Physical forces during collective cell migration. Nature Physics, *5 (6): 426-430*



First joint research unit

IBEC and the Centre de Recerca en Salut International de Barcelona (CRESIB, now ISGlobal) established of a mixed unit of personnel from both institutes aimed at developing diagnostic and therapeutic nanomedicine-based systems to be applied to malaria – the Nanomalaria joint unit.

Plithotaxis: how crowds of cells find their way

IBEC's Integrative Cell and Tissue Dynamics group collaborated with Harvard investigators to come up with a brand new concept in biology, plithotaxis, which describes the way in which each cell pushes and pulls on its neighbours in a chaotic 'dance', yet moving the whole cooperatively in its intended direction.

Trepat, X. & Fredberg, J. J. (2011). Plithotaxis and emergent dynamics in collective cellular migration. Trends in Cell Biology, *21 (11), 638-646*

Start of Tenure Track at IBEC

In 2012 IBEC implemented its Tenure Track procedure, in which existing or new senior researchers are established on a career path that depends on regular evaluation.

2010 2011 2012

Two Nature papers for Nanoprobes and Nanoswitches

In a study published in *Nature Chemistry*, the Nanoprobes and Nanoswitches group and researchers at ICMAB characterized a robust molecular switch in solution that operates at very low voltages, can be 'patterned' by electrical input and has exceptionally high long-term stability, reversibility and reproducibility, offering a very promising platform for use in memory devices.

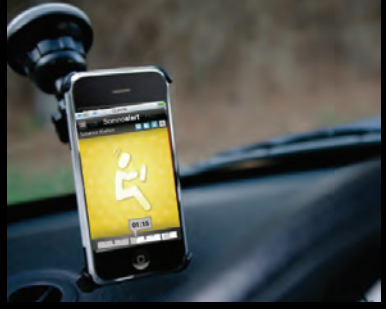
Simao, C. et al. (2011). A robust molecular platform for non-volatile memory devices with optical and magnetic responses. Nature Chemistry, *3 (5), 359-364*

Flick a switch, turn a knob or pull a lever and you're operating an electromechanical device, albeit a complex one. Ismael Díez, a researcher in the same group, broke new ground with a proven concept for the first such electronic component to operate using just a single-molecule electrical contact.

Diez-Perez, I. et al (2011). Controlling single molecule conductance through lateral coupling of [pi] orbitals. Nature Nanotechnology, *6 (4), 226-231*

Heads together with industry to develop driving app

IBEC, UB and industry partner Ficosa joined forces to develop a new technology to combat dozing off when driving. The drowsiness alerter, Somnoalert, is an app that uses inertial sensors and GPS data to detect movements that are characteristic of nodding off at the wheel, such as deviation from the driving lane, or sudden corrections. By 2016, IBEC's Signal and information processing for sensing systems group, led by Santiago Marco, would be proud to see their invention appearing in the new Lexus RX, known as a "Sway Warning", following its commercialisation.



All change at the top

The departure of founding director Josep A. Planell was followed by the appointment of Josep Samitier as new director.

Launch of Core Facilities

The acquisition of the Nanotechnology Platform from the Park Científic de Barcelona was part of the institute's longer-term strategic plan to create new scientific–technical facilities in nanofabrication and bionanocharacterization.

Uncovering a basic mechanism in breast cancer

In a study published in and featured on the cover of *Nature Materials*, researchers in IBEC's Cellular and Respiratory Biomechanics group and London's Barts Cancer Institute demonstrated how the molecules that cells use to attach to their environment, integrins, allow cells to detect and adapt to tissue rigidity, one of the first signs of tumor development.

Elosegui-Artola, A et al. (2014). Rigidity sensing and adaptation through regulation of integrin types. Nature Materials, *13 (6): 631-637*

First IBEC/industry joint unit

IBEC's first joint unit with industry alongside Genomica S.A. was launched in 2014. It is based at IBEC, and aims to develop and bring to market point-of-care diagnostic products and other medical devices and technologies.

2013 2014

Pioneering breakthrough in drugs controlled by light

Pau Gorostiza from IBEC and Ernest Giralt from the Institute for Research in Biomedicine (IRB) had a breakthrough in the development of light-regulated therapeutic molecules. The scientists synthesized two peptides which, on irradiation with light, change shape, thereby allowing or preventing a specific protein-protein interaction. The researchers highlighted the immediate applicability of these molecules to study, for example, *in vitro* endocytosis in cancer cells – where this process is uncontrolled – which would allow selective inhibition of the proliferation of these cells.

Nevola, L., et al (2013). Light-regulated stapled peptides to inhibit protein-protein interactions involved in clathrin-mediated endocytosis. Angewandte Chemie - International Edition *52, 30, 7704-7708*

First functional human 'splenon-on-a-chip'

Scientists from Nanobioengineering and ISGlobal's research centre CRESIB designed the first-ever functional 3D splenon capable of reproducing the function of the spleen – filtering red blood cells. In the study published in *Lab on a Chip*, they described creating a microscale platform that reproduces the physical and hydrodynamic properties of the functional unit of the splenon, or splenic red pulp, including two flow-division channels to recreate the closed-fast and open-slow microcirculations of the blood in the spleen. The device was tested with healthy and malaria-infected human red blood cells, and may serve to investigate potential drugs for malaria and other blood disorders.

Rigat-Brugarolas, L. G. et al (2014). A functional microengineered model of the human splenon-on-a-chip. Lab on a Chip *1410, 1715-1724*

EXCELENCIA SEVERO OCHOA

Severo Ochoa success

2015 will always be memorable as the one in which IBEC received the Severo Ochoa Excellence Award, becoming the nineteenth Spanish centre to do so. The award, a huge milestone in the evolution and consolidation of IBEC, was presented at a ceremony at MINECO in Madrid in July.

HR EXCELLENCE IN RESEARCH

Human Resources Excellence in Research

We received the 'Human Resources Excellence in Research' stamp from the European Commission in recognition of our commitment to continuously improving our HR policies in line with The European Charter of Researchers and The Code of Conduct for the Recruitment of Researchers (Charter and Code). We were one of just ten CERCA institutes to have received the award; in Spain as a whole, only 21 institutions were recognized.

3D bioprinter

With IBEC's acquisition of a 3D bioprinter, the only one with the precision and characteristics required for regenerative medicine purposes in southern Europe and one of very few on the continent, researchers will be able to add biological properties to implanted tissues such as bone, and may eventually be able to manufacture entire organs for transplantation. By offering this possibility to its researchers as well as to companies and scientists across the region and beyond, IBEC stands at forefront of a new revolution in regenerative medicine.

2015

Banc Sabadell Award for Biomedical Research

ICREA research professor Xavier Trepat, leader of the Integrative Cell and Tissue Dynamics group, was named winner of 2015's Banc Sabadell Award for Biomedical Research for his work on understanding the fundamental biophysical mechanisms underlying cell interaction and communication. As a physicist, he was the first ever non-life scientist to win the award.

Genetic "editing" to fight inherited disease

Researchers at IBEC participated in a study that used molecular "scissors" to remove mitochondrial mutations in mouse eggs. In the study, published in Cell, researchers developed a simple technique to eliminate mitochondrial mutations in eggs or embryos at an early stage of development. The researchers focused on two types of molecules – nucleases – that can be designed to cut specific DNA strands and function like a sort of "molecular scissors". A team at the Salk Institute, which led the research, designed nucleases that only cut the mitochondrial DNA in eggs or embryos containing mutations that cause disease, leaving healthy mitochondria intact. Nuria Montserrat contributed the characterization and design of cellular systems used.

Reddy, P. et al (2015). Selective elimination of mitochondrial mutations in the germline by genome editing. Cell *1613, 459-469*

Presenting the fruits of a collaboration

At the MEDICA congress in Germany, GENOMICA presented a new *in vitro* diagnostics device for HPV testing developed by the IBEC-GENOMICA Joint Unit, a tangible success story in the institute's active pursuit of the establishment of research projects with industry partners who share its commitment to bringing high-quality health research and technologies to market and the patient.

Premi Nacional de Recerca al Talent Jove

Samuel Sánchez received the 2016 Premi Nacional de Recerca al Talent Jove (National Research Award for Young Talent) from the Generalitat de Catalunya and the Catalan Foundation for Research and Innovation (FCRI).

Record-breaker

Samuel Sanchez's nanojets set a new world record for the smallest man-made jet engine ever. Samuel and his colleagues and collaborators at the Max-Planck Institute for Intelligent Systems, Germany, and the Harbin Institute of Technology, China, described their bubble-free propelled tubular nanojets which, at 200nm, were a third of the size of their smallest jet engines so far.

Xing Ma et al (2016). Bubble-Free Propulsion of Ultrasmall Tubular Nanojets Powered by Biocatalytic Reactions. J. Am. Chem. Soc. *138 (42), 13782–13785*

2016

Cells move en masse towards rigid tissues

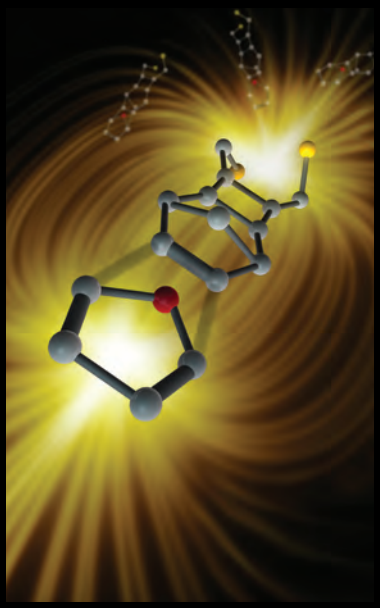
In a study published in *Science*, Xavier Trepat's group showed that several types of cells are attracted to the most rigid areas of tissues. They developed new techniques to create biomaterials with variations in stiffness, and used these to observe which cell groups preferentially moved to the more rigid areas. The larger the group, the more efficient the movement; individual cells were unable to find their way to the most rigid areas. The researchers developed a theory explaining the phenomenon, naming it collective durotaxis, as cells need to physically interact with each other to transmit information collectively in order to move.

R. Sunyer et al (2016). Collective durotaxis cell emerges from long-range force intercellular transmission. Science, *353, 6304, 1157-1161*

Resolution of a long-standing chemistry enigma

Publishing in *Nature*, the Nanoprobes and Nanoswitches group announced one of the biggest breakthroughs of the period with their new way of catalysing chemical reactions by applying an electric field between the reacting molecules. Theory suggested that many chemical reactions – and not just redox (electron transferring) reactions, as is often thought – might be catalysed by applying an electric field, and the study provided experimental evidence for this for the first time.

A.C. Aragonès et al (2016). Electrostatic catalysis of a Diels–Alder reaction. Nature, *531, 88–91*



IBEC investigators show that physical forces activate genes involved in cancer

In their effort to shed light on the role that physical forces play in the body, Pere Roca-Cusachs' group at IBEC showed how these forces 'switch on' the expression of genes that may result in cancer.

Cells apply mechanical forces to their surrounding tissue, and this mechanical effect is crucial for tissue function. In diseases such as cancer or liver and lung fibrosis, tissue rigidity and mechanical forces increase, promoting the progression of the disease.

A. Elosegui-Artola et al (2017). Force triggers YAP nuclear entry by regulating transport across nuclear pores. Cell*, in press*

Light-regulated drugs as analgesics

A study involving scientists from IBEC, IQAC/CSIC and CNRS in France uses light-regulated drugs to alleviate the negative emotions associated with chronic pain.

X. Gómez-Santacana et al (2017). Illuminating Phenylazopyridines To Photoswitch Metabotropic Glutamate Receptors: From the Flask to the Animals. ACS Central Science *DOI: 10.1021/acscentsci.6b00353*

BIST Barcelona Institute of Science and Technology

IBEC joins BIST

The Board of Trustees of the Barcelona Institute of Science and Technology (BIST), presided over by Andreu Mas-Colell, has approved the incorporation of IBEC as a new member.

IBEC will bring its expertise and excellent research in the confluence between biology and engineering to BIST, an initiative of six of Catalonia's research centers of excellence – the CRG, ICFO, ICIQ, ICN2, IFAE, and IRB Barcelona) – to increase their levels of collaboration and build a joint scientific project together. BIST's strength is based on the research capacity of its centers and its potential to promote cutting-edge research projects in multidisciplinary research.

2017

Tissue engineering by decellularization and 3D bioprinting

With IBEC devoted to being the organization in southern Europe that provides 3D bioprinting capabilities to researchers, companies and clinicians, several IBEC groups published a review in the high-impact journal *Materials Today* examining recent progess in de- and recellularization techniques alongside the use of this emerging technology to create promising tissue constructs.

E. Garreta et al (2017). Tissue engineering by decellularization and 3D bioprinting. Materials Today*, 20, 4,166-178*

Cells feel their environment to explore it

The way cells find their way around is by 'groping' rather than seeing their surroundings: this was the main conclusion of a study published in *Nature* involving several IBEC groups and their collaborators.

R. Oria et al (2017). Force loading explains spatial sensing of ligands by cells. Nature*, 552, 219–224*

€7m project to develop therapeutic approaches for cancer

January 2017 saw the start of the largest European project ever coordinated at IBEC, Pere Roca-Cusachs' MECHANOCONTROL, which aims to come up with new therapeutic or diagnostic approaches for cancer and other diseases.

Funded under Horizon 2020's FET Proactive programme, which helps new research communities to be developed by encouraging researchers from different disciplines to work together, MECHANOCONTROL will focus on understanding and controlling how cells transmit and detect mechanical forces.

2017 in review: News

Scientific highlights 2017

January

New DNA-based technique for depositing materials with a resolution of less than 10nm

A study led by CSIC and involving IBEC researchers proposed a new technique using molecules 'a la carte' to obtain nanoscale surfaces that will have many useful applications in microelectronics and biomedicine.

The new method means that researchers can obtain nanoscale surfaces with many molecules arranged in an ordered way.

I. Gállego et al. (2017). DNA origami-driven lithography for patterning on gold surfaces with sub-10 nanometer resolution. Adv. Materials*, 29, 1603233*

Light-regulated drugs as analgesics

A study involving scientists from IBEC, IQAC/CSIC and CNRS in France uses light-regulated drugs to alleviate the negative emotions associated with chronic pain.

In the paper published in *ACS Central Science*, IBEC's Nanoprobes and Nanoswitches group and their colleagues obtained a series of phenylazopyridines, molecules that act on the mGlu5 receptor – one of two brain receptors related to the sensation of pain and negative emotions – that change their structure when irradiated with light, like a switch.

X. Gómez-Santacana et al (2017). Illuminating Phenylazopyridines To Photoswitch Metabotropic Glutamate Receptors: From the Flask to the Animals. ACS Central Science *3(1): 81-91*

Examining epiboly

Daniel Navajas and his colleagues demonstrated a new way to physically regulate concerted cellular movements that might be instrumental for the mechanical control of many morphogenetic processes.

They applied hydrodynamic regression to identify biomechanically active structures and changes in cortex local tension during epiboly, an essential embryonic event in which three tissues coordinate to direct the expansion of the blastoderm, in zebrafish.

A. Hernández-Vega et al (2017). Polarized cortical tension drives zebrafish epiboly movements. EMBO J. *36(1): 25-41*

February

An optogenetic tool that directs cellular contractility using light

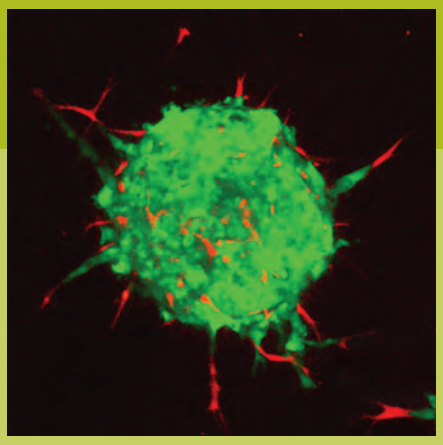
Researchers at IBEC have controlled the contractility of a group of epithelial cells using an optogenetic switch activated by light.

The study, published in *Nature Communications*, explains how this novel technique allows for rapid, local and reversible changes in the forces exerted by cells, as well as tissue contraction.

L. Valon et al (2017). Optogenetic control of cellular forces and mechanotransduction. Nature Communications, *8 ,14396*

How tumor cells hijack healthy cells to promote metastasis

In a study published in *Nature Cell Biology* and supported by Obra Social "la Caixa", researchers at IBEC identified an interaction between two proteins that enables cancerous cells to use the physical forces of healthy cells to start tumor metastasis.



Mixed spheroid (multicellular aggregate) of cancer cells (green) and Cancer-Associated-Fibroblasts (CAFs in red) invading an extracellular matrix. The CAFs are leading the collective invasion of cancer cells through mechanical forces. (Picture credit: Takuya Kato)

Metastasis, responsible for the majority of deaths in patients with cancer, is the process by which cancer cells separate from the original tumor to form new tumors in other organs or tissues of the body.

A. Labernadie et al (2017). A mechanically active heterotypic E-cadherin/N-cadherin adhesion enables fibroblasts to drive cancer cell invasion. Nature Cell Biology*, 19(3): 224-237*

A new therapeutic target that could slow the progression of Parkinson's disease

Researchers at IBEC identified a potential way to slow down the neurodegenerative progression of Parkinson's disease.

They focused their work on the cellular prion protein (PrP^c), a specialized molecule located in the membranes of neurons that's involved in a number of functions such as cell cycle control and neurotransmission. They found that aside from carrying out these functions, PrP^c also binds to and increases the spreading of damaged α-synuclein – the protein responsible for neuronal degeneration and death in diseases such as Parkinson's – between neurons. This points to PrP^c as a possible pharmacological target to slow neurodegeneration in these types of pathologies.

L. Urrea et al (2017). Involvement of Cellular Prion Protein in α-Synuclein Transport in Neurons. Mol Neurobiol*., DOI 10.1007/s12035-017-0451-4*

Highly versatile anisotropic chips

Suspended planar-array (SPA) chips embody millions of individual miniaturized arrays to work in extremely small volumes. Using just one device, we can enter a living cell and make multiple detections of many biological parameters. The Nanobioengineering group demonstrated a robust methodology for the fabrication of these silicon chips using photolithography which dictates their physical anisotropy, while subsequent 2D or 3D chemical modifications extend their functionality by incorporating homogeneous or patterned chemical signatures. The high versatility of the anisotropic chips opens up a vast number of applications for future life science applications.

J. P. Agusil et al (2017). Highly Anisotropic Suspended Planar-Array Chips with Multidimensional Sub-Micrometric Biomolecular Patterns. Adv. Funct. Mater. *27, 1605912*

March

3D printing biocompatible hydrogels

IBEC researchers laid the groundwork for faster advances in 3D bioprinting for regenerative medicine by creating a system of ink and matrices that offers a solid basis for tissue regeneration.

Due to their high water content, hydrogels are highly attractive biomaterials for 3D printing as efficient 'surrogates' for the extracellular matrix, onto which cells can be cultured. However, while they are relatively easy to produce using a method called extrusion printing, their stability and structural integrity can weaken when they're in contact with biological fluids or extracellular matrices.

