



IBEC ANNUAL REPORT











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Barcelona Institute of Science and Technology

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INTRODUCTION

BY JOSEP SAMITIER



"The year in which science was more demanded than ever, IBEC was at the forefront" The year in which science was more demanded than ever, IBEC was at the forefront. In 2020, with the outbreak of COVID19 pandemic we showed, once again, that excellent research in bioengineering is at the service of society, helping to improve health and to generate wealth. This annual report is a round-up of the scientific, innovation, and institutional highlights, but also a prove of the extraordinary evolution of IBEC in the last years.

In 2020, IBEC researchers achieved their own record of 184 indexed scientific papers. But this year, in the middle of the lockdown, IBEC also rapidly adapted its laboratories to contribute, together with other research institutes and hospitals, to the analysis of thousands of samples of people at risk of suffering COVID19 within the OR-FEU Programme of Generalitat de Catalunya. Moreover, IBEC scientists such as ICREA Research Professors Nuria Montserrat, Paul Verschure, Javier Ramón or Giuseppe Battaglia reoriented their research, putting bioengineering against SARS-CoV-2 at the centre of their efforts, and leading to the discovery of a drug blocking coronavirus, developing methods to evaluate the impact of lockdowns on mental health or exploring new technologies to fight sequela after coronavirus infection. At the same time, IBEC managed to keep on going its research against diseases besides COVID19. With substantial scientific contributions against cancer, Alzheimer, or tuberculosis, IBEC researchers were able to further contribute to our main mission: to search for bioengineering solutions which can help improving global health challenges.

2020 was also the year in which IBEC researchers were, once again, awarded for their talent and excellence in research. Javier Ramón was selected as new ICREA Research Professor, accounting for a total number of 8 ICREA Research Professors and 2 ICREA Academia Awardees at

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IBEC. Xavier Trepat received this year the highest distinction by the European Research Council (ERC), obtaining the ERC Advanced Grant. Trepat had been previously awarded by ERC with the Starting grant, Consolidator grant and Proof of Concept grant.

Nuria Montserrat, ICREA Research Professor and Group Leader at IBEC received the prestigious ERC Consolidator Grant, and became new member of EMBO, joining the elite in European biology. Nuria Montserrat was also awarded the "Íñigo Álvarez de Toledo" and "Constantes y Vitales" Prizes, thank to her outstanding research in bioengineering for nephrology and against COVID19. Samuel Sánchez, on the other hand, was elected as a new member of the Young Academy of Spain.

Another important award was recognised to Pere Roca-Cusachs, group leader at IBEC and Associate Professor at the Faculty of Medicine of the University of Barcelona (UB), who became full member of the European Molecular Biology Organization (EMBO), a prestigious network that brings together some of the most brilliant researchers in the world.

IBEC also performed at the highest level in clinical collaborations and technology transfer. This year, we also contributed, together with hospitals, to significant advances not only against COVID19, but also against childhood cancer or to a protocol for bioengineered implants for infarcted hearts. In 2020, IBEC also submitted 6 new patents, and we have also signed two license contracts with companies. This 2020 has also been a great year concerning our institutional alliances. In January, we signed a 5-year collaboration agreement with ICMS of TU Eindhoven, a centre with which we have been closely collaborating since 2018. And in February we celebrated an extraordinary and successful first "EMBL-IBEC Winter Conference", also as a result of our 5-year collaboration agreement with EMBL.

IBEC received or visited many distinguished guests such as the Minister of Science and Innovation, Pedro Duque, the Major of Barcelona, Ada Colau, the Director of the Health Institute Carlos III, Raquel Yotti, or Robert Langer from the MIT. And regarding the social impact, we are proud to have reached millions of people with our press and communication activities, hundreds of students with our education and outreach activities and to have been able to launch an initiative with young creative talent, which will bring to life IBBI, the first figure of a Bioengineering Superhero.

Finally, I would like to specially thank all the IBEC community for their essential work, resilience, and commitment in this difficult time for everybody. It has been a year in which we can proudly say that scientists respond fast and without hesitation when world-wide health emergency occurs.

We look forward to 2021, in which we will further bring IBEC and Bioengineering to the forefront.

Institute for Bioengineering of Catalonia

Josep Samitier Director of IBEC INTRODUCTION

A YEAR IN NUMBERS







BIG SCIENTIFIC AWARDS

<u>NEW EU</u> <u>COORDINATED</u> <u>PROJECTS</u> 17 PHD THESES DEFENDED





<u>NEW SUPPLY AND</u> <u>COMMERCIALIZATION</u> <u>AGREEMENT</u> <u>NEW "LA CAIXA HEALTH"</u> <u>GRANTS</u>

860K € '

INVOICED TO COMPANIES FOR CONTRACT RESEARCH AGREEMENTS >28,9M







LAUNCH OF THE "SUPERFRIENDS PROGRAMME" PREPARATION OF FIRST BIOENGINEERING SUPERHERO

INTRODUCTION

RESEARCH GROUPS



Research Group: NANOSCOPY FOR NANOMEDICINE

Group Leader: Lorenzo Albertazzi

Selected publication: E. Fuentes et al. (2020). An azobenzene-based single-component supramolecular polymer responsive to multiple stimuli in water. *Journal of the American Chemical Society* 142, (22), 10069-10078.



Research Group: MOLECULAR BIONICS

Group Leader: Giuseppe Battaglia

Selected publication: X. Tian et al. (2020). On the shuttling across the blood-brain barrier via tubule formation: Mechanism and cargo avidity bias. *Science Advances* 6, (48).

Research Group:

PROTEIN PHASE TRANSITIONS IN HEALTH AND DISEASE

Group Leader: Benedetta Bolognesi

Selected publication: M. Badia and B. Bolognesi (accepted in 2020). Assembling the right type of switch: Protein condensation to signal cell death. "Curr Opin Cell Biol", 15;69:55-61.



Research Group:

SYNTHETIC MORPHOGENESIS

Group Leader: Vito Conte





BIOMATERIALS FOR REGENERATIVE THERAPIES

Group Leader: Elisabeth Engel

Selected publication: G. Rubí-Sans et al. (2020). Development of a three-dimensional bioengineered platform for articular cartilage regeneration. *Biomolecules* 10, (1), 52.



Research Group:

Group Leader: Xavier Fernández- Busquets

Selected publication: A. Biosca et al. (2020) Detection of protein aggregation in live *Plasmodium* parasites. *Antimicrob. Agents Chemother.* 64, e02135-19.

Research Group:

NANOSCALE BIOELECTRICAL CHARACTERIZATION

Group Leader: Gabriel Gomila

Selected publication: A. Kyndiah et al., (2020). Nanoscale mapping of the conductivity and interfacial capacitance of an electrolyte-gated organic field-effect transistor under operation. *Advanced Functional Materials*, 2008032.



Research Group:

NANOPROBES AND NANOSWITCHES

Group Leader: Pau Gorostiza

Selected publication: N. Camarero et al., (2020). Photoswitchable dynasore analogs to control endocytosis with light. *Chemical Science* 11, (33), 8981-8988.





BIOMEDICAL SIGNAL PROCESSING AND INTERPRETATION

Group Leader: Raimon Jané

Selected publication: M. Calvo et al., (2020). Health outcomes from home hospitalization: Multisource predictive modeling. *Journal of Medical Internet Research* 22, (10), e21367.



Research Group:

SIGNAL AND INFORMATION PROCESSING FOR SENSING SYSTEMS

Group Leader: Santiago Marco

Selected publication: F. Madrid-Gambin et al., (2020). AlpsNMR: an R package for signal processing of fully untargeted NMR-based metabolomics. *Bioinformatics* 36, (9), 2943–2945.

Research Group:

BIOMIMETIC SYSTEMS FOR CELL ENGINEERING

Group Leader: Elena Martínez

Selected publication: A. Vila et al. (2020). Hydrogel conetworks of gelatine methacrylate and poly(ethylene glycol) diacrylate sustain 3D functional *in vitro* models of intestinal mucosa. *Biofabrication* 12, 025008.



Research Group:

PLURIPOTENCY FOR ORGAN REGENERATION

Group Leader: Núria Montserrat

Selected publication: V. Monteil et al., (2020). Inhibition of SARS-CoV-2 infections in engineered human tissues using clinical-grade soluble human ACE2. *Cell* 181, (4), 905-913.e7.





TARGETED THERAPEUTICS AND NANODEVICES

Group Leader: Silvia Muro

Selected publication: R. Manthe et al., (2020). Intertwined mechanisms define transport of anti-ICAM nanocarriers across the endothelium and brain delivery of a therapeutic enzyme. *Journal of Controlled Release* 324, 181-193.



Research Group:

CELLULAR AND RESPIRATORY BIOMECHANICS

Group Leader: Daniel Navajas

Selected publication: C. Prat-Vidal, et al., (2020). First-in-human PeriCord cardiac bioimplant: Scalability and GMP manufacturing of an allogeneic engineered tissue graft. *EBioMedicine* 54, 102729.

Research Group:

BIOSENSORS FOR BIOENGINEERING

Group Leader: Javier Ramón Azcón

Selected publication: F. Velasco et al., (2020). New volumetric CNT-doped Gelatin-Cellulose scaffold for skeletal muscle tissue engineering. *Nanoscale Advances* 2, (7), 2885-2896.



Research Group:

MOLECULAR AND CELLULAR NEUROBIOTECHNOLOGY

Group Leader: José Antonio del Río.

Selected publication: J. Sala-Jarque et al.,, (2020). Neuromuscular Activity Induces Paracrine Signaling and Triggers Axonal Regrowth after Injury in Microfluidic Lab-On-Chip Devices. *Cells*, 9 (2).





CELLULAR AND MOLECULAR MECHANOBIOLOGY

Group Leader: Pere Roca-Cusachs

Selected publication: M. Lerche et al. (2020). Integrin Binding Dynamics Modulate Ligand-Specific Mechanosensing in Mammary Gland Fibroblasts. *IScience*, 23 (3), 100907.



Research Group:

NANOBIOENGINEERING

Group Leader: Josep Samitier

Selected publication: C. Alcon et al. (2020) Sequential combinations of chemotherapeutic agents with BH3 mimetics to treat rhabdomyosarcoma and avoid resistance. *Cell Death & Disease*, 11 (8): 634.

Research Group:

SMART NANO-BIO-DEVICES

Group Leader: Samuel Sánchez

Selected publication: Hortelão et al. (2020). LipoBots: Using liposomal vesicles as protective shell of urease-based nanomotors. *Advanced Functional Materials* 30, (42), 2002767.



Research Group:

BACTERIAL INFECTIONS: ANTIMICROBIAL THERAPIES

Group Leader: Eduard Torrents

Selected publication: M. Cendra and E. Torrents (2020). Differential adaptability between reference strains and clinical isolates of Pseudomonas aeruginosa into the lung epithelium intracellular lifestyle. *Virulence* 11, (1), 862-876.





INTEGRATIVE CELL AND TISSUE DYNAMICS

Group Leader: Xavier Trepat

Selected publication: M. Gómez-González et al., (2020). Measuring mechanical stress in living tissues. *Nature Reviews Physics* 2, (6), 300-317.



Research Group:

SYNTHETIC, PERCEPTIVE, EMOTIVE AND COGNITIVE SYSTEMS (SPECS)

Group Leader: Paul Verschure

Selected Publication: H. López-Carral et al. (2020). Subjective ratings of emotive stimuli predict the impact of the COVID-19 quarantine on affective states. *PLOS ONE*, 15, (8), e0237631.

SCIENTIFIC HIGHLIGHTS

RESEARCHERS CONTRIBUTE TO IDENTIFYING A DRUG IN CLINICAL PHASE THAT BLOCKS THE EFFECTS OF SARS-CoV-2



IBEC researchers led by ICREA Research Professor Nuria Montserrat, together with international collaborators, achieved in 2020 a highlight against COVID-19 in the most challenging time of the pandemic. Montserrat and colleagues used organoids generated by bioengineering techniques to decipher how SARS-CoV-2 interacts and infects human kidney cells. Researchers also identified a drug capable of inhibiting the infection by SARS-CoV-2, the origin of the coronavirus disease 2019, on engineered human tissues.

To do so, researchers focused on a receptor called ACE2, which is expressed in the lungs but also in multiple tissues, including the heart, blood vessels, intestine, and kidneys, which would explain the multi-organ dysfunction seen in patients. The fact that this receptor is strongly expressed in the kidneys and that SARS-CoV-2 can be found in urine, is what has led the researchers to use these human kidney organoids as a testing model, whose creation Montserrat is an international benchmark.

First, the researchers proved that the kidney organoids contained different groups of cells that expressed ACE2 receptor in a similar way to that seen in the native tissue, and then proceeded to infect them with SARS-CoV-2. Once they obtained these infected mini-kidneys, they applied different therapies, and, as a result of the study, they concluded that hrsACE2 (human recombinant soluble ACE2), a drug that has already passed phase 1 clinical trials (in healthy volunteers) and phase 2 (in patients with acute respiratory distress syndrome), significantly inhibits SARS-CoV-2 infections and reduces the viral load.

The treatment, that was proven effective in mini-kidneys generated from human stem cells, is planned to be tested on two hundred COVID-19 patients, in collaboration with hospitals, as explained in section "Clinical Collaborations".

The work of Montserrat and international colleagues was published in the prestigious journal *Cell*.



Monteil et al, (2020). Inhibition of SARS-CoV-2 infections in engineered human tissues using clinical-grade soluble human ACE2. Cell , Vol 181, Issue 4, P905-913.

A NEW METHOD CONFIRMS THE IMPACT OF COVID-19 CONFINEMENT MEASURES ON MENTAL HEALTH AND WELLBEING



Researchers from the SPECS Lab led by ICREA Research Professor Paul Verschure developed a new method to evaluate the mental health and wellbeing of people living under strict confinement measures such those during COVID-19 pandemic. The study, conducted with people living in 17 countries, confirmed that confinement measurements lead to a negative impact on the emotional wellbeing. The researchers also detected some personal situations that can entail a higher risk for the mental health and wellbeing. The experiment was performed between the 9th and the 20th of April 2020, with 112 subjects (64.29 % females). The international sample was composed by people from 19 nationalities living in 17 European countries (53,57% in Spain). During the study, participants were asked to rate the emotional content of a series of 30 affective images in terms of the negativity or positivity (valence or pleasure) of their content, as well as the intensity (arousal). After this, the participants answered questions to assess their personal living situation during the confinement. Moreover, the authors applied machine learning techniques to assess the plausibility of automatic identification of participants who might be more at risk of developing mood disorders.

Researchers are also working on a system that will be able to provide continuous monitoring of emotional health using smartphone apps. This would enable an at-home remote diagnostics system at a low cost, allowing clinicians to diagnose, monitor and treat individuals who present emotional alterations.

H. López-Carral et al. (2020). Subjective ratings of emotive stimuli predict the impact of the COVID-19 quarantine on affective states. PLOS ONE. 15(8): e0237631.

approach with a new type of nanomotors, called LipoBots (LBs), driven by the enzyme urease.

Researchers developed functional nanostructures in which the enzymes that provide fuel for movement—urease molecules in this case—were encapsulated in a liposome, i.e., a spherical vesicle that has a lipid surface of at least two layers. In order to compare, they also synthesized another type of nanomotor, in which the urease enzymes were attached to the outer surface of the liposome.

This research opens the way for the application of encapsulated LipoBots to the development of new active drug administration systems. Since their enzymatic features are preserved after exposure to a hostile environment and their movement is activated *in situ*, these liposomes-based nanomotors could be used, for example, in the gastrointestinal tract, where bile salts are naturally present .

A. Hortelão et al. (2020). LipoBots: Using Liposomal Vesicles as Protective Shell of Urease-Based Nanomotors. Adv. Funct. Mat., Vol. 30, Issue 42.

LIPOBOTS: ROBUST NANOMOTORS FOR BIOMEDICAL APPLICATIONS



A team of researchers led by ICREA Research Professor Samuel Sánchez and Smart Nano-Bio-Devices Group Leader at IBEC developed self-propeld nanomotors that retain their functionalities after being exposed to different acidic pHs due to enzymatic encapsulation. IBEC and ICN2 researchers demonstrated, as described in an article published in *Advanced Functional Materials*, the validity of this BIOENGINEERING AGAINST THE MOST RESISTANT AND DEADLY BACTERIAL INFECTION



Even in times of coronavirus, tuberculosis remains the deadliest infectious disease worldwide. It is estimated that a third of the population is affected by *Mycobacterium tuberculosis*, the bacterium responsible for tuberculosis. Currently, the most widely used therapy to fight diseases such as tuberculosis consists of the combined administration of large amounts of antibiotics over a long period of time.

In 2020, an international team, led by ICREA Research Professor and Group Leader at IBEC Giuseppe Battaglia, carried out a study that opens the door to a new therapy capable of quickly and effectively eliminating infections caused by intracellular bacteria, the most resistant to immune defences. -> Together with researchers from several international institutions, IBEC experts have shown the ability of synthetic vesicles to penetrate macrophages and specifically release drugs to lower and, in some cases, even eliminate infection. The paper, published in the ACS Nano Journal, shows the efficacy of this therapy in reducing the bacterial load of macrophages infected by *Mycobacterium tuberculosis* as well as other intracellular bacteria. The researchers managed to totally eradicate infection according to the combination of drugs, in both *in vitro* experiments, with human cells, and *in vivo*, using zebrafish as animal model.

F. Fenaroli et al. (2020). Polymersomes eradicating intracellular bacteria. ACS Nano, Vol. 14, Issue 7, 8287–8298.



RESEARCHERS IDENTIFY A MECHANISM THAT EXPLAINS THE RECURRENCE OF MANY LUNG INFECTIONS

A team of researchers led by IBEC Group Leader and UB Professor Eduard Torrents discovered that strains of the bacterium *Pseudomonas aeruginosa* isolated from patients are more persistent than laboratory strains and propose a molecular mechanism to explain intracellular survival. The study, published in the journal *Virulence*, finds that the class II ribonucleotide reductase enzyme (RNR) plays a key role in frequent lung infections, for example, those that occur in patients with cystic fibrosis.

This discovery can help to develop medications to prevent recurrences of lung infections. "A drug against this new antimicrobial target, RNR class II, could be helpful in inhibiting the bacterium during its intracellular persistence," explains Dr. Torrents. Also, since humans don't have this enzyme, it would be a very selective therapy and the therapeutic approach could be useful for infections caused by *P. aeruginosa* also in other organs.

M. Del Mar Cendra and E. Torrents (2020). Differential adaptability between reference strains and clinical isolates of Pseudomonas aeruginosa into the lung epithelium intracellular lifestyle. Virulence, Vol. 11, Issue1, 862-876. NEW MOLECULES DEVELOPED AT IBEC ALLOW DILATING THE PUPIL WITH LIGHT



Current dilation procedures performed to examine the optic nerve and the retina present adverse side effects such as blurred vision, increased sensitivity to light, and increased eye pressure.

Now, researchers from the 'Nanoprobes and Nanoswitches' group of the Institute for Bioengineering of Catalonia (IBEC), and the CIBER-BBN, led by research professor ICREA Pau Gorostiza, in collaboration with other research institutes (UAH, EHU, UAB, IRYCIS, IDIBAPS, IRB), have found an innovative alternative. In a study published in the journal *Angewandte Chemie International Edition*, researchers have shown that adrenergic receptors or adrenoreceptors can be "switched on and off" using light and a set of new molecules developed at IBEC. Researchers called these innovative molecules "adrenoswitches", or "adrenergic switches".

They demonstrated, first, that these "adrenoswitches" are capable, under the right conditions of illumination, of dilating blood vessels in rats (antihypertensive effect) and reducing mobility in zebrafish (sedative effect).

Researchers at IBEC envisioned a drug that would dilate the pupil only during the exam, and then de-activate, as soon as the light is gone.

D. Prischich et al., (2020). Adrenergic modulation with photochromic ligands. Angewandte Chemie, International Edition. Vol. 60, Issue 7,3625-3631.

CHEMICAL LEGO BLOCKS FOR HEALTH SOLUTIONS



IBEC researchers develop new multi-responsive molecules able to self-assemble in water forming fibre-like structures. The so-called discotic molecules show responsiveness to temperature, light, pH and ionic strength, and they might show great potential for medical applications such as drug delivery systems, diagnosis or tissue engineering.

The Group of Lorenzo Albertazzi at IBEC started a fruitful collaboration with the Group of Ilja Voets at ICMS, at the Technical University in Eindhoven. But not only this, two other groups of experts joined this collaboration: the Nanoprobes and Nanoswitches Group led by Pau Gorostiza at IBEC and the Polymer Chemistry and Materials Group led by José Berrocal at Adolphe Merkle Institute in Switzerland. As a result of this great team, researchers have recently reported a highlight paper published by Journal of the *American Society of Chemistry (JACS)*.

The disk-like molecule synthesized in Barcelona incorporated a peptidic part made of lysine (pH responsive), an octaethylene glycol chain responsive to temperature and an azobenzene part which responds to light stimuli. Researchers observe that when combining these parts into a single molecule, the final compound keeps responsiveness, changing its charge and shape. And even more fascinating, these changes can promote the disc-like molecules to stack one on top of each other forming a pile of molecules.

E. Fuentes et al. (2020). An Azobenzene-Based Single-Component Supramolecular Polymer Responsive to Multiple Stimuli in Water. JACS, Vol. 142, Issue 22, 10069-10078.

ELECTRIC FORCES CHARACTERIZE FUTURE BIOCOMPATIBLE ORGANIC ELECTRONIC DEVICES



Electronic biosensors based on organic materials are currently evolving at a very fast rate. Organic bioelectronic devices like the Electrolyte Gated Organic Field Effect Transistor (EGOFET) or the Organic Electrochemical Transistor (OECT) can make soon a reality the dream of lowcost, disposable, flexible and biocompatible electronic devices for the interaction with biological systems.

In 2020, a joint collaboration between the Nanoscale bioelectrical characterization group, led by Gabriel Gomila, IBEC Group Leader and UB Professor, the Institute of Materials Science of Barcelona (ICMAB) and The University of Manchester has succeeded in mapping the electrical properties of organic biosensor/electrolyte interfaces at the nanoscale by measuring local electric forces.

This study, by visualizing electrical properties of biosensor interfaces that until now had remained invisible, offers novel avenues for the optimization of the performance of the organic biosensor devices and paves the way for its faster adoption in applications in the medical real.

A. Kyndiah et al (2020). Nanoscale Mapping of the Conductivity and Interfacial Capacitance of an Electrolyte-Gated Organic Field-Effect Transistor under Operation. Advanced Functional Materials. Vol.31, Issue5, 2008032.



RESEARCHERS IDENTIFY THE GENES THAT PROTECT **AGAINST KIDNEY DISEASES**

Chronic kidney disease affects more than 697 million people around the world. Researchers from IBEC, led by ICREA Research Professor Nuria Montserrat, in collaboration with international researchers from the University of Pennsylvania and the Gwangju Institute of Science and Technology in Sowth Corea, identified the genes that could protect the kidney from chronic damage.

Using innovative techniques such as single cell RNA-sequencing, the researchers unravelled the crucial role that lipid metabolism genes play in protecting against chronic kidney failure, observing for the first time important differences between healthy and diseased cells in the proximal tubule. For this, analyses were carried out with animal models and human mini-kidneys. The results were validated using almost one hundred patient samples.

Then researchers identified the genes protecting from damage, using mini-kidneys created from human stem cells and generated in the laboratory. In the study, published in the journal Cell Metabolism, they also demonstrate in animal models that it is possible to reverse this deficiency, and that the proximal tubule cells could regain their function in the different study models.

P. Dhillon et al (2021). The nuclear receptor ESRRA protects from kidney disease by coupling metabolism and differentiation. Cell Metabolism, Vol. 33, Issue 2, 379-394.



A NEW WAY TO EFFECTIVELY TRANSPORT DRUGS TO THE BRAIN

An international group of researchers from the University of Maryland (United States) and the Institute for Bioengineering of Catalonia (IBEC) led by ICREA Research Professor Silvia Muro, identified a new way of transporting drugs to the brain, one of the major challenges of the pharmaceutical science today, that could help to come up with new treatments for neurological diseases such as Parkinson or Alzheimer.

The Blood-Brain Barrier (BBB) works effectively by protecting the brain from pathogens and toxic substances circulating in the blood, which makes diseases affecting the brain difficult to treat, since 98% of drugs cannot cross it.

In order to find solutions to this challenge, the experts linked an antibody capable of recognizing the ICAM-1 protein - a molecule expressed on the surface of blood vessels - to a series of polymeric nanoparticles that can transport drugs and inject them intravenously to mice. Researchers reported that shortly after its administration in mice, the nanoparticles coated with this antibody managed to reach the brain by crossing the BBB.

The results of this work are summarized in a scientific paper published in the prestigious Journal of Controlled Release.

R. Manthe et al. (2020). Intertwined mechanisms define transport of anti-ICAM nanocarriers across the endothelium and brain delivery of a therapeutic enzyme. Journal of Controlled Release. Vol.324, 181-193.



IDENTIFIED A NEW REPAIRING MECHANISM OF THE PERIPHERAL NERVOUS

SYSTEM BY APPLYING **BIOENGINEERING TECHNIQUES**

A research group at the Institute for Bioengineering of Catalonia (IBEC) led by José Antonio del Río, Group Leader of the Cellular and Molecular Neurobiotechnology laboratory and UB Professor, and Arnau Hervera, Post-Doctoral researcher in the same group, have developed a device --- lab-on-a-chip— to study and repair injuries in the nervous system by combining two technologies based in bioengineering: microfluidics —which uses systems that process or manipulate very small quantities of fluids through channels with the aim of studying the response to different stimuli- and optogenetics —which combines light and genetic engineering to control the neuronal activity—. This last one is extremely useful in neurobiology because enables the modulation of cellular activity using light, without the need of electrical field stimulation, which is nonspecific and can cause cell damage.

Thanks to the combination of microfluidics and optogenetics the experts discovered that the muscle sends regenerative signals to the neurons in order to promote reconnexion and restorage of functions and contraction control lost after the injury.

J. Sala-Jarque et al (2020). Neuromuscular Activity Induces Paracrine Signaling and Triggers Axonal Regrowth after Injury in Microfluidic Lab-On-Chip Devices. Cells, Vol. 9, issue 2, p.302.