C. Echalier et al (2017). Modular bioink for 3D printing of biocompatible hydrogels: sol–gel polymerization of hybrid peptides and polymers. RSC Adv.*, 12231*

Screening improvements for asthma and obstructive pulmonary disease patients

Some IBEC research published in *PLoS ONE* offered a step towards better screening of patients with asthma and other sufferers of obstructive pulmonary diseases.

The new integrated approach to continuous adventitious respiratory sound (CAS) analysis, developed by Raimon Jané's Biomedical Signal Processing and Interpretation

group within the framework of IBEC's Joint Research Unit with the Institut d'Investigació Hospital Germans Trias i Pujol (IGTP), improves assessment in the clinic.

M. Lozano-García et al (2017). Novel approach to continuous adventitious respiratory sound analysis for the assessment of bronchodilator response. PLoS ONE *12(2): e0171455*

April

The most efficient single-molecule diode ever made

Researchers at the University of Barcelona (UB) and IBEC created the most efficient single-molecule diode ever.

Diodes are common in everyday electronic devices, in which they control the current by allowing it to flow in one direction while blocking it in the opposite direction. The researchers created one of just 1 nanometer in size with a rectification ratio – the ratio of the current that flows in one direction compared to the other – several orders of magnitude higher than previously.

A. C. Aragones et al. (2017). Single-molecule electrical contacts on silicon electrodes under ambient conditions. Nat. Commun. *8, 15056*

May

A cellular model to help study the relationship between neurodegenerative diseases

From the cells of a patient with a rare neurodegenerative disease, Gerstmann-Sträussler-Scheinker syndrome (GSS), researchers at IBEC have managed to generate neurons that also present parallel neurodegenerative processes unrelated to the syndrome.

The capability to develop cellular models with hallmarks of two unrelated neurodegenerative diseases in the same neurons could help with the study of other neurodegenerative diseases with similar diagnosis, like Alzheimer's.

A. Matamoros-Angles et al. (2017). iPS Cell Cultures from a Gerstmann-Sträussler-Scheinker Patient with the Y218N PRNP Mutation Recapitulate tau Pathology. Molecular Neurobiology, *doi:10.1007/s12035-017-0506-6*

Tissue engineering by decellularization and 3D bioprinting

With IBEC devoted to being the organization in southern Europe that provides 3D bioprinting capabilities to researchers, companies and clinicians, several IBEC groups published a review in the high-impact journal *Materials Today* examining recent progess in de- and recellularization techniques alongside the use of this emerging technology to create promising tissue constructs.

Human donor organs can provide decellularized extracellular matrix (dECM) scaffolds suitable for organ engineering, but what are needed are ways to properly reintroduce cells into these scaffolds and ensure their growth and functional activity.

One option is to use of human pluripotent stem cells (hPSCs) for recellularization, together with 3D bioprinting techniques using organ-specific dECM hydrogels – which offer the correct biochemical and mechanical cues that guide tissue formation – as printing "inks" to fabricate biomaterial constructs that mimic the *in vivo* environment and can be laden with cells.

E. Garreta et al (2017). Tissue engineering by decellularization and 3D bioprinting. Materials Today*, 20, 4,166-178*

Micromotors can remove a wide variety of pollutants in contaminated water

RAB5A induces large-scale, coordinated motility

Dynamics of epithelial monolayers has recently been interpreted in terms of a jamming or rigidity transition. How cells control such phase transitions is, however, unknown. In 2017 Xavier Trepat's group and their collaborators showed that RAB5A, a key endocytic protein, is sufficient to induce large-scale, coordinated motility over tens of cells, and ballistic motion in otherwise kinetically arrested monolayers.

C. Malinverno et al (2017). Endocytic reawakening of motility in jammed epithelia. Nat Mater. *16(5): 587-596*

June

Non-invasive analysis technique contributes to a better understanding of COPD

Some research published in *PLoS ONE* represented a new step towards translating IBEC's basic research – specifically the novel signal processing and interpretation algorithms developed by Raimon Jané's group – to clinical applications in hospitals.

The group collaborated with the Hospital del Mar-IMIM in Barcelona to tackle the current lack of instruments for assessing respiratory muscle activation during the breathing cycle in clinical conditions.

L. Sarlabous et al (2017). Inspiratory muscle activation increases with COPD severity as confirmed by non-invasive mechanomyographic analysis. PLoS ONE *12(5): e01777300*

IBEC at the forefront of research in mechanobiology

Three IBEC group leaders – Pere Roca-Cusachs, Vito Conte and Xavier Trepat – consolidated the institute's leadership in mechanobiology by publishing a review of the field in *Nature Cell Biology*.

Their paper, "Quantifying forces in cell biology", summarizes a wide range of sensors and sensing methods able to quantify the forces generated by cells. During the last two decades, advances in our understanding of these mechanisms have allowed researchers to find out more about cell-generated forces at different scales, ranging from molecular forces – how a protein domain folds – to long-range supra-cellular force patterns such as the ones that govern wound healing or collective cell migration.

P. Roca-Cusachs et al (2017). Quantifying forces in cell biology. Nature Cell Biology, *19, 7*

Micro-swimmers that remove disease-causing bacteria from water

The Smart nano-bio-devices group, together with their collaborators from the Max Planck for Intelligent Systems in Stuttgart, engineered tiny robots that can remove disease-causing bacteria, such as *E. coli*, from water.

Contaminated drinking water is a persistent public health problem that can cause potentially life-threatening illnesses when proper treatment isn't available, as in many areas of the world. It can be disinfected with chlorine or other disinfectants, but some hardy bacteria and other microorganisms stick around and can be hard to remove. Sometimes, the byproducts of these disinfectants can be harmful to human health as well.

D. Vilela et al (2017). Microbots decorated with silver nanoparticles kill bacteria in aqueous media. ACS Applied Materials & Interfaces, *9 (27) 22093–22100*

Xavier Trepat, Raimon Sunyer and Pilar Rodríguez-Franco published in *Nature Materials* this year

July

IBEC research features in ChemComm's "Emerging Investigators" issue

The Nanoscopy for Nanomedicine group's paper in the 2017 edition of *ChemComm Emerging Investigators*, which is published annually by the UK's Royal Society of Chemistry, describes a new way to study the structure and dynamics of nanostructures obtained by the self-assembly of short peptides, which play a pivotal role in nanotechnology and materials chemistry due to their interesting properties and the ease with which they can be synthesized.

Now in its seventh year, the special issue showcases research carried out by internationally recognised, up-and-coming scientists in the early stages of their independent careers, and who are making outstanding contributions to their respective fields.

S. Pujals et al (2017). Studying structure and dynamics of self-assembled peptide nanostructures using fluorescence and super resolution microscopy. Chemical Communications*, 2017, 53, 7294-7297*

Nanoscale imaging method shows electron transfer pathways

An IBEC group developed a new imaging method that can characterize the conductance of single molecules, shedding light on the molecular mechanisms behind biological processes such as respiration, photosynthesis and repair.

The Nanoprobes and Nanoswitches group described a new way to observe conduction pathways in redox proteins and complexes – in which the transfer of electrons causes a change in oxidation – at the nanoscale.

M. López-Martínez et al (2017). Differential Electrochemical Conductance Imaging at the Nanoscale. Small*, 13(36):1700958*

A new model sheds light on cell migration

IBEC's Nanobioengineering group made important inroads in mechanobiology by creating an *in vitro* model of the extracellular matrix that shows how this environment works with protein complex actomyosin – the essential substance that allows muscle to contract – to direct the movement of cells.

The group's paper shed light on cell migration, which is essential for many biological processes such as embryonic development and wound healing when things are going right, and cancer progression when things go wrong.

D. Caballero et al (2017). An Interplay Between Matrix Anisotropy and Actomyosin Contractility Regulates 3D Directed Cell Migration. Advanced Functional Materials*, 10.1002/adfm.201702322*

September

Cell collisions reveal a new type of wave

Researchers at IBEC observed, for the first time, mechanical waves that form after collisions between cellular tissues.

After a collision, cells are pushed and deformed into waves that travel at a speed of three millimeters a day. This unexpected behavior defies what we know about cellular dynamics, and could be relevant to understand embryonic development or metastasis.

Mechanical waves – such as seismic waves, sound, or waves in the sea – are a phenomenon easily explained by the laws of physics: when two particles collide, a wave travels through the surrounding material.

P. Rodríguez-Franco et al (2017). Long-lived force patterns and deformation waves at repulsive epithelial boundaries. Nature Materials*, 16, 1029–1037*

October

An effective strategy for the targeted delivery of new antimalarials

Xavier Fernàndez Busquets' joint IBEC-ISGlobal Nanomalaria group moved a step closer to the validation of immunoliposomes as a vehicle for antimalarial drugs by showing that they increase the efficacy of lipohilic (poorly soluble) compounds in a mouse model of malaria.

The results suggest that this strategy could be used for the treatment of severe malaria.

Most antimalarial drugs currently in the pipeline are poorly soluble in water, and high amounts are needed to ensure their efficacy, particularly in cases of severe malaria.

E. Moles et al. (2017). ImmunoPEGliposomes for the targeted delivery of novel lipophilic drugs to red blood cells in a falciparum *malaria murine model.* Biomaterials*, 145:178-191*

Microswimmers use 'good' bacteria to target harmful biofilms

A paper by IBEC's Smart nano-bio-devices group addressed the problem of biofilms, the "microbe cities" that enhance cell-to-cell communication for bacteria, allowing infection to thrive and increasing the chances of evading the immune system. In the body, they can be found in a wide variety of microbial infections, such as in the lungs of cystic fibrosis or chronic obstructive pulmonary disease patients.

Biofilm colonies are usually resistant to antibiotics and require targeted methods of removal. One method uses nanoparticles as carriers for antibiotic delivery, where they randomly circulate in fluid until they make contact with the infected areas. These are not very effective, however, as they need to be able to get much closer to the biofilm.

M. M. Stanton et al (2017). Magnetotactic Bacteria Powered Biohybrids Target E. coli *Biofilms.* ACS Nano*, 11 (10), 9968–9978*

IBEC researchers uncover flaws in one of the most commonly used bacterial strains

Eduard Torrents' group at IBEC published some important findings that could lead to a change in common experimental protocol.

Along with their collaborators at Hospital Universitari Vall d'Hebron and in the Department de Genètica i Microbiologia of the UAB, Eduard and PhD student Anna Crespo reveal in Scientific Reports that the most-used laboratory strain of bacteria may not be the reliable reference tool for testing new antibiotic treatments that it was previously thought to be.

A. Crespo et al (2017). A single point mutation in class III ribonucleotide reductase promoter renders Pseudomonas aeruginosa *PAO1 inefficient for anaerobic growth and infection.* Scientific Reports*, 7: 13350*

Physical forces activate genes involved in cancer

In their effort to shed light on the role that physical forces play in the body, Pere Roca-Cusachs' group at IBEC showed how these forces 'switch on' the expression of genes that may result in cancer.

Cells apply mechanical forces to their surrounding tissue, and this mechanical effect is crucial for tissue function. In diseases such as cancer or liver and lung fibrosis, tissue rigidity and mechanical forces increase, promoting the progression of the disease. In their study published in *Cell*, IBEC's researchers revealed how forces trigger the expression of certain genes by increasing the activity of a protein called YAP in the nucleus of the cell.

A. Elosegui-Artola et al (2017). Force triggers YAP nuclear entry by regulating transport across nuclear pores. Cell*, 71 (6): 1397-1410*

November

IBEC researchers make an electrical contact out of a single protein

IBEC's Nanoprobes and Nanoswitches group designed a single-protein electrical contact which can efficiently transfer an electrical charge.

Through a subtle mutation in a copper protein which is responsible for various metabolic redox processes in the bacterium *Pseudomona aeruginosa*, they managed to control the transport of electrons in the biomolecule.

Their nanometric electrical contact was based on a single biomolecule, azurin. Azurin's electrical conduction pathways can be adjusted very precisely by means of point mutations in the external part of the protein, without affecting its overall structure and function.

M.P. Ruiz et al. (2017). Bioengineering a Single-Protein Junction. J Am Chem Soc*. 139(43):15337-15346*

December

Deciphering cell language

Understanding the language of cells in order to redirect them when necessary: this was one possibility unveiled by researchers at the Center for Regenerative Medicine of Barcelona (CMR[B]), led by Dr. Samuel Ojosnegros, who described the intercellular communications mechanism involved in cell relocation.

The work, published in *PNAS*, was carried out in collaboration with the IBEC group of Elena Martínez and that of Melike Lakadamyali at ICFO, among others. The authors developed a new microscopy technique that allows them to observe communication signals in living cells. This technique is able to show protein aggregation at the sub-pixel level, which is represented by a colour scale, and allows real-time sequences of how a cell responds to a specific stimulus at high resolution to be recorded.

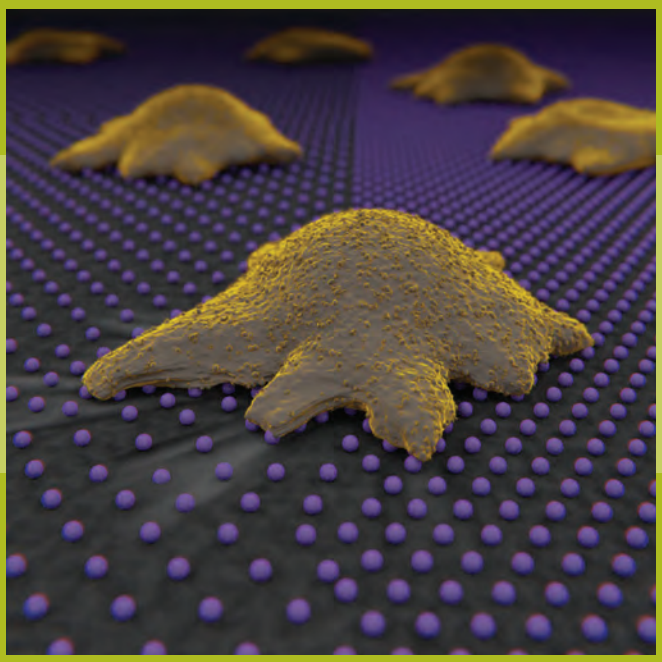
S. Ojosnegros et al (2017) Eph-ephrin signaling modulated by polymerization and condensation of receptors. PNAS*, 114(50): 13188-13193*

Cells feel their environment to explore it

The way cells find their way around is by 'groping' rather than seeing their surroundings: this was the main conclusion of a study published in *Nature* involving several IBEC groups and their collaborators.

"We determined how cells detect the position of molecules (or ligands) in their environment with nanometric accuracy," explains Pere Roca-Cusachs, group leader at IBEC and assistant professor at the University of Barcelona, who led the study. "By adhering to the ligands, the cells apply a force they can detect. As this force depends on the spatial distribution of the ligands, this allows the cells to 'feel' their surroundings. It's like recognizing somebody's face in the dark by touching it with your hand, rather than seeing the person."

R. Oria et al (2017). Force loading explains spatial sensing of ligands by cells. Nature*, 552, 219–224*



Cells find their way around by 'groping' rather than seeing their surroundings: R. Oria et al, *Nature*, 2017

Enzyme-powered nanomotors deliver anti-cancer drugs more efficiently

IBEC researchers demonstrated that their enzyme-powered nanobots show a marked improvement in drug delivery efficiency over passive ones.

The *Advanced Functional Materials* paper was the result of two years of work at IBEC, where Samuel Sanchez's group has been experimenting with enzyme catalysis to power micro- and nanomotors. By consuming biocompatible fuels, these nanoparticles can then be used for biomedical applications such as targeted drug delivery to cancer cells.

A. C. Hortelão et al (2017). Enzyme-Powered Nanobots Enhance Anticancer Drug Delivery. Advanced Functional Materials*, 10.1002/adfm.201705086*

A molecular mechanism could explain how bacteria resist antibiotics

IBEC researchers showed for the first time how bacteria make DNA under stressful conditions, such as drug treatments. This new knowledge could help develop new antibiotics that work, tackling the urgent problem of antibiotic resistance.

The Bacterial infections: antimicrobial therapies group led by Eduard Torrents was studying the bacterial strain *Pseudomonas aeruginosa*, which can cause severe chronic lung infections in cystic fibrosis (CF) patients, leading to severely impaired lung function, an increased risk of respiratory failure, and death.

A. Crespo et al (2017). Regulation of ribonucleotide synthesis by the Pseudomonas aeruginosa *two-component system AlgR in response to oxidative stress.* Scientific Reports *7, 17892*

How perception shapes our actions

Anticipatory motor actions are essential for sport, but also underlie our everyday behavior, from walking or grasping to riding a bicycle or typing on a keyboard. But how exactly are these actions controlled?

A study by the new SPECS group at IBEC, directed by Paul Verschure, challenged the dominant view in neuroscience that the brain produces anticipatory actions as a sensory-motor process driven by errors in motor performance – in other words, an error in behavior triggers corrective motor commands that are executed before the less optimal action is realized. In contrast, the new study proposes that adaptive fast and skilled motor actions result from the surprising ability of the brain to simulate the future.

Using a theoretical model, and in collaboration with Karl Friston's Theoretical Neurobiology group at University College London – recently named the most influential scientist in neuroscience – the SPECS group hypothesized that animals seamlessly and unconsciously control their bodies based on an internal simulation of what the world will be like just after motor actions are realized. Through learning, this internal simulation will get more and more precise in predicting the future, and the motor systems that respond to it will be better tuned to how the body interacts with the real world.

G. Maffei et al (2017). The perceptual shaping of anticipatory actions. Proc. R. Soc. B*, 284, 20171780*

2017 in review: News
Other highlights 2017

January

PIONER award for IBEC student

Former IBEC PhD student Ariadna Bartra was awarded a Premi PIONER from CERCA.

The Signal and Information Processing for Sensing Systems group's student's thesis, 'Detecció d'estats inadequats per la conducció d'un vehicle a partir de la degradació del control dinàmic', was selected for its "direct applicability and market-minded approach, as well as its impact on improving road safety", according to the judging panel. Her research carried out in Santiago Marco's group was connected to the driver drowsiness alerter developed by IBEC and the company Ficosa.

€7m project to develop therapeutic approaches for cancer

January 2017 saw the start of the largest European project ever coordinated at IBEC, Pere Roca-Cusachs' MECHANOCONTROL, which aims to come up with new therapeutic or diagnostic approaches for cancer and other diseases.

Funded under Horizon 2020's FET Proactive programme, which helps new research communities to be developed by encouraging researchers from different disciplines to work together, MECHANOCONTROL will focus on understanding and controlling how cells transmit and detect mechanical forces.

Training the next generation of advanced microscopy experts

IBEC's Nanoscale bioelectrical characterization group was awarded EU funding to coordinate a project that aims to train a new generation of researchers in the science and technology of Scanning Probe Microscopes.

Thanks to the Marie Curie ITN funding, the ten consortium members of the SPM2.0 European Training Network – located in Spain, France, Austria, the UK and Italy – will be able to provide researchers with state-of-the-art multidisciplinary scientific training in the field of Scanning Probe microscopies, covering basic science to industrial applications, which should enable them to generate new scientific knowledge.

March

Samuel receives Premi Nacional de Recerca al Talent Jove

IBEC group leader and ICREA research professor Samuel Sánchez was one of the five honorees at the ceremony of the Premis Nacionals de Recerca 2016 of the Fundació Catalana per a la Recerca i la Innovació (FCRI).

Samuel received his Young Talent award from president of the Generalitat Carles Puigdemont, Minister for Business and Enterprise Jordi Baiget, actress Silvia Bel, and FCRI president Antoni Esteve at the Teatre Nacional de Catalunya.

IBEC researcher's ERC project highlighted in Madrid exhibition

Javier Ramon's European Research Council-funded project, DAMOC, was one of eight highlighted in a special exhibition in Madrid to mark the ERC's tenth anniversary.

Alcobendas' Museo Nacional de Ciencia y Tecnología (MUNCYT) displayed the most "outstanding" projects led by researchers in Spain as part of a full weekend of activities to celebrate the first decade of the prestigious funding body, which was launched in 2007 by the European Union and has funded nearly 7,000 researchers, among them six Nobel Prize winners.

2017 saw IBEC celebrate its first ten years of research activity, with June's 10th Anniversary Symposium kicking off the celebrations

April

IBEC-mentored student wins prize for research project

One of IBEC's mentees under the BATX2LAB programme was a prize winner at the initiative's annual ceremony to award the best research projects.

In BATX2LAB, organised by the PCB and CatalunyaCaixa, researchers working in the science park are assigned as tutors to secondary school pupils who are starting their A-level/Baccalaureate research projects. It enables participating students to carry out their research in a 'real' lab with the support of an experienced scientist.

May

IBEC is bioprinting partner in major 3D printing hub in Catalonia

IBEC is to be part of a multi-million euro 3D printing infrastructure in Catalonia that was presented at a press conference at La Pedrera.

The Global 3D Printing Hub, which will receive up to 28 million euros from the Generalitat by 2020, will aim to consolidate Catalonia as a world leader in 3D printing, one of the key technologies in industry 4.0.

IBEC and EF Clif combine expertise to fight liver failure

IBEC signed a Memorandum of Understanding with the EF Clif, the European Foundation for the Study of Chronic Liver Failure.

The five-year agreement will enable the two organizations to share staff and knowledge, apply for funding together and otherwise collaborate with the goal of improving knowledge of the mechanisms of chronic liver failure and increasing survival rates for patients.

June

Happy 10th birthday, IBEC

2017 saw IBEC celebrate its first ten years of research activity, with June's 10th Anniversary Symposium kicking off the celebrations.

It's been a hair-raisingly fast climb up to the near top of the tree of centres in the Catalan research arena, with IBEC already holding its own alongside bigger and more established organizations for scientific output, number of ERC grants, patents, spin-offs, training programmes, national or EU-level stamps and endorsements, and other important indicators.

IBEC researcher selected by EC for ECSITE meeting

Nanoprobes and Nanoswitches postdoc Miquel Bosch was one of just six Marie Skłodowska-Curie Actions fellows to be invited by the European Commission to participate in the annual ECSITE Conference 2017.

Taking place in Porto, the conference is the largest in Europe devoted to communicating science, attracting more than 1000 people. Miquel was specially selected, along with five other MSCA fellows from all over Europe – out of a total of more than 100,000 – to take part at their stand at the event, where he explained his research in a visual and attractive way, "Shedding light upon the brain".

IBEC joins BIST

The Board of Trustees of the Barcelona Institute of Science and Technology (BIST), presided over by Andreu Mas-Colell, approved the incorporation of IBEC as a new member.

IBEC will bring its expertise and excellent research in the confluence between biology and engineering to BIST, an initiative of six of Catalonia's research centers of excellence – the Center for Genomic Regulation (CRG), the Institute of Photonic Sciences (ICFO), the Institute of Chemical

Research of Catalonia (ICIQ), the Catalan Institute of Nanoscience and Nanotechnology (ICN2), the Institute of High Energy Physics (IFAE), and the Institute of Biomedical Research of Barcelona (IRB Barcelona) – to increase their levels of collaboration and build a joint scientific project together. BIST's strength is based on the research capacity of its centers and its potential to promote cutting-edge research projects in multidisciplinary research.

July

New research group boosts neuroengineering focus at IBEC

IBEC gained a world-renowned neuroscientist and psychologist with the move of ICREA professor Paul Verschure and his Synthetic Perceptive, Emotive and Cognitive Systems group (SPECS) from the Universitat Pompeu Fabra to the institute.

A multidisciplinary group founded in 2005, SPECS aims to find a unified theory of mind, brain and body by using synthetic methods, and to apply such a theory to the development of new cognitive technologies. It's led by ICREA professor and ERC grantee Paul Verschure, who has an MA and PhD in psychology and who has pursued his research in the USA (San Diego Neurosciences Institute and the Salk Institute) and Europe (University of Amsterdam, University of Zurich and the Swiss Federal Institute of Technology).

IBEC and Hospital Clinic move forward in 3D bioprinting with CaixaImpulse funding

IBEC and Hospital Clinic joined forces in 3D bioprinting applied to cancer diagnostics to win funding from Caixaimpulse.

Core Facilities' Mateu Pla Roca is the fifth IBEC researcher to win funding from the programme, an initiative of Obra Social "la Caixa" with Caixa Capital Risc, which aims to promote technology transfer in science. His project, "3D bioprinted array tissue-like cores: tissue-like controls for cancer diagnostics" (3DBIOcores), will be carried out in collaboration with Antoni Martinez, head of the histopathology service at Hospital Clinic.

Inphinit success for IBEC

IBEC welcomed no fewer than three new PhD students with fellowships from the "la Caixa" Foundation's new Inphinit programme, placing the institute fourth among the 28 centres that were chosen.

The doctoral fellowship programme, which aims to attract international early-stage researchers to the top Spanish research centres – namely the MINECO-selected Severo Ochoa centres and Maria de Maeztu units of excellence, and the Spanish Ministry of Health's Carlos III centres of excellence – closed its first call in February this year.

It attracted 438 applications for the 57 positions, which are co-funded by the European Commission through COFUND, one of the Marie Skłodowska-Curie initiatives of the Horizon 2020 Framework Programme.

September

Nobel Laureate is special guest speaker at IBEC event

IBEC welcomed Edvard Moser, Nobel Prize in Medicine or Physiology 2014, as the keynote speaker in a special event to mark the move of ICREA professor and ERC grantee Paul Verschure to the institute.

During the event entitled "From the Science of Memory to the Future of Neuroengineering", held at Palau Macaya and supported by Obra Social "La Caixa", Prof. Moser talked about his pioneering work into the basic neural computations that underlie cognition and behavior.

Prof. Edvard Moser (left) was keynote speaker at "From the Science of Memory to the Future of Neuroengineering" in September

ERC success for Lorenzo Albertazzi

The Nanoscopy for Nanomedicine junior group leader was successful in the European Research Council's 2017 call for Starting Grants, of which just 17 out of the total of 406 have been awarded to scientists working in Spain.

Lorenzo's project, "Design of Nanomaterials for Targeted Therapies Guided by Super Resolution Imaging" (NANOSTORM), plans to use super resolution microscopy to examine nanomaterials that have potential as therapies for cancer, and understand their interactions with their target: the diseased cells. Doing so will help identify the key principles that are needed to rationally design the next generation of targeted, super-efficient cancer treatments

IBEC to represent Catalonia in EC's Smart Specialisation Platform

IBEC is to be the official representative of Catalonia in the European Commission's Smart Specialisation Platform for Industrial Modernisation (S3P-Industry) in the area of Medical Technology.

S3P-Industry, which was launched in 2016, is one of three Smart Specialisation Platforms created by the EC to help regions develop or share infrastructures such as testing facilities, pilot plants or data centres, with the ultimate goal of fostering interregional cooperation in specialist areas and creating an investment pipeline of mature projects.

Samuel breaks own record for smallest jet engine

Samuel Sanchez broke his own Guinness World Record for the smallest jet engine.

The ultimate authority in record-breaking achievements recognized his and Xing Ma's nanotube, 220nm or 0.00022 millimeters in size, as the world's tiniest jet engine. Previously, Samuel and his collaborators from IFW Dresden held the record until this year, with a 600nm tube.

The tubular 'engine' is powered by an enzyme-triggered biocatalytic reaction using urea as fuel. The reaction creates an internal flow that extends out into the surrounding fluid through one of the cavities, causing a flux of fluid that results in thrust, propelling the nanotube along.

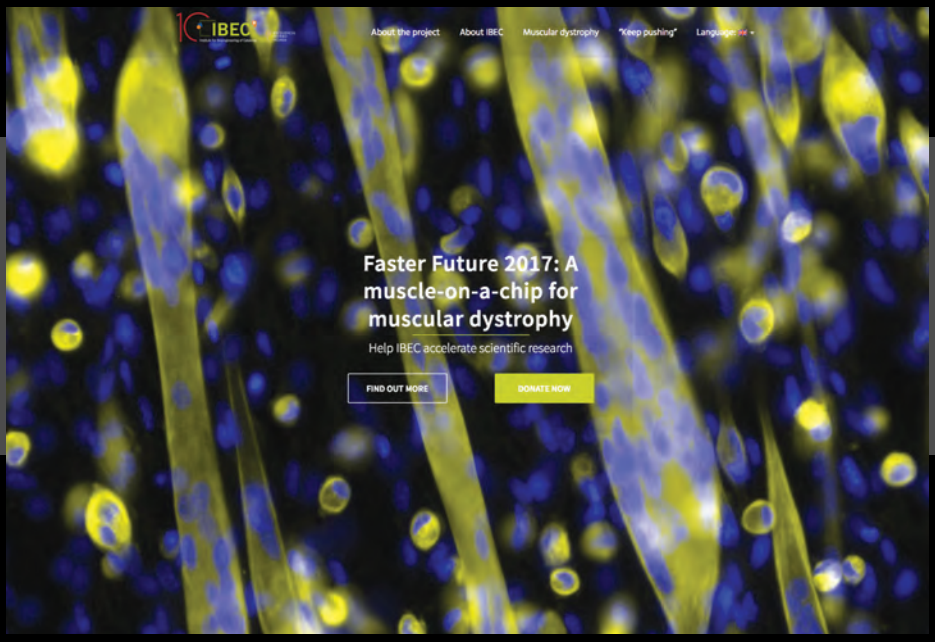
October

Visit of DGR staff to the PCB

About 35 members of staff from the Generalitat's Direcció General de Recerca (DGR) came to the PCB to visit IBEC and the IRB, the two CERCA centres located there.

Director General of Research Francesc Subirada and Assistant Director General Iolanda Font de Rubinat and their colleagues – who work in finance, HR, IT and other administration roles – carry out visits like this every year to find out what goes on at the organizations that are members of CERCA, the Generalitat's institution that supervises, supports and facilitates the activities of Catalonia's research centres. In previous years they visited the PPRB and ICFO.

Other highlights 2017



IBEC's first Faster Future campaign raised money for Javier Ramon's muscle-on-a-chip for muscular dystrophy

The joint program for the morning started with institutional talks by directors Josep Samitier (IBEC) and Joan Guinovart (IRB), followed by a coffee break and then a tour of some of the labs and platforms of both the centres.

SOMMa launches in Madrid

Directors and representatives of Spain's 25 Severo Ochoa centres – including IBEC's Josep Samitier – and 16 María de Maeztu units gathered in Madrid to launch SOMMa, an alliance aimed at raising the national and international profile of science in Spain.

Secretary of State for R&D+I Carmen Vela chaired the kick-off meeting, which defined the strategic and working plan for the coming months. Luis Serrano, director of Barcelona's Centre for Genomic Regulation, will head the alliance over the next two years, while Teresa Garcia-Milà, director of the Barcelona Graduate School of Economics, will be its vice-president.

SOMMa will achieve its goal by promoting the exchange of knowledge, technology and best practices among its centres and units and with the international scientific community and other stakeholders, by cooperating with other research centres in Spain to strengthen the R&D+i system, and by being a voice in Spanish and European science policy.

IBEC group leader opens Premis ceremony

IBEC group leader Elena Martínez gave the opening speech at the Premis Extraordinaris de Batxillerat 2016-2017 ceremony at the Palau de la Generalitat de Catalunya.

IBEC regularly hosts young winners of the prestigious award, which is the government's recognition of excellence for students completing their baccalaureate studies in the two years before university. To qualify, candidates need their total mark for the entire baccalaureate to equal or be more than 8,75.

As well as being something to put on their CV, the award offers exemption from university fees for the first year, a free course at an official language school, the possibility to participate in the National Baccalaureate Awards, and a stay in a research institution related to the student's field of interest.

FUNDALUCE grant for IBEC research into vision restoration

IBEC group leader and ICREA professor Pau Gorostiza won the research grant 'FUNDALUCE 2016' for a project that aims to develop prosthetic molecular switches that could replace degenerated photoreceptors in the retina to restore vision.

"Fotoconmutadores covalentes para el control remoto de receptores endógenos", which will be carried out with collaborators at IQAC-CSIC, the Universidad Miguel Hernández, Universidad de Alcalá de Henares and the Instituto de Neurociencias de Alicante, proposes the concept of nanoprosthesis: that if a functional characteristic of an organ or tissue is regulated by a given receptor, it should be possible to use directed covalent photoswitches to control that particular receptor with light, thereby manipulating their function.

November

IBEC's newest group leader will advance drug delivery systems

IBEC gained another new group leader, with Prof. Silvia Muro joining the institute as an ICREA research professor to lead her Targeted Therapeutics and Nanodevices group.

In her new position, she will carry out research into macromolecular nano-assemblies which can be loaded with drugs to target the chronic conditions that affect our pediatric and ageing populations, such as neurodegenerative, cardiovascular or metabolic diseases, as well as cancer.

Prof. Muro spent the last nine years at the University of Maryland, first as an Assistant Professor and then as a tenured Associate Professor with a joint appointment in the Fischell Department of Bioengineering and the Institute for Bioscience and Biotechnology Research.

IBEC launches Faster Future, a new fundraising initiative, on Giving Tuesday

IBEC's new Faster Future initiative aims to help accelerate research projects that are close to tackling major challenges in health.

In 2017, Faster Future was raising money for a new solution for muscular dystrophy being developed in Javier Ramon's Biosensors for Bioengineering group. Their 'muscle-on-a-chip' will use a patient's own cells to study myotonic dystrophy type 1, a progressive disability that begins in adulthood.

As well as modelling the patient's disease in a personalized way, the platform will also allow the study of different drugs or treatments in conditions that mimic the body as closely as possible, as well as offering a more reliable alternative to animal models.

December

Another IBEC winner nets a Premi PIONER

Maria Valls from IBEC's Biomimetic systems for cell engineering group won a PIONER prize from CERCA for her doctoral thesis.

She was the second ever IBEC winner of one of these prestigious prizes, which since their launch in 2014 have recognised theses with results that are clearly aimed at commercial exploitation.

The jury described her thesis, 'Development of an advanced 3D culture system for human cardiac tissue engineering', as having "a high degree of complexity and promising results, which combines different disciplines within the field of bioengineering to create a bioreactor".

Joining forces with FEDER to collaborate on solutions for rare diseases

IBEC signed a collaboration agreement with the Federación Española de Enfermedades Raras (FEDER), a non-profit organization that represents the three million people suffering from rare diseases throughout the country.

Rare diseases are those that affect fewer than 5 out of every 10,000 inhabitants. According to the WHO, there are about 7,000 such diseases affecting 7% of the world's population, so altogether they affect a huge number of people – and they can appear at any stage of life. The agreement with IBEC will connect the institute with patients' associations to develop projects together that have a direct application according to the needs of sufferers.

2017 in review: News

Technology Transfer

Effective translation of knowledge and discoveries to patients and to the market is a must. IBEC is committed to the market-driven technology transfer and has a fruitful relationship with industry, based on the needs of the companies and the determination of IBEC's researchers to find real solutions.

IBEC and AVINENT launch a collaboration to create bone substitutes using 3D printing

The company AVINENT S.L. and IBEC are set to carry out a research project to print personalized bone structures using 3D technology, offering new personalized solutions to improve treatments for bone diseases or injury.

The joint research agreement will take advantage of the possibilities offered by IBEC's 3D bioprinter, one of the few that offers the level of precision and features needed in regenerative medicine in southern Europe, as well as the research centre's ample knowledge in bioprinting that has resulted from long-term, advanced research.

AVINENT will contribute its know-how on procedures, workflows and digital technology acquired from more than 10 years' experience in the medical sector, together with a team of biomedical engineers of its own. The cooperation between the two institutions includes a project plan that will be developed in collaboration with IBEC's Biomaterials for Regenerative Therapies group, led by Elisabeth Engel. With the 3D bioprinter and the specialized tools and software for this type of application, together IBEC and AVINENT are at the forefront of a new technological revolution.

NIHS sets up a collaborative research project with IBEC

The Nestlé Institute of Health Sciences (NIHS) was established as a new frontier of Nestlé's R&D capability to conduct pioneering research in the innovative area of targeted health science nutrition. The scientific areas of health and nutrition are especially important to Nestlé, since they provide the basis for understanding human nutrition and for finding appropriate targeted solutions for people with the ultimate aim of enhancing quality of life. At IBEC, a collaborative project with NIHS is being led by Santiago Marco, group leader of the Signal and Information Processing for Sensing Systems group.

The goal of NIHS is to better understand health, and therefore the progression on a continuum from health to chronic disease conditions such as Alzheimer's disease, diabetes, and obesity. This provides a context for healthcare and nutritional interventions that help to improve the management of these conditions, which are increasingly placing an unsustainable burden on the world's healthcare systems. NIHS has established leading-edge capabilities in new technologies and biological models and Integrated Systems Approach which aim to define health and to provide an understanding of the relationship of genetics, diet and lifestyle to propose new science-based solutions for targeted nutritional intervention.

Israel's Clear-Cut Medical Ltd establishes a new research project with IBEC

A project with Clear-Cut Medical Ltd. is being led by Santiago Marco, group leader of the Signal and Information Processing for Sensing Systems group. Clear-Cut, the magnetic resonance company in oncology,

AVINENT and IBEC will collaborate to print personalized bone structures using 3D technology, offering new personalized solutions to improve treatments for bone diseases or injury

develops and commercializes its proprietary technology and tools for accurate and effective removal of cancer. Its platform technology is based on innovative magnetic resonance (MR) imaging protocols that enable accurate and rapid surface imaging for real-time assessment of tissue microstructure in the operating room. Initial proof of concept has been established in a multi-center clinical trial evaluating samples from few dozen breast cancer patients. The results have shown over 90% sensitivity and specificity.

The company's first product, The ClearSight™ MRI System, is focused on breast cancer lumpectomy for intraoperative margin assessment of surgically removed lumps. By providing accurate, real-time margin analysis to the surgeon in the operating room, the system is expected to significantly improve surgical outcomes and reduce re-excision rates. Future applications include prostate cancer, breast cancer biopsies and skin cancer excisions as well as additional cancer applications including colorectal and lung cancers.

GENOMICA and IBEC reinforce their strategic collaboration

Since 2015 GENOMICA, the leading company in molecular diagnostics and in the analysis of genetic identification, has had a long-term collaboration agreement with IBEC in the field of diagnostics. The first product to reach the market from this fruitful collaboration, NEDxA, was launched at Medica 2016 in Germany. In 2017 Genomica and IBEC reinforced their strategic collaboration by signing a new agreement.