IBEC RESEARCHERS DESCRIBE HOW TO MEASURE MECHANICAL STRESS IN LIVING TISSUES



A team of experts from the Institute for Bioengineering of Catalonia (IBEC) led by ICREA Research Professor Xavier Trepat in collaboration with Prof. Marino Arroyo, UPC Professor and associated researcher at IBEC, published a review in the journal *Nature Reviews Physics* detailing the different techniques used to calculate mechanical stress in tissues, both in cell cultures and *in vivo*. Determining these mechanisms of mechanical stress is crucial to study processes linked to morphogenesis, homeostasis, and diseases such as cancer.

A group of IBEC researchers have examined and reviewed the different types of tools that exist today to measure mechanical stress in tissues at both cellular and subcellular resolution. In the article, experts discuss the advantages and disadvantages of each technique and propose the optimization of theirs use based on these strengths and weaknesses.

On the one hand, the operation of techniques applicable to 2D cell cultures were described in detail, such as traction force microscopy (TFM), micropillar arrays, monolayer stress microscopy (MSM) and suspended monolayers. On the other hand, techniques to measure mechanical stress in 3D cell cultures were examined. Specifically, 2.5D and 3D traction

force microscopy (2.5 TFM and 3D TFM) and the microbulge test. Finally, the researchers evaluated *in vivo* measurement methods, such as pressure gauges, inclusions, FRET tension sensors, laser ablation and force-inference methods.

M. Gómez-González et al. (2020). Measuring mechanical stress in living tissues. Nature Reviews Physics. Vol. 2, p 300–317.

NANOTECHNOLOGY TO IMPROVE HUMAN TISSUE GROWTH IN THE LABORATORY



Pharmaceutical industry for medicine is based on the production of drugs that must pass exhaustive assays that rely almost exclusively on animal models or *in vitro* cell culture. The first entails some ethical problems besides the difficulty to extrapolate the data to human conditions. On the other hand, *in vitro* cell cultures are difficult to establish and to simulate the complex cell–cell and cell– matrix interactions that are decisive in the regulation of cell performance.

Researchers at IBEC led by ICREA Research Professor Javier Ramón developed an innovative scaffold combining carbon nanotubes with cryogel technology that allows muscle tissues growth at the millimetre scale in the laboratory. The newly developed biocomposite scaffold gets together the good tissue regeneration properties of the gelatin, and the cellulose and carbon nanotubes, which improves the mechanical stability and increases the scaffold's electrical features. This technology opens the door to potential applications in fields such as organ transplantation and engineering, drug screening and disease modelling, as it will improve the "organ-on-a-chip" technology that simulates the activities, mechanics and physiological response of entire organs. This innovative scaffold, based on nano and cryogel technology, which allows growing tissues at the millimetre scale in the laboratory, was reported in the journal of *Nanoscale Advances*.

F. Velasco-Mallorquí et al. (2020). New volumetric CNT-doped Gelatin-Cellulose scaffolds for skeletal muscle tissue engineering. Nanoscale Adv., Vol. 2, Issue 7, 2885-2896.

A "TUBULAR SHUTTLE" TO TRAVEL TO THE BRAIN



Imbalances in the Blood-Brain Barrier (BBB) are the basis of many pathologies related to brain deterioration and are therefore behind diseases such as Alzheimer's. In 2020, a team made up of scientists from China, USA, Italy, the United Kingdom and Spain led by ICREA Research Professor Giuseppe Battaglia at IBEC, described how the transport of molecules occurs through brain endothelial cells, located in the blood-brain barrier. The study, published in the prestigious journal Science Advances, elucidated for the first time the mechanism by which the low-density lipoprotein receptor-related protein 1 (LRP1) activates vesicular or tubular transport. They used synthetic small constructs in the size range of viruses, called polymersomes, modified with LRP1 ligands both in mice and rats. Indeed, in vivo and in vitro studies show how the avidity between the cargo to be transported and the receptor plays a determining role, bringing light to safe and efficient entrance of drugs to the brain via tubular channels.

X. Tian et al. (2020). On the shuttling across the blood-brain barrier via tubule formation: mechanism and cargo avidity bias. Science Advances, Vol. 6, Issue 48, eabc4397.

LIGHTS, CELLS, ACTION! IBEC DEVELOPS SMALL MOLECULES ABLE TO CONTROL ENDOCYTOSIS WITH LIGHT



Endocytosis is a mechanism used by all eukaryotic cells to internalize extracellular material and regulates key physiological processes as the uptake of nutrients and growth factors. Moreover, it also constitutes the entry pathway of a variety of pathogens. IBEC's research group "Nanoprobes and nanoswitches" led by ICREA Research Professor Pau Gorostiza created, in collaboration with IQAC-CSIC, IPMC, IRB, IDIBELL, UB and UAB, the so-called "Dynazos": the first inhibitors of endocytosis controlled by light.

The newly developed light-sensitive small-molecule inhibitors of endocytosis (called dynazos) are water-soluble, cell permeable, photostable, and enable fast photoswitchable inhibition of endocytosis. This technology will allow more accurate and controlled studies where endocytosis is crucial, as in cellular grow, differentiation and motility.

N. Camarero et al. (2020). Photoswitchable dynasore analogs to control endocytosis with light. Chem. Sci., Vol. 11, Issue 33, 8981-8988.

NANOSCALE CELLULAR ADHESION IS A KEY FACTOR FOR CARTILAGE PRODUCTION IN VITRO



Adhesion-assisted mesenchymal cell recruitment and condensation

The World Health Organization estimates that more than 300 million people in the world suffer osteoarthritis each year. This disease entails a progressive tear and degradation of cartilage in the joints, leading to chronic pain and impaired mobility. IBEC Nanobioengineering research group, led by UB Professor Josep Samitier, published in the *International Journal of Molecular Sciences* a research work that deals with the cartilage generation *in vitro* using human mesenchymal stem cells (MSCs).

The group of Professor Samitier used nanopatterns, substrates for cell culture to control and modify MSCs adhesion during the early steps of cartilage formation. By modifying the amount and spacing between the RGD motifs in the nanopatterns, they determined that there is more differentiation when using certain nanopatterns (those presenting 90% of their surface with a distance between RGD motifs lower than 70 nm).

I. Casanellas et al. (2020). The Janus Role of Adhesion in Chondrogenesis. Int. J. Mol. Sci. Viol. 21, Issue15, 5269.



INSTITUTIONAL HIGHLIGHTS

IBEC SIGNS A NEW AGREEMENT WITH ICMS AT TU EINDHOVEN



The Institute for Bioengineering of Catalonia (IBEC) and the Institute for Complex Molecular Systems (ICMS), a research institute of the Eindhoven University of Technology (TU/e), signed the first agreement between the two institutes to foster their collaboration. Both research centres share similarities such as their multidisciplinarity, their active missions to connect with industry and clinicians, and a strong research in nanomedicine, chemical biology, chip technology, regenerative medicine and tissue engineering. This institutional alliance will allow to share resources, knowledge and provide mobility programs.

This partnership will have an initial duration of five years and will explore mutual cooperation in the areas of scientific research, infrastructures and education. Moreover, this alliance enables the application for joint international project proposals and offer joint master, doctorate and postdoctoral programs.

The collaboration started back in 2018 when ICMS and IBEC planted the first seed of this promising partnership by celebrating the first joint symposium in Eindhoven.

IBEC LEADS THREE NEW EUROPEAN PROJECTS



The Europan Union granted in 2020 the coordination of three European projects IBEC to continue combining medicine, science and technology with the aim of improving people's health.

The first one was the BRIGHTER project, led by Professor Elena Martínez, group leader of the 'Biomimetic Systems for Cell Engineering' group and UB Professor. The EU has contributed to this initiative that will be used by the consortium partners to develop an innovative high resolution 3D bioprinting technology able to fabricate 3D cell culture substrates which could be useful to produce artificial organs in the future.

The second initiative is the BLOC, project, which is led by the ICREA Research Professor and Group Leader Javier Ramón and the Postdoctoral Researcher Irene Marco, both of the 'Biosensors for Bioengineering' group. The EU is backing this collaborative Project that will be devoted to design a new technology capable of monitoring metabolic diseases such as type 2 diabetes and to assess the response to some drugs.

Finally, through the nAngioDerm project, IBEC and their international partners will promote the development of new techniques for skin regeneration using nanoparticles. This initiative coordinated by Professor Elisabeth Engel, Group Leader of the 'Biomaterials for regenerative therapies' group at IBEC and UPC Professor, is specifically focused in regenerating the tissue of chronic wounds and skin burns.

JAVIER RAMÓN, NEW ICREA PROFESSOR AT IBEC



Javier Ramón, Group Leader of the "Biosensors for Bioengineering" group at IBEC, was appointed new Research Professor by the Catalan Institution for Research and Advanced Studies, ICREA.

ICREA is a foundation funded by the Catalan Government aimed at recruiting the most extraordinary and talented international scientific researchers. With this appointment, IBEC hosts 8 ICREA Professors and 2 ICREA Academia (UB affiliated professors), one of the highest numbers among all research centres in Catalonia.

After a stay in Japan as an associated researcher and Assistant Professor at the University of Hygo and Tohoku, Javier Ramón joined IBEC in 2015 obtaining the prestigious grant "Ramón y Cajal". In 2017, he received the prestigious "ERC Starting Grant", worth 1.5 million euros, to design a multi-organ-on-a-chip to test drugs against Diabetis. In January 2020, Professor Ramón received almost three million euros of funding to lead the BLOC project funded by the European Union as part of the programme H2020 Future and Emerging Technologies (FET).

The group led by Javier Ramón integrates biosensor technology and nanotechnology with stem cell research and with tissue engineering. This combination of fully functional tissues with microscale biosensors technology enables the design of devices that can be used, for example, in pharmaceutical assays to test drugs with the patient's own cells and also to develop knowledge about tissue construction and its functions and it's relation to human diseases.



XAVIER TREPAT RECEIVES THE ERC ADVANCED GRANT TO LAY THE BASIS OF A NEW GENERATION OF BIOLOGICAL MACHINES

ICREA Research Professor at IBEC, Xavier Trepat, received in 2020 the prestigious ERC Advanced Grant awarded by the European Research Council (ERC) worth 2.5 million euros. Previously, Professor Trepat had obtained the "Starting grant", "Consolidator grant" and "Proof of Concept grant", all of them awarded by the ERC.

Thanks to this new grant the expert and his group will be able to study the mechanical properties of the epithelium in 3D and to lay the foundations for a pioneering technology called "Epifluidics", which will allow the design and Developing of a brand-new technology towards engineered biological entities. What is most innovative and ambitious about this project is that these principles will be applied to the design of a new generation of biohybrid devices with a unique potential to power functions such as filtration, secretion, self-regeneration, or propulsion.

These unique micro-robots built with hydrogels and epithelia cell layers will be able to maintain the multifunctional and self-regenerating properties of the epithelium, as well as being able to sense, absorb, secrete, filter and carry out enzymatic activities.



NURIA MONTSERRAT AWARDED THE "ERC CONSOLIDATOR GRANT" TO STUDY KIDNEY DISEASES USING BIOENGINEERED ORGANOIDS

Nuria Montserrat, ICREA Research Professor and Group Leader at IBEC, was awarded the prestigious "Consolidator Grant" from the European Research Council (ERC). Having finished her previous 5-year funded Starting Grant Project, the new ENGINORG project will allow to Professor Montserrat and her team at IBEC working in identifying and understanding the interaction between metabolism and mechanobiology in embryonic kidney development, as well as during kidney disease.

The European Research Council announced the list of winners of the competition for the prestigious "ERC Consolidator Grants". Of the 2506 proposals submitted this year, only 327 have been selected, a 13% that will be funded with a total of 655 million euros. In this edition, 37% of the grants were awarded to female researchers, the highest ratio since the start of the European Consolidator Grants.



PERE ROCA-CUSACHS BECOMES FULL MEMBER OF THE EUROPEAN ELITE IN BIOLOGY

Pere Roca-Cusachs, group leader at the Institute for Bioengineering of Catalonia (IBEC) and Associate Professor at the Faculty of Medicine of the University of Barcelona (UB), was selected to join, as a full member, the European Molecular Biology Organization (EMBO), a prestigious network that brings together some of the most brilliant researchers in the world. Roca-Cusachs is a pioneer in Europe in the mechanobiology field and in the study of how physical forces affect diseases such as cancer. As leader of the "Cellular and Molecular Mechanobiology" group at IBEC, Prof. Roca-Cusachs focuses his research to unravel the mechanisms that cells and molecules use to detect and respond to mechanical forces and stimuli, such as, for example, tissue stiffness. These environmental stimuli determine how cells proliferate, differentiate, and move, and regulate processes such as embryonic development, tumour progression, or wound healing.

Since 2017, Pere Roca-Cusachs leads the "Mechano-Control" project, which, with funding from the European Union of more than 7 million euros, seeks to decipher and control how cells transmit and detect mechanical forces. The objective of Mechano-Control is to identify new tools to slow the progression of cancer and especially against breast cancer.