Founded in 1990, GENOMICA is owned by PharmaMar. Its mission is to improve the present molecular diagnostics tools and human identification methods through reliability, automation and the highest quality standards. GENOMICA's main objective is to maintain leadership in genomics applications within the Spanish market, and to internationally extend their activities in the area of molecular diagnostics by means of the design, development, automation, and commercialization of new diagnostic applications of their innovative technological platform, Clinical Arrays Technology (CLART®). GENOMICA has developed diagnostic tests for human papillomavirus associated with cervical cancer, the diagnosis of viral respiratory diseases, multiple detection of human herpes and enteroviruses, as well as detection of gene regions associated to the determination of human therapy response factors, in particular in the field of oncology.

BSH reinforce their innovation portfolio with IBEC

For the last three years Santiago Marco, group leader of the Signal and Information Processing for Sensing Systems group at IBEC, has established a long- term strategic collaboration with BSH Hausgeräte GmbH in the innovation of their products. BSH is the largest home appliance manufacturer in Europe and one of the world's leading companies. Alongside the global brands Bosch and Siemens, as well as Gaggenau and Neff, BSH's brand portfolio includes the local brands Thermador, Balay, Profilo, Constructa, Pitsos, Coldex, Ufesa and Zelmer. While the global brands are aligned to their respective target groups practically everywhere in the world, the local BSH brands each maintain a strong local relationship to the consumers.

In October IBEC attended the second edition of 'IN(3D)USTRY: From Needs to Solutions', the international meeting devoted to 3D printing

New lighting system, licensed to Telstar and Luxiona, reaches the market

A new lighting system for operating theatres developed at IBEC, UPC and the Consorci Sanitari Parc Taulí reached the market after licencing to Telstar and Luxiona.

The system, built into ceilings, automatically orientates the light source to any point on command of the user within the surgical working space in a precise manner while eliminating the physical obstacles imposed by traditional lighting to provide higher quality, precision and asepsis level in the operating zone. The innovative system was introduced by Telstar into three different hospitals in Catalonia.

This new system provides stability and cleanliness of the air volume provided by the laminar flow system. It also facilitates operability within the surgical process by eliminating the physical obstacles typically encountered. Comprised of motorized spot lights embedded in the laminar flow ceiling, this system replaces conventional surgical lamps to provide an open space within the working area, removing obstructions in the laminar flow ventilation process, which is one of the main drawbacks caused by the presence of traditional lamps. In this manner, the new lighting system ensures the cleanliness and asepsis within the working area, offering the maximum degree of protection against possible post-surgical infections produced by microorganisms in the air inside the operating theatres, caused or generated by exposed instruments, equipment and lamps in the air flow.

Rob Surgical, UPC and IBEC's spin-off company, complete Bitrack's technical validation

The Bitrack surgical robot for minimally invasive laparoscopy surgery, based on technology developed in IBEC and UPC and licensed to the spin-off Rob Surgical Systems, has successfully completed its technical validation on experimental models and is preparing for European authorization and to enter the market by 2019.

Bitrack is the modular, flexible and more economical alternative to the USA's Da Vinci robot installed in many leading hospitals around the world, including Barcelona's Hospital Clínic and Vall d'Hebron University Hospital. The trials using the final prototype were conducted in the new experimental operating theatre at Specipig, a CRO with GLP certification specialised in offering this service to medical technology companies. The trials involved surgeons specialized in surgical robotics with knowledge of the Da Vinci system, including Dr Javier Magriña, a Mayo Clinic surgeon.

"The global challenge of robotic surgery is to improve efficiency without losing any of the effectiveness of the current systems, making it possible to acquire robots at a lower cost that meet the technical demands of the medical community," explains Jaume Amat, CEO of Rob Surgical and President of CataloniaBio & HealthTech. "We set out to put robotic surgery within the reach of most hospitals."

IBEC and Hospital Clinic move forward in 3D bioprinting with CaixaImpulse funding

In 2017 Core Facilities' Mateu Pla Roca was the fifth IBEC researcher to win funding from the CaixaImpulse programme, an initiative of Obra Social "la Caixa" with Caixa Capital Risc, which aims to promote technology transfer in science. The project, '3D bioprinted array tissue-like cores: tissue-like controls for cancer diagnostics' (3DBIOcores), will be carried out in collaboration with Antoni Martinez, head of the histopathology service at Hospital Clínic.

The project will take advantage of 3D bioprinting to create quality control samples that assure and improve cancer diagnostics. Usually, diagnosis is done by histopathology – the microscopic examination of tissues – and then the biomarkers that are found are quantified. However, histological techniques face some degree of variability that can lead to misinterpretation, and for this reason, such tests require quality control samples to be processed side-by-side with patient samples to verify the final diagnosis.

Currently, hospitals use surplus human tissue which is known to express the required biomarkers as quality control samples, but these are scarce and non-homogeneous, and their use raises ethical issues. The project proposes 3DBIOcores as a new source of these essential controls. Taking advantage of 3D bioprinting technology, tissue-like structures containing cell lines with relevant cancer biomarkers will be produced and used as a new source of control samples.

Second edition of IN(3D)USTRY

In October IBEC attended the second edition of 'IN(3D)USTRY: From Needs to Solutions', the international meeting devoted to 3D printing. The institute has a stand in the exhibition area, where Head of Technology Transfer Xavier Rubies, Technology Transfer manager Xavier Puñet and Nanotechnology Platform Coordinator Mateu Pla welcomed visitors interested in finding out more about IBEC's 3D bioprinting capabilities. IBEC director Josep Samitier gave a talk about the challenges and possibilities of 3D bioprinting, where he outlined some of IBEC's relevant projects and future trends in the field. He also talked about the work by several IBEC groups, together with Hospital General Universitario Gregorio Marañón and Hospital Clinic, that was published in *Materials Today* earlier in 2017, which examined progess in de- and recellularization techniques alongside the use of this emerging technology to create promising tissue constructs. Afterwards Josep took part in a round table with some other major players in 3D printing in Catalonia and beyond.

IBEC takes active role in 3D printing events

In October, IBEC presented and was an active member in a meeting about 3D printing in hospitals that was organized by ACCIO's Global 3D Printing Hub, the HealthTech Cluster and Althaia, 'La impressió 3D al món clinic'. At the event, representatives from Avinent, Althaia, Hospital Parc Taulí, Hospital Clínic, GAES, Hospial Sant Joan de Deu, among others, presented their work.

The Global 3D Printing Hub was created by the Catalan Government through the agency ACCIO in 2017, with IBEC a key member in the health area, being very active in 3D bioprinting of tissues and regenerative medicine and applied to medical devices as diagnostic tools, among others. 3D printing technology represents one of the fundamental aspects of Industry 4.0, the new paradigm of tomorrow's factories based on digitalisation. At present, the global 3D printing business volume comes to some $4,200m and is forecast to reach $12,800m by 2020. The Global 3D Printing Hub in Catalonia will act as a point of reference in this new technological trend.

In September, IBEC was also present at an event organized by the Spanish Platform for Nanomedicine (NanoMed Spain,), the Spanish Platform for Innovation in Healthcare

Technology and the HealthTech Cluster, 'Jornada sobre bioimpresión 3D: Aplicaciones prácticas en salud'. Clinical researchers from all over Spain, hospitals, health authorities and representatives of pharmaceutical, biotechnology and health technology companies, among others, met to discuss the use of 3D bioprinting – 3D printing with cells – whose potential in the field of health, and particularly in tissue and organ regeneration, is huge. During the event's three round table discussions, they talked about the current situation, future prospects and challenges presented by this new technology.

IBEC meets the biggest global pharma companies at Bio-Europe

IBEC's Technology Transfer team attended the 23rd annual BIO-Europe conference, held in the CityCube of Berlin, in November 2017. This meeting offers research and technology centres an opportunity to build new partnering with a wide range of businesses, from biotech to pharmaceutical companies, among other potential investors.

Xavier Rubies, IBEC's Head of Technology Transfer, and Diana González, project manager of the same unit, arranged 20 one-to-one meetings, 11 with big pharmas and 9 with biotech companies during the conference, where they discussed novel target and inhibitory compounds for the treatment of solid tumors, specifically of pancreatic cancer. The patent is a first in class in the area of mechanobiology applied to oncology and leveraged major interest in oncology companies.

Bio-Europe is Europe's largest life science partnering conference. Its workshops, panels and exhibitions, along with thousands of prescheduled one-to-one meetings, make the event an unrivalled forum for companies across the biotech value chain to meet and do business. The BIO-Europe 2017 partnering event received over 3,800 industry attendees for three days of high level networking, representing upwards of 2,000 companies from over 60 countries.

IBEC meets wound healing and surgery monitoring companies

At MEDICA in Germany in November, IBEC presented results about two of its technologies: Ischemsurg, a minimally invasive microsensor for ischemia monitoring, addressing ischemia control in free flaps post-surgery and in compartment syndrome; and Dermoglass, angiogenic microparticles for wound healing, addressed to the elderly and diabetic wound care markets. In both cases, Technology Transfer representatives from IBEC met potential partners in co-development and/or licensing and started negotiations.

MEDICA is the world's biggest medical trade fair and the international leading specialist trade fair for the supplier market for the medical technology industry. Of a total of 123,500 professional visitors, over 60% came from countries outside Germany, from 130 different countries. Among these were visitor groups with members who were the top of their field, from China, India, Columbia and Nepal, along with visitor groups from the most important markets for medical technology in Europe who have attended for many years.

IBEC winner nets a Premi PIONER

Maria Valls from IBEC's Biomimetic Systems for Cell Engineering group won a PIONER prize from CERCA for her doctoral thesis in 2017. She was the second ever IBEC winner of one of these prestigious prizes, which since their launch in 2014 have recognised theses with results that are clearly aimed at commercial exploitation. The jury described her thesis, 'Development of an advanced 3D culture system for human cardiac tissue engineering', as having "a high degree of complexity and promising results, which combines different disciplines within the field of bioengineering to create a bioreactor".

Maria Valls from IBEC's Biomimetic systems for cell engineering group won a PIONER prize from CERCA for her doctoral thesis in 2017

Technology Transfer strategy presented at the 100xCiencia meeting

The second 100xCiencia meeting, 'Co-creating Value in Scientific Research', brought together Spain's Severo Ochoa and María de Maeztu centers of excellence – among them IBEC – to analyze and discuss the transfer of scientific knowledge to industry. IBEC director Josep Samitier, Head of Strategic Initiatives Teresa Sanchis, and Head of Technology Transfer Xavier Rubies were in attendance at the meeting in Alicante in November.

Xavier Rúbies presented the Technology Transfer strategy at IBEC, with emphasis on Market Driven Technology Transfer, wherein projects are managed from a market perspective. As in many other research institutions, IBEC identifies and patent new discoveries and results, and offers its know-how to industry with contract research agreements or assessment. Its added value, however, is in the market focus. IBEC has a strong channel of communication with industry and is aware of their needs and constraints at every step of the process. The Technology Transfer unit consults key opinion leaders to understand market opportunities and limitations, and surveys clinicians to understand current clinical practice and identify which products and services would be valuable. The strategy also incorporates regulatory affairs to identify the best method to bring a product to market and anticipate what IBEC's partners will need.

2017 in review: News
Clinical Translation

Opening doors to personalized, optimized cancer treatments

A new project involving researchers at IBEC and VHIO will improve cancer diagnosis, treatment and survival by determining how mechanical factors govern cancer invasion.

The project, "Understanding and measuring mechanical tumor properties to improve cancer diagnosis, treatment, and survival: Application to liquid biopsies", is funded by the Obra Social La Caixa's Joint Programme with IBEC in Healthy Ageing Research and will harness the expertise of the IBEC groups of Pere Roca-Cusachs, Xavier Trepat, Lorenzo Albertazzi and Josep Samitier to reveal how the mechanical properties of tissues affect cancer progression. The researchers will work with VHIO to carry out analysis of patient samples and data to assess the effect of these mechanical factors on diagnosis and treatment, thereby opening the way to developing personalized, efficient diagnostic approaches and targeted drug delivery strategies.

Concentrating on breast and gastrointestinal cancers, the project will design therapeutic strategies that consider not only molecular mutations, but also the stiffness of the specific tumor and how those parameters interact. Rather than measuring this using traditional, solid biopsies, however, their approach will harness liquid biopsies – in other words, detecting biomarkers in blood – which can be taken less invasively, and which better reflect the changes in tumor dynamics and drug sensitivity which can occur during therapy.

A new therapeutic target could slow down Parkinson's disease

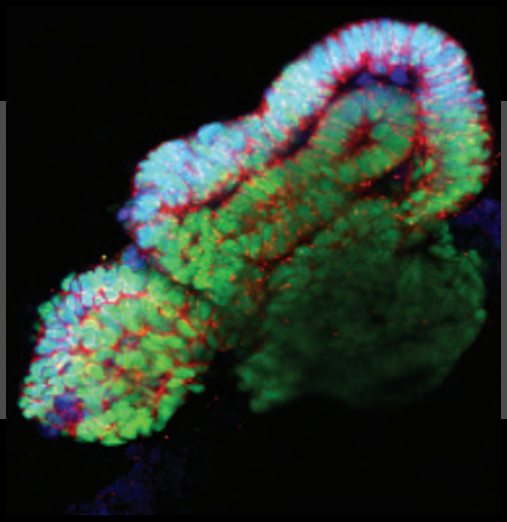
The cellular prion protein PrP^c is involved in a number of functions such as cell cycle control and neurotransmission. In 2017, the IBEC research groups of José Antonio Del Río, Josep Samitier, and Eduard Torrents, together with colleagues in the Tokyo Metropolitan Institute of Medical Science, Barcelona's Bellvitge Hospital and Vall d'Hebron Research Institute, and the Aragón Institute for Engineering Research at the University of Zaragoza, found that aside from carrying out these functions, PrP^c also binds to and increases the spreading of damaged a-synuclein – the protein responsible for neuronal degeneration and death in diseases such as Parkinson's – between neurons. This points to PrP^c as a possible pharmacological target to slow neurodegeneration in these types of diseases, including some types of dementia.

A PERIS project on cardiac regeneration after heart attack

Together with Elena Martinez's Biomimetic Systems for Cell Engineering group, Daniel Navajas' Cellular and Respiratory Biomechanics group is participating in a project funded by the Catalan Department of Health under the PERIS programme (Pla estratègic de recerca i innovació en salut). Coordinated at Hospital Germans Trias i Pujol, "Cardiopoesi amb biomatrius per regenerar la cicatriu post infart: From bench to bedside (first-in-man trial)" is a two-year project during which IBEC's cardiac patches will be implanted in pigs.

CIBER-BBN projects with clinical partners

Spain's Centro de Investigación Biomédica en Red (CIBER), a legal entity financed by the Instituto de Salud Carlos III, creates large multidisciplinary and multi-institutional networks of research centres that will integrate basic and clinical research. Eleven IBEC group leaders aggregated in six research groups work in programmes within CIBER, such as CIBER-BBN, which covers bioengineering, biomaterials and nanomedicine, CIBERNED for neurodegenerative diseases, and CIBERES, the Centro de Investigación en Red de Enfermedades Respiratorias, which addresses



IBEC works with embryonal kidney samples with Hospital Clinic to study the molecular mechanisms of kidney diseases (page 32)

respiratory illnesses. Many of the projects have clinicians as collaborators.

Joint Research Unit with ISGlobal

Since 2010, the Nanomalaria group led by Xavier Fernández-Busquets is a Joint Research Unit within the framework of a research agreement signed between IBEC and the Barcelona Institute for Global Health (ISGlobal). ISGlobal grew out of work first started in healthcare by the Hospital Clínic and the Parc de Salut Mar and in the academic sphere by the Barcelona and Pompeu Fabra universities. Its goal is to help close the gaps in health disparities between and within different regions of the world.

Respiratory diseases collaborations with hospitals

A joint research Unit between IBEC's Biomedical Signal Processing and Interpretation group and Hospital Universitari Germans Trias i Pujol is developing a collaborative project in respiratory sound analysis. Research they published in *PlosOne* during 2017 offers a step towards better screening of patients with asthma and other sufferers of obstructive pulmonary diseases. The study proposes new signal processing algorithms to detect and characterize continuous adventitious respiratory sounds (CAS), such as wheezes, which may be different between asthmatics with and without a significant bronchodilator response (BDR).

The same IBEC group also collaborated with the Hospital del Mar-IMIM to test respiratory muscle mechanomyography (MMG) as a way to assess the mechanical activation of the inspiratory muscles of the lower chest wall in both patients with chronic obstructive pulmonary disease (COPD) and healthy subjects. Their results suggest that respiratory muscle MMG is a good reflection of inspiratory effort, and could be used in clinical conditions to estimate the efficiency of the mechanical activation of the inspiratory muscles, contributing to a better understanding of breathing in COPD patients.

Collaborations with two hospitals in the search for biomarkers

During 2017 Santi Marco's group worked with Hospital Clínic and the UB in the search for volatile biomarkers that can be detected in breath, leading to a publication at the beginning of 2018 that proposes a methodology to identify putative biomarkers in the presence of instrumental shifts in Gas Chromatography/Mass Spectrometry analysis, thus dealing with current limitations of hypersensitivity of the results.

Secondly, the group has an ongoing collaboration with the Department of Digestive Diseases at the Hospital Vall d'Hebron to explore the possibilities to find gas phase biomarkers in flatulence for diverse digestive conditions.

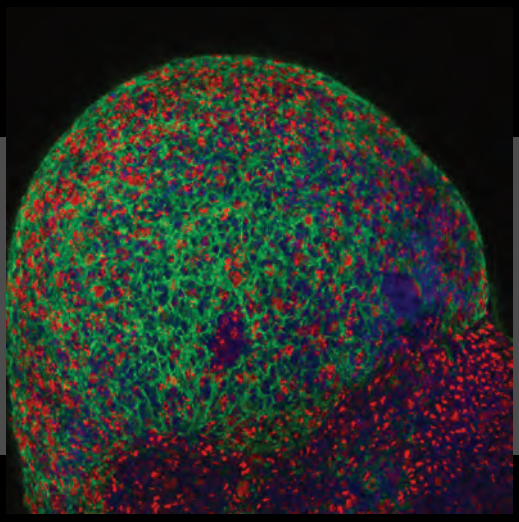
Creating a 3D *in vitro* model of the human intestine

During 2017 Elena Martinez's Biomimetic Systems for Cell Engineering group continued its collaborative alliance with Barcelona's Vall d'Hebron Research Institute (VHIR) to evaluation and characterize the intestinal barrier in a 3D *in vitro* model of the human intestine. The collaboration, specifically with VHIR's unit focused on the Physiology and Pathophysiology of the Digestive Tract, will validate the model as an *in vitro* representation of intestinal disorders.

GLAM project working with Radboud UMC

In the H2020-funded GLAM project (Glass-Laser Multiplexed Biosensor), which aims to develop an innovative device for personalized diagnosis and therapy monitoring for genitourinary cancers, the Biomimetic Systems for Cell Engineering group continued working in collaboration with the Department of Urology at the Radboud University

Clinical Translation in 2017



A mass of neurons derived from GSS-affected pluripotent stem cells (iPS), developed in José Antonio Del Río's lab

Medical Center in Nijmegen, The Netherlands during 2017. As the clinical partner, Radboud provides patient samples to be used in testing biomarkers in genito-urinary oncology, particularly bladder cancer.

AECC funding for IBEC project

Nuria Montserrat's group was granted funding from the Fundación Científica de la Asociación Española Contra el Cáncer in their 2017 Ayudas LAB AECC call. They will work together with their collaborators at Vall d'Hebron Institut d'Oncologia, ICO-IDIBELL and Hospital Clínic to create a 3D-organoid – a kidney-on-a-chip – from human pluripotent stem cells, which will demonstrate how the tissue in the organ develops, as well as how it reacts when other changes take place, such as disease. Within this model, the researchers will be able use a gene editing method, CRISPR-Cas9, to manipulate those genes related to the appearance of disease and identify possible early signs that cancer might develop. The project 'Generation of Isogenic Models of Clear Cell Renal Cell Carcinoma using CRISPR-engineered Kidney Organoids, for the identification of diagnostic biomarkers' will receive support over a three-year period from the AECC Scientific Foundation, whose 'Ayudas LAB' funds emerging groups to carry out projects in cancer that have obvious translational possibilities.

Nuria Montserrat's incorporation into the TACTICS group in 2017

By pooling the efforts of leading expert groups, the international consortium Transnational AllianCe for regenerative Therapies In Cardiovascular Syndromes (TACTICS, www.tacticsalliance.org) will develop effective treatments that will improve the prognosis of patients with a wide range of heart and vascular diseases. Nuria Montserrat, already a member of the Cardiorenal Dysfunction Group of the European Society of Cardiology's Heart Failure Association (HFA) since 2016, was incorporated into the consortium during 2017.

Kidney and iPS collaborations with Hospital Clínic

Nuria Montserrat's group continued to work with Dr. Eduard Gratacós, Head of BCNatal (Hospital Clínic/Hospital Sant Joan de Déu) and Professor at the University of Barcelona with embryonal kidney samples to study the molecular mechanisms of kidney diseases, as part of a research agreement established during 2016. The alliance follows on from a similar agreement reached in 2015 to facilitate the same IBEC group to work with Josep M. Campistol (Hospital Clínic/IDIBAPS) on using pluripotent stem cells to identify transcription factors and epigenetic modifiers responsible for aging.

Clinica CEMTRO collaboration on cartilage lesions

In 2017 Nuria Montserrat's Pluripotent Stem Cells and Activation of Endogenous Tissue Programs for Organ Regeneration group continued its collaboration within the framework of the CIBER project "CHONDREG: Identification of the epigenetic mechanisms preventing chondrocyte de-differentiation: generation of novel therapeutic strategies for the treatment of cartilage chronic osteochondral lesions" with Clinica CEMTRO in Madrid.

IBEC group as TERCEL node

Nuria Montserrat's group is a node group in the Red de Terapia Celular (TerCel) network, a collaborative project launched by the Instituto de Salud Carlos III in 2003 to promote research in cell therapy and transfer scientific advances to Spain's national health system. In this

framework, the IBEC group is now a partner in the network's CardioCel programme, which is oriented towards the research, development, production and application of cell therapy drugs in cardiovascular disease. The group will aim to develop strategies for heart healing using different regenerative approaches, from the use of pluripotent stem cells to 3D bioprinting.

IBEC's newest group leader will advance drug delivery systems

With Silvia Muro joining the institute as an ICREA research professor to lead her Targeted Therapeutics and Nanodevices group in 2017, IBEC is planning to establish a joint unit with Barcelona's Hospital Sant Joan de Deu which will enable her to maintain a small laboratory space at the hospital. This will serve as an avenue for her to translate her research into macromolecular nano-assemblies which can be loaded with drugs to target the chronic conditions that affect our pediatric and ageing populations, such as neurodegenerative, cardiovascular or metabolic diseases, as well as cancer.

Studying sleep apnea with Hospital Clínic

Daniel Navajas' Cellular and Respiratory Biomechanics group continued their collaboration with the Sleep Laboratory of the Pneumology Department of Hospital Clínic, Barcelona, during 2017, publishing several papers on the topic of sleep apnea.

'Muscle-on-a-chip' project is focus of IBEC's new fundraising initiative

Javier Ramon's Biosensors for bioengineering group's project to develop a new platform – a 'muscle-on-a-chip' – that uses a patient's own cells to study Myotonic dystrophy type 1 (DM1), the most common form of muscular dystrophy, was the focus of IBEC's first Faster Future fundraising drive in 2017. The project will engineer 3D skeletal muscle tissue using patients' own cells by encapsulating the cells in 3D-printed biomaterials that act as scaffolds. The resulting tissue will be incorporated in a microscale chip and combined with biosensors that can measure important variables such as glucose consumption by the muscles, secretions, or insulin. As well as modelling the patient's disease in a personalized way, the platform will also allow the study of different drugs or treatments. Several hospitals, including the Hospital de la Fé (Valencia), Instituto de Investigación de Enfermedades Raras–ISCIII (Madrid) and the Asociación Instituto de Biodonostia (Basque Country), have expressed interest in getting involved in the project.

The Faster Future campaign had raised more than €19.000 for the project by the end of 2017.

A cellular model to help study the relationship between neurodegenerative diseases

From the cells of a patient with a rare neurodegenerative disease, Gerstmann-Sträussler-Scheinker syndrome (GSS), researchers at IBEC managed to generate neurons that also present parallel neurodegenerative processes unrelated to the syndrome. The capability to develop cellular models with hallmarks of two unrelated neurodegenerative diseases in the same neurons could help with the study of other neurodegenerative diseases with similar diagnosis, like Alzheimer's. The work was the result of a collaboration between experts from José Antonio Del Río's Molecular and Cellular Neurobiotechnology group and neuropathologist Isidre Ferrer, professor at the Faculty of Medicine and Health Sciences and the Institute of Neurosciences of the UB, and neurologist Adolfo López at the Donostia University Hospital.

CaixaImpulse support for tumor project

Pere Roca-Cusachs' Solid Tumor Therapy project, which was awarded funding by CaixaImpulse at the end of 2016, tackles the fact that current cancer treatments often fail in the long run, reducing life expectancy. To solve this problem, there is a pressing need for new treatments that operate through novel mechanisms and that can therefore be used in combination or independently from current approaches. His project aims to do this by targeting a novel aspect of cancer: tumor stiffness. As exemplified by the hard lumps characteristic of breast cancer, solid tumors of many different origins are systematically stiffer than healthy tissue, and this stiffening per se promotes tumor progression. "We have identified a family of drugs that inhibits cell response to increased stiffness, and that therefore have a high potential to inhibit tumor growth," he explains. "Our project will develop these drugs and test their efficacy. If successful, they will have therapeutic potential for an array of solid tumors in the breast, prostate, pancreas, lung, or brain."

Fetal surgery collaboration with two hospitals

Monica Mir from the Nanobioengineering group is the IBEC lead in two projects together with the Fetal Medicine Research Centre, Fetal i+D (Hospital Clínic and Hospital Sant Joan de Déu) which are supported by the Cellex Foundation and the "la Caixa" Foundation. A fetal surgery part, promoted by Cellex, will improve the interventions currently being carried out, as well as developing new surgery to treat problems that currently lack solutions. A prenatal diseases part, supported by "la Caixa", is searching for new clinical biomarkers to identify the neurological and cardiovascular impact that fetal diseases have on adulthood. One sub-project, Robotics and Electronic Biosensors, is coordinated at IBEC and involves the Nanobioengineering group developing biosensors designed to be applied in the field of fetal medicine, and the group of Associated Researcher Alícia Casals developing a guidance system.

ISCHEMSURG addresses tissue ischemia in reparative surgeries

Monica Mir's CaixaImpulse project, granted at the end of 2016, works with Hospital Clínic de Barcelona's Department de cirurgia plastic i maxillofacial and and Hospital Parc Taulí de Sabadell's Departament de Cirurgia Ortopedica i Traumatologia to develop a miniaturized electrochemical sensor for the real-time, minimally invasive control of post-operative tissue ischemia, which can result from inaccurate reconnection to the microvascular system after surgery.

Splenic chip model for rare anemias

With Hospital Clínic in 2014, the Nanobioengineering group developed for the first time a novel micro-engineered device of the human splenon-on-a-chip. This device mimicked the splenic closed-fast and open-slow microcirculation, the mesh where red blood cells are recycled, and the spleen's filtering function. The group's postdoc Maria José López Martínez is continuing the collaboration with the hospital as part of a CIBER project to develop the model for rare anemias.

PoC tool for respiratory diseases with Hospital Clínic

IBEC's Nanobioengineering group headed by director Josep Samitier is working together with clinicians at Barcelona's Hospital Clínic to develop a point-of-care platform for respiratory diseases. Aimed at primary care providers, the diagnostic and monitoring tool will help to detect and track the progress of diseases such as chronic obstructive pulmonary disease (COPD).

A stroke patient training with SPECS' Rehabilitation Gaming System under the supervision of her physician/physiotherapist at Val d'Hebron Hospital in Barcelona

ERC funding to develop 'lab-in-a-patch' device

Smart Nano-Bio-Devices group leader and ICREA research professor Samuel Sanchez was awarded a ERC-PoC project in the 2017 round that will be carried out in collaboration with the Hospital Sant Joan de Déu. Starting in 2018, the project, LABPATCH, will develop a 'lab-in-a-patch' for self-assessment by sufferers of PKU, a rare inherited disorder.

Flaws in one of the most commonly used bacterial strains

Along with their collaborators at Hospital Universitari Vall d'Hebron and the Department de Genètica i Microbiologia of the UAB, Eduard Torrents' group at IBEC revealed in Scientific Reports in 2017 that the most-used laboratory strain of bacteria may not be the reliable reference tool for testing new antibiotic treatments that it was previously thought to be. "It appears that PAO1 has adapted to laboratory conditions, a bit like when our bodies become resistant to antibiotics," says Eduard. "During infection, clinical P. aeruginosa acts under anaerobic conditions, but the P. aeruginosa lab strain PAO1 can't grow anaerobically. We found, though, that a single mutation in the class III RNR promoter region of the PAO1 strain disrupts its anaerobic transcription, decreasing its virulence. This means PAO1 is inappropriate for anaerobic or infection studies, and nor is it good for when you're searching for new antimicrobial compounds that involve anaerobic conditions."

New strategies to combat bacterial infections

Eduard Torrent's Bacterial Infections: Antimicrobial Therapies group's project with the Associació Catalana de Fibrosi Quística (ACFQ) aims to develop new strategies to combat bacterial infections and possible therapeutic targets. At the end of 2016 the work received a boost for three years thanks to a new funding initiative from the La Caixa Foundation. The clinical data for the project is provided via the group's close collaboration with the Hospital Universitari Vall d'Hebron. In 2017, they published a paper in *Scientific Reports* describing the link between bacterial DNA synthesis and stressful conditions like antibiotic treatment. The results of this work enable the identification of a new bacterial target that can be used for the treatment of chronic bacterial infections.

Eodyne's Rehabilitation Gaming System in use in several hospitals

Eodyne is a spin-off company of IBEC's new SPECS research group and the Catalan Institute of Advanced Studies in Barcelona. Eodyne's flagship product is the Rehabilitation Gaming System (RGS), a science-based neuro-rehabilitation solution for the integrated treatment of deficits resulting from brain damage. RGS has been validated in a large number of clinical studies and is used daily in a number of hospitals for the treatment of stroke patients.

2017 in review: Governance

The IBEC foundation

IBEC is a non-profit foundation established at the end of 2005 by the Generalitat de Catalunya (Autonomous Government of Catalonia), the University of Barcelona (UB) and the Technical University of Catalonia (UPC).

IBEC's relationship with the universities

IBEC's forerunner, the Centre of Research for Bioengineering (CREB) of the Technical University of Catalonia (UPC), was founded in 1992 by six research groups from five different departments with the aim of collaborating in research and industrial projects in the broader area of bioengineering. IBEC's first director, Prof. Josep A. Planell, was director of CREB from 1997 and led the process that resulted in the creation in 2003 of the Catalan Reference Centre for Bioengineering (CREBEC), composed of different divisions from the above-mentioned CREB and the Research Centre on Bioelectronics and Nanobioscience (CBEN) of the University of Barcelona (UB). CREBEC, which aimed to coordinate the multidisciplinary research activities in biomedical engineering carried out in Catalonia, was transformed at the end of December 2005 into the Institute for Bioengineering of Catalonia (IBEC).

The research groups affiliated with the University of Barcelona which are seconded at IBEC are:

- Nanoscale Bioelectrical Characterization, led by Gabriel Gomila
- Nanoprobes and Nanoswitches, Pau Gorostiza/Fausto Sanz
- Signal and Information Processing for Sensing Systems, Santiago Marco
- Cellular and Respiratory Biomechanics, Daniel Navajas
- Molecular and Cellular Neurobiotechnology, José Antonio Del Río
- Nanobioengineering, Josep Samitier

Those affiliated with the UPC are:

- Biomaterials for Regenerative Therapies, Elisabeth Engel
- Biomedical Signal Processing and Interpretation, Raimon Jané

IBEC's PhD students are able to follow their doctoral courses at the universities, which offer degrees in physics, chemistry, biology, materials science and engineering, among others, and masters courses related to bioengineering and nanomedicine, attracting students from all over the world. Several others of IBEC's research staff are also involved in the doctoral programmes, particularly in the joint Biomedical Engineering Programme. Moreover, being located on the same campus, the relationship with both universities and the access to their facilities – library, scientific services, etc – is very fruitful.

Members of IBEC's Board of Trustees form the panel for the opening ceremony of the institute's annual symposium

IBEC's current director, Josep Samitier, was Vice-Rector of Research and Innovation and Acting Rector of the University of Barcelona (UB) from 2005 to 2008. He remains Full Professor of Electronics in the university's Physics Faculty.

Board of Trustees (for most of 2017)

The main governing body of IBEC is its Board of Trustees with representatives from the Catalan ministries of Health and Research, the UB and UPC. The Board of Trustees meets twice a year to approve IBEC's annual budget and monitor its activity to ensure that it pursues scientific excellence with societal impact. For executive purposes, a Management Committee (chosen from the Board) monitors IBEC's activities through *ad hoc* meetings with the Director and Managing Director.

PRESIDENT

Hble. Sr. Antoni Comín i Oliveres
Minister of Health Generalitat de Catalunya

FIRST VICE-PRESIDENT

Hble. Sr. Santi Vila
Minister of Economy and Knowledge Generalitat de Catalunya

SECOND VICE-PRESIDENT

Excm. i Mgfc. Sr. Joan Elias i Garcia
Rector University of Barcelona (UB)

Excm. i Mgfc. Sr. Enric Fossas Colet
Rector Technical University of Catalonia (UPC)

MEMBERS

Dr. Arcadi Navarro i Cuartiellas
Secretary for Universities and Research Ministry of Economy and Knowledge, Generalitat de Catalunya

Dr. Francesc Subirada i Curcó
Director General for Research Ministry of Economy and Knowledge, Generalitat de Catalunya

Sra. Montserrat Llavayol i Giralt
Deputy Director General for Research and Innovation Ministry of Health, Generalitat de Catalunya

Dr. Antoni Andreu Périz
Head of Research and Innovation Ministry of Health, Generalitat de Catalunya

Dr. Carlos Enrique Alemán Llansó
Full Professor Technical University of Catalonia

Dr. Domènec Espriu i Climent
Vice-Rector of Research University of Barcelona

Dr. Fernando Orejas Valdés
Vice-Rector of Research Policies UPC

Dr. Francisco Ciruela Alferez
Vice-Rector of Scientific Policies UB

SECRETARY

Sr. Josep Maria Alcoberro Pericay
CERCA, Ministry of Economy and Knowledge, Generalitat de Catalunya

Standing Committee

PRESIDENT

Dr. Francesc Subirada i Curcó
Director General for Research Ministry of Economy and Knowledge, Generalitat de Catalunya

MEMBERS

Dr. Antoni Andreu Périz
Head of Research and Innovation Ministry of Health, Generalitat de Catalunya

Dr. Domènec Espriu i Climent
Vice-President for Research, Innovation and Transfer University of Barcelona (UB)

IBEC's International Scientific Committee advises the institute's board on its decisions

Dr. Fernando Orejas Valdés
Vice-Rector of Research Policies UPC

SECRETARY

Sr. Josep Maria Alcoberro Pericay
CERCA, Ministry of Economy and Knowledge, Generalitat de Catalunya

International Scientific Committee

The Board's decisions are guided by an independent International Scientific Committee (ISC). This committee ensures practices and criteria are implemented in accordance with international standards of excellence in research.