NURIA MONTSERRAT SELECTED AS NEW MEMBER OF THE EMBO YOUNG INVESTIGATOR PROGRAMME



Nuria Montserrat was selected to join The European Molecular Biology Organization (EMBO), a prestigious network that brings together some of the most brilliant researchers in life sciences in the world. This year only 30 scientists have been selected among 216 candidates. The selected scientists will join the existing network of 73 current and 384 former members of the program. The new EMBO Young Investigators will receive financial and practical support for a period of four years, starting in January 2021 and they will benefit from a variety of networking opportunities.

The EMBO members are excellent scientists who carry out cutting-edge research in the different disciplines of the life sciences, among which there are 88 members who have received Nobel prizes. Nuria Montserrat will join the group of two other Group Leaders at IBEC who are members of EMBO: Xavier Trepat, who is member since 2018, and Pere Roca-Cusachs who was accepted in 2016 in the "EMBO Young Investigator Programme" and became full member in 2020.

JOSEP SAMITIER, AWARDED WITH THE NARCÍS MONTURIOL MEDAL FOR HIS CONTRIBUTION TO SCIENCE AND TECHNOLOGY



The Catalan Government awarded the Narcís Monturiol Medal award for scientific and technological merit to Josep Samitier Martí, for his contribution to the development of the Catalan system of science and technology. Josep Samitier Martí is Director of the Institute for Bioengineering of Catalonia (IBEC), Professor of the Department of Electronic and Biomedical Engineering at the University of Barcelona (UB) and President of the Catalan Association of Research Entities (ACER). He is a promoter of nanobioengineering through the research group he leads at IBEC, which focuses on applying nanotechnology to develop new biomedical systems and devices, mainly for diagnostic purposes, and integrated organ-on-a-chip microfluidic devices, to study diseases and for drug screening.

In total, ten researchers from the Catalan knowledge system (six men and four women) have received this distinction, as well as a research center that has been awarded the Narcís Monturiol Plaque, which recognizes an institution in the country.

BIOENGINEERING AGAINST CANCER: IBEC RESEARCHERS RECEIVE FUNDING FROM LA CAIXA FOUNDATION



Three IBEC researchers received in 2020 funding from the third edition of the "Health Research Call" from the "La Caixa" Foundation, in order to use innovative techniques to decipher the mechanisms that promote metastasis in colorectal cancer.

The PROMISE project, led by Elena Martínez, group leader at IBEC and Professor at the University of Barcelona, aims to develop a novel platform that will mimic the tumor vascular microenvironment of patients with metastatic colorectal cancer in order to help doctors to find the best therapeutic approach and help monitoring the course of the disease. To achieve its objectives, Elena Martínez's team at IBEC will have the collaboration of the International Nanotechnology Laboratory (INL) and the Vall Hebrón Oncology Research Institute (VHIO).

On the other hand, the Mech4Cancer project, led by ICREA Research Professor Xavier Trepat and Pere Roca-Cusachs, Associate Professor at the University of Barcelona, will seek to develop sensors that help visualize how forces affect cells and promote the progression of colorectal cancer.

Trepat and Roca-Cusachs aim to develop a new technology based on fluorescent light emitted by molecules, which allows achieving a cell-scale resolution. Trepat and Roca-Cusachs, two European references in the mechanobiology field, which focuses on the study of how forces affect processes such as cancer, will validate this new technology in animal models with colorectal and breast cancer in collaboration with other international centres such as the Netherlands Cancer Institute in Amsterdam.

NURIA MONTSERRAT RECEIVES "CONSTANTES Y VITALES" AWARD FOR THE BEST BIOMEDICAL PUBLICATION OF THE YEAR



The 6th edition of the "Constantes y Vitales" Awards recognized Nuria Montserrat, ICREA research professor and principal investigator at IBEC, for her study of SARS-CoV-2 through the use of human organoids created with bioengineering techniques. The awards ceremony took place at the Palacio de Neptuno in Madrid and it has been led by the initiative's ambassador and moderator of La Sexta TV, Mamen Mendizábal. Olga Sánchez, president of the AXA Foundation, handed the award to Nuria Montserrat.

The event was supported by Pedro Duque, Minister of Science and Innovation and Antonio Zapatero, Deputy Minister of Health of the Community of Madrid.

The Pluripotency for organ regeneration group at IBEC made an important breakthrough last April 2020, in a collaboration with other international partners, by using, for the first time, laboratory organoids to study SARS-CoV-2 virus. Researchers demonstrated that renal organoids contained groups of cells that expressed a cell receptor called ACE2 in a similar way to the one seen in native tissue and proceeded to infect organoids with the SARS-CoV-2 virus. Once they obtained the infected mini-kidneys, they applied different drugs to inhibit SARS-CoV-2 infections and reduced their viral load. Through these studies, IBEC researchers helped identify a clinical phase drug that blocked the effects of SARS-CoV-2 virus. The work was published in *Cell Journal.*

NURIA MONTSERRAT WINS ÍÑIGO ÁLVAREZ DE TOLEDO AWARD



Nuria Montserrat, ICREA research professor and principal investigator of the "Pluripotency for organ regeneration" group at IBEC, unanimously won the XXXI Íñigo Álvarez de Toledo Award for Basic Research granted by the "Fundación Renal Íñigo Álvarez de Toledo". Established in 1989, these Awards are the greatest recognition granted in Spain to research related to kidney pathology. Her Majesty Queen Sofia presented the nephrology research awards to the winners of the last two editions, corresponding to the 2018 and 2019 calls.

Thanks to her work published in *Nature Materials "Fine tuning the extracellular environment accelerates the derivation of kidney organoids from human pluripotent stem cells"* Nuria Montserrat won the XXXI Iñigo Álvarez de Toledo Prize for Basic Research. As a result of this work, researchers obtained the first vascularized kidney organoid that is similar to a human kidney in its first weeks of gestation.

During the ceremony, a tribute was paid to Margarita Salas, who was president of the jury until her passing last November. The award ceremony was held in the hall of CSIC residence in Madrid. Her Majesty, the Queen Sofia, presided the event, which was also attended by the Health General Secretary, Faustino Blanco, Vice Councilor of Health Humanization of the Community of Madrid, José María Antón García, as well as personalities from the Nephrology field in Spain.

SAMUEL SÁNCHEZ, A REFERENT IN THE NANOTECHNOLOGY FIELD, ELECTED NEW MEMBER OF THE YOUNG ACADEMY OF SPAIN



An international committee elected Samuel Sánchez, a European pioneer in the field of nanomotors, as one of the new 13 researchers, among 185 candidates, who will be a member of the Young Academy of Spain.

The General Board of the Young Academy of Spain elected 13 new academic members. An independent international committee composed of highly prestigious researchers from different areas of knowledge participated in the selection process. In this call, to which 185 candidates applied, only 7% of the applicants have been selected in a highly competitive process. Among the researchers chosen, some of them have been awarded with other prestigious grants from the European Research Council, the ERC-Starting Grant and Consolidator Grant, such as Samuel Sánchez himself, as well as two winners of the Princess of Girona Prize, among which is also Samuel and several researchers from the Ramón y Cajal Program.

ICREA Research Professor Samuel Sánchez aims to contribute to the Academy with his international profile and expertise, his passion for science, for scientific communication and his efforts to develop excellent science. In addition, he has a great interest in being a reference for young researchers and helping them in their scientific career. IRENE MARCO AND NÚRIA TORRAS WINNERS OF THE SECOND EDITION OF "TO THE MOTHERS OF SCIENCE" PROGRAMME



IBEC researchers Irene Marco and Núria Torras, together with eight more female scientists, won the programme "To the Mothers of Science" organized by The Barcelona Institute of Science and Technology (BIST), supporting them along the way to greater responsibility positions.

The Barcelona Institute of Science and Technology (BIST) announced the winners of the second edition of the To the Mothers of Science programme, which offers supporting grants and coaching sessions to talented BIST female researchers to recognise their roles as scientists and mothers, and support them along their way to attaining positions of greater responsibility.

The winners will participate in four guided coaching sessions aimed at increasing leadership skills and will receive a monthly salary top-up of \notin 400 over the course of a full year. In this year's edition, five finalists will also get to participate in the coaching programme, which aims to create a peer support group and address the specific needs of researchers who are also mothers.

The second edition of the To the Mothers of Science programme coincided with a delicate moment in time due to the COVID-19 pandemic. All programme winners have expressed the difficulties associated with working from home with their children, some stressing that the burden of childcare has fallen on them.

AN IBEC PROJECT ON COVID-19 RECEIVES FUNDING FROM "FUNDACIÓN BBVA"



ICREA Research Professor Nuria Montserrat and her research team at IBEC, have received funding from "Fundación BBVA" to lead a research project on COVID-19. Montserrat's project is one of the 20 projects selected from among almost 1,000 proposals submitted to the call, which will receive a total of 2.7 million euros. The psychosocial and economic impact derived from the pandemic will also be studied.

Thanks to a grant of 250,000 euros from "Fundación BBVA", Nuria Montserrat's group, together with Josef Penninger from the Austrian Institute of Molecular Biotechnology and Ali Mirazimi from the Karolinska Institute, in Sweden, will study how SARS-CoV-2 infects the cells, for this, they will use 'mini kidneys' generated from human stem cells. In these organoids, by using the CRIS-PR gene editing technique, it will be possible to "open and close" the proteins that the virus uses as a gateway to enter the cells -ACE2, among others-, and thus study the infection mechanism that it uses. In addition, the researchers will also study the molecular pathways that are activated once the virus infects the cell. The use of these organoids, which reflect the complexity of the real organ, makes it possible to accelerate a type of research that would otherwise take years.

IBEC RECEIVES A VISIT FROM THE MAYOR OF BARCELONA INTERESTED IN OUR RESEARCH AGAINST COVID19



The Mayor of Barcelona, Ada Colau, visited IBEC facilities to learn, by our Director and a group of researchers, how bioengineering can help find solutions to health problems such as COVID-19, cancer, or degenerative diseases.

When in early 2020, more than 200 scientists gathered in La Pedrera in Barcelona to discuss the present and future of bioengineering, no one imagined that the world would experience the first pandemic of the 21st century and that science would take on more importance than ever.

At the beginning of her visit, the Mayor could visit the laboratory of one of the world experts in organoid technology, Research Professor ICREA Núria Montserrat. Núria Montserrat explained how, precisely during the conference in La Pedrera that the Mayor herself inaugurated, she met Austrian researchers with whom she would frantically work to make important discoveries against COVID-19. And it is that Dr. Montserrat and her team, a few months ago, have put their "mini-kidneys" at the service of the most cutting-edge research to prove that a drug is capable of blocking the entrance door of SARS-CoV-2 to human cells human.

Afterwards, the Mayor met with a group of IBEC volunteers participating in the COVID-19 Mass Testing Program Orfeu, among them, Dr. Isabel Oliveira (Head of Core Facilities at IBEC), Dr. Maria Gallo and Dr Juanma Fernández. Ada Colau also visited Prof. Josep Samitier's laboratory to learn about his research in cancer diagnostic systems together with Dr. Clara Alcón. Finally, the delegation visited the IBEC interdisciplinary laboratory of the Junior Group Leader, Dr. Benedetta Bolognesi, to learn about their research in protein mutations and their application to neurodegenerative diseases and aging. pez-Ortiz from the Nanoprobes & Nanoswitches Group led by ICREA Research Professor Pau Gorostiza, won the Prize to the Best Talk at the International Online Conference on Bio-hybrid Approaches to Solar Energy Conversion.

Every year, researchers at IBEC have the opportunity to participate in workshops and trainings about scientific writing and science communication provided by Human Resources and Communications Units.

IBEC RESEARCHERS AWARDED FOR THEIR COMMUNICATION ACTIVITIES



Several IBEC researchers were awarded in 2020 for their quality in spreading the word of bioengineering. From scientific talks, to videos and posters, IBEC scientists and engineers showed their talent inside, but also, outside the lab.

A group of researchers from the Biosensors for Bioengineering at IBEC won the video contest of the Barcelona Institute for Science and Technology (BIST) for a video explaining the research and technologies developed within their group led by ICREA Research Professor Javier Ramón. The winners were: Marc Azagra, Irene Marco, Júlia Rodríguez, Ferran Velasco, José Yeste, Francesco de Chiara, Jordina Balaguer, Maria Alejandra Ortega and Juanma Fernández.

Maria Arista from Nanoscopy for Nanomedicine group led by Lorenzo Albertazzi, was awarded with the runner-up prize for the Best Presentation at the 2nd Research Symposium on Coronavirus Virology Meeting 2020 by the Catalan Society of Biology. Manuel Ló-



NEWS

CLINICAL COLLABORATIONS

IBEC WORKS WITH HOSPITALS TO UNDERSTAND AND STOP CORONAVIRUS



The COVID-19 Fund managed by the Carlos III Health Institute awarded more than 300,000 euros to the "ACE2-ORG" project led by ICREA research professor Núria Montserrat at IBEC.

The resources are intended to study COVID-19 and specify new therapeutic approaches against the SARS-CoV-2. The partners of this project are the Karolinska Institute of Sweden, the Institute of Molecular Biotechnology of the Austrian Academy of Sciences, the Hospital Clinic of Barcelona and the University of Navarra. The researchers will also have access to cells from the kidney and heart tissue of patients from the Hospital Clínic de Barcelona and thus establish a platform for validating the results found in the organoid models to improve understanding of how organoids interact and infect human cells.