PRESIDENT

Prof. Samuel I. Stupp
Director Institute for Bionanotechnology in Medicine, Northwestern University, Evanston, IL, USA

MEMBERS

Prof. Sergio Cerutti
Professor in Biomedical Signal and Data Processing Department of Biomedical Engineering, Politecnico di Milano, Italy

Prof. Charles J. Dorman
Chair of Microbiology Trinity College Dublin, Ireland

Prof. Günter R. Fuhr
Director Fraunhofer Institute for Biomedical Engineering, Germany

Prof. Roger Kamm
Cecil and Ida Green Distinguished Professor of Biological and Mechanical Engineering Massachusetts Institute of Technology, Boston, MA, USA

Prof. Chwee Teck Lim
Professor / Deputy Head Department of Biomedical Engineering and Department of Mechanical Engineering, National University of Singapore, Singapore

Prof. Krishna Persaud
Professor of Chemoreception School of Chemical Engineering and Analytical Science, University of Manchester, UK

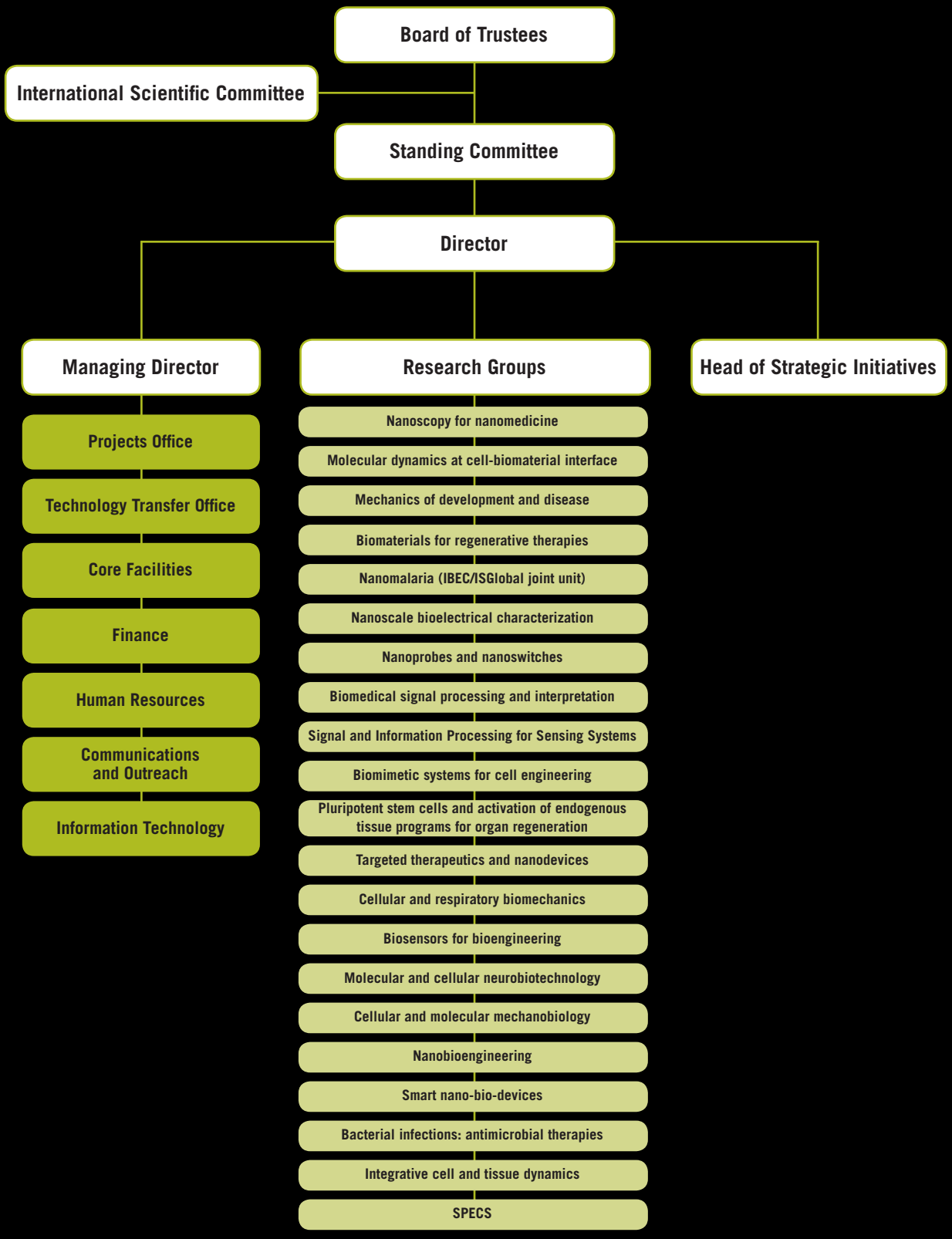
Prof. Bernat Soria
Director Departamento de Células Troncales, Centro Andaluz de Biología Molecular (CABIMER), Seville, Spain

Prof. Molly Stevens
Professor of Biomedical Materials and Regenerative Medicine / Research Director for Biomedical Material Sciences, Institute of Biomedical Engineering Imperial College, London, UK

Jocelyne Troccaz, PhD
Director de Recherche, CNRS Equipe Gestes Médico-Chirurgicaux Assistés par Ordinateur (GMCAO), Laboratoire TIMC-IMAG, Université Joseph Fourier-CNRS, France

2017 in review: Governance

Organigram



2017 in review: Governance
Strategic Plan 2014-2017

IBEC's Strategic Plan for the period 2014-2017 identifies the following four areas in which to concentrate our efforts:

- To expand the centre both in size and in results by recruiting new professionals and scientists, as well as renewing groups that perform at the highest standard in terms of both scientific quality, and transfer and innovation.
- To focus its scientific work on the areas where it can stand out most distinctively and compete internationally, with an orientation towards scientific and technological challenges with a high impact on people's health and quality of life.
- To forge alliances with organisations of recognised international standing to consolidate the institute's path of specialisation, differentiation and internationalisation.
- To improve the way the institute is managed by implementing tools such as an integrated management system and management by results, in order to make the best use of resources and align management with its strategy.

In this way, IBEC's Strategic Plan for 2014-2017 is structured in terms of four strategic goals:

- **SG1.** To consolidate top-class science which enables IBEC to strengthen its international position, by focusing its core activity on three areas of application: "Bioengineering for Regenerative Therapies", "Bioengineering for Future Medicine" and "Bioengineering for Active Ageing".
- **SG2.** To develop technology and applications thereof that help to improve business competitiveness and the quality of hospital services.
- **SG3.** To run a distinctive specialist training programme to attract international talent.
- **SG4.** To develop a culture of excellence in management, self-sustainability and management by objectives.

Each of these strategic goals is pursued in the following areas of action: Research, Technology transfer and translation, Training development, Human resources (see next page), Management, Alliances, and Communication.

During 2017, work began on the Strategic Plan for 2018-2020, which will be submitted for the approval of the IBEC Board of Trustees during 2018.

IBEC was awarded the 'Human Resources Excellence in Research' from the European Commission in 2015, in recognition of its commitment to continuously improving its HR policies in line with The European Charter of Researchers and The Code of Conduct for the Recruitment of Researchers

Human Resources Strategy for Researchers (HRS4R)

Part of IBEC's Strategic Plan 2014-2017 has been the design and implementation of a new Human Resources Strategy for Researchers (HRS4R) according to the principles of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers.

A Monitoring Committee with eight volunteers from career stages R1 to R4 (predoc to group leader), the Managing Director and two heads of support units started to meet by the end of 2015 to discuss the implementation of the actions. The HR Unit was appointed as leader and coordinator of the development and implementation of the HRS4R, and the Monitoring Committee acts as a support, advising and monitoring the implementation of the actions.

IBEC's Action Plan applies to all staff categories and consists of 22 actions with different scope: from short-term and hands-on actions, to important, long-term ones significant to the progress of IBEC.

As part of the process of implementing the HRS4R, IBEC commits to undertaking a self-assessment every second year. This happened in July when IBEC published its self-assessment report and sent it to the European Commission for evaluation. This report contained information about the evolution of the HRS4R Action Plan and the status of each action, as well as new actions planned for the following years (2018-2020). To create the self-assessment report, a participative project took place with an internal online survey, meetings with the Monitoring Committee of the Charter and Code and working groups, such as the one for the OTM-R Checklist (Open, Transparent and Merit-based Recruitment).

During 2017 the implementation of the Action Plan mainly focused on:

Selection

- Training in interviewing skills for group leaders, senior researchers and heads of unit took place in November. An opportunity for interviewers to practice and perfect their interviewing techniques by sharing knowledge and good practices in research.
- In May IBEC organised another edition of reSearch4Talent, an open day to attract talent aimed at undergraduate and master students. IBEC also participated in careers fairs in the Physics and Chemistry faculties of Barcelona University in May, the 1st Talent Forum in Biomedical Engineering, and the Career Day at the ENABLE conference, the first European symposium organized by and for PhD students and postdocs in November.
- A new PhD brochure was made available from January 2017.

Training

- A yearly Training Catalogue was produced, outlining more than 21 training courses in transferable skills for all IBEC members, and with focus on offering more courses to postdocs and senior researchers.

IBEC's Strategic Plan 2014-2017

IBEC's Mentoring Scheme for postdocs was implemented in 2017

- Training courses in technology transfer and in job placement and CV preparation took place.
- A new Mentoring Scheme for postdocs was implemented.
- IBEC's values, core competencies and specific competencies for all researchers (R1 to R4) were defined.
- New job descriptions for R1 to R4 were defined and are handed out to all newcomers in the welcome pack.

Working Conditions

- The second Equal Opportunities and Diversity Management Plan with 34 actions for the next three years has been defined and published in June. If the first Plan was a good starting point laying down some good bases for the promotion of equal opportunities and diversity management, this second Plan is more ambitious, incorporating the gender and diversity perspective transversally at all levels of the institute. This was thanks to a multidisciplinary, inter-hierarchical and diverse team (The Gender and Diversity Commission), with the participation of men and women of different nationalities, both from the research and support areas and with different levels of responsibility inside the institute. Its members are very involved and proactive in the implementation of the actions.
- A new procedure for conflict resolution was developed by the Monitoring Committee of the HRS4R. The conflict resolution procedure promotes open communication and foster a safe environment for addressing differences of opinions. The purpose of this procedure is to provide fair, effective and consistently applied methods for an individual to present his or her concerns and have them resolved.
- IBEC's Induction Plan was improved and updated.

Ethical Issues

- An interdisciplinary working group has created a Code of Conduct for Research Integrity. It is planned that it will be published in the first semester of 2018 once it has been revised and approved by IBEC's Directorate. This Code is a framework for good research practice, setting the criteria for proper research behaviour and establishing an environment conducive to high-quality research, thus ensuring that research is conducted according to international ethical standards. This code sets out the ethical standards and standards of research conduct of those engaged in research, and sets out principles, recommendations and commitments.
- Training in Research Integrity has been scheduled for the first semester of 2018.

All these actions are proof that the HR Strategy has become a transversal project at the institute and is fully embedded into the IBEC Strategic Plan 2014-2017, the HR strategy being one of its seven programmes.

2017 in review: Governance
Transparency

In compliance with Law 19/2014 (Transparency, public access to information and good governance), a section of the IBEC website provides all the information we are obliged to provide in order to adhere to the principles of this law.

The section (www.ibecbarcelona.eu/about-us/transparency) contains the following information and/or documents:

Organització

Estructura organitzativa i de funcionament
- Organs de govern i organigrames
- Acords de creació i funcionament d'entitats del sector públic
- Cartes i catàlegs de serveis
- Catàleg de procediments

Alts càrrecs i directius
- Relació d'alts càrrecs i directius
- Incompatibilitats
- Activitats, béns i interessos
- Retribucions, indemnitzacions i dietes
- Codi de bones pràctiques per als alts càrrecs de la Generalitat de Catalunya

Empleats públics
- Relació de llocs de treball del sector públic
- Personal adscrit per adjudicataris de contractes signats amb l'Administració
- Retribucions, indemnitzacions i dietes

Convocatòries: accés i resolució
- Convocatòries personal laboral, col·lectius específics i formació per promoció.

Representació sindical
- Nombre i cost d'alliberats sindicals

Procediments i actuacions jurídiques

Normativa
- Normativa sectorial
- Directives, instruccions i circulars
- Normativa en tràmit

Règim d'intervenció administrativa
- Actes amb incidència sobre el domini públic i sobre la gestió dels serveis públics

Revisió d'actes administratius
- Revisió d'actes administratius

Resolucions administratives i judicials amb rellevància pública
- Resolucions administratives i judicials amb rellevància pública

Dictàmens
- Respostes a consultes sobre interpretació i aplicació de la normativa

Línies d'actuació

Plans i programes generals i sectorials, auditories i informació estadística

Econòmica i finances

Pressupostos
- Pressupostos aprovats; executats; liquidats
- Comptes anuals

Informes d'auditoria de comptes i fiscalització
- Informes d'auditoria de comptes i fiscalització

Patrimoni de la Generalitat
- Inventari de béns immobles
- Béns mobles de valor especial
- Gestió de patrimoni
- Contractació patrimonial

Subvencions i ajuts
- Subvencions i ajuts públics previstos; públics atorgats
- Control financer de les subvencions i els ajuts

Contractació

Contractes

Convenis
- Registre de convenis de col·laboració Altres convenis
- Altres convenis

Territori

Plans territorials sectorials
- Plans territorials sectorials

Informació cartogràfica
- Informació cartogràfica

Riesgos laborales

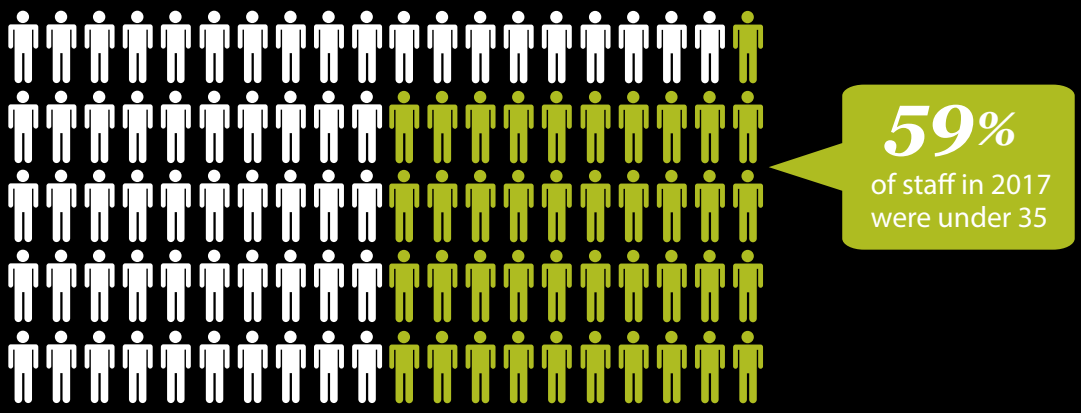
Prevención de riesgos laborales
- Memoria del Servicio de Prevención 2016
- Certificado de auditoria de prevención de riesgos laborales

2017 in review: Statistics

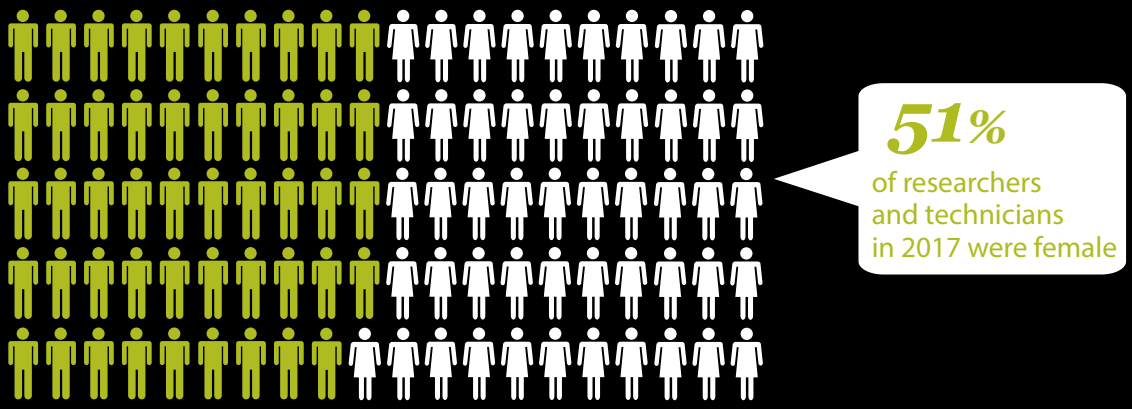
IBEC in figures, 2017

In 2017 IBEC's total staff, including administration staff as well as researchers, students and technicians, numbered 285. Of this total, 198 were hired by IBEC, while the rest are seconded, affiliated, externals, visitors or other status.

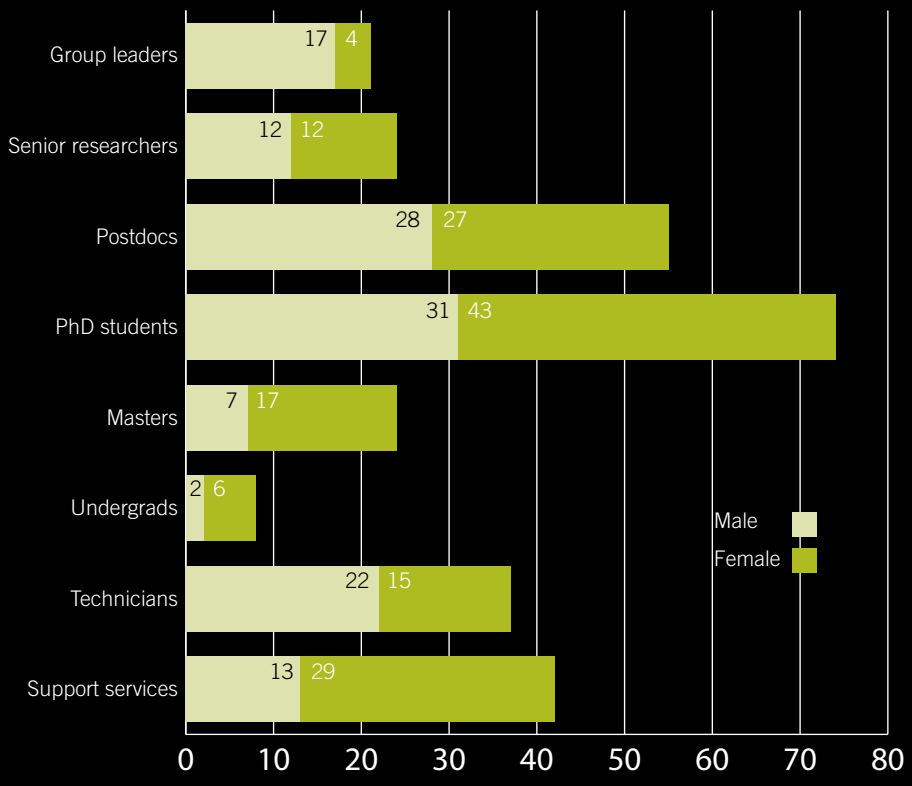
The following statistics reflect the state of affairs on 31st December 2017.



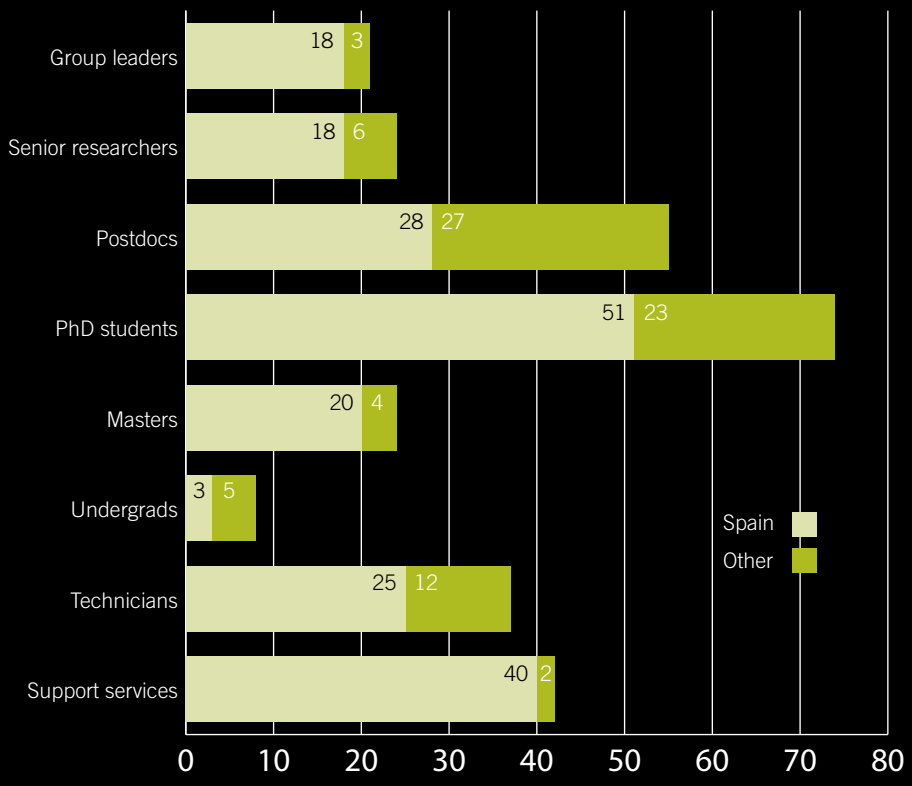
1. Age of all IBEC staff (researchers, technicians and administration)



2. Gender of researchers and technicians



3. All staff by gender and job category



4. All staff by nationality (Spain/other) and job category

IBEC in figures, 2017

5. All IBEC staff by nationality (map)

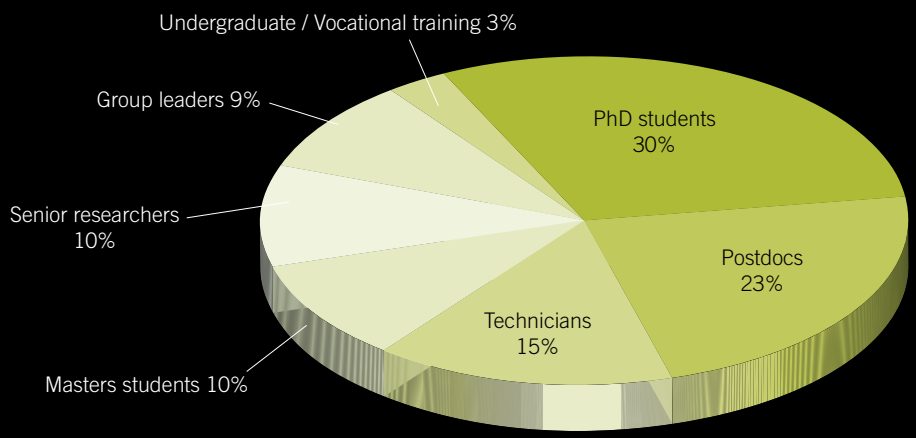
The 285 personnel at IBEC in 2017 (including administration staff) represented

29 countries

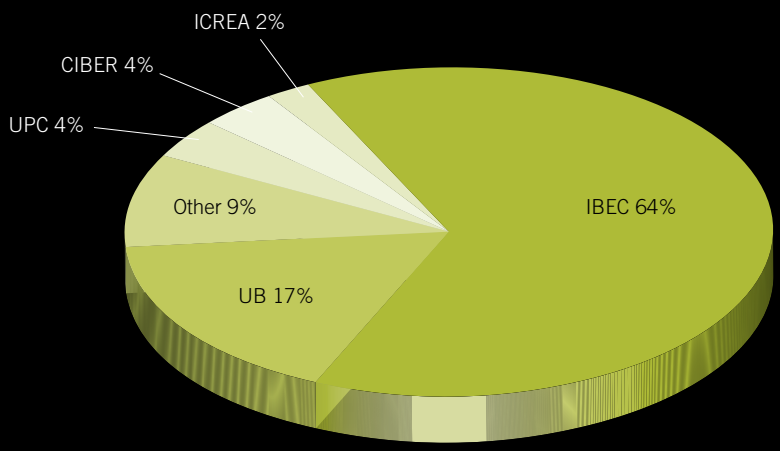
Argentina: 2
Brazil: 2
Chile: 2
Colombia: 3
Costa Rica: 1
Cuba: 1
Mexico: 3
Panama: 1
Uruguay: 1
Venezuela: 1

17 were from Latin America

6. IBEC researchers and technicians by job category



7. IBEC researchers and technicians by associated or contracting institution



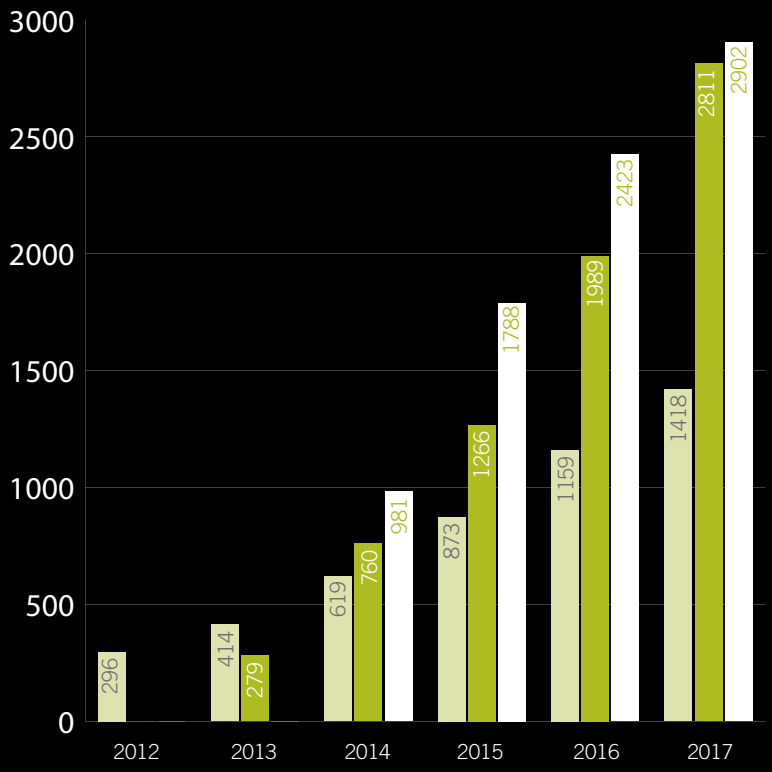
8. Mobility in 2016

7 went to other labs in Spain

11 went to labs in Europe

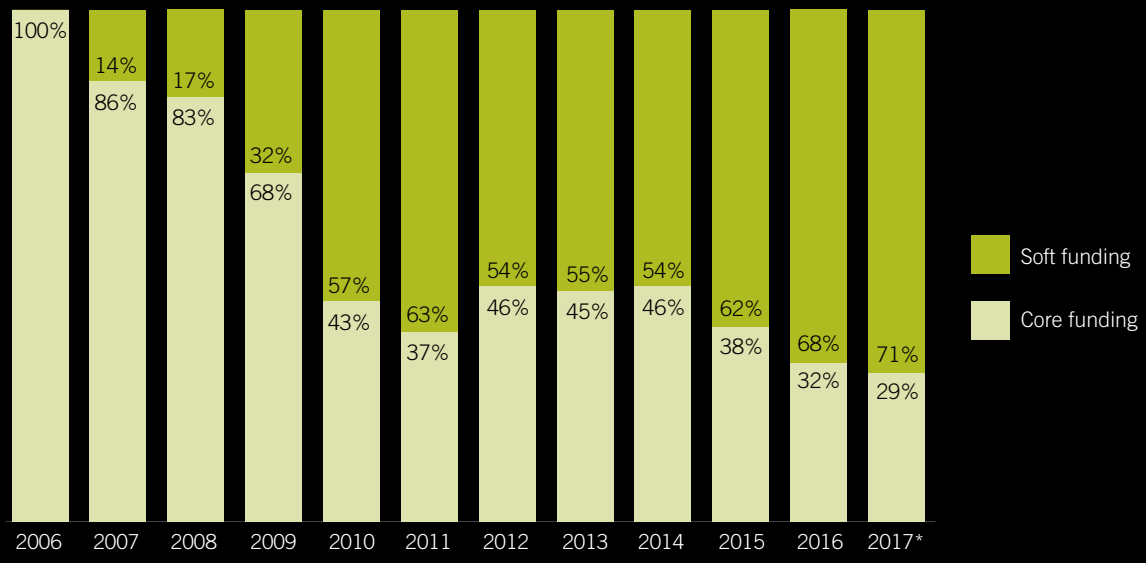
2 went to the rest of the world

Number of researchers who spent time elsewhere in 2017: **20**



9. Number of followers on social media 2012-2017

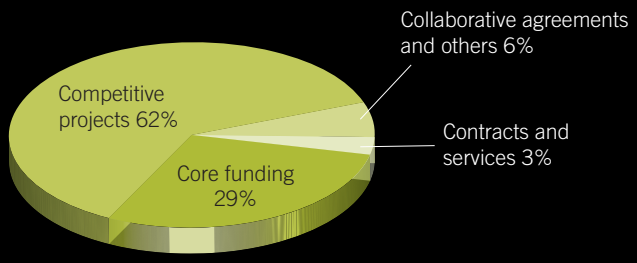
10. Funding sources in 2017



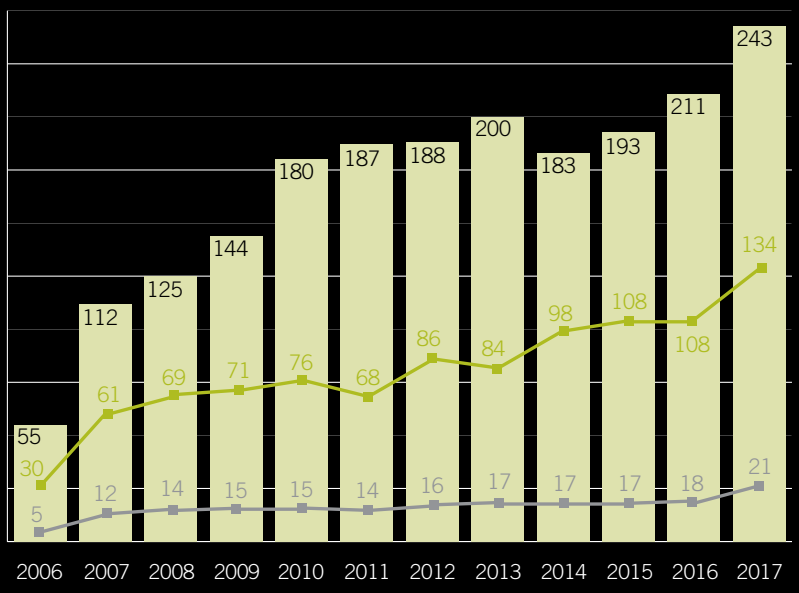
Graph: Percentage of funding from core v. competitive sources. Core funding is funding from trustees. Soft funding includes competitive projects (funded by sources such as the EU's H2020 programme, the Spanish Ministry of Science or the Catalan Ministry of Research), Industry contracts, funding from private institutions.

Pie chart: Different sources of funding in 2017, broken down into types.

** Figures for 2017 are provisional, pending audit*



11. Evolution of IBEC



Researchers

Publications

Indexed journal articles only, not including conference proceedings, etc

74%

of IBEC's indexed journal papers in 2017 were in the first quartile

Number of groups

Media appearances

Top ten by readership

pronto

Los tumores utilizan las células sanas para iniciar la metástasis

Xavier Trepat, investigador del Institut de Bioenginyeria de Catalunya, y su equipo han hecho un descubrimiento que puede ser trascendental en el tratamiento de las metástasis. Al parecer las células cancerígenas emplean la fuerza de unas células sanas, los fibroblastos, a los que se enganchan físicamente para diseminarse por el resto del cuerpo y colonizar otros órganos sanos. Esta investigación abre las puertas al posible bloqueo de este proceso mediante la utilización de fármacos.

EL MUNDO

Xavier Trepat, profesor de investigación ICREA en el IBEC, ha liderado el trabajo que publica 'Nature Cell Biology'. ANTONI BOFARULL

ONCOLOGÍA INSTITUTO DE BIOINGENIERÍA DE CATALUNYA

DESVELAN UN PROCESO CLAVE PARA LA METÁSTASIS

El trabajo muestra cómo las células tumorales 'secuestran' a las sanas para propagarse hacia nuevas zonas usando las posibilidades de movimiento de los fibroblastos, células que mantienen los tejidos

LIDIA MONTES BARCELONA

PHYS.ORG

Cells sense and explore their environments

14 December 2017

In order to carry the research out, researchers developed some low-rigidity gel substrates to which a passion of gold nanospheres covered by a protein are adhered, and which can control its separations. Credit: R. Oria et al.

Interaction between cells and their ligands (the cell microenvironment) is essential to maintaining tissue function, and the detection of changes in the cell environment is essential in all situations where there is tissue remodelling, such as embryonic development, tumoral proliferation or the healing of a wound.

"Depending on this cell force distribution, it can affect the activation of genetic transcription, a phenomenon that determines which genes are expressed," says Roger Oria, first author of the study and Ph.D. student at the UB in Dr Roca-Cusachs' laboratory.

With this deeper knowledge of how cells detect their surroundings, researchers proved that by altering the conditions of the cell's environment (rigidity and distribution of those ligands that create the extracellular matrix), they can control the adherence response of the cell, and even define a range in which the cell adheres. This result, says Roca-Cusachs, could be important in tumoral processes, since greater rigidity is related to a higher activation of oncogenes.

Researchers have known cells are able to perceive spatial and physical information at the nanoscale.

EL MUNDO

CATALUNYA

LA CONVERSACIÓN ENTRE CEREBROS Y ORDENADORES

Según Edvard Moser, autor del GPS cerebral y Nobel de Medicina en 2014, partes no funcionales de este órgano serán reemplazadas por máquinas en un futuro

LIDIA MONTES

Edvard Moser, en el Palau Macaya en Barcelona. ANTONI BOFARULL

ALZHEIMER

El Nobel confían que se alcanzará una cura para esta enfermedad. Aunque no es nueva, reconoce una mayor incidencia debido al envejecimiento de la población: «Ha crecido un 20%».

NEUROCIENCIA

Moser apunta que los avances tecnológicos están permitiendo dar pasos de gigante en esta disciplina: «Con las ordenadoras podemos crear nuevos modelos y procesos para estudiar el cerebro».

Top 10 media appearances


elPeriódico

EL FUTURO DE LA BIOINGENIERÍA

Las bioimpresoras abren la vía a la creación de órganos en 3D

Científicos del IBEC en Barcelona crean tejidos cardiacos a partir de células madre

Los cultivos se pueden procesar hasta conseguir estructuras con formas variadas

Células madre obtenidas del propio paciente


elPeriódico

Líderes en impresión 3D

La Generalitat impulsará un 'hub' en BCN dedicado a la nueva tecnología, en el que invertirá 28 millones hasta el 2020 ■ El proyecto cuenta con el apoyo de firmas como HP, Ricoh y Renishaw

La iniciativa busca situar a Catalunya como el epicentro de la reproducción tridimensional

600,000 | 500,000 | 400,000 | 300,000 | 200,000 | 100,000


elPeriódico

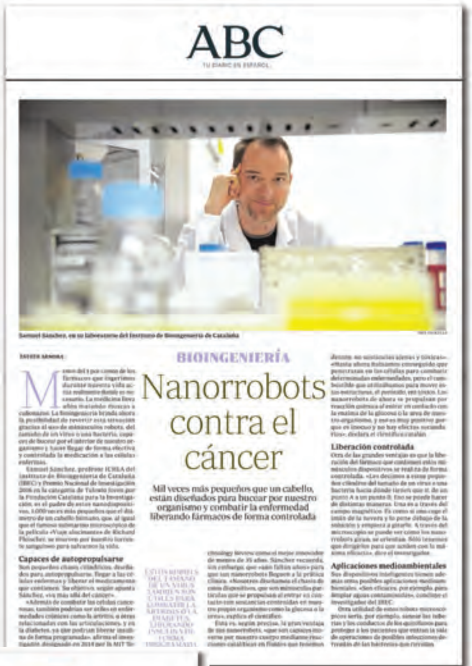
INSTITUTO DE BIOINGENIERÍA DE CATALUNYA (IBEC)

Un músculo en un chip

Un nuevo biorreactor reproduce en miniatura el comportamiento de las células musculares

El objetivo es poder valorar la eficacia de los fármacos de manera personalizada

50.000 afectados de distrofia muscular miotónica en España


ABC

BIOINGENIERÍA

Nanorrobots contra el cáncer

Mil veces más pequeños que un cabello, están diseñados para buscar por nuestro organismo y combatir la enfermedad liberando fármacos de forma controlada

Capaces de autopropulsarse

Liberación controlada

Aplicaciones medioambientales


elPeriódico

ENTREGA DE LOS PREMIS NACIONALS DE RECERCA

2017 in review: Visibility
Events in 2017

January

26 Kick-Off meeting of the **SPM2.0 European Training Network**, the Nanoscale bioelectrical characterization group's has been awarded EU project that aims to train a new generation of researchers in the science and technology of Scanning Probe Microscopes.

February

2 NanoMed Spain co-hosted the fourth edition of **Nano World Cancer Day 2017**.

17 **MECHANOCONTROL** kick-off meeting, the largest EU project ever coordinated at IBEC

24 **Bioengineering workshop** (Associació de Biotecnòlegs de Catalunya & IBEC PhD Committee)

28 An event at Hospital Sant Joan de Déu for **International Rare Disease Day**

March

7-8 NanoMedSpain participated, as every year, in the **Annual Conference of Technological Platforms of Biomedical Research** in Madrid

20 IBEC attended **BIO-EUROPE SPRING**, the partnering conference for biotech, pharma and finance in Europe.

27-28 **IBEC International PhD Programme** interviews

April

6 Meeting of the **FIBROGELNET** consortium, a European Commission Marie Curie – Industry Academia Partnerships and Pathways project coordinated at IBEC

May

10 Third general assembly of the **Health Tech Cluster**, an alliance of industry, research centres and other health technologies bodies, of which IBEC is a member

12 Third annual IBEC **reSearch4Talent** open doors event for young scholars interested in a career in science.

18 30 delegates from the **23rd World Smart Systems & Micromachine Summit** (MMS 2017) visited IBEC.

June

6-7 IBEC's **10th Anniversary Symposium**, 'Bioengineering for Future Medicine'

8 **ISC** meeting

9 **10th Anniversary Gala Celebration**: Birthday Party for IBEC scientists, staff and alumni

23 In collaboration with IRB, IBEC held another edition of **Kids' Day**, when staff and researchers from the two institutes are invited to bring their children for a morning of science activities.

Events in 2017

July

14 Elisabeth Engel was one of five scientific guests to take part in a round table session at the annual general assembly of **Barcelona Global** at the PRBB.

August

September

4 Prof. Edvard Moser, Nobel Prize in Medicine or Physiology 2014, was the keynote speaker at **'From the Science of Memory to the Future of Neuroengineering'**.

20 Presentation by András Badacsonyi, **ERC** Scientific Officer

21 **Conference on 3D printing and its applications** in the health sector in Barcelona, co-organised by NanoMed Spain

October

16 35 members of staff from the Generalitat's Direcció General de Recerca (**DGR**) came to the PCB to visit IBEC and the IRB, the two CERCA centres located there.

24 Elena Martínez gave the opening speech at the **Premis Extraordinaris de Batxillerat** 2016-2017 ceremony at the Palau de la Generalitat de Catalunya.

24-25 IBEC **Retreat** for group leaders, heads of units and directorate.

November

2-3 The second **100xCiencia** meeting, 'Co-creating Value in Scientific Research', brought together Spain's Severo Ochoa and María de Maeztu centers of excellence in Alicante.

10 IBEC **B·Debate**, 'Adding life to years', at CosmoCaixa.

15 **'Oportunidades de financiación en I+D+i'** workshop organised by NanoMed Spain, CDTI, EIT Health Spain and ACCIÓ.

22 **NanoBio&Med2017**

December

20 **IBEC Christmas Celebration**

2017 in review: Visibility

Outreach activities

Top ten in 2017

February: The Youth Mobile Festival, Mobile World Conference

The Youth Mobile Festival (YOMO) of the Mobile World Congress, the world's largest gathering for the mobile industry.

March: '10alamenos9': Festival de Nanociència i Nanotecnologia

Festival of Nanoscience taking place simultaneously in Barcelona, Saragossa, Bellaterra, San Sebastian and Madrid.