The objective of the project against COVID-19 led by the IBEC researcher, which they have named "ACE2-ORG" after the cellular receptor (ACE2) that the virus uses to enter cells, is to identify the cellular responses in these 'mini- organs' exposed to various clinical manifestations that worsen the prognosis of COVID-19, such as diabetes, in order to specify new therapeutic approaches.

IBEC LABS REPURPOSED FOR MASS COVID-19 TESTING SERVICE



Laboratories in three Catalan research centers, including IBEC, were adapted in 2020 as COVID-19 mass detection services.

The Centre for Genomic Regulation (CRG) coordinated a task force with the Institute for Research in Biomedicine (IRB Barcelona) and the Institute for Bioengineering of Catalonia (IBEC), as requested by the Generalitat de Catalunya, to set up mass testing for citizens to stop the spread of the new coronavirus outbreak.

There were two mass testing sites – one coordinated by the CRG at its labs at the Barcelona Biomedical Research Park (PRBB) and another at the Parc Cientific de Barcelona, jointly coordinated by IRB Barcelona, IBEC and the Centro Nacional de Análisis Genómico (CNAG-CRG), part of the CRG.

The project, codenamed Programa Orfeu by the Generalitat de Catalunya, aimed to run massive tests, which were expected to last for an initial period of six weeks. The mass testing sites were used to detect infected people both during the lockdown and as measures were progressively relaxed. This allowed citizens to better isolate the sick, lower infection rates, let essential workers get back to work and save lives.

By the end of the programme, research centres in Catalonia conducted around 50,000 PCR tests.



BIOENGINEERING PROVIDES CRUCIAL KNOWLEDGE ABOUT AGGRESSIVENESS IN BRAIN CHILDHOOD CANCER

Researchers led by IBEC Group Leader and UB Professor Josep Samitier, together with the INCLIVA Health Research Institute and the "Hospital Clínico de Valencia" made a further headway in understanding how childhood tumors evolve by discovering how the rigidity of the tumor extracellular matrix affects the aggressiveness of neuroblastoma.

Researchers used a three-dimensional model obtained through 3D printing capable of generating different levels of stiffness to recreate simplified versions of tumors. Thanks to this new technology, the experts were able to see how the biomechanical properties of the tumor extracellular matrix affected the evolution of neuroblastoma. The results of this work show that the stiffer matrices favor the adaptation and growth of the most aggressive cells over time, which proves that the rigidity of the tumor extracellular membrane plays a key role in tumor development. Furthermore, this opens the door to future therapeutic trials aimed at blocking cellular interaction with the components that confer rigidity to the tumor extracellular matrix.

The details of this investigation were published in the journal *Scientific Reports.*

E. Monferrer et al. A three-dimensional bioprinted model to evaluate the effect of stiffness on neuroblastoma cell cluster dynamics and behavior. Scientific Reports volume 10, Article number: 6370 (2020).

NEW METHOD TO FIND THE BEST TREATMENT FOR A PEDIATRIC CANCER

A study carried out by IBEC researchers from the Nanobioengineering group led by Josep Samitier, used a functional predictive biomarker to anticipate the effect of treatments against rhabdomyosarcoma, the most common soft-tissue cancer affecting childhood and adolescence. This advance can help in predicting treatment efficiency thus, avoiding tumor resistance and decreasing undesired secondary effects.

IBEC researchers Clara Alcon, Albert Manzano, Josep Samitier and Joan Montero, together with researchers from VHIR, IDIBELL and IRSJD institutes, associated to Sant Joan de Déu Hospital, published in *Cell Death & Disease*, a journal from Nature publishing group, a work that finds a novel effective sequential combination of drugs for this disease.

The authors found three new combinations of currently used drugs to treat rhabdomyosarcoma (RMS) with specific anti-apoptotic inhibitors, that killed cancer cells without affecting non-tumoral. In addition, those combinations when applied sequentially acted synergistically, which allowed a dose reduction. This is a key aspect of the work, as secondary effects derived from chemotherapy administration in children are severe and may include infertility, cardiomyopathy, or the appearance of other cancers. By using this new methodology, the timing and dosage of drug administration can be optimized to reduce those undesired side effects.

C. Alcon et al. (2020). Sequential combinations of chemotherapeutic agents with BH3 mimetics to treat rhabdomyosarcoma and avoid resistance. Cell Death and Disease. 11:634.

PERICORD, A BIOIMPLANT FOR INFARCTED HEARTS



The journal *EBioMedicine* of The Lancet published in 2020 the procedure that allowed the creation of "Peri-Cord", the first human cardiac bioimplant, in which Prof. Daniel Navajas, IBEC Group Leader and UB Professor, and colleagues at IBEC played a crucial role. In May 2019, a collaboration between the 'Germans Trias i Pujol' Hospital, the Blood and Tissue Bank (BST) and IBEC took a step forward for heart patients combining medicine, science and engineering. More specifically, the doctors introduced a bioimplant called *PeriCord* to a 63-year-old patient who had suffered a heart attack.

In this work, the authors explain that for the elaboration of the bioimplant –named like this after the two components that form it: the pericardium and the umbilical cord- they incorporated the cells into a pericardium matrix, acting as a vehicle, which enabled the application of the cells that were contained in the scaffold directly on the infracted area.

This bioimplant has a hardness comparable to that of a ventricle, it is made of decellularised human pericardium and enriched with mesenchymal stem cells, which come from the umbilical cord. These cells are characterized by possessing, apart from a great plasticity and important immunomodulatory and anti-inflammatory properties, the ability to regenerate tissues, which explains the reduction in the size of the scar caused by the heart attack.

C. Prat-Vidal et al. (2020). First-in-human PeriCord cardiac bioimplant: Scalability and GMP manufacturing of an allogeneic engineered tissue graft. EBioMedicine, 54, 102729.

A MULTISOURCE INNOVATIVE MODEL PREDICTS HOME HOSPITALIZATION SUCCESS



A study led by Raimon Jané, IBEC Group Leader and UPC Professor, in collaboration with Hospital Clínic Barcelona, analysed home hospitalization and early discharge (HH/ ED) of 1925 patients over a 10-year period.

Researchers developed an innovative prediction model which includes not only patients' functional and clinical features (from electronic medical records) but also, and for the first time, the Catalan population–health risk assessment scoring known as Adjusted Morbidity Groups (GMA).

The results showed potential for feeding clinical decision support systems aimed at supporting health professionals for inclusion of candidates into the HH/ED program, and have the capacity to guide transitions toward communitybased care at HH discharge.

This study proved the potential of the proposed multisource machine-learning models for the prediction of risk of re-admissions and deaths in patients undergoing homebased hospitalization in a real-world setting.

M. Calvo et al. (2020). Health Outcomes from Home Hospitalization: Multisource Predictive Modeling. Journal of Medical Internet Research. Vol. 22, no. 10 p. e21367.

A LOW-COST VENTILATOR FOR AREAS WITH LIMITED MEANS



UB Professor and IBEC Group Leader Daniel Navajas together with other experts and colleagues from the Biophysics and Bioengineering Unit of the University of Barcelona, the IN2UB, the August Pi i Sunyer Institute for Biomedical Research (IDIBAPS) and the Respiratory Diseases Networking Biomedical Research Centre (CIBERES), developed a prototype of a low-cost non-invasive ventilator to support patients with respiratory diseases in areas with limited means. Non-invasive ventilators are usually used to treat patients with respiratory failure: for example, those with severe complications due to COVID-19.

All the details and technical features related to the use of this ventilator were published in the *European Respiratory Journal*. In this work, the authors report that the prototype is non-invasive, which means that provides air through facial or nasal masks that introduce pressurized air into the lungs. The ventilator can be built at a very economic price using commercial components. Also, it can be easily replicated and is aimed at hospitals and health systems to help cover the demand of respiratory equipment due to the COVID-19 and other severe lung diseases.

Participants wore facial masks over their nose to ease breathing and marked their feeling of comfort or discomfort, both with and without a respiratory support. Thanks to this, the researchers observed that the ventilator adapted to the spontaneous breathing rhythm and provided a feeling of breathing relief similar to a commercial ventilator.

M. Garmendia et al. (2020). Low-cost, easy-to-build non-invasive pressure support ventilator for under-resourced regions: open source hardware description, performance and feasibility testing. European Respiratory Journal. 55: 2000846.

NEW ADVANCES IN THE IMPROVEMENT OF THE DESIGN OF DRUGS AGAINST GLIAL GLOBULAR TAUOPATHY



This study showed that not only tau is responsible for these pathologies as previously believed, but that many other proteins are abnormally phosphorylated, which leads to the formation of these protein deposits. These findings also demonstrated that these accumulations not only affect neurons, but also the accompanying glial cells, which can lead to the dysfunction of neuronal connections. In addition, these aggregates can move from one neuron to another, causing the spread of damage to healthy cells, as if it was an infection.

To carry out the study, several patients' cases with this type of tauopathy were analysed, thanks to the participation of the Hospital of Navarra, which has been responsible for performing the proteomic and phosphorylation analysis.

These findings opened a new research path for the design of new drugs that stop disease progression. To do this, we must first take into account that the addition of phosphate groups not only affects tau, but also other proteins and, on the other hand, not only neurons but also glial cells are involved, which also favours transmission and disease expansion.

I. Ferrer et al. (2020). Familial globular glial tauopathy linked to MAPT mutations: molecular neuropathology and seeding capacity of a prototypical mixed neuronal and glial tauopathy. Acta Neuropathologica. 139, pages735–771.

IBEC PARTICIPATES IN A EU PROJECT AIMING TO SPEED UP CLINICAL RESEARCH FOR VISION IMPAIRMENT



IBEC participates in an international consortium which aims to develop a new method to bring eyes back to life from deceased donors for clinical research purposes.

Current technological limitations mean that eyes can only be kept at 4°C for a period of 48 hours before irreversible degradation. This greatly limits their use for experiments, particularly to test the effectiveness of new drugs and treatments.

Now, an interdisciplinary consortium composed by seven international research centres will work to find new solutions within the framework of the European Project ECa-BOX. The project has been awarded 3.5 million euros by the European Union's Future and Emerging Technologies Open research /FET-OPEN) programme, which funds radical new technologies.

ECaBOX project will be coordinated by Pia Cosma at the CRG in collaboration with two other Catalan Research centres - Ricardo Casaroli at the Universitat de Barcelona and Nuria Montserrat, ICREA Research Professor and Group Leader at the Institute for Bioengineering of Catalonia (IBEC). Other international collaborators include King's College London (KCL) in the UK, the Association for the Advancement of Tissue Engineering and Cell Based Technologies & Therapies (A4TEC) in Portugal, AFERE-TICA in Italy and the Barllan University (BIU) in Israel.

NEW AVENUES FOR IDENTIFYING AND EVALUATING **TREATMENTS**



FOR RARE DISEASE CDKL5 DEFICIENCY

Researchers from IBEC including Arnau Hervera participated in a study led by Imperial College London in collaboration with the Department of Anesthesiology, Medical College of Wisconsin, USA, on the role of cyclin-dependent protein kinase 5 (CDKL5) in pain perception.

The defective version of the gene that produces this protein is behind CDKL5 deficiency and CDD disease affecting cognitive processes as important as learning and memory.

The study showed, for the first time, that the CDKL5 gene is also expressed in the Peripheral Nervous System (PNS). The work has indicated that the deficiency of the CDKL5 protein also translates into defective innervation of the skin, which probably results in the deterioration of pain perception, as occurs in patients with CDD. The study was published on the cover of the prestigious Journal Science Translational Medicine.

P. Montanara et al. (2020). Cyclin-dependent-like kinase 5 is required for pain signaling in human sensory neurons. Science Translational Medicine. Vol. 12, Issue 551, eaax4846.



Researchers led by Santiago Marco, UB Professor and Group Leader at IBEC, and international partners including scientists from Nestlé Research in Switzerland, developed a software for biomarker discovery in samples such as urine, blood or cell extracts.

Researchers used an approach called NMR metabolomics, with the advantage that it does not require previous knowledge on a specific metabolic pathway but provides precious information about fingerprints that these specific conditions reveal. NMR metabolomics comprises the investigation of low-molecular-weight compounds, called metabolites, that are dysregulated under specific conditions such as illness.

The developed tool, called AlpsNMR (Automated spectraL Processing System for NMR), is an R package that applies a concise workflow in an automated manner, in which users does not need too much knowledge about the procedure.

F. Madrid-Gambin et al. (2020). AlpsNMR: an R package for signal processing of fully untargeted NMR-based metabolomics. Bioinformatics, Vol. 36, Issue9, 2943-2945.



IBEC launched in 2020 the Faster Future "A por la CO-VID-19" campaign, with the aim of raising the 100.000€ needed to accelerate three research projects in collaboration with hospitals and patient's associations. Three ICREA Research Professors at IBEC aim to accelerate their research against COVID-19, in collaboration with various hospitals such as the Hospital Clínic de Barcelona, Jiménez Díaz de Madrid, Vall d'Hebron, Hospital de la Santa Creu i Sant Pau in Barcelona and the NHS Royal Free in London, among others.

The project of Professor Nuria Montserrat seeks to control the "doors" entrance gates of the virus into organs such as the kidneys, heart or lungs. To do this, Montserrat and her team are creating mini-organs in the laboratory, also called organoids, which when infected with the virus, will provide information about its spread and possible blocking pathways.

On the other hand, Professor Giuseppe Battaglia's group seeks to develop a nanocapsule system that serves as targeted delivery therapy, increasing the effectiveness of drugs and reducing their side effects.

Finally, the team of Professor Javier Ramón focuses on people who have overcome the disease, with the aim of

studying the impact of COVID-19 on the muscles. They will adapt their diagnostic platforms of "muscle on a chip" device to explore the effectiveness of potential drugs in muscle tissues.

The support of foundations and private companies, together with individual donors, have been essential to make these COVID-19 research projects possible.



IBEC launched in 2020 the guide "BIOENGINEERING for CANCER diagnosis, prognosis and personalized therapy".

One of the group of pathologies that can benefit most from the novel bioengineering approach is cancer. IBEC researchers, in collaboration with international clinical groups and companies, are using their bioengineering expertise to develop novel therapies and diagnostic tools against cancer with, for instance, liquid biopsies, tumour on chip, tumour organoids, mechanobiology, metabolomics, immunotherapies, imaging or targeted drug delivery.

Out of the 22 groups presently working at IBEC, 13 are currently involved in projects related to cancer. Since 2018, our researchers have published more than 80 publications addressing cancer, including contributions in top impact journals such as Nature Materials, Nature Physics, Clinical Cancer Research, or PNAS. In the last years, our research against cancer has attracted competitive funding including ERC grants, FET Open and other H2020 collaborative projects, as well as private funding from La Caixa or the Spanish Association against Cancer (AECC). At an institutional level, IBEC co-coordinates an institutional project together with the MIT (USA) entitled "Bioengineering against cancer" to foster transoceanic collaborations. Moreover, as coordinator of the Spanish Platform of Nanomedicine, which gathers universities, research centres, companies and other stakeholders applying bioengineering and nanotechnology to health, IBEC fosters the use of nanomedicine to tackle cancer.

TECHNOLOGY TRANSFER HIGHLIGHTS

Despite the difficulties suffered in 2020, IBEC obtained ca. 860 K Eur from research contracts with industries, only 27% less than in 2019, a year that was considered extraordinary, and 1,8 times the income obtained in 2018. In 2020, IBEC was also able to increase by 20% the number of companies IBEC is working with, and we have signed two new license contracts.

IBEC also signed a supply and commercialization agreement with a company leading the supply of innovative and high-performance life science reagents, for the product Phototrexate. It was the first time IBEC signed a supply and commercialization agreement. The product will be launched in 2021. IBEC filled 6 new patent applications and 2 PCT applications.

IBEC RENEWS THE TECNIO SEAL TO PROMOTE TECHNOLOGY TRANSFER TO COMPANIES



IBEC renewed in 2020 the TECNIO seal until 2023, the accreditation granted by the Generalitat, through ACCIÓ - the Agency for the competitiveness, dependent on the Department of Business and Knowledge.

The TECNIO seal allows SMEs and large companies to find the entities that offer differential technology, with the aim that the Catalan productive industries can access innovative technologies that solve the needs in their projects. On the other hand, for technology centers it is an opportunity to reach new partners, technology providers and international R & D & I program.

With the renewal of the TECNIO seal and its portfolio of available technologies, IBEC continues its commitment to transferring technology from excellent bioengineering to the productive and industrial sector.



Dermoglass became in 2020 the first project funded by the Caixalmpulse program to be licensed to a pharmaceutical company, ERN Laboratories. Dermoglass is a technology developed by the research group "Biomaterials for Regenerative Therapies" led by Dr. Elisabeth Engel at the Institute for Bioengineering of Catalonia (IBEC), who is also Professor at Polytechnic University of Cata-Ionia (UPC). Dermoglass patented technology uses bioengineering and nanomaterials to solve a problem that affects around 100 million people in the world and that is considered a silent epidemic in the XXI century: chronic ulcers. Based on calcium nanoparticles, this technology recovers damaged tissue by stimulating skin cells "such as fibroblasts" and also vascularization, that is the formation of new blood vessels to repair the affected tissue. As a result, the healing process is faster and more definitive.

ERN will lead the development of the technology until it reaches the market, with the support of IBEC in the next phases of formulation and scaling, speeding up the technology transfer process.



PATENTED 3D PRINTED HYDROGELS FOR CANCER IMMUNOTHERAPY T-CELL GROWTH

Cancer immunotherapy is based on using and strengthening the patient's own immune system to recognize and fight tumor cells, without damaging healthy tissues. In this context, IBEC contributed in 2020 to a step towards immunotherapy for cancer.

The 3D hydrogels designed by researchers Judith Guasch, from the Institute of Materials Science of Barcelona (ICMAB-CSIC) and Elisabeth Engel, from the Institute for Bioengineering of Catalonia (IBEC) and Professor at the Polytechnic University of Catalonia (UPC), provide higher rates of cell proliferation and capacity to select the type of cells obtained, since they are able to mimic the organs where T cells reproduce *in vivo*, the lymph nodes.

The aim of the project is to print large-sized 3D hydrogels compatible with clinical bioreactors in order to expand T-cells more efficiently, and to develop a laboratory prototype and carry out the first experiments for clinical phase validation. Industrial partners are sought for further co-development, mainly biomedical and pharmaceutical companies, but also investors interested in creating a spin off to transfer this innovative technology to the market, to make it available in hospitals soon.



ELENA MARTÍNEZ FROM IBEC GRANTED BY THE EUROPEAN RESEARCH COUNCIL TO BRING RESEARCH TO THE MARKET

Elena Martínez, Group Leader at IBEC and UB Professor, was awarded the prestigious "Proof of Concept" grant of the European Research Council (ERC). With her "GUT-3D-PLATE" project, Martínez and her team at the "Biomimetic systems for cell engineering" group will further develop technology to fabricate ready-to-commercialize 3D cell culture substrates mimicking the intestinal physiology.

Elena Martinez and her group developed 3D cell culture scaffolds that accurately mimic the villus and crypt morphologies of the human intestine using soft materials. To achieve these scaffolds, they used an innovative light-based approach to fabricate hydrogel scaffolds with the proper dimensions and mechanical properties of the tissue, in a reproducible manner. With her "Ready-to-use cell culture plates for gut 3D models" (GUT3D-PLATE) they will be able to further develop this technology and customize a 3D low cost printing device that will be able to fabricate ready-to-commercialize 3D cell culture substrates mimicking the intestinal physiology.

THE BIOVAC PROJECT LED BY IBEC AND ICN2 AWARDED AT THE BIST IGNITE AWARDS 2020



BioVac, a project led jointly by the Institute for Bioengineering of Catalonia (IBEC) and the Catalan Institute of Nanoscience and Nanotechnology (ICN2) was awarded the BIST Ignite Awards 2020. The aim of this collaboration is to populate nanoparticles with antigens to create a new generation of vaccines against untreatable infections and multi-resistant bacteria.

Last April 2019, the 5 winners of the BIST Ignite Grants were announced, with € 20,000 financing among them, the BioVac project. Thanks to this first phase, now the project led by UB Professor Eduard Torrents, head of the "Bacterial infections: antimicrobial therapies" group at IBEC and Daniel Ruiz of the ICN2 has been one of the two beneficiaries of additional financing that will allow them, for 12 months, to advance in the second phase of project development, which will give a solution to important medical challenges.

The hypothesis behind the project is that polymeric particles that mimic the size and shape of the target bacteria, and incorporate antigens from this pathogen, could cause the immune system to produce an immune reaction better than by administering the antigens alone, and without the risks and limitations

IBEC TECHNOLOGY AGAINST MALARIA GETS NEW IMPULSE



Only in 2018, an estimated 228 million cases of malaria occurred worldwide, accounting for hundreds of thousands of deaths. One of the main challenges when facing malaria is the lack of rapid, cost-efficient and reliable diagnostic tools. To overcome these obstacles, IBEC researchers developed a new method for the rapid identification of DNA molecules, called aptamers. Aptamers are short oligonucleotides capable of specific ligand recognition, much faster and cheaper to produce than antibodies, the current gold-standard for malaria detection. With the boost from the Caixalmpulse program, IBEC researchers aim to incorporate the patented technology in a rapid diagnostic test (RDT).

The project led by IBEC researcher Elena Lantero from Nanomalaria IBEC-ISGlobal Joint Group, got funding from Caixalmpulse Validate program to develop a new technology for rapid, cheap and efficient diagnosis of the disease.

IBEC JOINS THE BASE3D COMMUNITY TO CONTRIBUTE TO THE FUTURE OF 3D PRINTING



The groups led by Josep Samitier, Elisabeth Engel, Núria Montserrat and Javier Ramón at IBEC join the BASE3D project in 2020. IBEC will contribute its extensive experience in 3D printing and bioprinting to the BASE 3D community, an entity that brings together research centers and companies from all over Catalonia with the aim of promoting R+D+i in the field of 3D printing.

The project is led by the CIM of the Polytechnic University of Catalonia (UPC) —an entity belonging to the UPC whose mission is to transfer engineering knowledge and technology management— and brings together the most prestigious research centres in Catalonia to enhance R+D+i in 3D printing. With a budget of 3.7 M €, the consortium aims to face the main current challenges of additive manufacturing technologies, among which are the formulation of new materials, the optimization of technology to obtain functional parts, the finishes and post-processing, and an increased productivity. Each of the technologies proposed by the project will have a great impact in sectors such as the traditional industry, the food industry, the biomedical sector and the construction sector.





Participants from different fields and nationalities participated in the 3rd edition of the Innovation Day (i-Day), a series of events organised by EIT Health in partnership with local research and health institutions such as IBEC, the University of Barcelona and Hospital Clinic Barcelona. Thirty-one locations around Europe host this year events, for the first time in virtual format. IBEC contributed with experts, facilitators, jury, and a challenge to the workshop held in Barcelona. Successful teams received resources to develop their ideas, and students from the regions EIT Health serves will be encouraged to get involved within a network. Innovation Days are accessible to all undergraduate and postgraduate students with an interest in healthcare innovation. At the end of the week, the teams pitched their ideas and were judged by a panel of experts, including Eduardo Salas, Head of Technology Transfer at IBEC.

Three challenges were proposed by different institutions, in particular IBEC launched the challenge: How to tackle the negative health consequences of lockdowns in populations? Héctor López Carral, from SPECS group was the expert in charge of presenting IBEC's challenge. Other IBEC members were involved in this i-Day, for instance Maria Alejandra Ortega, senior researcher at the Biosensors for Bioengineering group at IBEC participated as expert, and was in charge of helping the participants through the design thinking process. Cristina Arimany, Project Manager at the Strategic Initiatives division was a facilitator.

THE IBEC FOUNDATION

IBEC was established in 2005 by the Department of Innovation, Universities and Enterprises and the Department of Health of the Generalitat de Catalunya (Autonomous Government of Catalonia), the University of Barcelona (UB) and the Polytechnic University of Catalonia (UPC).

The institute currently has 22 research groups, 314 researchers and 49 administrative staff. IBEC's headquarters and most of its labs are located in the Barcelona Science Park, which offers a highly stimulating environment in which the institute can work closely with organizations from the public and private sector interested in biomedical applications. A few of IBEC's labs are located at The Clinic and Bellvitge Health Sciences Campus and the Diagonal-Besòs Campus, which provide the clinical access, equipment or collaborative requirements specific to those groups.

The main governing body of IBEC is its Board of Trustees with representatives from the Catalan Departments of Health, Economy and Knowledge, the UB and the UPC.

UNIVERSITAT DE BARCELONA	UNIVERSITY OF BARCELONA (UB)
UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH	TECHNICAL UNIVERSITY OF CATALONIA (UPC)
Generalitat de Catalunya Departament de Salut	DEPARTMENT OF HEALTH , GENERALITAT DE CATALUNYA
Generalitat de Catalunya Departament d'Economia i Coneixement	DEPARTMENT OF ECONOMY AND KNOWLEDGE (FORMERLY INNOVATION, UNIVERSITIES AND ENTERPRISES), GENERALITAT DE CATALUNYA

BOARD OF TRUSTEES (for most of 2020)

The governing body of IBEC is its Board of Trustees, composed of members of the four founding institutions. IBEC's Board of Trustees receives advice from the director of the institute and from the International Scientific Committee. The Board of Trustees meets twice a year to approve IBEC's annual budget and monitor its activities to ensure that it pursues scientific excellence with an impact for society.

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SECRETARY	Mr. Josep Maria Alcoberro Pericay	CERCA, Àrea jurídica

* Hble. Sr. Ramon Tremosa I Balcells (from 15.10.2020)

INTERNATIONAL SCIENTIFIC COMMITTEE

IBEC's International Scientific Committee plays a key role in the activities of the institute, focusing especially on the selection and evaluation processes of the research group leaders. The committee is composed of international renowned scientists in different bioengineering fields, as well as prestigious professionals in key areas within the activities of IBEC, such as research results valorization or medical technologies validation.