March: Premios Princesa de Girona

The prize-giving ceremony of the Premios Fundación Princesa de Girona.

May: Recerca en Directe

'Live Research' fair for schools and the general public, held at CosmoCaixa museum.

Top ten outreach activities in 2017

June: Kids' Day

In collaboration with the IRB, children between 3 and 12 years old enjoy a scientific play, a tour of the IBEC facilities, and a range of fun, hands-on workshops.

July: Barcelona International Youth Science Challenge (BIYSC)

Aims to stimulate scientific talent among undergraduate students aged between 16 and 19 from all over the world.

October: 'El futuro de la medicina'

A talk by Biomaterials for Regenerative Therapies group leader Elisabeth Engel as part of the La Caixa Foundation's conference series.

October: Coventry Life Festival, UK

IBEC's first outreach activity abroad, supported by EIT Health. A celebration of active ageing in the university town not far from Birmingham.

November: Fundació Catalunya-La Pedrera's Professors i Ciència

An initiative for teachers to learn experiments and activities to take back to the classroom.

November: Setmana de la Ciència

The 22nd annual Science Week festival, organised by the Fundació Catalana per a la Recerca i la Innovació (FCRI), which aims to bring research closer to the public.

2017 in review: People
Administration

Director
Josep Samitier

Assistant to the Director
Ester Sánchez

Managing Director
David Badia

IMS Developer
Carles Ortega

DIRECTORATE

Head of Strategic Initiatives
Teresa Sanchis

Project Manager
Sergio González

STRATEGIC INITIATIVES

Head of Finance
Ana María González

Accounting Technician
Victòria López

Accounting Assistant
Jessica Díaz

Purchasing Technician
Mayte Muñoz

Accounting Manager
José Antonio Martín

FINANCE

IT Technician
Francisco Contreras

IT Manager
Julio Bafaluy

IT Technician
Alejandro Silverio

INFORMATION TECHNOLOGY

Coordinator of Events and Outreach
Pilar Jiménez

Head of Communications and Outreach
Vienna Leigh

COMMUNICATIONS AND OUTREACH

Project Manager
Sara Vicente

Funding Manager
Esther Gallardo

Project Manager
Ester Rodríguez

Assistant to the Projects Office
Judith Forné

Project Manager
Guillermo Talavera

Head of Projects Office
Javier Adrián

Project Managers
Javier Selva
Rosa Miralles

PROJECTS OFFICE

Human Resources Technician
Neus Vilalta

Head of Human Resources
Carolina Marí

Human Resources Technician
Ciara Boter

Health and Safety Technician
Raquel Guillén

Human Resources Technician
Núria Jané

HUMAN RESOURCES

Communications Assistant
Pilar Rodríguez

Coordinator of Media Relations and Branding
Àngels López

Project Manager
Xavier Puñet

Head of Technology Transfer Office
Xavier Rúbies

Project Manager
Diana Mª González

TECHNOLOGY TRANSFER

For the Core Facilities staff list, see the Research and Services section, page 98

PhD theses in 2017

The data shows the date of the defence, the name of the student, his or her group at IBEC, the title of the PhD thesis and the awarding body.

■ January 20

Pilar Rodríguez
Integrative Cell and Tissue Dynamics
'Mechanics of boundary formation in epithelial monolayers by Eph-ephrin interactions'
(UB)

■ April 27

Anna Crespo
Bacterial infections and antimicrobial therapies
'Estudi transcripcional i funcional de les ribonucleotidil reductases de *Pseudomonas aeruginosa*'
(UB)

■ June 30

Dencho Gugutkov
Molecular Dynamics at Cell-Biomaterial Interface
'Nanoengineering approaches for guiding cellular behavior'
(UPC)

■ June 30

Veronica Hortigüela
Biomimetic Systems for Cell Engineering
'Study of cell response over nanopatterned ligands on diblock copolymer surfaces'
(UB)

■ July 3

Francisco Palacios
Signal and information Processing for Sensing Systems
'Desarrollo de una tarjeta RFID flexible con capacidades sensoras para aplicaciones en logística de alimentación'
(UB)

■ July 7

Maria Valls
Biomimetic Systems for Cell Engineering
'Development of an advanced 3D culture system for human cardiac tissue engineering'
(UB)

■ July 11

Albert Garcia
Biomimetic Systems for Cell Engineering
'Engineering poly(ethylene glycol) diacrylate-based microstructures to develop an *in vitro* model of small intestinal epithelium'
(UB)

■ July 18

Marta Pozuelo
Nanoprobes and Nanoswitches
'Bioengineering single-protein wires'
(UB)

PhD theses defended in 2017

13 students, including Montse Lopez (centre), defended their PhDs during 2017

■ September 26

Montserrat Lopez
Nanoprobes and Nanoswitches
'Electrochemical tunneling microscopy and spectroscopy of electron transfer proteins"
(UB)

■ October 5

Jose Luis Sebastian
Nanobioengineering
'Desarrollo de aptasensores para la detección de bacterias enteropatógenas'
(UB)

■ November 20

Claudia Navarro
Biomaterials for Regenerative Therapies
'Stimulation of Wound Healing and Vascularization with Calcium-Releasing Biomaterials'
(UB)

■ December 15

Agata Mata
Molecular and Cellular Neurobiotechnology
'Nuevas funciones de moléculas de remodelación vascular durante el desarrollo y modulación de la corteza cerebral de ratón'
(UB)

■ December 15

Daniel Pacheco
SPECS
'Space, Memory, Action, Insights from Behavior and Neurophysiology'
(UPF)

IBEC Seminars in 2017

Throughout the year, international experts, scientists who work with our research teams on certain projects, and some of the IBEC group leaders are invited to give lectures as part of the IBEC Seminars programme. The aim of these events is to provide an overview of the state-of-the-art research in various fields and to give the audience the opportunity to discuss recent developments with the guest speakers.

In addition, the PhD Discussions Sessions are intended to encourage the participation of PhD students, providing a forum where they can present the results of their research and discuss it with fellow students and researchers. Throughout 2017, 10 PhD students presented their work in these sessions. Additionally, in order to help IBEC students in their career development and provide them with additional skills, invited speakers gave lectures on "From PhD to industry: tips for the researcher" and "Planning your academic career with an open mind".

■ January 16

Christian A. Nijhuis, Department of Chemistry, National University of Singapore
'Molecular Diodes with Rectification Ratios of Nearly Six Orders of Magnitude'

■ February 3

Giuseppe Battaglia, Department of Chemistry and Department of Chemical Engineering, University College London
'Bionic nanoscopic carriers for precision drug delivery'

■ February 8

Stijn Mertens, TU Wien, Institute of Applied Physics / KU Leuven, Chemistry Department
'Electrochemical surface science of TiO2 rutile (110), graphene and boron nitride'

■ February 16

Jesús Martínez de la Fuente, Instituto de Ciencia de Materiales de Aragón, CSIC/University of Zaragoza
'Designing Hybrid Nanoparticles for Therapy and Diagnosis'

■ March 3

Maria Virumbrales, University of Zaragoza
'Development of microfluidic tools to reproduce and characterize the tumor microenvironment'

■ March 6

David Cahen, Weizmann Institute of Science, Rehovot, Israel
'Electron Transport across Peptides and Proteins'

■ March 29

Aranzazu Villasante, Department of Biomedical Engineering, Columbia University, New York
'Cancer Engineering: Strategies to Engineer Predictable Tumor Models'

■ April 27

IBEC-IRB Barcelona joint seminar: **Erik Sahai**, The Francis Crick Institute, London
'Imaging therapy response and failure'

IBEC Seminars and PhD Discussions

Erik Sahai was a speaker in this year's programme of IBEC Seminars (photo © The Josh Carrick Foundation)

■ May 19

Verena Ruprecht, Cell & Developmental Biology program, CRG, Barcelona (Spain)
'Tuning cell and tissue dynamics by the biomechanical microenvironment'

■ June 2

Esteve Trias, Oscar Fariñas – Barcelona Tissue Bank (Banc de Sang I Teixits)
'Research challenges of the Barcelona Tissue Bank'

■ July 14

Maria Vinaixa, Synthetic Biology for Fine and Speciality Chemicals (SYNBIOCHEM), Manchester Institute of Biotechnology
'Mass spectrometry and metabolomics data analysis for synthetic biology'

■ July 25

Ronen Zaidel-Bar, Mechanobiology Institute Singapore and Tel-Aviv University Medical School
'Regulation of actomyosin contractility in *C. elegans*'

■ September 28

Silvain Muller, RegenHu
'Bioprinting Software for the RegenHU 3DBioprinting System'

■ October 6

Fabio Variola, Associate Professor, Biomedical Engineering, Cellular and Molecular Medicine, University of Ottawa
'At the intersection of biomaterials, surface science and medicine'
Visiting researcher in Elena Martínez's Biomimetic Systems for Cell Engineering group during 2017.

■ October 11

Extra IBEC Seminar: **Stephan Haberstock**, Detection Specialist, Tecan
A user day for multimode microplate readers

■ October 18

Arpita Upadhyaya, Associate Professor, Department of Physics, IPST, University of Maryland
'Push, pull and sense: Forces and mechanosensing in immune cells'

■ December 18

Jonel Trebicka, Laboratory for Liver Fibrosis and Portal Hypertension, Dept of Internal Medicine, University of Bonn
'Liver fibrosis and Portal hypertension'
Visiting researcher in Xavier Trepat's Integrative Cell and Tissue Dynamics group during 2017, funded by the European Foundation for the Study of Chronic Liver Failure (EF-CLIF).

Training in 2017

These pages list the specific training courses that took place at IBEC during 2017.

Every year, IBEC provides a number of ongoing regular courses such as English classes (intermediate and advanced) for all staff and scientists with an IBEC labour contract, and to all PhD students regardless of contracting institution; Yoga classes; Risk prevention courses focused on job requirements in the laboratory, and offices, safety courses and health promotion workshops; and Welcome and Intranet training to offer newcomers information so that their incorporation into IBEC is as fast and smooth as possible.

■ January 18

Using a Scanning Electron Microscope (SEM) (Training activity in Scientific tools & techniques)
Course provider: internal trainer, Core Facilities
For researchers and technicians at IBEC
16 attendees

■ April 26

Curso de Primeros Auxilios (Training activity in Risk Prevention)
Course provider: internal trainer
For all IBEC members
14 attendees

■ May 4

Mindfulness for improved self-mastery & resilience (Training activity in Leadership & management skills)
Course provider: Andrés Martín
For all IBEC members
13 attendees

■ May 8

Say it so it stays: Oral presentation skills training for scientists (Training activity in Transferable skills)
Course provider: Elinor Thompson
For PhD students and postdocs
11 attendees

■ May 18

Mentoring skills for Senior Scientists (Leadership & management skills)
Course provider: Louise Schubert
For Group Leaders participating in the IBEC's Mentoring Programme
9 attendees

■ May 23

Technology Transfer (Training activity in Innovation skills)
Course provider: internal trainer
For all IBEC members
22 attendees

■ May 24

Good practices in a multidisciplinary lab (Scientific tools & techniques)
Course provider: internal trainer
For vocational training students, undergraduate students, master students and PhDs in their first year
15 attendees

■ June 20

Interviewer training: How can I get the right candidate? (Leadership & management skills)
Course provider: Paola Rigiroli
For Group Leaders and Senior Researchers
10 attendees

■ June 27

Image J and video Processing (Scientific tools & techniques)
Course provider: Pere Roca-Cusachs, Group Leader
For PhD students, master students and postdocs
13 attendees

Training in 2017

Training at IBEC develops internal talent and offers an array of courses to meet the needs of IBEC's scientists and staff

■ July 11

Career Development for Scientists (Leadership & management skills)
Course provider: Tobias Maier
For PhD students and postdocs
10 attendees

■ July 13

Science Communication to a non-scientific audience (Transferable skills)
Course provider: Tobias Maier
For all IBEC members
11 attendees

■ September 20

Cross-cultural Communication Skills for Successful Collaboration (Leadership & management skills)
Course provider: Alicia Marín
For all IBEC members
14 attendees

■ September 27

Good practices workshop "How to design experiments" (Scientific tools & techniques)
Course provider: internal trainer
For 1st year PhD and master students
10 attendees

■ October 4

Data Visualization (Scientific tools & techniques)
Course provider: Andy Kirk
For PhD students and postdocs
14 attendees

■ October 17

Becoming a Scientific Writer, putting 'why' before 'how' (Transferable skills)
Course provider: Gavin Lucas
For PhD students and postdocs
13 attendees

■ November 2 and 7

Taller competencial en comunicación y proactividad (Competency workshop on communication and proactivity) (Leadership & management skills)
Course provider: internal trainer
For Support Staff: level 1
12 attendees

■ November 9

Learning to write clearly, the 'how' of good scientific writing (ransferable skills)
Course provider: Gavin Lucas
For PhD students and postdocs
11 attendees

■ November 15 and 23

Taller competencial en comunicación y proactividad (Competency workshop on communication and proactivity) (Leadership & management skills)
Course provider: internal trainer
For Support Staff: level 2
7 attendees

■ November 29

Patents and other IP Rights: What every researcher should know (Innovation skills)
Course provider:
All IBEC members
15 attendees

2017 in review: People
Groups at a glance

In 2017, IBEC had 21 research groups. Group leaders are listed here together with their group name and a top or representative publication from 2017.

Information about IBEC's Associated Researchers can be found on page 94 of the Research and Services section.

Nanoscopy for nanomedicine – Lorenzo Albertazzi

- Duro-Castano, A. et al (2017). Capturing "extraordinary" soft-assembled charge-like polypeptides as a strategy for nanocarrier design. *Advanced Materials* 29, (39), 1702888

Molecular dynamics at cell-biomaterial interface – George Altankov

- Nedjari, S. et al (2017). Three dimensional honeycomb patterned fibrinogen based nanofibers induce substantial osteogenic response of mesenchymal stem cells. *Scientific Reports*, 7 (1): 15947

Mechanics of development and disease – Vito Conte

- Perez-Mockus, G. et al. (2017). Spatial regulation of contractility by Neuralized and Bearded during furrow invagination in Drosophila. *Nature Communications* 8, (1), 1594

Biomaterials for regenerative therapies – Elisabeth Engel

- Oliveira, H.et al (2017). The proangiogenic potential of a novel calcium releasing composite biomaterial: Orthotopic *in vivo* evaluation. *Acta Biomaterialia*, 54 377-385

Nanomalaria (joint group IBEC/ISGlobal) – Xavier Fernandez-Busquets

- Moles, E. et al (2017). ImmunoPEGliposomes for the targeted delivery of novel lipophilic drugs to red blood cells in a *falciparum* malaria murine model. *Biomaterials*, 145 178-191

Nanoscale bioelectrical characterization – Gabriel Gomila

- Biagi, M. C. et al (2017). Direct mapping of the electric permittivity of heterogeneous non-planar thin films at gigahertz frequencies by SMM. *Phys. Chem. Chem. Phys*, 19 (5): 3884-3893

Nanoprobes and nanoswitches – Pau Gorostiza, Fausto Sanz

- Ruiz, M. P. et al (2017). Bioengineering a single-protein junction. *Journal of the American Chemical Society* 139, (43), 15337–15346

Biomedical signal processing and interpretation – Raimon Jané

- Sarlabous, L. et al (2017). Inspiratory muscle activation increases with COPD severity as confirmed by non-invasive mechanomyographic analysis. *PLoS ONE*, 12 (5): e0177730

Signal and information processing for sensing systems – Santiago Marco

- Pomareda, V. et al (2017). Chemical source localization fusing concentration information in the presence of chemical background noise. *Sensors*, 17 (4): 904

Biomimetic systems for cell engineering – Elena Martínez

- Ojosnegros, S. et al. (2017). Eph-ephrin signaling modulated by polymerization and condensation of receptors. *Proceedings of the National Academy of Sciences* 114, (50), 13188-13193

iPSCs and activation of endogenous tissue programs for organ regeneration – Núria Montserrat

- Garreta, E. et al (2017). Tissue engineering by decellularization and 3D bioprinting. *Materials Today* 20, (4), 166-178

Targeted therapeutics and nanodevices – Silvia Muro

- Garnacho. C. et al (2017). Endothelial delivery and effects of acid sphingomyelinase by ICAM-1 targeted nanocarriers in type B Niemann-Pick disease. *Mol. Ther.* 25(7):1686-1696

Cellular and respiratory biomechanics – Daniel Navajas

- Hernández-Vega, A. et al (2017). Polarized cortical tension drives zebrafish epiboly movements. *EMBO Journal*, 36 (1): 25-41

Biosensors for bioengineering – Javier Ramón

- Mohammadi, M. H. et al (2017). Engineered muscle tissues for disease modeling and drug screening applications. *Current Pharmaceutical Design*, 23 (20): 2991-3004

Molecular and cellular neurobiotechnology – José A. Del Río

- Mata, A. et al (2017). Reelin expression in Creutzfeldt-Jakob disease and experimental models of transmissible spongiform encephalopathies. *Molecular Neurobiology*, 54 (8): 6412-6425

Cellular and molecular mechanobiology – Pere Roca-Cusachs

- Oria, R. et al (2017). Force loading explains spatial sensing of ligands by cells. *Nature*, 552 (7684), 219-224

Nanobioengineering – Josep Samitier

- Gállego, I. et al (2017). DNA-origami-driven lithography for patterning on gold surfaces with sub-10 nm resolution. *Advanced Materials* 29, 1603233

Smart nano-bio-devices – Samuel Sánchez

- Katuri, J. et al (2017). Designing micro- and nanoswimmers for specific applications *Accounts of Chemical Research* 50, (1), 2-11

Bacterial infections: antimicrobial therapies – Eduard Torrents

- Crespo, A. et al (2017). Regulation of ribonucleotide synthesis by the *Pseudomonas aeruginosa* two-component system AlgR in response to oxidative stress. *Scientific Reports*, 7 (1): 17892

Integrative cell and tissue dynamics – Xavier Trepat

- Rodríguez, P. et al (2017). Long-lived force patterns and deformation waves at repulsive epithelial boundaries. *Nature Materials* 16, 1029–1037

Synthetic, Perceptive, Emotive & Cognitive Systems (SPECS) – Paul Verschure

- Maffei, G. et al (2017). The perceptual shaping of anticipatory actions. *Proceedings of the Royal Society B*, 284 (1869)

Notes

Notes

Compiled and produced by the Communications and Outreach Unit, IBEC.
Texts by the Communications and Outreach Department.

Picture credits: IBEC's Communications and Outreach Unit; Ricard Badia; Marc Vergés; Jordi Anguera; the staff and scientists of IBEC.

www.ibecbarcelona.eu

Institute for Bioengineering of Catalonia (IBEC)
c/Baldiri Reixac, 10-12
08028 Barcelona, Spain
Tel. +34 934 039 706
Email info@ibecbarcelona.eu

www.ibecbarcelona.eu

A centre of: BIST Barcelona Institute of Science and Technology — A member of: Institució CERCA Centres de Recerca de Catalunya

Universitat de Barcelona · Universitat Politècnica de Catalunya BarcelonaTech · Generalitat de Catalunya · Unió Europea Fons europeu de desenvolupament regional