Samuel Stupp (President)	Director, Simpson Querrey Institute for BioNanotechnology, Northwestern University, Chicago (USA)
Karljin Bouten	Professor of cell-matrix interaction for cardiovascular regeneration, Department of Biomedical Engineering, Eindhoven University of Technology, Netherlands
Sergio Cerutti	Professor in Biomedical Signal and Data Processing, Department of Biomedical Engineering, Politecnico di Milano, Italy
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Roger Kamm	Cecil and Ida Green Distinguished Professor of Biological and Mechanical Engineering and former Associate Head of the Department of Mechanical Engineering at MIT
Luis de Lecea	Professor of Psychiatry and Behavioral Sciences Stanford University
Krishna Persaud	Professor of Chemoreception, School of Chemical Engineering and Analytical Science, University of Manchester
Bernat Soria	Director, Andalusian Molecular Biology and Regenerative Medicine Centre (CABIMER)
Molly Stevens	Professor of Biomedical Materials and Regenerative Medicine and the Research Director for Biomedical Material Sciences in the Institute of Biomedical Engineering at Imperial College
Fiona M. Watt	Director, Centre for Stem Cells & Regenerative Medicine, King's College London
Heiko Zimmermann	Managing Head of the Fraunhofer Institute for Biomedical Engineering

ORGANIGRAM



TRANSPARENCY

In compliance with Law 19/2014 (Transparency, public access to information and good provide in order to adhere to the principles of this law.

ORGANIZATIONAL AND OPERATIONAL STRUCTURE Government organs Organization charts Agreements for the creation and operation of public sector entities Lists and catalogues of services Catalogue of procedures SENIOR POSITIONS AND MANAGERS List of senior positions and managers Incompatibilities Activities, goods and interests Remuneration, compensation and subsistence allowance Code of good practices for posts of the Generalitat of Catalonia PUBLIC EMPLOYEES List of jobs in the public sector Staff assigned by contract bidding agreed with the Administration Remuneration, compensation and subsistence allowances CALLS: ACCESS AND RESOLUTION Calls for work staff, specific groups and promotion training UNION REPRESENTATION Number and cost of full-time union representatives REGULATIONS Sectoral regulations Directives, instructions and memos Regulations in process ADMINISTRATIVE INTERVENTION RULES

REVIEW OF ADMINISTRATIVE ACTS ADMINISTRATIVE AND JUDICIAL RESOLUTIONS WITH PUBLIC RELEVANCE **OPINIONS**

GENERAL AND SECTORAL PLANS AND PROGRAMS, AUDITS, AND STATISTICAL INFORMATION

- IBEC Annual Report (years 2007 to 2018)
- IBEC Strategic Plan 2014-2017
- Human resources strategy for researchers

BUDGETS

- Approved budgets; executed; liquidated Annual accounts
- AUDITING AND AUDITING REPORTS

Auditing and auditing reports (years 2014-2017)

- PATRIMONY OF THE GENERALITAT OF CATALONIA
- Inventory of real estate
- Movable assets of special value
- Assets management
- Patrimonial management and contracting
- SUBSIDIES AND GRANTS
- Subsidies and public aid (planned and awarded)
- Financial monitoring of subsidies and aid

CONTRACTS

- Bidding and related procedures
- **AGREEMENTS**
- Registration of collaboration agreements
- Other agreements

SECTORAL TERRITORIAL PLANS CARTOGRAPHIC INFORMATION

RISK PREVENTION AND SAFETY AND HEALTH OF EMPLOYEES AT WORK

- Report of the Prevention Service 2017
- Occupational risks prevention audit certificate
- Rights and responsibilities of personnel

IBEC PEOPLE







DIRECTORATE

Director Josep Samitier Managing Director David Badia Assistant to the Director Ester Sánchez Executive Assistant Cristina Del Campo **Executive Assistant Patricia González**

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HUMAN RESOURCES























STATISTICS

IBEC IN FIGURES

In 2020, the total number of IBEC's staff (including administration personnel as well as researchers, students and technicians) was **363**. Of this total, **243** were hired by IBEC, while the rest are seconded, affiliated, externals, visitors or other status.

The following statistics reflect the situation on 31st December 2020.





All Staff by gender and job category









Number of followers on social media 2012-2020



Funding sources 2009-2020



Percentage of funding from core vs. competitive sources. Core funding is funding from trustees. Soft funding includes competitive projects (funded by sources such as the EU's H2020 program, the Spanish Ministry of Science and the Catalan Ministry of Research), industry contracts, funding from private institutions.

DIFFERENT RESOURCES OF FUNDING IN 2020, BROKEN DOWN INTO TYPES



SOFT FUNDING

CORE FUNDING



TOP MEDIA MENTIONS



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"EN 20 AÑOS LOS MINIRROBOTS NOS TRATARÁN LAS ENFERMEDADES"

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Silvia Pujals, senior researcher of the "Nanoscopy for Nanomedicine" group, talks about the importance and need for more women references in science.

52

SOCIEDAD

ANTIBIOTICOTERAPIA

Científicos del IBEC logran avances contra las infecciones pulmonares Supone un gran paso en la lucha contra la fibrosis quística y las EPOC

Ayudará a elegir la mejor terapia antimicrobiana en estas patologías

Núria Morr

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Probado con éxito en

T

p a IBEC i professors investigació ICREA

Identificado un fármaco capaz de bloquear el virus que causa la Covid-19

100

SARS

Eduard Torrents and his group



Nuria Montserrat, group leader of the "Pluripotency for organ regeneration" and her group have participated in an international study to find a treatment to stop the Coronavirus from infecting other cells, to prevent the virus from replicating.



53



Hallan una forma de transportar eficazmente fármacos al cerebro

L'i haliazoo picitila a trataint laces nomo

A team of international

scientists led by Group

a "faster, more effective

and safer" therapy to

intracellular bacteria

that cause diseases

such as tuberculosis.

eliminate infections of

Leader Giuseppe

Battaglia and the researcher Loris Rizzello of IBEC, has developed

La Gira Mujeres Weekend de Coca-Cola formară a

Silvia Muro, group leader of the "Targeted therapeutics and nanodevices" group found

LAVANGUARDIA

000

Desarrollan una nueva terapia "más rápida y segura" contra la tuberculosis

REDACCIÓN

Barcelona, 19 jun (EFE).- Un equipo de científicos Internacionales liderado por el Instituto de Bioingeniería de Cataluña (IBEC) ha desarrollado una terapia "más rápida, eficaz y segura" para eliminar infecciones de bacterias intracelulares causantes de enfermedades como la tuberculosis.

Are a suspension sales.

Se trata de vesículas sintéticas capaces de reducir "considerablemente" la dosis y la duración de los tratamientos antimicrobianos y disminuir el peligro a generar resistencia a los antibióticos, según han indicado este viernes los expertos en un comunicado.

El estudio, publicado en la revista "ACS Nano", ha demostrado la capacidad de estas vesículas sintéticas de penetrar en los macrófagos, células del sistema inmunitario especializadas en la lucha contra patógenos, y liberar fármacos de manera específica "en cuestión de minutos".





TV

Researchers from the **SPECS** lab at IBEC have develop a new method to evaluate the mental health and wellbeing of people living under strict confinement measures such those during COVID-19 pandemic on April 2020.

IBEC Group Leaders, Elena Martínez, Xavier Trepat and Pere Roca-Cucachs are developing two devices for

developing two devices for cancer research. One willl recreate the environment in which tumors develop to see how they metastasize and the other will enable the researchers to see how physical forces affect the nuclei of cells in metastasis.

40 cultura & vida

Salud

Investigación Un dispositivo recreará el ambiente en que se extienden los **tumores**

El objetivo es ver cómo las fuerzas de la física afectan los núcleos de las células en metástasis

SHICK CAR

Investigadoens del han Bioenginyeria de Can (IMC) están desarrolla dispositivo para recrear biente en el cual se deu las sumores para ver com metidatal, y citro para u

> nicleos de las refutais en metiais das Los investigadores de IBUC El las diartínez, Xerier Trepai y Per Roza-Camerto se han propores etiended i las processos que por miseres metianais en el choise colorieren al militando invorsador berramientes de bieningenierier como la bioingeneido y la mierro copia regar de revelas fuerzas ecolas ecisias. Los des propetes

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projectos del IBEC ar projeenditar técnicas innovaciones permitan descrittrati ion mecoa nas que promavem la metita en el chuere colorrectal, cont yenab a posibles soluciones cocalgan parar o retastar proceso.

Las Investigaciones El prospecto PROMINE, Edward por Elena Martínez, investigador principal al IBIC y protosira de l Universitat de Barcelona, tien como objetitivo el denarmillo d una plataforma que initará el mi ercombiente vancular transort d parimiens en ocienter vidorenda metantikizes, para oytular kos notdicus a esevoratzar el suejor esdoque resequerizo y monitercitar el ranzo de la radiometidal. Para etas lados, el propresen balevida este lados, el propresen balevida este sensoren que sysden a a tutalizar mona las faretara atorian las collador ratorneta. Canado la colador tutorneta esta comlas atorias retalas colas de doras destadormente la expressión de la surdistricar techneta, colaste doras destadormente la expressión de la sur-

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SALUD Tau, una proteína clave contra el Alzheimer

El programa CaixaHealth dirige sobre ella sus innovadoras investigaciones



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The researcher José Antonio del Rio, leads a project selected within the CaixaHealth program of "la Caixa" Foundation to develop two strategies against the Tau protein, key in Alzheimer's disease.

SOCIEDAD

Nuria Montserrat, ICREA professor and group award for the best biomedical publication of



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Homenaje a la ciencia en un año de pandemia

Los VI Premios «Constantes y Vitales» han reconocido la labor de tres científicos españoles y de la AECC

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El primer proyecto de Calual repulse que se licencia a la industria

nuclei of metastatic cells.

Dermoglass crece con ERN

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Xavier Trepat and Pere Roca-Cusachs recieve a grant of almost one million euros from "la Caixa" as part of the «Health Research Call» to tdevelop a device based on fluorescent sensors to recreate the environment in which tumors develop and see how physical forces affect the

Laagam capta 370.000 euros e implanta un modelo de "stock cero"



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Elisabeth Engel appears in different media

METÁSTASIS Bioingenieria contra el cáncer

SALUD II

VISIBILITY

TOP EVENTS

FIRST EMBL-IBEC WINTER CONFERENCE TOOK PLACE IN BARCELONA AND WAS A HUGE SUCCESS





The first "EMBL-IBEC Winter Conference on Engineering Multicellular Systems", took place in 2020 as a result of the collaboration agreement between IBEC and the European Molecular Biology Laboratory (EMBL). Both institutions conduct excellent and responsible research, developing precision medicine technology and essential knowledge for improving people's health. For this occasion, IBEC and EMBL brought together a total of 200 international experts in the field of bioengineering at the emblematic "La Pedrera building" in Barcelona.

The Conference was led by researchers Xavier Trepat, Núria Montserrat and Josep Samitier from IBEC, and James Sharpe, Miki Ebisuya and Vikas Trivedi from EMBL Barcelona, and it was focused on the medicine of the future. Latest advances in emerging fields of bioengineering were addressed, such as the generation of cellular models to study human embryogenesis, biological robots or the derivation of organoids for precision medicine applications, as well as the ethical dimension of these advances and their social impact.

The event was opened by the mayor of Barcelona, Ada Colau, who stressed the importance of public spending for research to address the opportunities posed by scientific and technological advances in fields such as bioengineering.

The conference counted with the participation of 20 world-renowned invited experts from the bioengineering field, among which we can highlight the presence of Professor Magdalena Zernicka-Goetz (Caltech, USA), one of the world leaders in embryonic development; Professor Roger Kamm (MIT, USA), pioneer in technological developments in organ-on-a-chip; Danijela Vignjevic (Institut Curie, France), expert in the derivation of organoids; and Wei Sun (Tsinghua University, China), one of the leaders in bioprinting and the generation of artificial tissue for biomedical applications. In order to address the ethical and social dimension of these issues, the conference counted with the intervention by Dr. Insoo Hyun (Harvard, USA), world expert in the area of stem cell, embryo and chimera ethics.

13TH IBEC SYMPOSIUM BROUGHT TOGETHER INTERNATIONAL EXPERTS IN PRECISION AND FUTURE MEDICINE



IBEC organized from the 27th to the 28th October its 13th Symposium. The event, that this year took place for the first time online, was focused on Bioengineering for Future & Precision Medicine. With more than 400 registered attendees, 18 flash presentations and 106 posters, the event also counted with contributions from top international speakers such as Robert Langer from the MIT, Ada Cavalcanti of the University of Heidelberg or Raquel Yotti, Director of the Carlos III Health Institute, among others.

The opening ceremony was conducted by Josep Samitier, Director of IBEC, by Robert Fabregat, General Director of Research and Innovation in Health of the Ministry of Health at Generalitat of Catalunya; by Alfredo González Gómez, Secretary General of Digital Health, Information and Innovation from the Spanish Ministry of Health and by Professor Francesc Torres, rector of the UPC. All of them pointed out the importance of research in the bioengineering field for its application to the present and future of health. Professor Francesc Torres also highlighted the importance of engineering and bioengineering in the future of the society, as an important tool to improve the technology and health.

HEALTH-TECH WORLD CANCER DAY 2020 "SMARTER TECHNOLOGIES TO BEAT CANCER!"



Cancer is a leading cause of mortality and morbidity, with huge unmet medical needs, still being fatal in almost half of diagnosed cases. In oncology, smart health technologies allow an earlier, more precise and less invasive diagnosis and a more efficient and less toxic treatment.

In this context, IBEC-managed Spanish Nanomedicine Platform, NanoMed Spain, co-hostered the seventh edition of Health TECH World Cancer Day, a global initiative organized as part of World Cancer Day. It was the fifth year running that the platform hosted the conference, which took place on February 3 at Sala Pau Viladiu at Hospital Duran i Reynals. Josep Samitier (Scientific Coordinator of NANOMED Spain and Director of the Institute for Bioengineering of Catalonia) and Isabel Fabregat (Coordinator of the Molecular Mechanisms and Experimental Therapy in Oncology Program and Researcher at IDIBELL) were in charge of the opening ceremony.

Among other experts, during the event ICREA Research Professor and Group Leader at IBEC, Samuel Sánchez presented his work on "TERANOBOTS: nanorobots for bladder cancer theranostics" and IBEC Associated Researcher and UB Professor Jordi Alcaraz "Aberrant fibrotic and nanomechanical phenotypes of patient-derived fibroblasts in lung cancer: translational opportunities".



<u>"BIOENGINEERING AGAINST</u> CANCER" EVENT GATHERS 400 INTERNATIONAL EXPERTS IN MEDTECH



The event "Bioengineering and MedTech against Cancer" organized by IBEC and Medicen Paris Region brought together more than 400 participants, Medtech and Biotech players fighting against cancer.

The event, organized jointly by Medicen Paris Region and the Institute for Bioengineering of Catalonia (IBEC), in collaboration with Biocat and "Ia Caixa" Foundation, recently focused on showcasing new advances in the intersection between bioengineering and medical technology in the field of cancer. The course, which was held on November 24 and 25, is part of the ToHealth program, an activity financed by EIT Health.

Among the speakers, scientific leaders from renowned centres such as the Director of IBEC, Josep Samitier, Finland's Institute Karolinska, Georges Pompidou European Hospital (France), Marie Curie Research Centre (France), Max Planck Institute (Germany), Beatson Institute for Cancer Research (University of Glasgow), University of Eindhoven, IDIBAPS, the Scientific Officer at the European Commission in charge of cancer.

The course included an "Innovation Track" where various projects previously selected were presented in front of a panel of investors and experts. The goal was to boost innovation transfer to society and to promote collaboration among the sector stakeholders. Afterwards, there were B2B meetings between projects and start-ups with investors.

IBEC ORGANIZED THE SIXTH EDITION OF RESEARCH4TALENT

Fifty undergraduate and master students attended in 2020 reSearch4Talent. That was the sixth time that IBEC opened its doors to young scholars interested in a scientific career, this time, virtually. On May 22nd IBEC welcomed the students with a presentation about the institute from IBEC's talent and education deputy and Group Leader Elena Martínez, followed by specific information about applications and admissions from Ciara Boter of the HR department. To finish with the presentations, Srivatsava Viswanadha Venkata Naga Sai, PhD at IBEC, shared his experience as doctoral student and did a brief presentation of the PhD Committee, which was set up in 2013 to enable students to have a voice in the running of the institute and to organize events of their own. After



that, five parallel sessions took place, in each session five IBEC research groups had the opportunity to explain their research and answer the participant's questions. Each session lasted for half an hour and a total of 24 groups had chance to participate in these sessions. The participants could choose which meetings to attend and could jump from one session to the other freely. In the previous year, IBEC signed more than 145 internship agreements for Undergraduate and Master Students who are at a key moment in their careers with a wide range of national and international universities.



The Spanish platform for Nanomedicine (Nanomed Spain), coordinated by IBEC, organized an event to present the latest innovations in Nanomedicine for the treatment and diagnosis of rare diseases, from early diagnosis, controlled drug release or the development of new therapies.

The event was opened by Josep Samitier, Coordinator of Nanomed Spain, and by Francesc Palau (Director of the Pediatric Institute of Rare Diseases (IPER) and Director of the Sant Joan de Déu Research Institute) and took place on February 27 at Hospital Sant Joan de Déu with more than 40 attendees.

Throughout the event, nanomedicine experts from different areas (research, business, clinical practice, health authorities, patients, etc.) presented the latest advances and gave attendees the opportunity to discover the role nanomedicine plays in health through creating new opportunities in the diagnosis and treatment of rare diseases.

VISIBILITY

EDUCATION AND OUTREACH

The Institute for Bioengineering of Catalonia organizes or takes part in a range of outreach and education activities throughout the year. These activities are coordinated by the Communications Unit at IBEC, in direct collaboration with researchers from all groups. Together, IBEC experts work to bring science, and especially bioengineering, to a broad non-scientific audience in a series of high-quality programme such as in fairs, festivals, shows, open doors and schools visits.

IBEC RENEWS THE ACCREDITATION AS A UNIT OF SCIENTIFIC CULTURE AND INNOVATION

In 2020, IBEC's Communication Unit was accredited again as a member of the Network of the Scientific Culture and Innovation Units (UCC + i), through the Spanish Foundation for Science and Technology (FECYT) for its contribution to the scientific and innovation culture. In 2020, IBEC received this accreditation again, for all the actions aimed at disseminating the scientific results in the media, as well as for its outreach activities. It is the third consecutive time that the centre renews this distinction since receiving it for the first time back in 2014.

In 2020 alone, the work of the UCC+i Unit at IBEC contributed to the generation of hundreds of impacts on scientific and innovation topics in the main media, achieving its own record of audience 28,9 Million people only with press. It is also achieved over 1000 impacts online, and 40 impacts on TV and radio. Thanks to IBEC's outreach and educational activities the institute also reached more than 2400 people.

<u>SCIENCE WITH WIT</u> <u>ON YOUTUBE</u>

IBEC launched in 2020 a new initiative called "Ciencia con Ingenio" where, in a series of YouTube videos, researchers invited public of every age to experiment at home with bioengineering through attractive stories: do you want to solve a crime, heal a disease or find out our origins?



During these experimental sessions, researchers performed one live video and performed some experiments such as how to extract your own DNA and be able to see it, what is a biosensor and how can you measure pH at home.

RED DE UNIDADES DE

CULTURA CIENTÍFICA Y DE LA INNOVACIÓN

MAGNET ALLIANCE

In 2020 IBEC continued its activity with the "Magnet, alliances for educational success" promoted by Fundació Jaume Bofill in collaboration with the Education Department of the Catalan Government. This is a program that unites educational centers that have an unbalanced social composition with an institution of excellence for 4 years. This union will allow the educational center to develop an innovative project that will become a reference project in its territory. Within the framework of the Magnet program IBEC scientists and staff interact with teachers and students from the center.

This year, we have incorporated the figure of the "expert friend" where an IBEC researcher becomes their role model in the science field. The students establish a fluent and close relationship throughout the year with the researcher, that will allow them to dive into the scientific topics of their interest and will help them in processes of inquiry, creativity and reflection.

THIRD EDITION OF CRAZY ABOUT BIOENGINEERING

IBEC celebrated in 2020 the third edition of "Crazy about Bioengineering", within the 'Bojos per la Ciència' initiative by La Pedrera Foundation. This is a course devoted to bioengineering, where 24 students had the opportunity to see how researchers work in an international reference research center and were able to learn different bioengineering disciplines with the aim to help solving health challenges. In total, 14 of the 22 IBEC research groups participated in the 2020 edition of the "Crazy about Science" program, that counted with 16 theoretical and practical sessions on bioengineering.



This year we launched a new program. Specifically, this year's IBEC course includes sessions on the main bioengineering research areas applied to health: diseases related to the aging of the population, the study of cancer and the study of rare diseases. To all this, we must add the traditional sessions on good laboratory practices, learn about ethical issues related to research field and on how to communicate science.



Every day, more than 300 scientists and engineers give their best for what we believe is a good and essential cause: understanding what allows us to be healthy or what makes us sick. But the Institute for Bioengineering of Catalonia (IBEC) will not be the same without all people interacting and supporting us.

Therefore, IBEC presented in 2020 one of its most special findings: the IBEC SUPERFRIENDS club, a way of being closer to the best bioengineering and of sharing our passion for curiosity, people and for health. Becoming an IBEC SUPERFRIEND means to have access to the latest scientific advances, events and much more about IBEC and bioengineering. IBEC SUPERFRIENDS will also offer the opportunity to visit IBEC and to contribute to IBEC campaigns for health. At the end of 2020, more than 600 people were already our SUPERFRIENDS.

IBEC FOSTERS WOMEN IN SCIENCE



IBEC joined in 2020 the initiative "100tíficas" organised by the Fundació Catalana per a la Recerca i la Innovació (FCRi), in collaboration with the Department of Education of the Generalitat de Catalunya, to foster the role of women in science. All over Catalonia, scientists from different universities, enterprises and research centers offered talks to a hundred schools around the territory.

IBEC researchers Silvia Pujals, Maria Arista, Marta Badia and Maria Guix participated in several events within the framework of the "100tíficas" initiative that aims to empower female researchers and promote them as role models for future generations.

Moreover, within the framework of the "International Day of Women and Girls in Science and with the Magnet alliance and Gayarre School, IBEC brought their researchers to different Catalan schools to assert the role of women in science and promote STEAM careers among young people.

IBEC COMMITTED WITH THE CREATIVE TALENT OF THE FUTURE



IBEC became in 2020 the first research center to take part in the "Creative talent and Business" program. This initiative, promoted by the education department of the Catalan Government, offers the possibility of collaboration between artistic and visual arts studies with an institution to encourage the realization of projects to integrate their knowledge in a real work environment.

Within this program, IBEC proposed the task of conceiving and designing a character that would humanize its brand and respond to its values with the aim of increasing the communication potential of the Institute. A total of 5 art and design schools from all over Catalonia took part in the challenge, and of the 24 initial proposals, 12 reached the second phase. After intense deliberation by a 10-member jury, it was decided to award two proposals, which will be the basis for the 2021 upcoming first Superhero in Bioengineering.



PEOPLE

PHD THESES IN 2020

13/1/20 25/11/20 LUCAS PEDRAZ LÓPEZ JESÚS ORDOÑO FERNÁNDEZ **Bacterial Infections: Antimicrobial Therapies Biomaterials for Regenerative Therapies** UB UPC Regulation of ribonucleotide reduction in facultative Lactate: unraveling the regenerative potential for cardiac anaerobic pathogens and its influence in bacterial tissue engineering fitness, virulence, and biofilm formation 26/11/20 15/1/20 RAFAEL MESTRE CASTILLO **AIDA GARRIDO CHARLES** Smart Nano-Bio-Devices Nanoprobes and Nanoswitches IIR UR Hybrid bio-robotics: from the nanoscale to the Optical control of endogenous receptors and cellular macroscale excitability with light 4/12/20 ARNAU BIOSCA ROMANILLOS 23/1/20 NATÀLIA FEINER GRACIA Nanomalaria Nanoscopy for Nanomedicine UR UR "Discovery of protein aggregation in Plasmodium parasites and development of a combinational Reaching the tumour: nanoscopy study of nanoparticles in the biological environment antimalarial therapy at the nanoscale" 24/2/20 4/12/20 MARTÍ CHECA NUALART JAVIER RODRÍGUEZ BENÍTEZ **Biomedical Signal Processing and Interpretation** Nanoscale Bioelectrical Characterization UB UPC A Novel Scanning Probe Microscopy Technique to study Characterization and interpretation of cardiovascular the Nanoscale Electrical properties of Cells and cardiorespiratory dynamics in cardiomyopathy natients 5/3/20 ANA MARIA SOLÓRZANO SORIA 10/12/20 Signal and Information Processing for Sensing Systems ANNA VILA GIRAUT UB Biomimetic Systems for Cell Engineering Fire Detectors Based on Chemical Sensor Arrays and UR Machine Learning Algorithms: Calibration and Test Hydrogel co-networks of gelatin methacryloyl and poly(ethylene glycol)diacrylate sustain 3D functional in 29/7/20 vitro models of intestinal mucosa **FABIO RIEFOLO** Nanoprobes and Nanoswitches 11/12/20 ELENA LANTERO ESCOLAR UB **Development and Applications of Photoswitchable** Nanomalaria Muscarinic Ligands UB "Targeting strategies against Plasmodium and practical 21/9/20 applications: blocking the parasite development with heparin derivatives and identifying new aptamers for **MARTINA MAIER** Synthetic, Perceptive, Emotive and Cognitive Systems diagnosis" (SPECS) UPF 15/12/20 The principles of advanced virtual reality-based SOCK CHING LOW neurorehabilitation Synthetic, Perceptive, Emotive and Cognitive Systems (SPECS) UPF 13/10/20 HELENA LOZANO CABALLERO Giving Centre Stage to Top-Down Inhibitory Mechanisms Nanoscale Bioelectrical Characterization for Selective Attention UB Electrical and topographical study of bacterial 21/12/20 appendages at the nanoscale LAIA LIDÓN GIL Molecular and Cellular Neurobiotechnology 9/11/20 UR Regulación de la expresión de PrPc como elemento **DOLORES BLANCO ALMAZÁN Biomedical Signal Processing and Interpretation** clave en las modificaciones de tau en la enfermedad de UPC Alzheimer Noninvasive multimodal analysis of thoracic bioimpedance and myographic signals for the assessment of chronic obstructive pulmonary disease



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